2.0 ENVIRONMENTAL SETTING

This chapter describes the physical characteristics of Load Line 2 and the surrounding environment that are factors in understanding potential contaminant transport pathways, receptors, and exposure scenarios for human health and ecological risks. The geology, hydrology, climate, and ecological characteristics of RVAAP were originally presented in Chapter 3.0 of the Phase I RI (USACE 1998a). The preliminary CSM for Load Line 2 is presented at the end of this chapter.

2.1 RVAAP PHYSIOGRAPHIC SETTING

RVAAP is located within the Southern New York Section of the Appalachian Plateaus physiographic province (USGS 1968). This province is characterized by elevated uplands underlain primarily by Mississippian- and Pennsylvanian-age bedrock units that are horizontal or gently dipping. The province is characterized by its rolling topography with incised streams having dendritic drainage patterns. The Southern New York Section has been modified by glaciation, which rounded ridges and filled major valleys and blanketed many areas with glacially derived unconsolidated deposits (i.e., sand, gravel, and finer-grained outwash deposits). As a result of glacial activity in this section, old stream drainage patterns were disrupted in many locales, and extensive wetland areas developed.

2.2 SURFACE FEATURES AND SITE TOPOGRAPHY

Load Line 2 is situated in the southeastern quadrant of the RVAAP facility, as shown in Figure 1-2. The topography within the bounds of the AOC is characterized as moderately subdued on a reworked sandstone bedrock surface (Figure 1-5). Topography of Load Line 2 was mapped by USACE in 1998 on a 0.6-m (2-ft) contour interval, with an accuracy of 0.006 m (0.02 ft), from aerial photographs taken in 1997. This survey is the basis for the topographic features presented in the figures in this Phase II RI report. Elevations within the bounds of the AOC vary from approximately 301 to 307 m (990 to 1,010 ft) above mean sea level (amsl). However, topography drops sharply to the south of the AOC, in the direction of Kelly’s Pond. In general, the land surface slopes from the center of the load line in all directions. There is a high point (1,020 ft) to the north of the AOC, and surface elevation decreases to 930 ft to the south within the bounds of RVAAP. Kelly’s Pond is located just south of the fenced boundary of Load Line 2 and a group of four unnamed ponds is found on the northeast border of the AOC. Figure 2-1 illustrates current site conditions in the former production area (March 2003).

Cultural features at Load Line 2 consist mainly of asphalt and gravel access roads, man-made ditches, sewer lines, manholes, ballast from old railroad tracks, and buildings/steel building frames associated with the load line. Parts of buildings have been removed during demolition activities, but the steel structures are still intact. The main process area is heavily vegetated with heavy grass and scrub vegetation between the major structures of the load line. The non-production areas around the main process area are characterized by scrub vegetation and immature hardwoods.

Figure 2-1. Site Conditions at Load Line 2, March 2003

2.3 SOILS AND GEOLOGY

2.3.1 Regional Geology

The regional geology at RVAAP consists of horizontal to gently dipping bedrock strata of Mississippian and Pennsylvanian age overlain by varying thickness of unconsolidated glacial deposits. The bedrock and unconsolidated geology at RVAAP and geology specific to Load Line 2 are presented in the following subsections.

2.3.1.1 Soils and glacial deposits

Bedrock at RVAAP is overlain by deposits of the Wisconsin-aged Lavery Till in the western portion of the facility and the younger Hiram Till and associated outwash deposits in the eastern portion (Figure 2-2) (ODNR 1982). Unconsolidated glacial deposits vary considerably in their character and thickness across RVAAP, with these deposits absent in some of the eastern portion of the facility and ranging up to an estimated 46 m (150 ft) in the south-central portion.

Thin coverings of glacial materials have been completely removed as a consequence of human activities at locations such as Ramsdell Quarry, and bedrock is present at or near the ground surface in many locations, such as at Load Line 1 and the Erie Burning Grounds (USACE 2001b). Where glacial materials are still present, their distribution and character indicate a ground moraine origin. These tills consist of laterally discontinuous assemblages of yellow-brown, brown, and gray silty clays to clayey silts, with sand and rock fragments. Deposits from bodies of glacial-age standing water may also have been encountered, in the form of >15-m (50-ft) -thick deposits of uniform light gray silt (USACE 2001b).

Soils at RVAAP are generally derived from the Wisconsin-age silty clay glacial till. Distributions of soil types are discussed and mapped in the Soil Survey of Portage County, Ohio (USDA 1978). Much of the native soil at RVAAP was reworked or removed during construction activities in operational areas of the installation. According to the Portage County soil survey, the major soil types found in the high-priority AOCs are silt or clay loams with permeabilities ranging from 6.0×10^{-7} to 1.4×10^{-3} cm/sec.

2.3.1.2 Bedrock stratigraphy

The bedrock encountered in studies of RVAAP includes formations of Mississippian and Pennsylvanian age, which dip to the south at a rate of approximately 5 to 10 ft/mile. The Mississippian Cuyahoga Group is present at depths of approximately 200 ft below ground surface (bgs) throughout the majority of the site. However, the Meadville Shale Member of the Cuyahoga Group is present at or near the surface in the very northeastern corner of RVAAP. The Meadville Shale is a blue-gray silty shale characterized by alternating thin beds of sandstone and siltstone.

The Sharon Member of the Pennsylvanian Pottsville Formation unconformably overlies the Meadville Shale Member of the Mississippian Cuyahoga Group. The unconformity has a relief of as much as 200 ft in Portage County, and this is reflected in the variation of thickness of the Sharon Member. The Sharon Member consists of two units: a shale and a conglomerate. The conglomerate unit of the Sharon Member (informally referred to as the Sharon Conglomerate) is a highly porous, permeable, cross-bedded, frequently fractured and weathered orthoquartzite sandstone, which is locally conglomeratic and exhibits an average thickness of 100 ft. The Sharon Conglomerate has a thickness of as much as 250 ft where it was deposited in a broad channel cut into Mississippian rocks. In marginal areas of the channel,

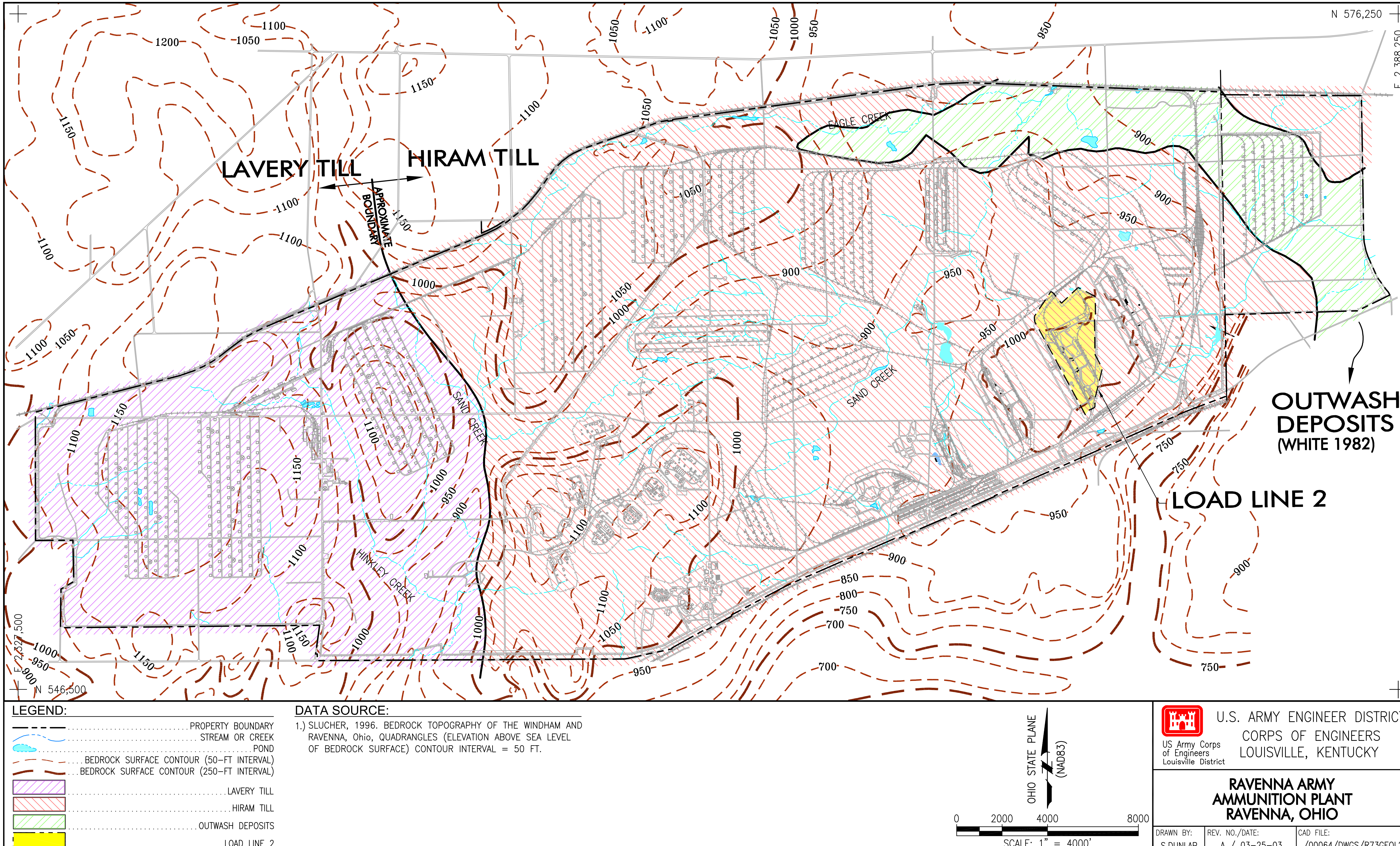

Figure 2-2. Geologic Map of Unconsolidated Deposits on RVAAP

the conglomerate unit thins to about 20 ft and in places may be missing, owing to non-depostion on the uplands of the early Pennsylvanian erosional surface. Thin shale lenses occur sporadically within the upper part of the conglomerate unit.

The shale unit of the Sharon Member (informally referred to as the Sharon Shale) is a light to dark-gray fissile shale, which overlies the conglomerate in some locations, but has been eroded in most areas of RVAAP. The Sharon Member outcrops in many locations in the eastern half of RVAAP.

In the western half of RVAAP, the remaining members of the Pottsville Formation found in the local area overlie the Sharon Member. These remaining members of the Pottsville Formation are not found in the eastern half of the site either because the land surface was above the level of deposition or they were eroded. The Connoquenessing Sandstone Member, which unconformably overlies the Sharon Member, is a sporadic, relatively thin channel sandstone comprised of gray to white, coarse-grained quartz with a higher percentage of feldspar and clay than the Sharon Conglomerate. The Mercer Member is found above the Connoquenessing Sandstone and consists of silty to carbonaceous shale with many thin and discontinuous lenses of sandstone in its upper part. The Homewood Sandstone Member unconformably overlies the Mercer and is the uppermost unit of the Pottsville Formation. The Homewood occurs as a caprock on bedrock highs in the subsurface and ranges from a well-sorted, coarse-grained, white quartz sandstone to a tan, poorly sorted, clay-bonded, micaceous, medium- to fine-grained sandstone.

2.3.2 Geologic Setting of Load Line 2

Subsurface characterization at Load Line 2 during the Phase I and II RIs was performed by installing six test trenches to depths of 3.048 m (10 ft) around the periphery of the AOC and by continuous sampling during the drilling of piezometer and monitoring well borings. Borings from soil sampling locations were also used to characterize the shallow subsurface soil interval. Bedrock was encountered in all Phase II RI subsurface borings at depths ranging from 1.22 m (4 ft) to 4.88 m (16 ft). Geologic information obtained from the test pits and borings at Load Line 2 was used to update the CSM initially developed based on Phase I data and presented in the Phase II RI SAP Addendum (Chapter 8.0).

2.3.2.1 Soils

At Load Line 2, soils of the Trumbull, Mitiwanga, and Mahoning series are present. The Trumbull series soils are deep, poorly drained, and occur on nearly level terrain. Permeabilities typically are low [less than 0.15 cm (0.06 in.) per hour], and the soil remains saturated with water for long periods in winter, spring, and summer. Ponding is common after heavy rains. This soil series is found mainly along small drainage features or in low-lying areas adjacent to Mahoning or Resmen series soils in areas less than 4 ha (10 acres) (USDA 1978).

Soil of the Mahoning series is typified by poorly drained soil formed in silty clay loam or clay loam glacial till where bedrock is generally greater than 1.8 m (6 ft). These soils are found on uplands. Runoff is typically medium to rapid, and the soil is seasonally wet. Permeabilites range from 1.52 to 5.08 cm (0.6 to 2.0 in.) per hour.

Mitiwanga series soils consist of moderately deep, somewhat poorly drained soils formed in glacial till overlying sandstone bedrock, and these soils are found primarily on undulating uplands. The soil is characterized most commonly as a silty clay loam varying in color from yellowish brown to dark yellowish brown. These soils exhibit a moderate available water capacity and have a water table near the surface late in winter and spring. Permeabilities range from 1.52 to 5.08 cm (0.6 to 2.0 in.) per hour.

A generalized geologic cross section depicting unconsolidated zone stratigraphy for the AOC from north to south is provided in Figure 2-3. At Load Line 2, unconsolidated zone characteristics vary widely in character from one area to another due to lateral discontinuity within the glacial till and site disturbances. Based on test pit and boring data, unconsolidated deposits consist primarily of a yellowish-brown (10YR5/4), silty to sandy clay with intermittent gravel, with thicknesses ranging from 0 to 5.49 m (0 to 18 ft). On average, the unconsolidated interval was 1.9 m (6.3 ft) thick at Load Line 2. This interval typically has a stiff consistency, low plasticity, and is dry to moist. In comparatively undisturbed areas where some test pits were excavated, the surface soil interval consisted of a light yellow brown (10YR5/4) to gray (2.5Y4/4) mottled, clayey silt to silty clay.

As observed from boring logs (reference Appendix A), some areas within Load Line 2 have been substantially reworked and contain sandy fill, pea gravel, ballast material, and slag; however, silty clays and silty sands dominate in the near surface interval. Concrete, rebar, nails, glass, paint chips, and other debris exist at the ground surface in many areas, especially in the vicinity of buildings. Additional geotechnical data collected during the Phase II RI are presented in Chapter 4.0 and in the geotechnical laboratory report provided in Appendix K of this RI Report. Geologic logs for piezometers and monitoring wells are in Appendix C and those for test pits are in Appendix E.

2.3.2.2 Bedrock geology

The Sharon Conglomerate unit of the Sharon Member (Pottsville Formation) was encountered in all subsurface borings at Load Line 2, which ranged in depth from 6.1 to 8.5 m (20 to 28 ft). Figure 2-3 illustrates bedrock lithologies encountered at Load Line 2. The unit is characterized by a light yellowish-brown to brownish-gray, fine- to medium-grained sandstone, which commonly contains iron-stained fractures. In the vicinity of Load Line 2, shale lenses of varying thickness were commonly observed in subsurface borings. These shale lenses are comprised of light brownish-gray to dark gray shale, typically 0.3 m (1 ft) in thickness or less. However, in the subsurface boring for well LL2mw-269, the observed lithology consisted of silty clays to clayey silts overlying shale and no sandstone was encountered. These shale lenses were also encountered in borings drilled during the Phase II RI at Load Line 3 at a greater frequency and thickness. The prevalence of shale in the Load Lines 2 and 3 vicinity was not observed during investigations at Load Line 1 and Ramsdell Quarry to the northeast; the Sharon Conglomerate in these areas consists of a much more homogenous quartz sandstone with little observed shale. Further to the west at Load Line 12, an extensive dark gray shale was encountered in subsurface borings. The observed facies changes imply a change of depositional environment across the southeastern portion of the facility with energetic conditions in the Load Line 1 and Ramsdell Quarry areas and increasingly quiescent conditions towards the south-central portion of RVAAP (e.g., vicinity of Load Lines 12 and 4).

2.4 HYDROLOGY

2.4.1 Regional Hydrogeology

Sand and gravel aquifers are present in the buried-valley and outwash deposits in Portage County, as described in the Phase I RI (USACE 1998a). Generally, these saturated zones are too thin and localized to provide large quantities of water for industrial or public water supplies; however, yields are sufficient for residential water supplies. Lateral continuity of these aquifers is not known. Recharge of these units comes from surface water infiltration of precipitation and surface streams. Specific groundwater recharge and discharge areas at RVAAP have not been delineated. However, extensive upland areas, such as north

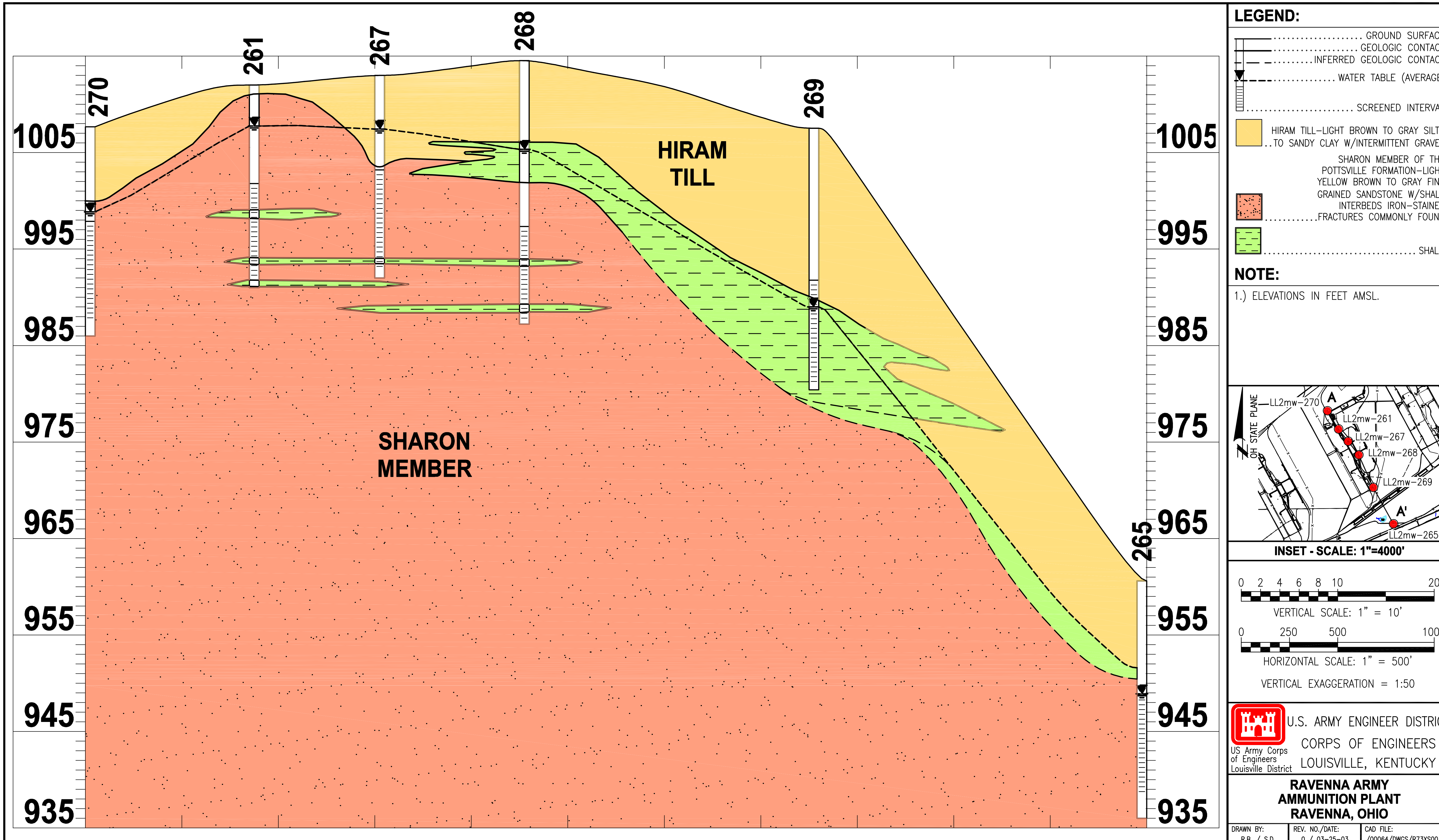

Figure 2-3. Generalized Geologic Cross Section of Unconsolidated Deposits at Load Line 2

of WBG and in the western portion of the facility, are presumed to be regional recharge zones. The major perennial surface water drainages (e.g., Sand Creek, Hinkley Creek, and Eagle Creek) are presumed to be the major groundwater discharge areas (Section 2.4.1.3).

2.4.1.1 Unconsolidated sediment

The thickness of the unconsolidated interval at RVAAP ranges from thin to absent in the eastern and northeastern portion of RVAAP to an estimated 45 m (150 ft) in the central portion of the installation. The groundwater table occurs within the unconsolidated zone in many areas of the installation. Because of the very heterogeneous nature of the unconsolidated glacial materials, groundwater flow patterns are difficult to determine with a high degree of accuracy. Vertical recharge from precipitation likely occurs via infiltration along root zones, desiccation cracks, and partings within the soil column. Laterally, most groundwater flow likely occurs along preferential pathways (e.g., sand seams, channel deposits, or other stratigraphic discontinuities) having higher permeabilities than surrounding clay or silt-rich materials. Available data indicate a wide-range of K values in the unconsolidated materials from as high as 4×10^{-2} cm/sec (1.31×10^{2} ft/day) in sandy materials to as low as 1×10^{-7} cm/sec (2.83×10^{-4} ft/day) for clays.

2.4.1.2 Bedrock hydrogeology

During the period of RVAAP operations, approximately 75 tests wells were drilled for potable and industrial uses. Of these, only 15 were considered adequate producers. As of 1978, only 5 wells were used continuously (USATHAMA 1978). The sandstone facies of the Sharon Member, and in particular the Sharon Conglomerate, were the primary sources of groundwater during RVAAP's active phase, although some wells were completed in the Sharon Shale. Past studies of the Sharon Conglomerate indicate that the highest yields come from the quartzite-pebble conglomerate facies and from jointed and fractured zones. Where it is present, the overlying Sharon Shale acts as a relatively impermeable confining layer for the sandstone. Hydraulic conductivities in wells completed in the Sharon Shale generally are much lower than those in the sandstone.

2.4.1.3 Groundwater flow directions

A facility-wide water table map was constructed using water-level measurements taken during a 2-day period (August 27 and 28, 2001) as part of the Phase II RI field investigation (Figure 2-4). Monitoring wells from which data were obtained are all screened within the uppermost groundwater interval at RVAAP, either at the water table or immediately below it. Both unconsolidated and bedrock zone wells are represented in the water level dataset; thus, the potentiometric map presents a generalized representation of the water table surface. Perennial streams and ponds present at RVAAP were considered as expressions of the water table surface. Thus, to augment water level data in areas that did not have adequate well coverage, elevations of perennial streams and ponds, estimated from topographic base map files, were used to infer water table elevations. Topographic surface controls from base map files were also used to guide placement of water table isopleths.

The facility-wide potentiometric map shows that the water table surface is a subdued representation of the topography of the region. The predominant groundwater flow direction is to the east, with water table elevations decreasing from a high of about 1,136 ft amsl at well BKGmw-063 in the northwest portion of the facility to a low of about 928 ft amsl southeast of Load Line 1 (well LL1mw-065). A significant potentiometric high centered around Load Line 2 is indicated in the southeastern portion of RVAAP. This potentiometric high results in localized radial flow vectors in this portion of the facility. A groundwater divide is inferred in the western portion of the facility based on surface stream and topographic elevations, although little potentiometric data exist in this region to confirm its presence.

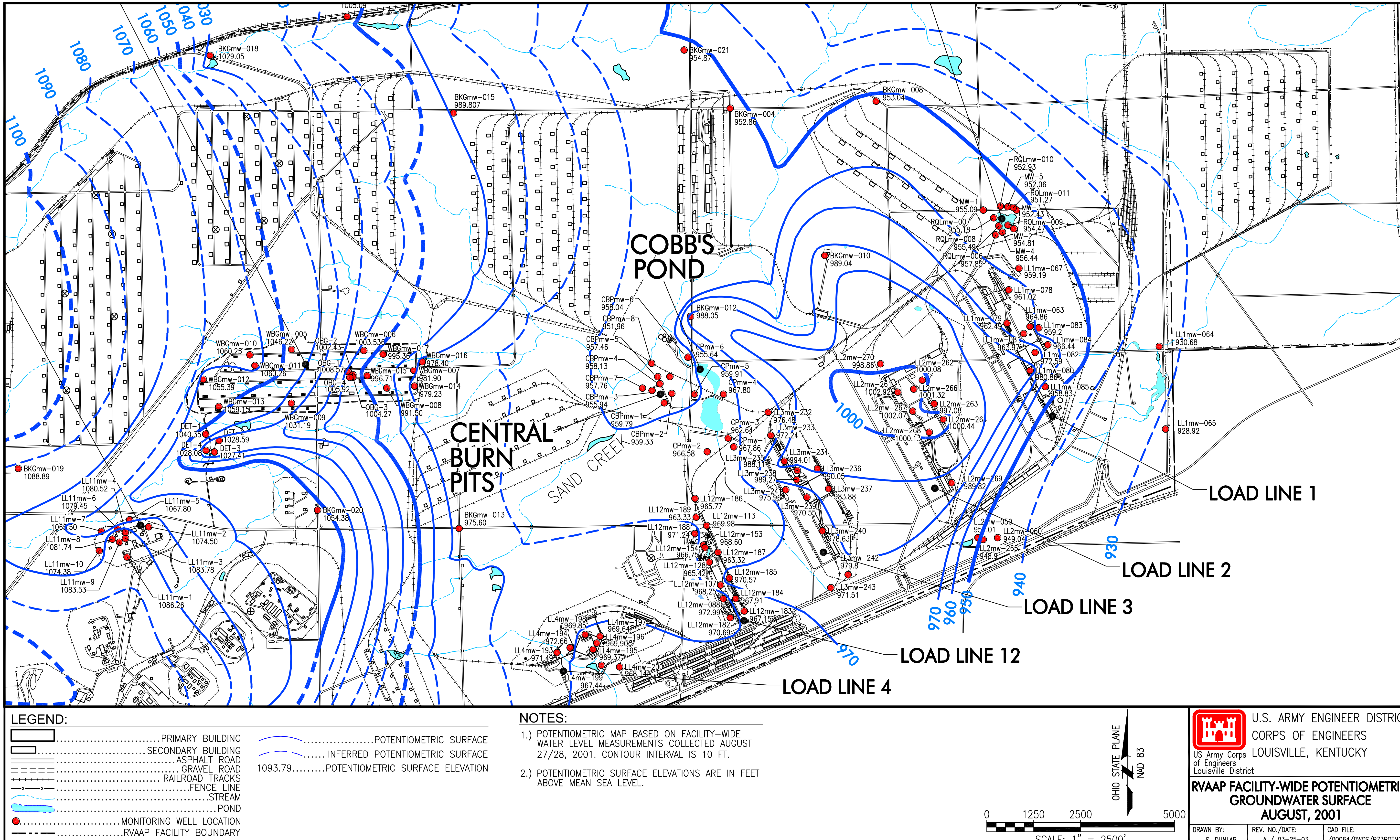

Figure 2-4. Facility-wide Potentiometric Map, August 2001

At the watershed scale (i.e., Sand Creek, Hinkley Creek, South Fork of Eagle Creek), groundwater flow generally mirrors surface drainage patterns. Regional drainage patterns along Sand Creek in the northeast portion of RVAAP result in a localized perturbation in the overall flow direction to the north-northeast. In several locations along the southern boundary of RVAAP, south-southeast perturbations in the overall observed groundwater flow patterns are observed as follows:

- a localized south-southeasterly flow component from the potentiometric high area centered around Load Lines 1, 2, and 3 toward the facility boundary;
- a localized southerly flow component toward the facility boundary from the southernmost portion of Load Line 12;
- a localized southerly flow component toward the facility boundary from Load Line 4, which mirrors the direction of surface water flow in the unnamed tributary that drains this load line; and
- groundwater flow to the south in association with Hinkley Creek in the southwest portion of the site (i.e., NACA Test Area and Demolition Area 1 vicinity).

The potentiometric surface may be interpreted with a higher degree of confidence in the southeastern portion of RVAAP than in many other areas of the facility because of the density of monitoring wells present (i.e., vicinity of Cobb's Pond, Ramsdell Quarry, Load Lines 1 through 4, and Load Line 12). The potentiometric surface and water table gradients in the vicinity of Cobb's Pond, Load Line 12, and Load Line 4 are subdued when compared to other portions of RVAAP and appear to be influenced by the abundant large surface water features and wetlands present in these areas.

Greater uncertainty in interpretation of groundwater flow directions exists in the vicinity of Load Line 12 and Demolition Area 2. Potential subsurface geologic heterogeneities in the vicinity of Load Line 12 create a complex potentiometric surface that is difficult to interpret with existing data. An apparent narrow potentiometric low oriented in a north-south direction extends along the central portion of Load Line 12 from South Service Road towards Cobb's Pond. This potentiometric low was also evident from water table data collected during 2000, and, as presented in the Load Line 12 Phase II Remedial Investigation Report (USACE 2001c), may be a representation of a zone of higher permeability, such as a channel deposit.

In the vicinity of Demolition Area 2, steep potentiometric gradients are inferred based on data from wells that existed in the area as of August 2001. Additional monitoring wells were installed at this AOC in the fall of 2002 as part of a Phase II RI. Data from the new Demolition Area 2 wells need to be included in any subsequent assessment of facility-wide potentiometric elevations and may alter the interpretation of gradients in this area.

2.4.1.4 Surface water system

The entire RVAAP facility is situated within the Ohio River Basin, with the West Branch of the Mahoning River representing the major surface stream in the area. This stream flows adjacent to the western end of the facility, generally from north to south, before flowing into the Michael J. Kirwan Reservoir that is located to the south of State Route 5. The West Branch flows out of the reservoir along the southern facility boundary before joining the Mahoning River east of RVAAP.

The western and northern portions of RVAAP are characterized by low hills and dendritic surface drainage. The eastern and southern portions are characterized by an undulating to moderately level surface, with less dissection by surface drainage. Numerous wetland areas occur on the facility. Three primary watercourses drain RVAAP: the South Fork of Eagle Creek, Sand Creek, and Hinkley Creek.

Sand Creek, with a drainage area of 36 square km (13.9 square miles), flows generally northeast to its confluence with the South Fork of Eagle Creek. In turn, the South Fork of Eagle Creek then continues in a northerly direction for 7 km (2.7 miles) to its confluence with Eagle Creek. The drainage area of the South Fork of Eagle Creek is 67.9 square km (26.2 square miles), including the area drained by Sand Creek. Hinkley Creek, with a drainage area of 28.5 square km (11.0 square miles), flows in a southerly direction through the installation to its confluence with the West Branch of the Mahoning River south of the facility.

Approximately 50 ponds are scattered throughout the installation. Many were built within natural drainageways to function as settling ponds or basins for process effluent and runoff. Others are natural glacial depressions or result from beaver activity. All major water bodies at RVAAP support an abundance of aquatic vegetation and are well stocked with fish. None of the ponds within the installation are used as water supply sources.

Storm water runoff is controlled primarily by natural drainage, except in former operations areas where extensive storm sewer networks and surface ditches help to direct runoff to streams and settling ponds. In addition, the storm sewer and drainage ditch systems were one of the primary drainage mechanisms for process effluent during the period that production facilities were in operation.

2.4.2 Load Line 2 Hydrogeologic Setting

All wells at Load Line 2 are screened within the Sharon Member conglomerate unit. A potentiometric surface map of Load Line 2 is provided in Figure 2-5. This AOC-specific water table map was constructed using static water level data from 12 monitoring wells installed during the Phase II RI and reflects the interpretations of the facility-wide potentiometric surface characterization described in Section 2.4.1.3. Within Load Line 2, a radial groundwater flow pattern exists, centered around a potentiometric high in the center of the load line. Water table elevations drop steeply on the south side of the AOC, consistent with topography. A 15.2-m (50-ft) decrease in water levels was observed from the center of the load line to monitoring wells located just to the south of Kelly's Pond, a distance of approximately 1,295 m (4,250 ft).

Results of slug tests performed at the 12 monitoring wells during September 2001 show low to moderate hydraulic conductivities. Hydraulic conductivities ranged from 3.67×10^{-6} cm/sec (1.04×10^{-2} ft/day) to 2.62×10^{-3} cm/sec (7.43 ft/day) (Table 2-1). Slug test results are representative of the entire screened interval for the monitoring wells; therefore, any local heterogeneities within the screened interval that affect hydraulic conductivity, such as shale lenses, are represented in the slug test.

The primary surface water conveyance at Load Line 2 drains to the south and ultimately discharges into Kelly's Pond (Figure 1-5). Surface water flows through a series of manmade ditches, which ultimately connect on the south end of the AOC and flow through a corrugated metal pipe underneath the railroad tracks en route to Kelly's Pond. The largest of these ditches begins just north of building DB-4 and is approximately 50 ft wide and 15 ft deep. Surface water also flows north through a smaller network of ditches to a group of four ponds situated on the northeast corner of Load Line 2, but the majority of surface water runoff is to the south. These ditches mainly served as a surface and wastewater (e.g., pink wastewater) runoff control system. Flow in the ditches is intermittent and driven primarily by storm events.

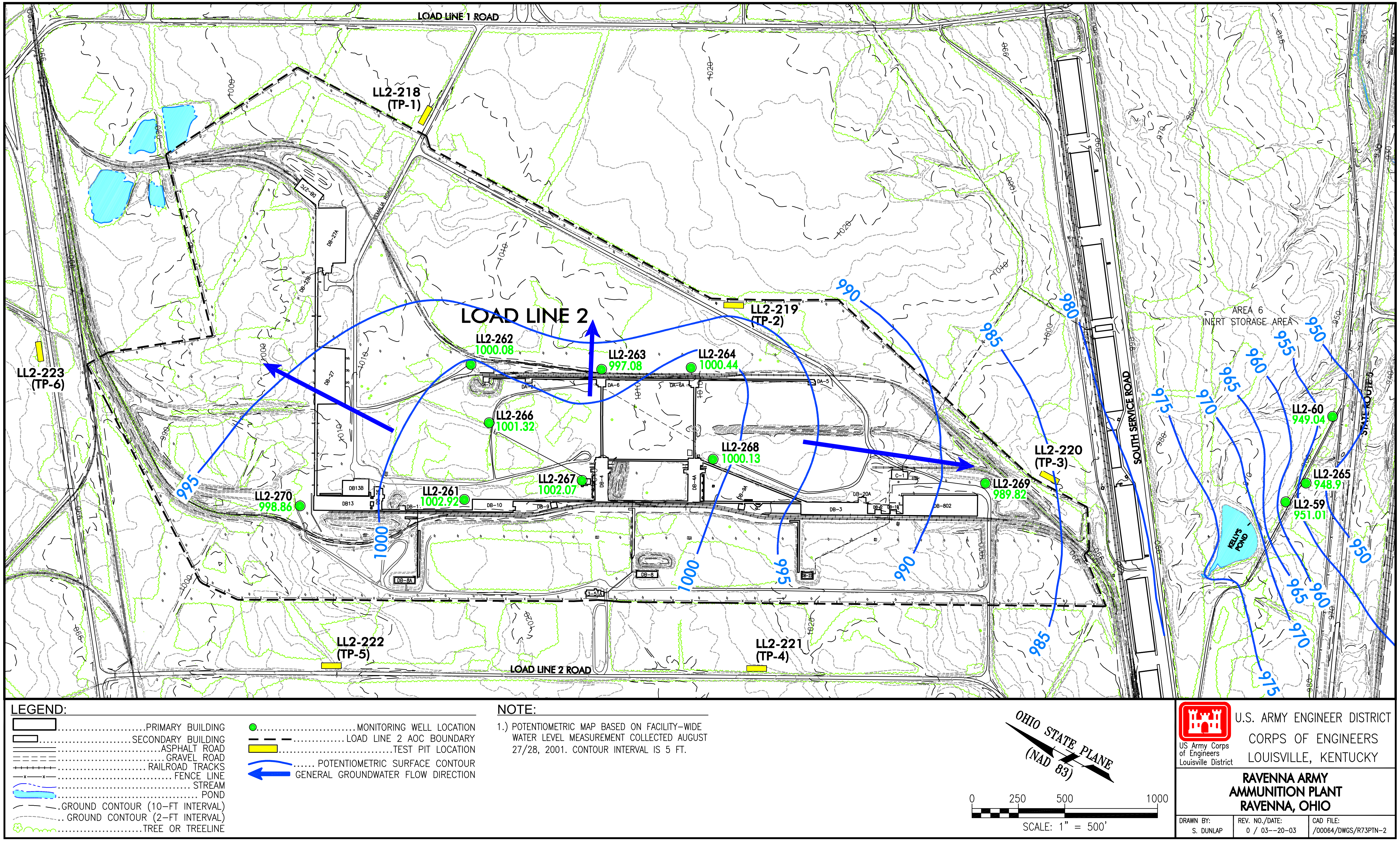

Figure 2-5. Potentiometric Groundwater Surface at Load Line 2, August 2001

Table 2-1. Horizontal Hydraulic Conductivities in Phase II RI Monitoring Wells

Monitoring Well ID	Total Depth (ft bgs)	Screened Interval (ft bgs)	Lithology in Screened Interval	Rising-Head or Falling-Head Test	Slug-Test-Determined Hydraulic Conductivity (cm/sec)
MW-261	22.41	9.8 to 19.8	Sandstone w/ shale interbeds	Falling	6.83E-04
				Rising	4.12E-04
MW-262	22.59	10.6 to 20.6	Sandstone w/ shale interbeds	Rising	2.49E-03
MW-263	22.75	10.8 to 20.8	Sandstone w/ shale interbeds	Rising	3.37E-04
MW-264	22.33	9.75 to 19.75	Sandstone w/ shale interbeds	Rising	2.62E-03
MW-265	24.36	11.82 to 21.82	Sandstone	Rising	7.17E-04
MW-266	21.65	9.8 to 19.8	Sandstone w/ shale interbeds	Rising	6.32E-04
MW-267	22.65	9.8 to 19.8	Sandstone w/ shale interbeds	Rising	9.91E-04
MW-268	29.85	17.29 to 27.29	Sandstone w/ shale interbeds	Falling	1.46E-03
				Rising	1.34E-03
MW-269	30.23	17.1 to 27.1	Shale	Rising	1.59E-03
MW-270	22.36	9.8 to 19.8	Sandstone	Rising	3.67E-06

bgs = Below ground surface.
ID = Identification.
RI = Remedial Investigation.

A below ground storm sewer system also exists within the former production area at Load Line 2 for management of stormwater runoff (refer to Figure 3-8). Runoff is collected at a series of inlets located adjacent to the primary buildings and along roadways, and is directed via pipes to discharge points at the major drainages ditches noted above. The stormwater system collected pink wastewater and runoff from contaminated surface soil in the immediate vicinity of the melt-pour buildings and other major production buildings.

2.5 CLIMATE

RVAAP has a humid continental climate characterized by warm, humid summers and cold winters. Precipitation varies widely through the year. The driest month is, on average, July, and the wettest month is February. Data from the National Weather Service compiled over the past 47 years indicate that the average rainfall for the area is 98 cm (38.72 in.) annually. The average snowfall is 108 cm (42.4 in.) annually. Severe weather, in the form of thunder and hail in summer and snowstorms in winter, is common. Tornadoes are infrequent in Portage County. The Phase II RI was conducted during the historically dry portion of the year (autumn), but overall, climate conditions for the year were normal.

2.6 POTENTIAL RECEPTORS

2.6.1 Human Receptors

RVAAP consists of 8,998.3 ha (21,419 acres) and is located in northeastern Ohio, approximately 37 km (23 miles) east-northeast of Akron and 48.3 km (30 miles) west-northwest of Youngstown. RVAAP occupies east-central Portage County and southwestern Trumbull County. The 2000 Census lists the total populations of Portage and Trumbull counties at 152,061 and 225,116, respectively. Population centers closest to RVAAP are Ravenna, with a population of 11,771, and Newton Falls, with a population of 5,002. Approximately 55% of Portage County, in which the majority of RVAAP is located, consists of either woodland or farm acreage. The Michael J. Kirwan Reservoir (also known as West Branch Reservoir) is the closest major recreational area and is adjacent to the western half of RVAAP south of State Route 5.

RVAAP is located in a rural area, is not accessible to the general public, and is not near any major industrial or developed areas. The facility is completely fenced and patrolled by security personnel. Army and full-time operating contractor staff (i.e., security, grounds and maintenance workers) are located on-site. Additional subcontractor staff are on-site for varying periods of time, ranging from several weeks to more than 12 months, to complete specific demolition/decommissioning projects. Training activities under the OHARNG involve an average of 4,500 personnel during the course of a month, who are on-site for periods of 3 days (inactive duty or weekend training) to 2 weeks (annual training).

Load Line 2 is located in the southeastern corner of RVAAP and is not currently used for OHARNG training activities. Some workers will be present during future demolition activities, which are currently suspended pending additional funding and desensitization of buildings for explosive compounds. The former production area is surrounded by a security fence and locked gates. Groundskeeping activities are limited to infrequent mowing and brush clearing along the perimeter areas outside of the AOC boundary fence. Load Line 2 is not presently included in the deer hunting program. The North Ponds are a catch-and-keep fishery with wading permitted (Morgan 2003). Recently, RVAAP instituted a limited catch and release fishing program, which includes Upper and Lower Cobb's Pond (OHARNG 2001). Six to 12 deer hunts take place at RVAAP during weekends each year in October and November. Kelly's Pond is not currently included in the limited catch and release fishing program. Security activities consist of gate checks and surveillance along South Service Road. Potential future land uses for Load Line 2 and the immediate vicinity under the March 2003 OHARNG reuse program include mounted training with no digging, waterfowl hunting, trapping, fishing, fire suppression, and dust control activities. Additional information on future land uses is included in Chapter 6.0, Section 6.3.1.

2.6.2 Ecological Receptors

The dominant types of vegetative cover at RVAAP, including portions of Load Line 2 and its immediate surroundings, are forests and old fields of various ages. More than 60% of RVAAP is now in forest (Morgan 2004). Most of the old field cover is the result of earlier agricultural practices that left these sites with poor topsoil, which limits forest regeneration. Several thousand acres of agricultural fields were planted in trees during the 1950s and 1960s, but these plantings were not successful in areas with poor topsoil. Some fields, leased for cattle grazing during the same time period, were delayed in their reversion to forest. A few fields have been periodically mowed, maintaining them as old field, and 36 ha (90 acres) are leased as hay fields. Load Line 2 is covered with rough grasses and scrub vegetation within the former production area and forested areas and old field in the non-production areas.

Forested wetlands, scrub-shrub wetlands, isolated wetlands, and wetlands associated with surface water features are abundant at RVAAP (OHARNG 2001). It is estimated that at least one-third to one-half of the property would meet the criteria for a jurisdictional wetland (OHARNG 2001). Jurisdictional wetland delineations are expensive and not practical for general planning purposes but can be done to support specific projects (OHARNG 2001). Various wetland maps are available for RVAAP, including the U.S. Fish and Wildlife Service National Wetlands Inventory (NWI) Maps, USACE Waterways Experiment Station maps of primary wetland areas, and U.S. Geological Survey identification of potential wetlands in Training Areas (OHARNG 2001). All of these maps are useful planning tools, but do not provide jurisdictional delineations suitable for compliance with Section 404 of the Clean Water Act

(OHARNG 2001). There have been two jurisdictional delineations done in recent years to support National Environmental Protection Act requirements of specific project proposals (OHARNG 2001).

The wetland acreage identified on the NWI maps is unknown, but is much less than one-third to one-half of the installation acreage (OHARNG 2001). The USACE Water Experiment Station maps of primary wetland areas, as interpreted from aerial photographs of the installation, identify 1,917 acres of wetlands at RVAAP (OHARNG 2001). The mapped wetlands do not identify a lot of the forested and scrub-shrub wetland communities and do not fully encompass the extent of wetlands likely present at RVAAP (OHARNG 2001). There are 12 types of wetland communities present at RVAAP (OHARNG 2001).

Most of these wetlands exist because of poorly drained and hydric soils. Beaver impoundments contribute to wetland diversification in some parts of the site. A forested wetland area occurs in the western portion of the Load Line 2, and wetland areas exist along the tributary draining to Upper Cobb's Pond.

The flora and fauna at RVAAP are varied and widespread. No federal threatened or endangered or candidate threatened or endangered species have been observed on RVAAP. A list of state endangered, state threatened or potentially threatened, and state special interest species confirmed to be on RVAAP is provided in Table 2-2 (Morgan 2000). Additionally, five rare plant communities/significant natural areas have been identified on RVAAP, including the northern woods, Wadsworth Glen, Group 3 woods, B&O Wye Road area, and South Patrol Road swamp forest.

Restricted land use and sound forest management practices have preserved and enabled large forest tracts to mature. Habitat conversion at RVAAP, unlike most other habitat conversions occurring nationwide, has been toward restoration of the forests that covered the area prior to its being cleared for agriculture. The reversion of these agricultural fields to mature forest provides a diverse habitat from old field through several successional stages. Overall, the trend toward forest cover enhances the area for use by both plant and animal forest species. Future IRP activities will require consideration of these species to ensure that detrimental effects on threatened or endangered RVAAP flora and fauna do not occur; this will be discussed in the ERA (Chapter 7.0). There are no federal, state, or local parks or protected areas on RVAAP property.

2.7 PRELIMINARY CONCEPTUAL SITE MODEL

The facility-wide hydrogeologic CSM for RVAAP presented in the Facility-wide SAP (USACE 2001a) is applicable to Load Line 2. The CSM for RVAAP, operational information, and data collected during the Phase I RI at Load Line 2 (USACE 1998a) were used to develop the preliminary Load Line 2 CSM outlined below. The preliminary CSM was used to develop sampling rationales and DQOs for the Phase II RI SAP Addendum. This preliminary CSM is refined in Chapter 8.0 to integrate the results of the Phase II RI evaluation of contaminant nature and extent, fate and transport modeling, and risk evaluations.

Soil

The soil cover thickness in Load Line 2 ranges from 1.22 m (4 ft) to a maximum of 4.88 m (16 ft) with an average depth to bedrock in the main production areas generally only about 1 ft. Previous sampling data at Load Line 2 indicate that contamination sources (represented by areas of soil contamination) are primarily the former operations areas. Elevated concentrations of explosives were observed primarily around the melt-pour buildings, Building DB-10, and Building DA-6A. Explosives contamination was not indicated during previous investigations in soil south of Building DB-9A. Chromium, lead, and manganese are commonly present above background concentrations. Site-related metals are concentrated

Table 2-2. RVAAP Rare Species List as of 2003

A. State Endangered		
	1.	Northern harrier, *Circus cyaneus*
	2.	Common barn owl, *Tyto alba*
	3.	Yellow-bellied sapsucker, *Sphyrapicus varius*
	4.	Mountain brook lamprey, *Ichthyomyzon greeleyi*
	5.	Graceful underwing, *Catocala gracilis*
	6.	Ovate spikerush, *Eleocharis ovata* (Blunt spike-rush)
	7.	Lurking leskea, *Plagiothecium latebricola*
	8.	Little blue heron, *Egretta caerulea* (suspected)
	9.	American bittern, *Botaurus lentiginosu* (migrant)
	10.	Canada warbler, *Wilsonia canadensis* (migrant)
	11.	Osprey, *Junco hyemalis* (migrant)
	12	Trumpeter swan, *Cygnus buccinator* (migrant)
	13.	Little blue heron, *Egretta caerulea* (migrant)
B. State Threatened		
	1.	Simple willow-herb, *Epilobium strictum*
C. State Potentially Threatened		
	1.	Gray birch, *Betula populifolia*
	2.	Round-leaved sundew, *Drosera rotundifolia*
	3.	Closed gentian, *Gentiana clausa*
	4.	Butternut, *Juglans cinerea*
	5.	Blunt mountain-mint, *Pycnanthemum muticum*
	6.	Northern rose azalea, *Rhododendron nudiflorum* var. *roseum*
	7.	Large cranberry, *Vaccinium macrocarpon*
	8.	Hobblebush, *Viburnum alnifolium*
	9.	Long beech fern, *Phegopteris connectilis*
	10.	Woodland horsetail, *Equisetum sylvaticum*
	11.	Weak sedge, *Carex debilis* var. *debilis*
	12.	Straw sedge, *Carex straminea*
	13.	Water avens, *Geum rivale*
	14.	Tall St. John's wort, *Hypercium majus*
	15.	Swamp oats, *Sphenopholis pensylvanica*
	16.	Shining ladies'-tresses, *Spiranthes lucida*
D. State Special Interest		
	1.	Sora, *Porzana carolina*
	2.	Virginia rail, *Rallus limicola*
	3.	Four-toed salamander, *Hemidactylium scutatum*
	4.	Smooth green snake, *Opheodrys vernalis*
	5.	Woodland jumping mouse, *Napaeozapus insignis*
	6.	Sharp-shinned hawk, *Accipiter striatus*
	7.	Solitary vireo, *Vireo solitarius*
	8.	Pygmy shrew, *Sorex hoyi*
	9.	Star-nosed mole, *Condylura cristata*
	10.	Red-shouldered hawk, *Buteo lineatus*
	11.	Henslow's sparrow, *Ammodramus henslowii*
	12.	Cerulean warbler, *Dendroica cerulea*
	13.	Common moorhen, *Gallinula chloropus*
	14.	Eastern box turtle, *Carolina carolina*
	15.	*Capperia evansi* (moth)
	16.	*Zanclognatha martha* (moth)
	17.	*Oligia bridghami* (moth)
	18.	*Chaetaglaea sericea* (moth)
	19.	*Sutyna privata* (moth)
	20.	*Homorthodes frufurata* (moth)

Source: Morgan (2003a).
RVAAP = Ravenna Army Ammunition Plant.

the highest around the melt-pour buildings and Building DB-10. Low levels of organic compounds (PAHs and pesticides/PCBs) were also detected near melt-pour buildings and building DB-10, with PCBs being found more commonly throughout the load line. Based on characterization data to date, contaminated soil within and adjacent to former process areas is a potential secondary source of contamination to sediment, surface water, and groundwater. Contaminants may be released from soil and migrate in storm runoff either in dissolved phase or adsorbed to particulates and/or colloids.

Sediment

Sediment in ditches and tributaries represents a receptor medium for contaminants eroded or leached from source area soils and transported by storm runoff. In addition, sediment may function as a transport mechanism, considering that particulates with adsorbed contaminants may be re-suspended under turbulent flow conditions (e.g., during storm events) and migrate incrementally down stream. Operational data suggest that the ditches in the vicinity of former process areas represent the most likely locations where contaminants may have accumulated through erosional transport. Site characteristics and available field data show that the primary surface water and sediment exit pathway from Load Line 2 is to the south-southeast via ditches to Kelly's Pond. These ditches are also a potential accumulation point for contaminants. Some of these elements of the CSM have been confirmed by previous Phase I RI sediment sampling (see Section 1.3.3) at 19 locations within drainage ditches and Kelly's Pond.

Surface Water

Sampling of surface water from conveyances within and adjacent to Load Line 2 was not conducted during the Phase I RI. Most of the surface water flows through ditches off of the AOC to Kelly's Pond. Overall surface water drainage patterns at Load Line 2 are to the east via the ditches to Kelly's Pond and some drainage occurs to the northwest to an unnamed set of four ponds. Therefore, potential transport of contaminants from Load Line 2 off of RVAAP is not an element of the CSM addressed by the Phase II RI. Potential contaminants would be expected to leach or erode from source areas into drainage ditches, particularly from former operations buildings, and migrate toward the exit point. Erosional transport of contaminants and migration through the surface water system is assumed to be primarily episodic in nature and related to storm events that flush the system and mobilize contaminated sediment.

Groundwater

Limited hydrogeologic and analytical data existed for groundwater at Load Line 2 prior to the Phase II RI (see Section 1.3.3); therefore, an accurate assessment of groundwater flow patterns has previously not been possible. For the purposes of DQO development and investigation planning, the CSM at the time of Phase II scoping presumed that the general groundwater flow patterns followed site topography and surface water drainage patterns, which indicated an overall gradient to the south-southeast toward Kelly's Pond. Due to fracturing and stratigraphic variations within the bedrock interval, localized variants in the overall flow patterns and preferred migration pathways (i.e., gravel or sand stringers) were presumed to exist at the site. Also, based on site conditions, groundwater flow off of the AOC to the south-southeast, and potentially off of RVAAP, was considered a possibility.

Some analytical evidence for groundwater contamination by SRCs identified in source area soils (i.e., explosives, metals, SVOCs) did exist for Load Line 2 prior to the Phase II RI. Two monitoring wells downgradient of Kelly's Pond (just off of the boundary of the AOC) were subjected to a full-suite of analyses and site-related inorganic analytes. Aluminum, arsenic, barium, cobalt, iron, manganese, nickel, zinc, and cyanide were found. Because of the limited available data, contaminant migration from source areas to groundwater (via leaching or surface water infiltration) has not been previously addressed. Potential source area SRCs identified to date have low mobility in groundwater.

Utilities

The storm and sanitary sewer system present at Load Line 2 may represent an accumulation point for contaminants introduced to the system via floor and sink drains during AOC operations. Discharge of the storm sewer system to surface drainage ditches represents an exit pathway for contaminants mobilized from source areas via runoff. Portions of the system are suspected to be below the water table because some of the lines were observed to contain water during site reconnaissance. Considering the age of the system, cracks or gaps in the piping potentially allow groundwater influx. Any accumulated contaminants in sludge or sediment in the piping may represent a source term to groundwater. Also, the system may function as a preferential migration pathway for shallow groundwater transport.

Current Site Conditions

The current potential for human exposure to potential contaminants migrating from the site is mitigated by inactivity at the site, the absence of permanent residents, and the low population density on adjacent private properties. In the non-production areas, no evidence of substantial ecological stress was observed during field reconnaissance and investigation activities.