3. ENVIRONMENTAL SETTING

The material presented in this section describes the physical characteristics of the AOCs and surrounding environment that must be understood in order to evaluate potential contaminant transport pathways, receptor populations, and exposure scenarios with respect to the evaluation of human health and ecological impacts. The geology, hydrogeology, climate, and ecological characteristics of the AOCs are presented using regional and local information, as well as site-specific data collected during Phase I. These data are integrated into a conceptual model of site conditions as they relate to contaminants present at RVAAP. In addition, a number of Ohio Department of Natural Resources (ODNR) geologic maps are available providing additional information; these include the Drift Thickness Map of Portage County, Ohio (1983), Surficial Materials of Portage County, Ohio (1987), Geologic Evaluation of Land Areas in Portage County, Ohio for Solid-Waste Disposal (1984), Groundwater Pollution Potential of Portage County, Ohio (1991), and Bedrock Topography of Portage County, Ohio (1983). There are also several useful figures contained in the 1982 Hydrologic Investigation depicting bedrock geology, bedrock stratigraphy of the Pottsville Formation, and well log data from the wells in the study area.

3.1 GEOLOGY

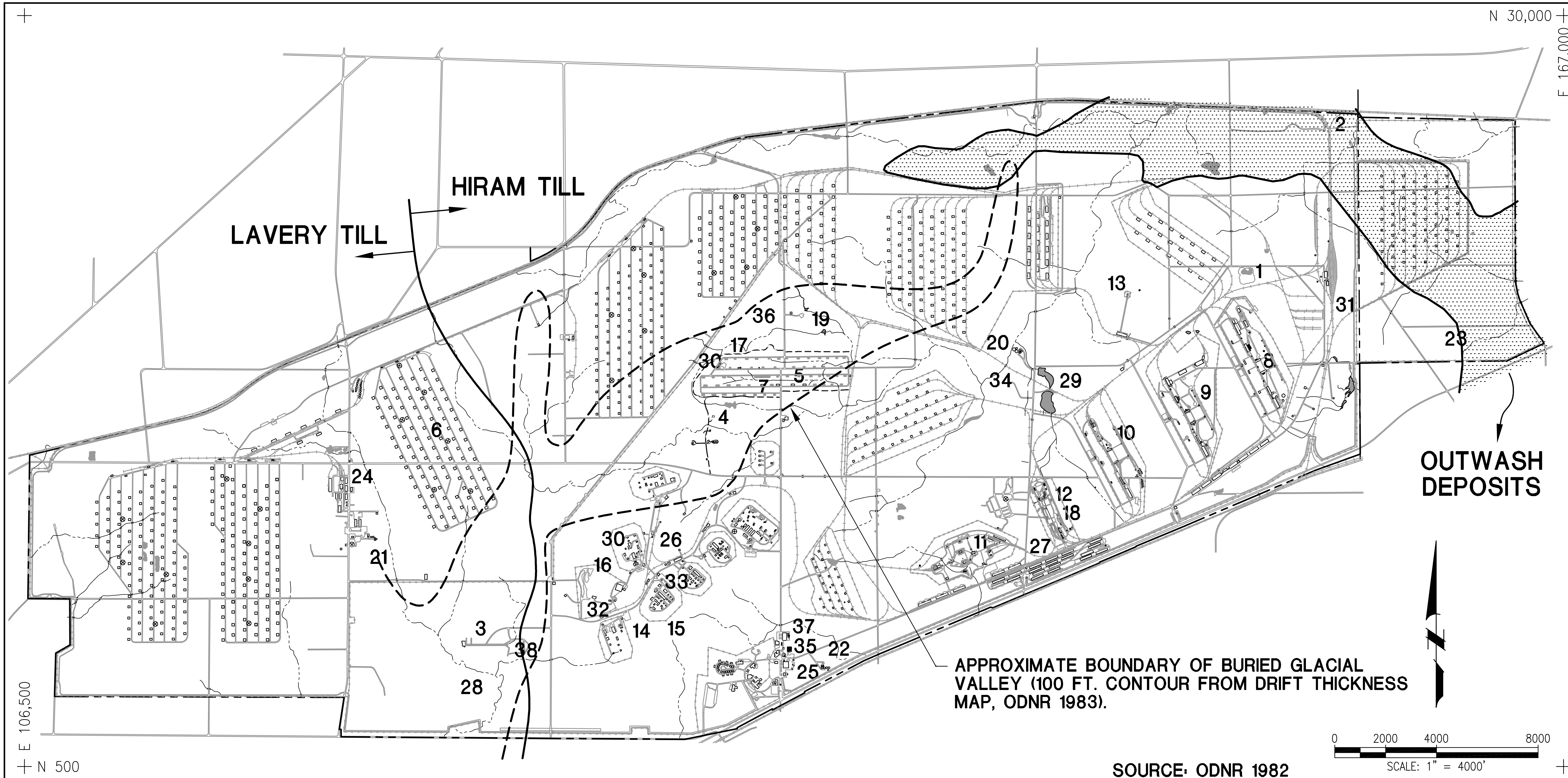
3.1.1 Glacial Deposits

Two Wisconsin-age glacial advances resulted in the deposition of a mantle of glacial till throughout the RVAAP installation in the Late Pleistocene. The first glacial advance deposited the Lavery Till. This till consists mostly of clayey silt with sparse cobbles and pebbles, and has an average thickness of 1.2 m (4 feet). The second glacial advance deposited the Hiram Till on the Lavery, over the eastern two-thirds of the facility only. The Hiram Till consists of silty clay with some sand, and occurs from 1.5 to 4.6 m (5 to 15 feet) BGS, although it may be locally 9.2 m (30 feet) or thicker based on wells installed during the Phase I RI (see Appendix A). In the far northeastern corner of RVAAP, the Hiram Till overlies thin beds of sandy outwash. Field observations indicate that overall thickness of glacial deposits is 0.6 m (2 feet) or less in some parts of the installation. This may be the result of natural erosion or construction grading rather than the non-deposition of till (ODNR 1982).

A buried glacial valley, oriented southwest-northeast, is located in the central portion of the facility. This valley is filled with glacial outwash consisting of poorly sorted clay, till, gravel, and silty sand. Depths of these deposits in the buried valley range from 30.5 to 61 m (100 to 200 feet) BGS. **Figure 3.1** shows the distribution of glacial deposits in the vicinity of RVAAP.

3.1.2 Bedrock

Mississippian- and Pennsylvanian-age sandstones and conglomerates make up the stratigraphy underlying the Hiram and Lavery Tills at RVAAP. The Mississippian Cuyahoga Formation, consisting of a blue-gray silty shale with interbedded sandstone, crops out in the far northeastern corner of the facility. The Cuyahoga Formation has a gentle southward regional dip of 1.5 to 3.0 m (5 to 10 feet) per 1.6 km (1 mile). The remainder of the facility is underlain by the Pottsville



LEGEND OF SITES:

1 .... RAMSDELL QUARRY LANDFILL
2 .... ERIE BURNING GROUNDS
3 .... DEMOLITIONS AREA #1
4 .... DEMOLITIONS AREA #2
5 .... WINKLEPECK BURNING GROUNDS
6 .... C BLOCK QUARRY
7 .... BLDG 1601 HAZARDOUS WASTE STORAGE
8 .... LOAD LINE 1 AND DILUTION/SETTLING POND
9 .... LOAD LINE 2 AND DILUTION/SETTLING POND
10 .... LOAD LINE 3 AND DILUTION/SETTLING POND
11 .... LOAD LINE 4 AND DILUTION/SETTLING POND
12 .... LOAD LINE 12 AND DILUTION/SETTLING POND
13 .... BLDG 1200 AND DILUTION/SETTLING POND
14 .... LOAD LINE 6, EVAPORATION UNIT
15 .... LOAD LINE 6, TREATMENT PLANT QUARRY LANDFILL/FORMER
16 .... FUZE & BOOSTER BURNING PITS
17 .... DEACTIVATION FURNACE
18 .... LOAD LINE 12 PINK WASTE WATER TREATMENT
19 LANDFILL NORTH OF WINKLEPECK BURNING GROUND
20 .... SAND CREEK SEWAGE TREATMENT PLANT
21 .... DEPOT SEWAGE TREATMENT PLANT
22 .... GEORGE ROAD SEWAGE TREATMENT PLANT
23 .... UNIT TRAINING SITE WASTE OIL TANK
24 RESERVE UNIT MAINTENANCE AREA WASTE OIL TANK
25 .... BLDG 1034 MOTOR POOL WASTE OIL TANK
26 .... FUZE BOOSTER AREA SETTLING TANKS
27 .... BLDG 854-PCB STORAGE
28 .... MUSTARD AGENT BURIAL SITE
29 .... UPPER AND LOWER COBBS POND COMPLEX
30 .... LOAD LINE 7 PINK WATER TREATMENT PLANT
31 .... ORE PILE RETENTION POND
32 .... 40 AND 60 MM FIRING RANGE
33 .... FIRESTONE TEST FACILITY
34 .... SAND CREEK DISPOSAL ROAD LANDFILL
35 .... 1037 BUILDING-LAUNDRY WASTEWATER SUMP
36 .... PISTOL RANGE
37 .... PESTICIDE BUILDING S-44S2
38 .... NACA TEST AREA

US Army Corps of Engineers Nashville District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
NASHVILLE, TENNESSEE

RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
GEOLOGY MAP

DRAWN BY:	REV. NO./DATE:	CAD FILE:
R. BEELER	REV. 0/04-17-97	95021/DWGS/573GWALL

Fig. 3-1. Glacial Deposits at RVAAP

Formation of Pennsylvanian age. The Pottsville rests unconformably on the eroded Cuyahoga Formation, and dips 1.5 to 3.5 m (5 to 10 m) per 1.6 km (1 mile) to the south.

The Connoquenessing, Mercer, and Homewood members of the Pottsville Formation are present beneath the western half of the RVAAP installation. The Connoquenessing is a coarse gray sandstone with thin interbeds and partings of sandy shale. The Mercer, overlying the Connoquenessing, consists of silty to carbonaceous shale with thin, discontinuous sandstone lenses. The Homewood Member lies unconformably on the Mercer and consists of coarse-grained crossbedded sandstones.

The Sharon member of the Cuyahoga Formation underlies the eastern half of the RVAAP facility. The Sharon Conglomerate is a porous, coarse-grained, gray-white sandstone, commonly with white quartz pebbles and locally thin shale lenses. The Sharon Shale overlies the conglomerate and consists of sandy, gray-black, fissile shale with plant fragments and thin flagstone beds.

3.1.3 Geology in the 11 AOCs

Seven monitoring well borings and 452 soil and sediment borings were installed as part of this investigation and used to develop a geologic conceptual model of the site. Lithologic logs from these boreholes are used to further characterize the surface and subsurface geology of the 11 AOCs. Some uncertainties and limitations exist in the following interpretations: (1) the variability of glacial deposits and areal extent of the site makes glacial stratigraphic correlations from one AOC to another difficult; (2) it is assumed that surface soils have been substantially reworked in the course of construction activities associated with the base; (3) all descriptions of bedrock from monitoring well borings were derived from cuttings, rather than undisturbed core samples; and (4) bedrock was penetrated only in Load Lines 1 and 2, during monitoring well drilling.

3.1.3.1 Stratigraphy

Stratigraphic units encountered at RVAAP during Phase I were, from oldest (deep) to youngest (shallow), Paleozoic bedrock, Quaternary glacial sediments, glacial tills, surface soils, and reworked soils. Boring logs provided in Appendices A and C illustrate the vertical distribution of these units and describe lithologies in detail.

Bedrock was encountered in four of the seven monitoring well borings: LL2mw-059, LL2mw-060, LL1mw-063, and LL1mw-067. Lithologies recorded in the field describe brown to yellowish-brown, fine- to medium-grained and coarse-grained sandstones, as well as weathered sandstones. Bedding could not be observed in the disturbed samples. The depth to top of bedrock varies from 1.73 m (5.7 feet) at LL1mw-067 to 6.61 m (22 feet) at LL1mw-063, and is present at a depth greater than 10.3 m (34.52 feet) at LL1mw-066. The sandstones belong to the Sharon member of the Pottsville Formation. Bedrock outcrops were excavated in order to construct buildings in Load Line 1, and shallow refusal of hand augers during Phase I RI sample collection throughout RVAAP indicates bedrock occurs close to the surface in many locations. Bedrock elevation data from the RCRA monitoring wells previously installed in Demolition Area #2 and Winklepeck Burning Grounds indicate that the bedrock surface is from 1.5 to 8.4 m (5 to 28 feet) BGS in that portion of the facility.

The bedrock is overlain with deposits of the Hiram Till and associated unconsolidated sands that appear to have varying thicknesses across the site. The variability in the thickness of the till may be the result of either construction activities or natural erosion of till on shallow bedrock. In large tracts throughout the Hiram ground moraine, the till is so thin it cannot be distinguished from soil. The till consists of a laterally discontinuous assemblage of yellow-brown, brown, and gray silty clays to clayey silts with minor sand. Mottling and rock fragments are common in the glacial silts and clays. Glacial materials were penetrated in five of the seven monitoring well borings. Thicknesses of the till ranges from 0.23 m (0.75 feet) at LL1mw-063 to 4.26 m (14.2 feet) at LL1mw-065. Till was either not present or reworked at LL1mw-063 and LL1mw-067, both within the industrial facility of Load Line 1. Associated sediments are present below the till in the form of (1) a well-sorted, saturated gray silt with clay lenses; and (2) unconsolidated fine- to medium-grained sands, encountered in monitoring wells LL1mw-064 and LL1mw-065. **Figure 3.2** shows a generalized stratigraphic column based on lithologies encountered during Phase I well installation.

A fairly uniform, low-plasticity, low-permeability gray silt was encountered in LL1mw-066. This gray silt, possibly representing an isolated area of glacial lake clay as evidenced by varves, was present from 1.80 to 10.30 m (6.0 to 34.3 feet) BGS in LL1mw-066, and was not penetrated when boring terminated. The silt was not encountered in LL2mw-060, 1051 m (3500 feet) to the southeast. An approximately 1 m thick gray clay was found 3.39 m (11.3 feet) BGS in LL1mw-065, some 600 m (2000 feet) away from LL1mw-066, and gray clay was also present at LL1mw-063 from 0.60 to 3.0 m (2 to 10 feet) BGS. A gray silty clay containing rounded gravel was penetrated in well point LL1wp-067 from 3.7 to 4.4 m (12 to 14.5 feet) BGS. Because of the wide spacings between sampling locations where this material was encountered, the lateral continuity of this saturated silt cannot be determined.

Unconsolidated sands were encountered in monitoring well borings LL1mw-063, LL1mw-064, and LL1mw-065. Textures vary from fine- to medium-grained. Thicknesses of the sands also vary, from 4.65 m (15.5 feet) at LL1mw-063 to 0.90 m (3 feet) at LL1mw-064. Unconsolidated sands were not documented in any of the well points for which lithologic logs are recorded.

Soils at RVAAP's 11 high-priority AOCs are derived from the silty clay glacial till, and described in detail in the Soil Survey of Portage County, Ohio (USDA 1978). Many of the soils have been reworked during the construction and operations of the facility. The five major soil types identified in the 11 high-priority AOCs can be described as follows:

- **Ellsworth silty clay loam (map symbol ElC2)**. These soils form on fairly steep (6 to 12 percent) slopes parallel to drainageways in and around the Landfill North of Winklepeck Burning Grounds and Demolition Area #2. They are moderately well drained, with permeabilities ranging from 0.002 to 0.51 cm (0.006 to 0.2 inch) per hour. They remain saturated for extended periods in winter and spring.

- **Mahoning silt loam (map symbol MgA)**. The Mahoning series form on level uplands and gentle slopes (2 to 6 percent), and cover areas of up to 400 ha (1,000 acres) in size. These are deep, somewhat poorly drained soils formed in silty clay loam or clay loam glacial till, generally where bedrock is greater than 1.8 m (6 feet) BGS. Runoff is medium to rapid, and

Lithology	Depth BGS (ft)	Description
soil	0-2	silts and silty loams
glacial till	2-14	silts to silty clays with sand lenses, rock fragments, locally very uniform silt
		unconsolidated fine-to medium-grained sand
bedrock	0->30	Pottsville Formation (Sharon Member) fine-to medium-grained and coarse-grained sandstone

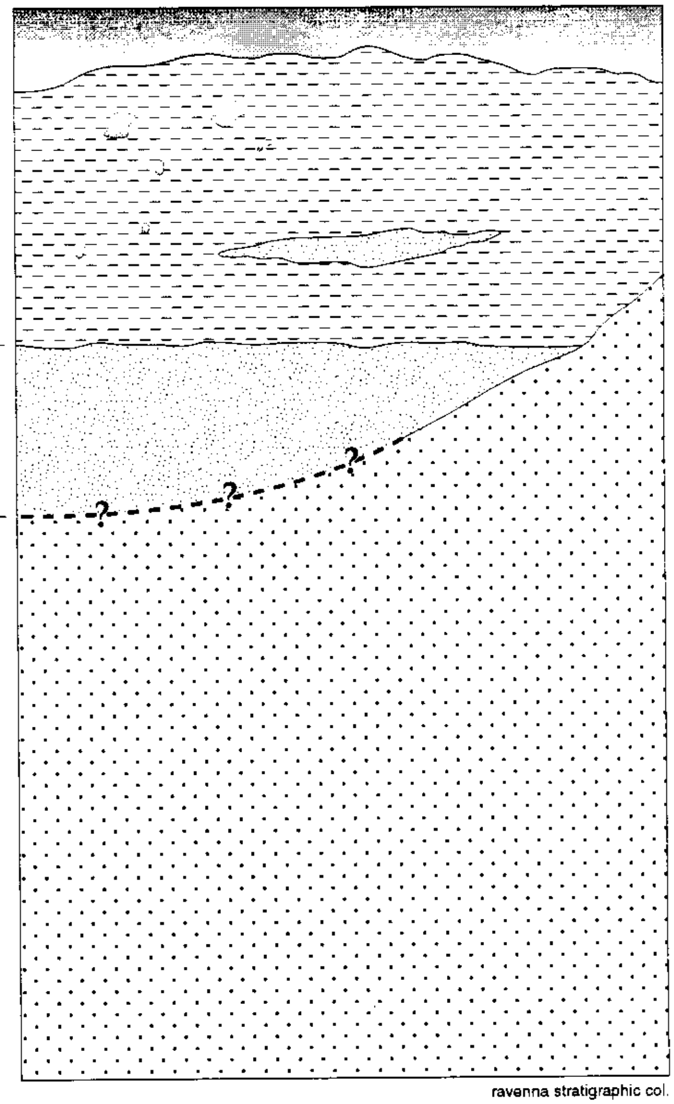


Figure 3.2. Generalized Stratigraphic Column at RVAAP

soils are seasonally wet. Permeabilities range from 1.52 to 5.08 cm (0.6 to 2.0 inches) per hour. Mahoning series soils are found at Winklepeck Burning Grounds, the load line complexes, Upper and Lower Cobbs Ponds, Building 1200, and in the undeveloped area southeast of Load Lines 1 and 2.

- **Mitiwanga silt loam (map symbol MtA and MtB).** These nearly level (MtA) to gently sloping (MtB) soils form over glacial tills overlying sandstone bedrock. They have moderate permeabilities of 1.52 to 5.08 cm (0.6 to 2.0 inch) per hour, are generally poorly drained, and are seasonally wet. Mitiwanga series soils are found in the vicinity of Building 1200 and at Load Line 1.

- **Trumbull silty clay loam (map symbol TrA).** The Trumbull series are deep, poorly drained soils on nearly level terrain. Permeabilities are low (less than 0.15 cm, or 0.06 inch, per hour), and the soils remain saturated with water for long periods in winter, spring, and summer. Ponding is common after heavy rains. TrA is found mainly along small drainageways or in small depressions adjacent to Mahoning or Remsen series soils, in areas smaller than 4 ha (10 acres). Trumbull series soils are found in the undeveloped area southeast of Load Line 1, and Load Lines 2, 4, and 12.

- **Wadsworth silt loam (map symbol WaB).** This soil consists of deep, somewhat poorly drained, gently sloping soils present in areas of 4 to 40 ha (10 to 100 acres) in size. Permeability is low, ranging from 0.15 to 0.51 cm (0.06 to 0.2 inch) per hour. On long slopes, lateral movement of water frequently results in seepage that may be slow to dry out. The Wadsworth series is present in Demolition Area #2.

3.2 HYDROLOGY

3.2.1 Unconsolidated Sediments

The largest groundwater aquifers within Portage County are located in two buried valleys that underlie Franklin, Brimfield, and Suffield Townships; and Streetsboro, Shalersville, and Mantua Townships, respectively. The sand and gravel within these buried valleys receive recharge from surface streams and surface infiltration. The water-bearing characteristics of the sand and gravel aquifers in the vicinity of the RVAAP installation are poorly documented. Wells that penetrate sand and gravel aquifers can yield up to 6080 liters per minute [1600 gallons per minute (GPM)]. However, yields from wells penetrating silty or clay till materials are significantly lower. In general, the Lavery and Hiram Tills are too thin and impermeable to produce useful quantities of water, but the glacial units do provide local residential sources of groundwater in areas where the till is thicker. Two wells investigated during the 1982 hydrogeologic study (Kammer 1982) derived water from sand and gravel at depths greater than 15 m (50 feet) BGS. Additionally, well records from the surrounding area indicate that the unconsolidated zone aquifer is used as a residential water supply.

3.2.2 Bedrock

The most significant bedrock sources of groundwater in the vicinity of the RVAAP facility are the sandstone/conglomerate members of the Pottsville Formation. These aquifers, together with two other deeper Mississippian/Devonian sandstone aquifers, represent the most important bedrock sources of groundwater in Northeastern Ohio.

The Sharon Conglomerate is the primary source of groundwater at RVAAP and maintains the most significant well yields of the Pottsville Formation members with hydraulic conductivity values of 5 to 2000 gallons per day per foot (GPD/feet). Past studies of the Sharon Conglomerate indicate that the highest yields are associated with the true conglomerate phase (coarse-grained sandstone with abundant quartz pebbles), and with joints and fractures in the bedrock. Where present, the overlying Sharon Shale acts as a relatively impermeable confining layer for the Sharon Conglomerate. Several flowing artesian production wells have been noted at the facility.

The Connoquenessing Sandstone and the Homewood Sandstone are the remaining aquifers of the Pottsville Formation and exhibit hydraulic conductivities of 5 to 300 GPD/feet and 5 to 200 GPD/feet, respectively. Well yields in the Connoquenessing and Homewood Sandstones, although lower than the Sharon Conglomerate, are high enough to provide significant quantities of water. Several wells at the RVAAP facility have penetrated both the Sharon Conglomerate and the Connoquenessing Sandstone and reportedly produced water from both units.

In general, hydraulic conductivities for the shales of the Sharon and Mercer members of the Pottsville Formation are low and result in insignificant groundwater yields. The porosity of the shales is likely secondary, in the form of joints and fractures in the bedrock; however, there is no facility-specific information available regarding the occurrence of joints and fractures in these units.

Results of slug tests performed at the six monitoring wells during August 1996 reveal moderately high hydraulic conductivities in the sandstone and unconsolidated sand units. Order-of-magnitude differences in hydraulic conductivities were observed between LL2mw-060 and the other three wells completed in sandstone bedrock. In addition, a difference of as much as two orders of magnitude is observed between the hydraulic conductivities in LL1mw-064, completed in unconsolidated sand, and in the bedrock monitoring wells. **Table 3.1** summarizes the results of the slug tests. Hydraulic conductivity for LL1mw-065 could not be calculated as there was insufficient change in hydraulic head to graph (see Appendix B, page B-14).

Potentiometric surface data are presented for portions of Load Line 1, the Landfill North of Winklepeck Burning Ground, and Upper and Lower Cobbs Ponds in **Figures 3.3 through 3.5**. These maps were constructed using static water level data from well points and, in Load Line 1, monitoring wells installed in Phase I. For comparison purposes, potentiometric surface data from the RCRA monitoring wells in Demolition Area #2 for June 1996 are presented in **Figure 3.6**. Because there are few data points, scattered across several square miles, these potentiometric surface maps do not depict what are undoubtedly complex flow systems within and between AOCs. In general, groundwater flow in the shallow water table zone is southeasterly along fairly shallow gradients in Load Line 1 (Figure 3.3). Southeast of Load Line 1, a steeper gradient is observed from LL1wp-067 to LL1mw-064 (Figure 3.3). Three well points installed around Lower Cobbs

Table 3.1. Hydraulic Conductivities Measured During Phase I RI

Monitoring Well ID	Screened Interval (depth BGS, m)	Geologic Material Adjacent to Screen	Hydraulic Conductivity (cm/sec)
LL2mw-059	2.80 to 5.75	Sandstone	9.8×10^{-5}
LL2mw-060	2.43 to 5.39	Sandstone	5.7×10^{-4}
LL1mw-063	5.14 to 8.14	Sandstone	2.35×10^{-5}
LL1mw-064	2.41 to 5.41	Unconsolidated sand	1.7×10^{-3}
LL1mw-065	3.06 to 6.07	Unconsolidated sand	Insufficient data
LL1mw-067	3.83 to 6.77	Sandstone	6.5×10^{-5}

Pond (Figure 3.5) indicate groundwater flows westward, i.e., downgradient from the pond. Groundwater flow at the Landfill North of Winklepeck Burning Grounds (Figure 3.4), derived from three well points, is to the southeast. Gradients vary from less than 6.06 m (20 feet) per 1.6 km (1 mile) to greater than 12.12 m (40 feet) per 1.6 km (1 mile). Groundwater flow in the RCRA wells is southeasterly in Demolition Area #2, with a more easterly component in Winklepeck Burning Grounds.

Historical data collected from RCRA monitoring wells in Demolition Area #2 and Winklepeck Burning Grounds indicate water levels in the shallow aquifer fluctuate as much as 1.5 m (5 feet) between summer droughts and spring wet seasons. All eight of the wells were installed in 1992 and screened in glacial materials overlying bedrock. Static water levels at the six wells installed for Phase I of the RI and the eight RCRA monitoring wells installed in Demolition Area #2 and Winklepeck Burning Grounds have been measured above the screened interval, indicating that the aquifer within RVAAP behaves as a confined unit.

3.2.3 Surface Water

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 west end of the facility, generally from north to south, before flowing into the M.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 (see Figure 1.1).

The western and northern portions of the RVAAP facility display low hills and dendritic surface drainage. The eastern and southern portions are characterized by an undulating to moderately level surface, with less dissection of the surface drainage. The facility is marked with marshy areas and flowing and intermittent streams, with headwaters located in the higher regions of the site. Three primary water courses drain RVAAP: (1) the South Fork of Eagle Creek, (2) Sand Creek, and (3) Hinkley Creek. All of these water courses have many associated tributaries.

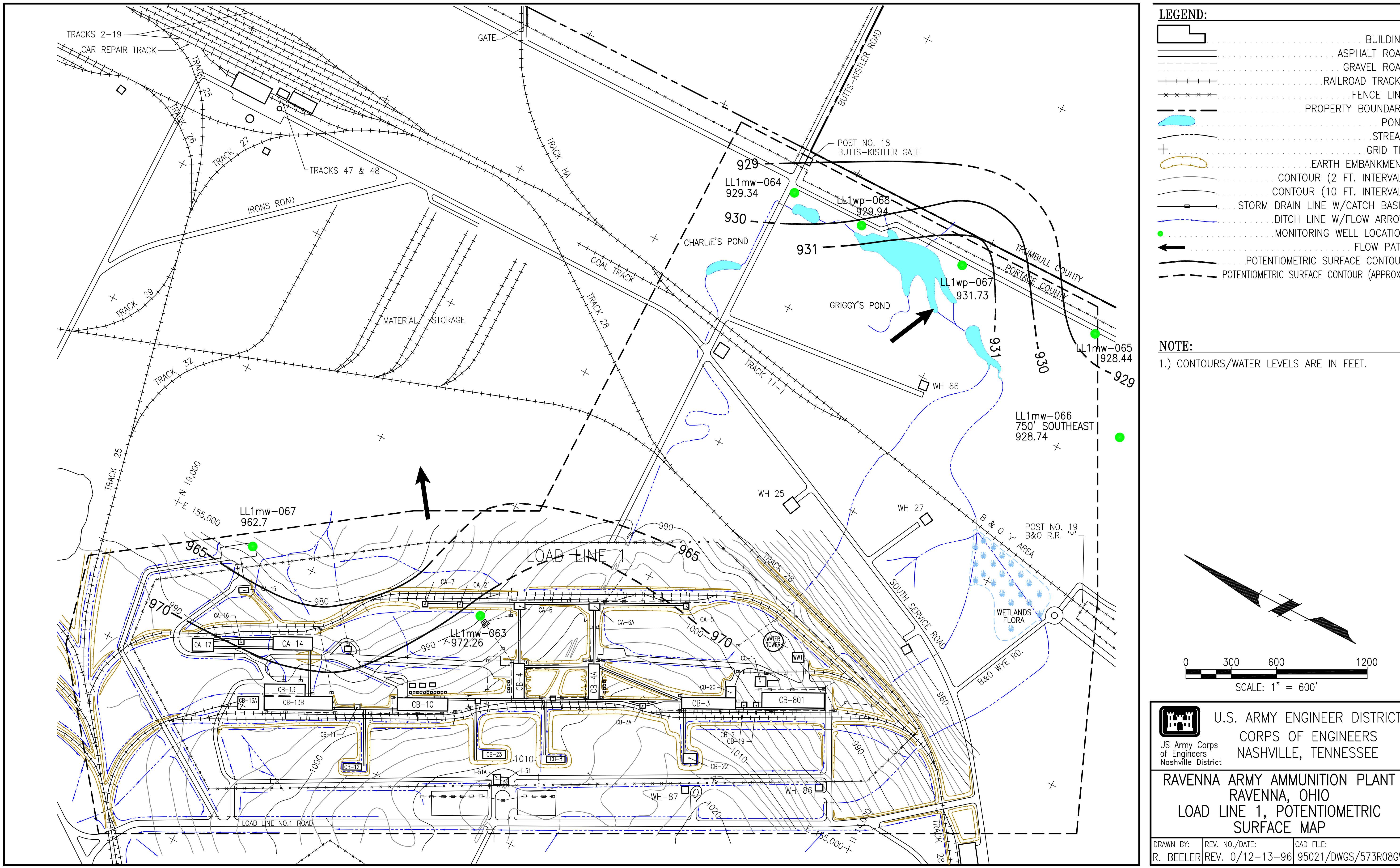


Fig. 3-3. LL1 Potentiometric Surface Map

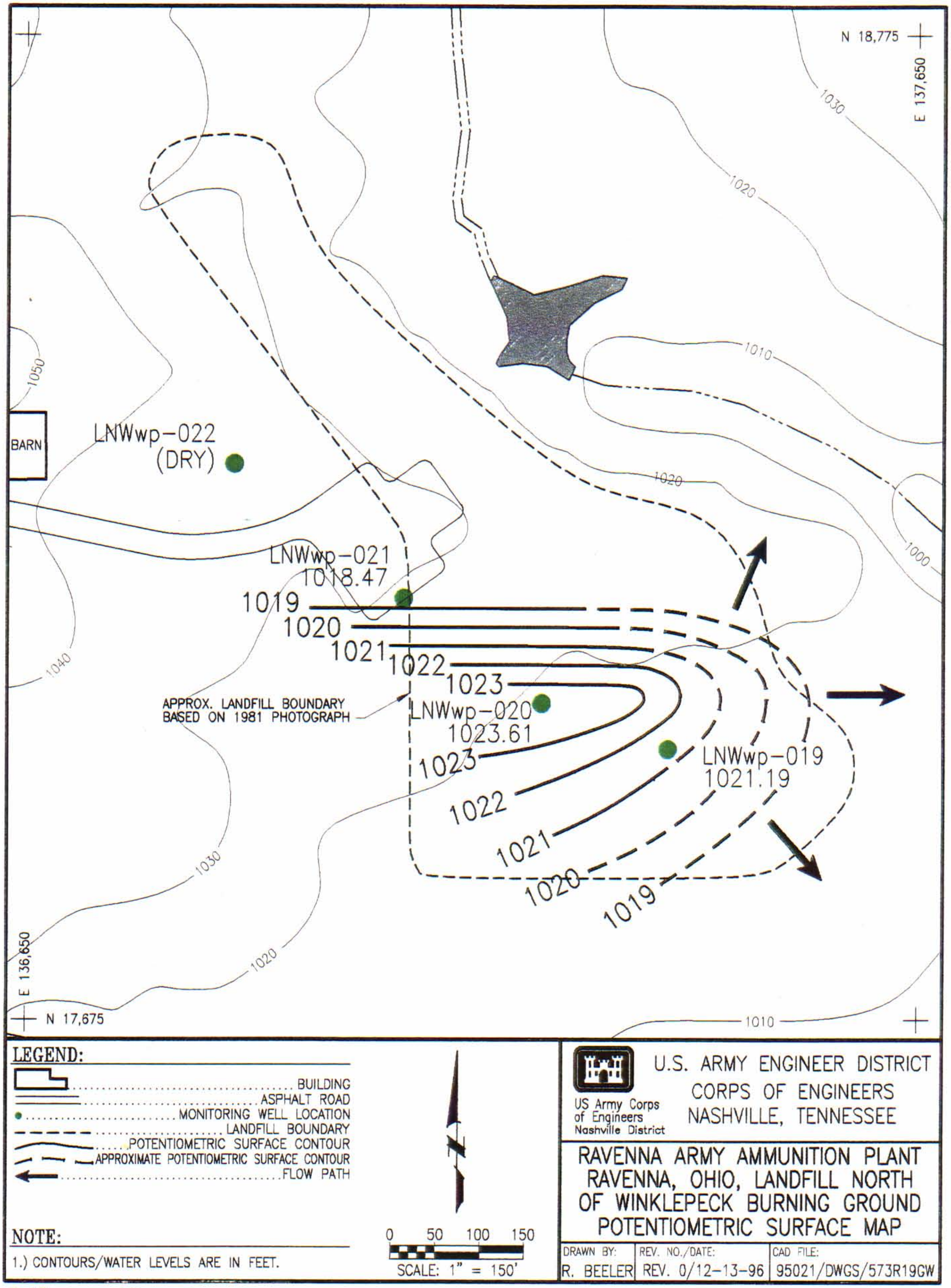


Figure 3.4. Landfill North of Winklepeck Burning Grounds Potentiometric Surface Map

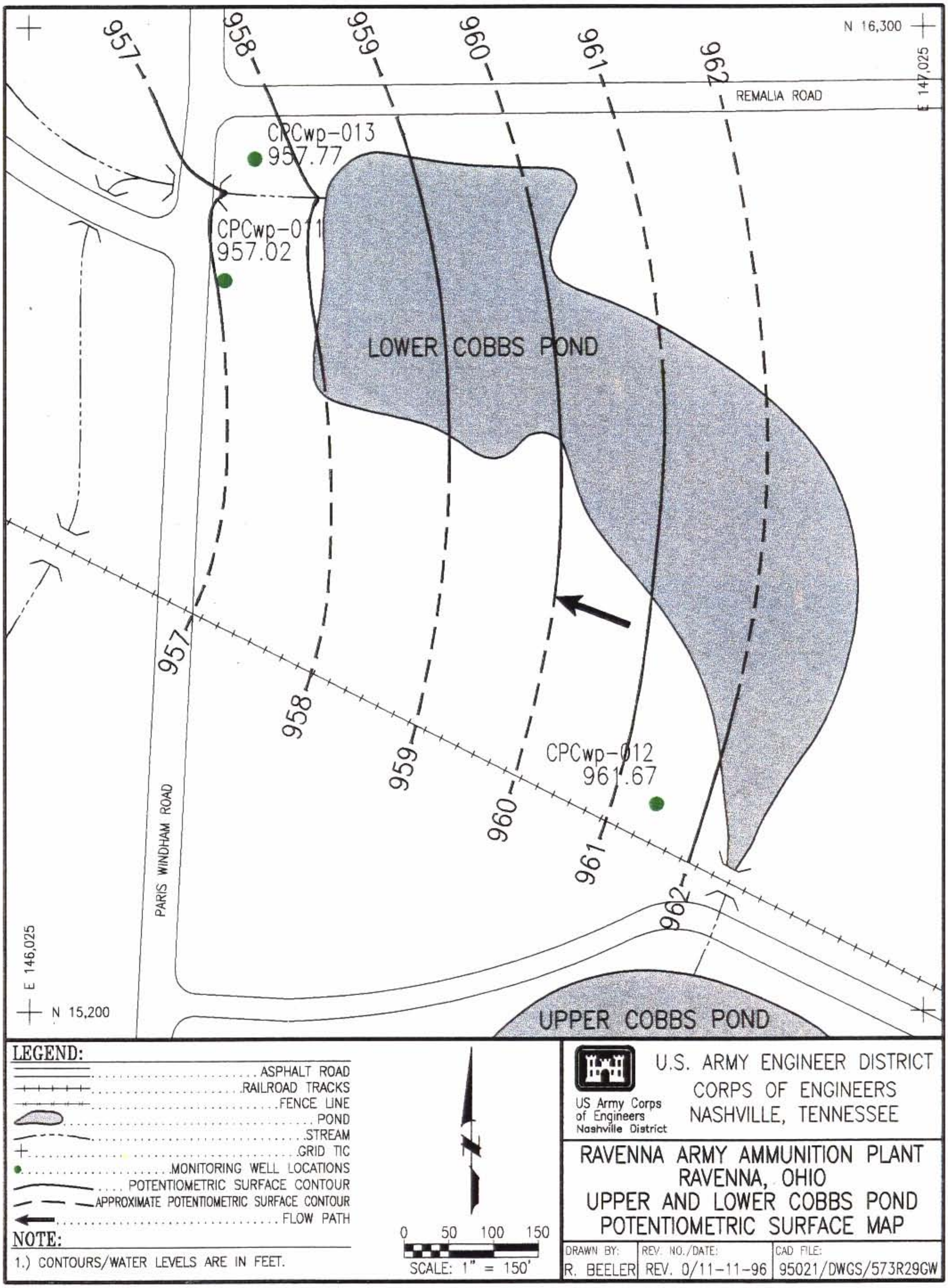


Figure 3.5. Upper and Lower Cobbs Ponds Potentiometric Surface Map

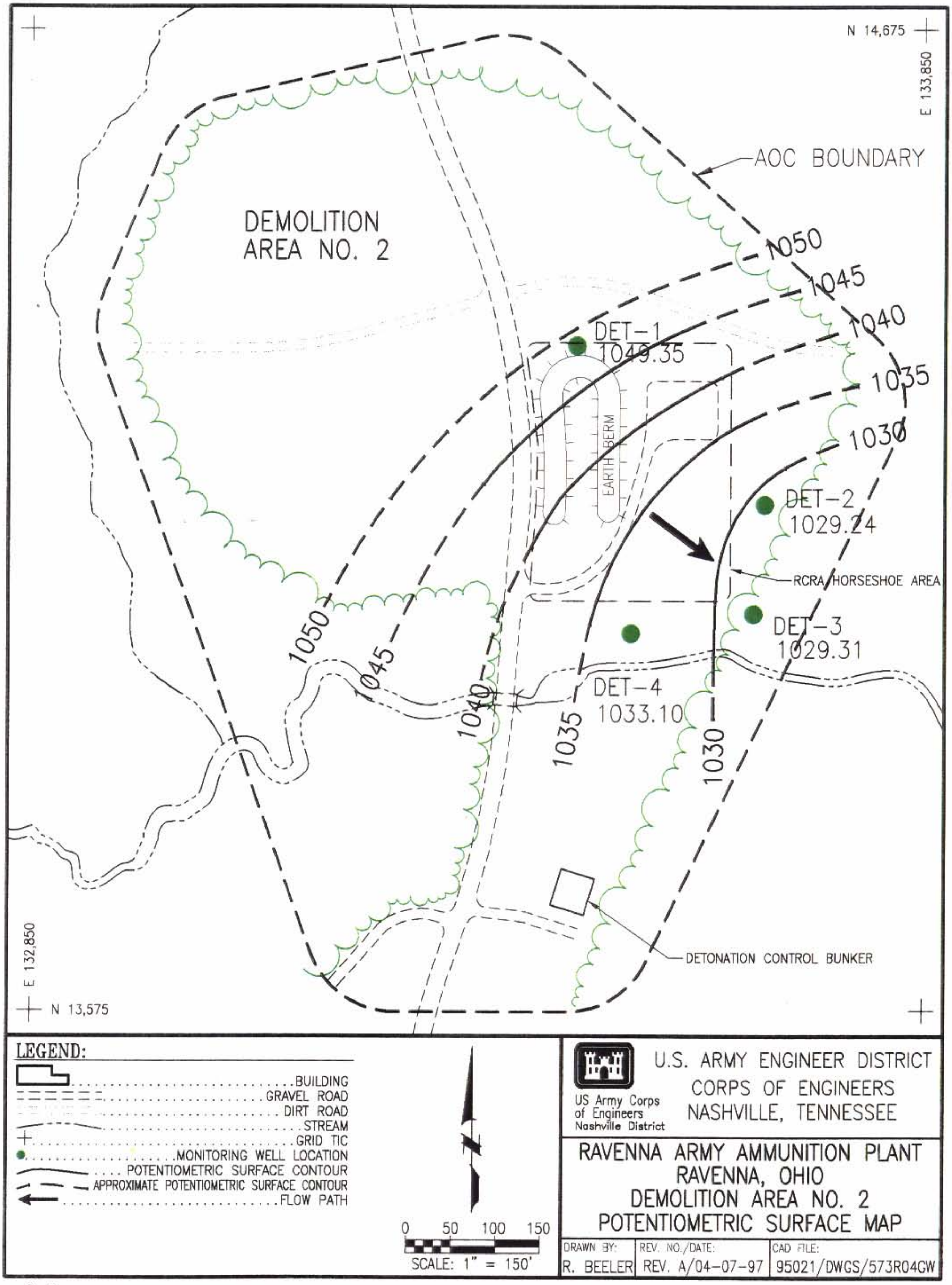


Figure 3.6. Demolition Area #2 Potentiometric Surface Map

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 originates southeast of the intersection between State Routes 88 and 303 to the north of the facility. 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 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 facility operations areas where an extensive storm sewer network helps to direct runoff to drainage ditches and settling ponds. In addition, the storm sewer system was one of the primary drainage mechanisms for process effluent during the period that production facilities were in operation.

3.3 CLIMATE

The general climate of the RVAAP area is considered continental and is characterized by moderately warm, humid summers, cold and cloudy winters, and wide variations in precipitation from year to year. The following climatologic data were obtained from the National Weather Service (NWS 1995) at the Youngstown-Warren Regional Airport in Trumbull County, and are based on a 30-year average.

Total annual rainfall in the RVAAP area is approximately 93.25 cm (37.3 inches), with the highest monthly average [10.2 cm (4.07 inches)] occurring in July. The lowest monthly average occurs in February [5.0 cm (2.03 inches)]. Average annual snowfall totals approximately 140.5 cm (56.2 inches), with the highest monthly average occurring in January [32.2 cm (12.9 inches)]. Lake-effect snowfall events associated with Lake Erie [located approximately 56.3 km (35 miles)] northwest of RVAAP cause a great variability in winter precipitation throughout northeast Ohio.

Average annual daily temperature for RVAAP and vicinity is 48.2° Fahrenheit (F); the average daily high temperature is 57.7° F, and the average daily low is 38.7° F. The record high temperature was recorded in July 1988 at 100° F, and the record low of -22° F occurred in January, 1994. The prevailing wind direction at RVAAP is from the southwest; the highest average wind speed occurs in January [18.7 km (11.6 miles) per hour], and the lowest average wind speed occurs in August [11.0 km (7.4 miles)] per hour.

Thunderstorms occur on approximately 35 days per year and are most common from April through August. The RVAAP is susceptible to severe weather, including tornadoes in the summer months.

3.4 POTENTIAL RECEPTORS

3.4.1 Ecological Receptors

Available estimates indicate that approximately one-third of the RVAAP facility property meets the regulatory definition of a wetland (USACE 1996). The majority of such wetland areas are located in the eastern portion of the facility. Wetland areas at RVAAP include seasonal wetlands, wet fields, and forested wetlands. Many of the wetland areas are the result of either natural drainage or beaver activity. However, some wetland areas are associated with anthropogenic settling ponds and drainage areas. The potential for impacts on wetlands at RVAAP is significant, given the amount of process effluent discharged to settling ponds and drainage ditches in the past.

The flora and fauna present at RVAAP are varied and abundant. Eighteen plant communities have been identified on the property, including marshes, swamps, and forest. Twelve plants listed by the State of Ohio as Potentially Threatened Species are present at RVAAP, including:

- gray birch,
- round-leaved sundew,
- closed gentian,
- butternut [also listed as a Federal Candidate (Category 2) species],
- blunt mountain mint,
- northern rose azalea,
- large cranberry,
- hobblebush,
- fox grape,
- woodland horsetail,
- long beach fern, and
- eel grass.

A large number of animal species have been identified on the property, including 26 mammal species, 143 species of birds, and 41 species of fish. Two animals—the cerulean warbler and Henslow's sparrow—are present at RVAAP and listed as Federal Candidate (Category 2) species. State of Ohio Endangered (1993 inventory) species include the northern harrier, the common barn-owl, the yellow-bellied sapsucker, the mountain brook lamprey, and the graceful underwing. The following animal species present at RVAAP are also listed as State of Ohio Special Concern species:

- woodland jumping mouse,
- solitary vireo,
- sharp-shinned hawk,
- sora,
- Virginia rail,
- four-toed salamander, and
- smooth green snake.

No documentation is available to support a determination that any plant or animal species have been directly affected by past plant operations. There are no known federal, state, or local parks or protected areas on RVAAP property. If wetlands are identified during a wetland survey in subsequent phases of investigation, such wetland areas would be federally protected.

3.4.2 Human Receptors

The RVAAP site consists of 8668.3 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. The RVAAP site also incorporates portions of two counties: east-central Portage County and southwestern Trumbull County. According to the 1990 Census, the total populations of Portage and Trumbull counties were 142,585 and 227,813, respectively. The population centers in closest proximity to RVAAP include the city of Ravenna (population 12,069), located approximately 3.2 km (2 miles) from the western site boundary in Portage County and the city of Newton Falls (population 4,866), located approximately 1.6 km (1 mile) from the southeastern site boundary in Trumbull County.

The RVAAP facility is located in a generally rural area, and is not in close proximity to any major industrial or otherwise developed areas. Based on data from the United States Census Bureau (1992) and the Portage County Soil and Water Conservation District Resources Inventory (1985), approximately 55 percent of Portage County, in which the majority of RVAAP acreage is located, consists of either woodland or farmland acreage. The Michael J. Kirwan Reservoir (also known as the West Branch Reservoir) is the closest major recreational area and is located adjacent to the western half of RVAAP south of State Route 5.

RVAAP is completely fenced, not inhabited, and not accessible to the general public. The installation employs about 25 people during a work week, and periodically is the venue of exercises of the Ohio National Guard.

3.5 SITE CONCEPTUAL MODEL

Information gathered during the Phase I RI and presented in this section has been used to construct a conceptual model for the portion of the RVAAP facility that contains the 11 high-priority AOCs. The elements of this site conceptual model are as follows:

- RVAAP's topography consists of gently undulating slopes and level areas resulting from the deposition of glacial ground moraine and subsequent reworking and dissection of glacial sediments by streams. Elevations range from approximately 270 to 315 m (900 to 1,050 feet) above sea level.

- Low-permeability soils and glacial tills cover much of the site, except where (1) bedrock crops out at the surface or (2) natural surface materials have been eroded or reworked. While moisture content can be seasonally high, these materials are too impermeable to serve as aquifers. The thickness of the low-permeability material appears to be greatest outside of the former active areas of the plant, where the potential for reworking of surface materials was lowest.

- Groundwater occurs in highly permeable sandstones of the Pottsville Formation (Sharon Member) and in unconsolidated sands in the southeast corner of the plant, and in sandy interbeds in glacial silts in Demolition Area #2 and Winklepeck Burning Grounds. Water level measurements indicate that groundwater exists under confined conditions in monitoring wells.

- Groundwater flow systems are undoubtedly complex, based on the occurrence of surface water and wetlands. Potentiometric surface data for the 11 AOCs studied in Phase I show southeasterly groundwater flow in Load Lines 1, 2, and 4 and the Landfill North of Winklepeck Burning Grounds; northeasterly flow in the vicinity of the Load Line 12 settling pond; and westward flow in the vicinity of Lower Cobbs Pond. Hydraulic gradients inferred are generally shallow, steepest in the vicinity of Griggy's Pond east of Load Line 1.

- Surface water drainage exits the property to the northeast and southeast. Ponds and wetlands are numerous across the site, and drain into surface streams and ditches.

- Although there are several communities surrounding the facility, the potential for human exposure to potential contaminant migration from the site is mitigated by the lack of permanent residents or a large work force at the plant itself and adjacent properties' being mostly uninhabited. Area residents do utilize the installation to fish and hunt, and the Ohio National Guard conducts training exercises on portions of the RVAAP installation. Acute impacts on ecological receptors as a result of any contaminant migration were not readily apparent during Phase I.