Identification of Potential Wetlands in Training Areas on Ravenna Army Ammunition Plant, Ohio, and Guidelines for Their Management

By Charles W. Schalk, John S. Tertuliani, and Robert A. Darner

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U.S. DEPARTMENT OF THE INTERIOR
BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY
Charles G. Groat, Director

For additional information write to

District Chief
U.S. Geological Survey
6480 Doubletree Avenue
Columbus, Ohio 43229-1111

Copies of this report can be purchased from:

U.S. Geological Survey
Branch of Information Services
Box 25286
Denver, CO 80225-0286

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CONVERSION FACTORS AND ABBREVIATIONS

Multiply	By	To obtain
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
meter (m)	3.281	foot
mile (mi)	1.609	kilometer
acre	0.4047	square hectometer

Temperature is given in degrees Fahrenheit (°F), which can be converted to degrees Celsius (°C) by use of the following equation:

$$°C = (temp\ °F - 32)/1.8$$

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ABSTRACT

Potential wetlands in training areas on Ravenna Army Ammunition Plant, Ohio, were mapped by use of geographic information system (GIS) data layers and field inspection. The GIS data layers were compiled from existing sources and interpretation of aerial photography. Data layers used in the GIS analysis were wetland-plant communities, hydric soils, National Wetlands Inventory designated areas, and wet areas based on photogrammetry. According to review of these data layers, potential wetlands constitute almost one-third of the land in the training areas. A composite map of these four data layers was compiled for use during inspection of the training areas. Field inspection focused on the presence of hydrophytic vegetation and macroscopic evidences of wetland hydrology. Results of the field inspection were in general agreement with those predicted by the GIS analysis, except that some wet areas were more extensive than predicted because of high amounts of precipitation during critical periods of 1995 and 1996. Guidelines for managing wetlands in the training areas are presented.

INTRODUCTION

The current threefold mission of Ravenna Army Ammunition Plant (or Ravenna AAP) in Portage and Trumbull Counties, Ohio, is to store explosives, manage and restore the natural resources and environment, and support part of the training mission of the Ohio Army National Guard (OHARNG) and Air Force Reserves. U.S. Army Industrial Operations Command (IOC), the AAP host, retains managerial jurisdiction over all parts of the AAP. Training plans formulated by OHARNG are subject to approval by IOC, especially when the environment can be affected in some way as a result of training. The AAP occupies about 21,400 acres; of these, about 3,330 acres are in Areas A through H and J, which are training areas for OHARNG (fig. 1). A tract of about 530 acres, referred to in this report as "Area CO," separates Area J from Areas F and G.

Although 17,000 people built the facilities and their supporting infrastructure in the 1940's and thousands worked on the AAP when munitions were produced, fewer than 50 people (most of them security and maintenance contractors) are required to maintain and support the current mission. Most of the AAP is largely undisturbed; as a result, the natural resources are uniquely and richly diverse.

Wetlands are one of the most abundant ecosystems on Ravenna AAP. According to Morgan (1995), at least one-third of the installation (7,140 acres) could meet standard criteria for wetlands. Andreas (1993) identified at least 10 wetland-plant communities on Ravenna AAP. Several of these wetland communities fall within the boundaries of training areas A through H and J.

In 1996, OHARNG initiated a project to examine how to expand their training objectives within the guidelines of wetlands management provided by Army IOC. The U.S. Geological Survey, in cooperation with OHARNG, provided mapping expertise to fulfill four primary program objectives, which were to (1) provide OHARNG with an inventory of potential wetlands in Areas A through H and J on Ravenna AAP, (2) provide aerial photographs of Areas A through H and J in which potential wetlands were delineated, (3) provide hardcopy and digital maps of Areas A through H and J showing potential wetlands delineated according to national wetland inventories, soil-conservation surveys, and interpretation of aerial

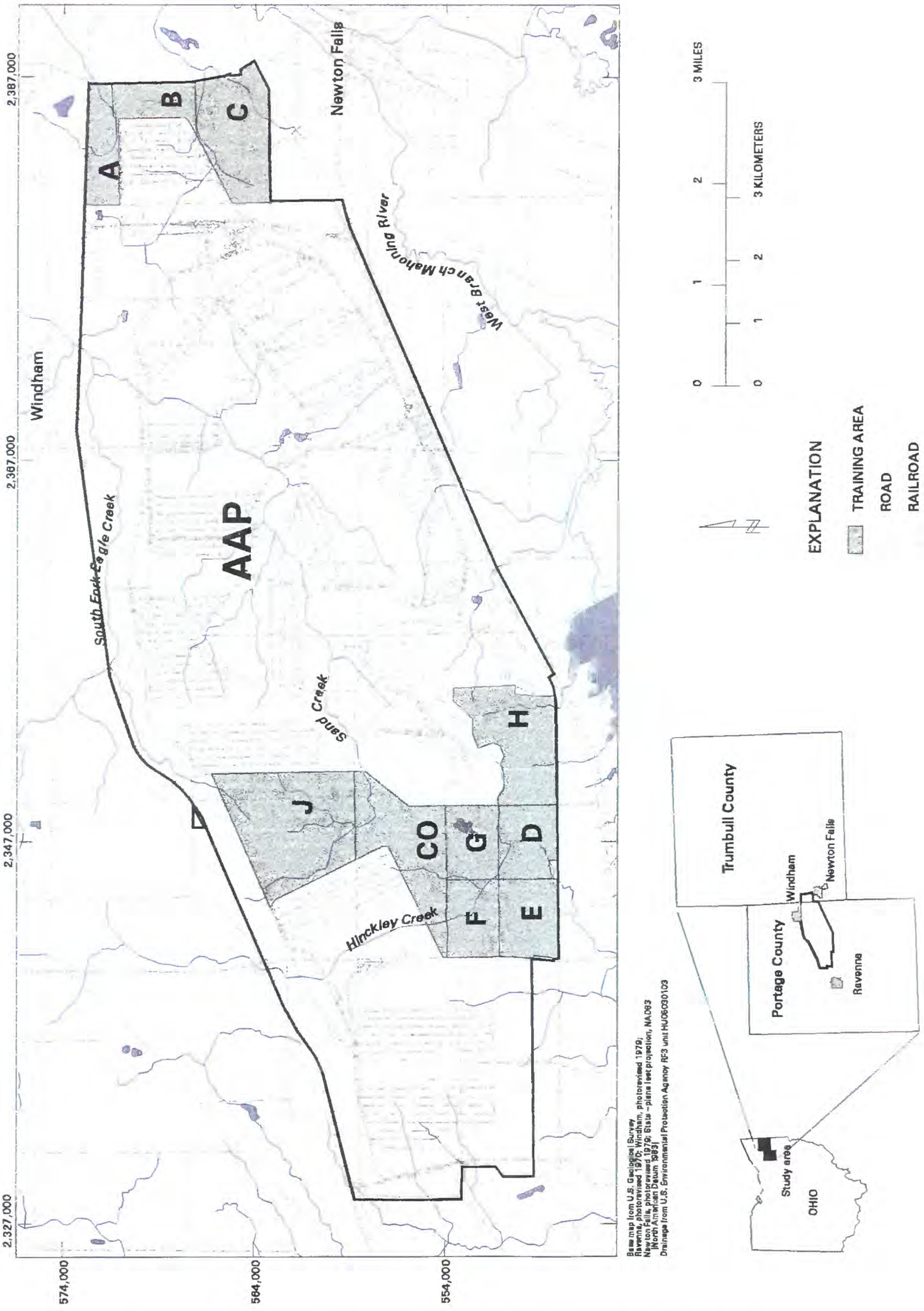

Figure 1. Location of Ravenna Army Ammunition Plant (AAP), Ohio.

photographs, and (4) prepare guidelines for wetlands management that will incorporate a summary of the activities associated with objectives 1-3, guidance on current development and training limitations, and guidance on more detailed determination of wetlands, should this need arise. This report fulfills the requirements of objectives 1 and 4, and can be used in conjunction with aerial photographs and maps that were compiled to fulfill objectives 2 and 3 and are described in Appendix A.

Purpose and Scope

The purpose of this report is to describe areas that probably qualify as wetlands— from interpretation of geographic information system (GIS) data layers, aerial photography, and field inspection — and to present some managerial guidelines for the use of these potential wetlands in the training areas on Ravenna AAP. Area CO also is included because OHARNG training plans include the passage of troops and light vehicles through this area.

A review of wetland regulations, identification criteria, and delineation procedures is provided to form a background for this study. Although the precise delineation of wetlands was not included in the scope of this project, wettest-case estimates of the extent of wetlands in the training areas are presented on the basis of the field inspection during November and December 1996 and March 1997. Guidelines for defining (or delineating) wetlands according to regulators' specifications are reviewed. A digital geographic data base, which was used to fulfill the objectives of the study, is described in an appendix to this report.

Description of Study Area

Ravenna AAP includes parts of Portage and Trumbull Counties in northeastern Ohio (fig. 1). The cities of Ravenna, Windham, and Newton Falls are within 3 miles (mi) of its boundary. It is in the drainage basin of West Branch Mahoning River. The major streams on the AAP are Hinckley Creek, which flows southward through the western part of the AAP; Sand Creek, which flows eastward through the center of the AAP; and South Fork Eagle Creek, which flows eastward along the north boundary of the AAP to its confluence with Sand Creek. The watersheds of these three streams cover about 14,700 acres, or 69 percent of Ravenna AAP.

Ravenna AAP is in the glaciated Allegheny Plateau of the Appalachian Plateaus Physiographic Province. The terrain is gently rolling. Topographic relief is about 290 ft; the high point is about 1,220 ft above sea level in the northwest corner, and the low point is about 930 ft above sea level in the southeast corner.

Soils on Ravenna AAP are mostly silt loams. Some loams, loamy sands, and mucks can be found in the bottoms of South Fork Eagle Creek. Other loams and loamy sands can be found in a few parts of Area C and in the bottoms of Sand Creek. The soil series most common to the AAP is the Mahoning-Ellsworth association, which consists of nearly level to sloping, somewhat poorly drained to moderately well drained soils that formed mostly in moderately fine textured glacial till on uplands. Some of the soils on the eastern part of the AAP are in the Sebring-Holly-Caneadea association, which are mostly level, poorly drained soils formed in lacustrine material. Details concerning the soils on Ravenna AAP can be found in Ritchie and others (1978) and Williams (1992).

About 37 in. of precipitation per year falls on the AAP, including an average of 54 in. of snow (National Oceanic and Atmospheric Administration, 1991). Average temperature ranges from 24.8°F in January to 71.9°F in July. The average growing season is 165 days, from about April 28 to October 18.

Areas A, B, and C, which are used by OHARNG for training, are on the east edge of Ravenna AAP. Tanks and other tracked vehicles are operated in Areas B and C, and because of construction to support the heavy machinery operations, erosion is sometimes a problem in those areas. Much of Area A is permanent wetland, and, subject to further study, most of the rest of Area A is available for wetland banking and

mitigation should other wetland areas be destroyed in favor of military training (Captain T. Daugherty, OHARNG, oral commun., March 1997). Areas A, B, and C total 923 acres.

Areas D through H are in the south-central part of the AAP and make up the bulk of the grounds currently available to OHARNG. Areas D, E, F, and G, which are traversed by Hinckley Creek, are used for dismounted tactical training, and some wheeled vehicles are permitted with restrictions. Area H is used primarily as a compass training course. These five areas total 1,585 acres.

Area J, encompassing 822 acres, is used by the Air Force Reserves for aerial drop training and by OHARNG for dismounted tactical training. Area CO (currently not designated as a training area), about 530 acres, connects Area J and Areas F and G. Sand Creek flows through Area CO.

WETLAND REGULATIONS, IDENTIFICATION CRITERIA, AND DELINEATION PROCEDURES

A discussion of wetland regulations, identification criteria, and delineation procedures is provided so that the reader can understand the frame of reference for this study.

Summary of Regulations

The primary Federal agency involved in the regulation and identification of wetlands is the U.S. Army Corps of Engineers (COE). Other agencies include the U.S. Environmental Protection Agency (USEPA), the U.S. Fish and Wildlife Service (FWS), and the Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture. These four agencies have compiled guidelines for delineating jurisdictional wetlands (Federal Interagency Committee for Wetland Delineation, 1989; hereafter referred to as FICWD), although the COE's Wetland Delineation Manual (WDM) (U.S. Army Corps of Engineers, Environmental Laboratory, 1987) remains the standard document for jurisdictional wetland delineation (Richard Chinn, U.S. Army Corps of Engineers, written commun., 1996). All Federal regulation of wetlands is based upon guidelines in these manuals.

Several Federal laws regulate jurisdictional determinations of wetlands. Section 404 of the Clean Water Act (33 U.S.Code 1344) authorized the Chief of Engineers of the U.S. Army to issue permits for the discharge of dredged or fill materials into the waters of the United States, including wetlands, with program oversight by USEPA. Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.Code 403) gives the COE authority to make jurisdictional delineations of wetlands. The FWS, under authority of the Fish and Wildlife Coordination Act, provides comments to COE on the environmental impacts of work involving wetlands. NRCS is involved in wetland determinations through the "Swampbuster" provisions of the Food Security Act of 1985. A 1990 executive order by President Bush mandated the goal of no net loss of wetlands (Lyon, 1993), and the White House Office on Environmental Policy under President Clinton issued principles for wetlands policymaking while strongly supporting President Bush's executive order (White House Office on Environmental Policy, 1993).

The Department of the Army has additional regulations concerning environmental protection and natural-resource enhancement. Regulation 200-1, chapter 1-38 enumerates several environmental quality goals, including those that "assure that consideration of the environment is an integral part of Army decision-making" and "restore lands and waters damaged through . . . past waste disposal activities" (U.S. Department of the Army, 1990). Chapter 1-39 states that "on lands under Army jurisdiction, an integrated, multi-use, natural resource and land management program will be conducted that promotes the conservation and enhancement of. . .wetlands and flood plains." Regulation 200-1 also identifies requirements for environmental actions such as discharge and dredging and filling under the Clean Water Act and the Federal Water Pollution Control Act (chap. 3). The National Environmental Policy Act mandates that methods for on-the-ground work done on Army installations be reviewed so that minimal damage is done to the environment, including wetlands (chap. 12-2 b(2)).

Army Regulation 200-3 (U.S. Department of the Army, 1995) states that the Army will comply with Executive Order 11990, which requires Federal agencies to minimize any action that causes the loss or degradation of wetlands. The Army's goal is "no net loss of values and functions to existing wetlands" and "no overall net loss of wetlands on Army controlled lands." Military installations are required to identify and maintain a current inventory of wetland resources.

Identification Criteria

Three formal definitions of wetlands are referred to in FICWD (1989). They are similar, but each emphasizes those aspects of wetlands that are important to the agency defining the wetland.

1. COE (and the rest of the Army) and USEPA use the following definition. Wetlands are
   Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.
2. The NRCS identifies wetlands on agricultural land as
   Areas that have a predominance of hydric soils and that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions, except lands in Alaska identified as having a high potential for agricultural development and a predominance of permafrost soils.

(3) The FWS defined wetlands as part of their effort to inventory wetlands in the United States. Their definition was published in Cowardin and others (1979):

> Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes, (2) the substrate is predominantly undrained hydric soil, and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year.

Each definition except that of the FWS includes only areas that are vegetated under *normal conditions*. Conceptually, all three definitions include three basic elements in wetland identification: vegetation, soils, and hydrology.

Lyon (1993) states:

> In essence, a wetland is the edge or interphase between uplands and adjacent water areas. The water may be in the form of rivers, lakes, ocean areas, or wet spots. As such, wetlands may be found almost anywhere. They will possess characteristics of both upland and aquatic environments and exhibit a mix of soil, plant, and hydrological conditions (p. 7).

As a rule of thumb, an evaluation of wetlands should include determination as to

> (1) whether the soils are considered hydric or waterlogged, (2) whether the soils show demonstrable evidence of hydrologic conditions associated with flooding or ponding of water, and (3) whether 50 percent of the dominant plants found growing on the site are those commonly found in wetlands (Lyon, 1993, p. 15)

Hydrophytic Vegetation

The primary documentation of hydrophytic plants in the United States is the "National List of Plant Species that Occur in Wetlands" (Reed, 1988). In this document, plants are separated into five categories on the basis of their likelihood of occurrence in wetlands. The categories are listed in table 1.

Table 1. Categories of hydrophytic plants found in wetlands [From Reed (1988)]

Category	Description	Definition	Index value
OBL	Obligate wetland plants	Occur almost always in wetlands (probability >99 percent) under natural conditions.	1.0
FACW[1]	Facultative wetland plants	Usually occur in wetlands (probability 67-99 percent), but occasionally are found in uplands.	2.0
FAC[1]	Facultative plants	Equally likely to occur in wetlands or uplands (probability 34-66 percent).	3.0
FACU[1]	Facultative upland plants	Usually occur in uplands (probability 67-99 percent) but occasionally are found in wetlands (probability 1-33 percent).	4.0
UPL	Obligate upland plants	Occur almost always in uplands (probability >99 percent) under natural conditions.	5.0

[1] Reed (1988) uses a plus (+) or minus (-) sign to specify a higher or lower portion, respectively, of a particular wetland indicator frequency for this category.

The process of determining whether a plot has hydrophytic vegetation involves several steps. First, the vegetation must be examined by stratum (that is, tree, shrub, herb, and so forth). Second, dominant species are identified according to their relative abundance or prevalence in the plot. Third, the plot is classified as a wetland if (1) more than 50 percent of all the dominant species from all strata are obligate, facultative wetland, and (or) facultative, or (2) a frequency analysis of all species in the plot yields a prevalence index value (see table 1) of less than 3.0.

Hydric Soils

Hydric soils are those that are saturated, flooded, or ponded long enough during the growing season (see Study Area section) to develop anaerobic conditions in the upper part (U.S. Department of Agriculture, 1991). Soils that meet this definition satisfy the following criteria:

1. All Histosols except Folists (taxonomic definitions of these soils can be found in any soil taxonomy text), or
2. Soils in Aquic suborder, Aquic subgroups, Albolls suborder, Salorthids great group, Pell great groups of Vertisols, Pachic subgroups, or Cumulic subgroups that are
   a. Somewhat poorly drained and have a frequently occurring water table at less than 0.5 ft from the surface for a significant period (usually more than 2 weeks) during the growing season, or
   b. Poorly drained or very poorly drained and have either
      (1) a frequently occurring water table at less than 0.5 ft from the surface for a significant period (usually more than 2 weeks) during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 in., or for other soils

(2) a frequently occurring water table at less than 1.0 ft from the surface for a significant period (usually more than 2 weeks) during the growing season if permeability is equal to or greater than 6.0 inches per hour (in/hr) in all layers within 20 in., or

(3) a frequently occurring water table at less than 1.5 ft from the surface for a significant period (usually more than 2 weeks) during the growing season if permeability is less than 6.0 in/hr in any layer within 20 in., or

3. Soils that are frequently ponded for long duration or very long duration during the growing season, or
4. Soils that are frequently flooded for long duration or very long duration during the growing season.

Long duration is defined as single-event inundation from 7 days to a month. *Very long duration* is defined as single-event inundation that is longer than a month; and *frequently flooded or ponded* is defined as more than 50 percent chance of flooding or ponding in any year or more than 50 times in 100 years.

Several characteristics are most indicative of hydric soil conditions. Hydric soils can be mottled, or mixed in color, normally as a result of the alternating saturated/unsaturated condition of the soil. Tubes of iron oxide, caused by the entrance of oxygen along plant roots during dry periods, can line channels in a normally saturated soil. Hydric soils can exhibit high organic content, as is the case for Histosols. The high organic content causes the soil to have a low bulk density (less than 1 gram per cubic centimeter (g/cm^3) whereas 1.35 g/cm^3 is average for mineral soils) and high water-retention capacity (Buol and others, 1973). Hydric soils that have been drained to the extent that they no longer exhibit wetland hydrology or support hydrophytic vegetation do not qualify as wetlands.

Wetland Hydrology

Of all the criteria used to decide whether an area should be classified as a wetland, hydrologic factors are the most decisive and yet the most difficult to determine. Indicators of saturation and (or) inundation (such as high water marks, drift lines, drainage patterns, and morphological plant adaptations) can be evident on site; but generally, for statistical reasons, wetlands-hydrology criteria cannot be determined with confidence with fewer than 10 years of data (Natural Resources Conservation Service, 1996, p. 123). Analyses of aerial photography (if available for a 5- to 10-year span) and historical records of streamflow and ground-water levels can be used in combination to reduce the amount of field data that are needed to verify hydrologic conditions suitable for wetlands. Data needed to assess wetland hydrology include precipitation, depth to ground water, and flooding duration and frequency.

A plot of land can be classified as having wetland hydrology on the basis of soil saturation, inundation, or both. A plot meets the soil-saturation criterion under the following conditions given by FICWD (1989):

1. In somewhat poorly drained mineral soils, the water table is less than 0.5 ft from the surface for usually 1 week or more during the growing season; or
2. In low-permeability (<6.0 in/hr), poorly drained or very poorly drained mineral soils, the water table is less than 1.5 ft from the surface for usually 1 week or more during the growing season; or
3. In more permeable (>6.0 in/hr), poorly drained or very poorly drained mineral soils, the water table is less than 1.0 ft from the surface for usually 1 week or more during the growing season; or
4. In poorly drained or very poorly drained organic soils, the water table is at a depth where saturation to the surface occurs more than rarely. This can be true even of drained and well-managed organic soils.

A plot meets the inundation criterion if ponded or frequently flooded with surface water for 1 week or more during the growing season.

Wetlands Delineation Procedures

This section is included in this review because OHARNG may need jurisdictional delineations of wetlands in the future. Jurisdictional delineations are stringent and data intensive, as they are based primarily on fieldwork and historical records.

The 1987 Wetlands Delineation Manual (WDM) (U.S. Army Corps of Engineers, Environmental Laboratory, 1987) defines the process of delineating jurisdictional wetlands of the interior and coastal waters of the United States. The objectives of WDM are to (1) provide technical guidelines for identifying wetlands, (2) provide methods for applying the technical guidelines, and (3) provide supporting information (in appendixes to WDM) useful in applying the guidelines.

According to WDM (Section II), wetlands are differentiated from other aquatic sites and nonwetlands by the types of vegetation, soils, and hydrology. Other aquatic sites include deepwater habitats, sanctuaries and refuges, mudflats, vegetated shallows, coral reefs, and riffle and pool complexes, which are not addressed in WDM.

The distinguishing characteristics of three indicators of wetlands (hydrophytic vegetation, hydric soils, and wetlands hydrology) are presented in Section III of WDM. The discussion is similar to that presented in the "Identification Criteria" section of this report but is more detailed. Each indicator is discussed separately and thoroughly.

WDM presents methods that are to be used in wetland delineations (Section IV). The first effort of any wetlands study is the accumulation of preliminary data, whether by gathering or synthesis. Sources such as USGS quadrangle maps, National Wetlands Inventory (NWI) maps, and soil surveys can be gathered to provide the necessary data for synthesizing information on site.

Wetland delineations can be classified as routine or comprehensive. Routine delineations can be subdivided into three levels: (1) onsite inspection unnecessary (if the gathered data are sufficient), (2) onsite inspection necessary, and (3) a combination of levels 1 and 2. Generally, routine delineations use minimal, qualitative information for offsite and onsite inspections. Steps of action and equipment needed to complete each of the levels of routine delineations are presented in Section IV.D. of WDM. Comprehensive delineations are detailed and quantitative, and they rely more upon collection of data onsite than do routine determinations. Steps of action and equipment needed to complete comprehensive delineations are presented in Section IV.E. of WDM.

The writers of WDM, recognizing that wetland-delineation work is not always routine, provided guidance for delineation in atypical and problem areas (Sections IV.F. and IV.G.). These sections address issues such as human-induced wetlands, alterations in hydrology, and seemingly contradictory indicators. Detailed steps of action are presented to resolve these issues.

METHODS OF STUDY

The study was divided into two primary components. The first was spatial analysis by use of a GIS and data layers assembled from several sources. The second was field reconnaissance of areas likely to be wetlands according to the GIS spatial analysis.

Spatial Analysis by Use of a Geographic Information System

A set of base GIS layers was created for the spatial analysis. These layers included AAP, municipal, township, county, and training-area boundaries; surface-water drainage; off-AAP pipelines; roads; railroads; 10-ft topographic contours; and wooded areas. All of these were digitized from 1:24,000-scale topographic quadrangle maps except the surface-water-drainage layer, which was obtained from the USEPA (L. Holman, U.S. Environmental Protection Agency, written commun., 1996). Documentation of metadata (data about the data, such as number of features) of these base layers is presented in Appendix A. All data layers were peer reviewed for accuracy in linework, annotation, and documentation.

High-altitude aerial photographs (1:40,000 scale) of the training areas on Ravenna AAP were obtained from the EROS Data Center in black and white (three images) and color infrared (CIR) (three images) formats[1]. Digital images of the three black-and-white aerial photographs were created by scanning the 9-in. by 9-in. film positives at a density of 10 micrometers (2,540 dots per inch). The images were saved as tag image file format (TIFF) files. The parts of the images that include the training areas were rectified into state plane coordinates (data layer names: ABC.TIF, AREAH2.TIF, and DEFGCOJ.TIF) using ARC/INFO image-processing software.

Several steps were necessary for the image-rectification process. A total of 17 control points, mostly consisting of building corners that were easily visible on the aerial photographs, were identified, and 16 were surveyed. These 16 control points proved sufficient to rectify the images. The surveys were run to third-order accuracy in the horizontal control with a Leitz Total Station. The benchmarks used are listed in Appendix B and are in the SPD OH N state-plane-coordinate system. The horizontal datum used for all points was North American Datum of 1983. The vertical control was not necessary to rectify the images and is not reported. The data from the total station were collected with a SDR33 data collector. The data were then downloaded from the SDR33 to a personal computer, checked for errors, and transferred into an ASCII file. The ASCII file was used to create a GIS data layer (data layer name: BASELINE) to check the rectification of the images.

Six points on each image were identified and registered with real-world coordinates. These points were then used as control links to register and transform the entire image to state plane coordinates. During this registration process, the images were trimmed to the extent of the area of interest.

Two of the rectified areas overlapped, which resulted in some minor errors due to interpolation differences in the two separate photographs. This error was corrected by additional rectification steps (converting the raster image into a raster grid and adjusting coordinate locations), which provided more control at the expense of processing and viewing time. The raster grids were reconverted to raster images after adjustments.

Four other data layers described below were created to examine potential wetlands in the training areas. Three of the four data layers were digitized from existing sources; the fourth was created by interpretation of aerial photographs.

Soil-survey maps were digitized (data-layer name: SOILS) at a scale of 1:15,840 from Williams (1992) and Ritchie and others (1978). These maps were used to locate hydric soils in the training areas, according to hydric soils listed in U.S. Department of Agriculture (1991). Wetland areas according to NWI maps (U.S. Fish and Wildlife Service 1977a, b, and c) were digitized (data-layer name: NWI) and annotated according to classification codes provided on the NWI maps. NWI maps were derived from interpretation of aerial photographs, with boundaries based upon vegetation, visible hydrology, and geography at the time the photograph was taken. Plant-community boundaries (Andreas, 1993) were digitized (data-layer name: PLNTCOMM) for the lands found in the training areas. Of the 18 communities listed in Andreas (1993), 7 mature wetland communities are found in the training areas. Metadata associated with these data layers are presented in Appendix A.

Paper copies of the aerial photographs, printed at a scale of 1:24,000, were used to identify potential wetland areas according to photogrammetric analytical procedures outlined in "Water Resources Remote Sensing Workshop" (U.S. Geological Survey, EROS Data Center, Sioux Falls, S. D.). The potential wetland areas were digitized (data-layer name: AERIAL) and included in the GIS database.

Before photogrammetric analysis, a field inspection was done to collect ground information to provide a reliable key for tonal differences. Ravenna AAP contains a number of easily recognizable wetlands in Area A, some of which were created by the activity of beavers. Locations of these wetlands and their tonal characteristics were noted. Known wetlands had a darker tone than adjacent uplands, characteristic of saturated or wet soils. Using these tonal differences, which were apparent on the black and white and CIR photography, the remainder of Areas A-H and J was classified.

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[1]Aerial photographs were part of the National Aerial Photography Program (NAPP), image scale 1:40,000. Black-and-white photographs included Cleveland South frames 7930-40, 7930-82, and 7934-214 (April 1994). Color infrared photographs included Cleveland South frames 555-21 (April 1991), 556-59 (May 1991), and 562-77 (November 1991).

Drainage and vegetative patterns also were used to identify potential wetlands. Most potential wetlands on Ravenna AAP are associated with streams. Potential wetlands observed in CIR photographs (and confirmed later in the field) had a characteristic pattern probably due to areas of high soil moisture. All drainages in Areas A-H and J were traced and evaluated for the patterns noted on both sets of photographs. Particular attention was paid to areas where streams crossed or flowed parallel to roads.

The data layers NWI, SOILS, PLNTCOMM, and AERIAL were used to target potential wetlands in the training areas by GIS composite overlay analysis. Because four data layers were used in the overlay analysis, a tract of ground could be likely to contain wetlands on the basis of as many as four independent criteria. The areas common to all four layers were mapped as highest priority for field inspection in each training area.

Field Reconnaissance

A biologist, hydrologist, and hydrologic technician inspected the targeted areas in the training areas for wetlands during late November and early December 1996 and March 1997. Although wetlands normally are delineated on the basis of conditions during the growing season, the startup date of the project precluded fieldwork earlier than November.

The team looked for macroscopic evidences of wetland hydrology (standing water, moss growth on trees) and plants (cattails, sedges, and others listed as obligate, facultative wetland, or facultative species in Reed (1988)) to estimate the extents of wetland areas. According to FICWD (1989), wetland vegetation used as criteria for jurisdictional delineations should have at least 50 percent of the community in a single stratum composed of OBL, FACW, and FAC species, or some combination thereof. Because the goals of this study were to identify and record general wetland boundaries, however, such a rigorous, quantitative approach was abandoned. Potential wetlands were targeted from the GIS overlay analysis described earlier.

Reconnaissance priorities were (according to Colonel Dennis Tomcik, OHARNG, oral commun., September 1996)

1. Areas B and C,
2. Areas D through H and J,
3. Area CO, and
4. Area A.

A military-issue, precise locational global positioning system (GPS) receiver (PLGR) was used to map to 4-m accuracy locations that later were generated into a GIS data layer (named FLDOBS). Field notes were kept of all their activities and observations and photographs were taken of distinguishing features of wetlands. The locations at which photographs were taken were recorded in a GIS data layer (named FLDFOTOS) for reference purposes.

Reconnaissance began at each area with a drive around the perimeter to orient the team and to verify the accuracy of a GIS map. The team completed the reconnaissance by walking the boundary of each wetland and recording positional coordinates (by use of a GPS receiver) where wetland plant species formed marked boundaries between wetland and upland forms. Wetland vegetation noted in each area was not always identified to the species level. Some trees and plants that could not be identified onsite were verified later by reference to Fassett (1969), Beal and Thieret (1986), and Brockman (1986).

POTENTIAL WETLANDS IN TRAINING AREAS

This study produced maps showing locations of potential wetlands in training areas on Ravenna AAP. Detailed descriptions and exact locations of wetland boundaries are not provided because they were outside the scope of the project.

Spatial Analysis by Use of a Geographic Information System

Andreas (1993) identified 18 plant communities on Ravenna AAP. Ten mature plant communities and probably parts of two transitional communities on Ravenna AAP are considered wetlands (Morgan, 1995). Of the ten mature wetland communities, seven are found in the training areas; these are listed in table 2 and shown in figure 2. Most of the wetland-plant communities in the training areas are mixed swamps. Areas C, J, and CO contain the most acreage of wetland-plant communities, whereas areas E, G, and H contain the fewest acres of wetland-plant communities.

Table 2. Wetland-plant communities in the training areas on Ravenna AAP [Training areas include A through H, J, and CO. Communities are numbered generally in order of wettest to driest. From Andreas (1993)]

Reference number (from Andreas, 1993)	Community	Acreage in training areas	Percentage of training areas	Primary location
3	Mixed emergent marsh	13.1	< 1	Center of CO
4	Cattail marsh	54.8	1.4	Southwestern Areas A and C
5	Sedge-grass meadow	17.5	< 1	Northwestern CO
6	Mixed shrub swamp	111.7	2.9	Along streams in Areas A and C
7	Buttonbush shrub swamp	2.0	< 1	Area G
8	Oak-maple swamp	100.3	2.6	Southern CO, western Areas A and C, northern Area J
9	Mixed swamp	451.4	11.7	Areas D and C; all areas along streams

Many wetland-plant communities that are present on the AAP (and presumably in the training areas) fall into the categories listed in table 2 but are too small to map (Andreas, 1993). Others not mapped are classified as edge-effect communities or are found in areas of heavy traffic (along roadsides, railroads, and powerlines). Although these communities are small, they are abundant, and probably play an important role in the overall ecology of the AAP.

Hydric soils in the training areas include the Frenchtown, Holly, Sebring, and Trumbull silt loams (table 3 and fig. 3) (U.S. Department of Agriculture, 1991). These soils cover 498.5 acres, or about 13 percent of the training areas. The hydric soils are associated mostly with creek bottoms, although Trumbull silt loams are found also in nonriverine settings in Areas G, J, and CO.

Table 3. Hydric soils in the training areas on Ravenna AAP

Symbol	Classification	Acreage in Areas A-H, J, and CO	Location description
Fr	Frenchtown silt loam	15.0	Southwestern part of CO east of Hinckley Creek
Ho	Holly silt loam, frequently flooded	65.4	Along Sand Creek in Area J and CO
Sb	Sebring silt loam	166.5	Along streams in northern Area J, Area A, and Area C
Sv	Sebring silt loam, dark surface variant	56.0	Western Area A
TrA	Trumbull silt loam	195.6	Central CO, northern and eastern Area J, and Area G

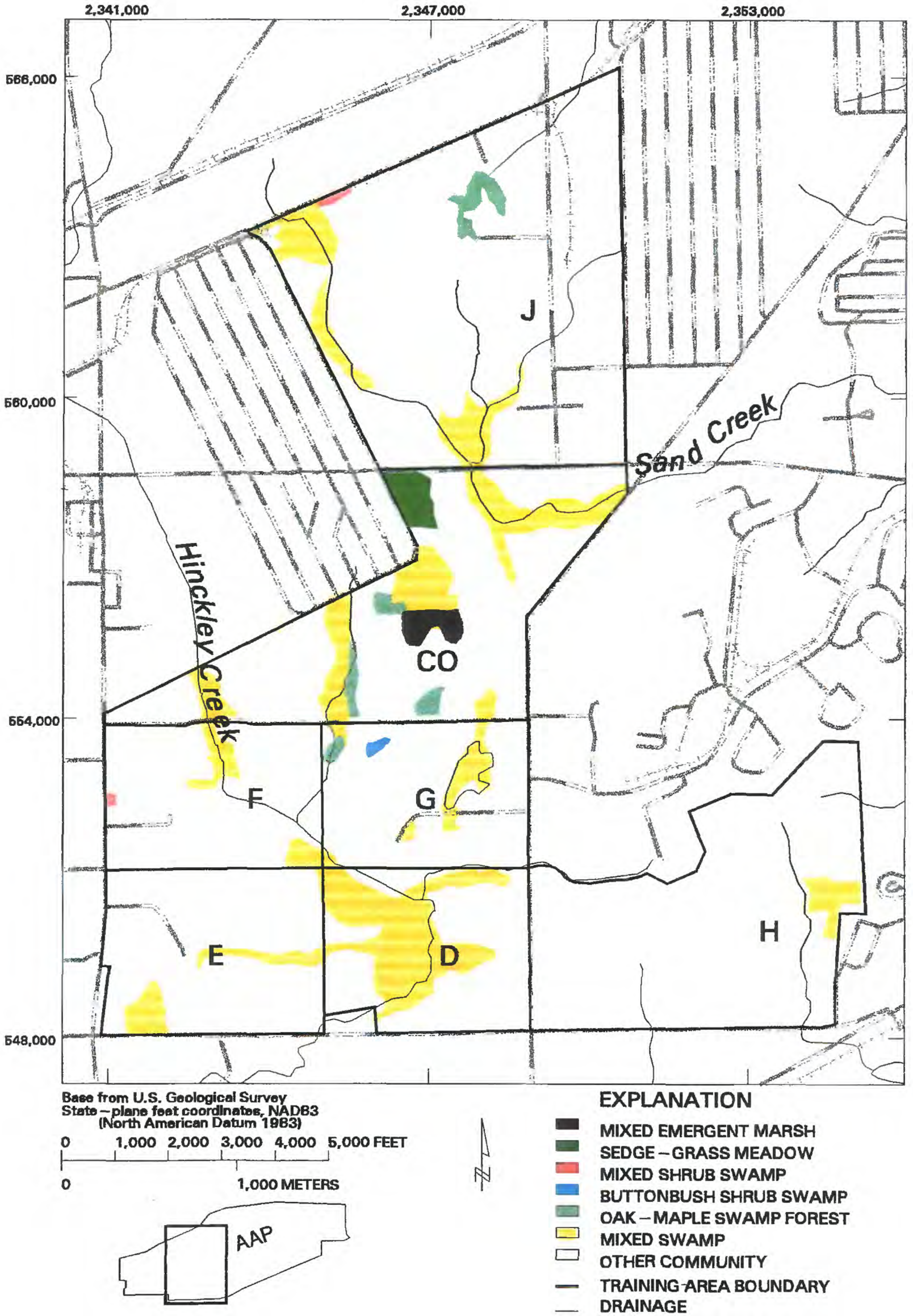

Figure 2. Wetland plant communities in training areas on Ravenna AAP, Ohio: (A) Areas D through H, J, and CO.

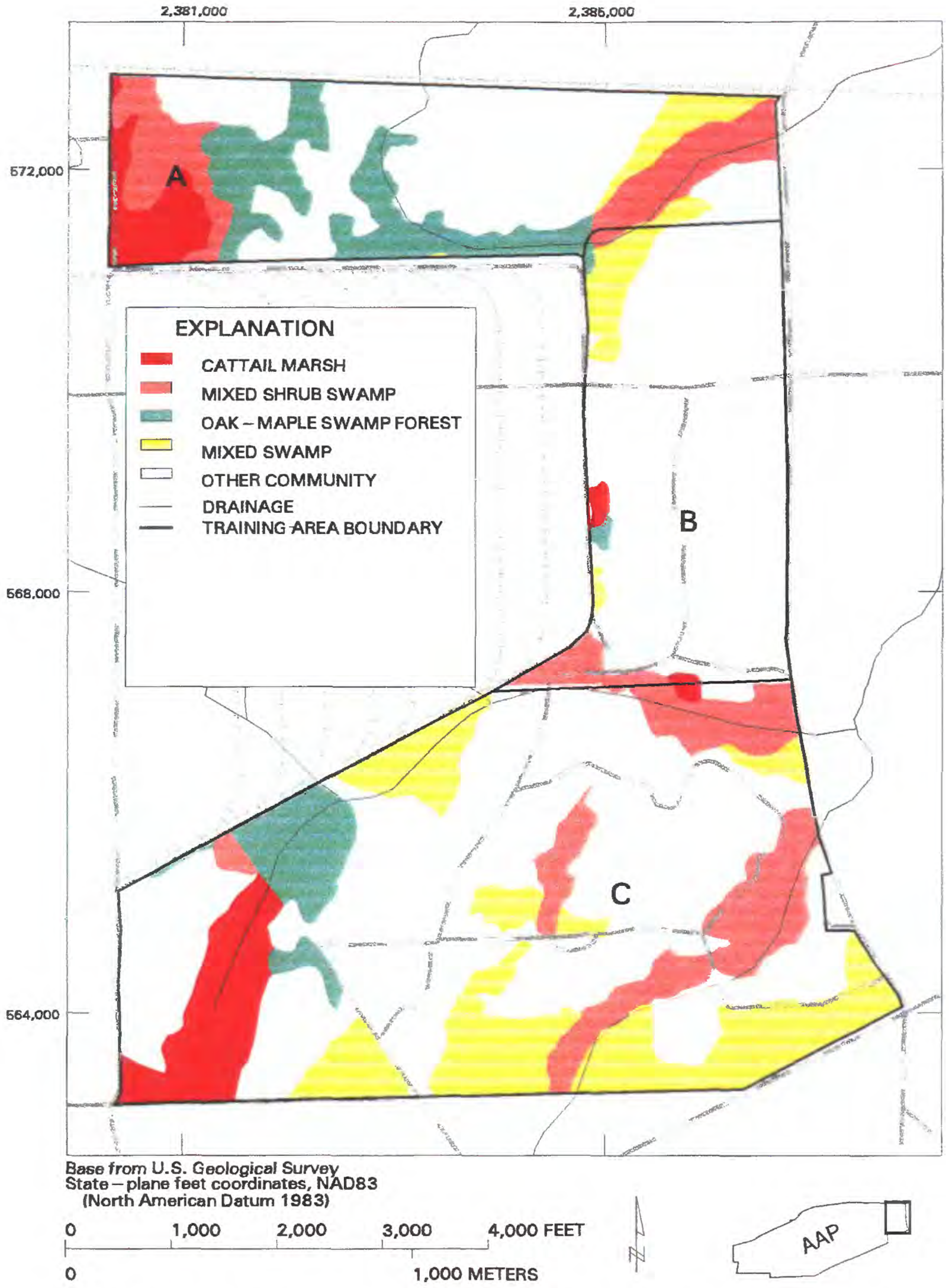

Figure 2. Wetland plant communities in training areas on Ravenna AAP, Ohio: (B) Areas A, B, and C (from Andreas, 1993).

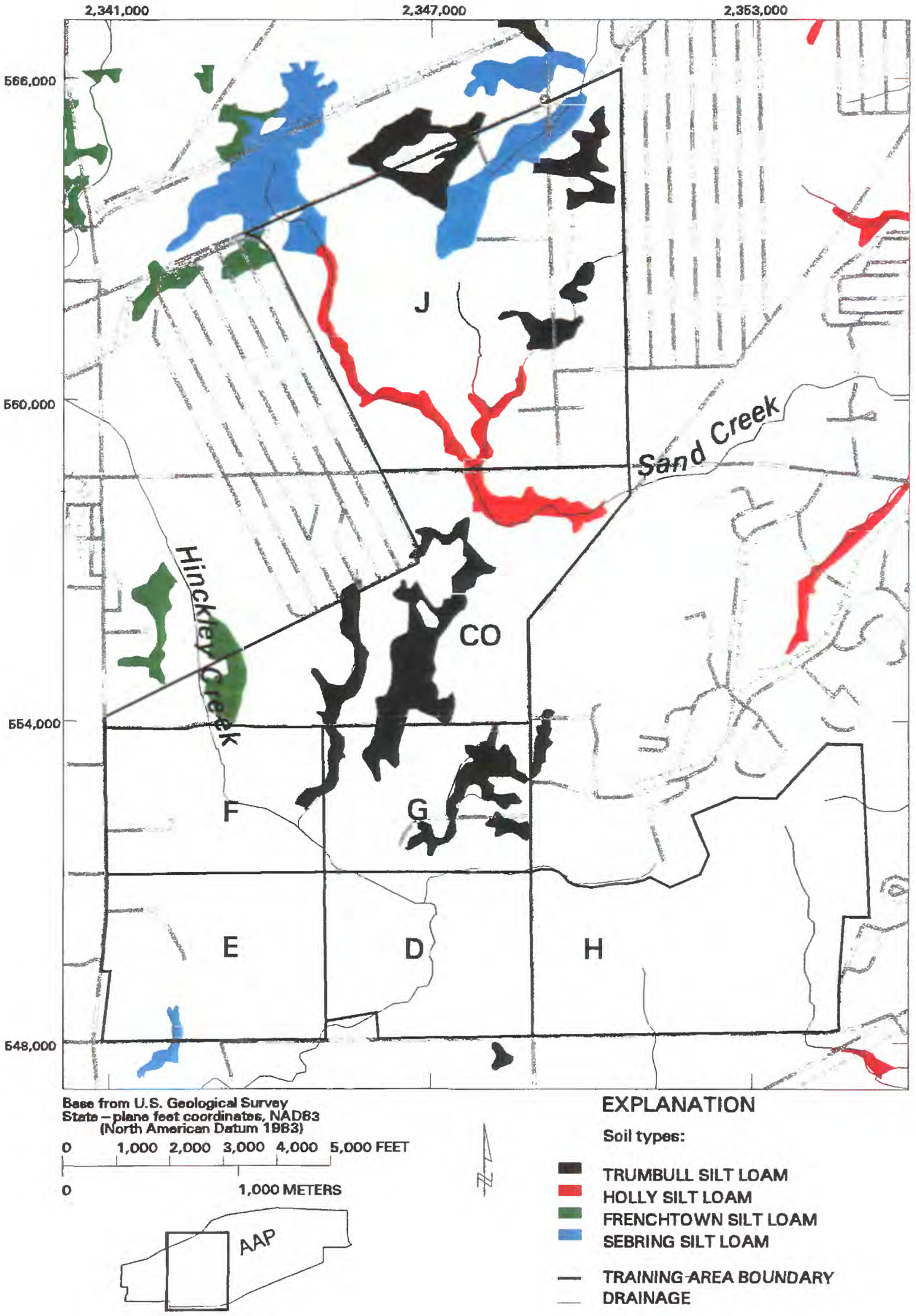

Figure 3. Hydric soils in training areas on Ravenna AAP, Ohio (A) Areas D through H, J, and CO (from Ritchie and others, 1978).

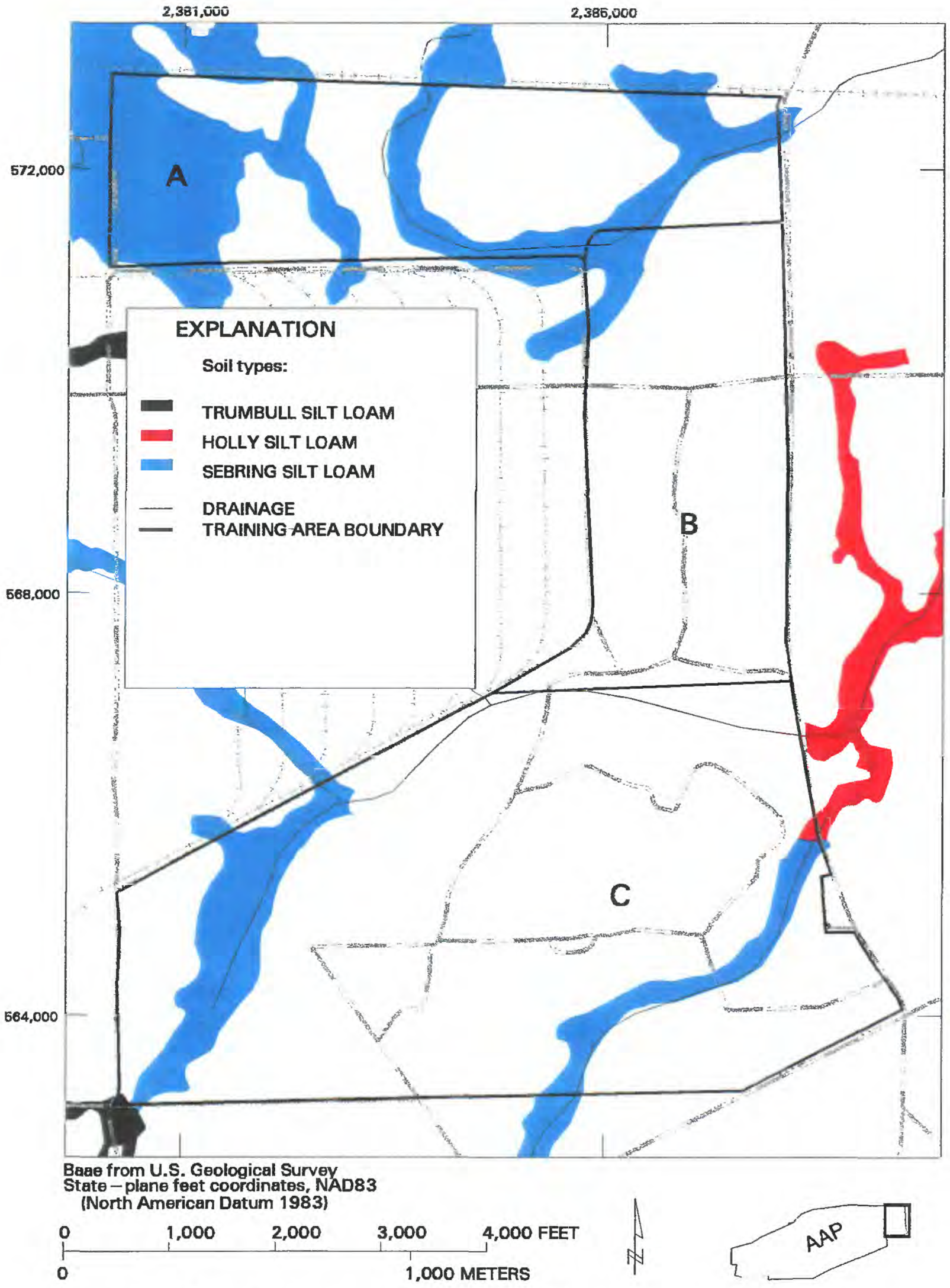

Figure 3. Hydric soils in training areas on Ravenna AAP, Ohio: (B) Areas A, B, and C (from Williams, 1992).

Also present in the training areas are lands designated as wetlands according to NWI surveys of the FWS. About 354 acres of the training areas are designated as wetlands according to NWI; all are palustrine except for a riverine wetland in southern Area D along Hinckley Creek (table 4 and fig. 4). Nearly all of the wetland areas (98 percent) are classified as either scrub/shrub wetlands or forested wetlands. The training areas containing the most NWI-designated lands are CO and A. Areas E and H contain almost no NWI-designated wetlands.

Table 4. Acreages of types of wetlands in training areas on Ravenna AAP [from Fish and Wildlife Service maps, 1977a, b, c]

Training area	Total acres	Acres of emergent wetlands	Acres of forested wetlands	Acreage of forested wetlands (dead)	Acres of open water wetlands	Acres of scrub/ shrub wetlands	Total acres of wetlands
A	228	0.2	19.5	0.3	0.0	56.7	76.7
B	193	0.0	0.0	0.0	0.0	12.6	12.6
C	502	1.0	22.4	0.0	0.5	1.7	25.6
D	264	0.0	0.1	0.0	0.0	49.6	49.7
E	293	0.0	4.3	0.0	0.0	0.0	4.3
F	254	0.0	8.1	0.0	0.0	12.4	20.5
G	242	6.1	27.6	0.0	0.0	7.2	40.9
H	532	0.0	2.0	0.0	0.0	0.0	2.0
J	822	0.0	25.7	0.0	0.0	5.5	31.2
CO	530	0.0	88.0	0.0	0.0	2.2	90.2

Aerial photographs of the training grounds were analyzed for wet areas. Areas likely to be wet by this analysis are shown in figure 5. The wet areas estimated by photogrammetric methods correspond very well with those estimated by other methods in most areas. Areas J (111 acres), A (104 acres), and C (100 acres) contain the greatest amount of wetlands according to aerial photography interpretation, whereas Area E (14 acres) contains the least.

The four data layers described above were combined in a composite analysis to determine which grounds in the training areas were most likely to contain wetlands. Those areas that were described as wetlands in all four data layers were given the closest scrutiny during field reconnaissance, followed by those described as wetlands in three data layers, and so forth. The results of this analysis are shown in figure 6 and table 5. Almost one-third of the land in the training areas, including CO, is potential wetlands. The areas most likely to contain wetlands include western Area A; creek bottoms in Areas A, B, and C; parts of the upper reaches of Sand and Hinckley Creeks and their tributaries in Areas F, J, and CO; and parts of central Area G and CO. Most of Areas B, E, and H do not contain areas likely to be wetlands.

Field Reconnaissance

The GIS composite analysis was used to identify target areas for a visual inspection of potential wetlands in the training areas. The field team inspected Areas B, C, E, and F during the week of November 18-22, 1996, and Areas D, G, H, J, and parts of CO during the week of December 2-6, 1996. Area A and the

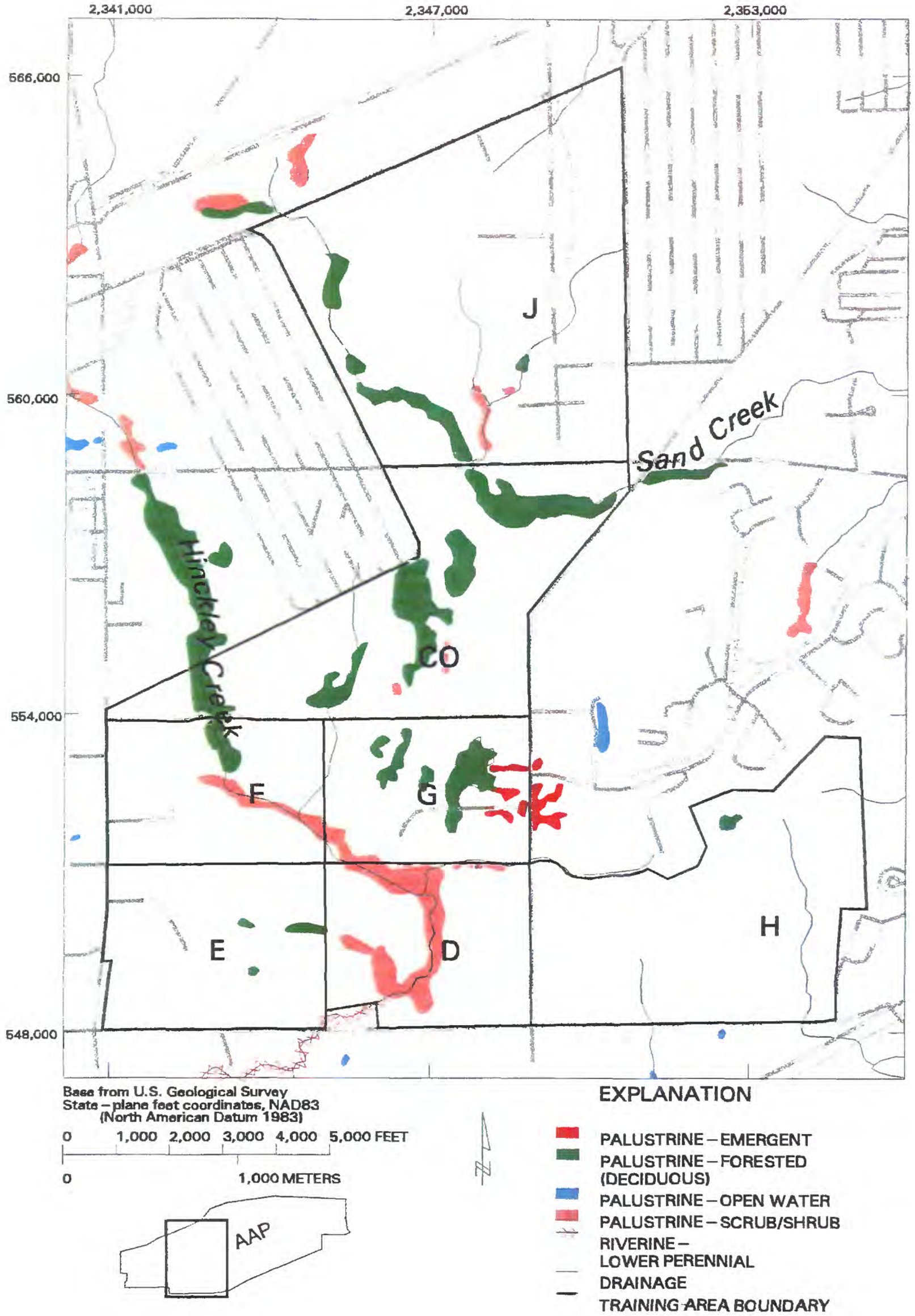

Figure 4. National Wetlands Inventory designated lands in training areas on Ravenna AAP, Ohio: (A) Areas D through H, J, and CO (from U.S. Fish and Wildlife Service, 1977b, c).

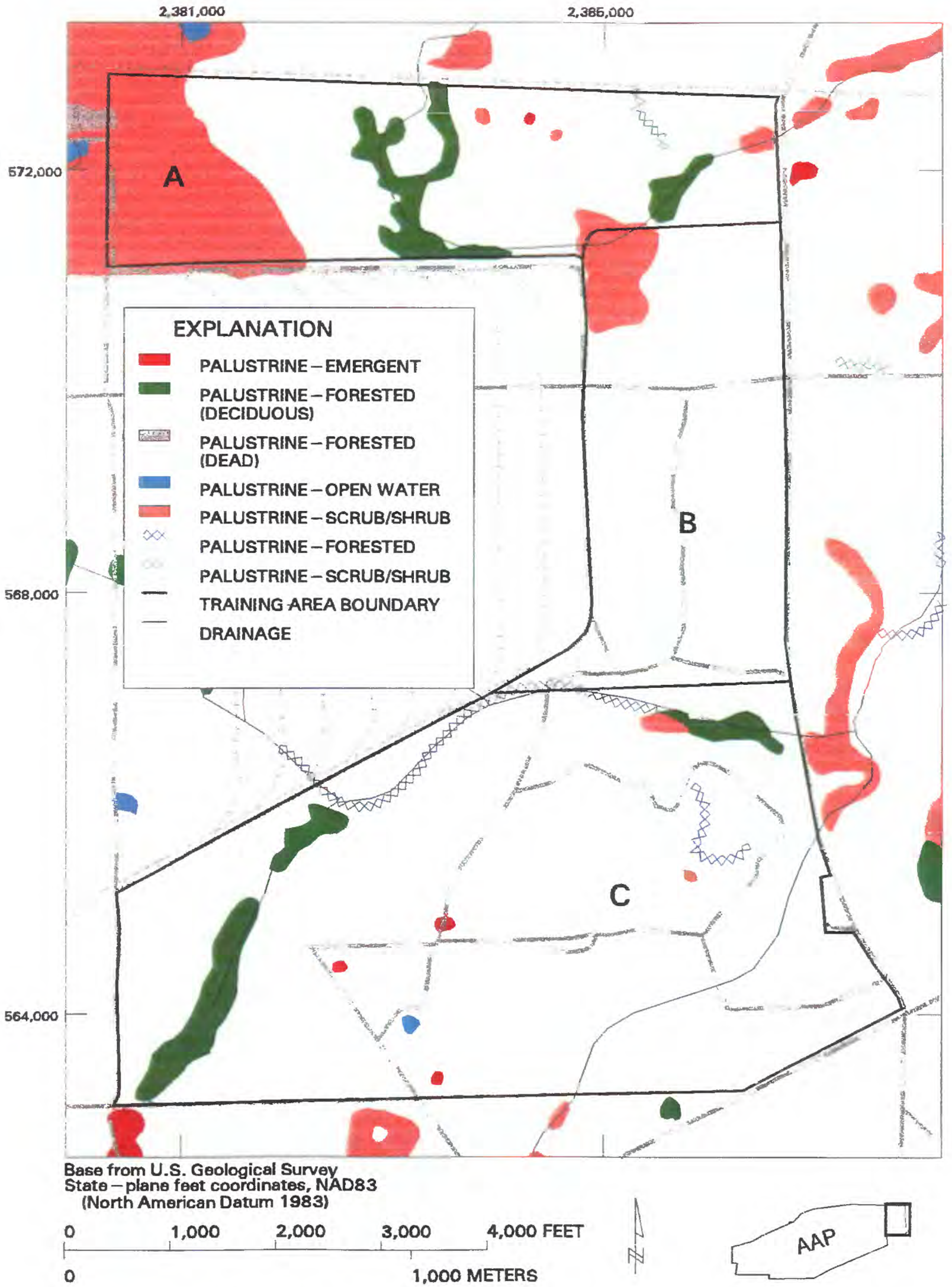

Figure 4. National Wetlands Inventory designated lands in training areas on Ravenna AAP, Ohio: (B) Areas A, B, and C (from U.S. Fish and Wildlife Service, 1977a, c).

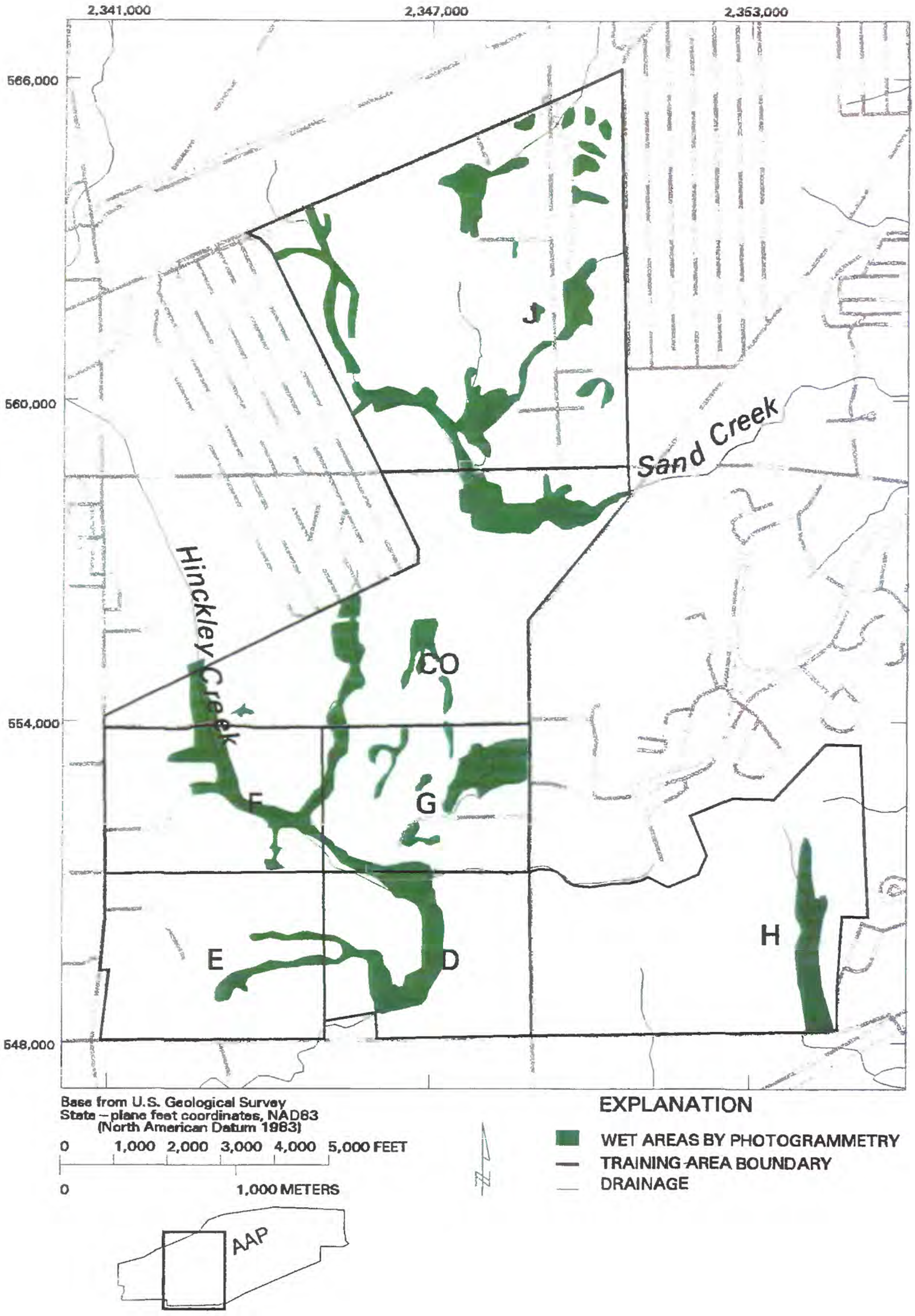

Figure 5. Wet areas in training areas on Ravenna AAP, Ohio, according to photogrammetric methods: (A) Areas D through through H, J, and CO.

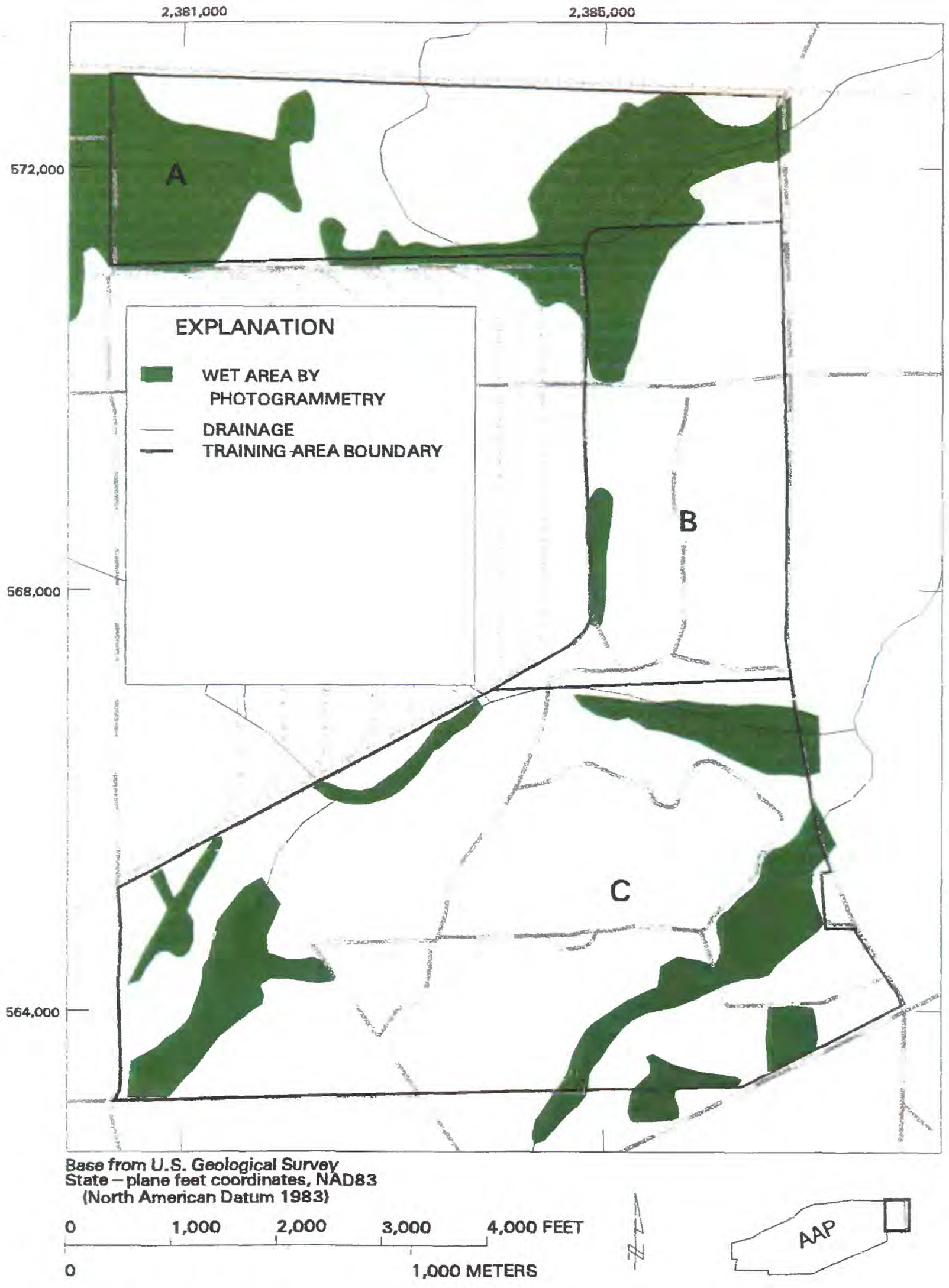

Figure 5. Wet areas in training areas on Ravenna AAP, Ohio, according to photogrammetric methods: (B) Areas A, B, and C.

rest of Area CO were inspected March 26 and 27, 1997. Wet areas were not delineated in Area CO because the field team's task was to find a dry corridor through Area CO for troop exercises, if such a dry corridor existed. Captain Thomas Daugherty, OHARNG, accompanied the team on Friday, December 6, during inspection of Area CO.

The boundaries of any land supporting a dominant community of OBL, FACW, and FAC species was mapped by use of a GPS receiver. Wet woods with dominant stands of woody species adapted for growing in saturated soils were mapped also. Woody species growing at the Ravenna AAP and considered wetland adaptive included red maple (*Acer rubrum*: FACW), pin oak (*Quercus palustris*: FAC), and willows (*Salix* spp.: OBL). Another woody species common to moist locations and often an abundant member of the wetland communities on Ravenna AAP was dogwood (*Cornus amomum*: FACW). Boundaries were mapped to accommodate stands of dogwood commonly growing at the distal limits, slightly upland from a wetland.

Field reconnaissance verified that the GIS maps were accurate locational representations of wet places on Ravenna AAP. Several wet areas, however, were proportionately larger than had been predicted by the GIS analysis, perhaps for two reasons. First, the field reconnaissance was done in late November and early December 1996, and March 1997, outside the growing season. Evapotranspiration, which tends to dry the soil during the growing season, had ended, resulting in more wetness than usual in areas that did not drain well. Second, higher than normal amounts of precipitation had fallen at critical times during the previous 2 years. Precipitation that fell on Ravenna, Ohio, in 1995 was 40.17 in. (National Oceanic and Atmospheric Administration, 1995), 1.95 in. above normal (National Oceanic and Atmospheric Administration, 1991). Precipitation that fell on Ravenna, Ohio, from January through November 1996 was 43.53 in., 8.31 in. above normal for that period (National Oceanic Atmospheric Administration, 1996 and unpublished data). During April and May 1996, precipitation that fell on Ravenna, Ohio, was 10.28 in., 3.2 in. above normal for those two months. High amounts of precipitation inundate lands not normally saturated; and when this occurs before peak growing season, conditions for aquatic plant habitation are enhanced. Dense stands of grasses, probably cutgrass (*Leersia* sp.: OBL) or reed canary grass (*Phalaris* sp.: FACW) and a few other aquatic plants, were evidence of recent inundations. These stands of grasses may have replaced upland plants that grew previously in the flat or depressed areas when normal amounts of precipitation fell on the AAP.

Table 5. Acres of land identified as potential wetlands by composite overlay analysis of four methods

Training area	Total acres	Acres of land identified by four methods	Acres of land identified by three methods	Acreage of land identified by two methods	Acres of land identified by one method	Total acres of land identified
A	228	45.3	30.3	26.2	56.0	157.8
B	193	8.3	2.3	7.3	15.1	33.0
C	502	13.0	29.0	60.2	146.7	246.9
D	264	0.0	24.9	20.4	77.7	123.0
E	293	0.0	0.0	5.7	33.7	39.4
F	254	0.0	7.5	12.8	30.1	50.4
G	242	10.8	9.6	21.3	52.7	94.4
H	532	0.0	0.0	0.0	35.1	35.1
J	822	8.5	30.3	57.7	135.0	231.5
CO	530	24.1	36.7	47.9	130.0	238.7
Total	3,860	110.0	170.6	259.5	712.1	1,252.2

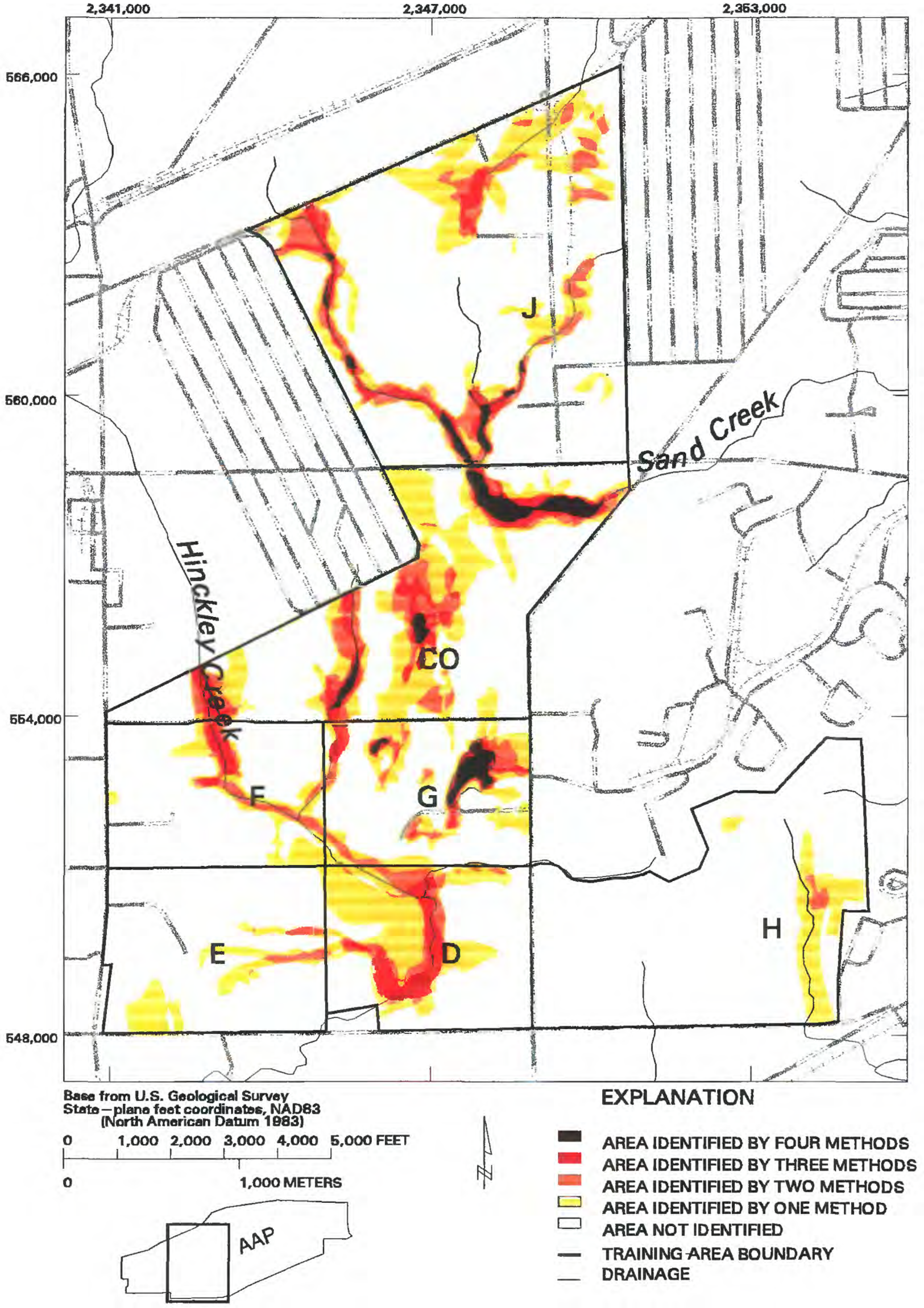

Figure 6. Potential wetlands in training areas on Ravenna AAP, Ohio, according to composite GIS overlay analysis: (A) Areas D through H, J, and CO.

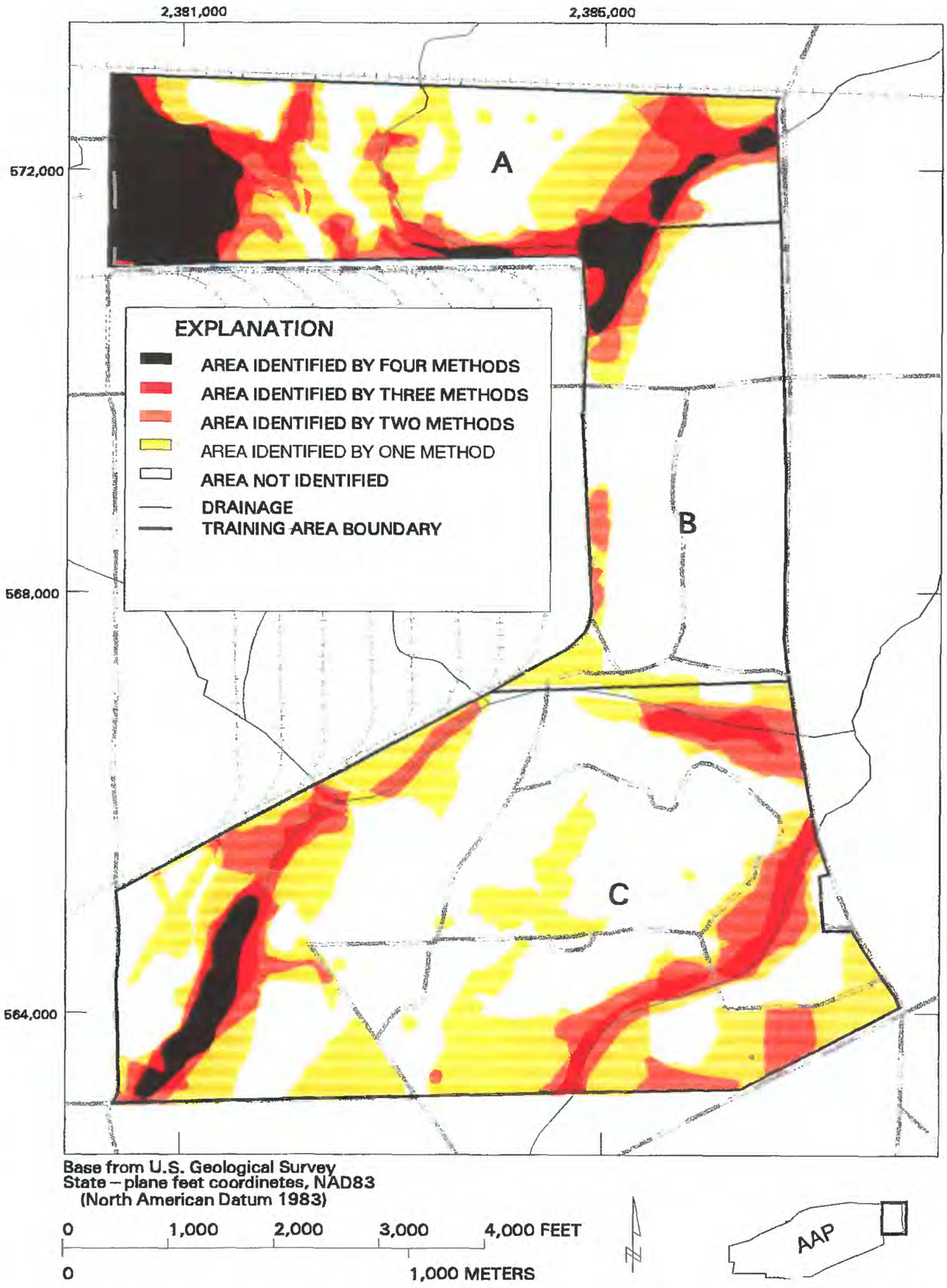

Figure 6. Potential wetlands in training areas on Ravenna AAP, Ohio, according to composite GIS overlay analysis: (B) Areas A, B, and C.

A summary of wetland areas identified by field inspection is presented in table 6. Area CO is not included in table 6 because it was not inspected fully for wetlands. Correlation of acres of wet areas by GIS analysis and field inspection generally is good ($r^2 = 0.76$); exceptions are for Areas G and J, which encompassed many more acres of wetlands by field inspection than by GIS analysis. The wet spots in Areas G and J are in flat, low-lying terrain, and the higher than average rainfall during 1995-96 probably saturated and inundated larger areas than had been mapped previously. Because of the overall wet conditions in Areas G and J, the field team mapped the boundaries of all of the wet terrain rather than only each mature pothole or marsh.

Table 6. Acreages of potential wetlands in training areas on Ravenna AAP, Ohio, according to GIS composite analysis and field inspection

Training area	Total acres	Wet areas by GIS analysis (acres) (from Table 5)	Wet areas by field inspection (acres)
A	228	157.8	150.5
B	193	33.0	21.6
C	502	248.9	248.8
D	264	123.0	100.1
E	293	39.4	34.2
F	254	50.4	80.4
G	242	94.4	212.1
H	532	35.1	36.3
J	822	231.5	397.1

The following is a summary of wetland and associated vegetation by training area.

Area A

Much of Area A was wet during field reconnaissance (fig. 7). The southeastern corner of Area A was wet field. Plant species observed growing in this corner included red maple, dogwood, pin oak, quaking aspen (*Populus tremula*: FACU), aster (*Aster* spp.: FACW), and bidens (*Bidens sp.*: FACW). The northeast corner of Area A was mostly wet woods containing many puddles. Red maple was the dominant species; also growing in these woods were American beech (*Fagus grandifolia*: FACU), sugar maple (*Acer saccharum*: UPL), black cherry (*Prunus serotina*: FACU), white oak (*Quercus alba*: FACU-), red oak (*Quercus rubra*: FACU-), shagbark hickory (*Carya ovata*: FACU-), and other tree species. Sensitive fern (*Onoclea sensibilis*: OBL) grew in the vehicle tracks that were wet or inundated.

A tributary to Eagle Creek enters the center of Area A from the north, flows along the southern boundary, and then exits at the northeast corner. A beaver dam just above the exit point of the stream from Area A had inundated part of the flood plain, and at least one more beaver dam had caused similar inundations further upstream. The inundated flood plain was inhabited by numerous wetland species, including broad-leaf cattail (*Typha latifolia*: OBL), soft rush (*Juncus effusus*: FACW+), soft-stem bulrush (*Scirpus validus*: OBL), and various grasses. In the riparian corridor above the flood plain grew red maple, sugar maple, pin oak, American beech, quaking aspen, American hornbeam (*Carpinus caroliniana*: FAC), swamp white oak (*Quercus bicolor*: FACW+), dogwood, and sensitive fern.

The flood plain in the central part of Area A was not inundated by beaver ponds. Cattails were absent, and fewer wetland plants were evident than in the eastern part of Area A, possibly because the overhead canopy was dense and the flood plain was not inundated. West of the Eagle Creek tributary were more woods containing scattered wet areas. The tree community in this part was similar to that found east of the tributary, though the population of white oak was greater west of the tributary than east of the tributary.

The western part of Area A was wet. Wetland-plant communities included cattail marshes, which contained broad- and narrow-leaf (*Typha angustifolia*: OBL) cattails; stands of wet woods, which were similar in diversity and composition to the woods growing in the central part of Area A; dense stands of dogwoods; black willow (*Salix nigra*: OBL) and pussy willow (*Salix discolor*: OBL) growing around inundated areas; and large colonies of reed canary grass.

Area B

Much of Area B is dry upland. Numerous potholes, a marsh, and wet woods were observed along the west border (fig. 7). The potholes and marsh were inhabited by broad-leaf cattail, soft rush, water horehound (*Lycopus* probably *americanus*: OBL), ditch stonecrop (*Penthorum sedoides*: OBL), and various grasses. The wet woods were inhabited by red maple, swamp white oak, pin oak, quaking aspen, and black cherry among others.

Area C

Much of Area C is wet (fig. 7). Two large streams flow north across it. One stream enters from the southwest corner and flows along the north border to the northeast corner. The other stream enters at the south-central border and flows out at the east border. The riparian corridors along these streams were inhabited by black cherry, quaking aspen, red maple, American beech, and pin oak. The flood plains were inhabited by dogwood, broad-leaf cattail, sensitive fern, water horehound, soft rush, sedges (*Carex* spp.: OBL-FACW), and various grasses. Parts of the uplands were inhabited by dense stands of dogwood, multiflora rose (*Rosa multiflora*: UPL), and similar brush.

Area D

Much of Area D is riparian corridor for Hinckley Creek, which enters at the northwest corner, receives flow from an unnamed tributary from the east, and flows out the southwest corner (fig. 8). Trees growing in uplands slightly higher in elevation than the flood plain were red oak, American elm (*Ulmus americana*), shagbark hickory, black cherry, sugar maple, American beech, and apple (*Malus* sp.: no wetland designation). Wetlands contained red maple, pin oak, quaking aspen, and willow. Other wetland plants were broad-leaf cattail, soft rush, sedges, soft-stem bulrush, sensitive fern, swamp dock (*Rumex verticillatus*: FACW), and various grasses. A large patch of common reed (*Phragmites australis*: FACW) was growing on the flood plain at the northeast corner of Area D. The southwest corner was covered by an American beech, red maple, and sugar maple woods. Much of the vegetation beyond the wooded riparian corridors was associated with upland fields. Some of these fields had wet seeps that supported thick stands of dogwood and multiflora rose.

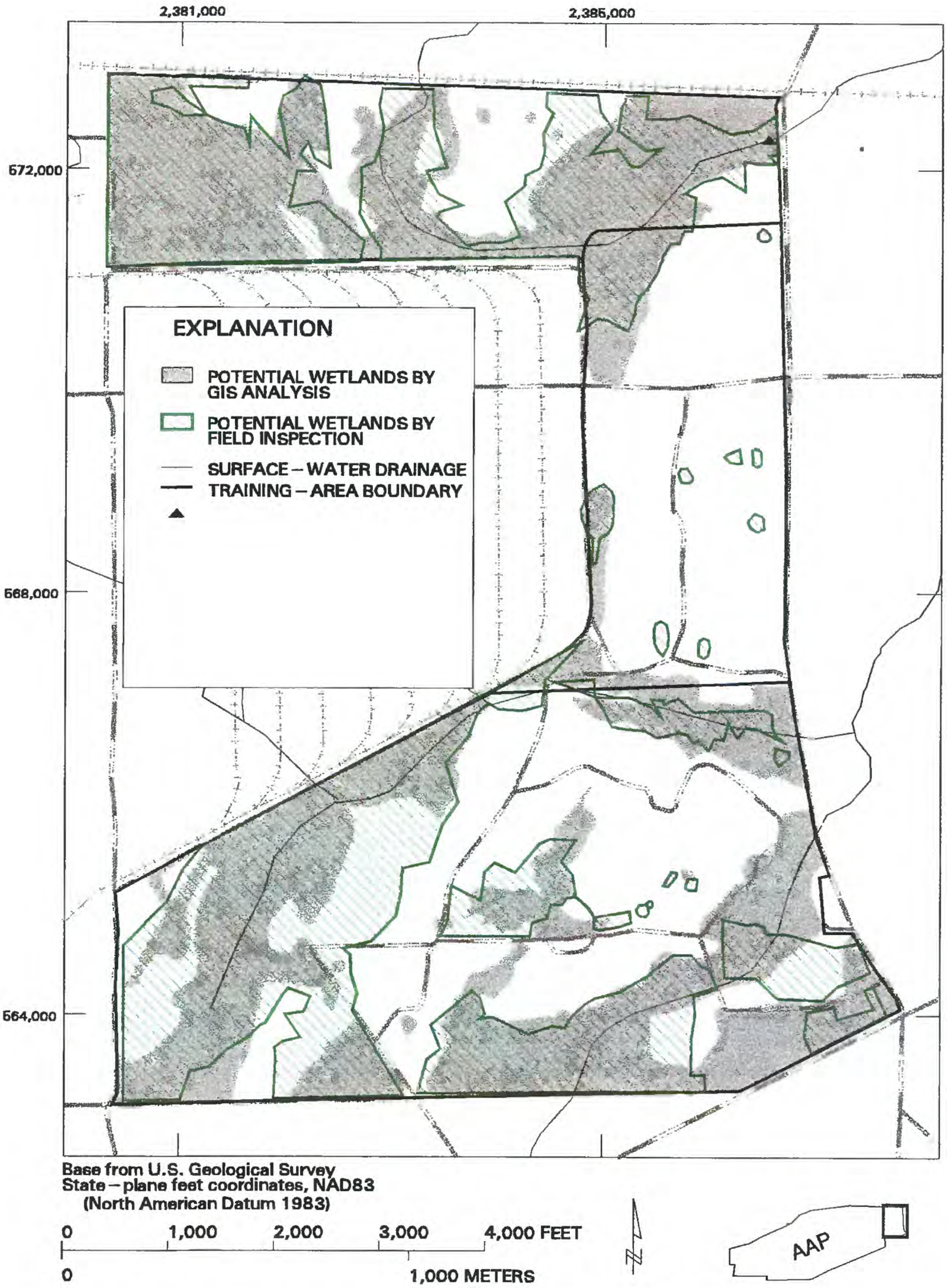

Figure 7. Field–inspected potential wetlands in training areas A, B, and C on Ravenna AAP, Ohio, November 1996 and March 1997.

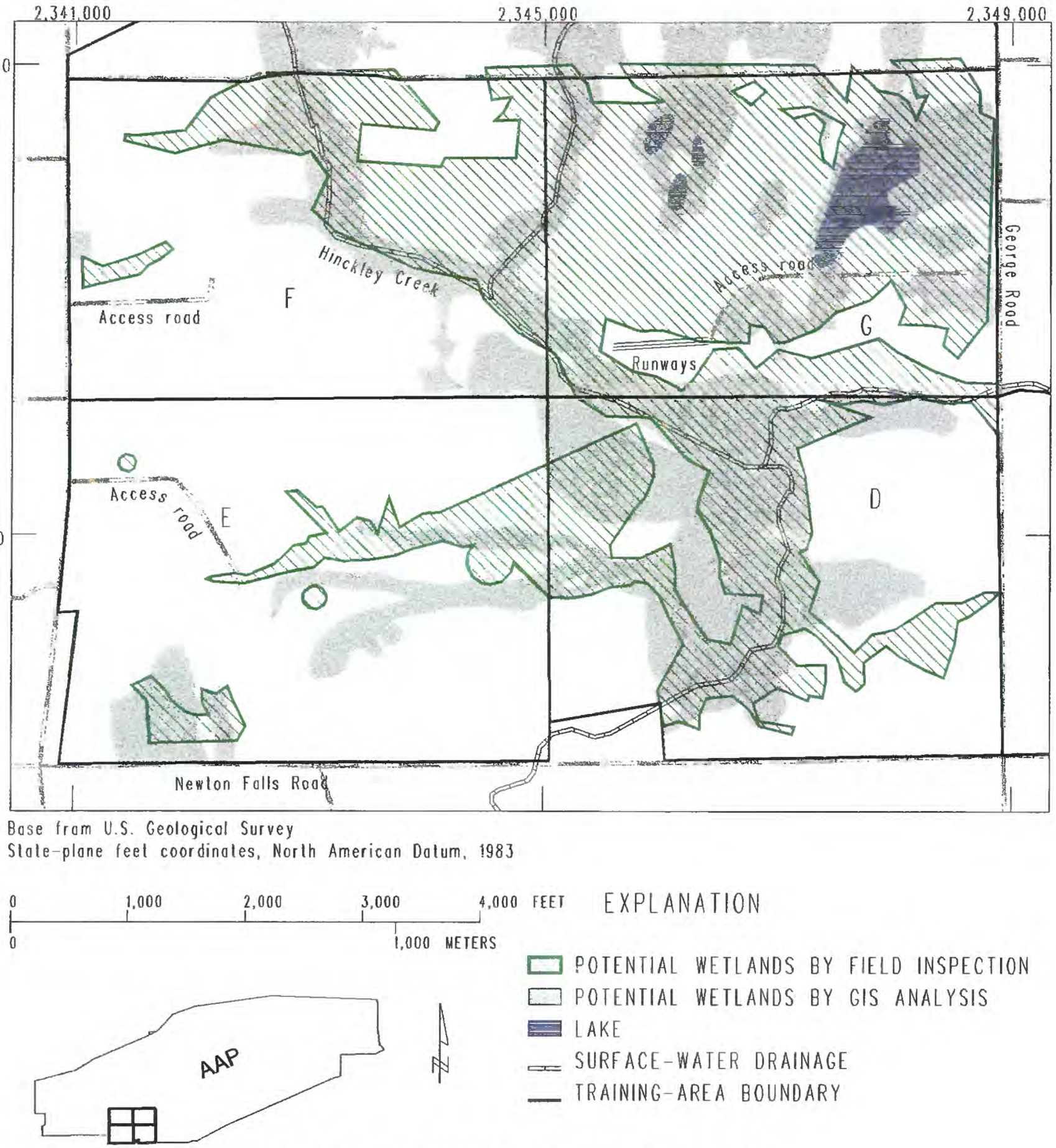

Figure 8. Field—inspected potential wetlands in training areas D through G on Ravenna AAP, Ohio, December 1996.

Area E

Much of Area E is upland field with slight changes in relief. Four locations were wet (fig. 8). One wetland was in the southwest corner near what appeared to be a former homestead. Domestic apple trees were growing in an order and number not common to chance seedings. Water drained from this wetland through a culvert under Newton Falls Road. The second wetland was near the center of Area E, just east of the terminus of an access road from the west boundary. This wetland flowed due east into Area D. The vegetation succession from west to east began as an upland field of grasses and briars, including multiflora rose; changed to hawthorn (*Crataegus* sp.: FAC) and dogwood; and ended with a mature stand of red maple and American beech. The third location was a small patch of wet woods due south of the second wetland. The fourth wetland was a pond in the northwest corner of Area E, along the access road north and west of the curve. This wetland was a typical cattail marsh. A stream flowed across the southeast corner through hills wooded with black cherry, red maple, red oak, American elm, hawthorn, and multiflora rose. Much of the central and eastern parts of Area E were wooded. Upland fields bordered the west boundary and flanked the access road.

Area F

Hinckley Creek enters Area F at the center of the north boundary and flows south to the southeast corner. The east half of Area F is flood plain and wetland for Hinckley Creek (fig. 8). Beyond the riparian corridor the hardwoods included red maple, sugar maple, American beech, black cherry, and American hornbeam. Dogwood bordered the hardwoods where woods receded and upland fields prevailed. Towards the center of Area F and west of Hinckley Creek, osage orange (*Maclura pomifera*: UPL) and willow grew. The west half of Area F is mostly upland field. One small wetland was observed along the west boundary, due north of the access road.

Area G

Area G mostly was wet (fig. 8). Hinckley Creek and an unnamed tributary created most of the wetlands along the western one-third. Several small lakes occupied the interior of Area G. The wetlands surrounding the ponds were typical of the cattail marshes elsewhere on Ravenna AAP. Quaking aspen grew near the wetlands in the edges between wet and dry zones. An access road and a double runway that ends at a concrete pad near the west boundary are on upland field that stretches nearly the entire width of Area G.

Area H

Area H is a large section with three large and three small wetlands (fig. 9). Each small wetland was associated with one of the large wetlands. Four streams originate in Area H and supply much of the water for the wetlands. The interior of Area H is as much as 35 ft higher than the stream bottoms; this elevation difference may have limited the development of flood plains and more wetlands.

In south-central Area H, one wetland begins as a T-shaped channel that drains the land north of the stream. The land in that area has been graded flat and is about 5 ft higher than the stream. A small wetland was found northwest of this large wetland. Around these wetlands grew narrow-leaf cattail, asters, soft rush, and sensitive fern.

The northeastern part of Area H is a broad, flat topographic high, occupied primarily by woods. Two streams, draining east and south, respectively, originate in this area. Access ways for electric powerlines (which run north-south near the headwaters of the stream that flows east) and sewers (which run east-west near both streams) were being maintained and mowed, creating a contrast with the surrounding woods. Firebreaks and fence maintenance also were evident in the northeast quarter of Area H.

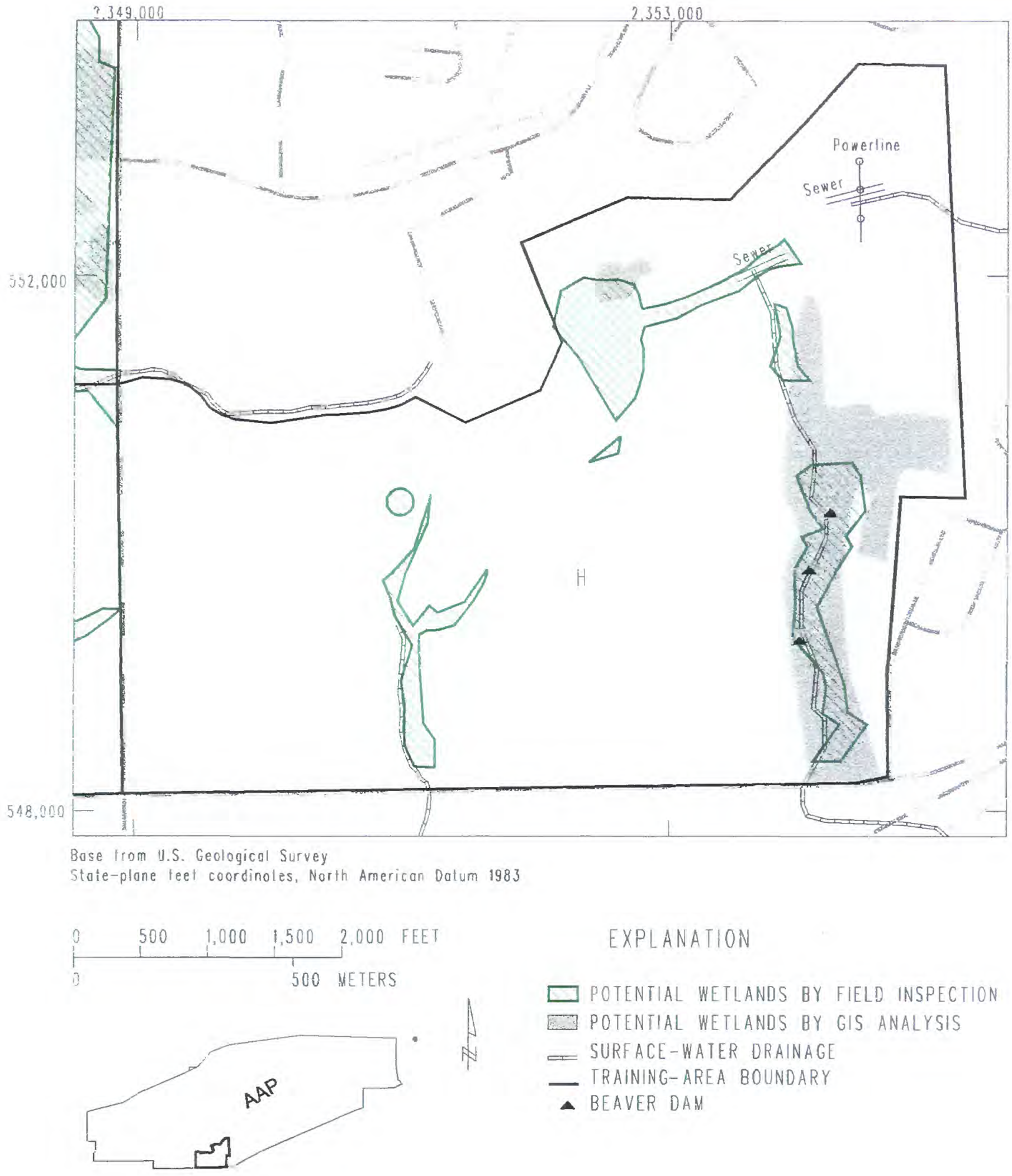

Figure 9. Field – inspected potential wetlands in training area H on Ravenna AAP, Ohio, December 1996.

The sewerlines were instrumental in forming part of the second wetland, observed along the northern part of Area H. A small stream (not shown in fig. 9, but draining toward the stream in the northwest) flows west in the excavated depression along the top of the sewerline. The riparian corridor is narrow along the eastern part of this wetland, and mature trees grew along much of it. The wetland widened toward the west and was surrounded by upland field. A small wetland was found south of this wide part of the second wetland.

The third stream begins in this northeast quarter and flows east. Some of the trees growing in this corridor included red oak, white oak, quaking aspen, black cherry, and American basswood (*Tilia americana*: FACU). The numerous powerline and sewerline rights-of-way had created linear wetlands along those features. The aquatic plants in this area were small, pioneering types, those species able to withstand continued human disturbance. Rushes, sedges, and other species were present.

The largest of the four streams flows south through steep terrain and drains most of the eastern one-third of Area H. The riparian corridor of this stream was narrow. Where the flood plain widens, two wetlands had formed — a small wetland in the upper reach and a large wetland in the lower reach. The headwaters begin in mature woods. Red maple, American beech, shagbark hickory, black cherry, red oak, pin oak, quaking aspen, American basswood, and American elm grew along the channelized upper reach. A beaver dam in the stream caused flooding near the center of the middle reach. On the wider flood plain above the beaver dam, wetland plants included bur-reed (*Sparganium* sp.: OBL), swamp milkweed (*Asclepias incarnata*: FACW+), soft-stem bulrush, sensitive fern, soft rush, broad-leaf cattail, and other species. An upland field surrounds the creek near the south road where the stream flows out of Ravenna AAP through a culvert. Wetland species south of the upland field included narrow-leaf cattail, asters, soft rush, and sensitive fern. Growing in the riparian corridor north of the upland field were hawthorn, red maple, shagbark hickory, American beech, American hornbeam, and other species.

Area J

Wet areas found in Area J are shown in figure 10. The drop zone in Area J is surrounded by streams and wetlands. Some of the northern parts of the drop zone were wet and supported rushes despite constant mowing and drainage maintenance. The interior is upland field, about 30 ft higher than much of the rest of Area J. The northwest corner is flat and swampy with dense stands of willow and dogwood. A cottonwood (*Populus deltoides*: FAC) and flatsedge (*Cyperus* sp.: FAC) were observed there as well. Southeast of this swamp was a flat tract of young red maple in the early stages of succession, probably a reseeding after a timber harvest. The southwest and southeast corners are upland fields of brush and briars. Throughout all the training areas, old upland and lowland fields that had been unattended for long periods were succeeding toward forest. Dominant trees growing in the middle to late stages of succession in Area J included red maple, sugar maple, American beech, black cherry, quaking aspen, pin oak, red oak, and American elm. A swamp near the center of the east boundary had been influenced by several old and new beaver dams. A small section of upland ground was observed north of the east swamp, but most of the rest of the northeast corner was patchy wetland.

Area CO

Rather than inspect all of Area CO for wetlands, as had been done for Areas B through H and J, the field team looked for a dry passage through CO between Areas J and G. Locating a dry passage was a top priority of OHARNG. Preliminary assessment by GIS indicated that a dry route possibly ran from the southwest corner of Area J to the northeast corner of Area G, passing south of the large bend in Sand Creek. Field reconnaissance found no dry corridor in the northern half of Area CO, although a corridor 100 ft wide south of Old Newton Falls Road was drier than the rest of the northern half. Much of the northern half and interior was wet (fig. 11). Water seeped or flowed east from spring heads across the northern,

narrow section of Area CO that lies between the bunkers in Block C and Sand Creek. South of Sand Creek, a dry corridor was found between Areas J and G. The driest offroad passage between Areas J and G is shown in figure 11.

The GIS composite analysis indicated three parallel, north-to-south bands of wet areas, and any training activity involving movement of troops between Areas J and F would have to cross at least two of these wet bands. It is probable that in conditions as wet as those at the time of the field inspection, no dry passage through Area CO between Areas J and F would be found.

The upland parts of Area CO were inhabited by forest communities that were similar in composition and distribution to those in the forested uplands in Area J. Red maple was dominant, more so in the eastern half of Area CO than in the western half. Other woody species included sugar maple, American beech, pin oak, red oak, white oak, shagbark hickory, and black cherry. Most of the red maple growing along the powerline in the eastern half of Area CO was 1 ft or less in diameter. The tree community in the western half was more diverse and contained larger trees than the community in the eastern half. The lowland parts and the transitional edges between upland and lowland were inhabited by dense stands of brush and briars. These stands consisted mostly of dogwood and multiflora rose. Upland field commonly bordered the woodlands in Area CO. Species growing in the upland fields included dogwood, black locust (*Robinia pseudoacacia*: UPL), hawthorn, apple, Virginia pine (*Pinus virginiana*: no wetland designation), goldenrod (*Solidago* spp.: FACU), and multiflora rose.

The extreme southwestern section was upland field. Plant communities in this section were similar to those growing in upland fields elsewhere in Area CO, except for spruce (*Picea* sp.: FACU), which may have been planted. Hinckley Creek flows south across the southwestern section of Area CO. The riparian corridor of this creek is wooded with red maple and other trees common in forests in Area CO.

Old beaver cuttings were found in the corridor of a tributary to Hinckley Creek (west-central Area CO), and a deteriorated dam partially blocked the flow through a culvert from Bunker Block C. Wetland species growing in the flood plain and the wet interior of Area CO east of the tributary included broad-leaf cattail, soft rush, sensitive fern, meadow-sweet (*Spirea tomentosa*: FACW, and *Spirea alba*: FACW), black willow, and pussy willow.

The riparian corridor of Sand Creek in the northeastern section was wooded. The thick canopy may have prevented some wetland species from inhabiting the flood plain. Much of the understory was inhabited by dense growths of dogwood and scattered growths of black willow.

The land in Area CO north of Sand Creek was a mixture of upland woods and upland field. Hardwoods such as red maple, sugar maple, American elm, white ash (*Fraxinus americana*: FACU), and black cherry grew in the woods, whereas pin oak, black locust, hawthorn, and multiflora rose grew in the fields.

GUIDELINES FOR MANAGEMENT OF WETLANDS IN TRAINING AREAS

One of the goals of OHARNG is to preserve natural ecosystems, including wetlands, while fulfilling its training mission. One of the objectives of this study was to develop guidelines for management of wetlands on the basis of GIS and field analyses. The results of these analyses depict wet areas that probably are more extensive and numerous than exist during dry or normal years, and thus can be considered "wettest case." Some of the guidelines presented here are intuitive and would apply generally to all wetlands; others are directed specifically at training practices on Ravenna AAP.

1. The water table on the AAP is high, generally less than 1.5 ft below land surface during wet periods. Infiltration generally is slow because of low permeability of the soils, and runoff generally is slow because of the low topographic relief. Slow infiltration and runoff combine to cause water to pond in low-lying areas for much of the year. These permanent wetlands could be irreparably damaged by drainage or other construction. Some attempt was made in the past to drain parts of Area J near the drop zone, and yet those parts of Area J still can be categorized as wet fields.

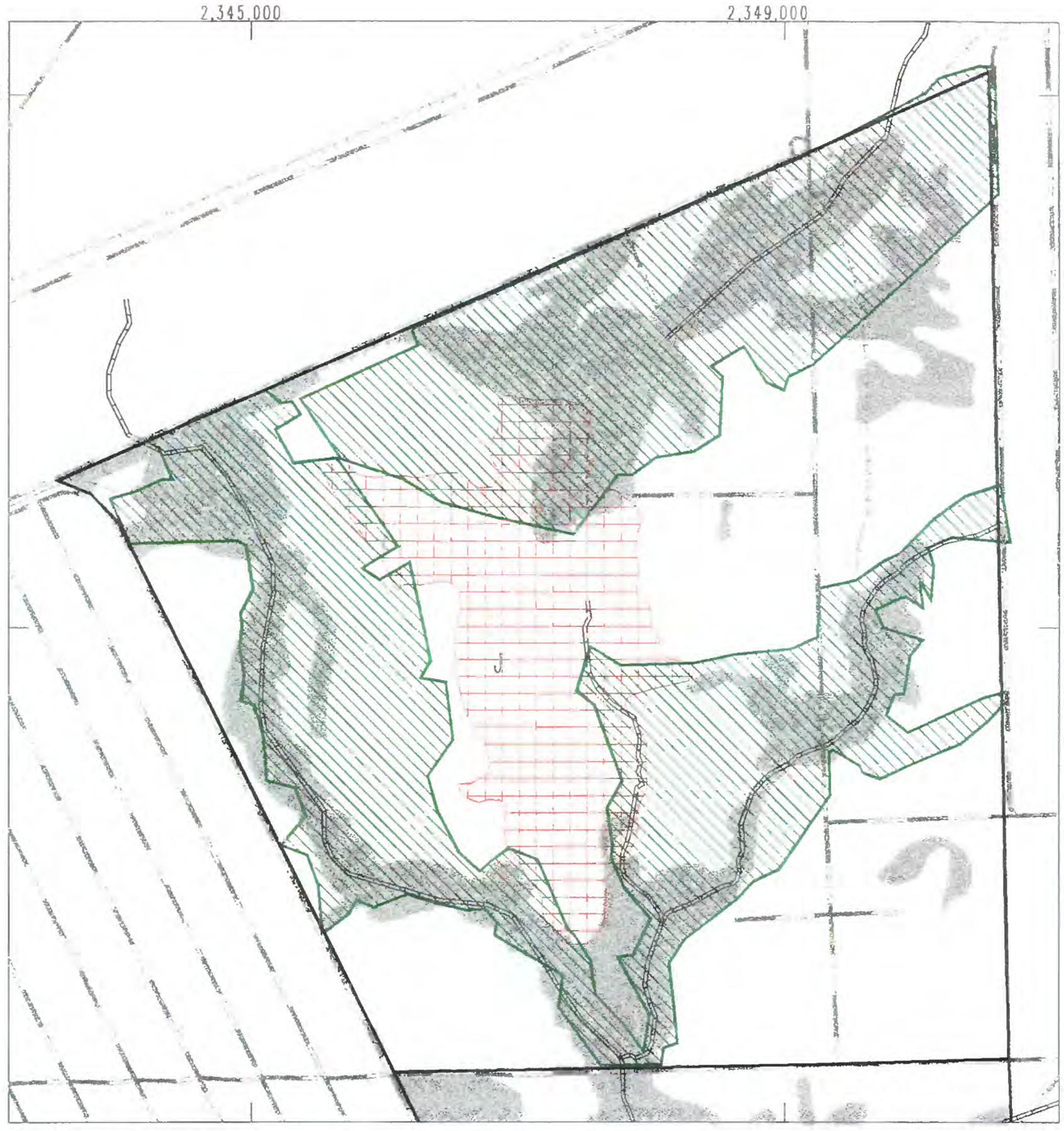

Figure 10. Field—inspected potential wetlands in training area J on Ravenna AAP, Ohio, December 1996.

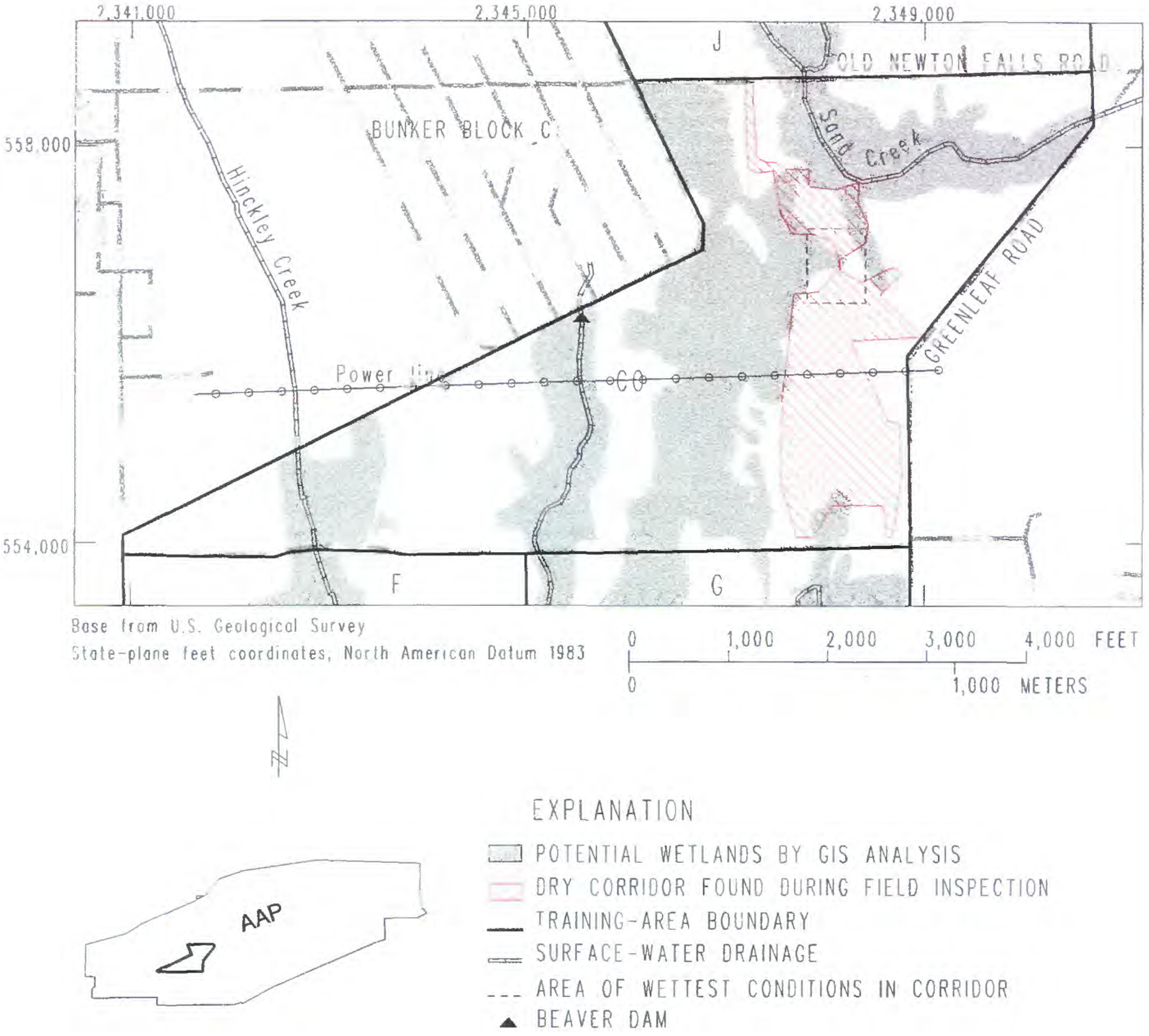

Figure 11. Dry corridor through Area CO on Ravenna AAP, Ohio, December 1996.

2. The activities that can adversely affect the existing wetlands on Ravenna AAP are those that decrease the amount of water flowing to the wetlands or the duration of such flow. Examples of these activities include road construction, artificial drainage, or land filling and grading. The types of wetlands that would be affected by such activities are those along riparian zones in lowland areas and flood plains. Such activities should be avoided if damage to these types of existing wetlands is to be prevented.

   Ideally, OHARNG would avoid construction projects that alter wetland hydrology in such areas; however, OHARNG's training mission probably always will require earth-moving projects. Although activities such as road construction, land filling, and grading can alter hydrology enough to damage existing wetlands, those same activities can alter hydrology to create new wetlands. The same project that decreases flow of water to one side of a road, for example, may impound water on the other side of the road. The effects these projects will have on wetland hydrology will be site-specific and must be determined individually.

3. Most construction projects or training practices that use heavy vehicles on Ravenna AAP would likely create more or larger wetlands rather than destroy or diminish existing wetlands. Heavy vehicle traffic created small, temporary wet areas in Area C, for example. (See photographs in Appendix D.) Given time, these wet areas will continue to develop into transitional, and then established, wetlands. Although the wetlands would be populated first with plants such as *Phragmites* or *Scirpus*, more diverse species would be transplanted to these wetlands as they mature.

   The topography and hydrology at Ravenna AAP are the reasons why heavy vehicle traffic affects wetlands so readily. A high water table in poorly permeable, low-relief terrain can become exposed at the surface due to only slight alterations in topography or drainage. It is possible that many small but well established wetlands will emerge in much of Area C because of the tank-training practices. If OHARNG continues to operate heavy vehicles in wet areas, additional new wetlands are likely to emerge.

4. Although wetlands can be mitigated by various construction practices, spring heads, once lost, cannot be recovered. They are a manifestation of the natural hydrology of the area, and cannot be recreated elsewhere. Hence, to avoid irreparable loss of wetland source water, spring heads in Area CO should not be damaged or altered in any way.

5. Movement of troops and light equipment through Area CO is possible; however, heavy equipment may require culverts or bridges. Greenleaf Road would be a dry and economical route between Areas J and G. Although figure 11 shows the driest off-road passage between these two training areas, the land in that passage still was somewhat wet, especially in the section highlighted. This area is wet because natural drainage is from west (spring heads in upland areas in bunker Block C) to east (Sand Creek) across the passage. To alleviate the wetness of the ground in this corridor, OHARNG could install drains and (or) culverts from the west side of the passage to the east side. Such drains would decrease the size of the wetlands in the corridor and provide more dry areas for troop maneuvers. Alternatively, OHARNG could reserve upland areas for training and equipment transport. The loss of wetlands due to drainage would have to be subject to mitigation requirements of COE.

   Heavy equipment activity and travel across Area CO would create more wetlands. Because current training plans for Areas D through H, J, and CO do not include heavy vehicles, this should not be a problem. Even light vehicles, however, can alter hydrology enough to create more wetlands if the routes through CO are not chosen carefully.

SUMMARY AND CONCLUSIONS

Potential wetlands were identified in Ohio Army National Guard (OHARNG) training areas on Ravenna Army Ammunition Plant, Ohio, by use of geographic information system (GIS) mapping and field inspection. These wetlands are considered "potential" because (1) above-average rainfall in 1995 and 1996 probably resulted in wetland indicators that could not exist during periods of normal precipitation, (2) the field inspection took place after the growing season, and (3) the processes used to identify the wet areas do not meet requirements for jurisdictional delineations according to the Federal Interagency Committee for Wetland Delineation (1989) and the Wetland Delineation Manual (U.S. Army Corps of Engineers, Environmental Laboratory, 1987).

Four GIS data layers were used to target wet areas for field inspection. These data layers included National Wetlands Inventory designated lands (data layer name: NWI), wetland-plant communities (data layer name: PLNTCOMM), hydric soils (data layer name: SOILS), and photogrammetric interpretation of aerial photographs (data layer name: AERIAL). According to these individual data layers, 354 to 751 acres of training grounds on Ravenna AAP can be considered wet. According to a composite analysis using these four data layers, as much as 1,252 acres of OHARNG training areas can be considered wet. The wettest training areas are A, C, D, G, J, and CO.

A field team inspected the training areas in late November and early December 1996 and March 1997. The team focused on verifying the findings of the GIS analysis and finding a dry corridor between Areas J, F, and G. The GIS analysis was roughly accurate except in Areas G and J; the wet areas in G and J were larger than the GIS analysis predicted, probably because of the higher than normal amounts of precipitation during 1995-96. Almost one-third of the land in the training areas, including CO, are potential wetlands. Correlation between predicted (GIS) and observed (field) wetlands in most of the rest of the training areas was good ($r^2 = 0.76$).

The field team found only a narrow corridor between Areas J and F that was dry. Most of the land in the northern part of Area CO was wet and unsuitable for vehicle traffic. A suitable corridor of dry land was found between the interior of Area CO and eastern Area G.

Guidelines for management practices to protect existing wetlands while expanding training opportunities can be summarized as follows:

1. Many areas are permanent wetlands due to their hydrologic nature (poorly permeable soils, low topographic relief, and abundant precipitation) and could be irreparably damaged by drainage or construction.

2. Some construction activities (road building, artificial drainage, land filling or grading) would obstruct the amount or duration of water flowing into wet areas; such activities should be avoided if damage to existing wetlands is to be avoided.

3. Operation of tanks and other heavy vehicles in wet areas should be discouraged if no additional wetlands are desired. Heavy vehicle traffic probably would create new wetlands in most of the training grounds. Temporary wetlands created by heavy vehicles can become transitional wetlands, then permanent wetlands.

4. To avoid irreparable loss of wetland source water, care should be taken to preserve undamaged the spring heads in Area CO.

5. Artificial drainage could be used to widen the dry corridor in Area CO between Areas J and G, but the wetlands lost would have to be mitigated according to Corps of Engineers' requirements. A wider and drier corridor than now exists would facilitate troop maneuvers.

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APPENDIX A: GEOGRAPHIC INFORMATION SYSTEM DATA BASE (METADATA)

Description of SINGLE precision coverage AERIAL

FEATURE CLASSES		ARCS	40
		POLYGONS	35 (TOPOLOGY)
		NODES	40
SECONDARY FEATURES		Arc Segments	1988
		Polygon Labels	34
TOLERANCES	Fuzzy =	0.515 V	
	Dangle =	0.000 N	

COVERAGE BOUNDARY

Xmin =	2342101.750	Xmax =	2387191.500
Ymin =	548551.688	Ymax =	572908.875

COORDINATE SYSTEM DESCRIPTION

Projection	STATEPLANE	Zone	4976
Datum	NAD83	Units	FEET
Spheroid	GRS1980		

NARRATIVE FILE - AERIAL

• Abstract: Digitized boundaries of wet areas in training areas A-H, J, and CO on Ravenna AAP, Ohio, according to photogrammetry.

• Keywords: Wetlands, aerial photography, photogrammetry

• Purpose: To draw approximate wetland-area boundaries using photogrammetric methods. This coverage was used with 3 others (SOILS, PLNTCOMM, and NWI) to target areas for field inspection of wetlands in the training areas on Ravenna AAP.

• Limitations of Data: The initial photointerpretation is limited by the resolution of source map (approximately 1:24,000-scale color-infrared aerial photographs). The coverage AERIAL was digitized against a background of high-resolution, scanned images of the same areas, but from black-and-white photography, same scale.

• Entity and Attribute Overview:
AERIAL: a flag to indicate whether a polygon represents a wet or dry area. If AERIAL > 0, the area is wet.

• Procedures Used: Color infrared photographs from the USGS NAPP program were printed at a scale of about 1:24,000. The photographs were Cleveland South images 562-77 (11/19/91), 555-21 (04/25/91), and 556-59 (05/01/91). Transparent overlay sheets were pin-registered to the 1:24,000-scale photographs. Using procedures described in the Remote Sensing Workshop, US Dept. Interior, USGS, EROS Data Center, boundaries representing potential wetlands were drawn on the transparent overlays. In the meantime, black-and-white photographs of the same area were scanned at a resolution of 10 microns and saved in a TIFF format. The black-and-white images were Cleveland South 7930-40 (4/14/94), 7934-214 (4/20/94), and 7930-82 (4/14/94). These scanned images were rectified into stateplane coordinates using ARC's Image Integrator and survey points that had been obtained for the purpose of photo rectification (8 points per photograph). Using these rectified images as background, the aerial-photo interpretations of wetlands were digitized from the transparent overlays into ARC. The linework in AERIAL representing Areas A, B, and C were digitized to correspond as closely as possible with the interpretations on the transparent overlays. The linework on the rest of the AAP is a composite of interpretations from 556-59 and 562-77, which overlap somewhat and were photointerpreted independently.

• Related Spatial and Tabular Data Sets: The user should see three rectified, scanned TIFF files called abc.tif, defgcoj.tif, and areah2.tif.

• Currentness Reference: Aerial photographs were shot at the dates mentioned above.

• Maintenance and Update Frequency: Could require revision based on new aerial photographs, especially if new photographs are shot at a better scale.

• Data Set Credit: Funded by Ohio Army National Guard.

• Cloud Cover: Nil, in the aerial photographs referred to.

Description of SINGLE precision coverage AREAAHJ

FEATURE CLASSES	ARCS	22
	POLYGONS	11 (TOPOLOGY)
	NODES	14
SECONDARY FEATURES	Tics	4
	Arc Segments	133
	Polygon Labels	10
TOLERANCES	Fuzzy =	1.393 V
	Dangle =	0.000 N

COVERAGE BOUNDARY

Xmin =	2340866.750	Xmax =	2387822.750
Ymin =	548038.750	Ymax =	572901.000

COORDINATE SYSTEM DESCRIPTION

Projection	STATEPLANE	Zone	4976
Datum	NAD83	Units	FEET
Spheroid	GRS1980		

NARRATIVE FILE - AREAAHJ

• Abstract: These data represent administrative areas A-H and J on Ravenna AAP, Portage County, Ohio. Areas A-H and J are operated by Ohio Army National Guard (OHARNG) as of 10/1/96, whereas the rest of the AAP (see BOUND) is operated by US Army National Guard.

• Keywords: administrative area

• Purpose: Show the boundaries of areas operated by OHARNG. These areas will be used to clip other coverages to the specific limits needed by OHARNG.

• Limitations of Data: Scale 1:24000. Valid as of 10/1/96.

• Entity and Attribute Overview:
NAME describes the administrative area. The polygon called 'CO' is proposed for use by OHARNG.

• Procedures Used: Roads and other features were used to draw these boundaries. The boundary of Area H is most likely to be erroneous, but should be close, based on what we have seen on OHARNG maps.

• Revisions: 1. Before USGS review. Lines were changed a little bit after a meeting with OHARNG, where we discovered boundaries weren't inclusive enough. Were drawn to line up well with the boundary in the BOUND coverage, which was digitized from the Ravenna, Windham, and Newton Falls quadrangles.

• Reviews Applied to Data: 1. USGS, Columbus, Ohio in-house. Date: 12/5/96. Ralph Haefner. No problems.

• Related Spatial and Tabular Data Sets: BOUND describes the entire Ravenna AAP boundary.

• Maintenance and Update Frequency: None expected.

• Access Constraints: None.

• Data Set Credit: Ohio Army National Guard.

• Completeness Report: No omissions known.

• Horizontal Positional Accuracy Report: Should be satisfactory, but is not quantified.

• Cloud Cover: NA.

Description of SINGLE precision coverage BASELINE

FEATURE CLASSES		POINTS	213 (TOPOLOGY)
SECONDARY FEATURES		Tics	4
TOLERANCES		Fuzzy =	6.295 N
		Dangle =	0.000 N
COVERAGE BOUNDARY			
Xmin =	2322335.000	Xmax =	2385288.500
Ymin =	548325.563	Ymax =	577322.250
COORDINATE SYSTEM DESCRIPTION			
Projection	STATEPLANE	Zone	4976
Datum	NAD83	Units	FEET
Spheroid	GRS1980		

NARRATIVE FILE - BASELINE

• Abstract: A third-order survey of sixteen control points was conducted on Ravenna AAP, Ohio, in order to rectify scanned aerial photographs. This coverage, BASELINE, is of the points that were used during the survey to establish the coordinates for the control points.

• Keywords: Surveying, control points

• Purpose: These points were used to establish coordinates of control points that were used to rectify scanned aerial photographs. This coverage is included in the Ravenna project archives because it could be of some use to OHARNG should the need for surveying arise again.

• Limitations of Data: Coordinates were determined to the nearest 1 ft by a third order survey. Reported in stateplane feet.

• Entity and Attribute Overview:

• Procedures Used: Seventeen control points, mostly consisting of building corners that were easily visible on the aerial photographs, were identified and sixteen were surveyed. These sixteen control points proved sufficient to rectify the images. The surveys were run to third order accuracy in the horizontal control (within 1 ft per mile of surveyed line) with a Leitz Total Station Set 3B. The benchmarks used are listed in Appendix B of the wetlands report by USGS to OHARNG and are in the SPD OH N stateplane-coordinate system. The horizontal datum used for all points was NAD83. The vertical control was not necessary to rectify the images and is not reported. The data from the Total Station were collected with a SDR33 data collector. The data were then downloaded from the SDR33 to a personal computer, checked for errors and converted into an ASCII file. The ASCII file was used to create a GIS data layer (data layer name: BASELINE) to check the rectification of the images.

• Revisions: None.

• Reviews Applied to Data: 1. Created by R.A. Darner, USGS. Checked by C.W. Schalk, USGS, December 1996. No problems.

• Related Spatial and Tabular Data Sets: No data sets by direct relate. Three TIFF images (ABC.TIF, AREAH.TIF, and DEFGHCOJ.TIF) were rectified using the data supplied by the survey recorded in this coverage.

• References Cited:

• Notes:

• Currentness Reference:

• Maintenance and Update Frequency: None.

• Access Constraints: None.

• Data Set Credit: Ohio Army National Guard.

• Completeness Report: All information necessary to provide control points for rectification of the aerial photographs.

• Horizontal Positional Accuracy Report: See Procedures Used.

• Vertical Positional Accuracy Report: See Procedures Used.

• Cloud Cover:

Description of DOUBLE precision coverage BOUND

FEATURE CLASSES	ARCS	2
	POLYGONS	3 (TOPOLOGY)
	NODES	2
SECONDARY FEATURES	Tics	868
	Arc Segments	255
	Polygon Labels	2
TOLERANCES	Fuzzy =	132.710 V
	Dangle =	0.000 N

COVERAGE BOUNDARY

Xmin =	2328260.789	Xmax =	2387831.824
Ymin =	548029.884	Ymax =	573288.352

COORDINATE SYSTEM DESCRIPTION

Projection	STATEPLANE	Zone	4976
Datum	NAD83	Units	FEET
Spheroid	GRS1980		

NARRATIVE FILE - BOUND

- Abstract: AAP boundary, Ravenna AAP.
- Keywords: boundary
- Purpose: Visual purposes, perhaps some clipping of other coverages.
- Limitations of Data: Digitized at 1:24000 scale.
- Entity and Attribute Overview: None.
- Procedures Used: Digitized from 1:24000 quadrangles: Ravenna, Windham, Newton Falls. RMS errors not recorded.
- Revisions: 1. Before USGS review.
- Reviews Applied to Data: 1. USGS. Columbus, Ohio, in-house. Date: 12/5/96. Ralph Haefner. No problems.
- Related Spatial and Tabular Data Sets: AREAAHJ delineates boundaries of some of the administrative areas.
- Maintenance and Update Frequency: None expected.
- Access Constraints: None.
- Data Set Credit: Ohio Army National Guard.
- Completeness Report: No omissions known.
- Horizontal Positional Accuracy Report: Should be satisfactory, but is not quantified.
- Vertical Positional Accuracy Report: NA.
- Cloud Cover: NA.

Description of SINGLE precision coverage COUNTY

FEATURE CLASSES		ARCS	10
		POLYGONS	3 (TOPOLOGY)
		NODES	9
SECONDARY FEATURES		Tics	4
		Arc Segments	11
		Polygon Labels	2
TOLERANCES		Fuzzy =	238.091 V
		Dangle=	331697.313 N

COVERAGE BOUNDARY

Xmin =	2276815.250	Xmax =	2513088.000
Ymin =	482003.969	Ymax =	672282.500

COORDINATE SYSTEM DESCRIPTION

Projection	STATEPLANE	Zone	4976
Datum	NAD83	Units	FEET
Spheroid	GRS1980		

NARRATIVE FILE - COUNTY

- Abstract: County boundaries. Portage and Trumbull Counties, Ohio
- Keywords: Counties
- Purpose: Illustrative purposes
- Limitations of Data: Scale unknown, but possibly 1:100,000 or 1:250,000
- Entity and Attribute Overview: FIPS codes are a numbering system based on the state's alphabetical position among all states and the counties' alphabetical position among all counties in that state. NAME is the name of the county.
- Procedures Used: This coverage was broken out from a coverage of all Ohio counties. Source map scale and resolution are unknown, as are creation procedures.
- Reviews Applied to Data: USGS, Columbus, Ohio, in-house. December 5, 1996. Ralph Haefner. No problems.
- Maintenance and Update Frequency: None planned.
- Access Constraints: None.
- Data Set Credit: Ohio Army National Guard.
- Completeness Report:
- Horizontal Positional Accuracy Report:
- Vertical Positional Accuracy Report:
- Cloud Cover:

Description of SINGLE precision coverage DRAINAGE

FEATURE CLASSES	ARCS	392 (TOPOLOGY)
	POLYGONS	77 (TOPOLOGY)
	NODES	382
	ANNOTATIONS	0
SECONDARY FEATURES	Tics	50
	Arc Segments	8471
	Polygon Labels	76
TOLERANCES	Fuzzy =	10.732 V
	Dangle =	32.807 N

COVERAGE BOUNDARY

Xmin =	2313111.500	Xmax =	2417342.250
Ymin =	530954.875	Ymax =	582729.125

COORDINATE SYSTEM DESCRIPTION

Projection	STATEPLANE	Zone	4976
Datum	NAD83	Units	FEET
Spheroid	GRS1980		

NARRATIVE FILE - DRAINAGE

• Abstract: This coverage was modified from USEPA's RF3 coverage of HU05030103, which was ftp'ed to the USGS by Louie Holman, USEPA. Modifications are described below. Scale of the original coverage (HU05030103) is not known.

• Keywords: drainage, surface water, hydrologic unit

• Purpose: This coverage is part of the base group of coverages to be given to Ohio Army National Guard for their wetlands work on Ravenna AAP. It is used mostly for illustrative purposes.

• Limitations of Data: The original scale of the coverage is unknown.

• Entity and Attribute Overview: NAME (AAT) - name of the stream represented by the line.
NAME (PAT) - name of the lake, pond, or reservoir.
TYPE (PAT) - indicator of island (ISL), lake (LAK)

• Procedures Used: The coverage HU05030103 was ftp'ed to the Ohio WRD district office. The only changes to this coverage were: Addition of some linework (1:24000 scale) to include streams that were shown on USGS topographic quadrangles (Ravenna, Windham, and Newton Falls) and were not included in the coverage from USEPA. Woodland areas (see WOODLAND coverage) overlapped many of the lines that form the boundary of the Kirwan Reservoir. Since the woodland boundaries had been digitized at 1:24000, it was assumed that they were correct and the HU05030103 lines were off. Consequently, many of the lines forming the Kirwan Reservoir boundary were moved slightly so that the woodland areas do not appear to be under water.

• Revisions: 1. Before USGS in-house review.

• Reviews Applied to Data: 1. USGS, Columbus, Ohio, in-house. Date: 12/5/96. Reviewer: Ralph Haefner. Comments: Use of RF3 file might be inadequate, as some detail is lacking. Will be left as is for now, with hopes a replacement can be digitized in the future.

• Related Spatial and Tabular Data Sets: HU05030103, a USEPA RF3 file.

• Maintenance and Update Frequency: Probably will be replaced once with 1:24,000-scale digitized drainage coverage.

• Access Constraints: None.

• Data Set Credit: Ohio Army National Guard.

• Horizontal Positional Accuracy Report: Variable, perhaps, due to 1:24000-scale of revisions (see above) and unknown scale of original (HU05030103).

Description of SINGLE precision coverage FLDFOTOS

FEATURE CLASSES		POINTS	91 (TOPOLOGY)
SECONDARY FEATURES		Tics	4
TOLERANCES		Fuzzy =	4.616 N
		Dangle =	0.000 N

COVERAGE BOUNDARY

Xmin =	2341401.750	Xmax =	2387562.250
Ymin =	548220.750	Ymax =	571488.063

COORDINATE SYSTEM DESCRIPTION

Projection	STATEPLANE	Zone	4976
Datum	NAD83	Units	FEET
Spheroid	GRS1980		

NARRATIVE FILE - FLDFOTOS

• Abstract: This coverage, FLDFOTOS, is a point coverage of locations where photographs were snapped as part of a field exercise to identify potential wetlands in training areas on Ravenna AAP, Ohio.

• Keywords: Photographs, field reconnaissance

• Purpose: Reference and orientation. The photographs will be delivered to Ohio Army National Guard at the conclusion of the project, and this coverage will pinpoint locations at which the photographs were taken.

• Limitations of Data: Some of the locations are approximate. See attribute discussion for 'DESCRIP.'

• Entity and Attribute Overview:

SHOTNUM - Number of photograph shot. Sequential, from 1-91.
LAT - Latitude, according to PLGR GPS, in DMS.s.
LONG - Longitude, according to PLGR GPS, in DMS.s.
ORIENTATION - Compass direction faced when photo was snapped.
DESCRIP - Description of what is seen in the photo.

• Procedures Used: The field crew recorded the location, orientation, and description of each photo they snapped while in the field. These data were transcribed into digital files in the office. Locations were converted from geographic coordinates to stateplane coordinates like this:

Arc: project file fieldfotos fieldfotos.sp
Project: input
Project: projection geographic
Project: units dms
Project: datum nad83
Project: parameters
Project: output
Project: projection stateplane
Project: units feet
Project: datum nad83
Project: zone 4976
Project: parameters

The resultant stateplane coordinates were GENERATEd into a point coverage. Attribute items were copied into a previously DEFINEd INFO table and were added to the coverage by JOINITEM.

• Reviews Applied to Data: USGS, Columbus, Ohio, in-house. Reviewer: Rob Darner.

• Notes: Areas A-H were covered, but the camera died before Area J and CO had been covered.

• Currentness Reference: The field exercise was Nov 18-22 and Dec 2-6, 1996, and March 26-27, 1997.

• Maintenance and Update Frequency: None expected.

• Access Constraints: None.

• Data Set Credit: Ohio Army National Guard.

• Horizontal Positional Accuracy Report: See LAT and LONG items above.

Description of SINGLE precision coverage FLDOBS

FEATURE CLASSES		ARCS	43
		POLYGONS	40 (TOPOLOGY)
		NODES	41
SECONDARY FEATURES		Tics	4
		Arc Segments	1131
		Polygon Labels	39
TOLERANCES		Fuzzy =	0.476 V
		Dangle =	0.000 V

COVERAGE BOUNDARY

Xmin =	2341063.250	Xmax =	2387688.750
Ymin =	548221.500	Ymax =	571469.500

COORDINATE SYSTEM DESCRIPTION

Projection	STATEPLANE	Zone	4976
Datum	NAD83	Units	FEET
Spheroid	GRS1980		

NARRATIVE FILE - FLDOBS

• Abstract: This coverage, FLDOBS, represents wet areas in training areas on Ravenna AAP according to field inspection Nov 18-22 and Dec 2-6, 1996, and March 26-27, 1997.

• Keywords: Wetlands

• Purpose: OHARNG required a GIS analysis and a field inspection of wetlands in their training grounds. This coverage satisfies the requirement for spatial presentation of potential wetlands.

• Limitations of Data: The dates of inspection were Nov 18-22 and Dec 2-6, 1996, and March 26-27, 1997. These weeks are outside the growing season and the previous two years were exceptionally wet, so in all likelihood, during the growing season of a year of normal precipitation, the wet areas would not be as numerous or extensive.

• Entity and Attribute Overview: SYMBOL - 1 = wet area, 0 = dry area.

• Procedures Used: The GIS composite analysis was used to identify target areas for a visual inspection of potential wetlands in the training areas. The field team inspected Areas B, C, E, and F during the week of November 18-22, 1996, and Areas D, G, H, J, and CO during the week of December 2-6, 1996. Only parts of Area CO were inspected, as the field team's task was to find a dry corridor through Area CO for troop exercises, if such a dry corridor existed. Area A was inspected March 26-27, 1997. Any land supporting a dominant community of OBL, FACW, and FAC species was mapped in rough boundary using a GPS receiver (accurate to a few meters). Wet woods with dominant stands of woody species adapted for growing in saturated soils were mapped as well. The team completed the reconnaissance by walking the boundary of each wetland and recording latitude and longitude coordinates (by use of a GPS receiver) where wetland plant species formed marked boundaries between wetland and dryland forms. For the purposes of this study, only gross wetland boundaries were identified and recorded. The boundary coordinates were typed into a spreadsheet, exported to ASCII, projected from geographic to stateplane coordinates, manipulated into a format amenable to GENERATE arcs, GENERATED, and compiled into a single coverage.

• Revisions: None.

• Reviews Applied to Data: 1. USGS, Columbus, Ohio, in-house review. Reviewer: C.W. Schalk, December 1996. Comments: No problems. Polygons matched areas inspected in the field, according to field notes.

• Currentness Reference: Field inspection Nov 18-22 and Dec 2-6, 1996, and March 26-27, 1997.

• Maintenance and Update Frequency: None planned.

• Access Constraints: None.

• Data Set Credit: Ohio Army National Guard.

• Completeness Report: All training areas were inspected. Parts of "unofficial" area CO were inspected to try to find a dry corridor between Areas F, G, and J.

• Horizontal Positional Accuracy Report: PLGR GPS unit good to a few meters.

• Vertical Positional Accuracy Report:

• Cloud Cover:

Description of DOUBLE precision coverage MUNICIP

FEATURE CLASSES	ARCS	3
	POLYGONS	4 (TOPOLOGY)
	NODES	3
SECONDARY FEATURES	Tics	868
	Arc Segments	110
	Polygon Labels	3
TOLERANCES	Fuzzy =	132.710 V
	Dangle =	0.000 N

COVERAGE BOUNDARY

Xmin =	2312422.411	Xmax =	2394532.811
Ymin =	541300.828	Ymax =	579529.772

COORDINATE SYSTEM DESCRIPTION

Projection	STATEPLANE	Zone	4976
Datum	NAD83	Units	FEET
Spheroid	GRS1980		

NARRATIVE FILE - MUNICIP

• Abstract: City boundaries as depicted on the 3 quads that span the Ravenna AAP (Ravenna, Windham, and Newton Falls, OH).

• Keywords: municipality

• Purpose: Illustrative purposes only.

• Limitations of Data: Scale 1:24000. Albers meters projection.

• Entity and Attribute Overview: NAME - name of city.

• Procedures Used: Digitized from the quads mentioned above. Digitizing precision not recorded.

• Revisions: 1. Before USGS, Columbus, Ohio, in-house review.

• Reviews Applied to Data: 1. USGS in-house review. Date: 12/5/96. Reviewer: Ralph Haefner. No problems.

• Related Spatial and Tabular Data Sets:

• References Cited:

• Notes:

• Currentness Reference:

• Maintenance and Update Frequency: Not expected.

• Access Constraints: None.

• Data Set Credit: Ohio Army National Guard.

• Horizontal Positional Accuracy Report:

• Vertical Positional Accuracy Report:

• Cloud Cover:

Description of DOUBLE precision coverage NWI

FEATURE CLASSES		ARCS	152 (TOPOLOGY)
		POLYGONS	126 (TOPOLOGY)
		NODES	150
SECONDARY FEATURES		Tics	867
		Arc Segments	6084
		Polygon Labels	125
TOLERANCES		Fuzzy =	123.602 V
		Dangle =	0.000 N

COVERAGE BOUNDARY

Xmin =	2335372.342	Xmax =	2389639.564
Ymin =	543236.697	Ymax =	574487.948

COORDINATE SYSTEM DESCRIPTION

Projection	STATEPLANE	Zone	4976
Datum	NAD83	Units	FEET
Spheroid	GRS1980		

NARRATIVE FILE - NWI

• Abstract: These data were digitized from National Wetlands Inventory (NWI) maps (Ravenna, Windham, and Newton Falls, Ohio, quadrangles) for Areas A-H and J on Ravenna AAP. Polygons and line features have attributes. The data were compiled digitally for the Ohio Army National Guard.

• Keywords: wetlands, GIS

• Purpose: This and several other coverages will be used to make preliminary assessments of wetland areas in Areas A-H and J.

• Limitations of Data: The data were digitized at a scale of 1:24000.

• Entity and Attribute Overview:
SYS - Ecological system, described on the NWI maps.
SUBSYS - Ecological subsystem, described on the NWI maps.
CLASS - Class, described on the NWI maps.
SUBCLASS - Subclass, described on the NWI maps.
MODIFIER - Modifying term, described on the NWI maps.
CODE1 - Primary composite wetland code designation.
CODE2 - Secondary composite wetland code designation.

• Procedures Used: The TICS for this coverage were derived from those in OHQUADS on /mnt/coverages. RMS digitizing errors for the three quadrangles ranged from 0.001 - 0.005 inch, correlating to errors of 0.9 - 2.8 meters. Polygon labels and line features were assigned attributes.

• Revisions: 1 - before USGS review.

• Reviews Applied to Data: 1 - USGS review in Columbus, OH. Date: 12/5/96, Ralph Haefner. Comments: INFO data structure could have been made easier with REDFINED items, but left as is.

• Related Spatial and Tabular Data Sets: None.

• Notes: Units are albers meters.

• Currentness Reference: Aerial photographs and other mapping info were described as '1977' on the NWI quads.

• Maintenance and Update Frequency: Unknown.

• Access Constraints: None.

• Data Set Credit: Ohio Army National Guard.

• Completeness Report: Only those wetlands seen in Areas A-H and J and immediately surrounding areas were digitized from the NWI maps.

• Horizontal Positional Accuracy Report: Ravenna quad: RMS = 0.005, 2.787 meters. Windham quad: RMS = 0.001, 0.875 meters. Newton Falls quad: RMS = 0.003, 1.763 meters.

• Vertical Positional Accuracy Report: NA.

• Cloud Cover: NA.

Description of DOUBLE precision coverage PIPELINE

FEATURE CLASSES		ARCS	14 (TOPOLOGY)
		NODES	27
SECONDARY FEATURES		Tics	868
		Arc Segments	300
TOLERANCES		Fuzzy =	132.710 N
		Dangle =	0.000 N

COVERAGE BOUNDARY

Xmin =	1293214.722	Xmax =	2526808.551
Ymin =	-470703.829	Ymax =	856392.930

COORDINATE SYSTEM DESCRIPTION

Projection	STATEPLANE	Zone	4976
Datum	NAD83	Units	FEET
Spheroid	GRS1980		

Narrative file - PIPELINE

- Abstract: Coverage depicts pipelines as drawn on Ravenna, Windham, and Newton Falls, OH, quadrangles.
- Keywords: pipe
- Purpose: Illustrative purposes only.
- Limitations of Data: Scale 1:24000. Not intended for engineering or construction.
- Entity and Attribute Overview:
- Procedures Used: Digitized from the quads mentioned above. Digitizing errors not recorded.
- Revisions: 1. Before USGS in-house review.
- Reviews Applied to Data: 1. USGS in-house. Date: 12/5/96. Ralph Haefner. No problems, after the coverage was built as a line coverage.
- Related Spatial and Tabular Data Sets:
- References Cited:
- Notes:
- Currentness Reference:
- Maintenance and Update Frequency: None planned.
- Access Constraints: None.
- Data Set Credit: Ohio Army National Guard.
- Completeness Report:
- Horizontal Positional Accuracy Report:
- Vertical Positional Accuracy Report:
- Cloud Cover:

Description of DOUBLE precision coverage PLNTCOMM

FEATURE CLASSES	ARCS	516
	POLYGONS	177 (TOPOLOGY)
	NODES	343
SECONDARY FEATURES	Tics	840
	Arc Segments	5174
	Polygon Labels	176
TOLERANCES	Fuzzy =	123.602 V
	Dangle =	0.000 N

COVERAGE BOUNDARY

Xmin =	2340866.838	Xmax =	2387822.848
Ymin =	548038.754	Ymax =	572901.028

COORDINATE SYSTEM DESCRIPTION

Projection	STATEPLANE	Zone	4976
Datum	NAD83	Units	FEET
Spheroid	GRS1980		

NARRATIVE FILE - PLNTCOMM

• Abstract: Polygons (areas) designating dominant plant communities in the training areas on Ravenna AAP, northeastern Ohio.

• Keywords: plant species; wetlands

• Purpose: Several of the plant communities are indicative of the presence of wetlands. It was intended that this map should serve as a coverage that provides criteria for field-examination of wetland areas.

• Limitations of Data: The source map scale was about 1:23,256. It was a blue-line copy of the original field map, which is on file at the Division of Natural Areas and Preserves, ODNR, under the management of Dan Rice. The source map was of poor quality. Some of the symbols and lines were difficult to read. The base map was a photo-reduced version of a 1:12,000-scale general area map of Ravenna AAP, and had roads, railroads, buildings, and streams on it.

• Entity and Attribute Overview:
COMSYM - plant-community symbol described by Andreas (1993).
SYMBOL - Integer version of COMSYM.

• Procedures Used: Ticks were created on the source map (the ticks were arbitrary reference points). The relevant parts of the source map (training areas A-H and J) were digitized; RMS errors 0.004 and 0.003. A coverage was prepared for TRANSFORM from the ROADS coverage. Because the source map had roads on it, we could define road-intersection points on the PLNT-COMM coverage and in the coverage to which the transformation would occur. Then we TRANSFORMed the coverage and added attribute data such as COMSYM and SYMBOL.

• Revisions: 1. Before USGS in-house review.

• Reviews Applied to Data: 1. USGS, Columbus, Ohio, in-house review. Date: 12/6/1996. Reviewer: Ralph Haefner. Comment: linework good. Some polygons that are coded "0.0" are blank on the source map, whereas others are "clear cut". These were not distinguished in the coverage, because we did not want to add any additional plant-community codes to those Andreas defined.

• Related Spatial and Tabular Data Sets: PLNTCOMM.LUT - a look-up table that describes the plant communities in PLNT-COMM. The relate items are PLNTCOMM.PAT:SYMBOL and PLNTCOMM.LUT:SYM.

• References Cited: Andreas, B.K., 1993, Plant communities, In Species and Plant Communities Inventory, Ravenna Army Ammunition Plant. Report for Ravenna AAP.

• Currentness Reference: Plant communities were described in 1992.

• Maintenance and Update Frequency: None planned.

• Access Constraints: None.

• Data Set Credit: Ohio Army National Guard and Tim Morgan, Forester, Ravenna AAP.

• Completeness Report: Covers only training areas A-H, J and CO. The plant communities on the rest of the AAP were not digitized.

• Horizontal Positional Accuracy Report: Poor in places, due to the digitizing errors, source map inadequacies, photo-reducing of the original base map, and TRANSFORM errors. Satisfactory along the centerline (E-W) of the coverage.

Description of DOUBLE precision coverage RAILROAD

FEATURE CLASSES		ARCS	352 (TOPOLOGY)
		NODES	298
SECONDARY FEATURES		Tics	868
		Arc Segments	2023
TOLERANCES		Fuzzy =	132.710 N
		Dangle =	0.000 N

COVERAGE BOUNDARY

Xmin =	1293214.722	Xmax =	2526808.551
Ymin =	-470703.829	Ymax =	856392.930

COORDINATE SYSTEM DESCRIPTION

Projection	STATEPLANE	Zone	4976
Datum	NAD83	Units	FEET
Spheroid	GRS1980		

NARRATIVE FILE - RAILROAD

• Abstract: This line coverage is to provide an illustrative coverage of railroads on and around Ravenna AAP, northeastern Ohio.

• Keywords: Railroad

• Purpose: Illustrative.

• Limitations of Data: Scale 1:24000.

• Entity and Attribute Overview: OWNER lists the name of the RR company, according to the topographic quadrangles.

• Procedures Used: Digitized from Ravenna, Windham, and Newton Falls quads, Ohio. 1:24000. Digitizing RMS errors not recorded.

• Revisions: 1. Before USGS in-house review.

• Reviews Applied to Data: 1. USGS, Columbus, Ohio, in-house. Date: 12/5/96. Reviewer: Ralph Haefner. Comment: Some short arcs were missing. These were added. One pair of lines that had snapped together were separated, as they were supposed to be.

• Related Spatial and Tabular Data Sets:

• References Cited:

• Currentness Reference:

• Maintenance and Update Frequency: Should be finished.

• Access Constraints: None.

• Data Set Credit: Ohio Army National Guard.

• Completeness Report:

• Horizontal Positional Accuracy Report:

• Vertical Positional Accuracy Report:

• Cloud Cover:

Description of DOUBLE precision coverage ROADS

FEATURE CLASSES		ARCS	1206 (TOPOLOGY)
		NODES	972
SECONDARY FEATURES		Tics	867
		Arc Segments	3862
TOLERANCES		Fuzzy =	123.602 N
		Dangle =	0.000 N

COVERAGE BOUNDARY

Xmin =	1293214.722	Xmax =	2526808.551
Ymin =	-470703.829	Ymax =	765311.690

COORDINATE SYSTEM DESCRIPTION

Projection	STATEPLANE	Zone	4976
Datum	NAD83	Units	FEET
Spheroid	GRS1980		

NARRATIVE FILE - ROADS

• Abstract: Coverage of roads in three quadrangles surrounding Ravenna AAP in northeastern Ohio.

• Keywords: roads

• Purpose: Provide a base layer of information - illustration.

• Limitations of Data: Digitized at 1:24000. RMS errors associated with digitizing not recorded.

• Entity and Attribute Overview: NAME - name of road, according to quadrangles.

• Procedures Used: Digitized from Ravenna (1960, photorevised 1970, photoinspected 1977), Windham (1959, photorevised 1979), and Newton Falls (1959, photorevised 1979) quads. Digitizing RMS not recorded.

• Revisions: 1. Before USGS review.

• Reviews Applied to Data: 1. USGS, Columbus, Ohio, in-house. Date: 12/5/96. Ralph Haefner. Comments: Not all roads outside the boundary were digitized. Selection was mostly arbitrary, except all major roads were digitized. Not all roads were named, but as many as could be, were.

• Related Spatial and Tabular Data Sets: None.

• References Cited:

• Notes:

• Currentness Reference:

• Maintenance and Update Frequency: None expected.

• Access Constraints: None.

• Data Set Credit: Ohio Army National Guard.

• Completeness Report: Small roads within city limits were excluded, but every road on the AAP and the surrounding countryside was included.

• Horizontal Positional Accuracy Report: Satisfactory. No documentation for this.

• Vertical Positional Accuracy Report: NA

Description of DOUBLE precision coverage SOILS

FEATURE CLASSES	ARCS	3078
	POLYGONS	1093 (TOPOLOGY)
	NODES	2127
SECONDARY FEATURES	Tics	860
	Arc Segments	75385
	Polygon Labels	1092
TOLERANCES	Fuzzy =	123.602 V
	Dangle =	0.000 N

COVERAGE BOUNDARY

Xmin =	2328852.321	Xmax =	2393309.641
Ymin =	542029.507	Ymax =	583054.290

COORDINATE SYSTEM DESCRIPTION

Projection	STATEPLANE	Zone	4976
Datum	NAD83	Units	FEET
Spheroid =	GRS1980		

NARRATIVE FILE - SOILS

• Abstract: Coverage of SCS soil designations on Ravenna AAP, Ohio.

• Keywords: soil type, hydric

• Purpose: One of the main criteria used to define wetlands is the presence of hydric soils. All the soils polygons were digitized so that this coverage could be used in overlays with other coverages that could be used for wetland mapping.

• Limitations of Data: This was digitized at 1:15840. See digitizing caveats below.

• Entity and Attribute Overview:
SSYM - SCS soil type code.
PSYM - an arbitrary plotting symbol.
HYDRIC - flag as to whether a soil type is hydric.

• Procedures Used: Digitizing: Loose-leaf maps were digitized in inches, with the intent of transforming them to real-world coordinates later. Tics were created at 10" intervals in the y-direction and 15" intervals in the x-direction (pretty nearly the dimensions of one of the map sheets). Digitizing RMS errors ranged from 0.003 (Trumbull sheet 57) to 0.008 (Portage sheet 30) Transforming: Empty coverages were created from ROADS coverage, and tics were added at points that were equally discernible on the Ravenna/Windham/Newton Falls quads and the aerial photographs over which the soils lines are drawn. At least 4 tics were added for each SCS sheet and corresponding locations in the empty coverages. The transformation parameters are presented below: (e.g., "soil23" corresponds to Portage sheet 23)

==========

Transforming coordinates for coverage soil23
Scale (X,Y) = (403.381.403.885) Skew (degrees) = (0.017)
Rotation (degrees) = (3.091) Translation = (229866.601,4312749.036)
RMS Error (input,output) = (0.002,0.732)

Affine	X = Ax + By + C		
	Y = Dx + Ey + F		
A =	402.794	B =	-21.662
C =	229866.601	D =	21.753
E =	403.303	F =	4312749.036

tic id	input x output x	input y output y	x error	y error
36	30.867	28.463		
	241682.832	4324899.093	0.355	0.653
37	44.893	27.861		
	247345.852	4324962.837	-0.352	-0.647
38	30.448	20.772		
	241681.142	4321789.272	-0.347	-0.639
39	44.796	20.083		
	247474.759	4321822.466	0.344	0.633

==========

Transforming coordinates for coverage soil24
Scale (X,Y) = (404.381,405.464) Skew (degrees) = (-0.117)
Rotation (degrees) = (3.287) Translation = (229770.313,4312652.964)
RMS Error (input,output) = (0.021,8.473)

Affine	X = Ax + By + C Y = Dx + Ey + F		
A =	403.716	B =	-24.069
C =	229770.313	D =	23.184
E =	404.750	F =	4312652.964

tic id	input x output x	input y output y	x error	y error
44	45.208	29.336		
	247322.094	4325576.510	-6.532	-1.876
45	57.960	27.831		
	252490.600	4325258.603	9.386	2.696
46	45.346	20.673		
	247573.141	4322069.659	6.650	1.910
47	57.898	21.789		
	252629.895	4322816.966	-9.504	-2.730

==========

Transforming coordinates for coverage soil28
Scale (X,Y) = (402.341,404.032) Skew (degrees) = (-0.137)
Rotation (degrees) = (3.061) Translation = (230024.676,4312857.820)
RMS Error (input,output) = (0.010,4.158)

Affine	X = Ax + By + C Y = Dx + Ey + F		
A =	401.767	B =	-22.541
C =	230024.676	D =	21.488
E =	403.404	F =	4312857.820

tic id	input x output x	input y output y	x error	y error
20	15.769	18.187		
	235949.097	4320529.708	0.971	3.852
21	29.329	18.904		
	241382.768	4321117.870	-0.939	-3.727
22	15.480	10.445		
	236009.597	4317408.319	-1.090	-4.322
23	27.511	10.851		
	240832.078	4317822.224	1.058	4.198

==========

Transforming coordinates for coverage soil29
Scale (X,Y) = (401.417,402.158) Skew (degrees) = (0.173)
Rotation (degrees) = (3.118) Translation = (229922.236,4312882.157)
RMS Error (input,output) = (0.014,5.776)

Affine	X = Ax + By + C Y = Dx + Ey + F		
A =	400.823	B =	-20.661
C =	229922.236	D =	21.835
E =	401.628	F =	4312882.157

tic id	input x output x	input y output y	x error	y error
32	30.796	17.902		
	241892.604	4320739.641	3.361	4.846
33	44.522	19.452		
	247368.437	4321670.761	-2.825	-4.073
34	32.032	10.380		
	242550.745	4317755.869	-3.727	-5.373
35	44.395	10.488		
	247496.723	4318059.136	3.190	4.600

==========

Transforming coordinates for coverage soil30
Scale (X,Y) = (404.350,403.756) Skew (degrees) = (0.325)
Rotation (degrees) = (3.174) Translation = (229711.033,4312798.692)
RMS Error (input,output) = (0.046,18.458)

Affine	X = Ax + By + C Y = Dx + Ey + F			
A =	403.729	B =	-20.069	
C =	229711.033	D =	22.389	
E =	403.264	F =	4312798.692	

tic id	input x output x	input y output y	x error	y error
40	47.308	17.692		
	248451.453	4320972.074	4.180	20.436
41	59.431	18.316		
	253341.110	4321533.637	-3.694	-18.060
42	45.388	11.127		
	247815.953	4318320.035	-3.670	-17.943
43	59.159	10.849		
	253374.475	4318482.772	3.184	15.567

==========

Transforming coordinates for coverage soil34
Scale (X,Y) = (403.614,400.952) Skew (degrees) = (0.300)
Rotation (degrees) = (3.132) Translation = (229971.627,4313000.666)
RMS Error (input,output) = (0.023,9.428)

Affine	X = Ax + By + C Y = Dx + Ey + F			
A =	403.011	B =	-19.813	
C =	229971.627	D =	22.054	
E =	400.468	F =	4313000.666	

tic id	input x output x	input y output y	x error	y error
24	15.196	9.303		
	235917.712	4317058.917	-6.207	2.256
25	29.743	8.947		
	241770.739	4317243.416	10.462	-3.802
26	16.124	1.529		
	236432.680	4313970.942	6.735	-2.44
27	29.613	4.200		
	241833.652	4315331.795	-10.990	3.994

==========

Transforming coordinates for coverage soil35
Scale (X,Y) = (402.421,401.660) Skew (degrees) = (0.197)
Rotation (degrees) = (3.109) Translation = (229896.530,4312991.476)
RMS Error (input,output) = (0.005,1.808)

Affine	X = Ax + By + C Y = Dx + Ey + F			
A =	401.829	B =	-20.409	
C =	229896.530	D =	21.827	
E =	401.144	F =	4312991.476	

tic id	input x output x	input y output y	x error	y error
28	30.929	9.201		
	242137.510	4317356.013	-0.554	1.309
29	44.123	8.919		
	247443.409	4317534.129	0.810	-1.913
30	31.055	0.213		
	242370.572	4313756.248	0.576	-1.361
31	43.858	2.702		
	247465.727	4315030.629	-0.832	1.965

==========

Transforming coordinates for coverage tsoil1n
Scale (X,Y) = (400.104,399.922) Skew (degrees) = (-0.192)
Rotation (degrees) = (1.547) Translation = (251149.229,4318769.210)
RMS Error (input,output) = (0.003,1.346)

Affine	X = Ax + By + C Y = Dx + Ey + F		
A =	399.958	B =	-12.136
C =	251149.229	D =	10.802
E =	399.740	F =	4318769.210

tic id	input x output x	input y output y	x error	y error
1067	3.736	16.028		
	252448.830	4325215.805	0.104	0.599
1069	10.919	13.229		
	255355.985	4324176.422	-0.188	-1.083
1068	8.067	9.952		
	254254.393	4322832.614	0.327	1.884
47	4.005	10.014		
	252629.895	4322816.966	-0.243	-1.399

==========

Transforming coordinates for coverage tsoil2s
Scale (X,Y) = (401.333,403.338) Skew (degrees) = (-0.221)
Rotation (degrees) = (1.871) Translation = (251140.166,4318864.620)
RMS Error (input,output) = (0.016,6.454)

Affine	X = Ax + By + C Y = Dx + Ey + F		
A =	401.119	B =	-14.719
C =	251140.166	D =	13.102
E =	403.073	F =	4318864.620

tic id	input x output x	input y output y	x error	y error
47	4.069	9.687		
	252629.895	4322816.966	-0.351	5.505
1071	11.540	7.480		
	255661.000	4322034.984	-2.125	-4.367
41	5.725	6.413		
	253341.110	4321533.637	1.108	-8.935
1070	2.059	5.716		
	251881.483	4321194.901	0.362	0.529
1072	9.509	3.788		
	254895.103	4320506.588	3.405	9.578
1073	5.632	1.158		
	253384.808	4319407.523	-2.399	-2.311

==========

The transformation of soil30 did not line up well with the others, but that was not surprising, since it had such a large RMS error. To get good line-matching at the boundaries, all of nsoil30 was moved up (north) 30 meters from where it had been transformed. Cleaning up: Most of the line matches were satisfactory, and the edges were cleaned up using splitting of arcs and moving of nodes in ArcEdit. There were no glaring, hugely mismatched lines. Attributing: Once all the linework looked good, the coverage was: BUILD SOILS POLYGON; CREATELABELS SOILS. Attribute fields were added, and polygons were tagged with S^YM.

- Revisions 1. Before USGS review.

- Reviews Applied to Data: 1. USGS, Columbus, Ohio, in-house. Date: 12/5/96, Ralph Haefner. Comments: Attribute coding is laborious. True, but did not change.

- Related Spatial and Tabular Data Sets: None. Those that were used to create this coverage were deleted.

- Notes: Resultant coverage SOILS in albers meters.

- Maintenance and Update Frequency: None expected.

- Access Constraints: None.

- Data Set Credit: Ohio Army National Guard.

- Completeness Report: Missing the far western part of the AAP.

- Horizontal Positional Accuracy Report: See the transformation and digitizing errors described above.

Description of DOUBLE precision coverage TOPO10FT

FEATURE CLASSES		ARCS	295 (TOPOLOGY)
		NODES	465
SECONDARY FEATURES		Tics	867
		Arc Segments	31322
TOLERANCES		Fuzzy =	5.207 N
		Dangle =	0.000 N

COVERAGE BOUNDARY

Xmin =	2340714.483	Xmax =	2392788.827
Ymin =	547966.780	Ymax =	575446.732

COORDINATE SYSTEM DESCRIPTION

Projection	STATEPLANE	Zone	4976
Datum	NAD83	Units	FEET
Spheroid	GRS1980		

NARRATIVE FILE - TOPO10FT

- Abstract: Land-surface altitudes in training areas on Ravenna AAP, Ohio. 10-ft contour interval.
- Keywords: Topographic map, altitude
- Purpose: Data available in digital form for OHARNG's use. This is a useful coverage for construction purposes
- Limitations of Data: Digitized at 1:24,000.
- Entity and Attribute Overview: ALT - land-surface altitude, in feet above sea level.
- Procedures Used: Parts of three quadrangles were digitized. Digitizing RMS was no greater than 0.003 (1.53). The quads were Ravenna (1960, photoinspected 1977), Windham (1959, photorevised 1979), and Newton Falls (1959, photorevised 1979). Contour lines were digitized for the areas centered on the training areas.
- Reviews Applied to Data: 1. USGS, Columbus, Ohio, In-house.
- Currentness Reference:
- Maintenance and Update Frequency: Expected to expand to cover all of Ravenna AAP.
- Access Constraints: None.
- Data Set Credit: Ohio Army National Guard.
- Completeness Report: Does not cover entire AAP, but only those areas used by OHARNG for training.
- Horizontal Positional Accuracy Report:
- Vertical Positional Accuracy Report:
- Cloud Cover:

Description of DOUBLE precision coverage TOWNSHIP

FEATURE CLASSES	ARCS	37
	POLYGONS	16 (TOPOLOGY)
	NODES	23
SECONDARY FEATURES	Tics	868
	Arc Segments	219
	Polygon Labels	15
TOLERANCES	Fuzzy =	132.710 V
	Dangle =	0.000 N

COVERAGE BOUNDARY

Xmin =	2311742.520	Xmax =	2417034.995
Ymin =	532101.806	Ymax =	582555.915

COORDINATE SYSTEM DESCRIPTION

Projection	STATEPLANE	Zone	4976
Datum	NAD83	Units	FEET
Spheroid	GRS1980		

NARRATIVE FILE - TOWNSHIP

• Abstract: Township boundaries in the vicinity of Ravenna AAP, northeastern Ohio

• Keywords: township

• Purpose: Illustration.

• Limitations of Data: Scale 1:24,000.

• Entity and Attribute Overview: NAME - name of township.

• Procedures Used: Digitized from Ravenna, Windham, and Newton Falls quads. Digitizing RMS not recorded.

• Revisions: 1. Before USGS in-house review.

• Reviews Applied to Data: 1. USGS, Columbus, Ohio, in-house. Date: 12/6/96. Reviewer: Ralph Haefner. Comment: close off all polygons and add NAME. Did so.

• Related Spatial and Tabular Data Sets:

• References Cited:

• Notes:

• Currentness Reference:

• Maintenance and Update Frequency: None.

• Access Constraints: None.

• Data Set Credit: Ohio Army National Guard.

• Completeness Report:

• Horizontal Positional Accuracy Report:

• Vertical Positional Accuracy Report:

Description of DOUBLE precision coverage WETSPOT

FEATURE CLASSES		POINTS	1649 (TOPOLOGY)
SECONDARY FEATURES		Tics	868
TOLERANCES		Fuzzy =	132.710 N
		Dangle =	0.000 N
COVERAGE BOUNDARY			
Xmin =	1293214.722	Xmax =	2526808.551
Ymin =	-470703.829	Ymax =	856392.930
COORDINATE SYSTEM DESCRIPTION			
Projection	STATEPLANE	Zone	4976
Datum	NAD83	Units	FEET
Spheroid	GRS1980		

NARRATIVE FILE - WETSPOT

• Abstract: This point coverage depicts the location of wetland areas according to the "swamp" symbols printed on USGS topographic quadrangles. The quads covered include Ravenna, Windham, and Newton Falls, OH. One point was generated for each full or partial swamp symbol on the topographic quadrangles.

• Keywords: wetlands

• Purpose: This coverage can be used in conjunction with others (SOILS, for example) to indicate locations of suspected wetland areas.

• Limitations of Data: Scale 1:24000. The density of these points may appear greater than that of the swamp markers on the quads because a point was generated for each partial AND complete swamp symbol printed on the quads.

• Entity and Attribute Overview:

• Procedures Used: A point was digitized for every full and partial swamp symbol shown on the 3 topo quads. (The swamp symbol is symbol #123 in usgs.mrk.)

• Revisions: 1. Before USGS review.

• Reviews Applied to Data: 1. USGS, Columbus, Ohio, in-house review. Date: 12/5/96. Reviewer: Ralph Haefner. Comment: A few missing points were added. Built as a point coverage.

• Related Spatial and Tabular Data Sets:

• References Cited:

• Notes:

• Currentness Reference:

• Maintenance and Update Frequency: None expected.

• Access Constraints: None.

• Data Set Credit: Ohio Army National Guard.

• Completeness Report:

• Horizontal Positional Accuracy Report:

• Vertical Positional Accuracy Report:

Description of DOUBLE precision coverage WOODLAND

FEATURE CLASSES	ARCS	455
	POLYGONS	446 (TOPOLOGY)
	NODES	455
SECONDARY FEATURES	Tics	868
	Arc Segments	14968
	Polygon Labels	445
TOLERANCES	Fuzzy =	132.710 V
	Dangle =	0.000 N

COVERAGE BOUNDARY

Xmin =	2312670.617	Xmax =	2389156.450
Ymin =	533797.235	Ymax =	574744.751

COORDINATE SYSTEM DESCRIPTION

Projection	STATEPLANE	Zone	4976
Datum	NAD83	Units	FEET
Spheroid	GRS1980		

NARRATIVE FILE - WOODLAND

• Abstract: Polygon coverage of wooded areas on Ravenna AAP. The wooded areas were digitized from Ravenna, Windham, and Newton Falls Ohio quads, and the extent includes only the AAP grounds.

• Keywords: Woodland

• Purpose: Illustrative mostly. Can be used as land-use information.

• Limitations of Data: Scale 1:24000. May be affected by further revisions to the topographic quadrangles. Dates of the quads used in this effort were: Ravenna - 1960, photoinspected 1977; Windham - 1959, photorevised 1979; Newton Falls - 1959, photorevised 1979.

• Procedures Used: Digitized from USGS topo quads. Digitizing RMS errors not recorded.

• Revisions: 1. Before USGS in-house review.

• Reviews Applied to Data: 1. USGS, Columbus, Ohio, in-house review. Date: 12/5/96. Reviewer: Ralph Haefner. Comments: Areas described as "orchards" were not included in the digitizing. Some minor linework errors were corrected.

• Related Spatial and Tabular Data Sets:

• References Cited:

• Notes:

• Currentness Reference:

• Maintenance and Update Frequency: None expected. Could be updated from photogrammetric methods (scanned, rectified aerial photographs of 1994 conditions will be available autumn 1996).

• Access Constraints: None.

• Data Set Credit: Ohio Army National Guard.

• Completeness Report: Digitized only for the areas on Ravenna AAP.

APPENDIX B: BENCHMARKS AND CONTROL POINTS USED IN THE THIRD-ORDER SURVEY

Listed below are the benchmarks that were used for the surveying at the Ravenna AAP. All horizontal controls are in NAD83 and all vertical controls are in NGVD29.

1. DESIGNATION - 73 037 1 P CO

POSITION - 41 10 01.17594(N) 081 11 20.63275(W) ADJUSTED
83 minus 27 - +00.20333 -00.63896 ADJUSTED

HEIGHT - 341.6 (meters) 1121. (feet) VERT ANG
88 minus 29 - -0.2 VERTCON

	North	East	Scale	Converg.
SPC OH N -	167,432.271	710,006.267	0.99994064	+0 51 40.4 MT

STATION DESCRIPTION

DESCRIBED BY PORTAGE COUNTY OHIO 1977 (GLW) THE STATION IS ABOUT 5-1/2 MILES SOUTHWEST OF FREEDOM, 3 MILES NORTHEAST OF RAVENNA, 2-1/4 MILES WEST OF CHARLESTOWN AND ON RIGHT-OF-WAY OF GARRETT ROAD, TOWNSHIP HIGHWAY 172.

TO REACH THE STATION FROM THE INTERSECTION OF STATE ROUTES 59, 14, AND COUNTY HIGHWAY 177, NEWTON FALLS ROAD, JUST EAST OF RAVENNA, GO EAST NORTHEAST ON NEWTON FALLS ROAD FOR 1.65 MILES TO THE INTERSECTION OF GARRETT ROAD. TURN LEFT AND GO NORTH ON GARRETT ROAD FOR 0.25 MILE TO THE STATION ON THE LEFT. CONTINUE NORTH ON GARRETT ROAD FOR 0.2 MILE TO AZIMUTH MARK 73 037 2 P CO ON THE RIGHT.

STATION MARKS, STAMPED---73-037-1 1977---, ARE PORTAGE COUNTY BRASS DISKS. THE SURFACE DISK IS SET IN THE TOP OF A 12-INCH CYLINDRICAL CONCRETE POST THAT IS FLUSH WITH THE GROUND SURFACE. IT IS 100.8 FEET WEST OF A CYCLONE FENCE CORNER OF THE RAVENNA ARMY AMMUNITION PLANT, 86.7 FEET NORTH OF TELEPHONE AND POWER POLE NUMBER 82/8, 74.7 FEET SOUTH OF TELEPHONE AND POWER POLE NUMBER 82320, AND 25.0 FEET WEST OF THE CENTER OF GARRETT ROAD. THE UNDERGROUND DISK IS SET IN AN IRREGULAR MASS OF CONCRETE ABOUT 42 INCHES BELOW THE GROUND SURFACE.

2. DESIGNATION - 73 037 2 P CO

POSITION - 41 10 10.71874(N) 081 11 20.63283(W) ADJUSTED
83 minus 27 - +00.20323 -00.63900 ADJUSTED

HEIGHT - 346. (meters) 1135. (feet) VERT ANG
88 minus 29 - -0. VERTCON

	North	East	Scale	Converg.
SPC OH N -	167,726.608	710,001.840	0.99994072	+0 51 40.4 MT

STATION DESCRIPTION

DESCRIBED BY PORTAGE COUNTY OHIO 1977 (GLW) THE STATION IS ABOUT 5-1/4 MILES SOUTH-SOUTHWEST OF FREEDOM, 3 MILES EAST-NORTHEAST OF RAVENNA, 1-1/4 MILES WEST-NORTHWEST OF AUGERBURG, AND ON THE RIGHT-OF-WAY OF GARRETT ROAD, TOWNSHIP HIGHWAY 172.

TO REACH THE STATION FROM THE INTERSECTION OF STATE ROUTES 59, 14, AND COUNTY HIGHWAY 177, NEWTON FALLS ROAD, JUST EAST OF RAVENNA, GO EAST ON NEWTON FALLS ROAD FOR 1.65 MILES TO THE T-INTERSECTION OF GARRETT ROAD. TURN LEFT AND

GO NORTH ON GARRETT ROAD FOR 0.45 MILE TO THE STATION ON THE LEFT.

STATION MARK, STAMPED---73-037-2 1977---, IS A PORTAGE COUNTY BRASS DISK SET IN THE TOP OF A 12-INCH CYLINDRICAL CONCRETE POST SET FLUSH WITH THE GROUND SURFACE. IT IS 112.2 FEET NORTH OF TELEPHONE AND POWER POLE NUMBER 82324, 48.2 FEET SOUTH OF TELEPHONE AND POWER POLE NUMBER 77414, AND 28.4 FEET WEST OF GARRETT ROAD.

3. DESIGNATION - KAREN

POSITION -	41 10 02.10997(N)	081 10 26.86148(W)	ADJUSTED
83 minus 27 -	+00.20328	-00.64063	ADJUSTED
HEIGHT -	362.7 (meters)	1190. (feet)	VERT ANG
88 minus 29 -	-0.2		VERTCON

	North	East	Scale	Converg.
SPC OH N -	167,480.027	711,259.116	0.99994064	+0 52 15.7 MT

STATION DESCRIPTION

DESCRIBED BY NATIONAL GEODETIC SURVEY 1977 (JRS) THE STATION IS ABOUT 3-1/2 MILES EAST-NORTHEAST OF RAVENNA, NEAR THE SOUTH BOUNDARY OF THE RAVENNA ARMY AMMUNITION PLANT AND ABOUT 3/4 MILE EAST OF THE SOUTHEAST CORNER OF THE BASE. PERMISSION FOR THE STATION GRANTED BY MR. ROBERT D. EMERSON, COMMANDERS REPRESENTATIVE, RAVENNA ARMY AMMUNITION PLANT, RAVENNA, OHIO 44266.

TO REACH THE STATION FROM THE JUNCTION OF STATE HIGHWAYS 225 AND 5 ABOUT 5 MILES NORTH OF THE SMALL VILLAGE OF PALMYRA, GO WEST ON STATE HIGHWAY 5 FOR 1.85 MILES TO THE ENTRANCE TO THE ARMY AMMUNITION PLANT. TURN RIGHT AND GO NORTH FOR 0.1 MILE TO THE MAIN GATE TO THE PLANT. PASS THROUGH GATE AND CONTINUE NORTH ON GEORGE ROAD FOR 1.5 MILES TO THE JUNCTION WITH NEWTON FALLS ROAD. TURN LEFT AND GO WEST ON NEWTON FALLS ROAD FOR 3.0 MILES TO THE JUNCTION WITH ROUTE 80. TURN LEFT AND GO SOUTH ON ROUTE 80 FOR 1.7 MILES TO GATE F4 AND A GRAVELED SIDE ROAD RIGHT. TURN RIGHT AND GO WEST ON THE GRAVELED ROAD FOR 1.15 MILES TO THE AZIMUTH MARK ON THE LEFT. CONTINUE WEST ON THE GRAVELED ROAD FOR 0.15 MILE TO THE STATION ON THE RIGHT.

STATION MARKS, STAMPED---KAREN 1977---, ARE STANDARD DISKS. THE SURFACE DISK IS SET IN THE TOP OF A 12-INCH ROUND CONCRETE MONUMENT THAT IS FLUSH WITH THE GROUND. IT IS 99.5 FEET NORTH OF AN EAST-WEST FENCE, 86 FEET NORTH-NORTHWEST OF A METAL WITNESS POST NEAR REFERENCE MARK 1, 40.5 FEET NORTH OF THE CENTER OF THE GRAVELED ROAD AND 5 FEET WEST-SOUTHWEST OF A METAL WITNESS POST NEAR THE STATION. THE UNDERGROUND DISK IS SET IN AN IRREGULAR MASS OF CONCRETE 42 INCHES BELOW THE GROUND SURFACE.

4. DESIGNATION - 63 016 2 P CO

POSITION -	41 10 16.98822(N)	081 04 26.69925(W)	ADJUSTED
83 minus 27 -	+00.20302	-00.65570	ADJUSTED
HEIGHT -	301.4 (meters)	989. (feet)	VERT ANG
88 minus 29 -	-0.2		VERTCON

	North	East	Scale	Converg.
SPC OH N -	168,071.362	719,646.066	0.99994077	+0 56 12.3 MT

STATION DESCRIPTION

DESCRIBED BY PORTAGE COUNTY OHIO 1977 (GLW) THE STATION IS ABOUT 5-3/4 MILES NORTHEAST OF EDINBURG, 5-1/4 MILES NORTHWEST OF PALMYRA, 1-3/4 MILES

WEST OF PARIS, AND ON THE RIGHT-OF-WAY OF STATE ROUTE 5.
TO REACH THE STATION FROM THE INTERSECTION OF STATE ROUTES 14 AND 5, JUST EAST OF RAVENNA, GO EAST ON STATE ROUTE 5 FOR 7.5 MILES TO THE INTERSECTION OF WAYLAND ROAD, COUNTY HIGHWAY 132. CONTINUE EAST ON STATE ROUTE 5 FOR 0.1 MILE TO THE STATION ON THE LEFT.

STATION MARK, STAMPED---63-016-2 1977---, IS A PORTAGE COUNTY BRASS DISK SET IN THE TOP OF A 12-INCH CYLINDRICAL CONCRETE POST THAT IS FLUSH WITH THE GROUND SURFACE. IT IS 130 FEET WEST OF A RAVINE AND CONCRETE CULVERT BOX CROSSING STATE ROUTE 5, 39.6 FEET NORTH OF THE CENTERLINE OF STATE ROUTE 5, 38.7 FEET SOUTH OF THE RAVENNA ARMY AMMUNITION PLANT FENCE, AND 28.5 FEET WEST OF A 24-INCH MAPLE TREE.

5. DESIGNATION - 63 016 1 P CO

POSITION -	41 10 00.07981(N)	081 05 07.74051(W)	ADJUSTED
83 minus 27 -	+00.20258	-00.65476	ADJUSTED

HEIGHT -	309.3 (meters)	1015. (feet)	VERT ANG
88 minus 29 -	-0.2		VERTCON

	North	East	Scale	Converg.
SPC OH N -	167,534.273	718,698.026	0.99994063	+0 55 45.4 MT

STATION DESCRIPTION

DESCRIBED BY PORTAGE COUNTY OHIO 1977 (GLW) THE STATION IS ABOUT 5-3/4 MILES NORTHEAST OF EDINBURG, 5-1/4 MILES NORTHWEST OF PALMYRA, 1-3/4 MILES WEST OF PARIS, AND ON THE RIGHT-OF-WAY OF STATE ROUTE 5.

TO REACH THE STATION FROM THE INTERSECTION OF STATE ROUTES 14 AND 5 JUST EAST OF RAVENNA, GO EAST ON STATE ROUTE 5 FOR 6.6 MILES TO THE INTERSECTION OF COUNTY HIGHWAY 177, NEWTON FALLS ROAD. CONTINUE EAST ON STATE ROUTE 5 FOR 0.5 MILE TO THE RAVENNA ARMY AMMUNITION PLANT MAIN GATE AND THE STATION ON THE RIGHT.

STATION MARKS, STAMPED---63-016-1 1977---, ARE PORTAGE COUNTY BRASS DISKS. THE SURFACE DISK IS SET IN THE TOP OF A 12-INCH CYLINDRICAL CONCRETE POST THAT IS FLUSH WITH THE GROUND SURFACE. IT IS 99.0 FEET SOUTHWEST OF THE SOUTHWEST CORNER OF A TRIANGULAR CONCRETE ISLAND IN THE MIDDLE OF THE ENTRANCE AND EXIT LANES TO THE RAVENNA AAP MAIN GATE, 89.0 FEET SOUTH OF A STREET LAMP POLE, 48.3 FEET EAST OF AN UNDERGROUND UNITED TELEPHONE CABLE WARNING SIGN, AND 44.2 FEET SOUTH OF THE CENTERLINE OF STATE ROUTE 5. THE UNDERGROUND DISK IS SET IN AN IRREGULAR MASS OF CONCRETE ABOUT 42 INCHES BELOW THE GROUND SURFACE.

6. DESIGNATION - 63 011 1 P CO

POSITION -	41 10 43.06702(N)	081 03 01.35062(W)	ADJUSTED
83 minus 27 -	+00.20313	-00.65861	ADJUSTED

HEIGHT -	300.7 (meters)	987. (feet)	VERT ANG
88 minus 29 -	-0.2		VERTCON

	North	East	Scale	Converg.
SPC OH N -	168,908.509	721,621.804	0.99994101	+0 57 08.4 MT

STATION DESCRIPTION

DESCRIBED BY PORTAGE COUNTY OHIO 1977 (GLW) THE STATION IS ABOUT 5-1/4 MILES WEST OF CHARLESTOWN, 4 MILES SOUTH OF WINDHAM, 3/4 MILE NORTH OF PARIS, AND ON RIGHT-OF-WAY OF STATE ROUTE 225.

THE STATION IS AT THE INTERSECTION OF STATE ROUTES 5 AND 225 ABOUT 1 MILE NORTH OF PARIS, IN THE SOUTHEAST CORNER OF THE INTERSECTION.

STATION MARK, STAMPED---63-011-1 1977---, IS A PORTAGE COUNTY BRASS DISK SET IN THE TOP OF A 12-INCH CYLINDRICAL CONCRETE POST THAT IS 6 INCHES BELOW THE GROUND SURFACE. IT IS 43.8 FEET EAST OF THE CENTERLINE OF STATE ROUTE 225 AND 34.5 FEET SOUTH OF THE CENTERLINE OF STATE ROUTE 5.

7. DESIGNATION - 63 012 1 P CO

POSITION -	41 10 57.92869(N)	081 02 16.21675(W)		ADJUSTED
83 minus 27 -	+00.20307	-00.66025		ADJUSTED
HEIGHT -	300.5 (meters)	986. (feet)		VERT ANG
88 minus 29 -	-0.2			VERTCON
	North	East	Scale	Converg.
SPC OH N -	169,384.448	722,665.875	0.99994115	+0 57 38.0 MT

STATION DESCRIPTION

DESCRIBED BY PORTAGE COUNTY OHIO 1977 (GLW) THE STATION IS ABOUT 3-3/4 MILES SOUTH-SOUTHEAST OF WINDHAM, 1-1/2 MILES NORTHWEST OF MC CLINTOCKSBURG, 1-1/4 MILES NORTHEAST OF PARIS, AND ON THE RIGHT-OF-WAY OF STATE ROUTE 5.

TO REACH THE STATION FROM THE INTERSECTION OF STATE ROUTES 225 AND 5 ABOUT 1 MILE NORTH OF PARIS, GO EAST ON STATE ROUTE 5 FOR 0.7 MILE TO THE STATION ON THE LEFT.

STATION MARK, STAMPED---63-012-1 1977---, IS A PORTAGE COUNTY BRASS DISK SET IN THE TOP OF A 12-INCH CYLINDRICAL CONCRETE POST THAT IS FLUSH WITH THE GROUND SURFACE. IT IS 42 FEET EAST-SOUTHEAST OF A 14-INCH MAPLE TREE, 36 FEET WEST-SOUTHWEST OF AN 18-INCH MAPLE TREE, AND 30 FEET NORTH OF THE CENTERLINE OF STATE ROUTE 5.

8. DESIGNATION - 63 013 2 P CO

POSITION -	41 11 08.87349(N)	081 01 41.22004(W)		ADJUSTED
83 minus 27 -	+00.20300	-00.66152		ADJUSTED
HEIGHT -	297.7 (meters)	977. (feet)		VERT ANG
88 minus 29 -	-0.2			VERTCON
	North	East	Scale	Converg.
SPC OH N -	169,735.738	723,475.655	0.99994126	+0 58 01.0 MT

STATION DESCRIPTION

DESCRIBED BY PORTAGE COUNTY OHIO 1977 (GLW) THE STATION IS ABOUT 3-1/2 MILES SOUTHEAST OF WINDHAM, 1-3/4 MILES NORTHEAST OF PARIS, 1-1/4 MILES NORTHWEST OF MC CLINTOCKSBURG, AND ON THE RIGHT-OF-WAY OF STATE ROUTE 5.

TO REACH THE STATION FROM THE INTERSECTION OF STATE ROUTES 5 AND 225 ABOUT 1 MILE NORTH OF PARIS, GO EAST ON STATE ROUTE 5 FOR 1.3 MILES TO THE STATION ON THE LEFT.

STATION MARK, STAMPED---63-013-2 1977---, IS A PORTAGE COUNTY BRASS DISK SET IN THE TOP OF A 12-INCH CYLINDRICAL CONCRETE POST THAT IS 4 INCHES BELOW THE GROUND SURFACE. IT IS 125 FEET EAST OF THE CENTERLINE OF A RAVENNA AAP GATE, 59.9 FEET SOUTHEAST OF THE CORNER FENCE POST EAST OF THE GATE, 50.9 FEET SOUTH OF THE FOURTH FENCE POST EAST OF THE CORNER POST, AND 26.5 FEET NORTH OF THE CENTERLINE OF STATE ROUTE 5.

9. DESIGNATION - 83 213 1 P CO

POSITION - 41 10 57.23596(N) 081 12 52.70682(W) ADJUSTED
83 minus 27 - +00.20357 -00.63448 ADJUSTED

HEIGHT - 332.6 (meters) 1091. (feet) VERT ANG
88 minus 29 - -0.2 VERTCON

	North	East	Scale	Converg.
SPC OH N -	169,129.445	707,834.734	0.99994114	+0 50 39.9 MT

STATION DESCRIPTION

DESCRIBED BY PORTAGE COUNTY OHIO 1977 (GLW) THE STATION IS ABOUT 5-1/4 MILES SOUTHWEST OF FREEDOM, 4 MILES SOUTH OF SHALERSVILLE, 3-3/4 MILES NORTHWEST OF CHARLESTOWN, AND ON THE RIGHT-OF-WAY OF PECK ROAD, COUNTY HIGHWAY 167.

TO REACH THE STATION FROM THE INTERSECTION OF STATE ROUTES 88 AND 14 IN NORTHEAST RAVENNA, GO NORTHEAST ON STATE ROUTE 88 FOR 0.25 MILE TO THE INTERSECTION OF LOVERS LANE, COUNTY HIGHWAY 163. (TURN RIGHT AND GO EAST FOR 0.45 MILE TO AZIMUTH MARK 83 123 1 P CO ON THE RIGHT, JUST BEFORE THE ERIE LACKAWANNA RAILROAD TRACKS). CONTINUE NORTHEAST ON STATE ROUTE 88 FOR 1.3 MILES TO THE INTERSECTION OF PECK ROAD. TURN SHARP RIGHT AND GO SOUTH FOR 0.35 MILE TO THE STATION ON THE RIGHT, JUST PAST THE SAME RAILROAD TRACK.

STATION MARKS, STAMPED---83-213-1 1977---, ARE PORTAGE COUNTY BRASS DISKS. THE SURFACE DISK IS SET IN THE TOP OF A 12-INCH CYLINDRICAL CONCRETE POST THAT IS FLUSH WITH THE GROUND SURFACE. IT IS 60.7 FEET NORTHWEST OF TELEPHONE AND POWER POLE, NUMBER 98/48, 32.3 FEET WEST OF THE CENTERLINE OF PECK ROAD, AND 6.6 FEET NORTHEAST OF A TELEGRAPH POLE. THE UNDERGROUND DISK IS SET IN AN IRREGULAR MASS OF CONCRETE ABOUT 42 INCHES BELOW THE GROUND SURFACE.

10. DESIGNATION - 64 058 1 P CO

POSITION - 41 14 28.26034(N) 081 01 48.07639(W) ADJUSTED
83 minus 27 - +00.20157 -00.66367 ADJUSTED

HEIGHT - 295. (meters) 968. (feet) VERT ANG
88 minus 29 - -0. VERTCON

	North	East	Scale	Converg.
SPC OH N -	175,882.791	723,212.237	0.99994371	+0 57 56.5 MT

STATION DESCRIPTION

DESCRIBED BY PORTAGE COUNTY OHIO 1977 (GLW) THE STATION IS ABOUT 6-1/2 MILES NORTH OF PARIS, 4-1/2 MILES SOUTH OF NELSON, 1 MILE NORTHEAST OF WINDHAM, AND ON THE RIGHT-OF-WAY OF HORN ROAD, TOWNSHIP HIGHWAY 239.

TO REACH THE STATION FROM WINDHAM AT THE INTERSECTION OF STATE ROUTE 303 AND PARKMAN ROAD, COUNTY HIGHWAY 299, GO EAST ON STATE ROUTE 303 FOR 1.0 MILE TO THE INTERSECTION OF HORN ROAD. TURN LEFT AND GO NORTH ON HORN ROAD FOR 0.4 MILE TO THE STATION ON THE LEFT, JUST SOUTH OF THE OHIO TURNPIKE OVERPASS.

STATION MARK, STAMPED---64-058-1 1977---, IS A PORTAGE COUNTY BRASS DISK SET IN THE TOP OF A 12-INCH CYLINDRICAL CONCRETE POST THAT IS FLUSH WITH THE GROUND SURFACE. IT IS 77.7 FEET SOUTHEAST OF THE NORTHEAST CORNER OF A HOUSE, ADDRESS NUMBER 9151, 73.0 FEET NORTHEAST OF THE SOUTHEAST CORNER OF THE SAME HOUSE, 61.0 FEET SOUTHWEST OF THE EAST CONCRETE BRIDGE GUARDRAIL POST OF THE OHIO TURNPIKE OVERPASS, 56.2 FEET SOUTH-SOUTHWEST OF THE WEST CONCRETE BRIDGE GUARDRAIL OF THE OVERPASS, 23.8 FEET EAST OF A FIRE HYDRANT,

AND 11.1 FEET WEST OF THE CENTERLINE OF HORN ROAD.

11. DESIGNATION - 64 079 1 P CO

POSITION -	41 14 57.72065(N)	081 01 48.12101(W)	ADJUSTED
83 minus 27 -	+00.20125	-00.66359	ADJUSTED

HEIGHT -	304.0 (meters)	997. (feet)	VERT ANG
88 minus 29 -	-0.2		VERTCON

	North	East	Scale	Converg.
SPC OH N -	176,791.433	723,195.882	0.99994415	+0 57 56.5 MT

STATION DESCRIPTION

DESCRIBED BY PORTAGE COUNTY OHIO 1977 (GLW) THE STATION IS ABOUT 6-1/2 MILES NORTH OF PARIS, 4-1/2 SOUTH OF NELSON, 1-1/2 MILES NORTHEAST OF WINDHAM, AND ON RIGHT-OF-WAY OF HORN ROAD, TOWNSHIP HIGHWAY 239.

TO REACH THE STATION FROM WINDHAM AT THE INTERSECTION OF STATE ROUTE 303 AND PARKMAN ROAD, GO EAST ON STATE ROUTE 303 FOR 0.75 MILE TO WINDHAM EAST CORPORATION LINE AND THE INTERSECTION OF HORN ROAD. TURN LEFT ON HORN ROAD AND GO NORTH FOR 0.5 MILE TO AZIMUTH MARK 64 058 1 P CO ON THE LEFT, JUST BEFORE THE OHIO TURNPIKE OVERPASS. CONTINUE NORTH ON HORN ROAD FOR 0.55 MILE TO THE STATION ON THE RIGHT.

STATION MARKS, STAMPED---64-079-1 1977---, ARE PORTAGE COUNTY BRASS DISKS. THE SURFACE DISK IS SET IN THE TOP OF A 12-INCH CYLINDRICAL CONCRETE POST THAT IS FLUSH WITH THE GROUND SURFACE. IT IS 145.3 FEET NORTHWEST OF THE NORTHWEST CORNER OF AN OLD TWO STORY FARM HOUSE, 80.1 FEET SOUTH SOUTHEAST OF A 16-INCH MAPLE TREE, 55.7 FEET SOUTHEAST OF A 26-INCH MAPLE TREE, 42.6 FEET EAST OF A 24-INCH MAPLE TREE, AND 18.5 FEET EAST OF THE CENTERLINE OF HORN ROAD. THE UNDERGROUND DISK IS SET IN AN IRREGULAR MASS OF CONCRETE ABOUT 42 INCHES BELOW THE GROUND SURFACE.

The following control points are located in the SPC OH N state plane coordinate system and were used to rectify aerial photographs. The horizontal datum used for all points is NAD83. "Crosshair" marks are on the hardcopies of the black-and-white aerial photographs used in this study.

Description of control points:

2 Northwest corner of small building just south of the turnpike. The western side of the bridge over the turnpike just north of 2 was also shot.

3 Southwest corner of house. 11.5 inches from NW crosshair and 4.75 inches from NE crosshair

4 Southwest corner of house 1.8 inches from SE crosshair and 5.5 inches from E crosshair.

5 Southeast corner of large building oriented N-S at main track switchyard. Eastern side of AAP.

6 Southwest corner of building furthest southwest in the railroad bunkers from intersection of Paris-Windham road and Old Newton Falls Road. Go N along Paris-Windham Road for 1.5 miles to station on west side of road.

7 Northwest corner of small building, first building on the right after entering the burn zone.

8 Southwest corner of third long warehouse inside the gate on the east side of Paris-Windham Road. Gate along southern AAP boundary at Paris-Windham Road.

9 Southeast corner of big building on west side of George Road just inside main gate and just north of Admin Loop Road. Building has a dark roof.

10 Southwest corner of large building along Fuze Line road. About 2000 ft east of Greenleaf Road, north side of road.

11 Southeast corner of large building on N side of an unnamed E-W road. The E-W road is about 1100 ft N of the intersection of Fuze Line and Greenleaf Roads. From this intersection go west to large building on north.

12 Northwest corner of dark roof building. 5.25 in. from NW crosshair and 10.55 inches from NE crosshair. From intersection of Greenleaf and Old Newton Falls Roads go west 1800 ft. Go north 1 mile to building on east.

13 Northwest corner of guard shack just inside the gate at southern AAP boundary at Greenleaf Road.

14 Southeast corner of northernmost building on west side of Freedom Road. From intersection of Freedom and Old Newton Falls Roads go south 600 ft to station on west.

15 Northeast corner of dark building just outside gate of Freedom Road at south AAP boundary.

16 Southeast corner of house along west boundary of AAP. 3.88 in. from SW crosshair and 5.31 in. from S crosshair.

17 Westernmost corner of long building along railroad tracks. 0.94 in. from west crosshair and 5.98 in. from SW crosshair. From intersection of Erie-Lackawanna railroad and Peck Road go NE along railroad 2800 ft to building on right.

Coordinates of control points just described:

Control point	Northing (state plane feet, NAD83, Ohio north zone)	Easting (state plane feet, NAD83, Ohio north zone)
2	576901.44	2373025.78
3	575075.88	2380856.14
4	558099.55	2385288.41
5	566532.32	2379206.60
6	566489.65	2367461.93
7	560605.64	2357847.70
8	554828.17	2367636.26
9	551856.76	2357869.91
10	552736.78	2350811.41
11	554036.14	2344127.87
12	563839.56	2349448.09
13	548325.55	2348961.38
14	558025.55	2340801.24
15	549338.26	2340608.60
16	550110.66	2329325.78
17	556692.04	2324489.67

APPENDIX C: PLANTS IDENTIFIED DURING THE FIELD INSPECTION OF WET AREAS

A partial list of upland and aquatic plants observed at the Ravenna AAP, Portage and Trumbull Counties, Ohio, during November 18-22 and December 2-6, 1996, and March 26-27, 1997.

Obligate wetland species (OBL)
Facultative wetland species (FACW)
Facultative species (FAC)
Facultative upland species (FACU)
Upland species (UPL)

The symbol "+" represents a wet condition and "-" represents a dry condition for the designation they follow.

American hornbeam (*Carpinus caroliniana*: FAC)
American basswood (*Tilia americana*: FACU)
American beech (*Fagus grandifolia*: FACU)
American elm (*Ulmus americana*)
Apple (*Malus* sp.: no wetland designation)
Asters (*Aster* spp.: FACW)
Bidens (*Bidens* sp.: FACW)
Black cherry (*Prunus serotina*: FACU)
Black locust (*Robinia pseudoacacia*: UPL)
Black willow (*Salix nigra*: OBL)
Broad-leaf cattail (*Typha latifolia*: OBL)
Bur-reed (*Sparganium* sp.: OBL)
Common reed (*Phragmites australis*: FACW)
Cottonwood (*Populus deltoides*: FAC)
Cutgrass (*Leersia* sp.: OBL)
Ditch stonecrop (*Penthorum sedoides*: OBL)
Dogwood (*Cornus amomum*: FACW)
Flatsedge (*Cyperus* sp.: FAC)
Goldenrod (*Solidago spp.*: FACU)
Hawthorn (*Crataegus* sp.: FAC)
Meadow-sweet (*Spirea tomentosa*: FACW and *Spirea alba*: FACW)
Multiflora rose (*Rosa multiflora*: UPL)
Narrow-leaf cattail (*Typha angustifolia*: OBL)
Osage orange (*Maclura pomifera*: UPL)
Pin oak (*Quercus palustris*: FAC)
Pussy willow (*Salix discolor*: OBL)
Quaking aspen (*Populus tremula*: FACU)
Red maple (*Acer rubrum*: FACW)
Red oak (*Quercus rubra*: FACU-)
Reed canary grass (*Phalaris* sp.:FACW)
Sedges (*Carex* spp.: OBL-FACW)
Sensitive fern (*Onoclea sensibilis*: OBL)
Shagbark hickory (*Carya ovata*: FACU-)
Soft rush (*Juncus effusus*: FACW+)
Soft-stem bulrush (*Scirpus validus*: OBL)
Spruce (*Picea* sp.: no wetland designation)
Sugar maple (*Acer saccharum*: UPL)
Swamp dock (*Rumex verticillatus*: FACW)
Swamp milkweed (*Asclepias incarnata*: FACW+)
Swamp white oak (*Quercus bicolor*: FACW+)
Virginia pine (*Pinus virginiani*: no wetland designation)
Water horehound (*Lycopus* probably *americanus*: OBL)
White ash (*Fraxinus americana*: FACU)
White oak (*Quercus alba*: FACU-)
Willows (*Salix* spp.: OBL)

APPENDIX D: PHOTOGRAPHS OF WETLAND FEATURES IN THE TRAINING AREAS

71. Typical pothole with dogwood and grasses in southern Area G.

10. Typical marsh in northeastern Area C. Mallards on pond.

64. Dogwoods and cattail marsh in northwestern Area E.

75. Wetland ponds in southern Area G.

77. Giant willows and red oaks in wet area in southeastern Area G.

28. Wet woods, aquatic plants, and vegetation in northern Area C.

61. Wet woods consisting of beech-maple, American elm, and shagbark hickory, Area E.

84. Wet woods (white oak, red and sugar maples, tulip poplar, cherry, American beech, red and pin oak, basswood) in northern Area F.

23. Creek and wet flood plain in northern Area C.

67. Wet flood plain in Area D.

80. Creek and wooded riparian corridor in southwestern Area D.

60. Grass community in low-lying area. Dogwoods, multiflora rose, sedges, sensitive fern, and grasses in Area E.

86. Sedges and soft rushes near a channelized stream that ends in a "T" where ground elevation changes, Area H.

14. Beaver dam and impoundment, northeastern Area C.

89. Wet area created by inactive beaver dam. Sedges, soft rushes, and soft-stem bulrushes, eastern Area H.

39. Wet woods resulting from tank activity in central Area C.

47. Wet woods resulting from tank activity in southern Area C.

73. Wet areas created by light vehicle traffic in southern Area G.

21. Open area reseeded with grass and pine. Water standing in vehicle tracks. Northern Area C.

31. Effect of road to create wet area, eastern Area C.