National Park Service
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Northeast Region
Philadelphia, Pennsylvania

Vegetation Classification and Mapping at Johnstown Flood National Memorial

Technical Report NPS/NER/NRTR--2006/034

ON THE COVER
Riverine Scour Vegetation adjacent to the South Fork of the Little Conemaugh River in Johnstown Flood National Memorial
Photograph by: Ephraim Zimmerman

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National Park Service
Northeast Region
Philadelphia, Pennsylvania

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Executive Summary

Vegetation classification and mapping was conducted at Johnstown Flood National Memorial, creating a current digital geospatial vegetation database for the park. Seven vegetation associations, Red Maple – Black Cherry Successional Forest / Woodland, Eastern Hemlock – Northern Hardwood Forest, Conifer Plantation, Silky Willow Shrub Swamp, Old Field, Cattail Marsh, and Riverine Scour Vegetation, that occur within the park were identified and described in detail.

These vegetation types reflect the land use history, ongoing management, and varied environmental settings of the park. The vegetation association that covers the largest area of the park is Old Field, with three subtypes, Herbaceous, Wet Meadow, and Hawthorn, represented in different sections of the park. Red Maple – Black Cherry Successional Forest / Woodland is the most common forest type in the park, although its vegetation structure and composition varies. Two small remnants of Eastern Hemlock – Northern Hardwood Forest occur on shallow north-facing slopes in the park. The Conifer Plantation areas are remnants from the pine stands planted in the lakebed in the middle of last century. The Cattail Marsh and Silky Willow Shrub Swamp are maintained by the railroad berm that influences the hydrology in the immediate area. The Riverine Scour Vegetation is located on bars, islands, and spits in the South Fork of the Little Conemaugh River and is influenced by water and ice scour from the river.

The effects of land use history and past and current management on these vegetation associations are discussed. Such land uses and management include creation and removal of plantations, lakebed hydroseeding, management of woody plants and exotic plant species, and natural succession. The habitat value of these vegetation associations for birds, reptiles, amphibians, and mammals is also discussed.

A map showing the locations of these vegetation associations in the park was created following the USGS/NPS Vegetation Mapping Program protocols (The Nature Conservancy and Environmental Systems Research Institute 1994a, b, c). These vegetation associations were crosswalked to the National Vegetation Classification System (NVCS) in order to provide a regional and global context for the park's vegetation. A dichotomous field key was developed for these vegetation associations to assist with field recognition and classification.

This project documents the vegetation associations of Johnstown Flood National Memorial based on 2003 aerial photography and 2004 field sampling, and completes one of 12 basic inventory data sets for the park.

Keywords: vegetation association, classification and mapping, Johnstown Flood National Memorial

Introduction

General Background

One of the goals of the National Park Service's Inventory and Monitoring Program is to provide the information and expertise needed by park managers for effective, long-term management of the natural resources held in trust (National Park Service 2003). The program recommends that 12 basic natural resource inventories be developed for each park that contains significant natural resources. These inventories provide crucial baseline information needed for proper park natural and cultural resource stewardship. A map of each park's vegetation based on aerial photography less than five years old is one of the 12 inventories recommended by the program (National Park Service 2003). To ensure that vegetation mapping is standardized across the National Park Service (NPS), The Nature Conservancy, in conjunction with NatureServe, the Federal Geographic Data Committee, and the Ecological Society of America Vegetation Subcommittee, developed a protocol for creating vegetation maps in national parks. This protocol was adopted by the United States Geological Survey (USGS)/NPS Vegetation Mapping Program as the standard (The Nature Conservancy and Environmental Systems Research Institute 1994a, b, c) and has been implemented at Johnstown Flood National Memorial by the Pennsylvania Natural Heritage Program.

The goal of the mapping effort at Johnstown Flood National Memorial was to produce an up-to-date digital geospatial vegetation database for the park and to provide a plant species list, a dichotomous key for vegetation associations, and descriptions of the vegetation associations in the park. Baseline information on plant community composition and rarity is critical to developing desired conditions and park management goals relating to native plant communities, nonnative plant and insect species, or effects of deer browse and other disturbances. The identification and description of plant communities also provide habitat information important to understanding associated organisms, including animals, protozoans, bacteria, and fungi. A map of vegetation communities may allow inferences about the location and abundance of species that are characteristic of each community.

This report also describes the park's vegetation in the context of a regional and national vegetation classification. The Nature Conservancy, in conjunction with NatureServe, the Federal Geographic Data Committee, and the Ecological Society of America Vegetation Subcommittee, developed the National Vegetation Classification System (NVCS) in order to standardize vegetation classification and facilitate the comparison of vegetation types throughout the United States and internationally. The NVCS is a systematic approach to classifying existing natural vegetation using physiognomics and floristics. This classification system has a hierarchical structure (Grossman et al. 1998).

The basic unit of vegetation classification in the NVCS is the association. An association is defined as a plant community type that is relatively homogeneous in composition and structure and occurs in a uniform habitat. For example, Eastern Hemlock – Northern Hardwood Forest is a common association typically found on cool, dry-mesic to mesic sites, often on rocky, north-facing slopes. Associations are also assigned global rarity ranks that indicate their conservation status and relative risk of extirpation (Grossman et al. 1998).

Several associations that share one or more dominant or characteristic species can be grouped to form an alliance. Alliances are generally more wide-ranging geographically than associations, covering multiple habitats and broader species composition. For example, the Eastern Hemlock – Northern Hardwood Forest association mentioned previously is grouped with other similar eastern hemlock-dominated forest associations into the Eastern Hemlock - Yellow Birch Forest Alliance. An association with unique species composition or environmental niche can be assigned to its own alliance, such that the alliance only contains one association instead of multiple associations.

One level above alliance is the formation, representing vegetation types that share a common physiognomy within broadly defined environmental factors (Grossman et al. 1998). For example, Mixed evergreen-deciduous forest is a common formation that encompasses numerous forest types in the northeastern and midwestern United States, including the Eastern Hemlock - Yellow Birch Forest Alliance mentioned above. Formation level vegetation types can be determined through aerial photo interpretation, and their delineation within a park is one of the first steps in vegetation mapping.

Park-specific Information

Johnstown Flood National Memorial is a 76 ha (187 ac) national park surrounding a portion of the South Fork of the Little Conemaugh River. The park encompasses the former lakebed of Lake Conemaugh, a two-mile-long reservoir on the South Fork originally constructed to supply water for the Pennsylvania Mainline Canal. After the reservoir was abandoned by the canal, it was rebuilt and used by the South Fork Fishing and Hunting Club. However, on May 31, 1889, the 22 m (72 ft) high earthen dam that created the reservoir breeched, causing a devastating flood in the towns downstream, including Johnstown, Pennsylvania. The park was established in 1964 to document this historic tragedy and commemorate the victims of the flood.

Project Area

Location and Regional Setting

Set in the Allegheny Mountains of southwestern Pennsylvania, Johnstown Flood National Memorial is located approximately 16 km (10 mi) northeast of Johnstown, PA. The park is bordered by US Route 219 and PA Route 869, near the town of St. Michael, and is located in Cambria County on the Geistown, PA 1:24,000 USGS topographic quad map (Figure 1). Park boundary files used in the report figures were obtained from the National Park Service in 2004. Within the Appalachian Plateau physiographic province, Johnstown Flood National Memorial occurs near the intersection of the Allegheny Mountain section and the Pittsburgh Low Plateau section of the physiographic province.

Historically, this region was forested; however, portions of Cambria County are now in agriculture or have been developed. The forests have been harvested multiple times in the last two centuries, though the landscape has regrown to be predominantly forested today. The forests are typically dominated by northern hardwood species such as sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), yellow birch (*Betula alleghaniensis*), red maple (*Acer rubrum*), and black cherry (*Prunus serotina*). Eastern hemlock (*Tsuga canadensis*) and eastern white pine (*Pinus strobus*) are common associated trees. Typical shrubs include striped maple (*Acer pensylvanicum*) and American witchhazel (*Hamamelis virginiana*). These forests can contain diverse wildflowers, herbaceous plants, and ferns in the understory (Cuff et al. 1989).

Park Environmental Attributes

Many environmental factors such as geology, topography, soils, and hydrology affect the types and distribution of vegetation within Johnstown Flood National Memorial. The bedrock geology within the majority of the lakebed of former Lake Conemaugh is Glenshaw Formation, a marine-derived sediment of Pennsylvanian age that is composed of shale and sandstone, with limited amounts of limestone and coal. The higher elevation portions of Johnstown Flood National Memorial are located on Casselman Formation, also a marine-derived sediment of Pennsylvanian age that is composed of shale and siltstone, with limited amounts of sandstone, limestone, and coal (Schultz 1999). Elevation within the park ranges from approximately 470–565 m (1,540–1,855 ft).

In the higher elevation sections of Johnstown Flood National Memorial, Wharton silt loam, Cavode silt loam, Blairton silt loam, and Cookport-Ernest sandy loam are common, somewhat poorly-drained to well-drained, soils associated with upland fields and forest. The areas surrounding the South Fork of the Little Conemaugh River are characterized by Atkins silt loam and Philo silt loam which are moderately well-drained floodplain soils. Other soils associated with the lakebed include Laidig loam, a well-drained soil formed in colluvium, and Brinkerton silt loam, a poorly-drained soil also formed in colluvium. The remaining portions of the dam are mapped as Udorthents, urban soil (Natural Resources Conservation Service 2001).

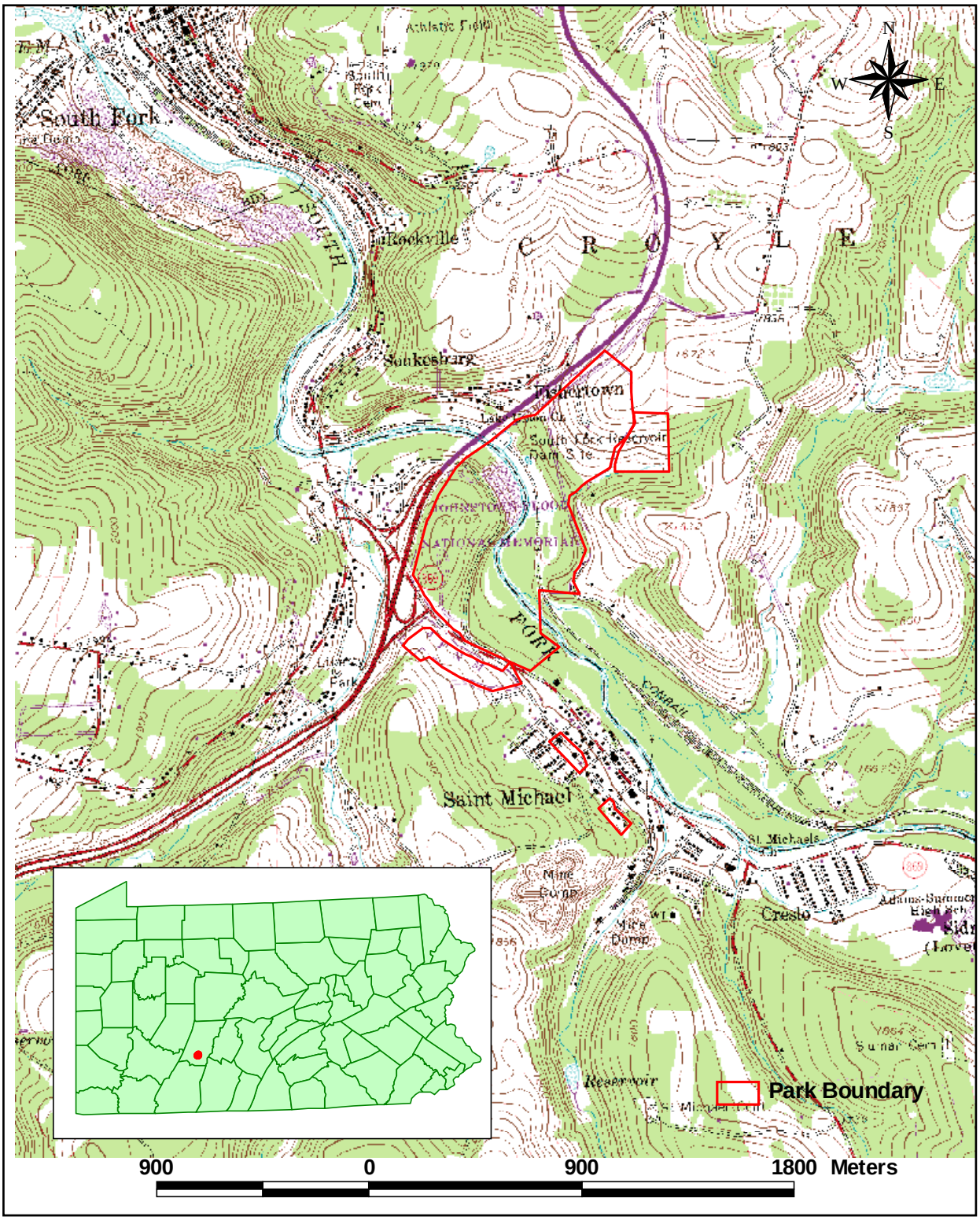

Figure 1. Location of Johnstown Flood National Memorial, Cambria County, Pennsylvania, on the Geistown, PA 1:24,000 USGS topographic quad map.

One of the park's important natural and cultural features is the lakebed of the former Lake Conemaugh that surrounds the South Fork of the Little Conemaugh River. Management of the vegetation in the lakebed has varied over the park's 40-year history (Eick 1996). Little is known about the first 20 years of management; By 1986, however, 12 ha (30 ac) of the 28 ha (69 ac) lakebed supported planted stands of Scotch pine (*Pinus sylvestris*), eastern white pine, and red pine (*P. resinosa*), and 6 ha (16 ac) contained mixed conifer-hardwood and northern hardwood forest communities (Bowersox 1986). The majority of the trees and shrubs were removed between 1988 and 1991 to improve the viewshed. Stumps of cut hardwood trees and shrubs were treated with herbicide and then grass and forb seeds were sown in the cleared areas (Eick 1996). Without the pine plantations and other woody vegetation in the lakebed visitors to the park are better able to visualize the extent of the former reservoir and the magnitude of the flood.

By 1995, one-third of the lakebed was dominated by thick growth of early-successional shrubs and tree saplings. Several invasive species, including Morrow's honeysuckle (*Lonicera morrowii*), purple crown vetch (*Coronilla varia*), Japanese knotweed (*Polygonum cuspidatum*), and multiflora rose (*Rosa multiflora*), had also established themselves in the lakebed. An intensive management regime of woody plant removal and herbicide application was employed from 1995 through 2000 (Eick 1996). In 2003, a crew of Student Conservation Association volunteers performed woody seedling control in the lakebed.

A railroad runs along the eastern side of the South Fork of the Little Conemaugh River. It was built in the early 1900's as a portion of the Pennsylvania Railroad (Eick 1996). The berm on which the railroad sits affects the hydrology of the floodplain and the flow of the water draining to the river from the east.

Materials and Methods

Planning and Scoping

Several steps were taken to prepare for the mapping and classification of vegetation at Johnstown Flood National Memorial. A planning and review meeting was held on February 13, 2004 with ecologists from the Pennsylvania Natural Heritage Program (both the Pennsylvania Science Office of The Nature Conservancy and the Western Pennsylvania Conservancy), National Park Service staff, and NatureServe staff. The project timeline, access issues, park resource management needs, current vegetation management, vegetation types of special interest, and applicable previous research conducted at the park were discussed. In addition, reconnaissance of the park's vegetation types was conducted to estimate the number and distribution of vegetation associations in the park.

Preliminary Data Collection and Review of Existing Information

Previous studies conducted at Johnstown Flood National Memorial were obtained from the park's natural resource manager and reviewed for information pertinent to the park's vegetation. These reports included previous vegetation mapping conducted by the Western Pennsylvania Conservancy and The Pennsylvania State University, proposals on lakebed vegetation management, National Wetland Inventory maps, inventories of invasive plant species, and inventories of birds, reptiles, amphibians, and mammals (Western Pennsylvania Conservancy 2003; Bowersox 1986; Eick 1996; Yahner et al. 2001; Yahner and Ross 2004).

Aerial Photography Acquisition and Processing

Color infrared, stereo pair 1:6,000 scale aerial photography for a digital orthophoto mosaic of Johnstown Flood National Memorial was acquired from an overflight on April 13, 2003 (i.e., during leaf-off conditions) by Kucera International. Some of the photography was overexposed and, at the request of the National Park Service, Kucera International scanned the photos at 1,200 dpi and color balanced and adjusted them. The NPS accepted these scanned images and sent them to North Carolina State University (NCSU). Upon receipt at NCSU the image files were counted to make sure that none were missing and placed in the air photo archive maintained at NCSU for the NPS Northeast Region Inventory & Monitoring Program. Associated data and information provided by Kucera International, and also stored in the air photo archive, include the airborne GPS/IMU files, the camera calibration certificate for the camera, and the hardcopy flight report for the photography that crosswalks the airborne GPS/IMU data to the photo frame numbers.

The mosaic was produced from 14 color infrared air photos scanned at 1200 dpi with 24-bit color depth. The scanned images of the air photos were imported into ERDAS Imagine (.img) format where a photo block was created using airborne GPS and IMU data that Kucera International supplied with the aerial photography. The photo block was manipulated until it could be triangulated with a root mean square error of less than one. At this point, single frame orthophotos (one for each air photo) were generated within Imagine and exported to Imagine .lan format. Then the .lan files were imported into ER Mapper's native (.ers) format, and an ER Mapper algorithm was created which contains the color balancing information and the cutlines

created for the final mosaic. In ER Mapper a band interleaved by line (.bil) image and header file of the final mosaic was generated, the .bil image was imported into Imagine .img format, and, finally, the .img image was compressed using MrSID software with a 20:1 compression ratio.

A metadata record for the mosaic was prepared according to current Federal Geographic Data Committee standards (1998a). Metadata were produced in notepad and parsed using the USGS metadata compiler program (MP) to locate errors and omissions (USGS 2004). After all errors and omissions were corrected MP was used to generate final TXT, HTML, and XML versions of each metadata record which are stored in the air photo archive. Key information for the Johnstown Flood National Memorial mosaic is summarized in Table 1.

Photointerpretation

After receiving the digital orthophoto mosaic from North Carolina State University, ecologists at the Pennsylvania Natural Heritage Program developed a formation-level vegetation map. Aerial photo interpretation was informed by viewing the diapositives through a stereoscope, viewing the mosaic onscreen, and overlaying the formation-level polygons onto digital topographic quad maps. Polygons were digitized onscreen using ArcView 3.2 (Environmental Systems Research Institute, Inc. 1992-2000). Polygons that represented vegetation were attributed with formation-level vegetation types from the National Vegetation Classification System. Polygons that represented other land uses, such as buildings and roads, were attributed with names modified from the Anderson level II categories (Anderson et al. 1976). An aerial photography interpretation key to the formation-level vegetation types and modified Anderson level II categories is provided in Appendix A. The resulting map (Figure 2) identified 61 map polygons each labeled with one of 12 different attributes (Table 2). Of these polygons, 26 represent transportation corridors, built-up land and the river. The remaining polygons were each attributed with one of nine formation-level vegetation types. The number of total mapped hectares listed in Table 2 is larger than the size of the park because the mapped polygons extend beyond the park boundary. This formation-level vegetation map was used to guide vegetation plot sampling in the park.

Field Data Collection and Classification

All vegetation plot sampling followed the USGS/NPS Vegetation Mapping Program protocols (The Nature Conservancy and Environmental Systems Research Institute 1994b). The protocol suggests that each vegetation association should be sampled at least three times in order to capture the naturally occurring variation within the park. If each of the formation-level vegetation types listed in Table 2 represented only one association in Johnstown Flood National Memorial, the minimum number of plots needed would have been 20. This assumed that areas labeled with modified Anderson level II categories would not be sampled, and that for formations with less than three polygons, one plot would be placed in each polygon. However, due to the small size of the park and the intensive level of vegetation management, fewer plots were needed to accurately characterize the park's vegetation. Based on our initial reconnaissance of Johnstown Flood National Memorial and previous vegetation mapping efforts at this and other parks, we concluded that 15 plots would be sufficient to capture the range of vegetation types.

Table 1. Summary of key information for the Johnstown Flood National Memorial mosaic.

Title of metadata record:	Johnstown Flood National Memorial Color Infrared Orthorectified Photomosaic (ERDAS Imagine 8.6 IMG and Mr. SID formats)
Publication date of mosaic (from metadata):	September 15, 2004
Date aerial photography was acquired:	April 13, 2003 (leaf-off)
Vendor that provided aerial photography:	Kucera International
Scale of photography:	1:6,000
Type of photography:	Color infrared, stereo pairs
Number of air photos delivered:	14
Archive location of air photos, airborne GPS/IMU files, camera calibration certificate, and hardcopy flight reports:	North Carolina State University, Center for Earth Observation
Scanning specifications:	1,200 dpi, 24-bit color depth
Horizontal positional accuracy of mosaic:	1.05 meters, meets Class 1 National Map Accuracy Standard
Number of ground control points upon which estimated accuracy is based:	33
Method of calculating positional accuracy:	Root mean square error
Archive location of mosaic and metadata:	North Carolina State University, Center for Earth Observation
Format(s) of archived mosaic:	.img (uncompressed); MrSID (20:1 compression)

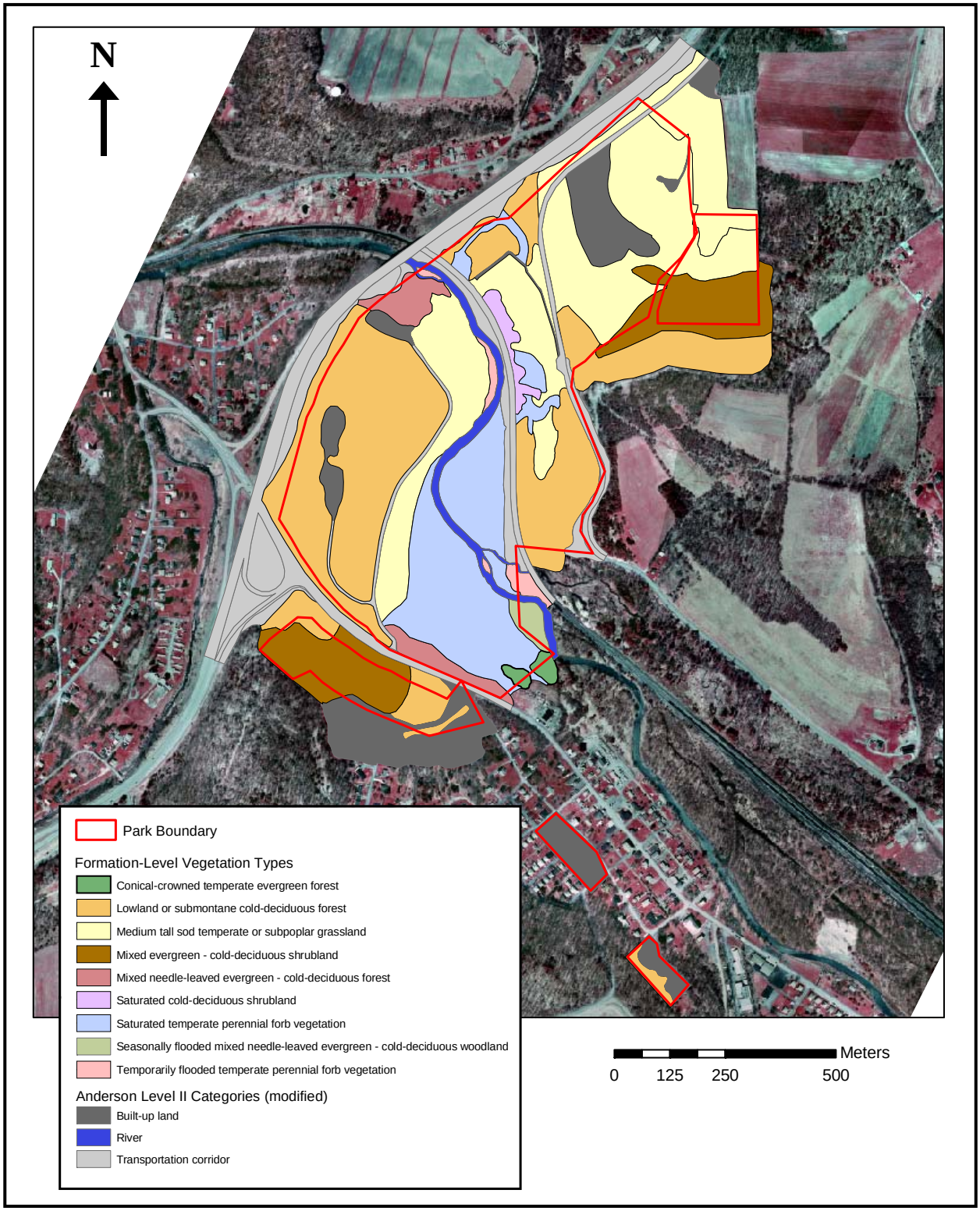

Figure 2. Formation-level vegetation types and Anderson level II categories (modified) for Johnstown Flood National Memorial.

Table 2. Number of polygons, total mapped hectares, mapped hectares within the park boundary, and number of plots sampled for formation-level vegetation types and Anderson level II categories (modified) at Johnstown Flood National Memorial.

	Number of Polygons	Total Mapped Hectares	Mapped Hectares within Park Boundary	Number of Plots Sampled
Formation-Level Vegetation Type				
Conical-crowned temperate evergreen forest	2	0.53	0.25	1
Lowland or submontane cold-deciduous forest	10	28.15	21.08	4
Medium-tall sod temperate or subpoplar grassland	7	23.88	20.36	3
Mixed evergreen - cold-deciduous shrubland	2	8.64	5.84	2
Mixed needle-leaved evergreen - cold-deciduous forest	2	2.26	2.08	1
Saturated cold-deciduous shrubland	1	0.79	0.79	1
Saturated temperate perennial forb vegetation	6	12.06	11.95	3
Seasonally flooded mixed needle-leaved evergreen - cold-deciduous woodland	1	0.62	0.19	0
Temporarily flooded temperate perennial forb vegetation	4	0.74	0.47	2
Anderson Level II Category (modified)				
Built-up land	9	10.99	6.77	0
River	1	1.95	1.57	0
Transportation corridor	16	17.44	4.30	0
Total	61	108.04	75.65	17

Field Survey

A plot was established in an area that was most representative of the existing vegetation association within each polygon selected for sampling (Mueller-Dombois and Ellenberg 1974). All vegetation data were collected following NatureServe's accepted natural heritage sampling protocols (Strakosch-Walz 2000), with 20-m x 20-m plots in forests and woodlands, 10-m x 10-m plots in shrublands, and 5-m x 5-m plots in herbaceous vegetation. The plot sampling data form used in this project is shown in Appendix B. The vegetation was visually divided into eight strata: emergent trees (variable height), tree canopy (variable height), tree subcanopy (>5m in height), tall shrub (2-5m), short shrub (<2m), herbaceous, non-vascular, and vines. The percent cover was estimated for each species in each stratum using modified Braun – Blanquet cover classes (Strakosch-Walz 2000). Specimens of species that were not identifiable in the field were collected for later identification. In addition to floristic information, the following environmental variables were recorded at each plot: slope, aspect, topographic position, hydrologic regime, soil stoniness, average soil texture, and soil drainage. Any unvegetated area of the plot was characterized by the exposed substrate. Notes were taken on the plot representativeness to the surrounding vegetation and any other significant environmental information, such as landscape context, herbivory, stand health, recent disturbance, or evidence of historic disturbance. The vegetation profile and topographic position were sketched in cross-section to represent the location and setting of the plot. A digital photograph of each plot was also taken. The location of each plot was recorded with a Trimble GeoXM global positioning system (GPS) unit, with the datum set to North America 1983 (Conus) and the coordinate system set to Universal Trans-Mercator (UTM) zone 17.

Plot sampling was conducted in July 2004. In total, 17 plots were sampled throughout Johnstown Flood National Memorial (Figure 3). All vegetation types were sampled over a range of environmental variables. The two additional plots were added to the original sampling strategy. These plots were placed in a Saturated temperate perennial forb vegetation polygon and a Temporarily flooded temperate perennial forb vegetation polygon in order to sufficiently capture the variation in species composition and environmental setting.

Vegetation Classification and Characterization

Data from the 17 vegetation plots were then entered into the NatureServe PLOTS 2.0 Database System on a Microsoft Access platform during August 2004. In the PLOTS 2.0 database species were assigned standardized codes based on *The PLANTS database*, Version3.5, developed by the Natural Resource Conservation Service in cooperation with the Biota of North America Program (United States Department of Agriculture, National Resources Conservation Service 2004). For this report, some common names listed in *The PLANTS database* were changed to reflect the common names typically used by ecologists and resource managers in this region.

The common and scientific names of plants observed during the vegetation plot sampling are listed in Appendix C. Some tree and shrub seedlings and immature herbaceous plants could only be identified to the genus level and are therefore listed in the appendix as such. Environmental variables and species percent cover data were exported from the PLOTS database into Excel in order to be manipulated into a format compatible with PC-ORD version 4.0 Multivariate Analysis software (McCune and Mefford 1999).

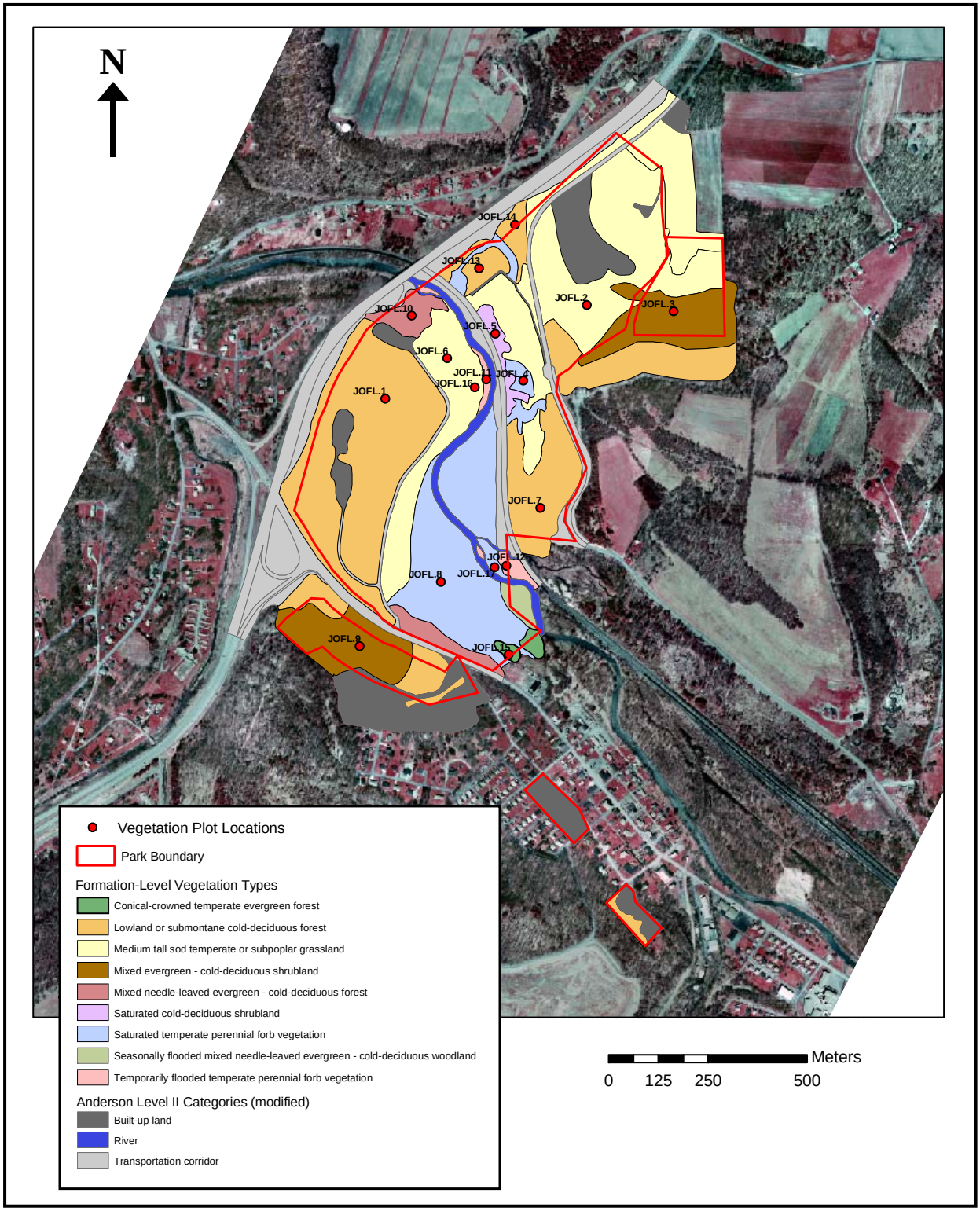

Figure 3. Locations of vegetation plots sampled in Johnstown Flood National Memorial for vegetation classification and mapping.

The vegetation plot data were analyzed using several multivariate statistical techniques available in the PC-ORD software. Different techniques were employed to provide multiple lines of evidence from which to interpret the results. For a detailed discussion of the statistical techniques used in this study, please refer to McCune and Grace (2002). To classify the plot data into vegetation associations, a two-way indicator species analysis (TWINSPAN) was performed using the percent cover of species data. TWINSPAN successively divides the plots into groups that are similar in species composition (Hill and Gauch 1979). A non-metric multidimensional ordination analysis (NMS) was also performed using both the percent cover of species and the environmental variables from the plots. NMS is an ordination technique well suited to non-normal data sets (Kruskgal and Wish 1978). In this analysis, Sorensen distance measure, a random starting configuration, and a stability criterion of 0.005 were employed. Forty runs were performed with the real data, with a maximum of 400 iterations. A multi-response permutation procedure (MRPP) was also performed on the plots' environmental data to determine if the differences between the vegetation associations classified by the TWINSPAN and NMS were statistically significant. Sorensen distance measure was used in the MRPP.

Based on these analyses, park-specific local vegetation associations were identified and described in detail. These vegetation associations were then crosswalked to the National Vegetation Classification System (NVCS). The NVCS was developed by ecologists of the Natural Heritage Program network and The Nature Conservancy after many years of literature review, data collection, and data analysis. This collaborative effort culminated in the publication of *International Classification of Ecological Communities: Terrestrial Vegetation of the United States* (Grossman et al. 1998). The International Classification of Ecological Communities, now known as the International Vegetation Classification, of which the NVCS is a subset, has been revised and refined since 1998, and is now managed by NatureServe in continued collaboration with the Natural Heritage Program network. The classification is housed in the Biotics database and is updated regularly. The upper levels of the NVCS were adopted as a standard by the Federal Geographic Data Committee to support the production of uniform statistics on vegetation at the national level (Federal Geographic Data Committee 1996). The Vegetation Mapping Program of the National Park Service adopted the alliance level, and where possible, the association level, as the mapping unit for national parks.

Based on the aforementioned analyses, the park-specific local vegetation associations were qualitatively compared to existing associations in the National Vegetation Classification System by searching for alliances sharing similar dominant species as well as physiognomy and environmental setting. Total floristic composition was used to determine the appropriate association within the alliance. Global information on the associations from the NVCS was then appended to the local descriptions to provide resource managers with a broader context for the vegetation in the park.

Each vegetation association was assigned a common name based on the Terrestrial and Palustrine Plant Communities of Pennsylvania (Fike 1999). If no appropriate name existed in Fike (1999), the National Vegetation Classification System common name was used or a park-specific common name was created for successional and cultural vegetation types not easily handled by Fike (1999) or the NVCS.

A park-specific dichotomous key was also created for the vegetation associations to guide accuracy assessment and for use by the park natural resource managers and others (Appendix D). A dichotomous key is a tool for identifying unknown entities, in this case, vegetation associations. It is structured by a series of couplets, two statements that describe different, mutually exclusive characteristics of the associations. Choosing the statement that best fits the association in question leads the user to the correct association. The dichotomous key should be used in conjunction with the detailed vegetation association descriptions to confirm that the association selected with the key is appropriate.

Vegetation Map Preparation

Following the vegetation data analysis, the formation-level vegetation map was further edited and refined to develop an association-level vegetation map. Using ArcView 3.2, polygon boundaries were revised onscreen based on the plot data and additional field observations. Each polygon was assigned one of seven vegetation associations based on plot data, field observations, aerial photography signatures, and topographic maps. An aerial photograph interpretation key for the vegetation associations and Anderson level II categories (modified) is located in Appendix A. After the vegetation association map was completed, the thematic accuracy of this map was assessed.

Accuracy Assessment

Two sources of potential error in the vegetation map include: 1) horizontal positional accuracy, in which a location on the photomosaic does not accurately align with the same location on the ground due to errors in orthorectification or triangulation; and 2) thematic accuracy, in which the vegetation type assigned to a particular location on the map does not correctly represent the vegetation at the same location in the park due to mapping error. The USGS/NPS Vegetation Mapping Program protocols (The Nature Conservancy and Environmental Systems Research Institute 1994c) were followed to assess the positional and thematic accuracy of the Johnstown Flood National Memorial vegetation map.

Positional Accuracy Assessment

The horizontal positional accuracy of the mosaic was assessed using guidelines of the USGS/NPS Vegetation Mapping Program (The Nature Conservancy and Environmental Systems Research Institute 1994c). Well-defined positional accuracy ground control points, spaced throughout all quadrants of the mosaic, were placed on the final mosaic in ArcMap. Ground control points and zoomed-in screenshots of each point were plotted on hard copy maps with the mosaic as a background. These maps and plots were used to locate the ground control points in the field. For each plotted ground control point, field staff noted any alterations to the locations in the field, and then recorded the field coordinates with a Trimble Pro XR/XRS or GeoXT. Mapped ground control points that were physically inaccessible were also noted. The field crew correctly located and collected accuracy assessment data at 36 ground control points. The coordinate data were collected with real time GPS and post processed with differential correction using Pathfinder Office software. Prior to calculating accuracy, three ground control points, identified as outliers with SAS's JMP program, were removed. For each of the remaining 33 points, the field-collected "true" or "reference" GPS coordinates were compared to the

coordinates obtained from the mosaic in ArcMap. Both pairs of coordinates for each point were entered into a spreadsheet in order to calculate horizontal accuracy (in meters). The accuracy calculation formula is based on root mean square error (FGDC 1998B; Minnesota Governor's Council on Geographic Information and Minnesota Land Management Information Center 1999). Figure 4 shows the distribution of these 33 ground control points within the park and surrounding area.

Thematic Accuracy Assessment

The thematic accuracy of the vegetation map was assessed by the Pennsylvania Natural Heritage Program. A stratified random sampling approach was used, distributing the sampling effort across the seven vegetation associations. Due to the small size of Johnstown Flood National Memorial and the limited number of polygons, a census of the vegetation map was attempted. Thirty-four of the 36 polygons attributed with vegetation association names were sampled; two polygons were excluded from sampling due to their small size. The thematic accuracy of polygons attributed with Anderson level II categories (modified) was not assessed.

In order to randomly determine the location of these sampling points in the polygons, the random number generator function in Microsoft Excel was used to create 600 sets of random x and y coordinates that fell within the boundaries of Johnstown Flood National Memorial. These coordinates were imported into ArcView 3.2 and overlaid onto the vegetation map. The first pair of coordinates listed in the table of coordinates to fall within a polygon at least 50 m from the polygon boundary was selected. All other points that fell within that polygon were deleted. This procedure was carried out until all points were assigned (Figure 5).

Each accuracy assessment point was then located in the field using a Trimble Geo XM GPS unit during August and September 2004. The vegetation association at that location was then determined using the dichotomous key and the detailed vegetation descriptions. The minimum area of observation around the sampling point was a circle with a radius of 50 m. The accuracy assessment data form used in this study is shown in Appendix E. Data from the 34 accuracy assessment points were then entered into the NatureServe PLOTS 2.0 Database System on a Microsoft Access platform during the fall of 2004. In the PLOTS 2.0 database, species were assigned standardized codes based on *The PLANTS database*, Version 3.5, developed by the Natural Resource Conservation Service in cooperation with the Biota of North America Program (United States Department of Agriculture, National Resources Conservation Service 2004). For this report, some common names listed in *The PLANTS database* were changed to reflect the common names typically used by ecologists and resource managers in this region. The common and scientific names of plants observed during the thematic accuracy assessment sampling are listed in Appendix C. Some tree and shrub seedlings and immature herbaceous plants could only be identified to the genus level and are therefore listed in the appendix as such.

The thematic accuracy was then tabulated using a contingency matrix that compared the mapped vegetation communities with the actual vegetation communities observed in the field. Overall percent accuracy and the Kappa index were calculated (The Nature Conservancy and Environmental Systems Research Institute 1994c). Overall percent accuracy was calculated by dividing the number of correctly classified accuracy assessment points by the total number of

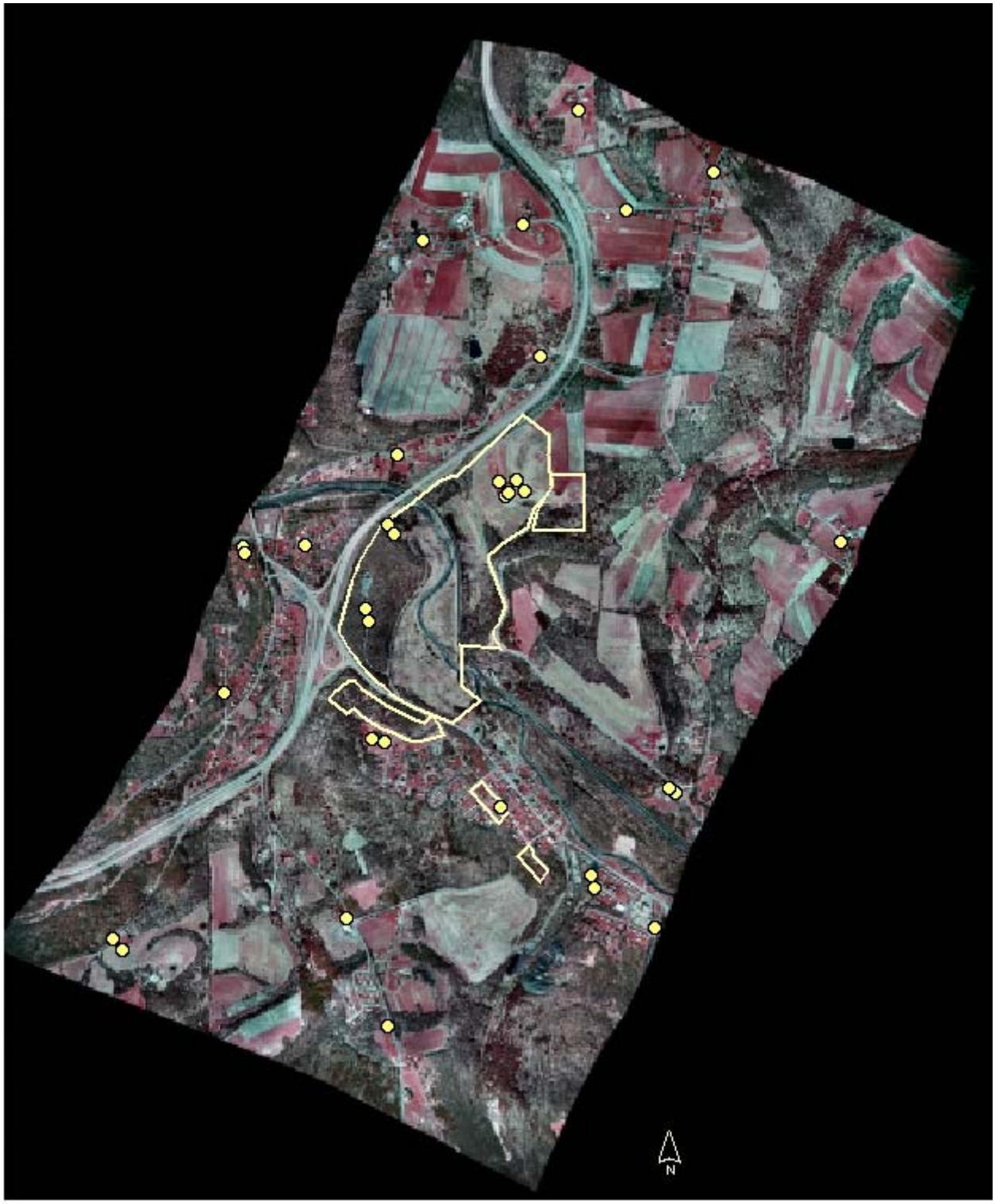

Figure 4. Ground control points (n=33) used to calculate horizontal positional accuracy of the Johnstown Flood National Memorial mosaic.

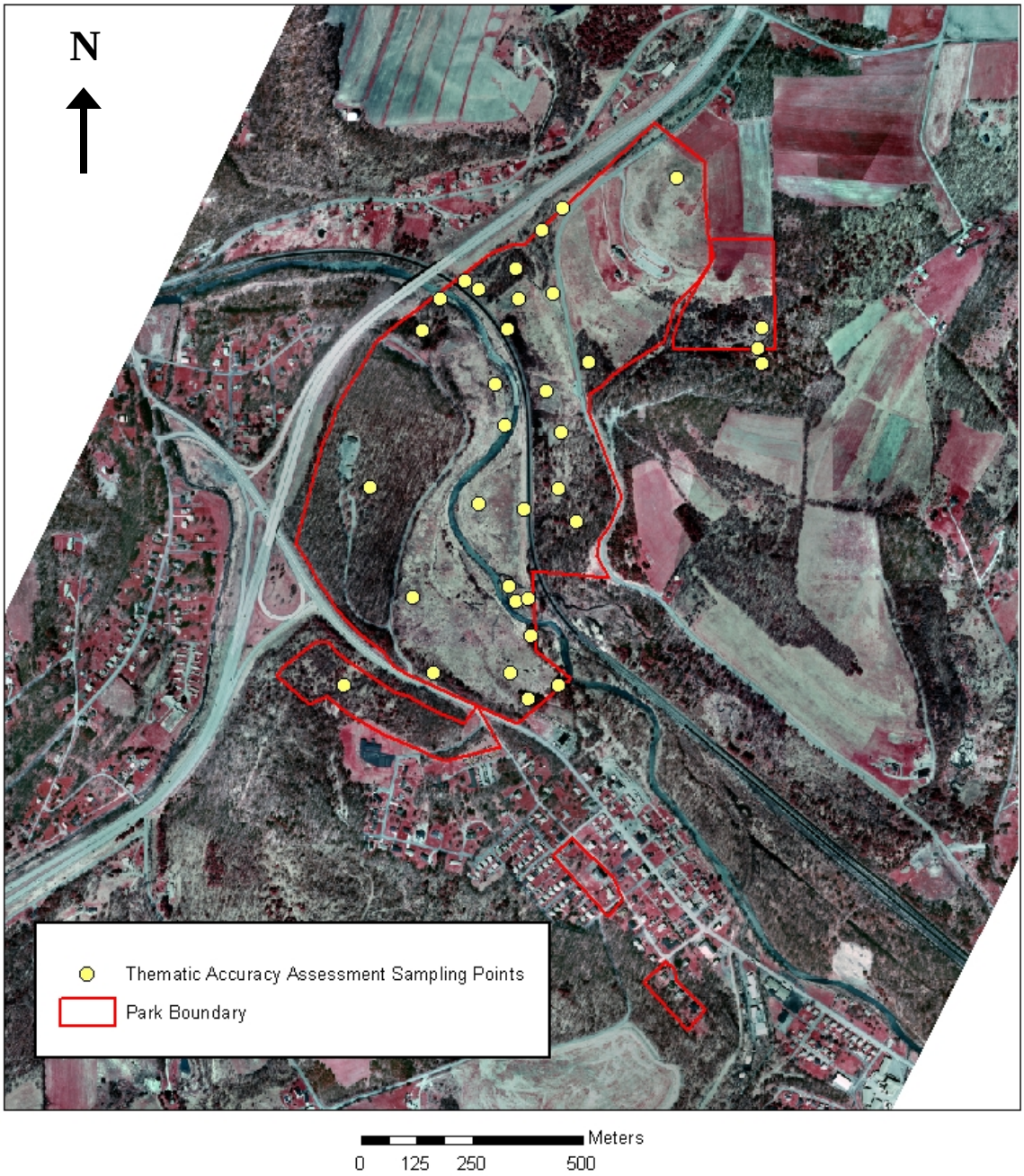

Figure 5. Locations of thematic accuracy assessment sampling points in Johnstown Flood National Memorial.

accuracy assessment points. The Kappa index is the preferred method of reporting overall thematic accuracy because it takes into account that a certain number of correct classifications will occur by chance (Foody 1992).

Errors of omission and errors of commission were also calculated for each vegetation association. Both of these errors are calculated by dividing the number of correctly classified points in one association by the total number of points sampled in that association. Errors of omission indicate the probability that an accuracy assessment point classification will be correct and are calculated by mapped vegetation type. Errors of commission indicate the probability that a mapped vegetation type actually represents the vegetation on the ground. This error is calculated by observed vegetation type (The Nature Conservancy and Environmental Systems Research Institute 1994c).

Results

Vegetation Classification and Characterization

The vegetation associations of Johnstown Flood National Memorial were classified using TWINSPAN and NMS analyses. A dendrogram of the TWINSPAN results is shown in Figure 6. In the dendrogram, five of the 17 plots were misclassified. Conifer Plantation, an association that includes wide variations in species composition, did not group well in this analysis. The NMS analysis recommended a three-dimensional ordination (Figure 7). For each axis, p = 0.0196 in which p is equal to the proportion of randomized runs in which the stress is less than or equal to the observed stress. Stress in NMS analysis is calculated based on the distances between data points in the ordination space as compared to the same distances in higher-dimensionality space (McCune and Grace 2002). The cumulative r^2 for the three axes was 0.780. Table 3 lists several environmental and physiognomic variables that showed strong correlations with the axes. As would be expected from these correlations, the palustrine associations and those associations dominated by shrubs and herbaceous vegetation tended to fall within the lower half and the right side of the ordination diagram. Terrestrial associations dominated by trees tended to fall within the upper half and to the left side of the diagram (Figure 7). Axes 1 and 3 were chosen for display in Figure 7 because they provided the clearest visual depiction of the seven groups.

Based on these analyses of multiple lines of evidence, it was determined that the vegetation at Johnstown Flood National Memorial can be described by seven vegetation associations: Red Maple – Black Cherry Successional Forest / Woodland, Eastern Hemlock – Northern Hardwood Forest, Conifer Plantation, Silky Willow Shrub Swamp, Old Field, Cattail Marsh, and Riverine Scour Vegetation. The MRPP indicated that the differences between these seven groups were statistically significant (p=0.00002, A=0.14, T=-5.55).

The species composition and environmental setting of the Old Field association varies widely throughout the park due to past land use, current management prescriptions, and hydrology. Because of this variation, three subtypes were also identified: Herbaceous subtype, Hawthorn subtype, and Wet Meadow subtype. These subtypes are described in detail in the following section.

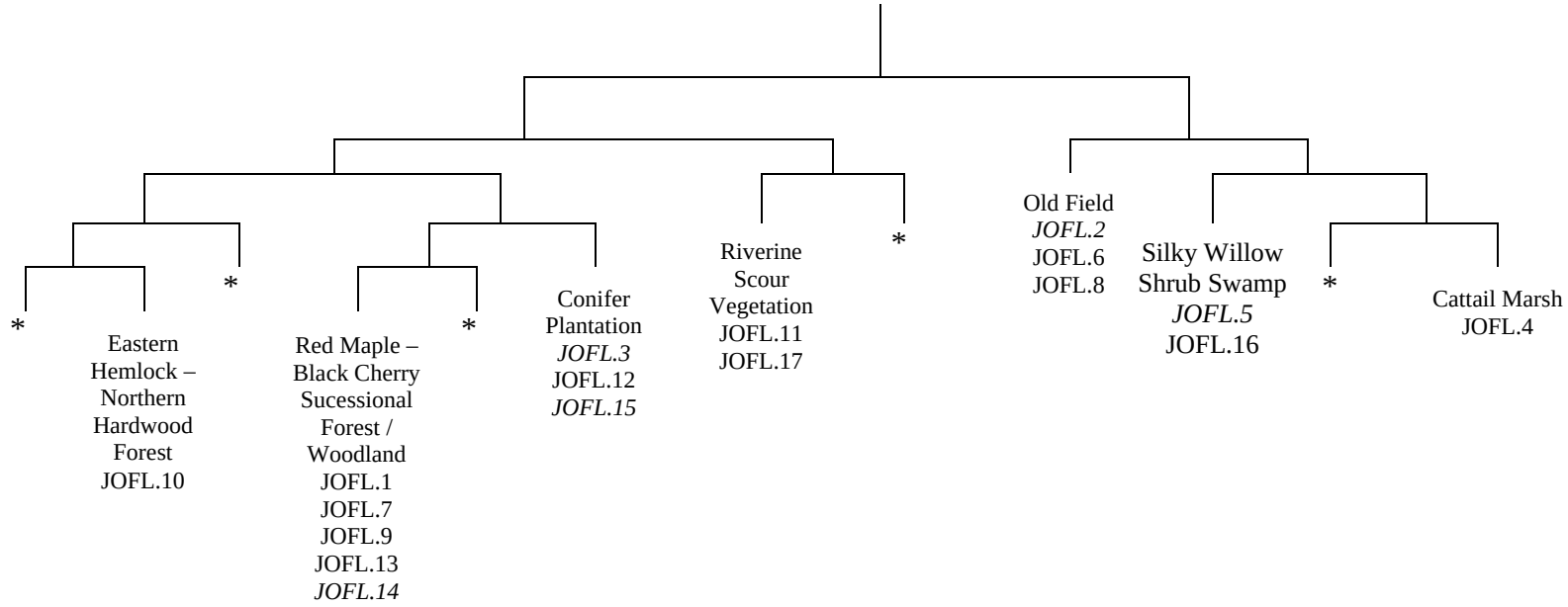

Figure 6. Dendrogram of the two-way indicator species analysis (TWINSPAN) results showing seven vegetation associations in Johnstown Flood National Memorial. The plots that were misclassified by the analysis are labeled in italics and are shown correctly classified. The branches of the dendrogram in which misclassified plots were originally incorrectly located are marked with asterisks (*).

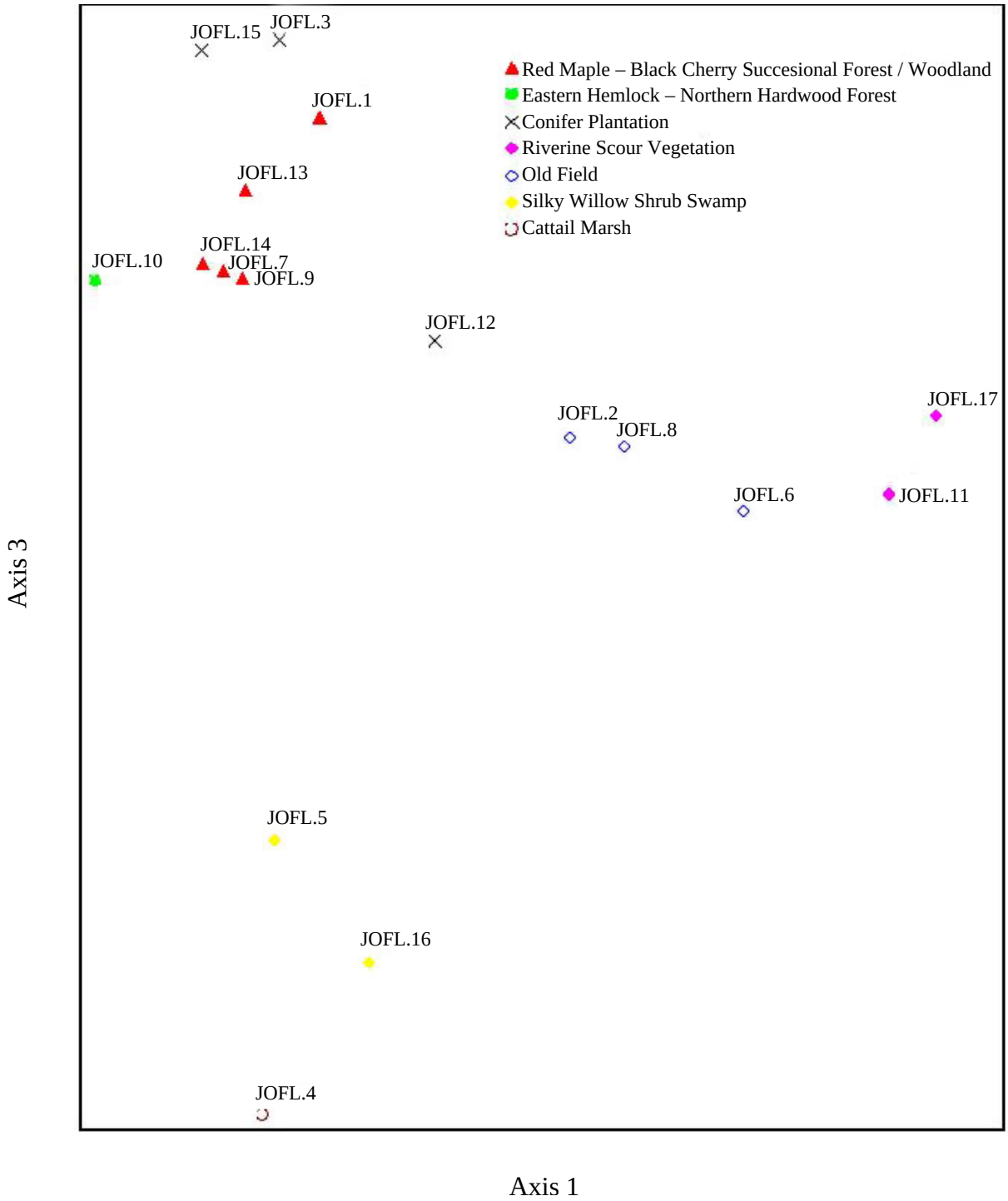

Figure 7. Ordination diagram from the non-metric multidimensional ordination analysis (NMS) showing seven vegetation associations.

Table 3. Correlations (r values) between measured variables and the three axes calculated in the non-metric multidimensional ordination analysis (NMS).

Measured Variable	Axis 1	Axis 2	Axis 3
Species Diversity	-0.450		0.765
Percent cover of emergent trees	-0.615	0.401	0.535
Percent cover of tree canopy	-0.621	0.534	0.681
Percent cover of subcanopy	-0.612	0.423	0.679
Percent cover of tall shrubs	-0.571		-0.436
Percent cover of herbaceous layer		-0.527	-0.422
Unvegetated Surface in Plot			
Percent cover of large rocks	0.634		
Percent cover of small rocks			0.471
Percent cover of litter		0.469	
Percent cover of wood			0.384
Percent cover of sand	0.649		
Percent cover of bare soil	-0.401		
Percent cover of water			-0.726

Vegetation Association Descriptions

Detailed local descriptions for seven vegetation associations were written based on the plot data, photographs of each plot, and the ecologists' field experiences at Johnstown Flood National Memorial. These vegetation associations were then crosswalked to the National Vegetation Classification System (NVCS). Detailed local and global descriptions of the vegetation associations follow. Representative photographs of each vegetation type are provided after each description. An index of these photos is located in Appendix F. A list of the plants found during the vegetation plot sampling and thematic accuracy assessment sampling is located in Appendix C. A bibliography for the sources cited in the global vegetation descriptions from the NVCS is provided in Appendix G.

A dichotomous key was also developed for these seven vegetation associations (Appendix D). The dichotomous key should be used in conjunction with the detailed vegetation community descriptions to confirm that the community selected with the key is appropriate. This key and the detailed vegetation community descriptions were used in the thematic accuracy assessment and may be used by park resource managers and others to identify vegetation communities in the park.

Common Name (Park-specific): Red Maple – Black Cherry Successional Forest / Woodland

SYNONYMS
NVC English Name: **Black Cherry - Tuliptree - Red Maple - White Ash Forest**
NVC Scientific Name: ***Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana* Forest**
NVC Identifier: **CEGL006599**

LOCAL INFORMATION

Environmental Description: This association is the most common forest type at Johnstown Flood National Memorial, occurring on moderate to somewhat steep slopes and moderately well- to well-drained silt loams and clay loams.
Vegetation Description: Due to varied historical land uses in the park, the species composition and vegetation structure of this forest vary. The most characteristic species, however, are red maple (*Acer rubrum*), black cherry (*Prunus serotina*), and occasionally black locust (*Robinia pseudoacacia*). For stands in an earlier successional state, the canopy structure is a woodland with at least 40% tree cover and open areas dominated by characteristic old-field graminoid and herbaceous species. Stands in a later successional state are closed-canopy forest with canopy and subcanopy layers. Tree heights range from 10-33 m. Other associated trees species are hawthorns (*Crataegus* spp.), white ash (*Fraxinus americana*), American beech (*Fagus grandifolia*), sweet birch (*Betula lenta*), and eastern white pine (*Pinus strobus*). This forest type typically contains a tall-shrub layer (2.5-7.5 m in height) that can cover 15-75% of the area. Common tall-shrub species include fanleaf hawthorn (*Crataegus flabellata*), cockspur hawthorn (*Crataegus crus-galli*), white ash, black cherry, red maple, common serviceberry (*Amelanchier arborea*), and northern spicebush (*Lindera benzoin*). A sparse short-shrub layer (<2 m in height) typically covers 15-35% of the forest and contains Allegheny blackberry (*Rubus allegheniensis*), black cherry, chokecherry (*Prunus virginiana*), northern spicebush, white ash, Morrow's honeysuckle (*Lonicera morrowii*), and multiflora rose (*Rosa multiflora*). The species composition of the herbaceous layer (40-80% cover) varies due to diverse canopy structure and past land-use history. Some common species include eastern hayscented fern (*Dennstaedtia punctilobula*), wrinkleleaf goldenrod (*Solidago rugosa*), white wood aster (*Eurybia divaricata*), flattened oatgrass (*Danthonia compressa*), jewelweed (*Impatiens capensis*), intermediate woodfern (*Dryopteris intermedia*), broadleaf enchanter's nightshade (*Circaea lutetiana*), ground ivy (*Glechoma hederacea*), Canadian white violet (*Viola canadensis*), common cinquefoil (*Potentilla simplex*), spotted ladysthumb (*Polygonum persicaria*), bearded shorthusk (*Brachyelytrum erectum*), deertongue (*Dichanthelium clandestinum*), white avens (*Geum canadense*), ribbed sedge (*Carex virescens*), Kentucky bluegrass (*Poa pratensis*), and grove bluegrass (*Poa alsodes*). Vines such as Virginia creeper (*Parthenocissus quinquefolia*) and eastern poison ivy (*Toxicodendron radicans*) are typically found in low abundance.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum, Prunus serotina*
Tree subcanopy	Broad-leaved deciduous tree	*Acer rubrum, Prunus serotina*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Crataegus* spp., *Fraxinus americana*
Short shrub/sapling	Broad-leaved deciduous shrub	*Rubus allegheniensis, Lindera benzoin*
Herb (field)	Forb	*Dennstaedtia punctilobula, Solidago rugosa, Eurybia divaricata*
Herb (field)	Graminoid	*Danthonia compressa*
Vine	Vine	*Parthenocissus quinquefolia*

Characteristic Species: *Acer rubrum, Prunus serotina, Robinia pseudoacacia, Crataegus* spp**.,** *Fraxinus americana*.
Other Noteworthy Species: Information not available.
Local Range: This common forest type is found throughout upland areas of the park.
Classification Comments: While this forest type is variable in species composition and vegetation structure, it is recognizable by the dominance of *Acer rubrum, Prunus serotina,* and/or *Robinia pseudoacacia* in the canopy.
Other Comments: None.
Local Description Authors: S.J. Perles (PNHP).
Plots: JOFL.1, JOFL.7, JOFL.9, JOFL.13, JOFL.14.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Prunus serotina - Acer rubrum - Amelanchier canadensis – Quercus* spp. Forest Alliance (A.237)
Alliance (English name)	Black Cherry - Red Maple - Canada Serviceberry - Oak species Forest Alliance
Association	*Prunus serotina - Liriodendron tulipifera - Acer rubrum – Fraxinus americana* Forest
Association (English name)	Black Cherry - Tuliptree - Red Maple - White Ash Forest
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: This early-successional woody vegetation of the northeastern United States occurs on sites that have generally been cleared for agriculture. Environmental setting varies, but generally sites are dry-mesic to mesic, with small seepage inclusions in some examples. Physiognomy of this vegetation is highly variable, ranging from closed forest, open forest, tall dense shrubland, to more open tall shrubland. Early-successional woody species dominate the canopy in a widely variable mix, depending on geographic location. Tree species may include *Prunus serotina, Liriodendron tulipifera, Fraxinus americana,* and *Acer rubrum*. Other associates can include *Juglans nigra, Sassafras albidum, Betula populifolia, Juniperus*

virginiana, Acer negundo, Acer saccharinum, Ailanthus altissima, Ulmus americana, Quercus spp., *Betula lenta, Amelanchier* spp., and *Robinia pseudoacacia*. Other woody species may contribute to the canopy or form a tall-shrub layer, including *Lindera benzoin* and *Carpinus caroliniana*. The low-shrub layer, if present, is usually characterized by the presence of *Rubus* spp. such as *Rubus flagellaris, Rubus allegheniensis, Rubus phoenicolasius,* or *Rubus hispidus*. This layer is often dominated by exotic species such as *Lonicera tatarica, Lonicera japonica, Rhamnus cathartica, Crataegus* spp., *Rosa multiflora*, and *Berberis thunbergii*. The herbaceous layer is variable, often containing grasses and forbs of both native and exotic origin.
Environmental Description: This vegetation occurs on sites that have been cleared for agriculture or otherwise heavily modified in the past. Generally sites are dry-mesic and may have small seepage inclusions in some examples.
Vegetation Description: Information not available.
Most Abundant Species: Information not available.
Characteristic Species: Information not available.
Other Noteworthy Species: Information not available.
USFWS Wetland System: Information not available.

DISTRIBUTION
Range: This vegetation is currently described from Pennsylvania but is of broader distribution in the northeastern U.S.
States/Provinces: NJ, NY, PA.
Federal Lands: NPS (Fort Necessity, Johnstown Flood, Morristown, Valley Forge).

CONSERVATION STATUS
Rank: GNA (ruderal) (29-Nov-2004).
Reasons: This vegetation is modified by human activity and not of conservation concern.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 3 – Weak.
Comments: This vegetation is broadly defined and varies widely in composition across its range, presenting a classification challenge at the alliance level.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES
Description Authors: L.A. Sneddon.
References: Eastern Ecology Working Group n.d., Fike 1999.

Figure 8. Red Maple – Black Cherry Successional Forest / Woodland at Johnstown Flood National Memorial (plot JOFL.7). July 2004. NAD 1983 / UTM easting 689173, northing 4468314.

Figure 9. Red Maple – Black Cherry Successional Forest / Woodland at Johnstown Flood National Memorial (plot JOFL.14). July 2004. NAD 1983 / UTM easting 689110, northing 4469029.

Common Name (Park-specific): Eastern Hemlock - Northern Hardwood Forest

SYNONYMS

NVC English Name: **Eastern Hemlock - Yellow Birch Lower New England / Northern Piedmont Forest**

NVC Scientific Name: ***Tsuga canadensis - Betula alleghaniensis* Lower New England / Northern Piedmont Forest**

NVC Identifier: **CEGL006109**

LOCAL INFORMATION

Environmental Description: This forest type occurs on north-facing slopes on moderately well-drained clay loam soils.

Vegetation Description: Eastern hemlock (*Tsuga canadensis*) is the diagnostic species for this community type, occurring in the moderately dense emergent tree layer (33 m in height) and canopy layer (24 m in height). Other canopy associates include sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), white ash (*Fraxinus americana*), northern red oak (*Quercus rubra*), black cherry (*Prunus serotina*), sweet birch (*Betula lenta*), and yellow birch (*Betula alleghaniensis*). A sparse subcanopy (15-20 m in height) may contain sugar maple and red maple (*Acer rubrum*). American beech, striped maple (*Acer pensylvanicum*), black cherry, and hophornbeam (*Ostrya virginiana*) create a moderately dense tall-shrub layer (2.5-6 m in height). These woody species are also found in the sparse short-shrub layer, along with northern spicebush (*Lindera benzoin*) and several species of raspberry (*Rubus* spp.). A dense herbaceous layer contains a diversity of species, including jewelweed (*Impatiens capensis*), silver false spleenwort (*Deparia acrostichoides*), mayapple (*Podophyllum peltatum*), wrinkleleaf goldenrod (*Solidago rugosa*), heartleaf foam flower (*Tiarella cordifolia*), white wood aster (*Eurybia divaricata*), ground ivy (*Glechoma hederacea*), Jack in the pulpit (*Arisaema triphyllum*), black bugbane (*Cimicifuga racemosa*), and New York fern (*Thelypteris noveboracensis*). Grape vines (*Vitis* spp.) can cover up to 25% of the forest and climb on tall shrubs and subcanopy trees. This forest type is susceptible to invasion by Morrow's honeysuckle (*Lonicera morrowii*) and multiflora rose (*Rosa multiflora*).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Tsuga canadensis*
Tree subcanopy	Broad-leaved deciduous tree	*Acer saccharum, Acer rubrum*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Fagus grandifolia, Acer pensylvanicum*
Short shrub/sapling	Broad-leaved deciduous shrub	*Lindera benzoin, Rubus* spp.
Herb (field)	Forb	*Impatiens capensis, Deparia acrostichoides, Podophyllum peltatum*
Vine	Vine	*Vitis* spp.

Characteristic Species: *Tsuga canadensis, Acer saccharum, Acer rubrum, Fagus grandifolia, Deparia acrostichoides, Podophyllum peltatum*.

Other Noteworthy Species: Information not available.

Local Range: This forest type occurs on north-facing slopes on the old dam abutments and along a stream near the park's eastern boundary.

Classification Comments: The fit with NVC type CEGL006109 is less than ideal. Johnstown Flood vegetation contains a richer herbaceous flora than does CEGL006109 in that it contains *Podophyllum peltatum*, *Arisaema triphyllum*, and *Cimicifuga racemosa*, suggesting a more nutrient-rich soil than is generally characteristic of CEGL006109. There is a slightly better match floristically with *Quercus rubra - Tsuga canadensis - Liriodendron tulipifera / Hamamelis virginiana* Forest (CEGL006566) of the *Tsuga canadensis - Liriodendron tulipifera* Forest Alliance (A.413), in the shared presence of *Podophyllum peltatum*, but *Liriodendron tulipifera* is not present in any Johnstown Flood vegetation types.
Other Comments: None.
Local Description Authors: S.J. Perles (PNHP).
Plots: JOFL.10.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Mixed evergreen-deciduous forest (I.C.)
Physiognomic Group	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.)
Physiognomic Subgroup	Natural/Semi-natural mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.)
Formation	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.a.)
Alliance	*Tsuga canadensis - Betula alleghaniensis* Forest Alliance (A.412)
Alliance (English name)	Eastern Hemlock - Yellow Birch Forest Alliance
Association	*Tsuga canadensis - Betula alleghaniensis* Lower New England / Northern Piedmont Forest
Association (English name)	Eastern Hemlock - Yellow Birch Lower New England / Northern Piedmont Forest
Ecological System(s):	Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593)

GLOBAL DESCRIPTION

Concept Summary: This association comprises mixed hemlock - northern hardwood forests of the northeastern United States. This forest is associated with cool, dry-mesic to mesic sites and acidic soils, often on rocky, north-facing slopes. Soils can have a thick, poorly decomposed duff layer over sandy loams. *Tsuga canadensis* is dominant and forms at least 50% of the canopy. *Betula alleghaniensis* can be codominant, with *Fagus grandifolia* and *Acer saccharum* common but not usually abundant in all but the very southern portion of the range of this type. *Quercus* spp. and *Pinus strobus* tend to be absent or, if present, only occur with low abundance. The shrub layer may be dense to fairly open and often includes *Viburnum acerifolium* and *Acer pensylvanicum* in addition to *Tsuga canadensis* regeneration. Herbs may be sparse, particularly in dense shade, but often include *Dryopteris intermedia*, *Medeola virginiana*, *Oxalis montana*, *Mitchella repens*, *Maianthemum canadense*, *Trientalis borealis*, *Huperzia lucidula*, *Eurybia divaricata*, and *Thelypteris noveboracensis*. Nonvascular plants may be well-developed, often characterized by the liverwort *Bazzania trilobata*. Diagnostic characteristics of this forest are the presence of *Betula alleghaniensis* and *Acer saccharum* and a lack of abundant *Quercus* spp., *Pinus strobus*, or *Betula lenta*.

Environmental Description: This forest is associated with cool, dry-mesic to mesic sites and acidic soils, often on rocky, north-facing slopes. Soils can have a thick, poorly decomposed duff layer over sandy loams.
Vegetation Description: *Tsuga canadensis* is dominant and forms at least 50% of the canopy. *Betula alleghaniensis* can be codominant, with *Fagus grandifolia* and *Acer saccharum* common but not usually abundant in all but the very southern portion of the range for this type. The shrub layer may be dense to fairly open, and often includes *Viburnum acerifolium* and *Acer pensylvanicum* in addition to *Tsuga canadensis* regeneration. Herbs may be sparse, particularly in dense shade, but often include *Dryopteris intermedia, Medeola virginiana, Oxalis montana, Mitchella repens, Maianthemum canadense, Trientalis borealis, Huperzia lucidula, Eurybia divaricata*, and *Thelypteris noveboracensis*. Nonvascular plants may be well-developed, often characterized by the liverwort *Bazzania trilobata*. Diagnostic characteristics of this forest are the presence of *Betula alleghaniensis* and *Acer saccharum* and a lack of abundant *Quercus* spp., *Pinus strobus*, or *Betula lenta*.
Most Abundant Species: Information not available.
Characteristic Species: *Betula alleghaniensis, Carex albicans, Dryopteris intermedia, Huperzia lucidula, Maianthemum canadense, Medeola virginiana, Mitchella repens, Oclemena acuminata, Tsuga canadensis, Viola rotundifolia*.
Other Noteworthy Species: Information not available.
USFWS Wetland System: Information not available.

DISTRIBUTION

Range: This community is generally distributed in large patches from New Hampshire south through New England, becoming more local in the north Atlantic Piedmont and restricted to local patches at higher elevations of the Central Appalachians in Maryland, West Virginia, and Virginia. In Virginia it is restricted to the northwestern part of the state, where occurrences are rather local but sometimes extensive.
States/Provinces: CT, MA, MD, NH, NJ:S3, NY, PA, RI, VA:S3, VT, WV?
Federal Lands: NPS (Johnstown Flood, Shenandoah); USFS (George Washington?).

CONSERVATION STATUS

Rank: G4? (31-Dec-1997).
Reasons: This association has a very large geographic distribution and occurs in large patches in the northern part of its range. All stands of this community are now highly threatened by the exotic insect pest hemlock woolly adelgid (*Adelges tsugae*), which causes decline and eventual mortality in *Tsuga canadensis*.

CLASSIFICATION INFORMATION

Status: Standard.
Confidence: 2 – Moderate.
Comments: Many stands of this vegetation type in the national forests and Shenandoah National Park have been devastated during the past decade by adelgid-caused tree mortality. In some cases, 100% of the canopy hemlocks have been killed, littering the forest floor with downed wood and stimulating massive increases in understory growth, particularly of *Betula* spp. and *Acer pensylvanicum*. Since there is no practical treatment for the adelgid on a landscape level, one can only hope that natural pathogens will emerge to keep the adelgid in check before all of our examples of this community are severely degraded or lost.

Similar Associations:

Betula alleghaniensis - (Tsuga canadensis) / Rhododendron maximum / Leucothoe fontanesiana Forest (CEGL007861)

Tsuga canadensis - (Betula alleghaniensis) - Picea rubens / Cornus canadensis Forest (CEGL006129)

Tsuga canadensis - (Betula alleghaniensis, Quercus rubra) / Ilex montana / Rhododendron catawbiense Forest (CEGL008513)

Tsuga canadensis - Fagus grandifolia - Quercus rubra Forest (CEGL006088).

Related Concepts:

Betula alleghaniensis - Tsuga canadensis / Dryopteris intermedia - Huperzia lucidula Forest (Coulling and Rawinski 1999) ?

Tsuga canadensis - Betula (alleghaniensis, lenta) / Dryopteris intermedia Forest (Fleming and Coulling 2001) ?

Tsuga canadensis - Betula lenta - Betula alleghaniensis Association (Fleming and Moorhead 1996) ?

Tsuga canadensis / Dryopteris intermedia / Bazzania trilobata Association (Rawinski et al. 1994) ?

CNE dry transitional forest on sandy / gravelly soils (Rawinski 1984) ?

CNE mesic conifer [transition] forest on acidic bedrock/till (Rawinski 1984) B

CNE mesic hardwood forest on acidic bedrock/till (Rawinski 1984) B

Eastern Hemlock: 23 (Eyre 1980) B

Hemlock - Yellow Birch: 24 (Eyre 1980) B

Hemlock Forest (Thompson 1996) B

Mesic Hemlock-Hardwood Forest (Breden 1989) B

SOURCES

Description Authors: S.L. Neid.

References: Breden 1989, Breden et al. 2001, Coulling and Rawinski 1999, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1993, Eyre 1980, Fleming and Coulling 2001, Fleming and Moorhead 1996, Fleming et al. 2001, Gawler 2002, Metzler and Barrett 2001, NAP pers. comm. 1998, Rawinski 1984, Rawinski et al. 1994, Smith 1983, Sperduto 2000a, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000.

Figure 10. Eastern Hemlock – Northern Hardwood Forest at Johnstown Flood National Memorial (plot JOFL.10). July 2004. NAD 1983 / UTM easting 688849, northing 4468798.

Common Name (Park-specific): Conifer Plantation

SYNONYMS
NVC English Name: **Conifer Plantation**
NVC Scientific Name: **Conifer Plantation**
NVC Identifier: **CEGL006313**

LOCAL INFORMATION

Environmental Description: Several conifer plantations were established in Johnstown Flood National Memorial and are currently in various stages of management. While most of the planted conifers have been removed from the lakebed, a few small patches of conifer plantations remain near the south end of the lakebed.

Vegetation Description: These small forest stands are dominated by a canopy of eastern white pine (*Pinus strobus*), Scotch pine (*Pinus sylvestris*), or red pine (*Pinus resinosa*) ranging in height from 20-26 m. The moderately dense subcanopy (15-20 m in height) contains a diversity of adventitious hardwoods such as sugar maple (*Acer saccharum*), sweet birch (*Betula lenta*), black cherry (*Prunus serotina*), red maple (*Acer rubrum*), yellow birch (*Betula alleghaniensis*), white ash (*Fraxinus americana*), cultivated apple (*Malus pumila*), and American beech (*Fagus grandifolia*). These same tree species can also be found in the sparse to moderately dense tall-shrub (2.5-7.5 m in height) and short-shrub (<2 m in height) layers. Fanleaf hawthorn (*Crataegus flabellata*) and northern spicebush (*Lindera benzoin*) are other commonly occurring shrubs. The herbaceous layer can be sparse to moderately dense and is dominated by New York fern (*Thelypteris noveboracensis*), asters (Asteraceae spp.), Canada mayflower (*Maianthemum canadense*), Canadian white violet (*Viola canadensis*), ribbed sedge (*Carex virescens*), and wrinkleleaf goldenrod (*Solidago rugosa*). Other associate species include flattened oatgrass (*Danthonia compressa*), sweet vernalgrass (*Anthoxanthum odoratum*), eastern hayscented fern (*Dennstaedtia punctilobula*), wild sarsaparilla (*Aralia nudicaulis*), intermediate woodfern (*Dryopteris intermedia*), and Jack in the pulpit (*Arisaema triphyllum*). This forest type is susceptible to invasion by garlic mustard (*Alliaria petiolata*), Tatarian honeysuckle (*Lonicera tatarica*), Morrow's honeysuckle (*Lonicera morrowii*), multiflora rose (*Rosa multiflora*), and Japanese barberry (*Berberis thunbergii*).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus strobus, Pinus sylvestris, Pinus resinosa*
Tree subcanopy	Broad-leaved deciduous tree	*Acer saccharum, Betula lenta, Prunus serotina, Acer rubrum*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Crataegus flabellata, Fraxinus americana*
Short shrub/sapling	Broad-leaved deciduous shrub	*Lonicera morrowii, Lindera benzoin*
Herb (field)	Graminoid	*Carex virescens*
Herb (field)	Forb	*Thelypteris noveboracensis, Maianthemum canadense,*
Vine	Vine	*Vitis* spp.

Characteristic Species: *Pinus strobus, Pinus sylvestris, Pinus resinosa, Thelypteris noveboracensis, Maianthemum canadense, Viola canadensis, Carex virescens.*
Other Noteworthy Species: Information not available.
Local Range: This forest type occurs in a few small patches near the south end of the lakebed.
Classification Comments: This is a local type only and does not have a crosswalk to the NVC.
Other Comments: None.
Local Description Authors: S.J. Perles (PNHP).
Plots: JOFL.3, JOFL.12, JOFL.15.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Information not available
Physiognomic Subclass	Information not available
Physiognomic Group	Information not available
Physiognomic Subgroup	Information not available
Formation	Information not available
Alliance	Information not available
Alliance (English name)	Information not available
Association	Conifer Plantation
Association (English name)	Conifer Plantation
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: Information not available.
Environmental Description: Information not available.
Vegetation Description: Information not available.
Most Abundant Species: Information not available.
Characteristic Species: Information not available.
Other Noteworthy Species: Information not available.
USFWS Wetland System: Information not available.

DISTRIBUTION

Range: Information not available.
States/Provinces: PA.
Federal Lands: NPS (Fort Necessity, Johnstown Flood).

CONSERVATION STATUS

Rank: GNA (modified/managed) (1-Dec-2004).
Reasons: This vegetation is modified by human activity and not of conservation concern.

CLASSIFICATION INFORMATION

Status: Nonstandard.
Confidence: Information not available.
Comments: Information not available.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES
Description Authors: Information not available.
References: Eastern Ecology Working Group n.d.

Figure 11. Conifer Plantation at Johnstown Flood National Memorial (plot JOFL.15). July 2004. NAD 1983 / UTM easting 689095, northing 4467945.

Common Name (Park-specific): Silky Willow Shrub Swamp

SYNONYMS
NVC English Name: **Silky Willow Shrubland**
NVC Scientific Name: ***Salix sericea* Shrubland**
NVC Identifier: **CEGL006305**

LOCAL INFORMATION

Environmental Description: This association is found in a low-lying area of Johnstown Flood National Memorial in very poorly drained muck soils. Drainage through this area is partially impounded by the railroad berm; therefore, standing water persists for most of the growing season.
Vegetation Description: Silky willow (*Salix sericea*) is the diagnostic species for this community. It occurs in the tall (2-3.5 m in height) and short (<2 m in height) shrub layers that can cover up to 70% of the area. A thick herbaceous layer (approximately 80% cover) of hydrophytic species is also characteristic of this community. Fringed loosestrife (*Lysimachia ciliata*), broadleaf cattail (*Typha latifolia*), fowl mannagrass (*Glyceria striata*), rice cutgrass (*Leersia oryzoides*), common rush (*Juncus effusus*), jewelweed (*Impatiens capensis*), flat-top goldentop (*Euthamia graminifolia*), and rough bedstraw (*Galium asprellum*) are the most common ground story species. Other associates include swamp verbena (*Verbena hastata*), wrinkleleaf goldenrod (*Solidago rugosa*), sensitive fern (*Onoclea sensibilis*), climbing nightshade (*Solanum dulcamara*), sedges (*Carex stipata, C. stricta, C. rosea, C. crinita, C. folliculata, C. lurida*), steeplebush (*Spiraea tomentosa*), common boneset (*Eupatorium perfoliatum*), cinnamon fern (*Osmunda cinnamomea*), reed canary grass (*Phalaris arundinacea*), and skunk cabbage (*Symplocarpus foetidus*). Sphagnums (*Sphagnum* spp.) can cover up to 10% of the wetland. This community type is susceptible to invasion by Morrow's honeysuckle (*Lonicera morrowii*).
Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Salix sericea*
Short shrub/sapling	Broad-leaved deciduous shrub	*Salix sericea*
Herb (field)	Graminoid	*Glyceria striata, Leersia oryzoides, Juncus effusus*
Herb (field)	Forb	*Lysimachia ciliata, Typha latifolia*

Characteristic Species: *Salix sericea, Glyceria striata, Leersia oryzoides, Juncus effusus, Lysimachia ciliata, Typha latifolia.*
Other Noteworthy Species: Information not available.
Local Range: This association occurs in the former lakebed, most prominently on the northeast side of the railroad berm, and in small patches in the old field vegetation on the river's west shore.
Classification Comments: This association can be identified by the dominance of *Salix sericea* in layers of thick shrubs.
Other Comments: None.
Local Description Authors: S.J. Perles (PNHP).
Plots: JOFL.5, JOFL.16.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Deciduous shrubland (III.B.)
Physiognomic Group	Cold-deciduous shrubland (III.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
Formation	Seasonally flooded cold-deciduous shrubland (III.B.2.N.e.)
Alliance	*Salix sericea* Seasonally Flooded Shrubland Alliance (A.3028)
Alliance (English name)	Silky Willow Seasonally Flooded Shrubland Alliance
Association	*Salix sericea* Shrubland
Association (English name)	Silky Willow Shrubland
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: This willow shrub swamp is known from the Central Appalachians of Pennsylvania and West Virginia. This vegetation, or a related type dominated by *Salix sericea*, is also known from Connecticut, New York, and New Jersey. The vegetation occurs in topographic basins, floodplain backswamps, along slow-moving streams, or on lakeshores. *Salix sericea* is dominant, forming a tall-shrub canopy 2-3 m in height. An associated shrub in the Central Appalachian region is *Hypericum densiflorum*. The herbaceous layer is often dense and variable, including *Solidago rugosa, Euthamia graminifolia, Glyceria striata, Glyceria canadensis, Juncus effusus, Carex stipata, Carex lurida*, and other herbs.

Environmental Description: The vegetation occurs in topographic basins, floodplain backswamps, along slow-moving streams, or on lakeshores.

Vegetation Description: *Salix sericea* is dominant, forming a tall-shrub canopy 2-3 m in height. An associated shrub in the Central Appalachian region is *Hypericum densiflorum*. The herbaceous layer is often dense and variable, including *Solidago rugosa, Euthamia graminifolia, Glyceria striata, Glyceria canadensis, Juncus effusus, Carex stipata, Carex lurida*, and other herbs.

Most Abundant Species: Information not available.

Characteristic Species: Information not available.

Other Noteworthy Species: Information not available.

USFWS Wetland System: Information not available.

DISTRIBUTION

Range: This vegetation occurs in the Central Appalachians and may extend into New York and Connecticut.

States/Provinces: CT, NJ, NY, PA, WV.

Federal Lands: NPS (Johnstown Flood); USFS (Monongahela).

CONSERVATION STATUS

Rank: GNR (10-Mar-2005).

Reasons: Much more information is needed about this vegetation across its range to assign a global rank.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 3 – Weak.
Comments: Information not available.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES
Description Authors: L.A. Sneddon.
References: Eastern Ecology Working Group n.d., Egler and Niering 1976, Gordon 1937b, Niering 1953, WVNHP n.d.b, Walbridge and Lang 1982.

Figure 12. Silky Willow Shrub Swamp at Johnstown Flood National Memorial (plot JOFL.5). July 2004. NAD 1983 / UTM easting 689060, northing 4468754.

Common Name (Park-specific): Old Field (Herbaceous subtype)

SYNONYMS
NVC English Name: **Orchard Grass - Sheep-sorrel Herbaceous Vegetation**
NVC Scientific Name: ***Dactylis glomerata - Rumex acetosella* Herbaceous Vegetation**
NVC Identifier: **CEGL006107**

LOCAL INFORMATION

Environmental Description: This type occurs on the gentle to steeply sloping fields above the former lakebed of Lake Conemaugh and surrounding the park's visitors center. These fields have not been farmed since the breech of the dam; however, they are still actively managed by the park resource managers. The soil is typically moderately well-drained silt loam or clay loam.
Vegetation Description: The Herbaceous subtype is dominated by graminoid and herbaceous species and is actively maintained in an open state by the park resource management staff. Although species dominance has a patchy distribution through this subtype, the primary species in the graminoid-herbaceous matrix are wrinkleleaf goldenrod (*Solidago rugosa*), timothy (*Phleum pratense*), shiny wedgescale (*Sphenopholis nitida*), sweet vernalgrass (*Anthoxanthum odoratum*), flat-top goldentop (*Euthamia graminifolia*), Canada goldenrod (*Solidago canadensis*), early goldenrod (*Solidago juncea*), and big bluestem (*Andropogon gerardii*). Other common species include Virginia strawberry (*Fragaria virginiana*), meadow ryegrass (*Lolium pratense*), ox eye daisy (*Leucanthemum vulgare*), deertongue (*Dichanthelium clandestinum*), poverty rush (*Juncus tenuis*), flattened oatgrass (*Danthonia compressa*), hoary mountainmint (*Pycnanthemum incanum*), broom sedge bluestem (*Andropogon virginicus*), spreading dogbane (*Apocynum androsaemifolium*), ground ivy (*Glechoma hederacea*), cinquefoil (*Potentilla* spp.), little bluestem (*Schizachyrium scoparium*), common velvetgrass (*Holcus lanatus*), Swan's sedge (*Carex swanii*), and prairie fleabane (*Erigeron strigosus*). Short shrubs (<2 m in height) may cover up to 25% of the field, with such species as Allegheny blackberry (*Rubus allegheniensis*) and steeplebush (*Spiraea tomentosa*). Virginia creeper (*Parthenocissus quinquefolia*) may be a common vine, covering up to 10% of the area. These fields are often susceptible to invasion by the exotic purple crownvetch (*Coronilla varia*).
Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Rubus allegheniensis, Spiraea tomentosa*
Herb (field)	Graminoid	*Phleum pratense, Sphenopholis nitida, Anthoxanthum odoratum*
Herb (field)	Forb	*Solidago* spp., *Euthamia graminifolia,*
Vine	Vine	*Parthenocissus quinquefolia*

Characteristic Species: *Solidago* spp. (numerous species), *Phleum pratense, Anthoxanthum odoratum, Euthamia graminifolia, Andropogon gerardii.*
Other Noteworthy Species: Information not available.
Local Range: This vegetation type occurs throughout the lakebed and on upland areas in the eastern portion of the park.
Classification Comments: The vegetation structure and species composition of the old fields in Johnstown Flood vary widely. The structure and composition of the old fields are influenced by past land use, current management prescriptions, and hydrology. The old field vegetation can be

divided into three subtypes: Herbaceous, Wet Meadow and Crataegus subtypes. Within one mapped old field polygon, multiple subtypes can be present. The boundaries and distinctions between these subtypes may not be definitive in the field.
Other Comments: None.
Local Description Authors: S.J. Perles (PNHP).
Plots: JOFL.2, JOFL.6; AA Points 4, 5, 25, 26.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Medium-tall sod temperate or subpolar grassland (V.A.5.N.c.)
Alliance	*Dactylis glomerata* - *Rumex acetosella* Herbaceous Alliance (A.1190)
Alliance (English name)	Orchard Grass - Sheep-sorrel Herbaceous Alliance
Association	*Dactylis glomerata* - *Rumex acetosella* Herbaceous Vegetation
Association (English name)	Orchard Grass - Sheep-sorrel Herbaceous Vegetation
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: This broadly defined vegetation type includes pasture and post-agricultural fields and is largely composed of nonnative grasses and herbs in the early stages of succession (generally of European origin). Physiognomically, these grasslands are generally comprised of mid-height (1-3 feet tall) grasses and forbs, with occasional scattered shrubs. Species composition varies from site to site, depending on land-use history and perhaps soil type, but in general, this vegetation is quite wide-ranging in northeastern and midwestern states, and at higher elevations (610-1220 m [2000-4000 feet]) in the southeastern states. In addition to the nominal species, other associates may include *Phleum pratense, Lolium perenne, Agrostis hyemalis, Elymus repens, Oxalis stricta, Schizachyrium scoparium, Achillea millefolium, Asclepias syriaca, Chenopodium album, Bromus tectorum, Bromus inermis*, and many others.
Environmental Description: Information not available.
Vegetation Description: In addition to *Dactylis glomerata* and *Rumex acetosella* these grassy fields are characterized by *Symphyotrichum* spp. (including *Symphyotrichum lateriflorum* var. *lateriflorum* and *Symphyotrichum novae-angliae*), *Rudbeckia hirta, Pteridium aquilinum, Chenopodium album, Asclepias syriaca, Andropogon virginicus, Schizachyrium scoparium, Phytolacca americana, Phleum pratense, Poa pratensis, Poa compressa, Elymus repens, Bromus inermis, Solidago* spp. (including *Solidago rugosa, Solidago nemoralis, Solidago juncea, Solidago canadensis, Solidago altissima), Euthamia graminifolia, Oenothera biennis, Potentilla simplex, Daucus carota, Ambrosia artemisiifolia, Hieracium* spp., *Taraxacum officinale, Vicia cracca, Trifolium* spp., and many others.
Most Abundant Species: Information not available.
Characteristic Species: Information not available.
Other Noteworthy Species: Information not available.
USFWS Wetland System: Information not available.

DISTRIBUTION

Range: This vegetation is quite wide-ranging in northeastern and midwestern states, and possibly occurs at higher elevations in the southeastern states.

States/Provinces: CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, TN, VA, VT, WV.

Federal Lands: NPS (Cape Cod, Cumberland Gap, Fort Necessity, Johnstown Flood, Morristown).

CONSERVATION STATUS

Rank: GNA (invasive) (28-Jan-2002).

Reasons: This vegetation type includes pasture and post-agricultural fields, and is largely composed of nonnative grasses and herbs (generally of European origin).

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 3 – Weak.

Comments: Information not available.

Similar Associations:

Dactylis glomerata - *Solidago* spp. Herbaceous Vegetation (CEGL006517)

Lolium (arundinaceum, pratense) Herbaceous Vegetation (CEGL004048)

Phleum pratense - *Bromus pubescens* - *Helenium autumnale* Herbaceous Vegetation (CEGL004018)

Related Concepts: Information not available.

SOURCES

Description Authors: Information not available.

References: Eastern Ecology Working Group n.d.

Figure 13. Herbaceous subtype of Old Field vegetation at Johnstown Flood National Memorial (plot JOFL.2). July 2004. NAD 1983 / UTM easting 689290, northing 4468826.

Figure 14. Herbaceous subtype of Old Field vegetation at Johnstown Flood National Memorial (plot JOFL.6). July 2004. NAD 1983 / UTM easting 688939, northing 4468691.

Common Name (Park-specific): Old Field (Wet Meadow subtype)

SYNONYMS
NVC English Name: **Steeplebush - Blackberry species / Reed Canarygrass Shrubland**
NVC Scientific Name: ***Spiraea tomentosa - Rubus spp. / Phalaris arundinacea* Shrubland**
NVC Identifier: **CEGL006571**

LOCAL INFORMATION

Environmental Description: This type occurs in low-lying sections of the lakebed of former Lake Conemaugh. These low-lying areas of the old field may be saturated for part of the year. The available surface water greatly influences the species composition of this subtype. These fields have not been farmed since the breech of the dam; however, they are still actively managed by the park resource managers.
Vegetation Description: In the Wet Meadow subtype, wrinkleleaf goldenrod (*Solidago rugosa*) is often dominant, with hydrophytic species as associates, such as arrowleaf tearthumb (*Polygonum sagittatum*), sedges (*Carex scoparia, C. lurida, C. vulpinoidea*), purplestem aster (*Symphyotrichum puniceum* var. *puniceum*), rice cutgrass (*Leersia oryzoides*), spikerush (*Eleocharis* spp.), common rush (*Juncus effusus*), hardstem bulrush (*Schoenoplectus acutus* var. *acutus*), creeping bentgrass (*Agrostis stolonifera*), and rough bentgrass (*Agrostis scabra*). Broadleaf cattail (*Typha latifolia*) may also be present in occasional patches. Big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), and switchgrass (*Panicum virgatum*) are prevalent throughout the former lakebed as a result of restoration plantings. Other upland species such as deertongue (*Dichanthelium clandestinum*) and flat-top goldentop (*Euthamia graminifolia*) typically found in the herbaceous subtype may also be common in the wet meadow subtype. Invasive species such as purple crownvetch (*Coronilla varia*) and reed canary grass (*Phalaris arundinacea*) often make up a large component of the herbaceous layer. Willows (*Salix* spp.), alders (*Alnus* spp.), Allegheny blackberry (*Rubus allegheniensis*), and Morrow's honeysuckle (*Lonicera morrowii*) often occur in dense small patches within the wet meadow subtype.
Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Salix* spp., *Alnus* spp., *Rubus allegheniensis, Lonicera morrowii*
Herb (field)	Graminoid	*Carex* spp., *Leersia oryzoides, Eleocharis* spp.
Herb (field)	Forb	*Solidago rugosa, Polygonum sagittatum, Aster puniceus*

Characteristic Species: *Solidago rugosa, Polygonum sagittatum, Aster puniceus, Carex* spp., *Leersia oryzoides, Eleocharis* spp.
Other Noteworthy Species: Information not available.
Local Range: This vegetation type occurs in low-lying areas of the lakebed of former Lake Conemaugh.
Classification Comments: The vegetation structure and species composition of the old fields in Johnstown Flood vary widely. The structure and composition of the old fields are influenced by past land use, current management prescriptions, and hydrology. The old field vegetation can be

divided into three subtypes: Herbaceous, Wet Meadow and Crataegus subtypes. Within one mapped old field polygon, multiple subtypes can be present. The boundaries and distinctions between these subtypes may not be definitive in the field.
Other Comments: None.
Local Description Authors: S.J. Perles (PNHP).
Plots: JOFL.8; AA Points 8, 11, 14.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Deciduous shrubland (III.B.)
Physiognomic Group	Cold-deciduous shrubland (III.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
Formation	Seasonally flooded cold-deciduous shrubland (III.B.2.N.e.)
Alliance	*Spiraea tomentosa* - *Rubus* spp. Seasonally Flooded Shrubland Alliance (A.3022)
Alliance (English name)	Steeplebush - Blackberry species Seasonally Flooded Shrubland Alliance
Association	*Spiraea tomentosa* - *Rubus* spp. / *Phalaris arundinacea* Shrubland
Association (English name)	Steeplebush - Blackberry species / Reed Canarygrass Shrubland
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: This wet meadow vegetation of the northeastern states occurs in a variety of settings, most frequently in low-lying areas of old fields or pastures, or beaver-impacted wetlands. The physiognomy is complex and variable, ranging from shrub thicket to herbaceous meadow with scattered shrubs. Shrub species usually include *Spiraea tomentosa, Spiraea alba var. alba, Rubus allegheniensis, Rubus hispidus, Lonicera morrowii, Salix* spp., and others. *Hypericum densiflorum* often occurs in the Central Appalachians. Associated herbaceous species are also variable in composition, depending on land-use history. Usually seen are *Phalaris arundinacea, Solidago rugosa, Solidago canadensis, Juncus effusus, Scirpus cyperinus, Leersia oryzoides, Carex scoparia, Carex folliculata, Carex lurida, Carex lupulina, Carex vulpinoidea, Vernonia noveboracensis, Eupatorium maculatum, Eleocharis* spp., and others.
Environmental Description: This wet meadow vegetation of the northeastern states occurs in a variety of settings, most frequently in low-lying areas of old fields or pastures, or beaver-impacted wetlands.
Vegetation Description: The physiognomy is complex and variable, ranging from shrub thicket to herbaceous meadow with scattered shrubs. Shrub species usually include *Spiraea tomentosa, Spiraea alba var. alba, Rubus allegheniensis, Rubus hispidus, Lonicera morrowii, Salix* spp., and others. *Hypericum densiflorum* often occurs in the Central Appalachians. Associated herbaceous species are also variable in composition, depending on land-use history. Usually seen are *Phalaris arundinacea, Solidago rugosa, Solidago canadensis, Juncus effusus, Scirpus cyperinus, Leersia oryzoides, Carex scoparia, Carex folliculata, Carex lurida, Carex lupulina, Carex vulpinoidea, Vernonia noveboracensis, Eupatorium maculatum, Eleocharis* spp., and others.

Most Abundant Species: Information not available.
Characteristic Species: Information not available.
Other Noteworthy Species: Information not available.
USFWS Wetland System: Information not available.

DISTRIBUTION

Range: Although this vegetation is widespread, its range has not been evaluated. It is known from the Central Appalachian ecoregion and the Lower New England / Northern Piedmont ecoregions, and is likely in others.
States/Provinces: NJ.
Federal Lands: NPS (Johnstown Flood); USFWS (Great Swamp).

CONSERVATION STATUS

Rank: GNR (8-Jul-1999).
Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.
Confidence: 2 – Moderate.
Comments: Information not available.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES

Description Authors: L.A. Sneddon.
References: Decker 1955, Eastern Ecology Working Group n.d., NatureServe and Russell 2003.

Figure 15. Wet Meadow subtype of Old Field vegetation at Johnstown Flood National Memorial (plot JOFL.8). July 2004. NAD 1983 / UTM easting 688923, northing 4468127.

Common Name (Park-specific): Old Field (Hawthorn subtype)

SYNONYMS
NVC English Name: **Orchard Grass - Sheep-sorrel Herbaceous Vegetation**
NVC Scientific Name: ***Dactylis glomerata - Rumex acetosella* Herbaceous Vegetation**
NVC Identifier: **CEGL006107**

LOCAL INFORMATION

Environmental Description: This type occurs on the gentle to steeply sloping fields above the former lakebed of Lake Conemaugh and surrounding the park's visitors center. The Hawthorn subtype occurs in areas that were probably farmed or used as pastureland prior to the creation of the park, but are no longer actively managed or mowed. The soil is typically moderately well-drained silt loam or clay loam.
Vegetation Description: The Hawthorn subtype is characterized by a sparse to dense tall-shrub layer and scattered established small trees. The tall shrubs, primarily hawthorns (*Crataegus* spp.) and apples (*Malus* spp.), may cover up to 50% of the field. Scotch pine (*Pinus sylvestris*), red maple (*Acer rubrum*), and black cherry (*Prunus serotina*) saplings and small trees (<40 feet tall) may also be present, seeded in from nearby conifer plantations and red maple - black cherry successional forests or woodlands. The ground story of this subtype is similar in composition to the herbaceous subtype, with a high cover of various grassland species and goldenrods (*Solidago* spp.). The relatively higher percent cover of woody species in these areas as compared with the herb-dominated old fields may simply be due to the difference in management.
Most Abundant Species:

Stratum	Lifeform	Species
Tree subcanopy	Broad-leaved deciduous tree	*Prunus serotina, Acer rubrum*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Crataegus* spp., *Malus* spp.
Short shrub/sapling	Broad-leaved deciduous shrub	*Rubus allegheniensis*
Herb (field)	Graminoid	*Phleum pratense, Anthoxanthum odoratum*
Herb (field)	Forb	*Solidago* spp., *Euthamia graminifolia,*
Vine	Vine	*Parthenocissus quinquefolia*

Characteristic Species: *Crataegus* spp., *Malus* spp., *Prunus serotina, Acer rubrum, Solidago* spp. (numerous species), *Phleum pratense, Anthoxanthum odoratum, Euthamia graminifolia, Andropogon gerardii.*
Other Noteworthy Species: Information not available.
Local Range: This vegetation type occurs in the fields above the former lakebed of Lake Conemaugh and surrounding the park's visitor center.
Classification Comments: The vegetation structure and species composition of the old fields in Johnstown Flood vary widely. The structure and composition of the old fields are influenced by past land use, current management prescriptions, and hydrology. The old field vegetation can be divided into three subtypes: Herbaceous, Wet Meadow and Crataegus subtypes. Within one mapped old field polygon, multiple subtypes can be present. The boundaries and distinctions between these subtypes may not be definitive in the field. Despite the high cover of woody plants in this vegetation type, the most appropriate NVC crosswalk is Orchard Grass - Sheep-sorrel Herbaceous Vegetation (CEGL006107).

Other Comments: None.
Local Description Authors: S.J. Perles (PNHP).
Plots: AA Points 6, 17.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Medium-tall sod temperate or subpolar grassland (V.A.5.N.c.)
Alliance	*Dactylis glomerata* - *Rumex acetosella* Herbaceous Alliance (A.1190)
Alliance (English name)	Orchard Grass - Sheep-sorrel Herbaceous Alliance
Association	*Dactylis glomerata* - *Rumex acetosella* Herbaceous Vegetation
Association (English name)	Orchard Grass - Sheep-sorrel Herbaceous Vegetation
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: This broadly defined vegetation type includes pasture and post-agricultural fields and is largely composed of nonnative grasses and herbs in the early stages of succession (generally of European origin). Physiognomically, these grasslands are generally comprised of mid-height (1-3 feet tall) grasses and forbs, with occasional scattered shrubs. Species composition varies from site to site, depending on land-use history and perhaps soil type, but in general, this vegetation is quite wide-ranging in northeastern and midwestern states, and at higher elevations (610-1220 m [2000-4000 feet]) in the southeastern states. In addition to the nominal species, other associates may include *Phleum pratense, Lolium perenne, Agrostis hyemalis, Elymus repens, Oxalis stricta, Schizachyrium scoparium, Achillea millefolium, Asclepias syriaca, Chenopodium album, Bromus tectorum, Bromus inermis,* and many others.
Environmental Description: Information not available.
Vegetation Description: In addition to *Dactylis glomerata* and *Rumex acetosella* these grassy fields are characterized by *Symphyotrichum* spp. (including *Symphyotrichum lateriflorum* var. *lateriflorum* and *Symphyotrichum novae-angliae*), *Rudbeckia hirta, Pteridium aquilinum, Chenopodium album, Asclepias syriaca, Andropogon virginicus, Schizachyrium scoparium, Phytolacca americana, Phleum pratense, Poa pratensis, Poa compressa, Elymus repens, Bromus inermis, Solidago* spp. (including *Solidago rugosa, Solidago nemoralis, Solidago juncea, Solidago canadensis, Solidago altissima), Euthamia graminifolia, Oenothera biennis, Potentilla simplex, Daucus carota, Ambrosia artemisiifolia, Hieracium* spp., *Taraxacum officinale, Vicia cracca, Trifolium* spp., and many others.
Most Abundant Species: Information not available.
Characteristic Species: Information not available.
Other Noteworthy Species: Information not available.
USFWS Wetland System: Information not available.

DISTRIBUTION

Range: This vegetation is quite wide-ranging in northeastern and midwestern states, and possibly occurs at higher elevations in the southeastern states.
States/Provinces: CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, TN, VA, VT, WV.
Federal Lands: NPS (Cape Cod, Cumberland Gap, Fort Necessity, Johnstown Flood, Morristown).

CONSERVATION STATUS

Rank: GNA (invasive) (28-Jan-2002).
Reasons: This vegetation type includes pasture and post-agricultural fields, and is largely composed of nonnative grasses and herbs (generally of European origin).

CLASSIFICATION INFORMATION

Status: Standard.
Confidence: 3 – Weak.
Comments: Information not available.
Similar Associations:
Dactylis glomerata - *Solidago* spp. Herbaceous Vegetation (CEGL006517)
Lolium (arundinaceum, pratense) Herbaceous Vegetation (CEGL004048)
Phleum pratense - *Bromus pubescens* - *Helenium autumnale* Herbaceous Vegetation (CEGL004018)
Related Concepts: Information not available.

SOURCES

Description Authors: Information not available.
References: Eastern Ecology Working Group n.d.

Common Name (Park-specific): Cattail Marsh

SYNONYMS

NVC English Name: **(Narrowleaf Cattail, Broadleaf Cattail) - (Clubrush species) Eastern Herbaceous Vegetation**

NVC Scientific Name: ***Typha (angustifolia, latifolia) - (Schoenoplectus spp.)*** **Eastern Herbaceous Vegetation**

NVC Identifier: **CEGL006153**

LOCAL INFORMATION

Environmental Description: This association is found in low-lying areas of Johnstown Flood National Memorial in very poorly drained muck soils. These areas hold standing water for most of the growing season.

Vegetation Description: This association is predominantly composed of hydrophytic species that form a thick herbaceous layer covering approximately 85% of the area. Broadleaf cattail (*Typha latifolia*), rice cutgrass (*Leersia oryzoides*), jewelweed (*Impatiens capensis*), and swamp verbena (*Verbena hastata*) are the dominant species. Other common associates include common rush (*Juncus effusus*), wool grass (*Scirpus cyperinus*), Allegheny monkeyflower (*Mimulus ringens*), watercress (*Rorippa nasturtium-aquaticum*), and climbing nightshade (*Solanum dulcamara*).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Leersia oryzoides*
Herb (field)	Forb	*Typha latifolia, Impatiens capensis, Verbena hastata*

Characteristic Species: *Typha latifolia, Leersia oryzoides, Verbena hastata, Scirpus cyperinus, Mimulus ringens.*

Other Noteworthy Species: Information not available.

Local Range: This association occurs in the former lakebed, most prominently on the northeast side of the railroad berm, and in small patches in the old field vegetation on the river's west shore.

Classification Comments: This vegetation type is distinguished by the dominance of *Typha latifolia* and the presence of other hydrophyllic species.

Other Comments: None.

Local Description Authors: S.J. Perles (PNHP).

Plots: JOFL.4.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Semipermanently flooded temperate or subpolar grassland (V.A.5.N.l.)
Alliance	*Typha (angustifolia, latifolia)* - *(Schoenoplectus* spp.) Semipermanently Flooded Herbaceous (A.1436) Alliance
Alliance (English name)	(Narrowleaf Cattail, Broadleaf Cattail) - (Clubrush species) Semipermanently Flooded Herbaceous Alliance
Association	*Typha (angustifolia, latifolia)* - *(Schoenoplectus* spp.) Eastern Herbaceous Vegetation
Association (English name)	(Narrowleaf Cattail, Broadleaf Cattail) - (Clubrush species) Eastern Herbaceous Vegetation
Ecological System(s):	Laurentian-Acadian Freshwater Marsh (CES201.594)

GLOBAL DESCRIPTION

Concept Summary: These tall emergent marshes are common throughout the northeastern United States and adjacent Canadian provinces. They occur in permanently flooded basins, often part of a larger wetland mosaic and associated with lakes, ponds, or slow-moving streams. The substrate is muck over mineral soil. Lacustrine cattail marshes typically have a muck-bottom zone bordering the shoreline, where cattails are rooted in the bottom substrate, and a floating mat zone, where the roots grow suspended in a buoyant peaty mat. Tall graminoids dominate the vegetation; scattered shrubs are often present (usually totaling less than 25% cover), and are frequently shorter than the graminoids. Trees are absent. Bryophyte cover varies, and is rarely extensive; bryophytes are mostly confined to the hummocks. *Typha angustifolia, Typha latifolia*, or their hybrid *Typha X glauca* dominate, either alone or in combination with other tall emergent marsh species. Associated species vary widely; sedges such as *Carex aquatilis, Carex lurida, Carex rostrata, Carex pellita, Scirpus cyperinus*, and bulrushes such as *Schoenoplectus americanus* and *Schoenoplectus acutus* occur, along with patchy grasses such as *Calamagrostis canadensis*. Broad-leaved herbs include *Thelypteris palustris, Asclepias incarnata, Calla palustris, Impatiens capensis, Sagittaria latifolia, Scutellaria lateriflora, Sparganium eurycarpum*, and *Verbena hastata*. Floating aquatics, such as *Lemna minor*, may be common in deeper zones. Shrub species vary across the geographic range of this type; in the northern part of its range, *Myrica gale, Ilex verticillata*, and *Spiraea alba* are common. The invasive exotic plants *Lythrum salicaria* and *Phragmites australis* may be abundant in parts of some occurrences. This association is distinguished from other northeastern freshwater marshes by the strong dominance of *Typha* spp.

Environmental Description: These tall emergent marshes are common throughout the northeastern United States and adjacent Canadian provinces. They occur in permanently flooded basins, often as part of a larger wetland mosaic and associated with lakes, ponds, or slow-moving streams. The substrate is muck over mineral soil. Lacustrine cattail marshes typically have a muck-bottom zone bordering the shoreline, where cattails are rooted in the bottom substrate, and

a floating mat zone, where the roots grow suspended in a buoyant peaty mat. This association is often found in impounded waters.

Vegetation Description: Tall graminoids dominate the vegetation; scattered shrubs are often present (usually totaling less than 25% cover) and are frequently shorter than the graminoids. Trees are absent. Bryophyte cover varies and is rarely extensive; bryophytes are mostly confined to the hummocks. *Typha angustifolia, Typha latifolia*, or their hybrid *Typha X glauca* dominate, either alone or in combination with other tall emergent marsh species. Associated species vary widely; sedges such as *Carex aquatilis, Carex lurida, Carex rostrata, Carex pellita, Scirpus cyperinus*, and bulrushes such as *Schoenoplectus americanus* and *Schoenoplectus acutus* occur, along with patchy grasses such as *Calamagrostis canadensis*. Broad-leaved herbs include *Thelypteris palustris, Asclepias incarnata, Calla palustris, Impatiens capensis, Sagittaria latifolia, Scutellaria lateriflora, Sparganium eurycarpum*, and *Verbena hastata*. Floating aquatics such as *Lemna minor* may be common in deeper zones. Shrub species vary across the geographic range of this type; in the northern part of its range, *Myrica gale, Ilex verticillata*, and *Spiraea alba* are common. The invasive exotic plants *Lythrum salicaria* and *Phragmites australis* may be abundant in parts of some occurrences.

Most Abundant Species: Information not available.

Characteristic Species: Information not available.

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: Information not available.

States/Provinces: CT, DE, MA, MD, ME:S5, NC, NH:S4?, NJ:S5, NY, PA, RI, VA, VT, WV.

Federal Lands: NPS (Acadia, Blue Ridge Parkway?, Cape Cod, Johnstown Flood); USFWS (Great Swamp).

CONSERVATION STATUS

Rank: G5 (1-Dec-1997).

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 3 – Weak.

Comments: *Typha angustifolia* can grow in deeper water compared to *Typha latifolia*, although both species reach maximum growth at a water depth of 50 cm (Grace and Wetzel 1981). *Typha* often occurs in pure stands and can colonize areas recently exposed by either natural or human causes.

Similar Associations:

Typha latifolia Southern Herbaceous Vegetation (CEGL004150)

Typha spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation (CEGL002229)

Typha spp. - *Schoenoplectus tabernaemontani* - Mixed Herbs Southern Great Lakes Shore Herbaceous Vegetation (CEGL005112)

Typha spp. Midwest Herbaceous Vegetation (CEGL002233)

Related Concepts:
Cattail Marsh (Thompson 1996) ?
Cattail Marsh (CAP pers. comm. 1998) ?
Palustrine Narrow-leaved Persistent Emergent Wetland, Permanently Flooded (PEM5H) (Cowardin et al. 1979) ?
Robust Emergent Marsh (Breden 1989) ? Southern New England nutrient-poor streamside/lakeside marsh (Rawinski 1984) ?
Southern New England nutrient-rich streamside/lakeside marsh (Rawinski 1984) ?

SOURCES
Description Authors: S.C. Gawler.
References: Breden 1989, Breden et al. 2001, CAP pers. comm. 1998, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fike 1999, Gawler 2002, Grace and Wetzel 1981, Metzler and Barrett 2001, Northern Appalachian Ecology Working Group 2000, Rawinski 1984, Sperduto 2000b, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000.

Figure 16. Cattail Marsh at Johnstown Flood National Memorial (plot JOFL.4). July 2004. NAD 1983 / UTM easting 689131, northing 4468635.

Common Name (Park-specific): Riverine Scour Vegetation

SYNONYMS
NVC English Name: **Fringed Loosestrife - Indian-hemp Sparse Vegetation**
NVC Scientific Name: ***Lysimachia ciliata - Apocynum cannabinum* Sparse Vegetation**
NVC Identifier: **CEGL006554**

LOCAL DESCRIPTION

Environmental Description: This association occurs on low terraces and cobble bars adjacent to the Little Conemaugh River channel. The cobble bars can be sparsely to densely vegetated, sometimes with high cover of bare sand and cobbles. These areas contain well-drained sandy and cobbly soil and experience frequent scour from elevated water levels. Species composition is highly variable due to the frequent scour that exposes new substrate and allows new propgules from a variety of sources to establish.

Vegetation Description: The association is characterized both by species typical of floodplain scour zones and weedy species typical of old fields and successional habitats. A sparse tall-shrub layer (2-6 m in height; 10% cover) and a moderately dense short-shrub layer (<2 m in height, 15-40% cover) are common in this community type. Typical shrub species include steeplebush (*Spiraea tomentosa*), river birch (*Betula nigra*), Scotch pine (*Pinus sylvestris*), autumn olive (*Elaeagnus umbellata*), black locust (*Robinia pseudoacacia*), red maple (*Acer rubrum*), Tatarian honeysuckle (*Lonicera tatarica*), Allegheny blackberry (*Rubus allegheniensis*), and black raspberry (*Rubus occidentalis*). The herbaceous layer can cover 15-50% of the area, with exposed cobbles and gravel covering the remaining unvegetated area. Common ground story species are spotted joepyeweed (*Eupatorium maculatum*), goldenrods (*Solidago canadensis, S. gigantea, S. speciosa, S. rugosa*), narrowleaf plantain (*Plantago lanceolata*), ox eye daisy (*Leucanthemum vulgare*), deertongue (*Dichanthelium clandestinum*), sweet vernalgrass (*Anthoxanthum odoratum*), common boneset (*Eupatorium perfoliatum*), jewelweed (*Impatiens capensis*), and common wood sorrel (*Oxalis stricta*). The exotic plants giant knotweed (*Polygonum sachalinense*) and spotted knapweed (*Centaurea biebersteinii*) can be invasive in this community type.

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Spiraea tomentosa, Betula nigra*
Herb (field)	Forb	*Eupatorium maculatum, Solidago* spp.
Vine	Vine	*Vitis* spp.

Characteristic Species: Species composition is highly variable in this vegetation type.
Other Noteworthy Species: Information not available.
Local Range: This association occurs adjacent to the South Fork of the Little Conemaugh River channel.
Classification Comments: The examples of this association at Johnstown Flood National Memorial are somewhat atypical in species composition when compared with other equivalent locations that have been sampled in the state. However, the topographic and hydrologic setting is consistent. One of the distinguishing characteristics of this association is its variable species composition caused by frequent scour that exposes new substrate and allows new propagules from a variety of sources to establish.

Other Comments: None.
Local Description Authors: S.J. Perles (PNHP).
Plots: JOFL.11, JOFL.17.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Sparse Vegetation (VII)
Physiognomic Subclass	Boulder, gravel, cobble, or talus sparse vegetation (VII.B.)
Physiognomic Group	Sparsely vegetated rock flats (VII.B.2.)
Physiognomic Subgroup	Natural/Semi-natural sparsely vegetated rock flats (VII.B.2.N.)
Formation	Cobble/gravel beaches and shores (VII.B.2.N.b.)
Alliance	Cobble/Gravel Shore Sparsely Vegetated Alliance (A.1850)
Alliance (English name)	Cobble/Gravel Shore Sparsely Vegetated Alliance
Association	*Lysimachia ciliata - Apocynum cannabinum* Sparse Vegetation
Association (English name)	Fringed Loosestrife - Indian-hemp Sparse Vegetation
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: 12/98 CAP Ice- or flood-scoured areas on dry sandy river bars and shores. Typical species are a mix of annuals and perennials including *Lysimachia ciliata, Lysimachia vulgaris, Lysimachia nummularia, Senecio* sp., Asteraceae spp., *Eupatorium* spp., *Convolvulus* spp., *Phyla lanceolata, Polygonum* spp., *Apocynum cannabinum, Betula nigra, Platanus occidentalis*. Defined mainly by its setting and disturbance regime.
Environmental Description: Information not available.
Vegetation Description: Information not available.
Most Abundant Species: Information not available.
Characteristic Species: Information not available.
Other Noteworthy Species: Information not available.
USFWS Wetland System: Information not available.

DISTRIBUTION

Range: Information not available.
States/Provinces: PA.
Federal Lands: NPS (Johnstown Flood).

CONSERVATION STATUS

Rank: GNR (8-Jul-1999).
Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Nonstandard.
Confidence: Information not available.
Comments: Information not available.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES
Description Authors: Information not available.
References: Eastern Ecology Working Group n.d.

Figure 17. Riverine Scour Vegetation at Johnstown Flood National Memorial (plot JOFL.11). July 2004. NAD 1983 / UTM easting 689038, northing 4468638.

Figure 18. Riverine Scour Vegetation at Johnstown Flood National Memorial (plot JOFL.17). July 2004. NAD 1983 / UTM easting 689059, northing 4468165.

Vegetation Map Production

In order to produce an association-level vegetation map, the formation-level vegetation map was edited and refined onscreen in ArcView 3.2. Based on the vegetation data analysis, each polygon was assigned one of the seven vegetation association types. The vegetation types were assigned using information from plot data, field observations, aerial photography signatures, and topographic maps. Polygon boundaries were also revised based on these four information sources. Polygons that were attributed with Anderson level II categories (modified) retained their attributes. One polygon of Medium-tall sod temperate or subpoplar grassland was assigned the Hayfield modified Anderson level II category in the final classification after field observations indicated that it was unlike other grasslands in the park. An aerial photograph interpretation key for the vegetation associations and Anderson level II categories (modified) is located in Appendix A.

The three subtypes of the Old Field association were not identified on the map for two reasons. First, the subtypes frequently intergrade, making it impossible to delineate accurate boundaries between them. Second, the Herbaceous and Wet Meadow subtypes are indistinguishable from each other on the aerial photography. In addition, one polygon was labeled as a mosaic of Old Field and Red Maple – Black Cherry Successional Forest / Woodland associations because both types were present and clear boundaries between them could not be delineated.

The thematic accuracy of this vegetation association map was then assessed. Based on the accuracy assessment sampling points, the association-level map was revised again to correct errors and create more accurate vegetation association polygon boundaries. In this final revision, accuracy assessment data, plot data, field observations, aerial photography signatures, and topographic maps were used to revise polygon boundaries and attributes. The resulting final vegetation association map is shown in Figure 19 and a summary of the vegetation association distribution and abundance is provided in Table 4. The number of total mapped hectares listed in Table 4 is larger than the number of mapped hectares in the park because some mapped polygons extend beyond the park boundary. Metadata for the vegetation association shapefile, the plot location and accuracy assessment sampling point location shapefiles, the digital photomosaic, and the PLOTS database were prepared according to Federal Geographic Data Committee standards and have been provided as a deliverable along with this report.

Accuracy Assessment

Positional Accuracy

The final horizontal positional accuracy for the mosaic is 1.05 m (3.44 ft) and meets Class 1 National Map Accuracy Standards (FGDC 1998b). A copy of the spreadsheet that contains the x and y coordinates for each ground control point and the accuracy calculation formula is included in the air photo archive at the North Carolina State University Center for Earth Observation.

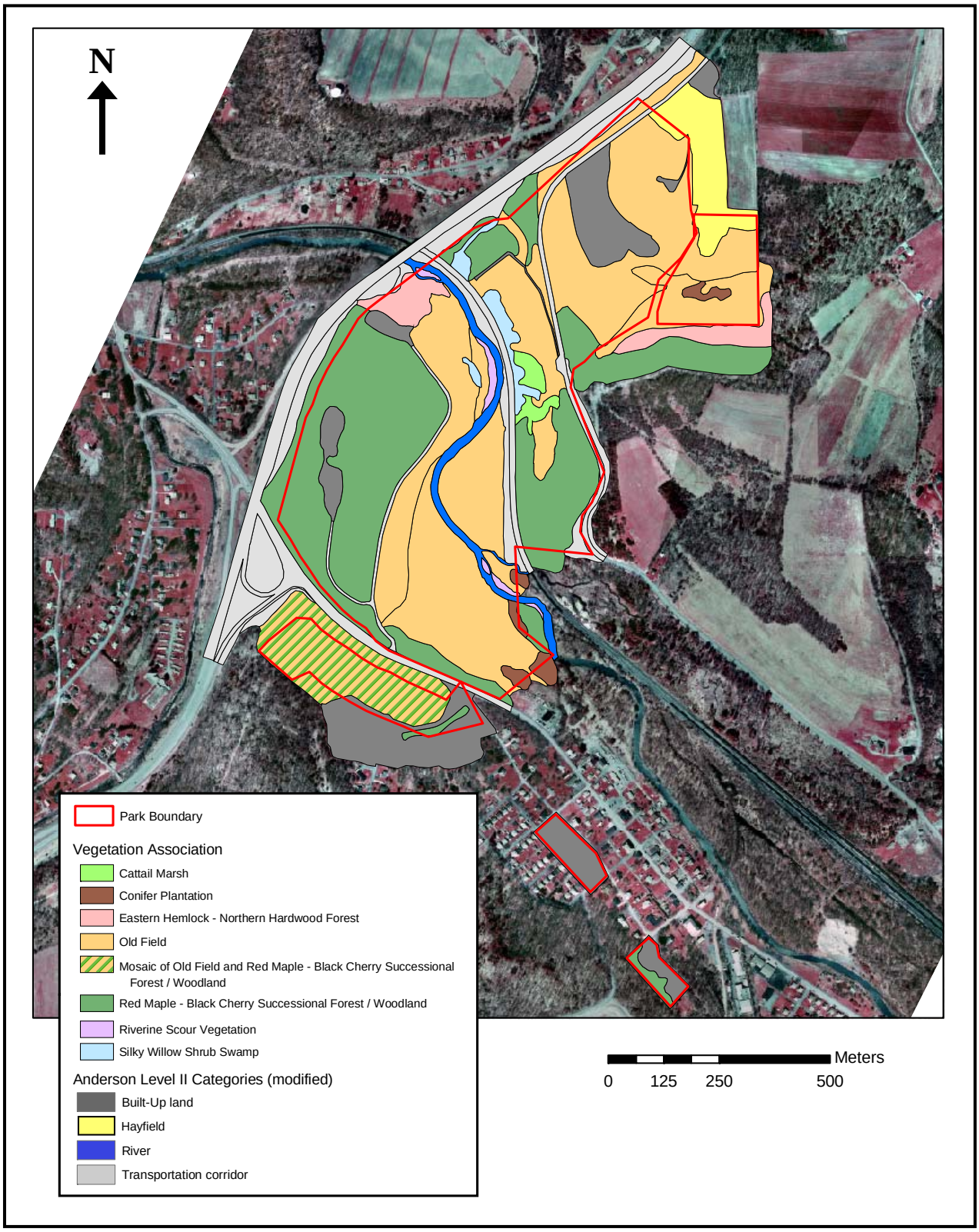

Figure 19. Vegetation associations of Johnstown Flood National Memorial.

Table 4. Number of polygons, total mapped hectares, and mapped hectares within the park boundary for vegetation associations and Anderson level II categories (modified) at Johnstown Flood National Memorial.

	Number of Polygons	Total Mapped Hectares	Mapped Hectares within Park Boundary
Vegetation Association			
Cattail Marsh	2	0.77	0.77
Conifer Plantation	5	1.07	0.68
Eastern Hemlock - Northern Hardwood Forest	2	2.68	1.08
Old Field	12	34.49	32.72
Mosaic of Old Field and Red Maple - Black Cherry Successional Forest / Woodland	1	6.18	4.01
Red Maple - Black Cherry Successional Forest / Woodland	10	26.99	21.18
Riverine Scour Vegetation	5	0.49	0.44
Silky Willow Shrub Swamp	3	1.21	1.21
Anderson Level II (modified)			
Built-Up land	9	10.99	6.77
Hayfield	1	3.62	0.92
River	1	1.95	1.57
Transportation corridor	16	17.33	4.30
Total	67	107.78	75.65

Thematic Accuracy

Based on the contingency matrix (Table 5), the Kappa index for the vegetation association map was 80.2% ± 12.9%, with the overall percent accuracy calculated as 84.4%. The errors of commission for six of the seven vegetation types exceeded the USGS/NPS vegetation mapping protocol requirement of 80% (Table 5). The exception was Silky Willow Shrub Swamp (50%).

The errors of omission for five of the seven vegetation types exceeded the USGS/NPS vegetation mapping protocol requirement of 80%. Riverine Scour Vegetation (66.7%) and Conifer Plantation (60.0%) did not meet the protocol requirements. These errors were caused by inaccurate polygon boundaries and were corrected in the final association map. However, these errors were also due to the park's small size and the limited number of polygons of each type available for accuracy assessment sampling. The calculated error for Silky Willow Shrub Swamp and the Riverine Scour Vegetation were caused by one incorrect observation point each. The calculated error for Conifer Plantation was caused by two incorrect observations.

Project Deliverables

Final products of the vegetation mapping project are shown in Table 6. All products have been delivered to the National Park Service by the Pennsylvania Science Office of The Nature Conservancy with this report.

Table 5. Contingency matrix and calculated errors for the thematic accuracy assessment of the vegetation association map of Johnstown Flood National Memorial.

	Mapped Vegetation Association								
Accuracy Assessment Observation	Cattail Marsh	Conifer Plantation	Eastern Hemlock - Northern Hardwood Forest	Old Field	Red Maple - Black Cherry Successional Forest / Woodland	Riverine Scour Vegetation	Silky Willow Shrub Swamp	Total	Errors of Commission (Percent Correct)
Cattail Marsh	2							2	100.0%
Conifer Plantation		3			1			4	75.0%
Eastern Hemlock - Northern Hardwood Forest			2					2	100.0%
Old Field		1		11		1		13	84.6%
Red Maple - Black Cherry Successional Forest / Woodland		1			7			8	87.5%
Riverine Scour Vegetation						2		2	100.0%
Silky Willow Shrub Swamp				1			1	2	50.0%
Total	2	5	2	12	8	3	1	33	
Errors of Omission (Percent Correct)	100.0%	60.00%	100.0%	91.70%	87.50%	66.70%	100.0%		
							Total Points Correct	28	
							Overall Accuracy	84.8%	
							Kappa Index	80.2%	
							90% confidence interval for Kappa Index	12.9%	

Table 6. Summary of products resulting from the Johnstown Flood National Memorial vegetation classification and mapping project.

Product	FGCD-compliant spatial metadata
Aerial photos, including flight line map and photoindex	Yes
Photomosaic as paper copy and in digital format	Yes
Annotated field forms with vegetation plot sampling data	Not applicable
Vegetation plot sampling data in the PLOTS 2.0 database	Not applicable
Differentially corrected GPS locations of vegetation plots	Yes
Annotated field forms with thematic accuracy assessment data	Not applicable
Thematic accuracy assessment data in the PLOTS 2.0 database	Not applicable
Differentially corrected GPS locations of thematic accuracy assessment sampling points	Yes
Digital photos representative of all vegetation types	Not applicable
Final map of vegetation associations as paper copy and in digital format	Yes
Final report as paper copy and in digital format	Not applicable

Discussion

Vegetation Classification and Characterization

This study of Johnstown Flood National Memorial identified seven vegetation associations: Red Maple – Black Cherry Successional Forest / Woodland, Eastern Hemlock – Northern Hardwood Forest, Conifer Plantation, Silky Willow Shrub Swamp, Old Field, Cattail Marsh, and Riverine Scour Vegetation. In addition, three subtypes of the Old Field association were identified, Herbaceous subtype, Wet Meadow subtype, and Hawthorn subtype.

These vegetation types reflect the land use history, ongoing management, and varied environmental settings of the park. At the time of the 1889 flood, the area that is now designated as the park was used for agriculture and recreation, or was underwater. After the flood, management of the land ceased until nearly 75 years later when the park was created. The current vegetation reflects this history and the current management regimes.

The vegetation association that covers the largest area of the park is Old Field, with three subtypes represented in different sections of the park. Old Field vegetation is the prominent vegetation in the former lakebed with the Herbaceous subtype and the Wet Meadow subtype intergrading throughout the lakebed. The Old Field association occurs in the lakebed because National Park Service resource managers maintain this vegetation type as such. Much of the lakebed was hydroseeded with a mixture of grasses following removal of the pine plantations in the late 1980's. Since then, the area has been managed using mechanical and chemical methods to prevent succession to shrubland and forest, and to control the spread of invasive plant species.

The Herbaceous subtype of the Old Field vegetation is dominated by grasses with few woody species. Although woody species are removed from the lakebed primarily to maintain visitor viewsheds, this management also maintains important habitat for several animal species dependent on this type of vegetation. Since unmowed open grasslands are a relatively rare habitat type in the state, the lakebed at Johnstown Flood National Memorial can be an important habitat for these species. Grassland-dependent birds that have been documented in Johnstown Flood National Memorial include Henslow's sparrow (*Ammodramus henslowii*), vesper sparrow (*Pooecetes gramineus*), field sparrow (*Spizella pusilla*), eastern meadowlark (*Sturnella magna*), and bobolink (*Dolichonyx oryzivorus*) (Yahner et al. 2001). The old fields also provide habitat for snakes such as the northern black racer (*Coluber constrictor*), eastern milk snake (*Lampropeltis triangulum*), eastern smooth green snake (*Opheodrys vernalis*), and northern brown snake (*Storeria dekayi*) (Yahner et al. 2004).

The low-lying sections of lakebed that are saturated for part of the year typically support the Wet Meadow subtype of the Old Field vegetation. Hydrophyllic species are favored in these wetter areas, although the upland grasses that were seeded in the lakebed can be interspersed with the hydrophytes. Due to the intergrading of terrestrial and palustrine plants, it is nearly impossible to distinguish the Herbaceous subtype from the Wet Meadow subtype on the aerial photography. These wet areas that form along drainages, springs, and seeps in the former lakebed may provide important habitat for several amphibian and mammal species, including northern two-lined salamander (*Eurycea bislineata*), northern spring salamanders (*Gyrinophilus porphyriticus*),

northern dusky salamander (*Desmognathus fuscus*), masked shrew (*Sorex cinereus*), and southern bog lemming (*Synaptomys cooperi*) (Yahner and Ross 2004).

The third Old Field subtype, Hawthorn subtype, occurs in two unmanaged upland fields that are no longer mowed or brush-cut. Without ongoing management, early successional woody plants such as hawthorn (*Crataegus* spp.), red maple (*Acer rubrum*), and black cherry (*Prunus serotina*) have become established in the field. Shrubs and saplings now dominate portions of these fields, with small patches of graminoid- and herbaceous-dominated openings persisting in between the clumps of woody plants. These successional fields provide habitat for gray catbird (*Dumetella carolinensis*), indigo bunting (*Passerina cyanea*), eastern towhee (*Pipilo erythrophthalmus*), and song sparrow (*Melospiza melodia*) (Yahner et al. 2001).

In addition to the Old Field vegetation, the lakebed contains four other of the park's seven vegetation associations, including Conifer Plantation, Cattail Marsh, Silky Willow Shrub Swamp, and Riverine Scour Vegetation. The past management of the lakebed has directly influenced the current vegetation. The existing Conifer Plantation areas are remnants from the pine stands planted in the lakebed in the middle of last century, consisting of planted Scotch pine (*Pinus sylvestris*), eastern white pine (*P. strobus*), and red pine (*P. resinosa*). Hardwood species, primarily maples (*Acer saccharum, A. rubrum*), are common in the subcanopy. Nonnative Morrow's honeysuckle (*Lonicera morrowii*), multiflora rose (Rosa multiflora), and Japanese barberry (*Berberis thunbergii*) are often found in the understory.

In the lakebed, Cattail Marsh and Silky Willow Shrub Swamp are maintained by the berm that supports the railroad and influences the hydrology in the immediate area. Despite a few culverts, the berm blocks water from draining to the South Fork of the Little Conemaugh River, causing it to pond behind the berm. This standing water favors obligate wetland plants such as broadleaf cattail (*Typha latifolia*) and silky willow (*Salix sericea*) and creates ideal conditions for Cattail Marsh and Silky Willow Shrub Swamp associations to establish and persist. This vegetation provides habitat for numerous birds, including yellow warbler (*Dendroica petechia*), willow flycatcher (*Empidonax trailii*), common yellowthroat (*Geothlypis trichas*), swamp sparrow (*Melospiza georgiana*), and red-winged blackbird (*Agelaius phoeniceus*) (Yahner et al. 2001).

The final association found in the lakebed is the Riverine Scour Vegetation located on bars, islands, and spits in and adjacent to the South Fork of the Little Conemaugh River. This association is highly variable in vegetation structure and species composition due to the frequent scour that these sites experience. These areas of river are underwater for a significant portion of the year and are exposed only at low water or in drought years. Therefore, this vegetation type is subject to high water velocities, floods, and ice scour that remove established vegetation and maintain or create exposed sediments. New seeds and plant propagules are constantly being dispersed to these areas by water, air, insects, and birds. This causes the continual flux in vegetation and species composition characteristic of this community. Because of the constant disturbance, nonnative species such as Japanese knotweed (*Polygonum cuspidatum*), giant knotweed (*Polygonum sachalinense*), and spotted knapweed (*Centaurea maculosa*) are able to establish in this vegetation type.

The Riverine Scour Vegetation, Cattail Marsh, and Silky Willow Shrub Swamp are palustrine vegetation types that can be crosswalked to the Cowardin classification system that was used for

the National Wetland Inventory mapping efforts (Cowardin et al. 1979). Riverine Scour Vegetation can be classified as Riverine, Upper Perennial, Unconsolidated Shore, Cobble-Gravel (R3US1). Cattail Marsh can be crosswalked to Palustrine, Emergent, Persistent (PEM1). Silky Willow Shrub Swamp can be classified as Palustrine, Scrub-Shrub, Broad-leaved Deciduous (PSS1).

Red Maple – Black Cherry Successional Forest / Woodland is the most common forest type in the park. Due to the successional nature of this association, variation in species composition and vegetation structure is observed across the park. For example, patches of woodland and forest can occur in the same polygon of Red Maple – Black Cherry Successional Forest / Woodland. This forest type developed on the former agriculture land abandoned after the flood. Red Maple – Black Cherry Successional Woodlands occur on old fields that have been colonized by woody plants which create a woodland setting. Red Maple – Black Cherry Successional Forests are essentially young, degraded versions of the northern hardwood forest type that is typical of this region of Pennsylvania. Given the fragmented nature of the landscape surrounding the park, it is unlikely that these patches of successional forest will ever develop into high quality examples of northern hardwood forest. However, as seen in relatively a large stand of older, fair quality Red Maple – Black Cherry Successional Forest on the western border of the park (plot JOFL.1), this forest type can provide habitat for rare plants such as Appalachian blue violet (*Viola appalachiensis*). This section of the park is also the least invaded by exotic species and should be maintained as such.

The two small examples of Eastern Hemlock – Northern Hardwood Forest that occur in the park are also remnants of the northern hardwood forest types that are typical of this region of Pennsylvania. This forest type occurs on shallow north facing slopes on moderately well-drained clay loam soils. The Eastern Hemlock – Northern Hardwood Forest that occurs along a stream in the eastern portion of Johnstown Flood National Memorial may provide habitat for southern red-backed vole (*Clethrionomys gapperi*) (Yahner and Ross 2004).

Vegetation Map Production

The final vegetation map for Johnstown Flood National Memorial includes seven vegetation associations and four modified Anderson level II categories. The original formation-level vegetation map identified nine formation-level types and three modified Anderson level II categories. Since the NVCS is hierarchical, one formation-level vegetation type typically contains several vegetation associations. However, for two formations in Johnstown Flood National Memorial, each formation corresponds to only one association. For example, Conical-crowned temperate evergreen forest corresponds to Conifer Plantation and Mixed needle-leaved – cold deciduous forest corresponds to Eastern Hemlock – Northern Hardwood Forest. Furthermore, due to the variation in the Old Field types, several formation-level vegetation types were assigned to the Old Field vegetation association. Medium-tall sod temperate or subpoplar grassland and Saturated temperate perennial forb vegetation formation-level types were both labeled as Old Field in the final map. Although this seems contrary to the hierarchical nature of the NVCS, it reflects the great variability in vegetation structure caused by past land use, natural resource management, and environmental setting. One polygon of Medium-tall sod temperate or subpoplar grassland was assigned the Hayfield modified Anderson level II category in the final classification after field observations indicated that it was unlike other grasslands in the park.

The final vegetation map is based on the aerial photography that was flown in April 2003. Since that time, the vegetation in the park continues to change. Ongoing management of invasive species and woody plants will alter the vegetation. Continued natural succession in the Old Field and Red Maple – Black Cherry Successional Forest / Woodland types will also influence the mapped vegetation. Despite these changes, the vegetation map produced by this project provides crucial baseline data for park resource managers.

Recommendations for Future Projects

Invasive exotic plant species are the main threat to the native vegetation at Johnstown Flood National Memorial. Continued inventory, monitoring, and management of invasive species should be a priority for the park's resource managers. The most common and problematic species include: giant knotweed (*Polygonum sachalinense*), Japanese knotweed (*Polygonum cuspidatum*), Morrow's honeysuckle (*Lonicera morrowii*), Tatarian honeysuckle (*Lonicera tatarica*), multiflora rose (*Rosa multiflora*), Japanese barberry (*Berberis thunbergii*), spotted knapweed (*Centaurea maculosa*), autumn olive (*Elaeagnus umbellata*), purple crownvetch (*Coronilla varia*), and Fuller's teasel (*Dipsacus fullonum*). A study being conducted by the Western Pennsylvania Conservancy on the status of invasive species in Johnstown Flood National Memorial will provide crucial information towards this end, and is scheduled for completion around October 2005.

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Appendix A.

Aerial photograph interpretation keys to formation- and association-level vegetation types and Anderson level II categories (modified) at Johnstown Flood National Memorial.

AERIAL PHOTOGRAPH INTERPRETATION KEY TO FORMATION-LEVEL VEGETATION TYPES AND ANDERSON LEVEL II CATEGORIES (MODIFIED) AT JOHNSTOWN FLOOD NATIONAL MEMORIAL

1. Individual tree crowns visible as gray, black, or pink signatures of varying architecture. Trees cover greater than 30% of area.

    2. Signatures of many trees are pink and conical, indicating evergreen trees.

        3. Evergreen tree crowns cover greater than 60% of the area, creating a near continuous pink canopy of conical crowns.
        Conical-crowned temperate evergreen forest

        3. Pink conical evergreen tree crowns cover 60% or less of the area, interspersed with light to dark gray deciduous tree crowns. Tree crowns occur either in a continuous canopy or within a matrix of white to light gray herbaceous vegetation.

            4. Pink conical evergreen tree crowns are interspersed with light to dark gray deciduous tree crowns, creating a near continuous canopy.
            Mixed needle-leaved evergreen – cold-deciduous forest

            4. Pink conical evergreen and gray deciduous tree crowns are scattered or clumped within a matrix of white to light gray herbaceous vegetation. Vegetation occurs near linear dark blue-gray feature with white mottles of varying density, indicating open flowing water.
        Seasonally-flooded mixed needle-leaved evergreen – cold-deciduous woodland

    2. Signatures of most trees are light to dark gray or black, indicating cold-deciduous trees. Pink conical tree crowns are rare or absent. Tree crowns cover greater than 60% of the area, creating a near continuous canopy.
    Lowland or submontane cold-deciduous forest

1. Individual tree crowns cover less than 30% of the area.

    5. Signature is primarily white, light pink, and/or light to dark gray, ranging from uniform to mottled. Buildings, structures, and parking lots are absent. Signature does not show a linear gray feature.

        6. Shrubs cover greater than 30% of the area, appearing as round gray circular features or small pink conical features, scattered or in clumps within a matrix of white to light gray herbaceous vegetation. Areas of dense shrub cover will have a bumpy rounded dark gray signature.

7. Photography shows bumpy rounded dark gray continuous signature of dense shrub cover. The white to light gray herbaceous vegetation signature is absent.

Saturated cold-deciduous shrubland

7. Shrubs appear as fuzzy round gray circular features and small pink conical features, scattered or in clumps within a matrix of white to light pink herbaceous vegetation.

Mixed evergreen – cold-deciduous shrubland

6. Shrubs (appearing as round gray circular features or small pink conical features) cover 30% or less of the area. Signature is mottled white, light pink and/or light gray.

8. Signature tends to contain more dark gray and white than light pink. Area contains dark gray indicating saturated soil can be present or occurs immediately adjacent to the river.

9. Area can occasionally occur, but is not usually, immediately adjacent to the river. Area contains dark gray linear drainage features or a fine, intense speckled signature of dark gray and bright white, indicating herbaceous or graminoid vegetation in standing water.

Saturated temperate perennial forb vegetation

9. Area only occurs immediately adjacent to the river on low curved bars, spits, shorelines or islands. Signature tends to be bluish-gray. Area does not contain dark gray linear drainage features or a fine, intense speckled signature of dark gray and bright white, indicating herbaceous or graminoid vegetation in standing water.

Temporarily flooded temperate perennial forb vegetation

8. Signature tends to contain more light pink and white than dark gray. Dark gray linear drainage features are absent. Signature may contain scattered shrubs as round gray circles or small pink conical features. Area can occasionally occur, but is not usually, immediately adjacent to the river.

Medium-tall sod temperate or subpolar grassland

5. Signature shows either a linear gray feature, or buildings, structures, and parking lots, often surrounded by frequently mowed turf grass that has a light to bright pink signature.

10. Buildings, structures, and parking lots, often surrounded by frequently mowed turf grass that has a light bright pink signature. Feature is not exclusively linear.

Built-up land

10. Signature shows a linear feature, with color ranging from light gray to dark blue-gray.

    11. Signature is uniform light gray to blue-gray, often with visible lane lines and automobiles. Linear gray feature can be surrounded by frequently mowed vegetation that has a light bright pink signature.

    Transportation corridor

    11. Signature is dark blue-gray with white mottles of varying density, indicating open, flowing water. No lane lines or automobiles are visible.

    River

AERIAL PHOTOGRAPH INTERPRETATION KEY TO ASSOCIATION-LEVEL VEGETATION TYPES AND ANDERSON LEVEL II CATEGORIES (MODIFIED) AT JOHNSTOWN FLOOD NATIONAL MEMORIAL

1. Individual tree crowns visible as gray, black, or pink signatures of varying architecture. Trees cover greater than 30% of area.

    2. The majority of tree signatures are pink and conical, indicating evergreen trees. Less than half of the trees have light to dark gray or black signatures, indicating cold-deciduous trees.

        3. Evergreen tree crowns tightly packed, creating a continuous pink canopy or large dense pink clumps of evergreen trees. Deciduous trees with gray or black signatures are scattered or rare.

        Conifer Plantation

        3. Pink conical evergreen tree crowns are interspersed with many light to dark gray deciduous tree crowns.

        Eastern Hemlock – Northern Hardwood Forest

    2. Signatures of trees are light to dark gray or black, indicating cold-deciduous trees. Pink conical tree crowns are rare or absent.

    Red Maple – Black Cherry Successional Forest / Woodland

1. Individual tree crowns cover less than 30% of the area.

    4. Signature is primarily white, light pink, and/or light to dark gray, ranging from uniform to mottled. Buildings, structures, and parking lots are absent. Signature does not show a linear gray feature.

        5. Shrubs cover greater than 30% of the area, appearing as round gray circular features or small pink conical features, scattered or in clumps within a matrix of white to light gray herbaceous vegetation. Areas of dense shrub cover will have a bumpy rounded dark gray signature.

            6. Photography shows bumpy rounded dark gray to black signature of dense shrub cover over standing water. Less dense shrubs will appear as light – dark gray fuzzy circular features along a linear dark gray or blue gray drainage feature. Pink conical shrubs are absent.

            Silky Willow Shrub Swamp

6. Shrubs appear as fuzzy round gray circular features and small pink conical features, scattered or in clumps within a matrix of white to light pink herbaceous vegetation. Linear dark gray or blue gray drainage features are absent.

Old Field (Hawthorn subtype)

5. Shrubs (appearing as round gray circular features or small pink conical features) cover 30% or less of the area. Signature is mottled white, light pink and/or light gray, or is uniformly bright pink.

7. Signature is uniformly bright pink and contains numerous parallel small light pink lines. Buildings, structures, parking lots, road lane lines and automobiles are not present or immediately adjacent.

Hayfield

7. Signature is not uniformly bright pink, but complexly mottled white, light pink and/or light gray.

8. Signature tends to contain more dark gray, blue gray, and white than light pink. Dark gray linear drainage features or dark gray circular features indicating saturated soil can be present. Signature also can contain fine, intense speckles of dark gray and bright white, indicating herbaceous or graminoid vegetation in standing water.

9. Area only occurs immediately adjacent to the river on low curved bars, spits, shorelines or islands. Signature tends to be bluish-gray. Area does not contain dark gray linear drainage features or a fine, intense speckled signature of dark gray and bright white, indicating herbaceous or graminoid vegetation in standing water.

Riverine Scour Vegetation

9. Area does not necessarily occur immediately adjacent to the river. Signature tends to be light to dark gray and white. Area can contain dark gray linear drainage features or a fine, intense speckled signature of dark gray and bright white, indicating herbaceous or graminoid vegetation in standing water.

10. Signature is white bright with fine, intense speckles of light or dark gray, indicating herbaceous vegetation in standing water.

Cattail Marsh

10. Signature is mottled dark gray and white with occasional light pink mottles. Dark gray linear drainage features or dark gray circular features indicating saturated soil can be present. (This vegetation type may be indistinguishable on aerial photography from the Herbaceous subtype due to the intergrading between the two types and past management that has altered the species composition of both.)

Old Field (Wet Meadow subtype)

8. Signature is mottled light pink and white with occasional dark gray mottles. Dark gray linear drainage features are absent. Signature may contain scattered shrubs as round gray circles or small pink conical features. (This vegetation type may be indistinguishable on aerial photography from the Wet Meadow subtype due to the intergrading between the two types and past management that has altered the species composition of both.)

Old Field (Herbaceous subtype)

4. Signature shows either a linear gray feature, or buildings, structures, and parking lots, often surrounded by frequently mowed turf grass that has a light to bright pink signature.

11. Buildings, structures, and parking lots, often surrounded by frequently mowed turf grass that has a light bright pink signature. Feature is not exclusively linear.

Built-up land

11. Signature shows a linear feature, with color ranging from light gray to dark blue-gray.

12. Signature is uniform light gray to blue-gray, often with visible lane lines and automobiles. Linear gray feature can be surrounded by frequently mowed vegetation that has a light bright pink signature.

Transportation corridor

12. Signature is dark blue-gray with white mottles of varying density, indicating open, flowing water. No lane lines or automobiles are visible.

River

Appendix B.
Vegetation plot sampling form.

NPS 6 Parks Vegetation Mapping Project

A. General Information

Plot Number:_____ Park Name:_____

Survey date: _____ Surveyors:_____

Easting: _ _ _ _ _ _ E Northing:_ _ _ _ _ _ _ N EPE/APE:_____ DOP:_____ Map datum:_____ Zone:_____

B. Environmental Description

Representative sketch of stand and landscape position

Picture No.:_____

Slope: _____

Aspect: _____

Elevation: _____

Stoniness:

___ Stone free <0.1%
___ Moderately stony 0.1-1%
___ Stony 3-15%
___ Very stony 15-50%
___ Exceedingly stony 50-90%
___ Stone piles >90%

Topographic position:

___ Interfluve (ridgetop)
___ High slope
___ High level
___ Midslope
___ Backslope
___ Step in slope
___ Other: _____
___ Low slope
___ Toe slope
___ Low level
___ Channel wall
___ Channel bed
___ Basin Floor

Hydrologic regime:

___ Permanently flooded
___ Semi-permanently flooded
___ Seasonally flooded
___ Intermittently flooded
___ Temporarily flooded
___ Artificially flooded
___ Saturated (wet, but never flooded)

Average soil texture:

___ sand
___ sandy loam
___ loam
___ silt loam
___ other: _____
___ clay loam
___ clay
___ peat
___ muck

Soil drainage:

___ Rapidly drained
___ Well drained
___ Moderately well drained
___ Somewhat poorly drained
___ Poorly Drained
___ Very poorly drained

Soil profile description: note depth, texture, and color of each horizon. Note significant changes such as depth to mottling, depth to water table, root penetration depth

Horizon	Depth	Texture	Color	pH	Comments

Unvegetated surface:

_____ % Bedrock
_____ % Litter, duff
_____ % Large rocks (> 10 cm)
_____ % Wood (> 1 cm)
_____ % Small rocks (0.2-10 cm)
_____ % Water
_____ % Sand (0.1-2 mm)
_____ % Bare soil
_____ % Other: _____

Plot representativeness: Note homogeneity of vegetation in plot versus rest of community

Environmental Comments: Note surrounding vegetation, landscape context, herbivory, stand health, recent/historic anthropogenic evidence, etc.

C. Vegetation

Cowardin System: _____ Terrestrial _____ Palustrine _____ Estuarine Plot number:_____ Plot dimensions: _____

Leaf Type	Leaf Phenology	Physiognomic Type			height	% cover
___ Broad-leaf	___ Deciduous	___ Forest	___ Woodland	T1 Emergent tree		
___ Semi-broad-leaf	___ Semi-deciduous	___ Sparse Woodland	___ Scrub Thicket	T2 Tree canopy		
___ Semi-needle-leaf	___ Semi-evergreen	___ Shrubland	___ Sparse Woodland	T3 Tree sub-canopy		
___ Needle-leaf	___ Evergreen	___ Dwarf Shrubland	___ Dwarf Scrub Thicket	S1 Tall shrub		
___ Broad-leaf herbaceous	___ Perennial	___ Sparse Dwarf Shrubland	___ Herbaceous	S2 Short shrub		
___ Graminoid	___ Annual	___ Non-Vascular	___ Sparsely Vegetated	H Herbaceous		
___ Pteridophyte				N Non-vascular		
R = 1 or few (+) = occasional 1 = <5% 2- = 5-12% 2+ = 13-25% 3 = 26-50% 4 = 51-75% 5 = 76+%				E Epiphyte		
				V Vine / liana		

Species / percent cover: starting with uppermost stratum, list all species and % cover for each in the stratum. For forest and woodlands, list on a separate line below each tree species the DBH of all trees above 10 cm diameter.

Appendix C.
Plants observed in Johnstown Flood National Memorial
during vegetation plot and thematic accuracy assessment sampling.

Plants Observed in Johnstown Flood National Memorial
During Vegetation Plot and Thematic Accuracy Assessment Sampling

Nomenclature follows *The PLANTS Database*, Version 3.5, developed by the Natural Resource Conservation Service in cooperation with the Biota of North America Program (United States Department of Agriculture, National Resources Conservation Service 2004). For this report, some common names listed in the PLANTS database were changed to reflect the common names typically used by ecologists and resource managers in this region.

Family	Scientific Name	Common Name
Aceraceae	*Acer pensylvanicum*	striped maple
	Acer rubrum	red maple
	Acer saccharum	sugar maple
Anacardiaceae	*Rhus hirta*	staghorn sumac
	Toxicodendron radicans	eastern poison ivy
Apiaceae	*Daucus carota*	Queen Anne's lace
Apocynaceae	*Apocynum androsaemifolium*	spreading dogbane
Araceae	*Arisaema triphyllum*	Jack in the pulpit
	Symplocarpus foetidus	skunk cabbage
Araliaceae	*Aralia nudicaulis*	wild sarsaparilla
	Aralia spinosa	devil's walkingstick
Aristolochiaceae	*Asarum canadense*	Canadian wildginger
Asteraceae	*Achillea millefolium*	common yarrow
	Ageratina altissima var. *altissima*	white snakeroot
	Ambrosia sp.	ragweed
	Arctium minus	lesser burrdock
	Centaurea biebersteinii	spotted knapweed
	Cirsium arvense	Canada thistle
	Erigeron strigosus	prairie fleabane
	Eupatorium fistulosum	trumpetweed
	Eupatorium maculatum	spotted joepyeweed
	Eupatorium perfoliatum	common boneset
	Eurybia divaricata	white wood aster
	Eurybia macrophylla	bigleaf aster
	Euthamia graminifolia	flat-top goldentop
	Hieracium sp.	hawkweed
	Leucanthemum vulgare	oxeye daisy
	Packera aurea	golden ragwort
	Prenanthes alba	white rattlesnakeroot
	Rudbeckia hirta	blackeyed Susan
	Solidago caesia	wreath goldenrod
	Solidago canadensis	Canada goldenrod
	Solidago canadensis var. *scabra*	Canada goldenrod
	Solidago gigantea	giant goldenrod
	Solidago juncea	early goldenrod
	Solidago patula	roundleaf goldenrod
	Solidago rugosa	wrinkleleaf goldenrod

Family	Scientific Name	Common Name
Asteraceae (cont.)	*Solidago speciosa*	showy goldenrod
	Symphyotrichum lateriflorum var. *lateriflorum*	calico aster
	Symphyotrichum pilosum var. *pilosum*	hairy white oldfield aster
	Symphyotrichum prenanthoides	crookedstem aster
	Symphyotrichum puniceum var. *puniceum*	purplestem aster
	Taraxacum officinale	common dandelion
	Verbesina alternifolia	wingstem
	Vernonia gigantea	giant ironweed
Balsaminaceae	*Impatiens capensis*	jewelweed
Berberidaceae	*Berberis thunbergii*	Japanese barberry
	Podophyllum peltatum	mayapple
Betulaceae	*Alnus glutinosa*	European alder
	Betula alleghaniensis	yellow birch
	Betula lenta	sweet birch
	Betula nigra	river birch
	Ostrya virginiana	hophornbeam
Brassicaceae	*Alliaria petiolata*	garlic mustard
	Barbarea vulgaris	garden yellowrocket
	Cardamine sp.	bittercress
	Hesperis matronalis	dames rocket
	Rorippa nasturtium-aquaticum	watercress
Campanulaceae	*Lobelia* sp.	lobelia
Caprifoliaceae	*Lonicera morrowii*	Morrow's honeysuckle
	Lonicera tatarica	Tatarian honeysuckle
	Sambucus nigra ssp. *canadensis*	common elderberry
	Sambucus racemosa var. *racemosa*	red elderberry
	Viburnum dentatum var. *lucidum*	southern arrowwood
Caryophyllaceae	*Dianthus armeria*	Deptford pink
	Stellaria media	common chickweed
	Stellaria pubera	star chickweed
Clusiaceae	*Hypericum perforatum*	common St. Johnswort
Convolvulaceae	*Ipomoea* sp.	morning-glory
Cornaceae	*Cornus alternifolia*	alternateleaf dogwood
Cyperaceae	*Carex appalachica*	Appalachian sedge
	Carex crinita	fringed sedge
	Carex debilis	white edge sedge
	Carex digitalis	slender woodland sedge
	Carex folliculata	northern long sedge
	Carex laevivaginata	smoothsheath sedge
	Carex laxiflora	broad looseflower sedge
	Carex lurida	shallow sedge
	Carex rosea	rosy sedge
	Carex scoparia	broom sedge
	Carex stipata	owlfruit sedge
	Carex stricta	tussock sedge
	Carex swanii	Swan's sedge
	Carex virescens	ribbed sedge

Family	Scientific Name	Common Name
Cyperaceae (cont.)	*Carex vulpinoidea*	fox sedge
	Eleocharis sp.	spikerush
	Schoenoplectus acutus var. *acutus*	hardstem bulrush
	Scirpus atrovirens	green bulrush
	Scirpus cyperinus	woolgrass
Dennstaedtiaceae	*Dennstaedtia punctilobula*	eastern hayscented fern
	Pteridium aquilinum	western brackenfern
Dipsacaceae	*Dipsacus fullonum*	Fuller's teasel
Dryopteridaceae	*Deparia acrostichoides*	silver false spleenwort
	Dryopteris carthusiana	spinulose woodfern
	Dryopteris intermedia	intermediate woodfern
	Onoclea sensibilis	sensitive fern
	Polystichum acrostichoides	Christmas fern
Elaeagnaceae	*Elaeagnus umbellata*	autumn olive
Equisetaceae	*Equisetum arvense*	field horsetail
Ericaceae	*Vaccinium angustifolium*	lowbush blueberry
Fabaceae	*Coronilla varia*	purple crownvetch
	Robinia pseudoacacia	black locust
Fagaceae	*Fagus grandifolia*	American beech
	Quercus rubra	northern red oak
Grossulariaceae	*Ribes* sp.	currant
Hamamelidaceae	*Hamamelis virginiana*	American witchhazel
Iridaceae	*Sisyrinchium* sp.	blue-eyed grass
Juglandaceae	*Carya cordiformis*	bitternut hickory
Juncaceae	*Juncus effusus*	common rush
	Juncus tenuis	poverty rush
	Luzula multiflora	common woodrush
Lamiaceae	*Clinopodium vulgare*	wild basil
	Galeopsis bifida	splitlip hempnettle
	Glechoma hederacea	ground ivy
	Lycopus uniflorus	northern bugleweed
	Prunella vulgaris	common selfheal
	Pycnanthemum incanum	hoary mountainmint
Lauraceae	*Lindera benzoin*	northern spicebush
Lemnaceae	*Lemna minor*	common duckweed
Liliaceae	*Lilium superbum*	turk's-cap lily
	Maianthemum canadense	Canada mayflower
	Maianthemum racemosum ssp. *racemosum*	feathery false lily of the valley
	Polygonatum pubescens	hairy Solomon's seal
	Trillium erectum	red trillium
	Uvularia sessilifolia	sessileleaf bellwort
Lycopodiaceae	*Huperzia lucidula*	shining clubmoss
	Lycopodium dendroideum	tree groundpine
Magnoliaceae	*Magnolia acuminata*	cucumber-tree
Oleaceae	*Fraxinus americana*	white ash
Onagraceae	*Circaea lutetiana*	broadleaf enchanter's nightshade
	Epilobium coloratum	purpleleaf willowherb

Family	Scientific Name	Common Name
Onagraceae (cont.)	*Oenothera* sp.	evening-primrose
Orchidaceae	*Epipactis helleborine*	broadleaf helleborine
Osmundaceae	*Osmunda cinnamomea*	cinnamon fern
Oxalidaceae	*Oxalis stricta*	common yellow oxalis
Phytolaccaceae	*Phytolacca americana*	American pokeweed
Pinaceae	*Pinus resinosa*	red pine
	Pinus strobus	eastern white pine
	Pinus sylvestris	Scotch pine
	Tsuga canadensis	eastern hemlock
Plantaginaceae	*Plantago lanceolata*	narrowleaf plantain
Poaceae	*Agrostis canina*	velvet bentgrass
	Agrostis capillaris	colonial bentgrass
	Agrostis scabra	rough bentgrass
	Agrostis stolonifera	creeping bentgrass
	Andropogon gerardii	big bluestem
	Andropogon virginicus	broomsedge bluestem
	Anthoxanthum odoratum	sweet vernalgrass
	Brachyelytrum erectum	bearded shorthusk
	Bromus inermis	smooth brome
	Dactylis glomerata	orchardgrass
	Danthonia compressa	flattened oatgrass
	Dichanthelium clandestinum	deertongue
	Glyceria canadensis	rattlesnake mannagrass
	Glyceria striata	fowl mannagrass
	Holcus lanatus	common velvetgrass
	Leersia oryzoides	rice cutgrass
	Leersia virginica	whitegrass
	Lolium pratense	meadow ryegrass
	Milium effusum	American milletgrass
	Panicum dichotomiflorum	fall panicgrass
	Panicum virgatum	switchgrass
	Phalaris arundinacea	reed canarygrass
	Phleum pratense	timothy
	Poa alsodes	grove bluegrass
	Poa pratensis	Kentucky bluegrass
	Schizachyrium scoparium	little bluestem
	Sphenopholis nitida	shiny wedgescale
Polygonaceae	*Polygonum cuspidatum*	Japanese knotweed
	Polygonum persicaria	spotted ladysthumb
	Polygonum sachalinense	giant knotweed
	Polygonum sagittatum	arrowleaf tearthumb
	Polygonum scandens	climbing false buckwheat
	Polygonum virginianum	jumpseed
	Rumex obtusifolius	bitter dock
Primulaceae	*Lysimachia ciliata*	fringed loosestrife
Ranunculaceae	*Cimicifuga racemosa*	black bugbane
	Ranunculus abortivus	littleleaf buttercup

Family	Scientific Name	Common Name
Ranunculaceae (cont.)	*Ranunculus hispidus*	bristly buttercup
	Thalictrum pubescens	king of the meadow
Rosaceae	*Agrimonia gryposepala*	tall hairy agrimony
	Amelanchier arborea	common serviceberry
	Crataegus crus-galli	cockspur hawthorn
	Crataegus flabellata	fanleaf hawthorn
	Fragaria virginiana	Virginia strawberry
	Geum canadense	white avens
	Malus pumila	paradise apple
	Physocarpus opulifolius	common ninebark
	Potentilla norvegica	Norwegian cinquefoil
	Potentilla simplex	common cinquefoil
	Prunus pensylvanica	pin cherry
	Prunus serotina	black cherry
	Prunus virginiana	chokecherry
	Rosa multiflora	multiflora rose
	Rubus allegheniensis	Allegheny blackberry
	Rubus flagellaris	northern dewberry
	Rubus hispidus	bristly dewberry
	Rubus occidentalis	black raspberry
	Rubus odoratus	purpleflowering raspberry
	Spiraea tomentosa	steeplebush
Rubiaceae	*Galium asprellum*	rough bedstraw
	Galium circaezans	licorice bedstraw
	Galium mollugo	false baby's breath
Salicaceae	*Populus tremuloides*	quaking aspen
	Salix sericea	silky willow
Saxifragaceae	*Tiarella cordifolia*	heartleaf foamflower
Scrophulariaceae	*Mimulus ringens*	Allegheny monkeyflower
	Penstemon digitalis	talus slope penstemon
	Veronica officinalis	common gypsyweed
Smilacaceae	*Smilax rotundifolia*	roundleaf greenbrier
Solanaceae	*Solanum dulcamara*	climbing nightshade
Sphagnaceae	*Sphagnum* sp.	sphagnum
Thelypteridaceae	*Thelypteris noveboracensis*	New York fern
Tiliaceae	*Tilia americana*	American basswood
Typhaceae	*Typha latifolia*	broadleaf cattail
Ulmaceae	*Ulmus americana*	American elm
Verbenaceae	*Verbena hastata*	swamp verbena
Violaceae	*Viola canadensis*	Canadian white violet
	Viola sororia	common blue violet
Vitaceae	*Parthenocissus quinquefolia*	Virginia creeper
	Vitis aestivalis	summer grape

Appendix D.
Dichotomous field key to the vegetation associations of
Johnstown Flood National Memorial.

KEY TO VEGETATION ASSOCIATIONS AT JOHNSTOWN FLOOD NATIONAL MEMORIAL

1. HERBACEOUS AND SHRUB VEGETATION: TREE COVER LESS THAN 30%.

    2. Tall Shrub (>1.5 m) cover less than 25%.

        3. Occurs on low terrace sand and cobble bars adjacent to the Little Conemaugh River channel that experience frequent scour from water and ice. Scour zones may be sparsely vegetated with such common species as black locust (*Robinia pseudoacacia*), spotted joepyeweed (*Eupatorium maculatum*), goldenrods (*Solidago* spp.), deertongue (*Dichanthelium clandestinum*), sweet vernalgrass (*Anthoxanthum odoratum*), jewelweed (*Impatiens capensis*) and common yellow oxalis (*Oxalis stricta*).

            Riverine Scour Vegetation

        3. Occurs on poorly drained to moderately well drained muck, silt loam or clay loam soils that do not experience frequent scour.

            4. Predominantly terrestrial vegetation with goldenrods (*Solidago* spp.) and grasses dominant on moderately well drained silt loam or clay loam soils. Common grass species include: timothy (*Phleum pratense*), shiny wedgescale (*Sphenopholis nitida*), sweet vernalgrass (*Anthoxanthum odoratum*) and big bluestem (*Andropogon gerardii*). May contain inclusions of wet meadow dominated by hydrophytic species, especially associated with the former lakebed.

                Old Field (Herbaceous subtype)

            4. Predominantly palustrine vegetation with hydrophytes such as sedges (*Carex* spp.), bulrushes (*Scirpus* spp.) and broadleaf cattail (*Typha latifolia*).

                5. Occurs on very poorly drained muck soils, often with standing water. Dominant species include broadleaf cattail (*Typha latifolia*), with associates rice cutgrass (*Leersia oryzoides*), jewelweed (*Impatiens capensis*) and swamp verbena (*Verbena hastata*).

                Cattail Marsh

                5. Occurs on somewhat poorly drained clay loam soils associated with the former lakebed. Dominant species include sedges (*Carex* spp.), bulrushes (*Scirpus* spp.), and arrowleaf tearthumb (*Polygonum sagittatum*), with small isolated patches of willows (*Salix* spp.). Terrestrial species such as goldenrods (*Solidago* spp.), timothy (*Phleum pratense*), shiny wedgescale (*Sphenopholis nitida*), sweet vernalgrass (*Anthoxanthum*

odoratum) and big bluestem (*Andropogon gerardii*) may be scattered throughout.

Old Field (Wet Meadow subtype)

2. Tall Shrub cover (>1.5 m) greater than 25%.

    6. Hawthorns (*Crataegus* spp.) dominant in the thick tall shrub layer with occasional Scotch pine (*Pinus sylvestris*), red maple (*Acer rubrum*) and black cherry (*Prunus serotina*). Predominantly terrestrial vegetation with goldenrods (*Solidago* spp.), timothy (*Phleum pratense*), shiny wedgescale (*Sphenopholis nitida*), sweet vernalgrass (*Anthoxanthum odoratum*) and big bluestem (*Andropogon gerardii*) occurring in open areas interspersed between the shrub thickets.

    Old Field (Hawthorn subtype)

    6. Hawthorns (*Crataegus spp.*) sparse to absent, predominantly palustrine vegetation.

        7. Occurs on well-drained, low terrace, often sparsely vegetated, sand and cobble bars adjacent to the Little Conemaugh River channel. Typical shrub species include: steeplebush (*Spiraea tomentosa*), river birch (*Betula nigra*), Scotch pine (*Pinus sylvestris*), autumn olive (*Elaeagnus umbellata*), black locust (*Robinia pseudoacacia*), red maple (*Acer rubrum*), raspberries (*Rubus* spp.). Common groundstory species are: spotted joepyeweed (*Eupatorium maculatum*), goldendrods (*Solidago* spp.), narrowleaf plantain (*Plantago lanceolata*), oxeye daisy (*Leucanthemum vulgare*), deertongue (*Dichanthelium clandestinum*), sweet vernalgrass (*Anthoxanthum odoratum*), common boneset (*Eupatorium perfoliatum*), jewelweed (*Impatiens capensis*) and common yellow oxalis (*Oxalis stricta*).

        Riverine Scour Vegetation

        7. Occurs in low-lying areas on very poorly drained muck soils, often with standing water. Silky willow (*Salix sericea*) is dominant, with fringed loosestrife (*Lysimachia ciliata*), broadleaf cattail (*Typha latifolia*), fowl mannagrass (*Glyceria striata*), rice cutgrass (*Leersia oryzoides*), common rush (*Juncus effusus*), jewelweed (*Impatiens capensis*), flat-top goldentop (*Euthamia graminifolia*) and rough bedstraw (*Galium asprellum*) as common associates.

        Silky Willow Shrub Swamp

1. FOREST AND WOODLAND, TREE COVER GREATER THAN 30%.

    8. Conifer tree cover greater than 30%.

        9. Eastern hemlock (*Tsuga canadensis*) is the dominant canopy tree, with associates sugar maple (*Acer saccharum)*, American beech (*Fagus grandifolia*), white ash (*Fraxinus americana*), northern red oak (*Quercus rubra*) and black cherry (*Prunus serotina*).

            Eastern Hemlock - Northern Hardwood Forest

        9. Eastern white pine (*Pinus strobus*), Scotch pine (*P. sylvestris*) or red pine (*P. resinosa*) is the dominant canopy tree. Adventitious hardwoods such as sugar maple (*Acer saccharum)*, sweet birch (*Betula lenta*), black cherry (*Prunus serotina*), red maple (*Acer rubrum*), yellow birch (*B. alleghaniensis*), white ash (*Fraxinus americana*) and paradise apple (*Malus pumila*) may be present in the subcanopy.

            Conifer Plantation

    8. Conifer tree cover is less than 30%. Dominant canopy species are red maple (*Acer rubrum*), black cherry (*Prunus serotina*) and occassionally black locust (*Robinia pseudoacacia*). Associate tree species include hawthorns (*Crataegus* spp.), white ash (*Fraxinus americana*), American beech (*Fagus grandifolia*) and sweet birch (*Betula lenta*).

        Red Maple – Black Cherry Successional Forest / Woodland

Appendix E.
Accuracy assessment data form.

Accuracy Assessment Form for USGS-NPS Vegetation Mapping Program

Plot Number _____ Park _____ Date _____ Observers _____

Easting: _ _ _ _ _ _ E Northing _ _ _ _ _ _ _ N EPE/APE: _____ DOP: ____ Map datum: _____ Zone: ____

Topographic Description: _____ Elevation: _____ Aspect: _____ Canopy Closure: _____

Vegetation Association at Point: _____

Veg Assoc 1 2/in 50 m of point: _____

Veg Assoc 2 w/in 50 m of point: _____

Major Species by Strata:

_____

_____

Rationale for Classification:

_____

_____

_____

Comments:

_____

_____

Plot Number _____ Park _____ Date _____ Observers _____

Easting: _ _ _ _ _ _ E Northing _ _ _ _ _ _ _ N EPE/APE: _____ DOP: ____ Map datum: _____ Zone: ____

Topographic Description: _____ Elevation: _____ Aspect: _____ Canopy Closure: _____

Vegetation Association at Point: _____

Veg Assoc 1 2/in 50 m of point: _____

Veg Assoc 2 w/in 50 m of point: _____

Major Species by Strata:

_____

_____

Rationale for Classification:

_____

_____

_____

Comments:

_____

_____

Appendix F.
Indexes of representative photographs of vegetation classification sampling plots in Johnstown Flood National Memorial.

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By Vegetation Association

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Red Maple – Black Cherry Successional Forest / Woodland

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Eastern Hemlock – Northern Hardwood Forest

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Conifer Plantation

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Silky Willow Shrub Swamp

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Old Field

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Cattail Marsh

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Riverine Scour Vegetation

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JOFL.7 Red Maple – Black Cherry Successional Forest / Woodland
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JOFL.14 Red Maple – Black Cherry Successional Forest / Woodland
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JOFL.15 Conifer Plantation (Figure 11) 39

JOFL.17 Riverine Scour Vegetation (Figure 18) 63

Appendix G.
Bibliography for global vegetation descriptions from the
National Vegetation Classification System.

Bibliography for global vegetation descriptions from the
National Vegetation Classification System

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