Vicksburg National Military Park

Environmental Assessment for Landscape Rehabilitation

Statement of Findings for Executive Order 11990
(Protection of Wetlands)

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Prepared for the National Park Service, U.S. Department of the Interior

by

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STATEMENT OF FINDINGS FOR EXECUTIVE ORDER 11990
(PROTECTION OF WETLANDS)

Vicksburg National Military Park
Environmental Assessment for Landscape Rehabilitation

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1. INTRODUCTION

The National Park Service (NPS) has prepared and is making available for public review a Cultural Landscape Report (CLR) and Environmental Assessment (EA) that sets forth the basic philosophy for managing land cover at Vicksburg National Military Park (NMP) and provides a framework for future decision making on this subject. Two of the alternatives considered in the EA would have adverse effects on wetlands. Accordingly, the NPS has prepared this Statement of Findings in compliance with the requirements of Executive Order (EO) 11990 ("Protection of Wetlands"), which requires the NPS and other Federal agencies to evaluate the likely impacts of their actions on wetlands.

Vicksburg NMP is located in Vicksburg, Warren County, Mississippi (Figure 1-1). The park consists of six noncontiguous parcels. These include the main battlefield unit, Louisiana Circle, South Fort, Navy Circle, Grant's Canal, and Pemberton's Headquarters. Vicksburg National Cemetery abuts the park and is administered by NPS.

The purpose of Vicksburg NMP (NPS, 1980) is the:

> *"preservation and protection of existing earthworks, fortifications, structures, monuments, memorials, and other outstanding natural and historical features within its jurisdiction in such a way as to provide the visitor with a pleasing and rewarding experience. It is also to further the visitor's understanding and appreciation of the ordeal experienced by all persons of both North and South at Vicksburg during the months of May, June, and July 1863."*

Vicksburg NMP and Vicksburg National Cemetery comprise 1,800 acres. The park includes approximately 1,330 monuments, 16 miles of tour roads, and many earthen fortifications that document the components of the Union and Confederate armies during the siege. NPS faces many challenges associated with the long-term management and maintenance of the park. As part of the planning process intended to support decisions regarding management of the park, NPS is preparing a CLR for Vicksburg NMP. The CLR is intended to provide NPS with an assessment of the character-defining features of the Vicksburg NMP landscape, document historic and existing conditions, and develop specific treatment recommendations to ensure the future protection of the park and its natural and cultural resources (NPS, 2008). The main battlefield unit (Figure 1-2) is the primary focus of the CLR although the three small forts along the Mississippi River – South Fort, Louisiana Circle, and Navy Circle – are also addressed in the report. Landscape treatments are also proposed at South Fort. The EA will analyze the preferred alternative and the other proposed alternatives in the CLR and their impacts on the environment.

Today, the Vicksburg battlefield bears little resemblance to the landscape at the time of the siege. NPS management practices since the establishment of the park have allowed parklands to be naturally reforested. Areas that were once cleared during the siege are now forested as a result of natural vegetative regeneration and plantings by the Civilian Conservation Corps (CCC) in the 1930s to minimize soil erosion. These areas now provide important wildlife habitat in a unique loess soil bluff environment. If landscape treatments described in the EA are not implemented, the existing park will continue to misrepresent historic battlefield landscape conditions and will reduce visitor understanding of the events that the park commemorates (NPS, 2008).

Figure 1-1 Vicksburg National Military Park Site Location Map

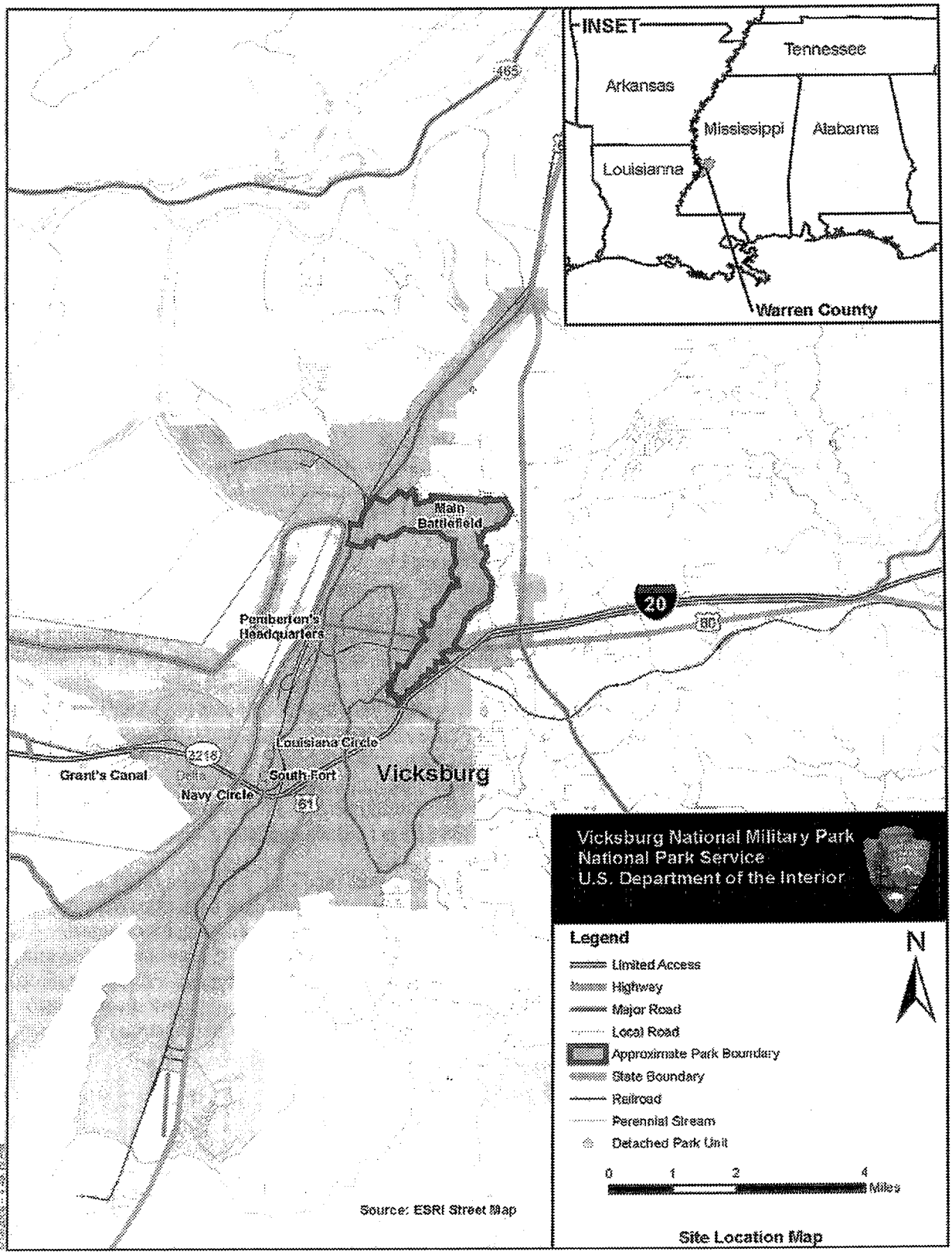
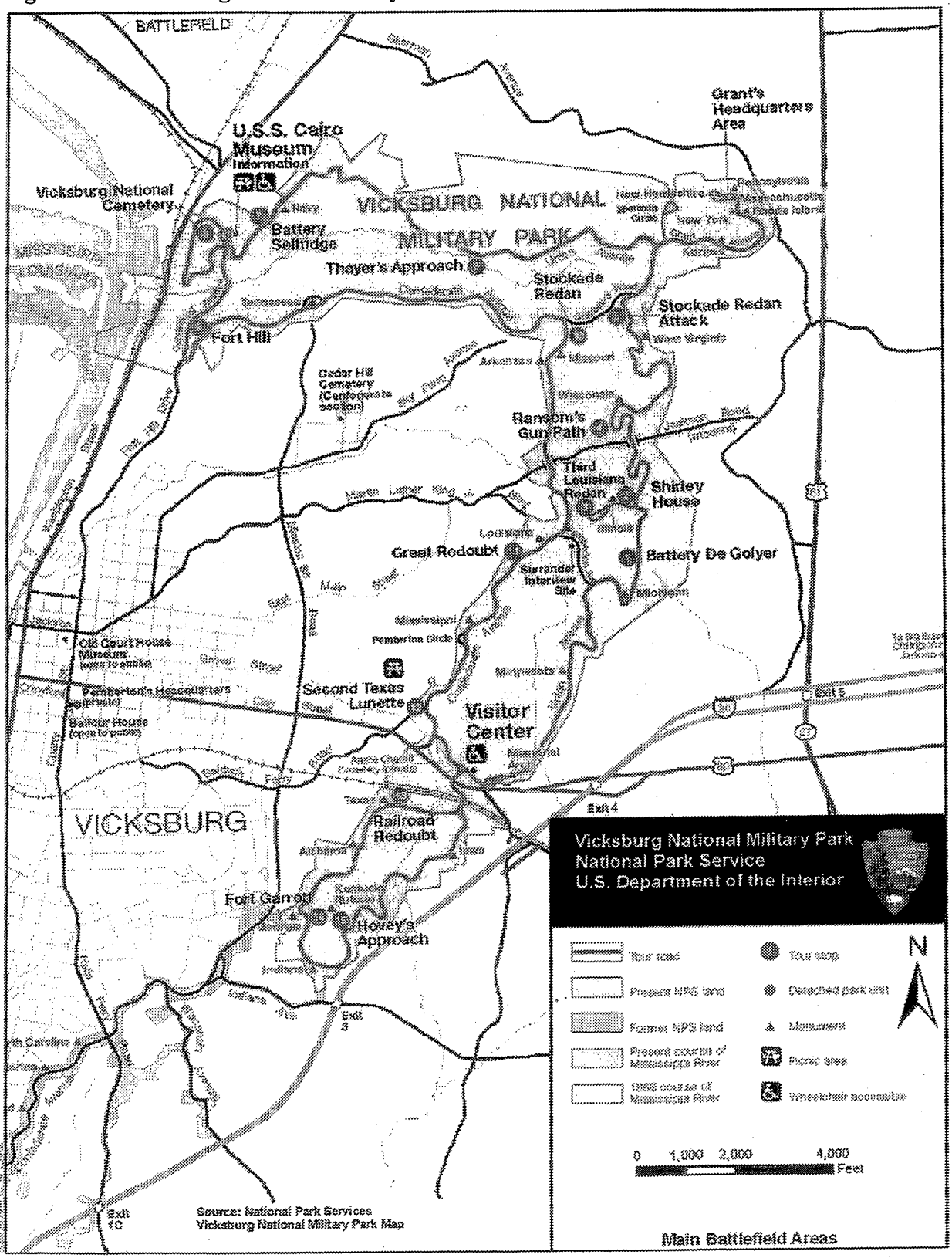


Figure 1-2 Vicksburg National Military Park Main Battlefield Areas



The CLR will also be used in support of an updated parkwide General Management Plan (GMP), a Comprehensive Long-range Interpretive Plan, and associated compliance as required by the National Environmental Policy Act (NEPA) of 1969, as amended. It will also be used to guide any additional landscape treatments beyond the initial landscape treatments discussed in the CLR. The GMP and Comprehensive Long-range Interpretive Plan are essential tools that will help guide future management of the park's resources (NPS, 2008).

EO 11990 ("Protection of Wetlands") requires the National Park Service and other Federal agencies to evaluate the likely impacts of their actions on wetlands. The objectives of the EO are to avoid, to the extent possible, the long-term and short-term adverse impacts associated with the occupancy, modification, or destruction of wetlands. NPS Management Policies (2006) and Director's Order 77-1, "Wetland Protection" (NPS 2002) reiterates the importance of safeguarding wetlands. NPS Procedural Manual #77-1 provides agency-specific procedures for complying with the EO. The purpose of this Statement of Findings is to present the rationale for undertaking a project with potential adverse impacts to wetlands and to document the anticipated effects.

EO 11988 ("Floodplain Management") requires the NPS and other federal agencies to evaluate the likely impacts of actions in floodplains. The objective of EO 11988 is to avoid, to the extent possible, the long and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative. NPS Director's Order #77-2 Floodplain Management and Procedural Manual #77-2 provide NPS policies and procedures for complying with EO 11988. The proposed project would have no adverse effect to known floodplain areas. The only Federal Emergency Management Agency (FEMA)-designated floodplains within Vicksburg NMP are in the northwest corner of the park where Mint Spring Bayou enters the Yazoo River Diversion Canal. None of the proposed alternatives would result in any impacts to the designated floodplain in this area. Therefore, guidance under Director's Order 77-2 would not apply to the proposed project.

2. PROPOSED ACTION

The purpose of the CLR is to guide landscape treatment and maintenance so that the park meets its mandate to "commemorate the campaign, siege and defense of Vicksburg, and to preserve the history of the battles and operations of the siege and defense on the ground where they were fought and were carried on. ..." The park's authorizing legislation further includes specific actions to meet the overall purpose: "to restore the forts and the lines of fortification, the parallels and approaches of the two armies, or so much thereof as may be necessary to the purposes of the park." The CLR seeks to provide a clear direction to manage the landscape in ways that commemorate the campaign, siege, and defense of Vicksburg, as required by Congress, by preserving resources and enhancing visitor understanding and appreciation of the events that occurred here while providing a variety of experiences and complying with other laws and regulations.

Four alternatives were evaluated as a part of the EA and are outlined below. Under the preferred alternative (Alternative C), the proposed action would reveal the historic landscape of the Civil War siege in the areas that collectively represent physical resources at key military engagement sites. At the time of the battle, the project areas consisted of fields, pasture, and meadows that were modified by military fortifications. During the 1863 siege, the landscape had been cleared of most forested areas. Trees were removed to establish clear fields of fire from Confederate earthworks, to construct additional fortifications and structures by both Union and Confederate forces, and to construct abatis (improvised obstacles) to impede the movement of Union forces.

The openness that characterized this area in 1863 persisted until the early 1900s. However, plantings by the CCC in the 1930s to minimize soil erosion and natural vegetation regrowth have established forested areas in these once open fields. The EA examines alternatives that involve rehabilitation of significant large-scale elements of the park's historic landscape, including the pattern of open fields and wooded areas. Rehabilitation would remove mature trees (60 to 80 feet tall) and replace them with grassed fields. Within riparian corridors, the mature trees would be replaced with a woody buffer consisting of low growing native trees and shrubs species (less than 15 feet tall). Vegetation that is less than 15 feet tall would be allowed to remain in the riparian area. Vegetation would be maintained by trimming to keep vegetation heights within wetlands and riparian areas below 15 feet. Removal of the non-historic vegetation would more accurately portray the historic avenues of approach and fields of fire that were important to the siege of Vicksburg.

ALTERNATIVES CONSIDERED BY THE EA

Four draft alternatives were developed during a November 2007 workshop with the project team. A full range of reasonable alternatives was developed, meeting the park's purpose and objectives for taking action and meeting NPS guidelines for providing different means of accomplishing park goals while protecting and/or minimizing impacts on some or all resources. Furthermore, the draft alternatives are consistent with applicable laws, policies, and regulations that guide NPS. The alternatives under consideration are listed below:

- Alternative A – Continue Existing Management (No Action)
- Alternative B – Preservation Through Best Management Practices (BMPs)
- Alternative C – Rehabilitate/Maintain Key Areas of Military Engagement
- Alternative D – Rehabilitate/Maintain the Broad Spectrum of Military Engagements

Two additional alternatives were considered but dismissed because they were determined to be unreasonable. Alternatives that were considered but dismissed are briefly discussed at the end of this section.

The no action alternative, Alternative A, would maintain the existing interpretive exhibits and landscape condition in the park. The three action alternatives include different ways of making the cultural

landscape and the story of Vicksburg more accessible to park visitors through a variety of interpretive programs, including technology and media exhibits and through clearing of the landscape. Alternative B (preservation through BMPs) focuses on technology and media exhibits as an important means of visitor interpretation, as well as protecting the existing cultural landscape through implementation of BMPs. Alternative C (rehabilitate/maintain areas of key military engagements) and Alternative D (rehabilitate/maintain the broad spectrum of military engagements) focus on clearing of the cultural landscape as a primary means of interpretation. Alternative C involves clearing in three key areas of activity during the siege, totaling approximately 90 acres, while Alternative D involves clearing of a broader area of military activity totaling approximately 350 acres.

These three action alternatives and the no action alternative were evaluated using a process called "Choosing by Advantages" (CBA) during meetings at Vicksburg NMP on June 24-25, 2008. This process evaluated alternatives by identifying and comparing the relative advantages of each according to a set of criteria. The alternatives were rated on how well they met following attributes and factors or had an advantage in meeting each attribute and factor:

- facilitating understanding and interpretation of the park story
- allowing visitors to experience history up close
- protecting physical features and resources from degradation
- providing opportunities for a variety of visitor experiences while maintaining the historic character and integrity of the landscape and managing visitor use conflicts
- protecting physical features from degradation
- developing sustainable ways of maintaining the landscape;
- protecting natural and cultural features relative to their place in achieving the purpose of Vicksburg NMP

Alternative C received the highest score of the four alternatives evaluated, and it is the NPS-preferred alternative. Alternative C provides the widest range of benefits to park visitors, the natural and cultural environments, and park maintenance, with minimal environmental degradation. Alternative A does not meet the purpose and need of the EA. Alternative B provides a variety of visitor use experiences, but it does not expose the cultural landscape of the siege activities so that the visitor can understand the Vicksburg campaign. Alternative D reveals more of the cultural landscape than does Alternative C, but it does so at the expense of park natural resources, including extensive wetland/stream impacts.

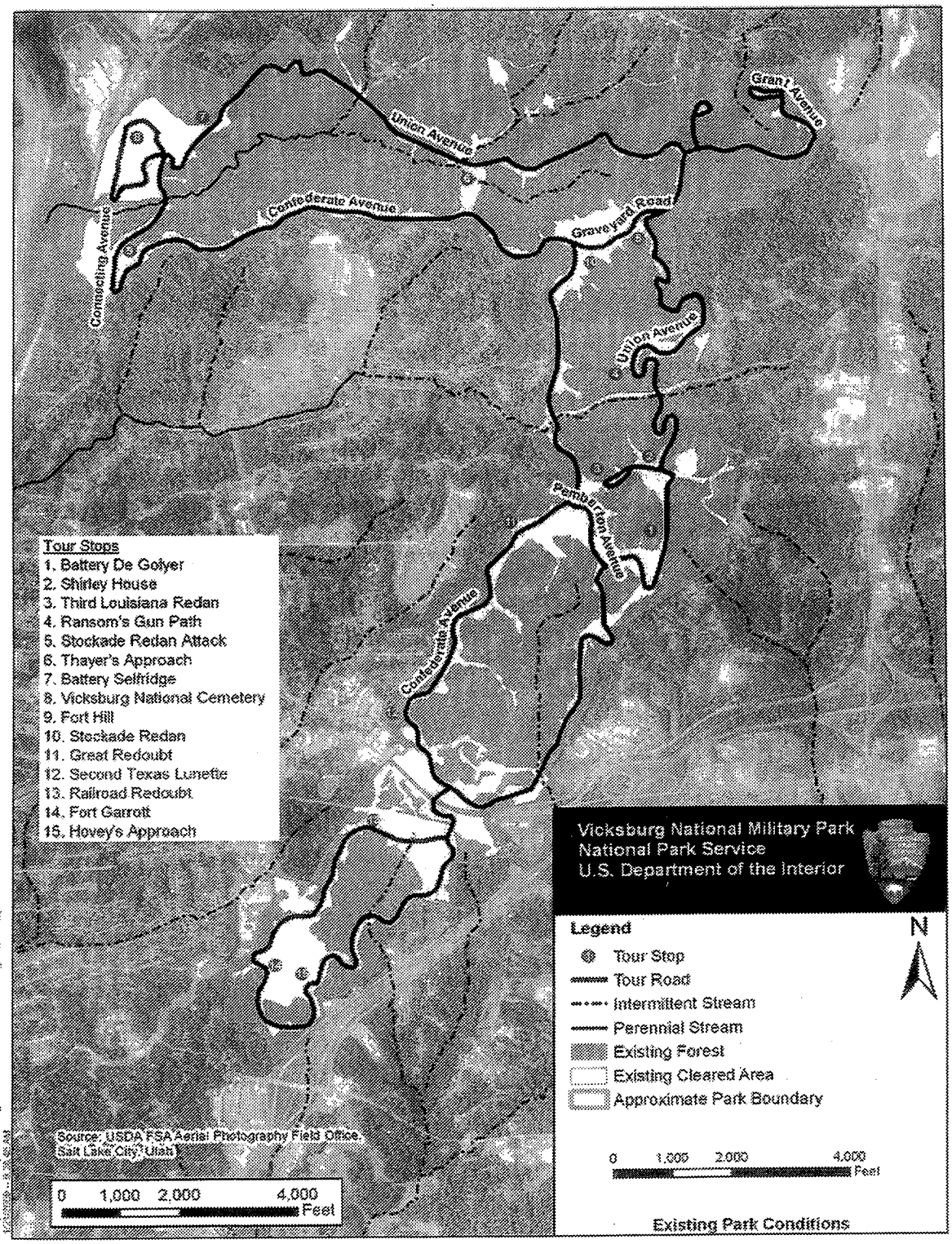
No impacts to wetlands and streams are proposed under Alternatives A and B. Alternative C would result in short-term and long-term adverse impacts to approximately 7 acres of forested wetlands as a result of their conversion from forested wetlands to scrub-shrub and emergent wetlands. Alternative D would result in short-term and long-term adverse impacts to approximately 97 acres of forested wetlands as a result of their conversion from forested wetlands to scrub-shrub and emergent wetlands.

Detailed descriptions of each of the alternatives follow. More detailed descriptions of the individual elements of each alternative and analyses of their proposed effects to the natural and human environments can be found in the EA prepared for the EA.

ALTERNATIVE A – CONTINUE EXISTING MANAGEMENT (NO ACTION)

The no action alternative describes the action of continuing the current management operations and conditions. It does not imply or direct any change to current management or the removal of existing uses, development, or facilities. The no action alternative provides a basis for comparing the management direction and environmental consequences of the action alternatives. Should the no action alternative be selected, NPS would respond to future needs and conditions associated with Vicksburg NMP without major actions or changes in present course. Figure 2-1 presents the existing park conditions, including the currently forested and cleared areas of the park.

Figure 2-1 Existing Park Conditions



ALTERNATIVE B – PRESERVATION THROUGH BMPS

Alternative B would preserve resources by applying BMPs to areas within the park. Interpretation would become the primary means for commemoration and communication of the site history to the visitor. This alternative would involve the development of new exhibits, waysides, signage and other interpretive features at different locations around the park. Also, three 10-acre sites would be converted to a new landcover type intended to best protect against soil erosion based on the recommendations of local ecologists and plant scientists. These sites would be monitored, and the approach adapted based on evaluation of the success of the resulting plant communities. Additional areas of the park would then be converted over time using this adaptive approach. It is anticipated that the alternative would not impact wetlands or riparian areas.

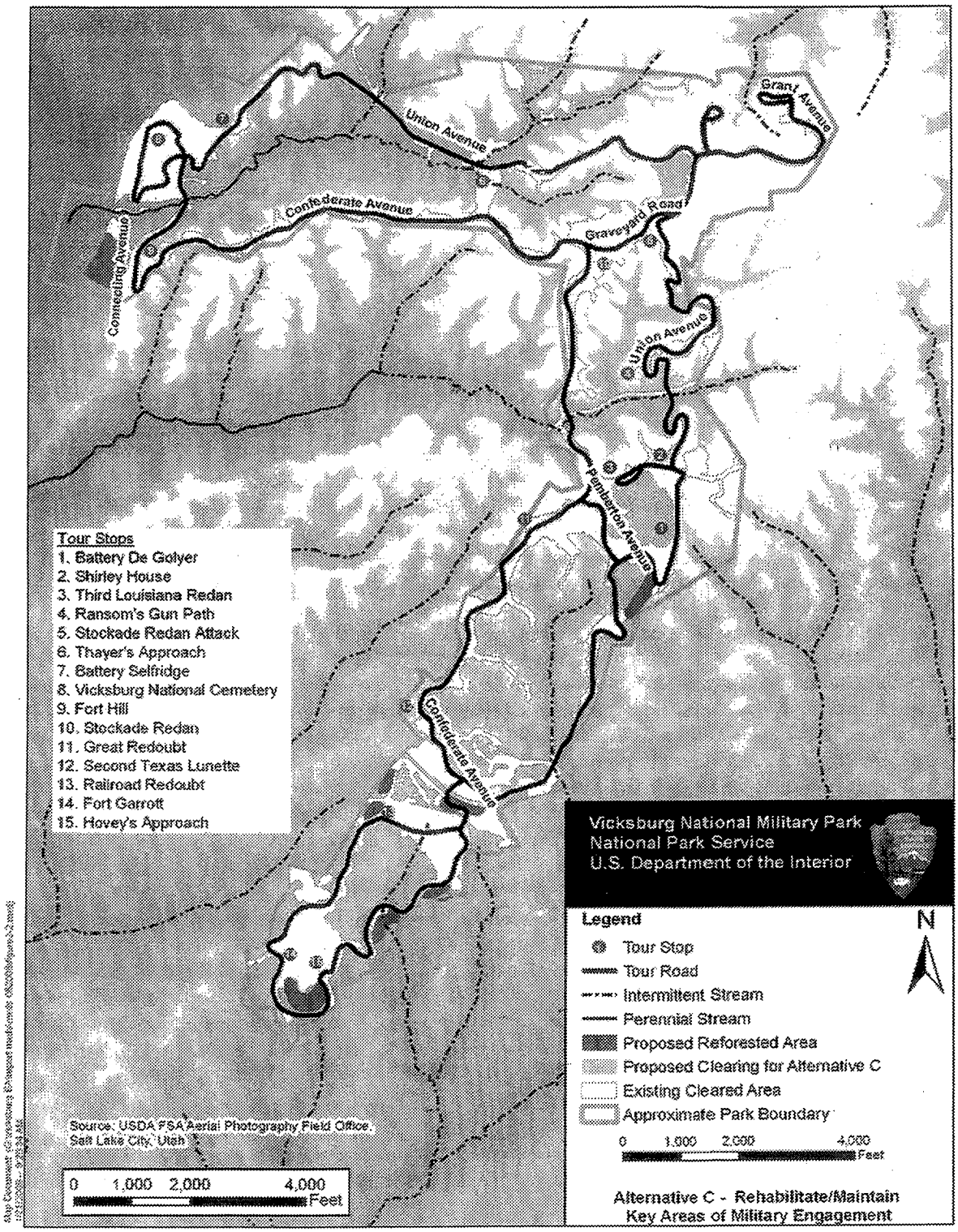
ALTERNATIVE C – REHABILITATE/MAINTAIN KEY AREAS OF MILITARY ENGAGEMENT

Under Alternative C, Vicksburg NMP would rehabilitate the park landscape, primarily by rehabilitating Civil War military resources. Alternative C would implement land cover changes within the park to reveal the historic landscape of the Civil War siege in the areas that collectively represent physical resources at key military engagement sites for meeting the legislative mandate of the park to "commemorate the campaign and siege and defense of Vicksburg," and "restore the forts and the lines of fortifications, the parallels and the approaches of the two armies, or so much thereof as may be necessary to the purposes of the park." Identification of the key areas was based on careful review and understanding of the military terrain that molded the events of September 1862 through July 1863 and its ability to convey the full range of important military events and activities that occurred there. Preservation and stabilization of important natural, cultural, and historic resources are assumed under rehabilitation. Rehabilitation accommodates new uses and can make historic associations more apparent. Furthermore, enhanced interpretive, park operations, and visitor use and experience elements would be included in Alternative C.

As shown in Figure 2-2, the key areas that would be considered priorities for maintaining open vegetative cover or where enhanced views and access are highly desirable to meet the park's mission of telling the story of the siege and attacks are:

- Area 1 – Old Jackson Road/Battery DeGolyer/Third Louisiana Redan. Implementation of this alternative would provide improved sight lines in this area. It would also benefit the cultural landscape by removing the old Administration Building. Removal would be addressed by the park in a future planning process. Clearing in this area would reveal Union earthworks, existing markers, key Union avenues of approach, and battlefield terrain that are currently obscured from view in the forested area between Confederate earthworks to the west and Union earthworks to the east. Union trench lines are contained within the forested area and are currently not visible from the Confederate earthworks and fortifications that they approached during the siege. Clearing in this area would also provide connectivity between existing cleared battlefield areas. No wetlands or streams are located within this proposed clearing area.
- Area 2 – Railroad Redoubt/Fort Garrott. Clearing in this area would reveal Union earthworks, existing markers, and battlefield terrain that are currently obscured from view in the forested area between Railroad Redoubt to the north and Fort Garrott to the south. Confederate earthworks are currently visible adjacent to the western edge of the proposed clearing limits along the South Loop Tour Road. Some Union earthworks are also visible along the tour road to the east of the proposed clearing limits, but several Union trench lines are contained within the forested area and are currently not visible from the Confederate earthworks and fortifications that they approached during the siege. These trench lines, including existing markers installed during the early years of

Figure 2-2 Alternative C – Rehabilitate/Maintain Key Areas of Military Engagement



Vicksburg NMP that document the locations of Brig. Gen. Lawler's 2nd Brigade, 14th Division, and Col. Lindsey's 2nd Brigade, 9th Division under the XIII Army Corps and Major General John A. McClernand, are concealed from view within the forested areas proposed to be cleared. Natural resource challenges include gley soils (soil that has been saturated over a long period of time, therefore reducing the iron and manganese content) and wetland areas.

- Area 3 – Graveyard Road/Stockade Redan. This area is the best place to tell the story of combat; the May 19 to 22, 1863, attacks; the construction methods and components of Stockade Redan; and a key Union avenue of approach. Natural resource challenges include wetlands, heavy forest, and Mint Spring Bayou.

Alternative C would enhance the visual accessibility of these three key areas of the battlefield landscape by removing approximately 90 acres of existing forest cover and replacing it with a low-growing groundcover. The alternative would retain older native trees where they do not block important views, particularly those that afford shade along the tour road.

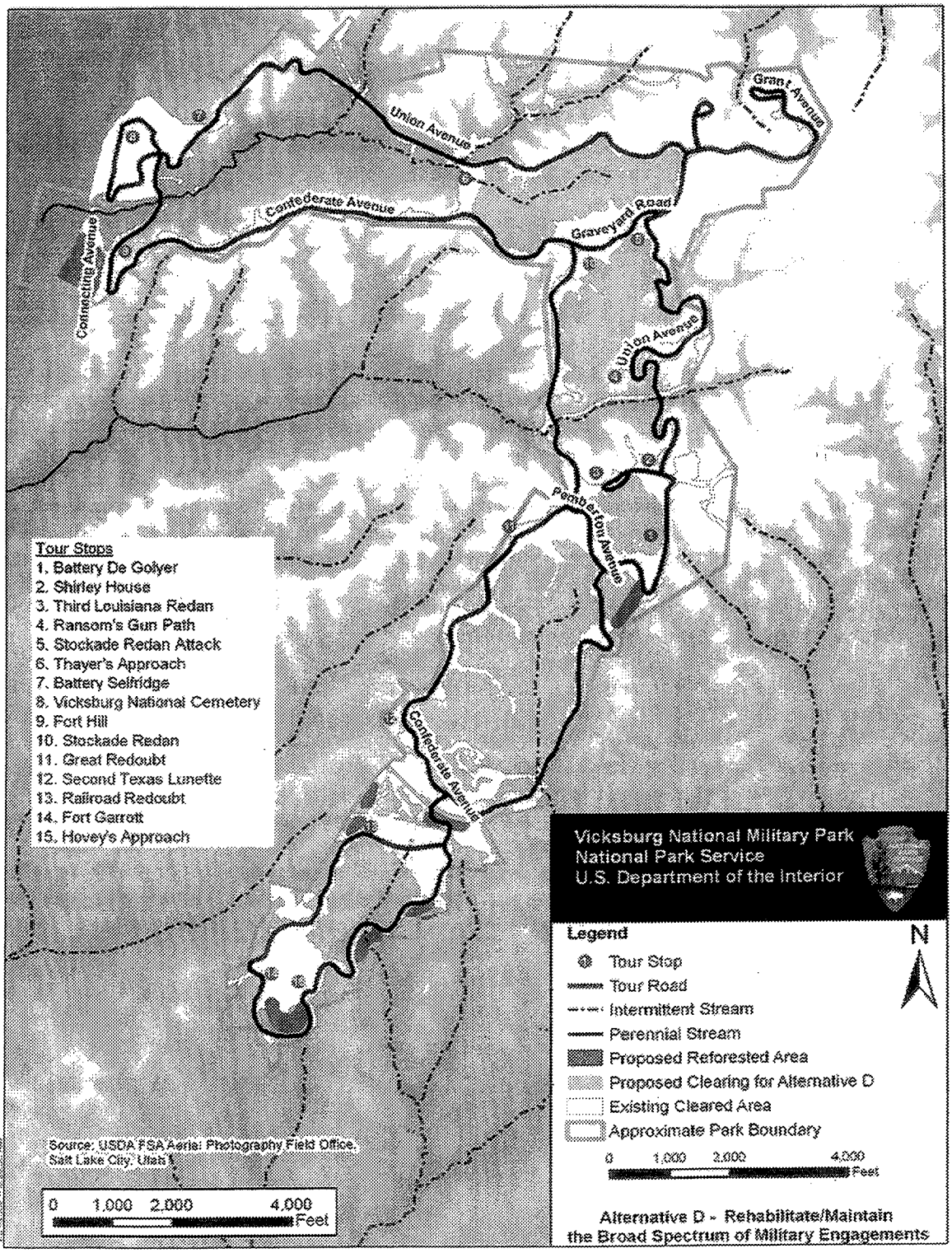
Alternative C would also include the re-establishment of spatial patterns associated with the 1863 battlefield landscape within view of the tour road corridor, such as key visual connections between artillery positions of the opposing armies, fields of fire, and exposure of terrain features that can be tied to the military engineering of the two lines. This approach would prioritize interventions that enhance the experience of the visitor touring the park within a vehicle, as many visitors do. This alternative would incorporate a combination of judicious woodland clearing, thinning, and limbing up of canopy trees to enhance visual accessibility along the auto tour route. Alternative C would also establish new forest cover over 20 acres of the park to enhance screening of incompatible views and help protect the park's setting and critical viewsheds. Reforestation would involve the planting of tree, shrub, and groundcover species representative of a desired future woodland composition.

Alternative D – Rehabilitate/Maintain the Broad Spectrum of Military Engagements

Under Alternative D, an extensive area of Vicksburg NMP would be rehabilitated by the removal of woodlands to reveal a broad spectrum of sites of military engagement. Alternative D assumes that interpretation and education of visitors should feature authentic connections between physical resources and military events, using military terrain analysis as the basis for revealing the key stories associated with the Vicksburg landscape. Implementation of Alternative D would enhance the legibility of Civil War-era resources and associations through the removal of forest cover that has grown up since the end of the siege and currently obscures many visual and physical relationships that were important to the events that occurred at Vicksburg in 1863. Tree clearing would occur in areas identified through military terrain analysis as key to the battle and siege tactics of Union and Confederate commanders, and to its understanding. Interpretation would be provided to help visitors understand what happened within these modified areas. Later additions to the landscape that support visitor use of the park and NPS administration of the site, as well as late 19th and early 20th century commemoration of the Civil War, would be retained to interpret the park's enabling legislation. Alternative D assumes that the best way to "commemorate the siege and preserve the history of the battles and operations of the siege and defense on the ground where they were fought and were carried on ..." is to reveal the landform, topography, and earthen fortifications associated with Union and Confederate lines and the landscape that was modified to offensive and defensive purposes between them.

As shown in Figure 2-3, the key areas that would be considered priorities for maintaining open vegetative cover or where enhanced views and access are highly desirable to meet the park's mission of telling the story of the siege and attacks are:

Figure 2-3 Alternative D – Rehabilitate/Maintain the Broad Spectrum of Military Engagements



- The extent of the Union and Confederate lines and the landscape between them between Thayer's Approach and Fort Garrott, with buffer plantings to be established or remain in association with the visitor center, maintenance area, and Clay Street.
- Clearing to expose a visual connection to the water battery from Fort Hill would be another localized effort that would support implementation of this alternative.
- Fort Hill and the landscape north and west of Thayer's Approach would not be cleared because there was little military activity in this area, and most of the park's forest and natural resources, wetlands, and Mint Spring Bayou exist within this area.
- However, forest would be retained in the area behind the Illinois Monument up to Old Jackson Road to protect the steeply sloped topography that could not otherwise be maintained, and to provide a visual screen for modern Jackson Road.

Alternative D would enhance the visual accessibility of the battlefield landscape by removing existing forest cover over approximately 350 acres, and replacing it with a low ground cover that does not interfere with visitor visual access of the enhanced areas. Bermuda grass, native grasses and forbs, and other groundcovers would be considered for establishment on newly cleared areas. The type of groundcover to be used in each area should be based on a park assessment of its facility in establishment and maintenance.

Alternative D would also establish new forest cover over 20 acres of the park to enhance screening of incompatible views and help protect the park's setting and critical viewsheds. Reforestation would involve the planting of tree, shrub, and groundcover species representative of a desired future woodland composition.

Alternatives Considered but Dismissed

Two additional alternatives were considered but dismissed. The two alternatives were Alternative E – Restoration to Civil War Siege Period (circa 1863) and Alternative F – Restoration to Park Development Period (1899 to 1917). Implementation of either of these alternatives would require the re-acquisition of former parkland that has been heavily impacted by adjacent development. Both alternatives would require extensive tree clearing and replanting of ground cover. Extensive resources would be required to maintain the ground cover. Monumentation would be removed, and interpretive resources would be required at an alternative location. Exceptions would also have to be made for the inclusion of features that do not date to the specified restoration period, such as commemorative monuments and the visitor center, which would negate the guiding concept of the alternatives. Because these alternatives would require extensive clearing of existing and former NPS property, as well as the loss of existing interpretive features, they were dismissed as being not reasonable.

3. SITE DESCRIPTION

No impacts to wetlands and streams would occur under Alternatives A and B. The project area for Alternative C (the preferred alternative) encompasses approximately 90 acres and would result in short-term and long-term adverse impacts to approximately 7 acres of forested wetlands as a result of their conversion from forested wetlands to scrub-shrub and emergent wetlands. The project area for Alternative D encompasses approximately 350 acres of clearing and would result in short-term and long-term adverse impacts to approximately 97 acres of forested wetlands as a result of their conversion from forested wetlands to scrub-shrub and emergent wetlands. Figure 3-1 shows the proposed clearing areas for Alternatives C and D.

Within the project area, potential wetland impacts under Alternatives C and D would be to either riverine, upper perennial, unconsolidated bottom streams or palustrine forested wetlands. These areas are located within the Two-Mile Creek, Durden Creek, Glass Bayou, or Mint Spring Bayou watersheds, all of which are tributary to the Mississippi River or the Yazoo River Diversion Canal. These wetland types are common throughout the park and in the surrounding region, and within the park, the wetland communities include areas dominated by Chinese privet (*Ligustrum sinense*).

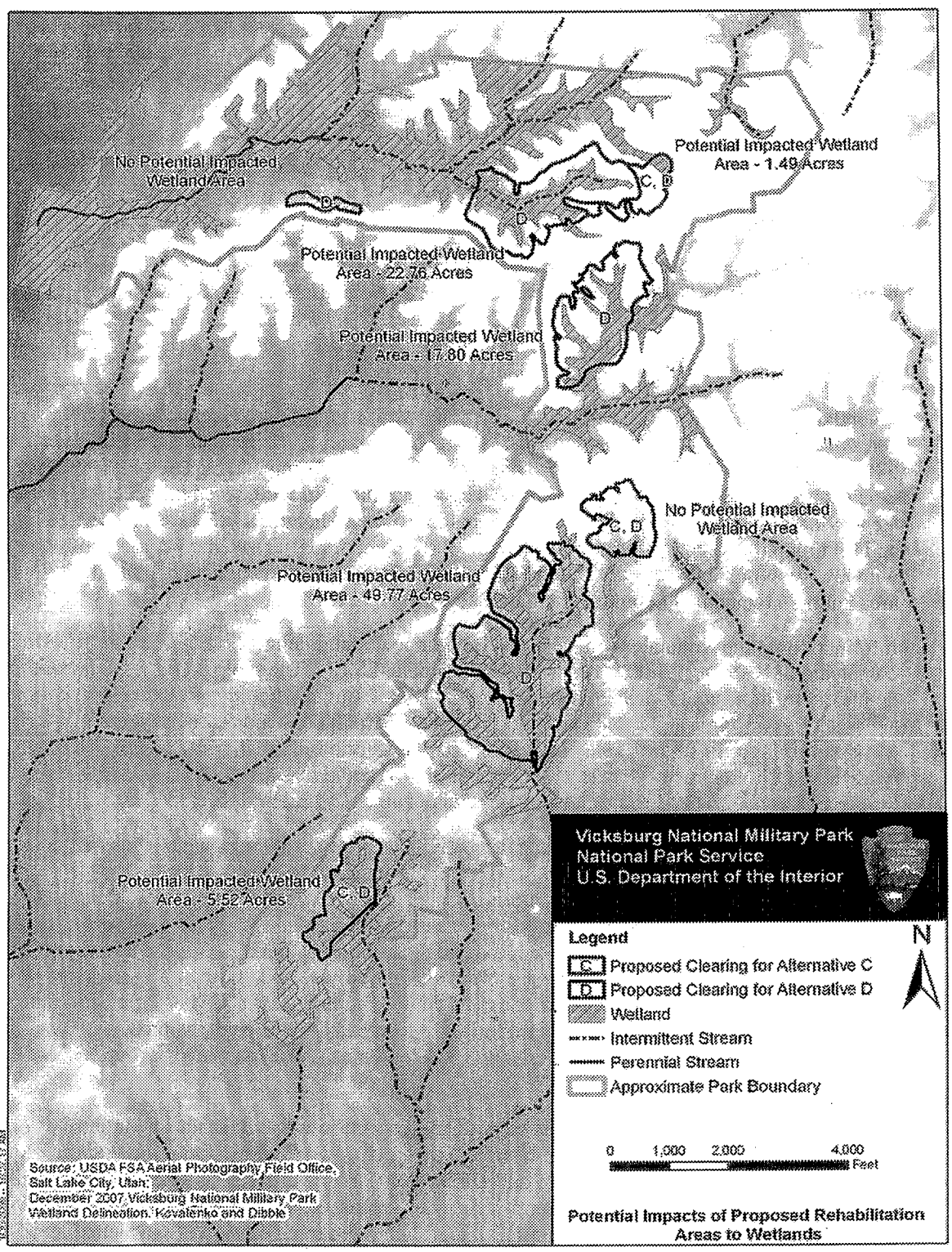
Potential impacts to wetlands from battlefield rehabilitation would involve clearing vegetation from 7.01 acres of forested wetland. Within a 50-foot buffer along streams (25 feet on each side), trees over 15 feet tall would be removed, while trees less than 15 feet tall would remain. This 50-foot streambank buffer would be replanted with native species as necessary to maintain woody vegetation along the streambanks. Vegetation in the buffer would be maintained at a maximum height of 15 feet using commercial pruning and trimming equipment. Outside of the 50-foot streambank buffer, wetland areas would be replanted with low-growing native grasses. Native woody vegetation would be allowed to naturally repopulate this area but maintained to a maximum height of 15 feet.

Information on the wetland systems is derived from a wetland delineation of Vicksburg NMP that was completed in December, 2007 (Kovalenko and Dibble, 2007). The principal investigators for the wetland delineation were Katya Kovalenko, a Ph.D. candidate of Aquatic Ecology in the Department of Wildlife and Fisheries at Mississippi State University, and Dr. Eric Dibble, a professor of Aquatic Ecology at Mississippi State University. This delineation report describes the hydrophytic plant communities, soil types, and hydrology of wetlands and streams in the park and classifies these wetland/stream areas within the Cowardin and hydrogeomorphic systems. The delineation report is included as Appendix A.

Functionally, forested wetlands in the park are defined as seepage or slope wetlands, which are recharged from rainwater that percolates from higher elevations and contributes to seepage, subsurface, and sheet flows. According to disturbance-level criteria, seepage and riverine wetlands in the park were judged pristine to moderately disturbed (primarily by upstream modifications and invasive plants), and modified wetlands were judged severely disturbed (Kovalenko and Dibble, 2007). Forested wetlands of the park may play an important role in control of erosion and siltation. Dense growth of Chinese privet may compromise this role and wetland functions; observations indicated very sparse herb and other shrub cover and lack of extensive root systems in gullies overgrown with privet, whereas nearby areas dominated by native giant cane (*Arundinaria gigantea*) had a more extensive root system in the upper part of the soil (Kovalenko and Dibble, 2007).

Water retention by seepage wetlands is essential for streamflow maintenance and integrity of the overall watershed. Saturated soils were observed in the park up to two months after the last significant precipitation was recorded (Kovalenko and Dibble, 2007). It is also possible that seepage wetlands prevent the soil from extreme desiccation, which may lead to changes in soil structure; therefore, this type of wetland is important for maintaining soil integrity and reducing erosion. (Kovalenko and Dibble, 2007).

Figure 3-1 Potential Impacts of Proposed Rehabilitation Areas to Wetlands



Biological functions of wetlands consist of maintenance of plant and animal communities and regional and landscape biodiversity. A variety of fish, macroinvertebrates, reptiles, and amphibians utilize the wetland and perennial stream habitats that would be cleared. Most of the proposed clearing would occur along intermittent and ephemeral stream channels, which would not maintain year-round populations of these animals. Several obligate wetland plants were observed in Vicksburg NMP during floristic assessment. Park wetlands have a relatively high habitat function. Vicksburg NMP contains one of the few remaining tracts of loess bluff hardwood forests on public land in the United States; therefore, some of the wetlands within the park support plant communities that are regionally rare. None of these areas are proposed to be cleared. No rare, threatened or endangered species are known to occur within the wetland areas. Some areas had lower habitat quality due to the presence of invasive species, especially English ivy and Chinese privet (Kovalenko and Dibble, 2007).

In total, there are four wetland systems evaluated within this document. The wetland areas and their proposed impacts from Alternatives C and D are as follows.

Table 3-1. Potential Impacts to Wetland Areas from Alternatives B, C, and D.

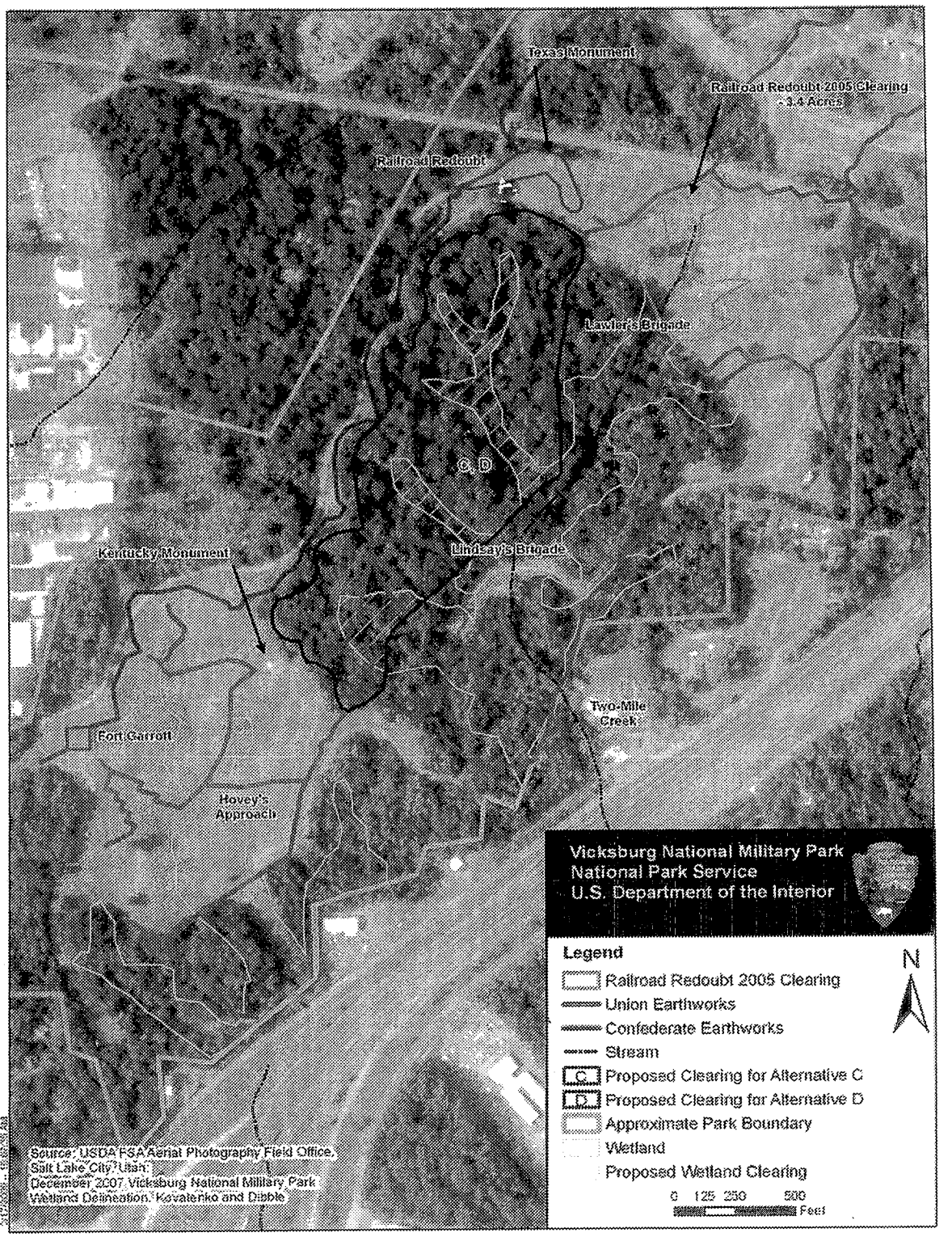
Wetland Area #	Potential Alternative B Wetland Impacts (acres)	Potential Alternative C Wetland Impacts (acres)	Potential Alternative D Wetland Impacts (acres)
(1) Two-Mile Creek Area	none	5.52	5.52
(2) Durden Creek Area	none	none	49.77
(3) Glass Bayou Area	none	none	17.60
(4) Mint Spring Bayou Area	none	1.49	24.25
TOTAL	none	7.01	97.14

TWO-MILE CREEK AREA (1).

Two-Mile Creek and its adjacent tributaries and wetlands are located near the southern boundary of Vicksburg NMP in an area known as the South Loop (Figure 3-2). Approximately 2,400 linear feet of Two-Mile Creek, its unnamed ephemeral and intermittent tributaries, and adjacent wetland areas are located within the proposed clearing limits for Alternatives C and D. Both Alternatives C and D would convert the existing overstory vegetation from approximately 60-80 feet high to approximately 15 feet high. The Cowardin *et al* (1979) classification for Two-Mile Creek is riverine, intermittent, streambed, seasonally flooded. The associated wetlands within the proposed clearing area total 5.52 acres and are classified as palustrine forested, broad-leaved deciduous, and seasonally flooded/saturated (PFO1B/C). Two-Mile Creek originates within park boundaries and flows generally to the south. The watershed sizes of impacts to the Two-Mile Creek tributaries are less than 20 acres each.

Species observed in the wetland during the delineation fieldwork included Chinese privet, Japanese honeysuckle (*Lonicera japonica*), muscadine (*Vitis rotundifolia*), boxelder (*Acer negundo*), sugarberry (*Celtis laevigata*), water oak (*Quercus nigra*), sweetgum (*Liquidambar styraciflua*), and sand violet (*Viola affinis*) (Kovalenko and Dibble, 2007).

Figure 3-2 Two-Mile Creek Area



Replacement of the wetland forest with a maintained scrub-shrub forest with a maximum canopy height of 15 feet would diminish some functional values in this area. The 50-foot buffer along streams would be cleared of exotic vegetation and vegetation taller than 15 feet, while other vegetation would remain within the 50-foot streambank buffer. Streams would no longer be shaded by mature trees, potentially resulting in elevated water temperatures during and after vegetation removal. A reduction in the amount of organic plant material entering the stream ecosystem may occur with the removal of larger trees. Removal of the larger trees would reduce the opportunity for adding large woody debris to the stream channels, which is an important component of a healthy stream system (Kovalenko and Dibble, 2007).

The conversion of forested wetland to native grasses and scrub-shrub areas may alter the faunal community that uses the area. Wildlife that prefer forested wetlands would relocate to other adjacent areas that remain forested, while species that prefer open or scrub-shrub wetland habitats would utilize the new habitats. The loss of mature trees would eliminate canopy cover, nesting, and food sources used by some wildlife species. During the short-term transition period immediately after tree removal, the reduced canopy cover would likely increase soil and water temperatures, which may be harmful to fish, reptiles, amphibians, and other water dependent wildlife. However, because the streams in this area are ephemeral and intermittent, the impacts to aquatic fauna utilizing this area are expected to be minimal. During the short-term transition period there may be an increased potential for erosion of exposed soils.

As with many of the riparian areas within the park, the wetlands in this area have become dominated by Chinese privet, an invasive species that the park is currently attempting to control. Clearing in this area would allow for the removal of privet and the re-establishment of native wetland and riparian species within the cleared areas. Photos 3-1 and 3-2 document the existing conditions of the Two-Mile Creek tributaries.

Other areas outside of the proposed clearing limits have been cleared recently to expand the viewshed between the Confederate and Union earthworks. To the south, woodlands and wetlands were cleared in 1998 to reveal the military terrain from Fort Garrott and along Hovey's Approach (Photo 3-3).

More recently, the Railroad Redoubt area, north of and adjacent to the proposed clearing area, was rehabilitated in 2005 to highlight an area of intense fighting on May 22, 1863, the only location where Union troops were temporarily able to penetrate the Confederate earthworks (Figure 3-2). Approximately 3.4 acres of wetlands were cleared during this rehabilitation. Prior to clearing, the wetland habitats and functions in this area were the same as those described above for the Two-Mile Creek area. The proposed clearing in the Two-Mile Creek area would further reveal the terrain in this area, allowing park visitors to see from Railroad Redoubt southward along the battlefield to Fort Garrott, similar to the actual conditions present during the siege. These clearings address the project purpose and need by facilitating understanding and interpretation of the park story.

DURDEN CREEK AREA (2).

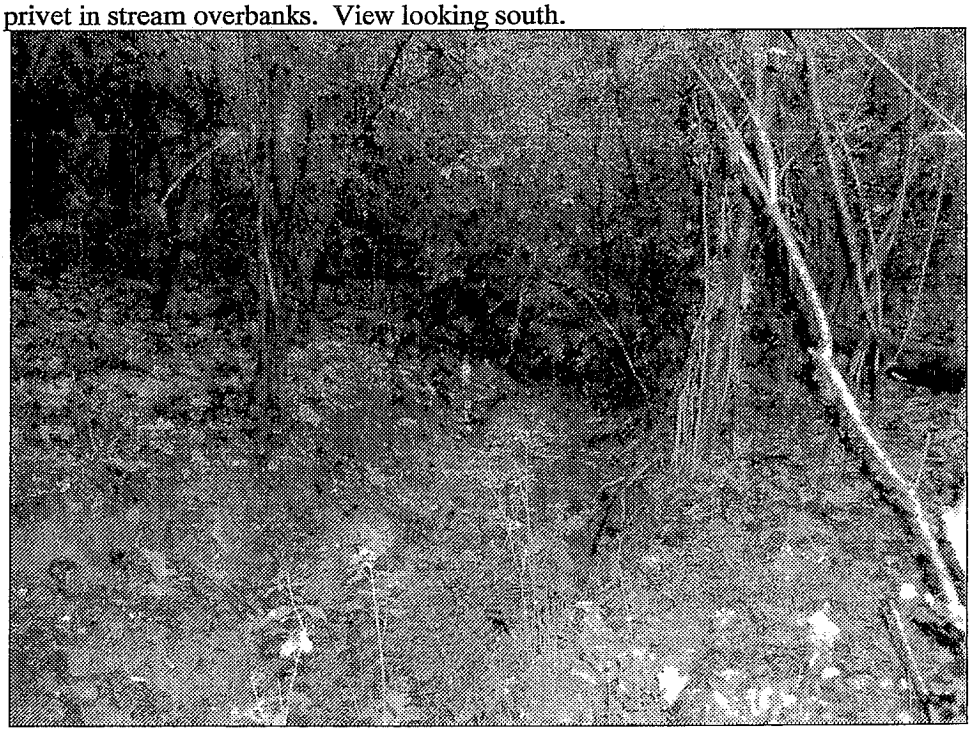
Durden Creek and its adjacent tributaries and wetlands are located north of the visitor center and maintenance facility, between Union Avenue and Confederate Avenue (Figure 3-3). Over 10,000 linear feet of Durden Creek, its unnamed ephemeral and intermittent tributaries, and adjacent wetland areas are located within the proposed clearing limits for Alternative D. Alternative D would convert the existing overstory vegetation from approximately 60-80 feet high to approximately 15 feet high. No clearing of the Durden Creek area is proposed under Alternative C (the preferred alternative). The Cowardin *et al* (1979) classification for Durden Creek is riverine, perennial, streambed, seasonally flooded. The associated wetlands within the proposed clearing area total 49.77 acres and are classified as palustrine forested, broad-leaved deciduous, and seasonally flooded/saturated (PFO1B/C). Durden Creek originates within park boundaries and flows generally to the south. The watershed size of Durden Creek at the proposed clearing area is approximately 230 acres.

Photograph 3-1 Ephemeral Stream in Two-Mile Creek Area.

Note marker showing location of Illinois 97th Infantry. View looking west.

Photograph 3-2 Intermittent Stream in Two-Mile Creek Area.

Note thick privet in stream overbanks. View looking south.



Photograph 3-3 View from Kentucky Monument to Fort Garrott.

Fort Garrott visible in distance to right in photo. Area cleared in 1998. View looking southwest.

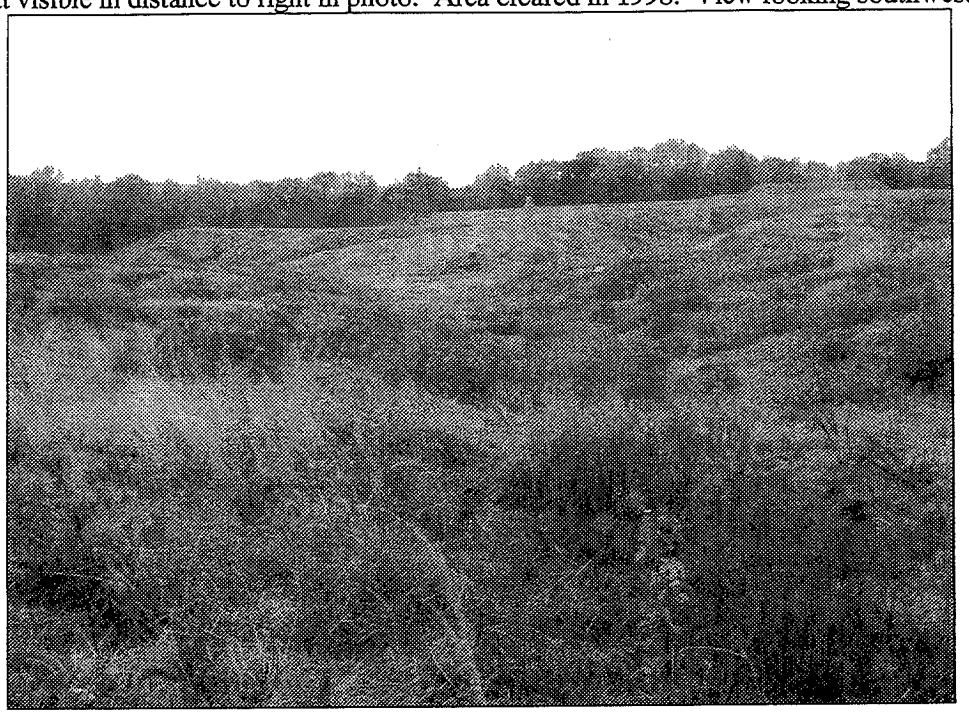
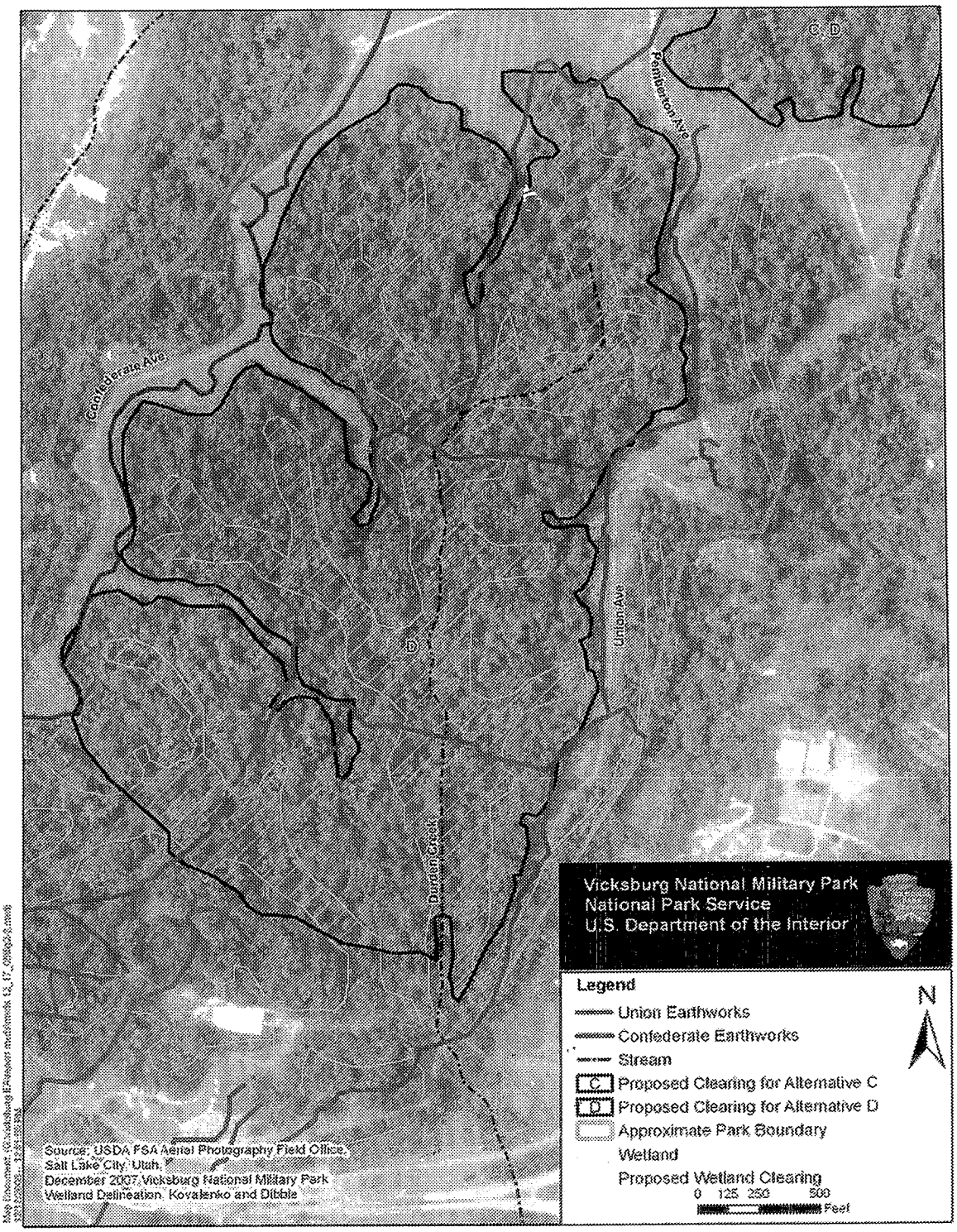


Figure 3-3 Durden Creek Area



Species observed in the wetland during the delineation fieldwork included Chinese privet, sycamore (*Platanus occidentalis*), boxelder, sweetgum, sugarberry, tulip tree (*Liriodendron tulipifera*), willow oak (*Quercus phellos*), flowering dogwood (*Cornus florida*), slippery elm (*Ulmus rubra*), giant cane, muscadine, Christmas fern (*Polystichum acrostichoides*), poison ivy (*Toxicodendron radicans*), violet (*Viola floridiana*), and sand violet (Kovalenko and Dibble, 2007).

Under Alternative C (the preferred alternative), this area would not be impacted. Under Alternative D, impacts to wetland and stream functions are consistent with those previously described for Two-Mile Creek. This area also contains Durden Creek, a perennial stream, which would maintain year-round populations of aquatic fauna. Impacts to the aquatic fauna in Durden Creek would be minimized by maintaining a 50-foot buffer along the creek with vegetation less than 15 foot tall.

The wetlands in this area have become dominated by privet. Clearing in this area would allow for the removal of privet and the re-establishment of native wetland and riparian species within the cleared areas. Removal of exotic plants allows for the regrowth of native vegetation, which benefits fauna using the wooded areas. Photos 3-4 and 3-5 document the existing conditions of Durden Creek and its tributaries.

Other areas outside of the proposed clearing limits are already cleared to show the viewshed between the Confederate and Union earthworks. To the north side of the proposed clearing, the Great Redoubt and Pemberton Avenue battlefields are maintained as clearings, and the larger scale of the battlefield terrain would be revealed by connecting this proposed clearing with the existing battlefield. Also, this clearing would connect with an additional proposed clearing area to the northeast that would not impact wetlands or streams.

GLASS BAYOU AREA (3).

Glass Bayou and its adjacent tributaries and wetlands are located just south of Graveyard Road, between Union Avenue and Confederate Avenue (Figure 3-4). Glass Bayou and its adjacent wetlands would not be directly impacted, but over 5,000 linear feet of unnamed ephemeral and intermittent tributaries to Glass Bayou and their adjacent wetland areas are located within the proposed clearing limits for Alternative D. Alternative D would convert the existing overstory vegetation from approximately 60-80 feet high to approximately 15 feet high. No clearing of the Glass Bayou area is proposed under Alternative C (the preferred alternative). The Cowardin *et al* (1979) classification for Glass Bayou is riverine, perennial, streambed, seasonally flooded. The associated wetlands within the proposed clearing area total 17.8 acres and are classified as palustrine forested, broad-leaved deciduous, and seasonally flooded/saturated (PFO1B/C). Glass Bayou originates to the east of Vicksburg NMP, outside of park boundaries, and flows generally to the west. The watershed size of Glass Bayou at the proposed clearing area is approximately 300 acres.

Species observed in the wetland during the delineation fieldwork included Chinese privet, boxelder, giant cane, sweetgum, American hornbeam (*Carpinus caroliniana*), Chinaberrytree (*Melia azedarach*), sycamore (*Platanus occidentalis*), tulip tree (*Liriodendron tulipifera*), eastern cottonwood (*Populus deltoides*), poison ivy, muscadine, and Virginia creeper (*Parthenocissus quinquefolia*) (Kovalenko and Dibble, 2007).

Under Alternative C (the preferred alternative), this area would not be impacted. Under Alternative D, impacts to wetland and stream functions are consistent with those previously described for Two-Mile Creek. This area also contains Glass Bayou, a perennial stream, which would maintain year-round populations of aquatic fauna. Impacts to the aquatic fauna in Glass Bayou would be minimized by maintaining a 50-foot buffer along the creek with vegetation less than 15 foot tall.

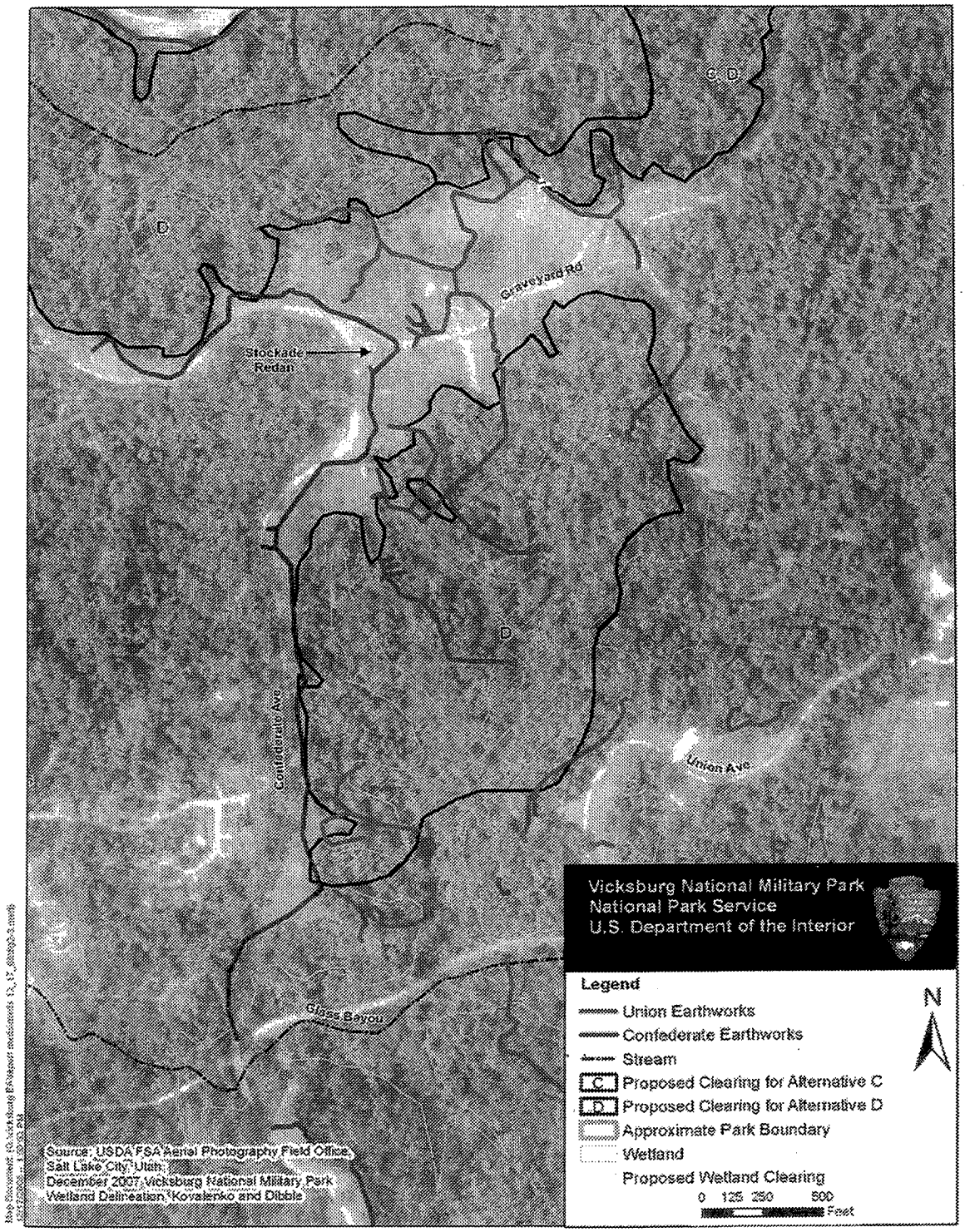
Photograph 3-4 View of Durden Creek from Union Avenue.

Looking downstream from Union Avenue bridge. Note thick privet in stream overbanks. View looking south.

Photograph 3-5 View of Durden Creek Tributary.

View looking east.

Figure 3-4 Glass Bayou Area



The wetlands in this area have become dominated by privet. Clearing in this area would allow for the removal of privet and the re-establishment of native wetland and riparian species within the cleared areas. Photos 3-6 and 3-7 document the existing conditions of the Glass Bayou tributaries.

Other areas outside of the proposed clearing limits are already cleared to show the viewshed between the Confederate and Union earthworks. To the north side of the proposed clearing, the Stockade Redan and Graveyard Road battlefields are maintained as clearings, and the larger scale of the battlefield terrain would be revealed by connecting this proposed clearing with the existing battlefield.

MINT SPRING BAYOU AREA (4).

Mint Spring Bayou and its adjacent tributaries and wetlands are located near the northern boundary of Vicksburg NMP (Figure 3-5). Mint Spring Bayou and its adjacent wetlands would not be directly impacted, but approximately 400 linear feet (under Alternative C) and over 5,000 linear feet (under Alternative D) of unnamed ephemeral and intermittent tributaries to Mint Spring Bayou and their adjacent wetland areas are located within the proposed clearing limits. Both Alternatives C and D would convert the existing overstory vegetation from approximately 60-80 feet high to approximately 15 feet high. The Cowardin *et al* (1979) classification for Mint Spring Bayou is riverine, perennial, streambed, seasonally flooded. The associated wetlands within the proposed clearing area of Alternative C (the preferred alternative) total 1.49 acres and within the proposed clearing area of Alternative D total 24.25 acres. These wetlands are classified as palustrine forested, broad-leaved deciduous, and seasonally flooded/saturated (PFO1B/C). Mint Spring Bayou originates to the east of Vicksburg NMP, outside of park boundaries, and flows generally to the west to its confluence with the Yazoo River Diversion Canal. The unnamed Mint Spring Bayou tributaries within the proposed cleared areas originate within park boundaries and flow generally to the west. The watershed size of the Mint Spring Bayou tributaries at the proposed clearing area is approximately 6 acres for Alternative C (the preferred alternative) and approximately 100 acres for Alternative D.

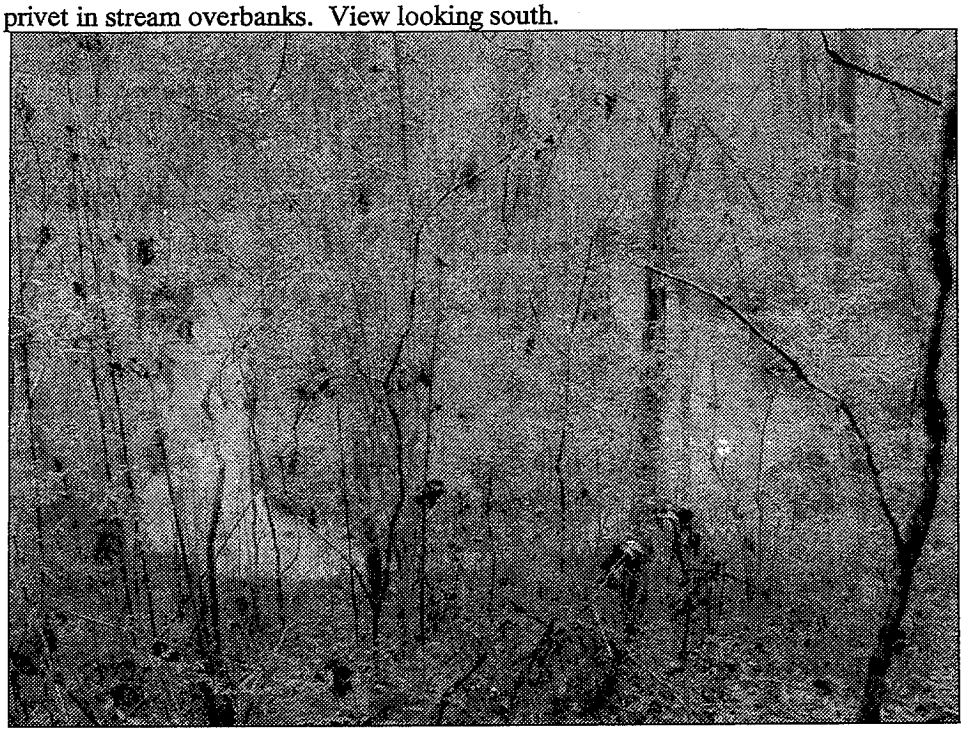
Species observed in the wetland during the delineation fieldwork included Chinese privet, tulip tree, boxelder, southern magnolia (*Magnolia grandiflora*), willow oak, muscadine, sweetgum, water oak, sycamore, bitternut hickory (*Carya cordiformis*), American hornbeam, slippery elm, and giant cane (Kovalenko and Dibble, 2007).

Impacts to wetland and stream functions are consistent with those previously described for Two-Mile Creek. This area also contains Mint Spring Bayou, a perennial stream, which would maintain year-round populations of aquatic fauna. Alternative C (the preferred alternative) would only impact intermittent and ephemeral tributaries to Mint Spring Bayou but would not impact the perennial portions of the larger stream. Impacts to the aquatic fauna in Mint Spring Bayou from Alternative D would be minimized by maintaining a 50-foot buffer along the creek with vegetation less than 15 feet tall.

The wetlands in this area have become dominated by privet. Clearing in this area would allow for the removal of privet and the re-establishment of native wetland and riparian species within the cleared areas. Photo 3-8 documents the existing condition of the Mint Spring Bayou tributaries.

Photograph 3-6 View of Glass Bayou Tributary.

Note thick privet in stream overbanks. View looking south.



Photograph 3-7 View of Cleared Swale in Glass Bayou Area.

Confederate earthworks visible to right in photo, along Confederate Avenue. Proposed clearing would remove additional vegetation within this swale. View looking south.

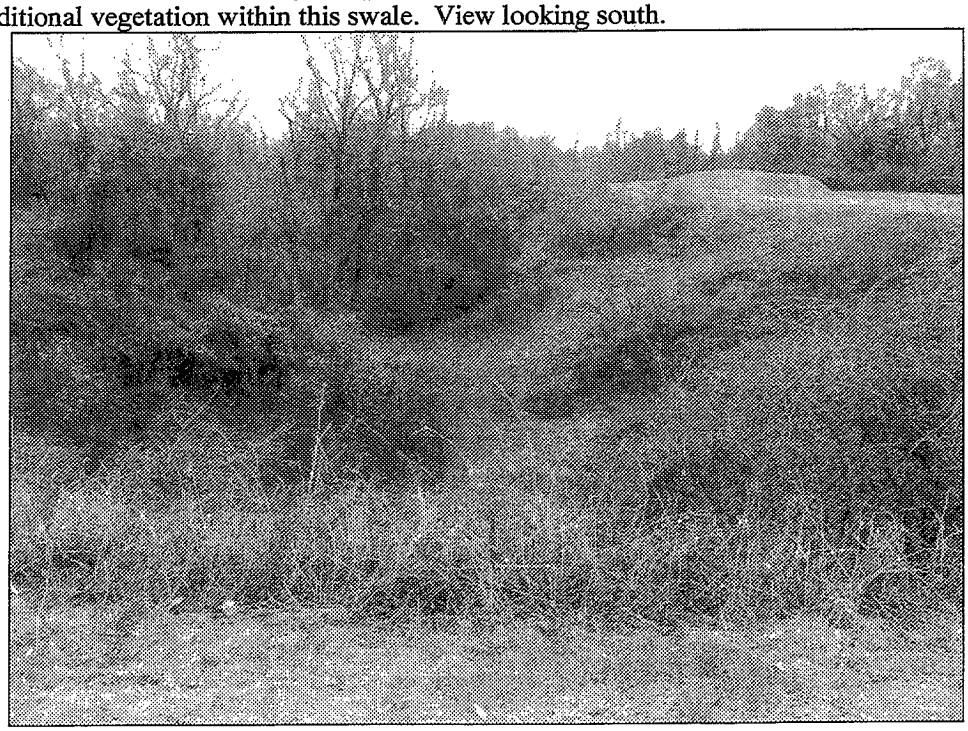
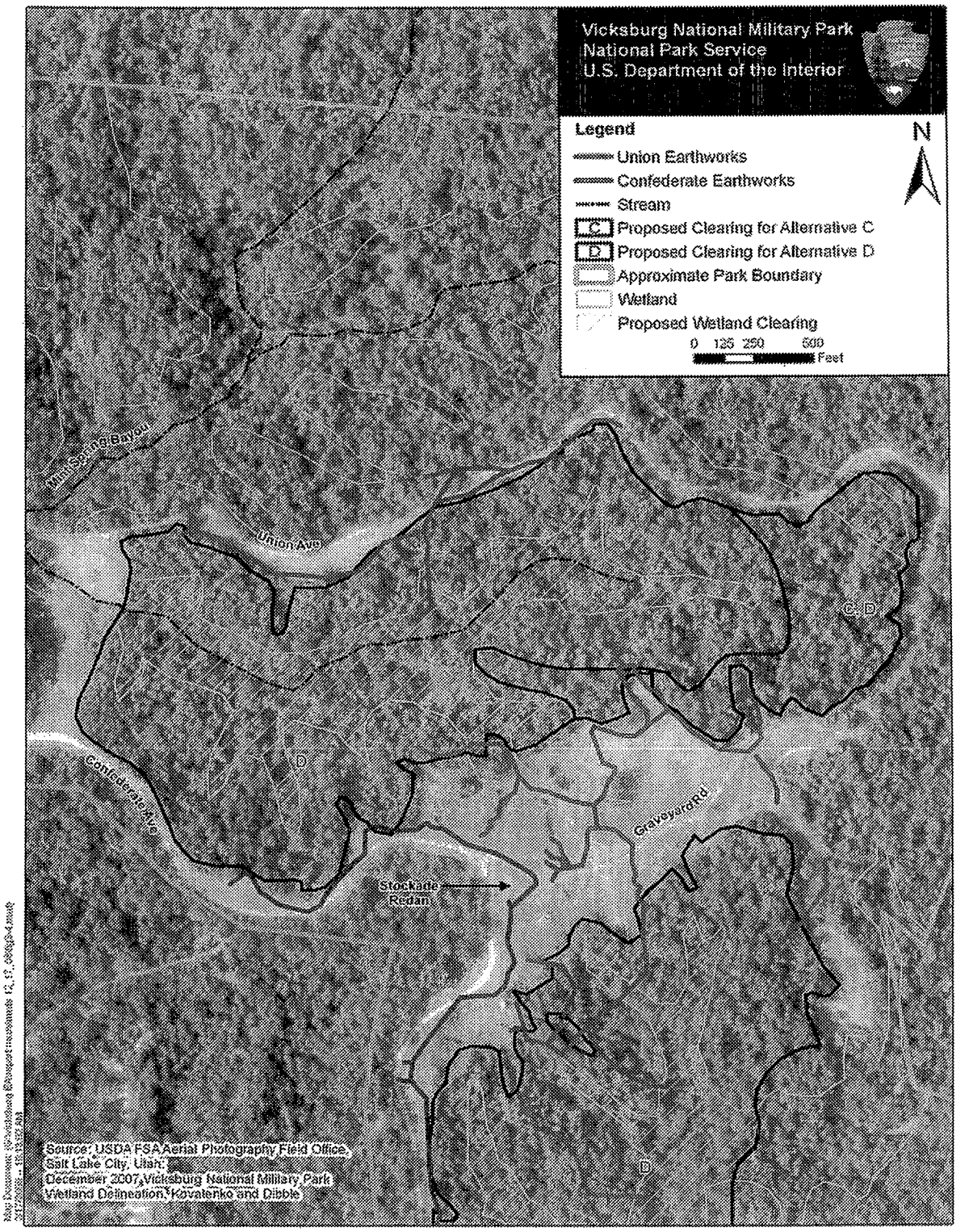


Figure 3-5 Mint Spring Bayou Area



Photograph 3-8 View of Unnamed Mint Spring Bayou Tributary.

Note thick privet along stream banks. View looking east from Thayer's Approach.

Other areas outside of the proposed clearing limits are already cleared to show the viewshed between the Confederate and Union earthworks. To the south side of the proposed clearing, the Stockade Redan and Graveyard Road battlefields are maintained as clearings, and to the west, Thayer's Approach is maintained as a clearing showing the steepness of the Union approach to the Confederate earthworks. The larger scale of the battlefield terrain would be revealed by connecting this proposed clearing with the existing battlefield. The proposed clearing in the Mint Spring Bayou area would further reveal the terrain in this area, allowing park visitors to see across the battlefield to the location of the opposing army, more accurately representing the conditions present during the siege.

4. MITIGATIVE MEASURES

During the "Choosing by Advantages" process, Alternative C was selected as the preferred alternative because it meets the purpose and need of the EA while minimizing impacts to the natural and cultural environment, including wetlands. Alternative C would impact significantly less wetland area than Alternative D (7 acres versus 97 acres). Based on the selection of Alternative C as the preferred alternative, Vicksburg NMP would propose the following mitigation for impacts that would result from the implementation of Alternative C. These mitigation areas are shown on Figure 4-1.

The National Park Service finds that there are no practicable alternatives to altering approximately 7.01 acres of wetlands within the project area under Alternative C and that still meet park goals outlined in the EA. If the proposed areas are not cleared, Vicksburg NMP will continue to misrepresent historic battlefield landscape conditions and will reduce visitor understanding of the events that the park commemorates. Because portions of the historic battlefield contain wetlands and streams, the rehabilitation activities must accordingly be conducted within the wetland areas.

Potential impacts to wetlands from battlefield rehabilitation would involve clearing vegetation from 7.01 acres of forested wetland. Within a 50-foot buffer along streams (25 feet on each side), trees over 15 feet tall would be removed, while trees less than 15 feet tall would remain. This 50-foot streambank buffer would be replanted with native species as necessary to maintain woody vegetation along the streambanks. Native species to be replanted may include boxelder, red maple, American hornbeam, elderberry (*Sambucus canadensis*), water oak, southern magnolia, tulip tree, black willow (*Salix nigra*), sugarberry, sycamore, sweetgum and cherrybark oak (*Quercus pagoda*). Vegetation in this area would be maintained at a maximum height of 15 feet using commercial pruning and trimming equipment. Outside of the 50-foot streambank buffer, wetland areas would be replanted with low-growing native grasses. Native woody vegetation would be allowed to naturally repopulate this area but maintained to a maximum height of 15 feet.

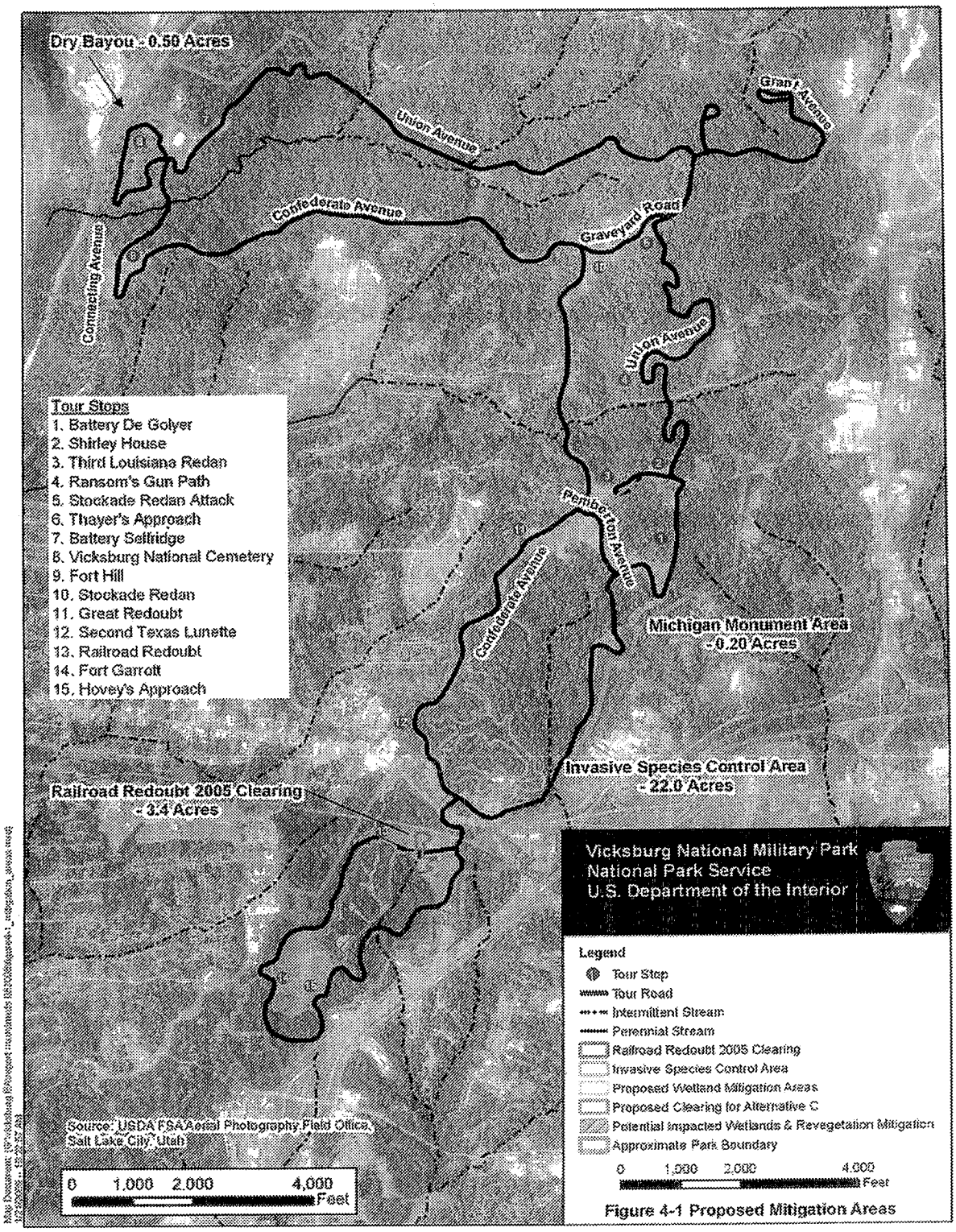
Additionally, Vicksburg NMP would mitigate for 3.4 acres of wetland areas that were impacted in 2005 during battlefield rehabilitation at Railroad Redoubt. The wetlands in this area were cleared during rehabilitation activities and are being allowed to naturally revegetate with native plants that occurred in the wetland prior to the clearing (species include black willow and boxelder). Thus, the proposed mitigation measures would account for the 7.01 acres of potential wetland impacts from Alternative C (the preferred alternative) and 3.4 acres from previous wetland impacts, for a total of 10.41 acres.

Proposed mitigation measure for impacts from the preferred alternative (Alternative C):

- After clearing, 7.01 acres of stream corridor and palustrine wetland in the Two-Mile Creek (Figure 3-2) and Mint Spring Bayou (Figure 3-5) areas outside of the 50-foot streambank buffer would be replanted to native grasses. Woody vegetation would be allowed to naturally regenerate in this area but maintained at a maximum height of 15 feet using commercial pruning and trimming equipment. Privet and other exotic species control in these areas would be conducted to avoid re-introduction of invasive species.

- A 50 foot buffer (25 feet per side) of native scrub/shrub vegetation would be maintained at 15-foot height or less along impacted stream corridors. Within the 50-foot streambank buffer, trees over 15 feet tall would be removed, while trees less than 15 feet tall would remain. The 50-foot streambank buffer would be replanted with native species as necessary to maintain woody vegetation along the streambanks. Vegetation in this area would be maintained at a maximum height of 15 feet using commercial pruning and trimming equipment. Native species to be replanted are listed above.

Figure 4-1 Proposed Mitigation Areas



- 0.20 acres of wetland currently maintained in herbaceous vegetation along Union Avenue downslope from the Michigan Monument would be replanted with native plant species (Photo 4-1). This area, cleared over 30 years ago and currently maintained as a grassed field, would be allowed to return to a forested wetland. Species to be replanted are listed above.

- Approximately 0.50 acres of a 1.16-acre parcel containing "Dry Bayou," a natural spring that has been disturbed by development, would be restored by removing debris, removing non-native vegetation, and replanting with native wetland plant species listed above. The spring is adjacent to the Vicksburg National Cemetery and was disturbed during construction of commercial facilities on the parcel. Vicksburg NMP acquired the "Dry Bayou" property in 2003.

- The park would conduct an exotic plant eradication on approximately 22.0 acres of forested wetlands in the Durden Creek watershed as shown on Figure 4-1. Privet and other invasive exotics would be removed from this area.

The total mitigation acreage proposed for potential impacts from Alternative C (the preferred alternative) is 29.71 acres. The proposed mitigation includes revegetation within the 7.01 acres to be cleared under Alternative C, and an additional 22.70 acres of wetland restoration and exotic species control in other wetland areas within the park. The mitigation measures are summarized below in Table 4-1.

Table 4-1. Preferred Alternative Proposed Mitigation Measures

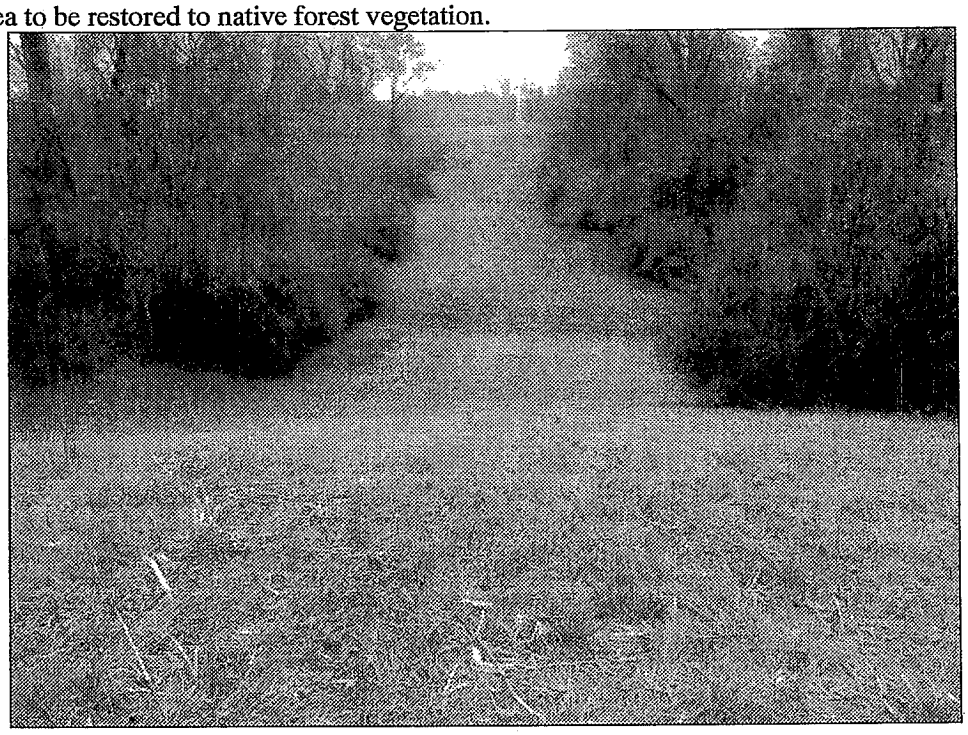
Proposed Mitigation	Mitigation size (acres)
Planting of native grasses and privet control in cleared wetland areas	7.01 (includes stream buffer replanting)
50-foot stream buffer replanting area and privet control	Acreage included above
Restoration of Michigan Monument wetland area	0.20
Restoration of Dry Bayou wetland area	0.50
Exotic species control along unnamed Durden Creek tributary	22.0
TOTAL	29.71

Best management practices for vegetation removal in wetland areas would be followed. Vegetation removal in wetlands would be done by hand and motorized vehicle access into wetlands would be done on protective mats when necessary to avoid disturbing surface soils. Trees would be felled away from streams and wetlands. Where possible, stumps would be left in place within wetland areas and the cut stumps would be treated with an herbicide safe for use in riparian and wetland areas. Activities would be timed to minimize any impacts on wildlife species and wetlands (generally occurring during dry periods).

Stream crossings would be avoided when possible. However, in the event of any stream crossing metal plates or other suitable bridging material would span the width of the stream, from bank to bank, and all equipment and debris would be transported across the metal plates. This would reduce the potential for incidental sediment eroding into the streams.

Photograph 4-1 Cleared Wetland Downslope from Michigan Monument

Cleared area to be restored to native forest vegetation.



The currently anticipated schedule to implement the preferred alternative and proposed mitigation is to start the battlefield rehabilitation in approximately five years (2014). The clearing activity would be done in three phases, with each phase taking approximately one year to complete. The project would be completed within approximately three years (2017), contingent on available funding.

The wetlands mitigation would begin at the same time as the initiation of the battlefield clearing activities and would progress concurrently with the clearing. Based on the park's experience in other clearing activities within Vicksburg NMP, the cleared and converted wetlands would require approximately four years to become fully functional as scrub/shrub wetlands.

A detailed monitoring and contingency plan would be developed to ensure that erosion and sedimentation control and proposed wetland mitigation are successful and in compliance with Director's Order 77-1. At a minimum, the monitoring plan would be conducted for five years after vegetation removal and would collect information on vegetation development and abundance, species composition, survivorship, and natural recruitment. Information regarding species composition, abundance, and plant survival would document the success of the mitigation efforts, to include areal cover of desirable vegetation and survival of desirable species (planted and natural recruits) in the mitigation areas. Monitoring and maintenance of the wetland mitigation areas would begin once the wetland areas have been cleared and would be implemented as an ongoing park maintenance activity. Maintenance of the converted wetlands would consist of maintaining vegetation at the specified height, with periodic removal of vegetation exceeding specified height limits. Maintenance of the re-vegetated areas would consist of ongoing monitoring for and correction of erosion. Monitoring would document the success of the revegetation and replanting effort. If the monitoring program indicates that replanting or revegetation efforts have not been successful, then a contingency plan would be instituted to address replanting and/or revegetation of cleared areas, as necessary.

Funding sources for the preferred alternative, including the proposed mitigation activities, would be obtained from multiple sources. Funding sources could include Repair/Rehabilitation (if funded in phases); Cultural Resource Preservation Program; Line Item Construction (if funded all at the same time); and donations.

5. COMPLIANCE

CLEAN WATER ACT SECTION 404

The proposed actions have the potential for incidental impacts to waters of the United States as defined by the Clean Water Act and are therefore subject to review by the U.S. Army Corps of Engineers (USACE). The Clean Water Act Section 404 regulates the discharge of dredged or fill material into the waters of the United States. The preferred alternative does not require fill or dredging of any stream or wetland. Since this action would not result in fill material being placed in streams or wetlands and the proposed activity within the wetlands would not involve mechanized clearing, the preferred alternative would not require a USACE 404 Permit under the Clean Water Act. Coordination with USACE would occur during the EA review process.

Erosion and Sedimentation Control Plans would be completed to determine suitable landings or areas on the ground where trees would be temporarily stored while awaiting removal from the site. Suitable landings would be determined by soil type and natural hydrology of the project area. Stream crossings are not recommended. However in the event of a stream crossing metal/steel plates would be used to minimize the potential impacts to streams.

NATIONAL ENVIRONMENTAL POLICY ACT

This Statement of Findings for Executive Order 11990 will be included as a part of the EA for the proposed project. The EA will document compliance with the requirements of the National Environmental Policy Act for this project, as required under Director's Order 12, "Conservation Planning, Environmental Impact Analysis, and Decision-making."

6. CONCLUSION

Under the preferred alternative (Alternative C), there would be no net loss of wetlands; however, the overstory canopy within wetlands along streams would be reduced from 60-80 feet tall to 15 feet tall or less. Although the wetlands are not being filled and the wetland hydrology is not being altered, replacement of the wetland forest with a scrub-shrub canopy would diminish some functional values. Removal of the trees would reduce the opportunity for adding large woody debris to the stream channels, which is an important component of a healthy stream system. The loss of trees would eliminate canopy cover, nesting, and food sources used by some wildlife species. During the short-term transition period immediately after tree removal, the reduced canopy cover would likely increase soil and water temperatures, which may be harmful to fish, reptiles, amphibians, and other water dependent wildlife. During the short-term transition period there may be an increased potential for erosion of exposed soils.

The National Park Service finds that there are no practicable alternatives to altering approximately 7.01 acres of wetlands within the project area under Alternative C and that still meet park goals outlined in the EA. Potential impacts to wetlands from battlefield rehabilitation would involve clearing vegetation from 7.01 acres of forested wetland. Within a 50-foot buffer along streams (25 feet on each side), trees over 15 feet tall would be removed, while trees less than 15 feet tall would remain. This 50-foot streambank buffer would be replanted with native species as necessary to maintain woody vegetation along the streambanks. Vegetation in this area would be maintained at a maximum height of 15 feet using commercial pruning and trimming equipment. Outside of the 50-foot streambank buffer, wetland areas would be replanted with low-growing native grasses. Native woody vegetation would be allowed to naturally repopulate this area but maintained to a maximum height of 15 feet. Compensatory mitigation for proposed impacts from the preferred alternative (Alternative C) is described in Section 4.

Care was taken to select an alternative that would minimize the impacts on natural resources, including wetlands, while still meeting project objectives. Wetland impacts would be avoided to the maximum practicable extent, and the wetland impacts that cannot be avoided would be minimized. Compensatory mitigation ratio for this project (for improvement over loss, i.e., the trade of functional loss for functional improvement from wetland restoration and exotic vegetation removal) is greater than a 1:1 ratio. This project is consistent with the NPS no net loss of wetlands policy. The National Park Service, therefore, finds that this project is in compliance with Executive Order 11990: "Protection of Wetlands."

7. REFERENCES

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APPENDIX A

VICKSBURG NATIONAL MILITARY PARK WETLAND DELINEATION

Vicksburg National Military Park

Wetland Delineation

Katya Kovalenko and Eric Dibble

Department of Wildlife and Fisheries
Mississippi State University

Final Report

December 2007

Executive Summary

This study was conducted to investigate potential wetlands in Vicksburg National Military Park. On-site determination was done according to the 1987 U.S. Corps of Engineers Manual and the decision about the status of each area was made following the U.S. Fish and Wildlife Service guidelines. This report describes the most common hydrophytic plant communities and discusses soil and hydrology indicators observed in the area. Wetlands were classified according to the National Wetlands Inventory as well as Hydrogeomorphic classification systems. Park wetlands were found to be either riverine, both unconsolidated bottom or streambed, or palustine forested wetlands. Wetlands in the park are most commonly associated with slopes with seepage-saturated soils, gullies, ephemeral creek beds, and streams. Attached map shows wetland boundaries to the best resolution of available digital elevation models. Qualitative assessments and analysis of available literature indicate that VNMP wetlands have several relatively high biological and hydrological functions.

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Introduction and definitions

Wetland is a generic term used to describe a variety of habitats including, but not limited to, marshes, swamps, bogs, and bottomland hardwood forests. According to the U.S. Fish and Wildlife Service, wetlands are "lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is covered by shallow water. For purposes of this classification, wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year" (Cowardin *et al.* 1979). Alternatively, according to the 1987 U.S. Corps of Engineers Manual (thereafter, the 1987 manual), all three criteria (hydrology, soils and vegetation) must be met for an area to be designated a wetland. National Park Service adopts the U.S. Fish and Wildlife Service wetland classification system.

Vicksburg National Military Park (VNMP) commemorates the siege and defense of Vicksburg and, in addition to important cultural resources, the park also has a rich variety of natural habitats. This goal of this project was to investigate potential wetlands in Vicksburg National Military Park and their possible functions.

Methods

Existing maps

Off-site wetland determination often relies on Soil Survey, NWI, USGS or aerial photography. All available maps and an infrared aerial photo were reviewed for preliminary assessment of wetlands. Soil Survey maps for Warren County were used for preliminary

assessment of soils. Since forested wetlands are difficult to interpret based on aerial photography and none of the maps reviewed provided sufficient detail for off-site determination, an on-site routine method for large area (Environmental Laboratory 1987) was used for delineating VNMP wetlands.

Transect choice

Transects were chosen to intersect the main features of the terrain for example, perpendicular to a stream or across a gully. When topography allowed, intervals between transects were less then or equal to 0.5 mile. In certain cases, more transects were done to account for highly heterogeneous terrain. Yet in other cases sampling was impossible due to steep slopes. Overall boundary determination was done by extrapolating sampling points by the elevational gradients. According to the 1987 Manual, a representative sampling point was selected within each distinct plant community in a transect.

All sampling points were mapped using a Garmin ® GPSmap 76, except for several areas that had no satellite reception due to dense vegetation and narrow gullies; these were mapped based on landmarks such as distance from stream. Transects were done in accordance with the 1987 manual but each datasheet also contains information on whether the site is a wetland according to Fish and Wildlife Service National Wetland Inventory criteria (Cowardin *et al.* 1979), as mandated by the Procedural Manual 77-1 (National Park Service). Field work was conducted in February (preliminary), March, April, July, October, and November 2007. No sampling was done in July because of high precipitation which had a potential to bias hydrology criteria.

Vegetation

Woody vegetation, shrubs, and vines are usually sampled in 10-m radius plots (Environmental Laboratory 1987); however, due to a very complex landscape in the park, it was often impossible to find large enough terraces and distinct plant communities were observed at different elevations, so 5-m radius plots were chosen instead. Groundcover, *i.e.*, all non-woody plants and woody plants less than 1 m tall, were assessed in a $1m^2$ representative plot. An exception was made for *Arudinaria gigantea* taller than 1.5-2 m: it clearly belonged to the next stratum and directly competed with shrubs, not groundcover, therefore it was placed in shrubs category. Abundance of shrubs, vines, and herbs was quantified as either density, if plants of similar size occupied the stratum, or actual areal cover. Relative abundance of woody vegetation was quantified by circumference at breast height (Fig. A-1, Appendix 1). Dominance was assessed using the 1987 manual 50/20 rule. Wetland indicator status was determined using the USDA Plants database for Region 2.

Numerical value was assigned to each plant indicator status (1 for OBL to 11 for UPL) and weighted averages method was employed to calculate overall dominance. Hygrophyte dominance was calculated separately for each stratum but the overall plant density in the stratum was noted as well (*i.e.*, very sparsely populated herb stratum is negligible in biomass compared to the tree stratum). Additionally, an existing list of vegetation occurring in the park (Walker 1997) was analyzed for the presence of hydrophytes.

Hydrology

Visual observation of primary (inundation, drift lines, sediment deposits, drainage patters) and secondary (oxidized root channels and water-stained leaves) indicators was

conducted on each site. Soil saturation was determined as described in Richards Chinn's manual (2006). Duration of inundation or saturation had to be at least 5% of the growing season. Growing season is defined as the portion of the year when soil temperature is above biological zero (5 C). In Vicksburg, Mississippi, the growing season is approximately 250 days long, and soil saturation has to be observed for at least 13 continuous days during the period from March to November.

Soil

Soil was sampled using soil auger and probe to the depth of 12 inches (Fig. A-2, Appendix 1). Soil texture was described using field determination methods from Richards Chinn's manual (2006). Munsell® Soil Color Chart was used to determine soil color. Soil redox potential was assessed either using 0.2% α, α'-dipyridyl solution buffered with 1N ammonium acetate for detecting ferrous iron or indirectly by the presence of hydrogen sulfide smell, indicative of highly reduced conditions (≤-150mV). Hydric indicators were described according to the 1987 Manual as well as National Hydric Soil Indicators (Hurt *et al.* 1998). Ephemeral creek beds do not automatically warrant wetland status since they may not hold water for sufficient time to develop anaerobic conditions, so they were surveyed along with their adjacent areas to determine whether duration criteria were satisfied.

Results and Discussion

Wetland Indicators

Vegetation

In general, gullies, slopes, and stream banks of the park are dominated by hydrophytic vegetation (from FAC to FACW+, see Table 2 for indicator explanation). Analysis of separate strata shows that woody vegetation is often more hydrophytic than its understory. This is likely to be related to deeper wetland hydrology and/or seasonal soil saturation.

Many hydrophytic plant communities include boxelder (*Acer negundo*), sycamore (*Platanus occidentalis*), sugarberry (*Celtis laevigata*), sweetgum (*Liquidambar styraciflua*), and, less frequently, willow oak (*Quercus phellos*), swamp chestnut oak (*Q. michauxii*), water oak (*Q. nigra*), and American hornbeam (*Carpinus caroliniana*) as canopy-forming vegetation with giant cane (*Arundinaria gigantea*) and scouringrush horsetail (*Equisetum hyemale*) in the understory (Figs. 1 and 2). Understory vegetation was often dominated by invasive plants, which complicated determination of its wetland status. For example, English ivy (*Hedera helix*) is a non-hydrophyte but was nevertheless observed in mesic areas of the park, displacing hydrophytic vegetation (Fig. 3). A list of commonly occurring plants and their indicator status is presented in Table 1.

A very similar palustrine forested wetland plant community was observed in East Texas by Tiner (1999). This community was dominated by boxelder, *Acer negundo*; water oak, *Quercos nigra*; sugarberry, *Celtis laevita*; and hornbeam, *Carpinus caroliniana* and included the following associated vegetation: sycamore, *Platanus occidentalis*; giant cane, *Arudinaria gigantea*; elder, *Sambucus candensis*, *Galium* sp., *Viola* sp., etc. This plant community was classified as mixed hardwood swamp.

Fig. 1. Scouring rush-boxelder riverine wetland community

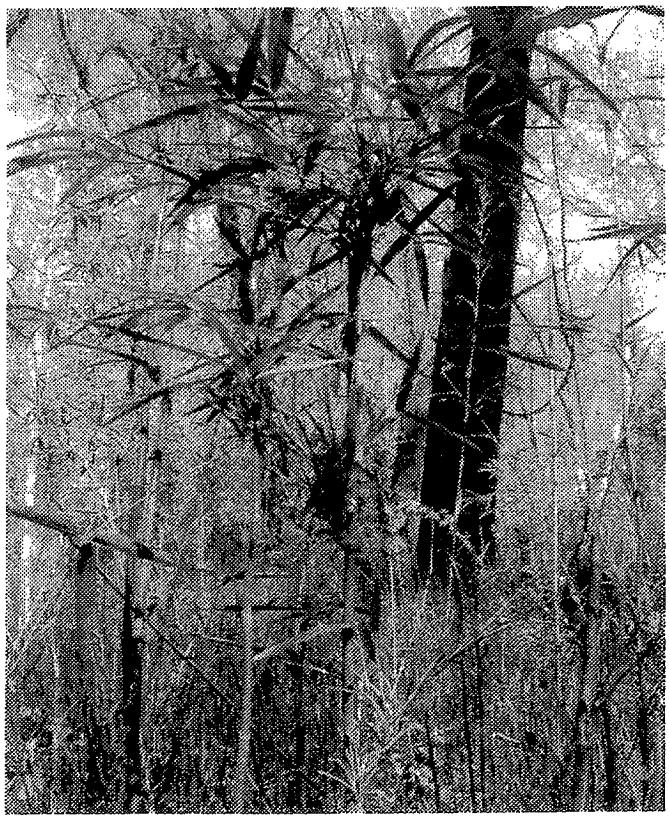

Fig. 2. Giant cane-sycamore riverine wetland community

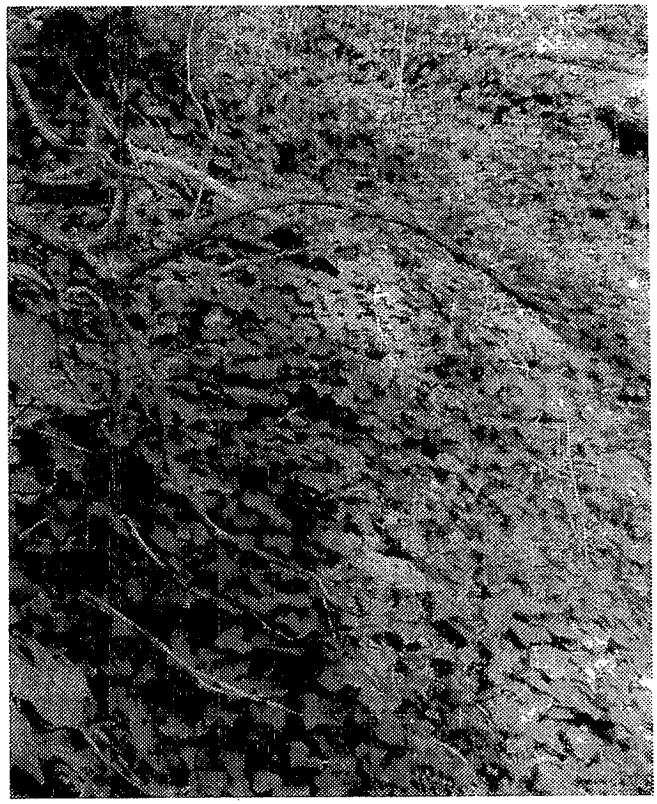

Fig. 3. Riverine wetland overgrown by English ivy.

Hydrology

Several primary wetland hydrology indicators were observed in the park. Most commonly, soil was saturated in the upper 12 inches, often months after the last rain. Loamy soils are well-drained and this saturation most likely indicates continuous seepage along the gravitational gradient. Stream-adjacent sites had water marks in the form of moss lines on tree trunks and, infrequently, buttressing. Drift lines, drainage patterns, and sediment deposits were observed in some cases; however, these features, independent of the duration of flooding, were assessed conservatively. Only non-vegetated flats (stream beds) and the area between the railroad tracks and the Yazoo canal experienced prolonged inundation (Fig. 4).

The most common secondary indicators were oxidized root channels and positive FAC-neutral test (indicating dominance of hydrophytes disregarding facultative vegetation). Some sites also had water-stained leaves, especially in ephemeral creek beds. The actual seepage wetlands have insufficient duration of inundation to display this feature, while duration of saturation is sufficient to display other indicators and be qualified as a wetland. Cautious interpretation of hydrology indicators is needed because of the unusual drought in the summer and fall of 2007 (USGS Drought Watch).

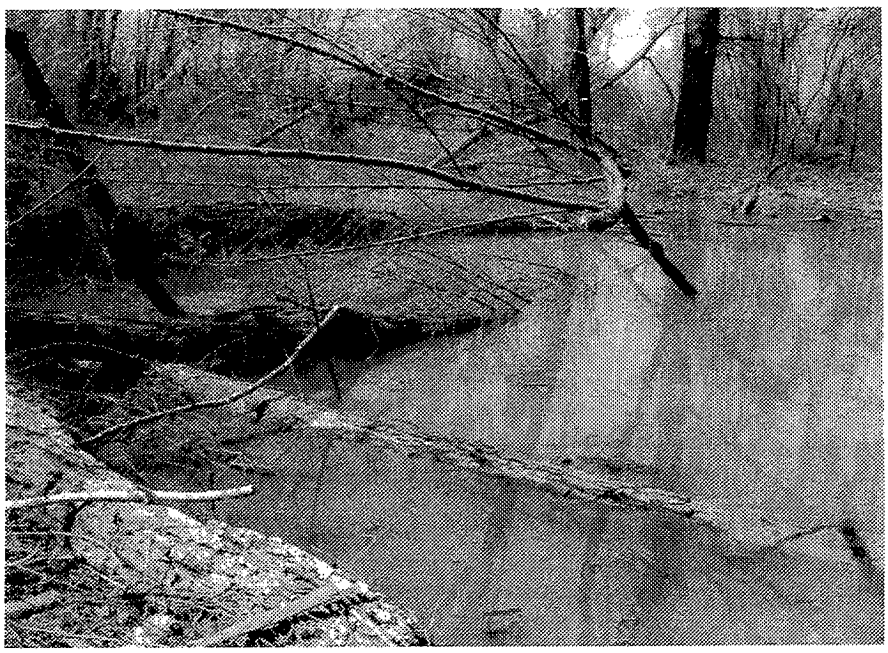

Fig. 4. Inundation of lower Mint Springs wetland by Yazoo flooding.

Soils

According to the Soil Survey maps, most of the park is described as Gullied land, which is not practical to classify as soil. These are young, recently deposited, and undifferentiated soils but may also include exposed bedrock. Soils from the less eroded parts of the park belong to Adler (Ad) and Memphis (MnD3, MeC3) series and are mostly silt loam by texture. Soil in the National Cemetery is classified by the Soil Survey Series as Silty land

(SsF), similar in material to Memphis silt loam but greatly modified. This area (the National Cemetery) was not sampled due to the expected lack of indicators in the modified soil and historical significance of the site.

On-site determination confirmed weak profile development in most areas of the park. Therefore, soil was not classified and three of the 1987 manual Hydric Soil indicators were not applicable: Aquic Moisture Regime; Listed on Local Hydric Soils and National Hydric Soils List. In the absence of profile development, the overall color pattern, mottles, and other properties were described. It was not possible to use the dipyridyl indicator, possibly due to the presence of unidentified interfering compounds or low iron content.

The most common soil textures were sandy loam and loamy sand except for the lower part of Mint Springs, which had sandy clay loam. Predominant soil colors were brown and yellowish brown (10YR 4/3 and 4/4, Munsell® Soil Color Chart) but other colors were observed as well. The 1987 Corps manual lists sandy and recently deposited soils as potential problem areas for determination as they may not posses any typical hydric soil properties. Not surprisingly, hydric soil indicators were observed less frequently than vegetation and hydrology indicators. Stream bank and ephemeral creek soils sometimes had hydrogen sulfide, indicative of very reduced, anaerobic conditions. These soils often had gleyed matrix (*e.g.*, site 30 at the South Loop, see Appendix 2, Table A.1 for data forms) or prominent gleyed inclusions (*e.g.*, site 101 at Thayer's approach).

Soil samples from many areas contained organic remains such as partially decomposed leaves, roots and unidentifiable plant tissues throughout the upper 12 in. High organic content was observed in the surface layer of some soil samples; however, this layer was never thicker than 2-3 cm. Most common distinction between hydric and nearby non-

hydric soils was the presence of redox depletions (gray colors), redox concentrations (red colors), and stratified soil with differently colored layers some of which appeared leached (light yellow with chroma 2 or less, or gley). This type of soil was frequently observed on slopes and in the gullies and areas adjacent to the streams or ephemeral creek beds.

Classification and mapping

Park wetlands belong to one of the following Cowardin *et al.* (1979) categories: 1. streams are Riverine, Upper perennial, Unconsolidated bottom (Fig. 5); 2. creeks are Riverine, Intermittent, Streambed; and 3. forested wetlands are Palustirne, Forested Wetlands. The following modifiers apply: all wetlands are non-tidal, seasonally flooded/saturated; inland fresh, circumneutral; on mineral soil. Some slope wetlands (see below) also had wetlands belonging to the Moss/Lichen class (Fig. 6); these are too small to be mapped separately but are nevertheless important for habitat heterogeneity. According to Brinson's Hydrogeomorphic Classification (HGM, 1993), VNMP wetlands belong to either riverine or slope (Fig. 7) hydrogeomorphic class.

Functionally, forested wetlands are seepage or slope wetlands, which are recharged from rainwater that percolates from higher elevations and contributes to seepage, subsurface, and sheet flows. While geology of the area was not studied, it is hypothesized that seepage occurs due to longitudinal orientation of deep strata and/or presence of impermeable strata (e.g, Stein et al., Tiner, 1999). Recharge depends on regional factors such as precipitation and local factors such as slope. A thorough understanding of the recharge mechanism is necessary for assessing potential impact of management actions on wetlands and adjacent non-wetland areas. According to disturbance level criteria (Cole *et al.* 1997), most seepage and riverine

wetlands in the park were judged pristine to moderately disturbed (primarily by up-stream modifications and invasive plants), except for modified wetlands that appeared severely disturbed.

Wetlands were mapped in ArcMap® (ESRI) to the best resolution available for current digital elevation models (MARIS). Ephemeral creek wetlands and unconsolidated bottom riverine wetlands were not mapped separately because at the available resolution they would appear as line features (due to their small size). HGM slope and riverine wetlands are mapped together because they are not hydrologically distinct (Fig. A-3, Appendix 2). For forested wetlands, topography may be more useful for making on-site management decisions than a map, because the latter may not show enough detail on this very complex and dissected landscape. Seepage wetlands are very patchy by nature but, as a useful approximation for ecosystem-oriented management, most slopes with seepage-saturated soils, gullies, ephemeral creek beds, and streams are to be considered wetlands.

Fig. 5. An example of Riverine, Upper Perennial, Unconsolidated Bottom wetland.

Fig. 6. An example of Moss-Lichen seepage wetland (Note that *Pteris multifida* is an exotic species and is not a wetland indicator).

Fig. 7. An example of Palustrine, Forested seepage wetland (on slopes only).

Wetland functions

Wetland functions are commonly assessed using hydrologic, biogeochemical, and biologic function criteria. Hydrologic functions of slope wetland commonly include ground and surface water interception and water retention and groundwater export. Water interception is a fundamental property of slope wetlands (Stein *et al.* 2004). Removal of vegetation outside of park boundaries as well as in some areas of the park may have led to increased siltation in nearby streams (Dibble, 2003). Therefore, forested wetlands of the park may play an important role in control of erosion and siltation. Dense growth of Chinese privet may compromise this and habitat wetland functions: observations indicate very sparse herb and other shrub cover and lack of extensive root system in gullies overgrown with privet, whereas nearby areas dominated by giant cane (*Arundinaria gigantea*) had a more extensive root system in the upper part of the soil (Fig. 2).

Water retention by seepage wetlands is essential for stream flow maintenance and integrity of the overall watershed. Study of slope wetlands in another part of the country has shown that ground-water levels remained near the surface for two to eight months, depending on the type of geologic setting (Stein *et al.* 2004). In this study, saturated soils were observed two months after the last significant precipitation. It is also possible that seepage wetlands prevent the soil from extreme desiccation, which may lead to changes in soil structure; therefore, this type of wetland is important for maintaining soil integrity and reducing erosion. Drier soil was observed in several areas of the park recently cleared of vegetation and reduced flows were observed in intermittent streams adjacent to cleared areas.

Biogeochemical functions of wetlands include organic carbon accumulation and export, retention and release of compounds, and nutrient cycling. These functions were not

assessed for park wetlands and their degree of importance cannot be extrapolated from the available data. Regional contribution of this type of function (downstream contribution to a major watershed) is likely to be correlated with watershed input contribution of park's streams.

Biological functions of wetlands consist of maintenance of plant and animal communities and regional and landscape biodiversity. Several obligatory wetland plants were observed in VNMP during floristic assessment (Walker 1997): water pennywort, *Hydrocotyle verticillata*; great blue lobelia, *Lobelia siphilitica*; redroot flatsedge, *Cyperus erythrorhizos*; smartweed, *Polygonum hydropiperoides*; water pimpernel, *Samolus floribundus*, etc. Presence of these species increases regional biodiversity because they would not be in the area if not for adequate hydrology and saturated soil conditions.

Park wetlands have relatively high habitat function: most seepage wetlands support diverse and locally unique plant communities. Several disturbance-sensitive plants, observed during implementation of this project, indicate high-quality habitat (*e.g.*, green dragon, *Arisaema dracontium*; American ginseng, *Panax quinquefolius*; Jack-in-the-pulpit, *Arisaema triphyllum*). Vicksburg NMP contains one of the few remaining tracts of loess bluff hardwood forests on public land in the United States (EAS 2004); therefore, these wetlands support plant communities that are regionally rare. Slope wetlands from other parts of the country have been shown to have relatively high plant and wildlife habitat function, disproportionate to their small area (*reviewed in* Stein *et al.* 2004). Some areas had lower habitat quality due to the presence of invasive species, especially English ivy and Chinese privet.

Some classification systems also include educational function – this function level is potentially high, since the area contains many trails intersecting high quality, regionally unique habitats, and also by virtue of it being a National Park. It is also interesting that several different types of wetlands occur within a park.

Impacted wetlands

Most common modification was clear-cutting of vegetation. These areas were assessed using only the soil criterion, in accordance with the 1987 manual treatment of *Problem Areas*. Several sites had modification in the form of drainage culverts; however, these sites were characterized as having *Normal Circumstances* since canopy-forming vegetation was present and appeared undisturbed.

Former/relict wetlands

Several modified areas were expected to have wetland soils but did not (e.g., sites 96-99). Possible reasons include very thick recent deposition due to extreme erosional events (upper 12 inches represented last few years instead of decades) in which wetland characteristics did not have time to develop, and in some areas also due to drying of the soil after vegetation removal. It is therefore impossible to determine whether those areas were formerly a wetland.

Potential for restoration

Based on qualitative observation of modified areas, hydrology and even soils appear altered after clearing; therefore, the potential for restoration is low. Seepage wetlands in

general are very difficult to restore due to their complex hydrodynamics. Riverine wetlands may have a greater restoration potential if the upstream flow is not altered; however, a detailed analysis of recharge mechanisms is necessary to make predictions of management impacts.

On the contrary, unmodified wetlands (satisfying Normal Circumstances criterion, which in this case means that natural vegetation is present), have a relatively high potential for restoration: habitat functions can be improved by control of invasive plants.

Acknowledgements

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Table 1. Plants encountered in transects and their wetland status.

Common name	Latin name	Stratum	Status
American beech	*Fagus grandifolia*	4-trees	FACU
American ginseng	*Panax quinquefolius*	1- herbs	UPL
American holly	*Ilex opaca*	2-shrubs	FAC-
American hornbeam	*Carpinus caroliniana*	4-trees	FAC
Asian netvein hollyfern	*Cyrtomium fortunei*	1- herbs	NI
birdeye speedwheel	*Veronica persica*	1- herbs	NI
bitternut hickory	*Carya cordiformis*	4-trees	FAC
black cherry	*Prunus serotina*	2-shrubs	FACU
blackberry	*Rubus argutus*	2-shrubs	FACU+
boxelder	*Acer negundo*	4-trees	FACW
Chinaberrytree	*Melia azedarach*	2-shrubs	NI
Christmas fern	*Polystichum acrostichoides*	1- herbs	FAC
cinnamon fern	*Osmunda cinnamomea*	1- herbs	FACW+
common ladyfern	*Athyrium filix-femina*	1- herbs	FAC
common persimon	*Diospyros virginiana*	2-shrubs	FAC
cutleaf geranium	*Geranium dissectum*	1- herbs	NI
eastern cottonwood	*Populus deltoides*	4-trees	FAC+
eastern hayscented fern	*Dennstaedtia punctilobula*	1- herbs	UPL
eastern redbud	*Cercis canadensis*	2-shrubs	FACU
eastern redcedar	*Juniperus virginiana*	4-trees	FACU-
English ivy	*Hedera helix*	3-vines	NI
flowering dogwood	*Cornus florida*	2-shrubs	FACU
giant cane	*Arundinaria gigantea*	2-shrubs	FACW
green dragon	*Arisaema dracontium*	1- herbs	FACW
hardy orange	*Poncirus trifoliata*	2-shrubs	UPL
hobblebush	*Viburnum lantanoides*	2-shrubs	FAC
Japanese honeysuckle	*Lonicera japonica*	2-shrubs	FAC-
jumpseed	*Polygonum virginianum*	1- herbs	FAC
ladyfern	*Athyrium filix-femina*	1- herbs	FAC
muscadine	*Vitis rotundifolia*	3-vines	FAC
Nepalese browntop	*Microstegium vimineum*	1- herbs	FAC+
northern maidenhair	*Adiantum pedatum*	1- herbs	FACU
oakleaf hydrangea	*Hydrangea quercifolia*	2-shrubs	UPL
pecan	*Carya illinoinensis*	4-trees	FAC+
poison ivy	*Toxicodendron radicans*	3-vines	FAC
privet, chinese	*Ligustrum sinense*	1- herbs	FAC
red maple	*Acer rubrum*	2-shrubs	FAC

red mulberry	*Morus rubra*	2-shrubs	FAC
sand violet	*Viola affinis*	1- herbs	FACW
saw greenbrier	*Smilax bona-nox*	3-vines	FAC
scouringrush horsetail	*Equisetum hyemale*	1- herbs	FAC+
sedge, narrowleaf	*Carex amphibola*	1- herbs	FACW
silky dogwood	*Cornus amomum*	2-shrubs	FACW+
slippery elm	*Ulmus rubra*	4-trees	FAC
southern magnolia	*Magnolia grandiflora*	4-trees	FAC+
sugarberry	*Celtis laevigata*	4-trees	FACW
swamp chestnut oak	*Quercus michauxii*	4-trees	FACW-
sweetgum	*Liquidambar styraciflua*	4-trees	FAC+
sycamore	*Platanus occidentalis*	4-trees	FACW-
tulip tree	*Liriodendron tulipifera*	4-trees	FAC
Virginia creeper	*Parthenocissus quinquefolia*	3-vines	FAC
Virginia creeper	*Parthenocissus quinquefolia*	3-vines	FAC
water oak	*Quercus nigra*	4-trees	FAC
wild hydrangea	*Hydrangea arborescens*	2-shrubs	FACU
wild hydrangea	*Hydrangea arborescens L.*	2-shrubs	FACU
willow oak	*Quercus phellos*	4-trees	FACW-
willow, peachleaf	*Salix amygdaloides*	4-trees	FACW
wisteria	*Wisteria frutescens*	3-vines	FACW

Table 2. Explanation of wetland indicator status (*Source*: Reed 1988; USDA Plants).

Indicator Category	Probability of occurrence in wetlands	Status
Obligate wetland (OBL)	>99% of the time	Hydrophyte
Facultative wetland (FACW)	67-99%	Hydrophyte
Facultative (FAC)	34-66%	FAC, FAC+ Hydrophyte FAC- Non-hydrophyte
Facultative upland (FACU)	1-33%	Non-hydrophyte
Upland (UPL)	<1%	Non-hydrophyte
No Indicator (NI)	-	Not enough information

Table 3. Potential value of VNMP wetlands in terms of some of the common wetland functions

Wetland Function	**Level**	**Notes**
Removing sediment	Med	Indirect, by flow attenuation
Removing nutrients/phosphorus	No data	Likely short residence time
Removing nutrients/nitrogen	No data	See above
Removing metals and toxic organic compounds	No data	
Reducing downstream erosion and flooding	High	Flow attenuation
Recharging groundwater and streams	Local: High Regional: Minor	Important for stream flow maintenance, integrity of the watershed
General habitat	High	Locally unique and regionally rare habitats
Habitat for invertebrates	No data	
Habitat for amphibians	High	At least 5 species of salamanders and 12 species of Anurans (Keiser 2002)
Habitat for birds	Med/High	Neotropical migrant use
Habitat for aquatic mammals	Med	Riverine wetlands only
Richness of native plants	High	
Supporting food webs	No data	
Educational	High	Trails, uncommon plant communities

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Appendix 1

Fig. A-1. Measuring tree circumference for dominance assessment.

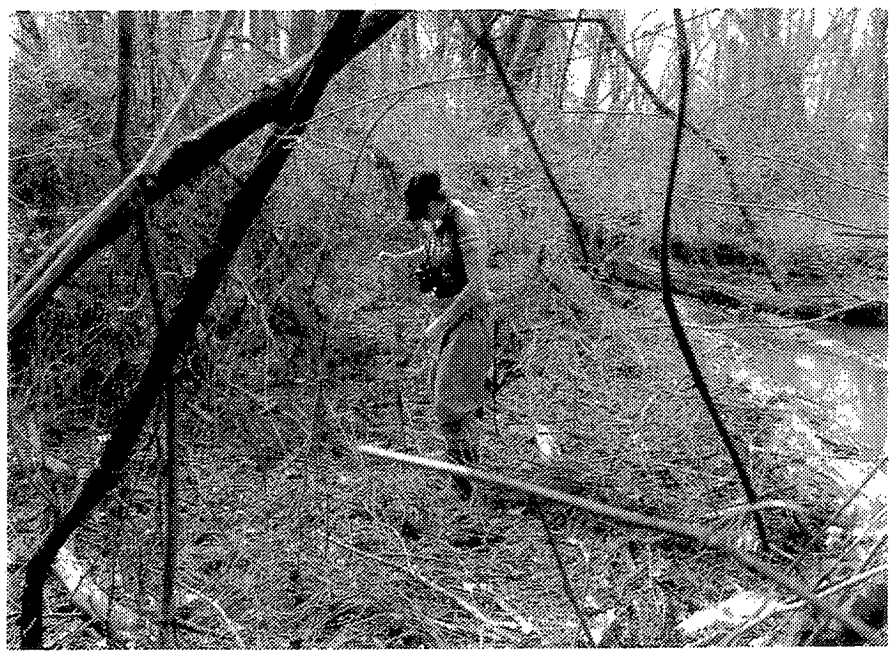

Fig. A-2. Sampling soil with a probe in a flooded riverine wetland.

Appendix 2

Fig. A-3. Map of the park with sampling locations and wetland boundaries.

Fig. A-4. Digital elevation model for Warren county (MARIS) with park boundaries.

Table A.1. Data forms.