Wetland Restoration Plan for the Woonasquatucket River Watershed, Rhode Island

Francis C. Golet, Dennis H.A. Myshrall, Nicholas A. Miller, and Michael P. Bradley

Department of Natural Resources Science
University of Rhode Island
Kingston, RI 02881

March 2003

RI DEM

EXECUTIVE SUMMARY

Background

Since 1999 the Rhode Island Department of Environmental Management (RIDEM); the U.S. Environmental Protection Agency (EPA), Region 1; and the University of Rhode Island's (URI) Department of Natural Resources Science have collaborated on a project to develop a freshwater wetland restoration strategy for Rhode Island. During Phase I, methods were devised for identifying and prioritizing restoration opportunities. The objective of Phase II was to use these methods to develop a comprehensive freshwater wetland restoration plan for the Woonasquatucket River watershed. This report describes the process used to identify and prioritize restoration opportunities throughout this watershed, presents the results of prioritization and restoration feasibility analyses, and lays out a watershed-wide implementation plan for wetland restoration. This plan is a joint effort of RIDEM, EPA, and URI, in partnership with the Woonasquatucket Watershed Council and officials from the six watershed cities and towns. Although the plan contains considerable information, it is not intended to be a stand-alone document; rather, it should be used in conjunction with the detailed site attribute data and GIS files contained in the restoration database. The database may be accessed via the RIDEM website (www.state.ri.us/dem/programs/benviron/water/wetlands/wetplan.htm).

Methods

This plan focuses on the two major wetland impact types in the Woonasquatucket watershed: filling, which destroys wetlands, and removal of adjacent upland vegetation, which degrades them. Potential restoration sites were identified through a combination of photo-interpretation and GIS analyses involving 1939 and 1988 conventional aerial photography, 1997 digital orthophotography, and RIGIS soils and wetlands coverages.

Prioritization of potential wetland restoration sites (i.e., wetland fill sites) involved three major steps:

- Assessment of the capacity of each site, if restored, to perform one or more of five wetland functions: flood abatement, water quality improvement, wildlife habitat, fish habitat, and heritage.

- Ranking of sites according to their relative capacities to perform each function and to perform multiple functions (i.e., six ranked lists).
- Creation of three broad tiers of sites based on overall functional potential, with Tier 1 representing the highest priority for restoration.

Potential buffer restoration sites (i.e., upland vegetation removal sites) also were divided into three tiers, based on the intensity of human land use adjacent to the wetland and the degree of sensitivity of the wetland type to land use impacts. Tier 1 sites had both intensive land use and highly sensitive wetlands, while Tier 3 sites had neither; Tier 2 sites had one, but not the other.

Landowners were identified for all wetland fill sites and for Tier 1 and Tier 2 upland vegetation removal sites. Parcels containing wetland fill sites were cross-referenced against the RIDEM enforcement database to identify sites with enforcement "flags" (i.e., potentially unresolved enforcement actions). Visits were made to publicly owned sites and to those private fill sites where landowner permission was obtained and there were no RIDEM enforcement flags. All sites where wetland filling or upland vegetation removal was confirmed in the field, and where current land use suggested that restoration was possible, were considered to be viable restoration opportunities. Detailed feasibility analyses were conducted at all of these sites; these analyses focused on those factors that would dictate the nature of the restoration process, or constrain it, at each site.

Results

Potential Wetland Restoration Sites

This study identified 77 potential wetland restoration sites (i.e., fill sites) in the Woonasquatucket watershed; most of these still need to be confirmed in the field. These sites occur along the main stem of the Woonasquatucket River, along its tributaries, and in isolated locations. They are found in urban, suburban, and rural settings, and in all watershed towns except Glocester. Eleven of the sites are publicly owned and 66 are on private land. Forty-two sites currently have RIDEM wetland enforcement flags. The area of individual wetland fill sites ranges from 0.10 to 21.84 acres; the average size is 1.49 acres.

If restored, more than 70% of the potential wetland restoration sites can be expected to contribute to water quality improvement, flood abatement, or heritage values. Fewer sites are considered capable of providing significant fish habitat (40%) or wildlife habitat (31%). Seventy-two of the 77 potential wetland restoration sites were estimated to be capable of performing at least two wetland functions, if restored. These results suggest that substantial benefits can be expected from wetland restoration in this watershed.

There are 24 potential wetland restoration sites in Tier 1, 22 in Tier 2, and 31 in Tier 3. The Tier 1 sites clearly stand out in terms of their potential contribution to wetland functions in the watershed if restoration were accomplished. Tier 1 sites average 2.51 acres and nearly all are associated with the main stem of the Woonasquatucket River, its tributaries, or other large wetlands. Tier 2 sites average 0.90 acres; they include medium to large sites isolated from other wetlands in an urban setting, as well as small sites in rural or suburban parts of the watershed. Nearly 80% of all Tier 3 sites are smaller than 0.50 acres. The majority occur in the urban, southern half of the watershed where they are isolated or contiguous with small wetlands. This plan identifies seven clusters, each comprising 4-10 potential wetland restoration sites, that may provide important foci for restoration planning and construction.

Restoration feasibility analyses were performed at three publicly owned wetland fill sites, including one Tier 1 site (455) and two Tier 2 sites (248, 370). Site 248, which is located in the southern part of Deerfield Park in Smithfield, is the most straightforward of the three opportunities. Once restored, this 1-acre site could have high educational and aesthetic value for visitors to Deerfield Park. Site 455 is located along the Woonasquatucket River west of the Lincoln Lace Brownfield site in Providence. At 1.62 acres, Site 455 represents a significant restoration opportunity, but the possible presence of contaminants from an old landfill poses a major constraint. Site 370, located at the western edge of Deerfield Park, should be viewed as a marginal restoration opportunity in light of its narrowness and its current value as a forested upland buffer between a former gravel pit and residential development.

Potential Buffer Restoration Sites

This study identified 239 potential buffer restoration sites (i.e., upland vegetation removal sites) in the Woonasquatucket watershed, including 18 on public property and 221 on private land. All but 10, where feasibility analyses were conducted, need to be confirmed as viable restoration opportunities in the field. Potential buffer restoration opportunities occur in all areas of the watershed. Crop production, commercial development, gravel mining, and industrial development are the most common high-impact land uses encountered at Tier 1 and Tier 2 sites. Marshes or wet meadows, small streams, ponds, and rivers are the sensitive wetland types that occur most often at these sites.

Forty potential buffer restoration sites (17%) fall within Tier 1. They typically occur in urbanized parts of the watershed and other highly disturbed areas that border open water bodies or marshes. Creation or expansion of woody buffers at Tier 1 sites is critically important to enhancing water quality and other wetland functions at the watershed scale. Seventy percent of the Tier 1 sites are in Smithfield or Johnston, and all are privately owned. There are 103 potential buffer restoration sites (43%) in Tier 2; restoration of these sites also should be a major goal of wetland management in this watershed. Tier 2 sites occur in the greatest variety of settings, ranging from urban commercial and industrial land to agricultural and residential land. Eleven of the 103 sites in Tier 2 are publicly owned. Tier 3 includes 96 potential buffer restoration sites (40%), seven of which are publicly owned. They are most common in suburban and rural areas, where low-impact land uses border less sensitive wetland types. For this reason, restoration of Tier 3 sites is clearly a lower priority than restoration of Tier 1 or Tier 2 sites. This plan identifies three major clusters of upland vegetation removal sites that occur in association with clusters of fill sites, and three other clusters that occur more or less independently of fill sites.

Restoration feasibility analyses were performed at 10 Tier 2 upland vegetation removal sites. Six are in Smithfield: Smithfield Sewage Treatment Plant (168); Whipple Field (171, 172); Smithfield Department of Public Works (173); and Deerfield Park (690, 695). Three sites (511, 512, 513) are on the Newman Preserve in Glocester, and one (640) occurs at the

Lincoln Lace Brownfield site in Providence. Significant improvements to buffer integrity appear to be possible at all of these sites.

Implementation

Tables 3-5 and 7-9 of this plan provide basic information on all of the potential wetland and buffer restoration sites by tier. Included in each table are columns entitled "Site status" and "Next step." The "Site status" column indicates where each site stands with respect to its ongoing evaluation as a viable restoration opportunity. The "Next step" column contains an alpha-numeric code (e.g., A1, B3) for each site which refers the reader to a specific step within one of four sets of guidelines in the Implementation section of the plan. The guidelines explain, in step-by-step fashion, what must be done to move a particular site farther along the path to restoration (see "Steps to Wetland Restoration" and "Steps to Buffer Restoration"). These guidelines provide the framework for implementing the results described above.

In general, we recommend that restoration be pursued first at those fill sites and upland vegetation removal sites where feasibility studies indicate good prospects for success, then at the other Tier 1 and Tier 2 sites, and finally at the Tier 3 sites. Within a tier, ideally fill sites should be pursued in order of their functional potential (i.e., from top to bottom of Tables 3-5). However, there may be cases where a site should be pursued because it ranks high on one of the single-function lists (Appendix G) and restoration of that site would help to offset a deficit in that function locally. We also recommend that, whenever possible, clusters of restorable wetlands be targeted to maximize the benefits in local geographic areas and to minimize costs.

Before many buffer restoration sites can be pursued, parcels will need to be checked against the RIDEM enforcement database to determine whether there are any enforcement flags, and landowners will need to be contacted for site access where such flags are lacking. Likewise, considerable time will need to be devoted to contacting owners of private fill sites to obtain permission for site visits. In all of these cases, the Methods section of this report should be consulted for standard procedures.

Restoration of wetland functions and values in the Woonasquatucket watershed will necessarily be a gradual process that will require a firm commitment of time, energy, and patience from all parties. The success of this process will be enhanced if:

- Site visits to assess the viability of restoration opportunities are made as early as possible.
- Expectations from restoration at specific sites are realistic and based on landscape and land use context.
- Funds and technical assistance for restoration planning, construction, and evaluation are aggressively pursued.
- Municipal governments, state and federal agencies, and nongovernmental organizations can find the means to purchase private lands with high restoration potential or develop other strong incentives for landowner participation.
- Marginal restoration opportunities can be identified and avoided in favor of others where the benefits are clearer.
- All parties agree that any strategy for wetland management at the watershed scale must be grounded, first and foremost, in the protection of existing wetlands.

ACKNOWLEDGEMENTS

Development of this plan was funded by the U.S. Environmental Protection Agency (EPA), Region 1, under Section 104(b)(3) of the Clean Water Act, the Rhode Island Department of Environmental Management's (RIDEM) Office of Water Resources (OWR), and the University of Rhode Island. Sue Kiernan, Deputy Chief of OWR, provided the vision and impetus for development of a statewide freshwater wetland restoration strategy. Russ Chateauneuf, Chief of Permitting of OWR, strongly encouraged the development of this proactive wetland restoration plan. Peter Holmes (EPA) also enthusiastically supported this concept and guided the research through two funding cycles; he also provided valuable feedback on draft methods and results. Special thanks go to Carol Murphy (OWR) for assistance in all facets of the research, from proposal writing and funding through review of RIDEM enforcement files and preparation of the final restoration plan; this project could not have succeeded without her diligence and facilitation. Hank Ellis and Steve Tyrrell (RIDEM Office of Compliance and Inspection) generously gave of their time in guiding our efforts to ascertain the enforcement status of potential restoration sites. Fred Presley (RIDEM Sustainable Watersheds Office) served as an intermediary between our research team and both municipal officials and private landowners; he helped greatly in the acquisition of plat and lot data from the cities and towns. The Woonasquatucket Watershed Council provided constant encouragement, as well as valuable feedback on methods for prioritizing restoration opportunities and draft results; we specifically acknowledge input from: Maurice Bourget, Donald Burns, Donald Driscoll, Bruce Hooke, Jean Lynch, Paul McElroy, Eugenia Marks, Jenny Pereira, Jane Sherman, and Johanna Hunter (EPA). We thank all of the municipal officials who provided parcel data and landowner information and who answered questions on specific sites; special thanks go to: Ray Goff (Glocester), Roberta Groch (Providence), Chris Hawkins (Smithfield), Jean Tracey McAreavey (Johnston), Michael Phillips (North Smithfield), and Leo Perotta (North Providence). Dennis Erkan (RIDEM Division of Fish and Wildlife) gave us advice on development of assessment criteria for freshwater fish habitat. Eugene Pepper (RIDEM Division of Agriculture) furnished updated land use information for the entire Woonasquatucket

watershed and shared his knowledge of the watershed's agricultural practices. Susan Ely (OWR) coordinated website development and compiled information on sources of grants and technical assistance for restoration; she wrote the first draft of Appendix J. Tony Veltri of the URI Department of Natural Resources Science (NRS) designed the website, while Debra Merrill (OWR), Paul Jordan (DEM), and Tom Epstein (DEM) also assisted with website development. Thanks go to Roland Duhaime (URI Environmental Data Center) for advice on GIS. Gary Blazejewski (NRS) offered his insights into the field component of the functional assessment process, based on his participation in Phase I research. Special thanks go to Barbara Brown (NRS) for word processing multiple drafts of this report. Dennis Skidds (NRS) also assisted in report preparation.

Table of Contents

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Importance of Wetlands to Society

Wetlands include a wide variety of areas that are intermediate in wetness between deep water and dry land; they are commonly known as marshes, swamps, bogs, fens, wet meadows, ponds, and streams (Cowardin et al. 1979). Some wetlands have shallow, permanent surface water; others have surface water only seasonally; and still others never have surface water, but have soil that is saturated for extended periods each year.

For more than 200 years, Americans drained, filled, polluted, or otherwise altered the wetlands of this country with little thought for the benefits that these ecosystems provide (Mitsch and Gosselink 2000). By the 1960s, we had begun to recognize both the values of wetlands and the hazards associated with living in or near them. Among the most widely recognized benefits of wetlands are flood storage and desynchronization, water quality improvement, fish and wildlife habitat, groundwater recharge and discharge, recreation, aesthetics, education, and open space (Greeson et al. 1979, Adamus et al. 1991, U.S. Army Corps of Engineers 1995). Recognition of the benefits and hazards of wetlands led to the passage of both the Rhode Island Freshwater Wetlands Act and the Rhode Island Coastal Resources Management Act in 1971. Since then, land use in and adjacent to our State's wetlands has been regulated by the Department of Environmental Management (and its predecessor, the Department of Natural Resources) and the Coastal Resources Management Council.

Nationwide, we have destroyed more than one-half of our original wetland acreage (Dahl 1990). This loss has resulted in millions of dollars of flood damage annually; degraded water quality in our streams, lakes, and groundwater supplies; declines in fish and wildlife populations; reduced recreational and educational opportunities; a decline in scenic amenities; and a loss of valuable open space. Over the last 10-15 years, numerous state and federal agencies, as well as nongovernmental organizations, have launched proactive, nonregulatory wetland restoration programs in an effort to undo some of the damage and to restore some of the lost benefits (Miller and Golet 2001).

Wetland restoration may be defined as the re-creation or rehabilitation of wetland ecosystems whose natural functions have been destroyed or impaired. This report provides a plan for freshwater wetland restoration in the Woonasquatucket River watershed of northern Rhode Island.

Wetlands of the Woonasquatucket River Watershed

Fifty-one square miles in area, the Woonasquatucket River watershed is a microcosm of Rhode Island and of southern New England in general, both in terms of its natural resources and human land use. The watershed extends from the rural headwaters of North Smithfield and Glocester in the north and west to the urban landscapes of Johnston, North Providence, and Providence in the south and east; it ultimately discharges into the northern end of Narragansett Bay (Fig. 1). The Town of Smithfield is contained almost entirely within the watershed and encompasses 46% of the watershed's total area.

As of 1988, the Woonasquatucket River watershed contained 4,817 acres, or roughly 4%, of the State's freshwater wetlands (Miller and Golet 2001). Freshwater wetland covers 15% of the watershed's area (Fig. 1). Forested swamps and shrub swamps comprise 68% of the wetlands, lakes and ponds account for 24%, marshes comprise 4%, riverine wetlands make up less than 2%, and fens and bogs also comprise less than 2% (Miller and Golet 2001).

Statewide, 16% of all freshwater wetland acreage is protected through ownership by federal, State, or municipal governments or nongovernmental conservation organizations (Miller and Golet 2001). In the Woonasquatucket River watershed, only 3.8% of the wetland area is so protected. In the Woonasquatucket, 61 acres of wetland are owned by the State, 68 acres are in municipal ownership, and 56 acres are owned by nongovernmental conservation organizations; none of the wetlands are federally owned (Miller and Golet 2001). More than 4,600 acres of wetland are privately owned.

There are no data on wetland losses in the Woonasquatucket River watershed; however, it is clear from a comparison of aerial photographs from the 1930's and the 1990's that

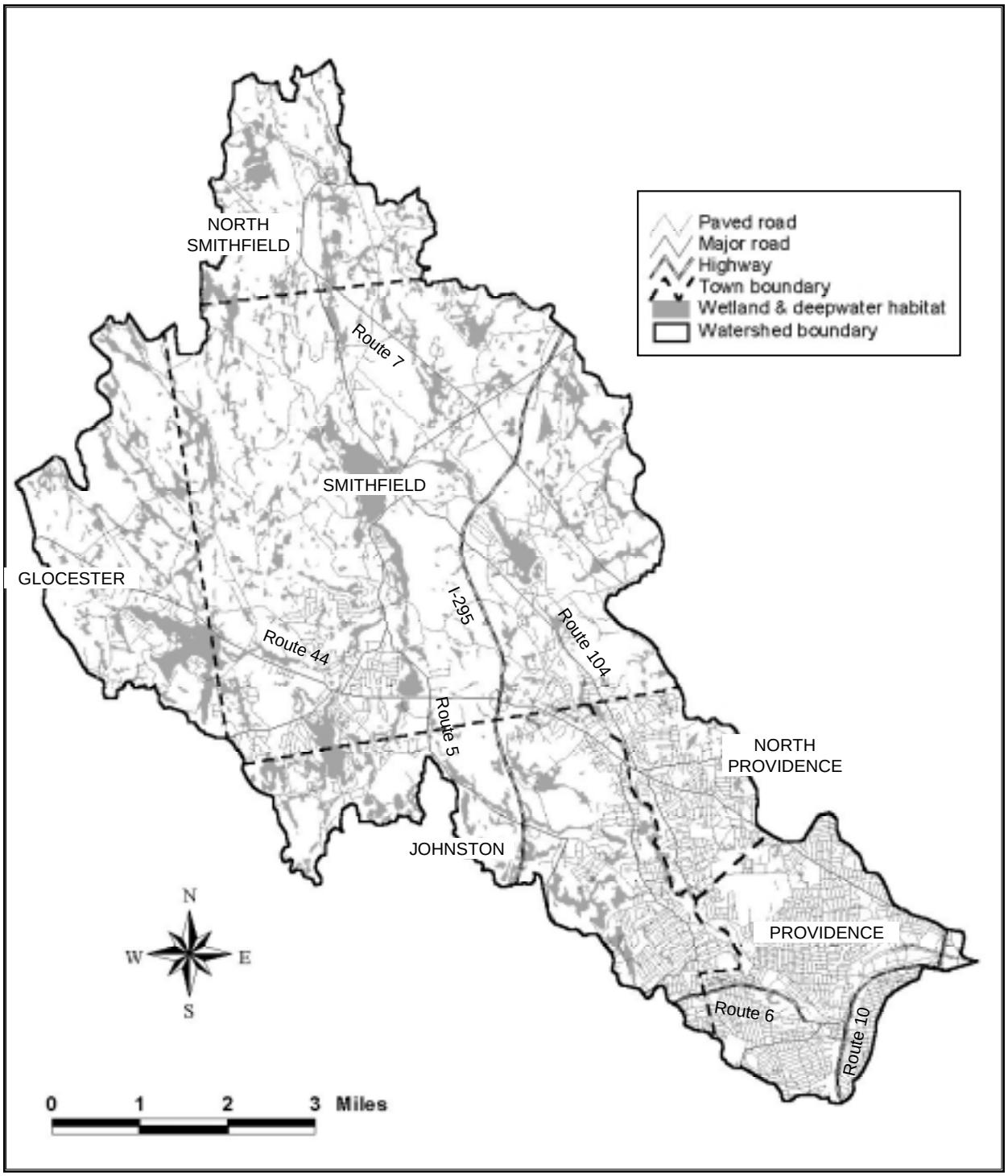

Figure 1. Major features of the Woonasquatucket River watershed.

losses have been great. Some of the principal causes of wetland destruction include gravel mining and associated filling; highway construction (especially I-295); and residential, commercial, and industrial development. Some wetlands also have been eliminated by landfills and construction of public facilities, such as schools and municipal athletic fields. Wetland losses due to farming appear to have been minor, but the hydrology and vegetation of some wetlands clearly have been altered through agriculturally related ditching, stream channelization, and pond construction.

Wetland water quality is severely degraded in many areas of the watershed as a result of industrial discharges and surface runoff from highways, commercial districts, residential subdivisions, landfills, gravel mines, and some agricultural lands. Discharge of effluent from failing septic systems is another likely source of pollutants in unsewered areas. Economic losses due to flooding of low-lying urban areas represent still another adverse impact of wetland destruction, particularly in the lower reaches of the Woonasquatucket River and its major tributaries. Proactive wetland restoration offers a means for offsetting some of this wetland loss and degradation at both local and watershed scales.

Study Background and Objectives

In 1999, the Rhode Island Department of Environmental Management (RIDEM); the U.S. Environmental Protection Agency (EPA), Region 1; and the University of Rhode Island's (URI) Department of Natural Resources Science began collaboration on a project to develop a freshwater wetland restoration strategy for Rhode Island. Phase I of this project was designed to develop a technical framework for identifying and prioritizing freshwater wetland restoration opportunities; a preliminary version of this methodology was tested in the middle of the Woonasquatucket River watershed (Miller and Golet (2001). The objective of Phase II was to use this basic methodology to develop a comprehensive freshwater wetland restoration plan for the entire Woonasquatucket River watershed. This report outlines the process used to identify and prioritize restoration opportunities throughout this watershed, presents the results of prioritization and feasibility analyses at selected sites, and lays out a watershed-wide implementation plan for wetland restoration. This plan is a joint effort of RIDEM, EPA, and URI, in

partnership with the Woonasquatucket Watershed Council and officials from the six watershed cities and towns. It is intended as a blueprint by which the people of the Woonasquatucket can increase the quantity and quality of the watershed's wetlands and the diverse benefits that they provide.

Putting the Plan into Perspective

In southern New England, when wetlands are destroyed it is usually by filling, and the purpose of filling is invariably to create building land. Once a site is built upon, any hope for wetland restoration is remote; for that reason, we need to make the most of every restoration opportunity that surfaces. At the same time, it is important to recognize that the science of restoration is far from perfected (Kusler and Kentula 1990, National Research Council 1992, Zedler and Calloway 1999, Miller and Golet 2001). We should not allow ourselves to think that it is easy to re-create such complex ecosystems or that restoration will reverse current and historic wetland losses. Any strategy for wetland management at the watershed scale must be grounded, first and foremost, in the protection of existing wetlands (Tiner 1995, Ehrenfeld 2000). Restoration should be viewed as a supplement to protection, not a substitute. Ultimately, the full benefits of wetland restoration can only be realized if existing wetlands are protected as well.

METHODS*

Identification of Potential Restoration Sites

Miller and Golet (2001) identified nine wetland impact types in a 12-square mile study area within the Woonasquatucket River watershed; they were: filling, drainage, stream channelization, impedance of surface flow, removal of wetland vegetation, removal of adjacent upland vegetation, trash dumping, invasive species, and sedimentation. The present study focuses on the two major wetland impact types: filling, which destroys wetlands, and removal of adjacent upland vegetation, which degrades them. These impact types were selected because of their prevalence and because impact removal would result in maximum gains of wetland functions. The opportunity for wetland restoration is, in large part, dependent upon current land use; for that reason, sites that had active land uses (e.g., buildings, roads, parking lots, athletic fields) were not considered to be potential restoration opportunities, unless the area was obviously abandoned.

A time-lapse approach was used to identify potential restoration sites where wetland had been destroyed as a result of filling between 1939 and 1997. The primary strategy was to compare images on 1939 aerial photography, which is the State's oldest data source, to the most recent GIS data, which included 1997 digital orthophotography and the 1988 RIGIS wetlands coverage. The 1939 photography and the GIS data were compared in a systematic fashion throughout the watershed in order to locate wetlands that had changed in size or shape or that had been lost entirely. In some cases, it was possible to identify wetland that had been filled between 1988 and 1997 because the 1997 orthophotos showed a disturbance within the 1988 wetland boundary.

The RIGIS soils coverage, derived from the Rhode Island Soil Survey (Rector 1981), also was useful. We used ArcView to select out the Udorthent (UD) and Urban Land (Ur) soil types—which indicate filling or excavation to at least 2 feet—and viewed those types

*****_Note_: This section provides an overview of the basic methods used in development of the Woonasquatucket wetland restoration plan. A more detailed description of identification and prioritization procedures can be found in Appendix A.

simultaneously with the RIGIS wetlands coverage to confirm potential restoration sites that had been identified during the initial time-lapse analysis and to identify possible wetland filling prior to 1939. Those areas where UD or Ur soil types were adjacent to wetlands were considered possible wetland fill sites. ArcView also was used to select out the hydric (wetland) soils from the soils data and to view them simultaneously with the RIGIS wetlands. This method permitted identification of areas that had hydric soils in 1981 but that were not mapped as wetland in 1988. Where the 1997 orthophotography showed evidence of disturbance within these areas, we concluded that wetland filling was likely. Finally, a small number of wetland fill sites were identified through stakeholder nominations.

The approximate boundaries of fill sites were delineated and digitized to create a GIS polygon coverage so that fill areas could be estimated and sites could be more easily located and assessed in the field.

Identification of wetlands that have been degraded as a result of the removal of adjacent upland vegetation, mainly trees and shrubs, was accomplished primarily by stereoscopically viewing the 1988 aerial photographs that bear the RIGIS wetland delineations. The presence of the wetland delineations, combined with the ability to systematically examine the upland-wetland interface in stereo, greatly expedited the identification process. Additional sites were identified by simultaneously viewing the 1997 orthophotography and the RIGIS wetlands coverage in ArcView; this procedure permitted detection of areas where upland vegetation had been removed since 1988. We digitized the upland vegetation removal sites as lines in ArcView, and created a GIS line coverage to depict the location and extent of vegetation removal.

Prioritization of Potential Restoration Sites

Because of the potentially large number of restoration opportunities, the scarcity of funding, and the reality that wetland restoration will proceed slowly in most watersheds, we developed methods to prioritize restoration opportunities at wetland fill sites and upland vegetation removal sites.

Functional Assessment and Ranking of Filled Wetlands

The first step toward prioritization of filled-wetland restoration sites was an assessment of the capacity of each site, if restored, to perform one or more of five wetland functions: flood abatement, water quality improvement, wildlife habitat, fish habitat, and heritage. The criteria used to assess these functions (Table 1) were generated from the experience of the authors and a review of wetland functional assessment methods developed by Adamus et al. (1987) and the U.S. Army Corps of Engineers (1995). Rationale for these criteria, as well as methods for assessing them, are described in Appendix B. The area of land that was assessed at each site was labeled the "restoration assessment unit" (Table 1). Where the fill site bordered directly on existing wetland, the assessment unit was the combined area of the fill site and the wetland; if there was no contiguous wetland, then the assessment unit was the fill site alone.

Data were collected in the field and in the lab to determine which criteria were met for each function (Appendix B). For each site, a score was calculated for each of the five wetland functions. The size of the score was a reflection of: (1) the likelihood that the site could perform the function if restoration occurred, (2) the benefits to society of that function at that location on the landscape, and (3) the size of the fill site. Fill sites were then ranked by individual wetland functions and by their ability to perform multiple functions, if restored (see Appendix D for details on scoring and ranking).

Tiering of Wetland Fill Sites

The functional assessment and ranking process generated six ranked lists of wetland fill sites that potentially could be restored, one list for each of the five functions and one list for multiple functions. Ultimately, the results from the six lists were combined to produce three tiers of sites, each tier comprising roughly one-third of the total pool.

- Tier 1 included (1) the top 18 sites from the multi-function list (i.e., all of the sites that were >0.5 acres *and* that had the potential to perform at least 4 of the 5 functions) and (2) the upper one-sixth of the sites from each of the five single-function lists.
- Tier 2 included sites that ranked approximately in the upper one-third of one or more of the single-function lists, unless the site had already been assigned to Tier 1.
- Tier 3 included those sites that did not qualify for either of the first two tiers.

Table 1. Functional assessment form for potential wetland restoration sites.

Site ID #: _____ **Date:_____**

Function	*	Criteria (highlighted criteria are necessary to the function)	O,E,S†	Source‡	Notes
Flood Abatement		1) Impervious surfaces cover > 20% of land within 500 feet of restoration assessment unit (RAU)**	O	L, f	
		2) Slopes within 500 feet of RAU are > 15%	O	L, f	
		3) Point-source discharge or concentrated stormwater flow into RAU	O	L, f	
		4) RAU borders or contains a lower perennial stream	O	l, F	
		5) RAU occurs within a basin	E	l, F	
		6) More than 50% of wetland unit (WU) area is dominated by dense, persistent vegetation (EM, SS, or FO)	E	L, f	***
		7) Developed flood-prone areas within 5 miles downstream of RAU (connection by stream or floodway required)	S	L	
Water Quality Improvement		1) Point-source discharge or concentrated stormwater flow into RAU	O	L, f	
		2) Impervious surfaces, active agricultural land, or barren land comprise > 20% of land within 500 feet of RAU	O	L, f	
		3) More than 50% of WU area is dominated by dense, persistent vegetation (EM, SS, or FO)	E	L, f	***
		4) RAU occurs within a basin	E	l, F	
		5) RAU has a constricted outlet	E	L, f	
		6) RAU is within a wellhead protection area	S	L	
		7) RAU borders or contains a water body that is on the Rhode Island List of Impaired Waters	S	L	
Wildlife Habitat		1) Wetlands and deepwater habitats comprise > 15% of land within 1 mile of RAU	E	L	
		2) RAU is contiguous with > 400 acres of moderate to high quality habitat (wetland or deepwater habitat, upland forest or shrubland, abandoned field, or agricultural land)	E	L	
		3) RAU > 5 acres	E	L	
		4) RAU contains wetland-dependent wildlife habitat (OW, marsh, bog, or fen)	E	L, f	***
		5) No point-source discharge or concentrated stormwater flow into RAU	E	L, f	
		6) Less than 0.25 acres of invasive plants in WU	E	l, F	***
		7) Moderate to high quality habitat (wetland or deepwater habitat, upland forest or shrubland, abandoned field, or agricultural land) comprises > 70% of land within 500	E	L, f	
	Y	8) Social significance assumed to be present	S		

(Continued)

Table 1. (Concluded).

Function	*	Criteria (highlighted criteria are necessary to the function)	O,E,S	Source	Notes
Fish Habitat		1) Permanent pond or lower perennial stream is present in RAU	O	l, F	
		2) No point-source discharge or concentrated stormwater flow into RAU	E	L, f	
		3) Permanent pond or lower perennial stream within RAU is bordered by trees or shrubs for > 75% of its length	E	L, f	
		4) Impervious surfaces cover < 20% of land within 500 feet of RAU	E	L, f	
		5) Open water, if present in RAU, > 2 acres	E	L	***
	Y	6) Social significance assumed to be present	S		
Heritage Aesthetics Recreation Education Research Open space Biodiversity		1) RAU is physically or visually accessible	O	F	
		2) RAU borders or contains public land	O	L, f	
		3) RAU contains open water	O	L, f	***
		4) No point-source discharge or concentrated stormwater flow into RAU	E	L, f	
		5) No evidence of noise pollution or trash in RAU	E	F	
		6) RAU contains 3 or more wetland types	E	L, f	***
		7) Uncommon wetland type (bog, fen, marsh, wet meadow, or cedar swamp) is present in RAU	E	L, f	***
		8) Waterbird habitat (OW or marsh) is present in RAU	E	L, f	***
		9) Moderate to high quality habitat (wetland or deepwater habitat, upland forest or shrubland, abandoned field, or agricultural land) comprises < 50% of land within 1 mile	S	L	
		10) Wetlands and deepwater habitats comprise < 10% of land within 1 mile of RAU	S	L	
		11) RAU is located within 1 mile of a school or college	S	L	

* Mark each box as Y, N, D, or NA (i.e., yes, no, don't know, or not applicable)

† O = opportunity; E = effectiveness; S = social significance

** Restoration assessment unit (RAU) may include (1) potential restoration site (PRS) and contiguous wetland unit (WU) or (2) just PRS (if no contiguous wetland is present).

‡ L,l = lab data; F,f = field data. Upper case signifies primary source; lower case signifies secondary source.

*** Not applicable if entire wetland unit has been destroyed.

Tiering of Upland Vegetation Removal Sites

Upland vegetation removal sites were ranked based on the answers to two questions: (1) Was the site vulnerable to major human impacts, based on context; and 2) was the contiguous wetland type highly sensitive to such impacts? Sites that were adjacent to roads, industry, commercial centers, high-density residential development, or other land uses (e.g., gravel mining, cattle grazing) that might contribute to further wetland degradation were considered vulnerable. Highly sensitive wetland types included bogs, fens, marshes or wet meadows, standing or flowing water bodies, and Atlantic white cedar (*Chamaecyparis thyoides*) swamps.

- Tier 1 included sites where the answer to both questions was "yes."
- Tier 2 included sites where the answer to one question was "yes" and the answer to the other question was "no."
- Tier 3 included sites where the answer to both questions was "no."

Within these priority groups, sites were further ranked by the total length of the upland vegetation removal impact (<400 ft, 400-800 ft, and >800 ft).

Landowner Research and Contacts

Landowner permission was obtained prior to visiting any potential restoration sites. Landowners were identified after first identifying plat and lot numbers for all parcels of land that intersected wetland fill sites or upland vegetation removal sites. For sites in Glocester and Providence, where digital plat data were available, ArcView was used to intersect the plat data with the fill-site polygon coverage and the line coverage from the upland vegetation removal sites. For sites located in the other four towns, ArcView was used to simultaneously view the polygon and line coverages, the 1997 orthophotographs, and plat and lot boundaries reproduced on an acetate sheet affixed to a computer screen. Plat and lot numbers for all parcels intersecting potential restoration sites were then identified and the boundaries of those parcels were digitized to create a GIS polygon coverage. Lists of plat and lot numbers associated with potential restoration sites were forwarded to municipal officials who then provided landowner names and addresses.

Landowners were identified for all wetland fill sites. Because of the large number of upland vegetation removal sites, and because this impact was considered to be of lower priority than wetland filling, we limited landowner identification to Tier 1 and Tier 2 upland vegetation removal sites only. Landowners were not identified for a small number of Tier 1 and Tier 2 upland vegetation removal sites bordering agricultural land because those sites were in Tier 3 at the time the landowner research was done. The change in tier was due to acquisition of more detailed agricultural land use data from RIDEM at a later date.

Permission to access publicly owned wetland fill sites and upland vegetation removal sites was obtained from officials in each town. All private owners of wetland fill sites whose property was free of RIDEM wetland enforcement flags (see below) were sent a letter requesting permission to conduct field inspections. If a telephone number was available, the letter was followed by a telephone call. Visits to landowner residences were made in some cases where contact could not be made by other means. No attempt was made to contact any of the private owners of upland vegetation removal sites.

Cross-referencing Sites with RIDEM Wetland Enforcement Files

Under the authority of the Rhode Island Fresh Water Wetlands Act, RIDEM initiates legal enforcement action against property owners who engage in unauthorized activities in wetlands without a permit and, therefore, violate the Act. It was agreed at the outset of this project that the focus would be proactive, nonregulatory, wetland restoration and that, if a potential restoration site were also the location of an alleged wetland violation being pursued by RIDEM through the regulatory enforcement process, then proactive restoration would not be pursued. For that reason, before attempting to contact landowners, the database of parcels containing wetland fill sites was cross-referenced against the RIDEM Office of Compliance and Inspection's (OCI) Foxpro database. RIDEM Office of Water Resources staff subsequently checked the OCI enforcement files for those Tier 1 and Tier 2 sites where an enforcement "flag" (i.e., a potentially unresolved enforcement action) was detected to determine current status. The fill sites were then sorted into four categories: private sites with enforcement flags, private sites

without enforcement flags, public sites with enforcement flags, and public sites without enforcement flags. No attempt was made to contact private landowners whose property had an enforcement flag or to visit those sites. Public fill sites with enforcement flags were visited to verify the presence of a restoration opportunity, but not pursued further. The OCI database was not examined for potential wetland violations at the upland vegetation removal sites; however, if a parcel was associated with both an upland vegetation removal site and a fill site, it was assigned an OCI status.

Field Verification of Restoration Opportunities

Visits were made to all potential restoration sites for which landowner permission was obtained. The primary purpose of the visit was to determine (1) whether the wetland impacts identified in the lab were real, and (2) how likely it was that the site could be restored, given the current land use. The site visit also permitted checks on the accuracy of the RIGIS wetlands mapping, the RIGIS land use classification, and the Soil Survey (Rector 1981).

At those sites where aerial photo-interpretation had suggested wetland filling, we looked for abrupt changes in topography at the edge of existing wetland and foreign material (e.g., gravel, cobbles, boulders, concrete, or other debris) overlying former wetland soils. Soil composition was examined using a 5-foot auger. Where the thickness of fill material exceeded 5 feet or the material was too rocky for augering, conclusions were based on surface material; relative elevations of existing wetland, upland, and suspected fill; and vegetation. For example, fill sites commonly supported early successional trees such as trembling aspen (*Populus tremuloides*), gray birch (*Betula populifolia*), or Bebb's willow (*Salix bebbiana*) and invasive species including multiflora rose (*Rosa multiflora*), bittersweet (*Celastrus* spp.), honeysuckle (*Lonicera tatarica*), and autumn olive (*Elaeagnus umbellata*). The location and areal extent of fill was then checked against the fill polygon delineated on a hard copy of the digital orthophotography. As long as a confirmed wetland fill site had no active land use that would render restoration unfeasible or highly unlikely, the site was considered to be a viable wetland restoration opportunity.

Those sites where aerial photo-interpretation had indicated no trees or tall shrubs at the wetland edge were field-checked to verify that (1) the site bordered on wetland, (2) there was less than 50 feet of upland forest or upland shrub vegetation along the wetland edge, and (3) there was reason to believe that the current land use would allow for re-establishment or expansion of a woody "buffer zone" at the site. If all of these criteria were met, the site was considered to be a viable restoration opportunity. Generally, lawns were considered to be viable restoration sites as long as the site to be restored was a small fraction of the total lawn area and sufficient lawn area would remain after restoration to allow for unimpeded pedestrian travel. Paved, actively used parking areas and utility rights-of-way were considered to be incompatible with buffer restoration.

Feasibility Analyses

Once it was clear that a given wetland fill site or upland vegetation removal site was a bona fide restoration opportunity, a more detailed analysis was conducted of those factors that would dictate the specific nature of the restoration process or constrain it at that site. These feasibility analyses were carried out primarily in the field. The following steps were included:

- The location and extent of each restoration opportunity was checked against the delineations made in the lab; corrections were made directly on hard copies of the 1997 digital orthophotography.
- Fill depths were estimated, based on auger samples or visual examination of local topography.
- Notes were recorded on existing vegetation, water regime, and land slopes within the fill site (if any) and the contiguous wetland, and at the wetland edge; the type and width of existing upland buffer vegetation were noted specifically.
- The size and approximate number of trees that would have to be removed from fill sites before excavation were estimated.
- The most promising access points for construction equipment were identified.
- Current land use within the restoration site and in the adjacent upland were noted, along with the presence of utility lines, sewer lines, storm drain systems, or other possible constraints.
- Potential sources of contamination at fill sites were identified by overlaying the fill-sites polygon coverage on RIGIS coverages for CERCLA (Superfund) sites and underground storage tanks in ArcView.

- Restoration costs (excluding land acquisition and design and permitting costs) were estimated for fill sites using the guidelines in Appendix E.
- For each site, an effort was made to anticipate issues that might be raised during the RIDEM wetland permitting process. Some of the issues considered were: the size of the project, the presence of sensitive wetland types, possible erosion and sedimentation problems, downstream impacts, and invasive species.

Landowner willingness to cooperate in on-the-ground restoration was not determined as part of the feasibility analyses.

RESULTS

Potential Wetland Restoration Sites

Overview

Initially, more than 140 potential wetland restoration sites (i.e., wetland fill sites) were identified through time-lapse comparisons among 1939 and 1988 aerial photographs, the 1988 RIGIS wetlands coverage, the RIGIS soils coverage, and 1997 digital orthophotography. After a close re-examination of the data, as well as field-checking at most of the publicly owned sites and at a small number of privately owned sites where landowner permission was granted, the list of potential restoration sites was reduced to 77. The presence of a viable restoration opportunity has not yet been confirmed in the field at most of these sites; for that reason, they must be regarded as *potential* restoration sites. Only those sites where feasibility studies have been done can be considered confirmed restoration opportunities at this time.

The 77 sites are exceedingly diverse. They occur along the main stem of the Woonasquatucket River, along its tributaries, and in isolated locations throughout the watershed (Fig. 2). They are found in urban, suburban, and rural settings. All towns in the watershed contain potential wetland restoration sites except for Glocester (Table 2). Smithfield, which comprises nearly one-half of the watershed's total area, contains 31 sites (40%). Johnston has 18, North Smithfield 15, and North Providence 7. Providence has the fewest sites overall (6), but the highest proportion of Tier 1 sites per town (67%); North Smithfield is second, with 40% of its sites in Tier 1. Eleven of the 77 sites are publicly owned and 66 are on private land (Table 2). The number of lots per fill site ranges from 1 to 58 (Tables 3-5; Appendix F). Three of the public sites and 39 of the private sites currently have RIDEM wetland enforcement flags. The area of individual wetland fill sites ranges from 0.10 to 21.84 acres; the average size is 1.49 acres (Tables 3-5).

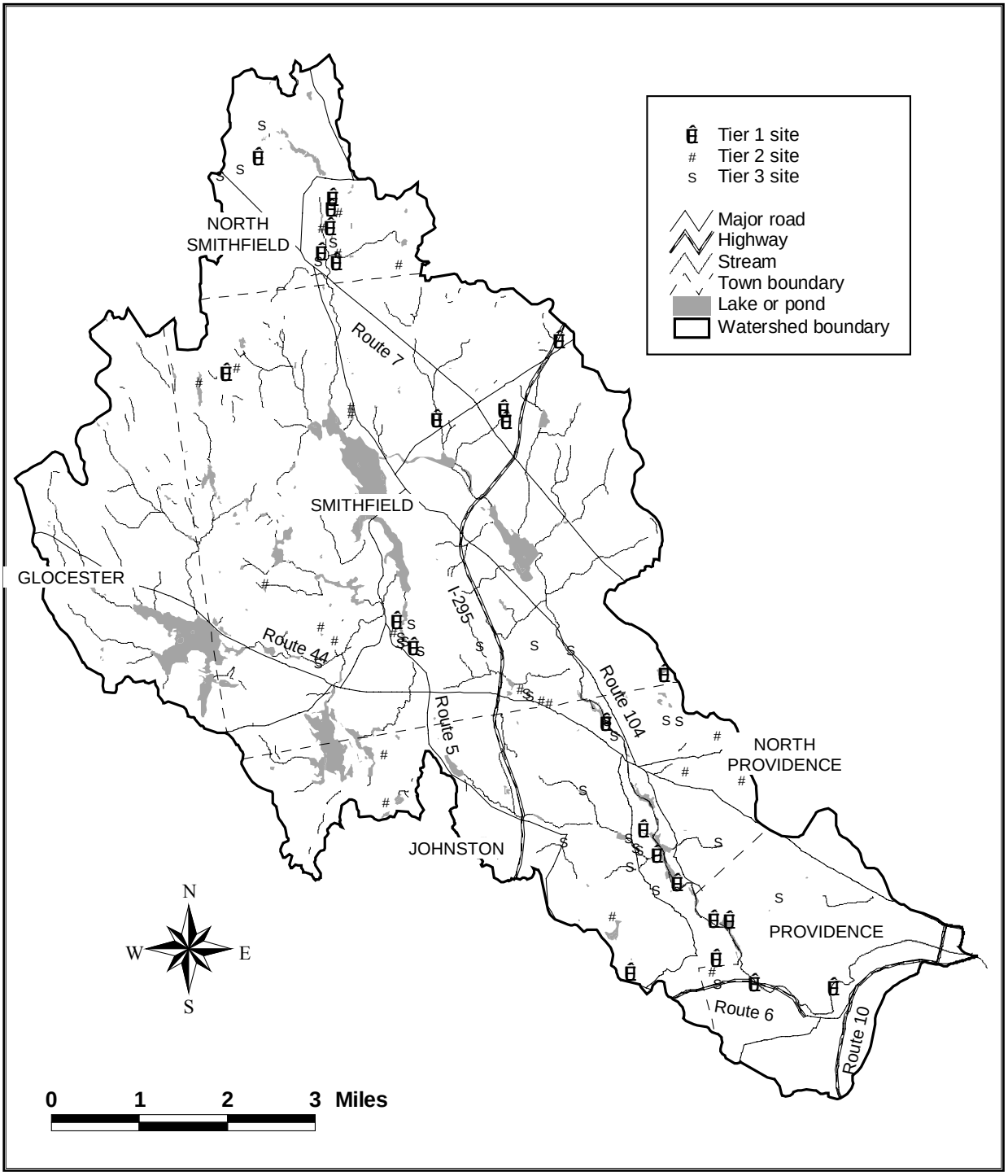

Figure 2. Distribution of potential wetland restoration sites in the Woonasquatucket River watershed.

Table 2. Priority level and ownership status of potential wetland restoration sites in the six towns comprising the Woonasquatucket River watershed.

Town	Priority*	Public enforce-ment†	Other public	Private enforce-ment†	Other private	Total
Glocester	Tier 1	0	0	0	0	0
	Tier 2	0	0	0	0	0
	Tier 3	0	0	0	0	0
	Subtotal	**0**	**0**	**0**	**0**	**0**
Johnston	Tier 1	0	0	2	3	5
	Tier 2	0	0	2	2	4
	Tier 3	0	2	3	4	9
	Subtotal	**0**	**2**	**7**	**9**	**18**
North Providence	Tier 1	0	0	0	1	1
	Tier 2	0	0	2	1	3
	Tier 3	2	1	0	0	3
	Subtotal	**2**	**1**	**2**	**2**	**7**
North Smithfield	Tier 1	0	0	3	3	6
	Tier 2	1	0	3	0	4
	Tier 3	0	0	4	1	5
	Subtotal	**1**	**0**	**10**	**4**	**15**
Providence	Tier 1	0	1	1	2	4
	Tier 2	0	0	0	0	0
	Tier 3	0	1	0	1	2
	Subtotal	**0**	**2**	**1**	**3**	**6**
Smithfield	Tier 1	0	1	6	1	8
	Tier 2	0	2	6	3	11
	Tier 3	0	0	7	5	12
	Subtotal	**0**	**3**	**19**	**9**	**31**
	Grand total	**3**	**8**	**39**	**27**	**77**

* See Tables 3-5.

† Indicates presence of a RIDEM wetland enforcement flag.

Table 3. Tier 1 potential wetland restoration sites.

Site ID	Town	Owner	No. lots	Area (acres)	Function performed[a]						Site status	Next step[b]
					FA	WQ	WH	FH	Her	Sum		
239	Smithfield	Private	4	21.84	x*	x*	x*	x*	x*	5*	Enforcement	B1
448	North Smithfield	Private	1	3.84	x*	x*	x*	x*	x*	5*	Not interested	B3
443	North Smithfield	Private	3	3.35	x*	x*	x*	x*	x*	5*	Enforcement	B1
278	North Smithfield	Private	4	3.03	x*	x*	x*	x*	x*	5*	Enforcement	B1
256	Providence	Private	1	4.73	x*	x*		x*	x*	4*	Needs permiss.	B3
425	Providence	Private	2	3.42	x*	x*		x*	x*	4*	Enforcement	B1
343	Smithfield	Private	3	3.04	x	x*	x*		x*	4*	Enforcement	B1
442	North Smithfield	Private	2	0.71	x	x	x*	x*	x	5*	Enforcement	B1
22	Johnston	Private	5	4.55	x*	x*			x*	3	Needs permiss.	B3
290	Smithfield	Private	1	4.09	x*	x*	x*			3	Enforcement	B1
449	North Providence	Private	1	2.91	x*	x*			x*	3	Needs permiss.	B3
272	North Smithfield	Private	1	1.59	x	x	x*	x	x	5*	Enforcement	B1
43	Smithfield	Public	2	2.08	x	x		x*	x	4*	Contaminated	NA
438	Smithfield	Private	2	0.73	x	x		x	x*	4*	Enforcement	B1
349	Johnston	Private	10	2.06	x*	x*			x	3	Enforcement	B1
258	Johnston	Private	15	4.92	x*	x*				2	Enforcement	B1
243	Smithfield	Private	1	3.13	x*	x*				2	Enforcement	B1
454	Providence	Private	1	2.07				x*	x*	2	Not interested	B3
237	Smithfield	Private	1	1.37	x	x	x	x	x	5*	Needs permiss.	B3
187	Smithfield	Private	2	1.26	x	x	x	x	x	5*	Enforcement	B1
455	Providence	Public	3	1.62	x	x		x	x	4*	Feasibility done	A1
53	Johnston	Private	3	1.91	x*	x			x	3	No phone info.	B2
214	Johnston	Private	2	0.54	x*	x			x	3	Owner unknown	B2
286	North Smithfield	Private	1	0.87		x	x*			2	Not interested	B3

a FA=Flood abatement, WQ=Water quality, WH=Wildlife habitat, FH=Fish habitat, Her=Heritage, and Sum=Total functions. An "x" indicates that a site has the potential to perform the given function (O-E-S score ≥ 0.6; see Appendix D).

b Refer to the Implementation section entitled "Steps to Wetland Restoration" for step descriptions.

***** Characteristic that qualified the site for inclusion in Tier 1; i.e., (1) final score within upper one-sixth of all sites for that function, or (2) area at least 0.5 acres and able to perform at least 4 functions.

Table 4. Tier 2 potential wetland restoration sites.

Site ID	Town	Owner	No. lots	Area (acres)	Function performed[a]						Site status	Next step[b]
					FA	WQ	WH	FH	Her	Sum		
236	Smithfield	Private	3	1.13	x*	x*			x*	3	Enforcement	B1
399	Johnston	Private	1	0.31	x	x	x*	x*	x	5	No phone info.	B2
248	Smithfield	Public	1	0.89	x*	x*			x	3	Feasibility done	A1
370	Smithfield	Public	1	0.51	x*	x			x*	3	Feasibility done	A1
427	Johnston/Prov	Private	58	4.75	x*	x*				2	Enforcement	B1
250	North Providence	Private	3	2.46	x*	x*				2	Enforcement	B1
193	Smithfield	Private	2	1.30	x*	x*				2	No phone info.	B2
67	Smithfield	Private	6	0.75	x*	x*				2	Enforcement	B1
5	Smithfield	Private	2	0.59	x*	x*				2	Enforcement	B1
445	North Smithfield	Private	2	0.37	x	x	x*	x	x	5	Enforcement	B1
447	North Smithfield	Private	2	0.32	x	x	x*	x	x	5	Enforcement	B1
340	North Smithfield	Public	1	0.27	x	x	x*		x	4	Enforcement	B1
230	Smithfield	Private	1	0.10		x	x*	x	x	4	Enforcement	B1
289	Smithfield	Private	2	1.59	x	x	x*			3	Enforcement	B1
423	North Providence	Private	1	1.08	x	x*			x	3	Owner unknown	B2
350	Johnston	Private	1	0.64	x	x*			x	3	Enforcement	B1
396	Johnston	Private	1	0.33		x		x*	x	3	Not interested	B3
406	Smithfield	Private	1	0.32			x*	x	x	3	Needs permiss.	B3
234	Smithfield	Private	2	0.69		x			x*	2	Needs permiss.	B3
47	North Providence	Private	7	0.60	x*	x				2	Enforcement	B1
34	Smithfield	Private	1	0.56		x			x*	2	Enforcement	B1
444	North Smithfield	Private	2	0.33			x	x*		2	Enforcement	B1

a FA=Flood abatement, WQ=Water quality, WH=Wildlife habitat, FH=Fish habitat, Her=Heritage, and Sum=Total functions. An "x" indicates that a site has the potential to perform the given function (O-E-S score ≥ 0.6; see Appendix D).

b Refer to the Implementation section entitled "Steps to Wetland Restoration" for step descriptions.

***** Characteristic that qualified the site for inclusion in Tier 2; i.e., final score ranked within upper one-third, but not upper one-sixth, of all sites for that function.

Table 5. Tier 3 potential wetland restoration sites.

Site ID	Town	Owner	No. lots	Area (acres)	Function performed[a]						Site status	Next step[b]
					FA	WQ	WH	FH	Her	Sum		
188	Smithfield	Private	2	0.43	x	x	x	x	x	5	Enforcement	B1
36	Smithfield	Private	1	0.34	x	x	x	x	x	5	Enforcement	B1
435	Smithfield	Private	1	0.32	x	x	x	x	x	5	No phone info.	B2
189	Smithfield	Private	2	0.26	x	x	x	x	x	5	Enforcement	B1
264	North Smithfield	Private	1	0.49		x	x	x	x	4	No phone info.	B2
24	Johnston	Private	2	0.43	x	x		x	x	4	Enforcement	B1
25	Johnston	Public	1	0.40	x	x		x	x	4	Needs field visit	B4
437	Smithfield	Private	1	0.35	x	x		x	x	4	Enforcement	B1
430	Providence	Public	1	1.83	x	x			x	3	Needs field visit	B4
452	North Providence	Private	1	0.25	x	x			x	3	Owner unknown	B2
287	North Smithfield	Private	2	0.25	x	x		x		3	Enforcement	B1
160	Smithfield	Private	1	0.19		x		x	x	3	No phone info.	B2
451	North Providence	Private	1	0.18	x	x			x	3	Owner unknown	B2
8	Smithfield	Private	1	0.13	x	x			x	3	Enforcement	B1
424	North Providence	Public	1	0.96		x			x	2	Needs field visit	B4
194	Smithfield	Private	1	0.49	x	x				2	No phone info.	B2
440	Smithfield	Private	1	0.45	x	x				2	Enforcement	B1
66	Johnston	Private	1	0.42	x	x				2	Needs permiss.	B3
446	North Smithfield	Private	1	0.41	x				x	2	Enforcement	B1
379	North Providence	Mix	2	0.35	x	x				2	Enforcement	B1
203	Johnston	Public	1	0.31	x	x				2	Needs field visit	B4
216	Johnston	Private	1	0.26	x	x				2	No phone info.	B2
274	North Smithfield	Private	1	0.23	x				x	2	Enforcement	B1
380	North Providence	Mix	3	0.23	x				x	2	Enforcement	B1
221	Johnston	Private	1	0.13	x	x				2	No phone info.	B2
55	Johnston	Private	1	0.11	x	x				2	Enforcement	B1
259	Providence	Private	7	1.88					x	1	No phone info.	B2
2	Smithfield	Private	2	1.37					x	1	Not interested	B3
50	Johnston	Private	1	0.56					x	1	Enforcement	B1
41	Smithfield	Private	1	0.52		x				1	Enforcement	B1
288	North Smithfield	Private	1	0.74						0	Enforcement	B1

a FA=Flood abatement, WQ=Water quality, WH=Wildlife habitat, FH=Fish habitat, Her=Heritage, and Sum=Total functions. An "x" indicates that a site has the potential to perform the given function (O-E-S score ≥ 0.6; see Appendix D).

b Refer to the Implementation section entitled "Steps to Wetland Restoration" for step descriptions.

Wetland Functions: Benefits to be Gained

Water quality improvement and flood abatement are two functions that 80% or more of the wetland fill sites could be expected to perform if they were restored (Fig. 3; Appendices G-1 and G-2). This is not surprising, given the high quantities of polluted runoff produced in an urbanized watershed such as the Woonasquatucket, and the fact that many potential restoration sites lie upstream from developed areas that are prone to flooding. A majority of sites (70%) also were judged to be capable of performing a heritage function, if restored (Fig. 3; Appendix G-5). In urban areas, the heritage function expresses itself primarily in the form of open space, education, or aesthetic value, whereas in rural areas such sites may also provide diverse recreational opportunities and contribute significantly to maintenance of plant and animal diversity. Forty percent of the potential wetland restoration sites were considered capable of providing fish habitat (Fig. 3; Appendix G-4), and only 31% were judged capable of providing significant wildlife habitat (Fig. 3; Appendix G-3). For both functions, the sites tend to be in rural parts of the watershed where wetlands and undeveloped uplands are relatively abundant and where water quality is good. Seventy-two of the 77 potential wetland restoration sites were estimated to be capable of performing at least two wetland functions, if restored, and more than 60% of the sites were judged capable of performing at least three functions (Fig. 4; Appendix G-6). These results suggest that substantial benefits can be expected from wetland restoration in this watershed.

Prioritization of Wetland Restoration Sites

Based on functional assessment scores, the number of functions that would be performed, and the area of the fill site, the 77 potential wetland restoration sites were divided into three tiers. A brief summary of the characteristics of sites in each tier follows.

Tier 1. There are 24 potential wetland restoration sites in Tier 1 (Table 3). As a group, these sites represent the "cream of the crop" in terms of the contribution that could be made to wetland functions in the watershed if restoration were accomplished. Tier 1 sites have the greatest potential to perform the functions assessed, and generally could perform

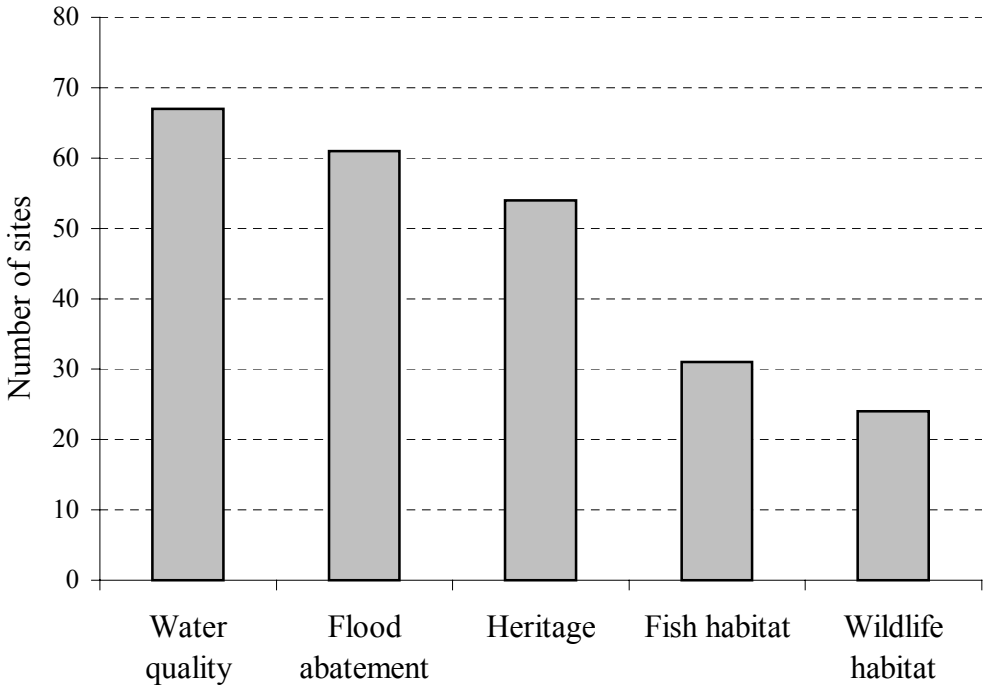

Figure 3. Number of potential wetland restoration sites likely to perform selected functions.

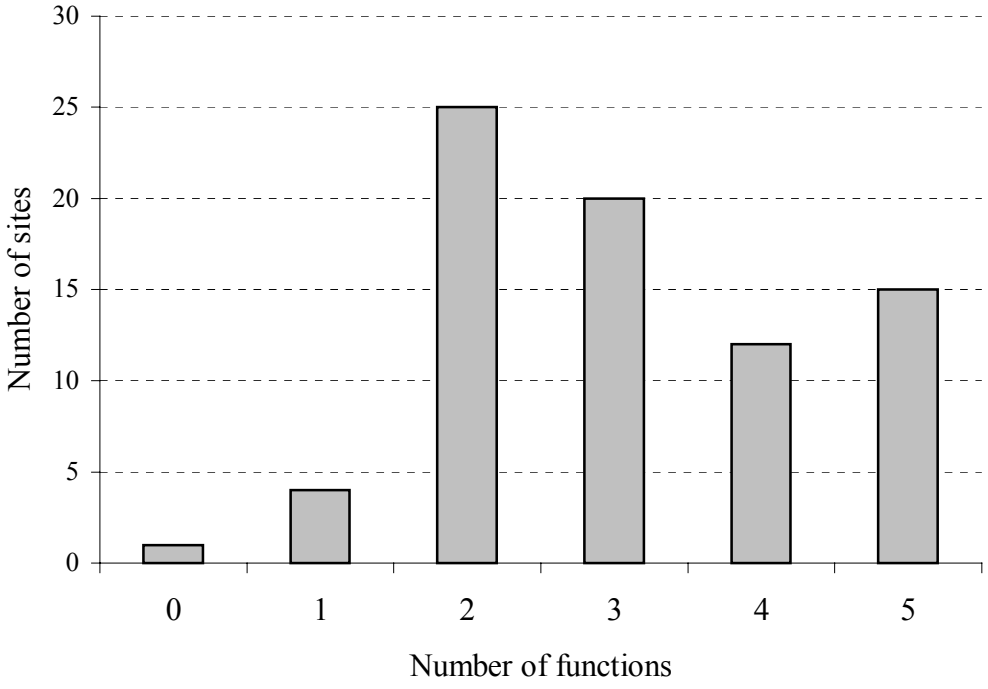

Figure 4. Number of potential wetland restoration sites likely to perform 0-5 functions.

the greatest number of functions. All Tier 1 fill sites are greater than 0.5 acres in size; excluding Site 239, which encompasses 21.84 acres, the average size is 2.51 acres. Ten of these sites scored within the top one-sixth of all sites for all five functions (Sites 239, 278, 443, 448); for four functions (Sites 256, 425); or for three functions (Sites 22, 290, 343, 449). Site 22 ranked first in the watershed for flood abatement, water quality improvement, and heritage functions (Appendices G-1, G-2, G-5). Tier 1 sites occur in urban, suburban, and rural areas of the watershed (Fig. 2). Nearly all are associated with the main stem of the Woonasquatucket River, its tributaries, or other large wetlands. Two-thirds of the Tier 1 sites have RIDEM enforcement flags.

Tier 2. There are 22 potential wetland restoration sites in Tier 2 (Table 4). Restoration of these sites would provide significant benefits to the watershed, but to a lesser degree than for the Tier 1 sites. Tier 2 fill sites range in size from 0.10 to 4.75 acres; the average size is 0.90 acres. Tier 2 sites scored within the upper one-third of all sites for one or more functions, but not within the upper one-sixth. Nine Tier 2 sites (5, 67, 193, 236, 248, 250, 370, 399, 427) are listed in the top one-third of all 77 sites for two or three functions, and four others (230, 340, 445, 447) are judged capable of performing 4 or 5 functions to some degree. Tier 2 sites generally are not directly associated with the main stem of the Woonasquatucket River (Fig. 2); they include medium to large sites in an isolated, urban setting, as well as small sites—often contiguous with other wetlands—in rural or suburban parts of the watershed. Fourteen of the 24 Tier 2 sites have RIDEM enforcement flags.

Tier 3. Tier 3 contains 31 potential restoration sites (Table 5). All but three sites are smaller than 1 acre, and nearly 80% are smaller than 0.50 acres; the average size is 0.49 acres. Eight of the sites (24, 25, 36, 188, 189, 264, 435, 437) have the ability to perform as many as 4 or 5 functions, if restored, but none of the scores fall within the upper one-third of the list for any function (Appendix G). With a few exceptions (most notably Sites 2, 259, 288, 430, and 424), restoration of a Tier 3 site probably would not, on its own, represent a significant contribution to wetland-related benefits at the watershed scale. However, restoration could enhance wetland functions locally, and the cumulative

benefits derived from restoration of multiple Tier 3 sites could well be significant. The great majority of Tier 3 sites occur in the urban, southern half of the watershed (Fig. 2). Most are surrounded by dry land or are contiguous with small wetlands; very few are associated with large streams. Roughly one-half of all Tier 3 sites have RIDEM enforcement flags.

Clusters of Wetland Restoration Sites

Potential wetland restoration sites are not evenly distributed across the watershed; some are relatively distant from other sites while others occur in groups or clusters (Fig. 2). Targeting such clusters is a logical step in restoration planning because it can maximize the benefits of restoration within specific areas of the watershed and, at the same time, reduce travel and construction costs among sites. Below are seven clusters of 4-10 sites each that may provide important foci for restoration planning and construction efforts.

- ***Lower Woonasquatucket Main Stem***
  - *Town(s):* Providence, North Providence, Johnston
  - *Sites and tiers*: Tier 1- 22, 53, 256, 425, 449, 454, 455
  - *General features*: Major cluster of 7 relatively large, Tier 1 sites bordering the channel of the lower Woonasquatucket River; includes several of the most significant sites in the watershed; highly urban.
  - *Total acreage of fill sites*: 21.21
- ***Woonasquatucket Headwaters***
  - *Town(s):* North Smithfield
  - *Sites and tiers:* Tier 1- 272, 278, 442, 443, 448; Tier 2- 444, 445, 447; Tier 3- 274, 446
  - *General features:* Very large, tight-knit cluster of 10 sites ranging widely in size, with several >3 acres; all tiers represented; 7 sites associated with gravel mine on east side of Woonasquatucket River; large acreage of high-value wetlands associated; rural setting.
  - *Total acreage of fill sites:* 14.18
- ***Mountaindale Reservoir***
  - *Town(s):* Smithfield
  - *Sites and tiers:* Tier 1- 187, 438; Tier 2- 34; Tier 3- 36, 188, 189, 435, 437
  - *General features:* Cluster of 8 small sites around southern half of Mountaindale Reservoir and associated wetlands; all tiers represented;

restoration would improve linkage between large forested wetland to south and Stillwater Reservoir to north; suburban setting.

- *Total acreage of fill sites:* 4.25

- ***Routes 295 and 44 East***
  - *Town(s):* Smithfield
  - *Sites and tiers:* Tier 2- 5, 67, 193; Tier 3- 160, 194
  - *General features:* Series of 5 small Tier 2 and Tier 3 sites just north of Route 44 and east of I-295; linear pattern follows historic tributary of Hawkins Brook; associated with wetlands to west, north, and east; suburban setting.
  - *Total acreage of fill sites:* 3.32
- ***East of Cat Hill***
  - *Town(s):* North Smithfield
  - *Sites and tiers:* Tier 1- 286; Tier 3- 264, 287, 288
  - *General features:* Group of 4 sites in western part of North Smithfield; 3 are fills for former railroad bed; 2 are associated with large forested wetland complex; rural setting.
  - *Total acreage of fill sites:* 2.35
- ***Greystone/Graniteville***
  - *Town(s):* North Providence, Johnston
  - *Sites and tiers:* Tier 1- 214; Tier 3- 50, 451, 452
  - *General features:* Group of 4 small sites flanking the Woonasquatucket River channel between the villages of Greystone and Graniteville; urban setting.
  - *Total acreage of fill sites:* 1.53
- ***East Johnston***
  - *Town(s):* Johnston
  - *Sites and tiers:* Tier 3- 24, 55, 66, 216, 221
  - *General features:* Cluster of 5 small Tier 3 sites north of Greenville Avenue and west of the Woonasquatucket River along Waterman Road; 4 sites associated with wetlands; urban setting.
  - *Total acreage of fill sites:* 1.35 acres

Potential Buffer Restoration Sites

Overview

More than 260 potential buffer restoration sites (i.e., upland vegetation removal sites) were identified through stereoscopic interpretation of the 1988 aerial photographs on

which the RIGIS wetlands were mapped, as well as inspection of 1997 digital orthophotography. After field-checks at most of the publicly owned sites and at several privately owned sites, the list was reduced to 239 potential opportunities, including 18 on public property and 221 on private property (Table 6). In more than 50% of the cases, site visits revealed errors in RIGIS wetland mapping, changes in adjacent land use or buffer conditions since the photographs had been taken, or other reasons why the site was not a viable restoration opportunity. Of the 239 sites that remain, restoration opportunities have been confirmed only at the 10 where feasibility analyses have been conducted. Until visits are made to the other 229 sites, they can only be considered *potential* buffer restoration opportunities.

Buffer restoration opportunities can be found in all areas of the Woonasquatucket watershed (Fig. 5). Half (121) of the sites are in Smithfield; Johnston (48) and Glocester (39) have intermediate numbers; and the fewest sites are in North Smithfield (13), Providence (9), and North Providence (9) (Table 6). The number of lots per buffer restoration site ranges from 1 to 10 (Appendix H). Plat and lot information was gathered and landowners were identified for nearly all Tier 1 sites (Table 7) and the majority of Tier 2 sites (Table 8); this information still needs to be obtained for nearly all of the Tier 3 sites (Table 9). None of the potential buffer restoration sites were specifically checked against the RIDEM Office of Compliance and Inspection's database to identify sites with enforcement flags. However, in a few cases, OCI status is known because the upland vegetation removal site is located on the same lot where wetland filling occurred, and the OCI status of the fill site was checked.

Adjacent Land Use and Wetland Sensitivity at Buffer Restoration Sites

High-impact land use occurred at nearly 40% of the potential buffer restoration sites (Table 10). Land use impact was interpreted to be high at all Tier 1 sites (by definition) and at nearly 50% of the Tier 2 sites. Crop production (21%), commercial development (19%), gravel mining (16%), and industrial development (14%) were the most frequent high-impact land uses encountered (Table 10). Land use impact was determined to be

Table 6. Priority level and ownership status of potential buffer restoration sites in the six towns comprising the Woonasquatucket River watershed.

Town	Priority*	Public	Private	Total
Glocester	Tier 1	0	2	2
	Tier 2	3	18	21
	Tier 3	0	16	16
	Subtotal	**3**	**36**	**39**
Johnston	Tier 1	0	12	12
	Tier 2	0	17	17
	Tier 3	3	16	19
	Subtotal	**3**	**45**	**48**
North Providence	Tier 1	0	4	4
	Tier 2	0	1	1
	Tier 3	0	4	4
	Subtotal	**0**	**9**	**9**
North Smithfield	Tier 1	0	5	5
	Tier 2	0	5	5
	Tier 3	0	3	3
	Subtotal	**0**	**13**	**13**
Providence	Tier 1	0	3	3
	Tier 2	1	2	3
	Tier 3	2	1	3
	Subtotal	**3**	**6**	**9**
Smithfield	Tier 1	0	16	16
	Tier 2	7	47	54
	Tier 3	2	49	51
	Subtotal	**9**	**112**	**121**
	Grand total	**18**	**221**	**239**

* Tier 1: vulnerable to human impact *and* adjacent to a highly sensitive wetland type; Tier 2: vulnerable to human impact *or* adjacent to a highly sensitive wetland type; Tier 3: not vulnerable to human impact *and* not adjacent to a highly sensitive wetland type.

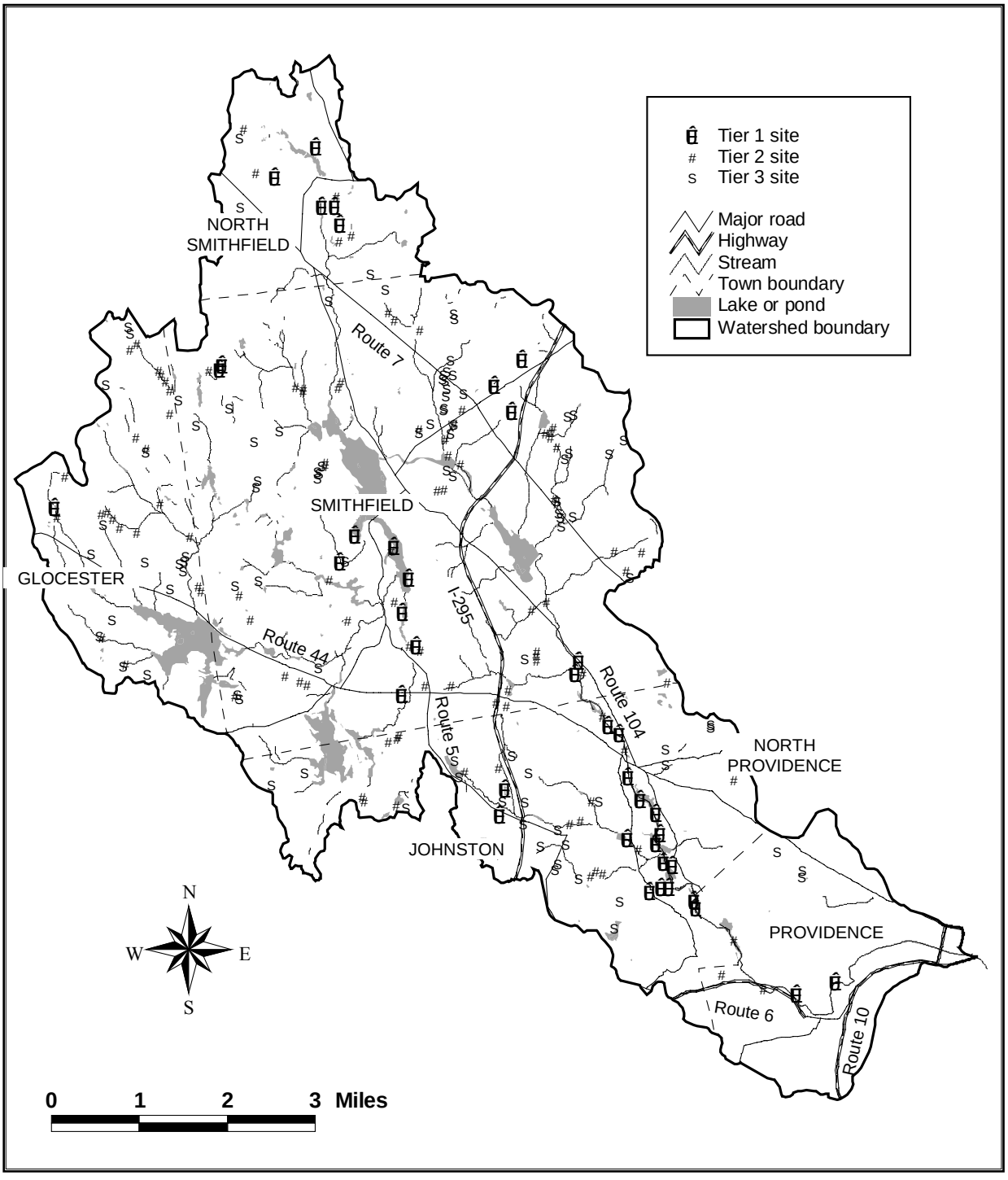

Figure 5. Distribution of potential buffer restoration sites in the Woonasquatucket River watershed.

Table 7. Tier 1 potential buffer restoration sites.

Site ID	Town	Owner	Length (ft)	Site status	Next step*
80	Johnston	Private	> 800	Needs OCI check	D2
131	Johnston	Private	> 800	Needs OCI check	D2
132	Johnston	Private	> 800	Needs OCI check	D2
134	Johnston	Private	> 800	Needs OCI check	D2
170	Smithfield	Private	> 800	Needs OCI check	D2
546	North Smithfield	Private	> 800	Enforcement	D3
549	North Smithfield	Private	> 800	Needs OCI check	D2
575	Smithfield	Private	> 800	Needs OCI check	D2
641	Providence	Private	> 800	Needs OCI check	D2
643	Providence	Private	> 800	Needs OCI check	D2
85	Johnston	Private	400-800	Needs OCI check	D2
87	North Providence	Private	400-800	Needs OCI check	D2
88	North Providence	Private	400-800	Needs OCI check	D2
169	Smithfield	Private	400-800	Needs OCI check	D2
174	Smithfield	Private	400-800	Needs OCI check	D2
191	Smithfield	Private	400-800	Needs OCI check	D2
227	Johnston	Private	400-800	Enforcement	D3
545	North Smithfield	Private	400-800	Needs OCI check	D2
547	North Smithfield	Private	400-800	Enforcement	D3
570	Smithfield	Private	400-800	Needs OCI check	D2
611	Smithfield	Private	400-800	Needs OCI check	D2
692	Johnston	Private	400-800	Needs OCI check	D2
693	Johnston	Private	400-800	Needs OCI check	D2
79	Johnston	Private	< 400	Needs OCI check	D2
82	North Providence	Private	< 400	Needs OCI check	D2
83	Johnston	Private	< 400	Needs OCI check	D2
96	Johnston	Private	< 400	Needs OCI check	D2
97	Johnston	Private	< 400	Needs OCI check	D2
135	North Providence	Private	< 400	Needs OCI check	D2
177	Smithfield	Private	< 400	Enforcement	D3
180	Smithfield	Private	< 400	Needs OCI check	D2
374	Smithfield	Private	< 400	Enforcement	D3
505	Smithfield	Private	< 400	Needs OCI check	D2
506	Smithfield	Private	< 400	Needs OCI check	D2
544	North Smithfield	Private	< 400	Needs plat/lot	D1
573	Smithfield	Private	< 400	Needs plat/lot	D1
581	Smithfield	Private	< 400	Needs plat/lot	D1
635	Providence	Private	< 400	Needs OCI check	D2
680	Smithfield	Private	< 400	Needs OCI check	D2
681	Glocester	Private	< 400	Needs OCI check	D2

* Refer to the Implementation section entitled “Steps to Buffer Restoration” for step descriptions.

Table 8. Tier 2 potential buffer restoration sites.

Site ID	Town	Owner	Length (ft)	Site status	Next step*
101	Johnston	Private	> 800	Needs plat/lot	D1
507	Smithfield	Private	> 800	Needs OCI check	D2
514	Glocester	Private	> 800	Needs plat/lot	D1
534	Glocester	Private	> 800	Needs plat/lot	D1
550	North Smithfield	Private	> 800	Enforcement	D3
557	Smithfield	Private	> 800	Needs plat/lot	D1
560	Smithfield	Private	> 800	Needs permiss.	D4
564	Smithfield	Private	> 800	Needs plat/lot	D1
571	Smithfield	Private	> 800	Needs OCI check	D2
579	Smithfield	Private	> 800	Needs plat/lot	D1
589	Smithfield	Private	> 800	Needs plat/lot	D1
596	Smithfield	Private	> 800	Needs plat/lot	D1
625	Smithfield	Private	> 800	Needs plat/lot	D1
636	Providence	Private	> 800	Needs OCI check	D2
650	Glocester	Private	> 800	Needs plat/lot	D1
682	Glocester	Private	> 800	Needs OCI check	D2
691	Smithfield	Private	> 800	Needs OCI check	D2
99	Johnston	Private	400-800	Needs plat/lot	D1
100	Johnston	Private	400-800	Needs plat/lot	D1
138	Johnston	Private	400-800	Needs OCI check	D2
139	Johnston	Private	400-800	Enforcement	D3
153	Johnston	Private	400-800	Needs plat/lot	D1
164	Smithfield	Private	400-800	Needs OCI check	D2
165	Smithfield	Private	400-800	Needs OCI check	D2
166	Smithfield	Private	400-800	Needs OCI check	D2
167	Smithfield	Private	400-800	Needs OCI check	D2
168	Smithfield	Public	400-800	Feasibility done	C3
173	Smithfield	Public	400-800	Feasibility done	C3
176	Smithfield	Private	400-800	Needs OCI check	D2
179	Smithfield	Private	400-800	Needs OCI check	D2
186	Johnston	Private	400-800	No phone info.	D4
503	North Smithfield	Private	400-800	Enforcement	D3
511	Glocester	Public	400-800	Feasibility done	C1
522	Glocester	Private	400-800	Needs OCI check	D2
523	Glocester	Private	400-800	Needs OCI check	D2
527	Glocester	Private	400-800	Needs plat/lot	D1
535	Glocester	Private	400-800	Needs OCI check	D2
548	North Smithfield	Private	400-800	Needs plat/lot	D1
552	North Smithfield	Private	400-800	Enforcement	D3
559	Smithfield	Private	400-800	Needs OCI check	D2
561	Smithfield	Private	400-800	Needs OCI check	D2

(Continued)

Table 8. (Continued).

Site ID	Town	Owner	Length (ft)	Site status	Next step*
585	Smithfield	Private	400-800	Needs plat/lot	D1
586	Smithfield	Private	400-800	Needs plat/lot	D1
592	Johnston	Private	400-800	Needs OCI check	D2
599	Smithfield	Private	400-800	Needs plat/lot	D1
601	Smithfield	Private	400-800	Needs plat/lot	D1
615	Smithfield	Private	400-800	Needs OCI check	D2
628	Smithfield	Private	400-800	Needs plat/lot	D1
639	Providence	Private	400-800	Needs OCI check	D2
640	Providence	Public	400-800	Feasibility done	C3
657	Smithfield	Private	400-800	Needs OCI check	D2
662	Smithfield	Private	400-800	Needs OCI check	D2
674	Smithfield	Private	400-800	Needs plat/lot	D1
683	Smithfield	Private	400-800	Needs plat/lot	D1
685	Smithfield	Private	400-800	Needs plat/lot	D1
694	Smithfield	Private	400-800	Needs OCI check	D2
72	Smithfield	Public	< 400	Needs field visit	D5
133	Johnston	Private	< 400	Needs OCI check	D2
136	Johnston	Private	< 400	Needs OCI check	D2
137	Johnston	Private	< 400	No phone info.	D4
145	Johnston	Private	< 400	Needs OCI check	D2
151	Johnston	Private	< 400	Needs OCI check	D2
155	Smithfield	Private	< 400	Needs plat/lot	D1
156	Smithfield	Private	< 400	Not interested	D4
157	Smithfield	Private	< 400	Needs plat/lot	D1
158	Smithfield	Private	< 400	Not interested	D4
171	Smithfield	Public	< 400	Feasibility done	C1
172	Smithfield	Public	< 400	Feasibility done	C1
178	Smithfield	Private	< 400	Enforcement	D3
182	Johnston	Private	< 400	Needs OCI check	D2
183	Johnston	Private	< 400	Needs OCI check	D2
184	Johnston	Private	< 400	Needs OCI check	D2
501	North Smithfield	Private	< 400	Needs OCI check	D2
512	Glocester	Public	< 400	Feasibility done	C1
513	Glocester	Public	< 400	Feasibility done	C1
518	Glocester	Private	< 400	Needs OCI check	D2
524	Glocester	Private	< 400	Needs plat/lot	D1
525	Glocester	Private	< 400	Needs OCI check	D2
526	Glocester	Private	< 400	Needs plat/lot	D1
528	Glocester	Private	< 400	Needs plat/lot	D1
529	Glocester	Private	< 400	Needs plat/lot	D1
531	Glocester	Private	< 400	Needs plat/lot	D1

(Continued)

Table 8. (Concluded).

Site ID	Town	Owner	Length (ft.)	Site status	Next step*
537	Glocester	Private	< 400	Needs plat/lot	D1
542	Glocester	Private	< 400	Needs plat/lot	D1
558	Smithfield	Private	< 400	Needs OCI check	D2
574	Smithfield	Private	< 400	Needs plat/lot	D1
587	Smithfield	Private	< 400	Needs plat/lot	D1
593	Johnston	Private	< 400	Needs OCI check	D2
600	Smithfield	Private	< 400	Needs plat/lot	D1
602	Smithfield	Private	< 400	Needs plat/lot	D1
613	Smithfield	Private	< 400	Needs plat/lot	D1
622	Smithfield	Private	< 400	Needs plat/lot	D1
624	Smithfield	Private	< 400	Needs plat/lot	D1
626	Smithfield	Private	< 400	Needs plat/lot	D1
646	Glocester	Private	< 400	Needs OCI check	D2
647	Glocester	Private	< 400	Needs OCI check	D2
670	Smithfield	Private	< 400	Needs OCI check	D2
671	Smithfield	Private	< 400	Needs OCI check	D2
677	Smithfield	Private	< 400	Needs plat/lot	D1
679	North Providence	Private	< 400	Needs OCI check	D2
686	Smithfield	Private	< 400	Needs OCI check	D2
690	Smithfield	Public	< 400	Feasibility done	C3
695	Smithfield	Public	< 400	Feasibility done	C3

* Refer to the Implementation section entitled “Steps to Buffer Restoration” for step descriptions.

Table 9. Tier 3 potential buffer restoration sites.

Site ID	Town	Owner	Length (ft)	Site status	Next step*
146	Johnston	Private	> 800	Needs plat/lot	D1
147	Johnston	Private	> 800	Needs plat/lot	D1
149	Johnston	Private	> 800	Needs plat/lot	D1
152	Johnston	Private	> 800	Needs plat/lot	D1
510	Smithfield	Private	> 800	Needs plat/lot	D1
515	Glocester	Private	> 800	Needs plat/lot	D1
533	Glocester	Private	> 800	Needs plat/lot	D1
555	Smithfield	Private	> 800	Needs plat/lot	D1
595	Smithfield	Private	> 800	Needs plat/lot	D1
603	Smithfield	Public	> 800	Needs plat/lot	D1
604	Smithfield	Private	> 800	Needs plat/lot	D1
607	Smithfield	Private	> 800	Needs plat/lot	D1
654	Glocester	Private	> 800	Needs plat/lot	D1
141	Johnston	Private	400-800	Needs plat/lot	D1
144	Johnston	Private	400-800	Needs plat/lot	D1
148	Johnston	Private	400-800	Needs plat/lot	D1
150	Johnston	Private	400-800	Needs plat/lot	D1
530	Glocester	Private	400-800	Needs plat/lot	D1
532	Glocester	Private	400-800	Needs plat/lot	D1
556	Smithfield	Private	400-800	Needs plat/lot	D1
580	Smithfield	Private	400-800	Needs permiss.	D4
582	Smithfield	Private	400-800	Needs plat/lot	D1
591	Johnston	Private	400-800	Needs plat/lot	D1
594	Johnston	Private	400-800	Needs plat/lot	D1
597	Smithfield	Private	400-800	Needs plat/lot	D1
606	Smithfield	Private	400-800	Needs plat/lot	D1
608	Smithfield	Private	400-800	Needs plat/lot	D1
609	Smithfield	Private	400-800	Needs plat/lot	D1
614	Smithfield	Private	400-800	Needs plat/lot	D1
618	Smithfield	Private	400-800	Needs plat/lot	D1
621	Smithfield	Private	400-800	Needs plat/lot	D1
629	Smithfield	Private	400-800	Needs plat/lot	D1
632	Providence	Public	400-800	Needs plat/lot	D1
633	Providence	Private	400-800	Needs plat/lot	D1
644	Johnston	Private	400-800	Enforcement	D3
655	Glocester	Private	400-800	Needs plat/lot	D1
659	Smithfield	Private	400-800	Needs plat/lot	D1
665	Smithfield	Private	400-800	Needs plat/lot	D1
676	Smithfield	Public	400-800	Needs plat/lot	D1
678	Smithfield	Private	400-800	Needs plat/lot	D1

(Continued)

Table 9. (Continued).

Site ID	Town	Owner	Length (ft)	Site status	Next step*
77	North Providence	Private	< 400	Needs plat/lot	D1
78	North Providence	Private	< 400	Needs plat/lot	D1
91	Johnston	Private	< 400	Needs plat/lot	D1
92	Johnston	Private	< 400	Needs plat/lot	D1
95	Johnston	Private	< 400	Needs plat/lot	D1
98	Johnston	Public	< 400	Enforcement	D3
140	Johnston	Private	< 400	Needs OCI check	D2
142	Johnston	Private	< 400	Needs OCI check	D2
143	Johnston	Public	< 400	Needs plat/lot	D1
159	Smithfield	Private	< 400	Needs plat/lot	D1
185	Johnston	Public	< 400	Needs plat/lot	D1
500	North Smithfield	Private	< 400	Needs plat/lot	D1
504	North Smithfield	Private	< 400	Needs plat/lot	D1
516	Glocester	Private	< 400	Needs plat/lot	D1
517	Smithfield	Private	< 400	Needs plat/lot	D1
536	Glocester	Private	< 400	Needs plat/lot	D1
541	Glocester	Private	< 400	Needs plat/lot	D1
543	Glocester	Private	< 400	Needs plat/lot	D1
551	North Smithfield	Private	< 400	Needs plat/lot	D1
565	Smithfield	Private	< 400	Needs plat/lot	D1
566	Smithfield	Private	< 400	Needs plat/lot	D1
567	Smithfield	Private	< 400	Needs plat/lot	D1
568	Smithfield	Private	< 400	Needs plat/lot	D1
569	Smithfield	Private	< 400	Needs plat/lot	D1
578	Smithfield	Private	< 400	Needs plat/lot	D1
588	Smithfield	Private	< 400	Needs plat/lot	D1
590	Smithfield	Private	< 400	Needs plat/lot	D1
605	Smithfield	Private	< 400	Needs plat/lot	D1
610	Smithfield	Private	< 400	Needs plat/lot	D1
612	Smithfield	Private	< 400	Needs plat/lot	D1
619	Smithfield	Private	< 400	Needs plat/lot	D1
620	Smithfield	Private	< 400	Needs plat/lot	D1
623	Smithfield	Private	< 400	Needs plat/lot	D1
627	Smithfield	Private	< 400	Needs plat/lot	D1
630	North Providence	Private	< 400	Needs OCI check	D2
631	North Providence	Private	< 400	Needs OCI check	D2
634	Providence	Public	< 400	Needs OCI check	D2
645	Glocester	Private	< 400	Needs plat/lot	D1
648	Glocester	Private	< 400	Needs plat/lot	D1
651	Glocester	Private	< 400	Needs plat/lot	D1
652	Glocester	Private	< 400	Needs plat/lot	D1

(Continued)

Table 9. (Concluded).

Site ID	Town	Owner	Length (ft)	Site status	Next step*
653	Glocester	Private	< 400	Needs plat/lot	D1
656	Glocester	Private	< 400	Needs plat/lot	D1
658	Smithfield	Private	< 400	Needs plat/lot	D1
660	Smithfield	Private	< 400	Needs plat/lot	D1
661	Smithfield	Private	< 400	Needs plat/lot	D1
666	Smithfield	Private	< 400	Needs plat/lot	D1
667	Smithfield	Private	< 400	Needs plat/lot	D1
668	Smithfield	Private	< 400	Needs plat/lot	D1
669	Smithfield	Private	< 400	Needs plat/lot	D1
672	Smithfield	Private	< 400	Needs plat/lot	D1
673	Smithfield	Private	< 400	Needs plat/lot	D1
684	Smithfield	Private	< 400	Needs OCI check	D2
687	Smithfield	Private	< 400	Needs plat/lot	D1
688	Smithfield	Private	< 400	Needs plat/lot	D1
689	Smithfield	Private	< 400	Needs plat/lot	D1

* Refer to the Implementation section entitled “Steps to Buffer Restoration” for step descriptions.

Table 10. Adjacent land use at potential buffer restoration sites by priority level.

Land use type*	Tier 1	Tier 2	Tier 3	Total
High-impact land use				
Cropland	3	16	NA	19
Commercial	8	9	NA	17
Mine or gravel pit	11	3	NA	14
Industrial	9	3	NA	12
Pasture	0	9	NA	9
Barren area	3	4	NA	7
Residential (≤0.25-acre lots)	4	2	NA	6
Junkyard	2	3	NA	5
Subtotal	**40**	**49**	**NA**	**89**
Low-impact land use				
Hayfield	NA	12	28	40
Vacant land	NA	14	23	37
Residential (>0.25-acre lots)	NA	13	16	29
Abandoned agriculture	NA	3	13	16
Orchard or nursery	NA	8	8	16
Powerline corridor	NA	1	6	7
Developed recreation	NA	3	2	5
Subtotal	**NA**	**54**	**96**	**150**
Grand total	**40**	**103**	**96**	**239**

* Based on 1995 data from RIGIS, with updates by E. Pepper, RIDEM Division of Agriculture.

low at all Tier 3 sites (by definition) and at one-half of the Tier 2 sites. The most common low-impact land uses encountered were hay farming (27%), vacant land (25%), and medium- to large-lot residential development (19%).

Wetland types that are highly sensitive to human impacts occurred at almost 40% of the sites overall (Table 11). Highly sensitive wetland types occurred at all of the Tier 1 sites (by definition) and at one-half of the Tier 2 sites. Sensitive wetland types that occurred most often were marshes or wet meadows (24%), small streams (21%), ponds (18%), and rivers (17%). Forested (non-cedar) swamps (77%) and shrub swamps (23%) comprised the less sensitive wetland types that occurred at all of the Tier 3 sites (by definition) and at nearly one-half of the Tier 2 sites. Appendix I provides information on adjacent land use and wetland types for each of the 239 potential buffer restoration sites.

Prioritization of Buffer Restoration Sites

The 239 potential buffer restoration sites were divided into three tiers based on the intensity of adjacent upland land use and the sensitivity of the wetland type to land use impacts such as water quality degradation or disturbance of breeding or migratory waterbirds. Below is a synopsis of the characteristics of sites from each tier.

Tier 1. Forty potential buffer restoration sites, or 17% of the total, fall within Tier 1 by virtue of their having both highly sensitive wetland types and high-impact upland land use types (Table 7). Tier 1 sites typically occur in highly urbanized areas of the watershed (Fig. 5) and other highly disturbed areas (e.g., gravel mines or construction sites) that border directly on open water bodies or marshes. Creation or expansion of forested or shrub buffers at Tier 1 sites is critically important to enhancing water quality and other wetland functions and values at the watershed scale. Tier 1 opportunities are almost equally divided among the three length categories: >800 ft, 400-800 ft, and <400 ft (Table 7). The great majority of Tier 1 sites are in Smithfield (40%) and Johnston (30%) (Table 6). All Tier 1 sites are privately owned.

Table 11. Wetland sensitivity at potential buffer restoration sites by priority level.

Wetland type*	Tier 1	Tier 2	Tier 3	Total
High sensitivity				
Marsh or wet meadow	4	19	NA	23
Stream**	10	10	NA	20
Pond	6	11	NA	17
River†	11	5	NA	16
Cedar swamp	5	4	NA	9
Shrub bog or fen	3	2	NA	5
Lake	1	2	NA	3
Emergent bog or fen	0	1	NA	1
Subtotal	**40**	**54**	**NA**	**94**
Lower sensitivity				
Other forested swamp	NA	41	71	112
Shrub swamp	NA	8	25	33
Subtotal	**NA**	**49**	**96**	**145**
Grand total	**40**	**103**	**96**	**239**

* Based on 1988 data from RIGIS.
** Mapped as a line in RIGIS.
† Mapped as a polygon in RIGIS.

Tier 2. There are 103 potential buffer restoration sites in Tier 2 (Table 8). Restoration of these sites also should be a major goal of wetland management at the watershed scale. Tier 2 sites are characterized by either: (1) high-impact land use and less sensitive wetland types or (2) low-impact land use and highly sensitive wetland types. Several different sets of circumstances can give rise to these conditions; as a result, Tier 2 sites are diverse and are found throughout the watershed (Fig. 5). Tier 2 sites located in commercial, industrial, or high-density residential areas generally occur where these high-impact land uses border forested (non-cedar) swamp or shrub swamp. In agricultural landscapes, Tier 2 opportunities occur where cultivated fields (high-impact land use) border non-cedar swamps or, more commonly, where hayfields (low-impact land use) border ponds, marshes, or streams. Glocester and Smithfield have many of these kinds of restoration opportunities. Tier 2 sites also can be found in rural areas where low-density residential development or other low-impact land uses border directly on cedar swamps, bogs, or open water bodies. Nearly one-half of all Tier 2 opportunities are less than 400 feet in length; only 17% are more than 800 feet long (Table 8). Eleven of the 103 sites in Tier 2 are publicly owned.

Tier 3. Ninety-six Tier 3 potential buffer restoration opportunities were identified (Table 9). At these sites, significant shrub or forest vegetation is lacking at the wetland edge; however, adjacent upland land use is considered to be low-impact and associated wetland types are forested (non-cedar) swamps or shrub swamps, which are generally less sensitive to impacts than other wetland types (Table 11). For these reasons, restoration of buffers at Tier 3 sites can be expected to enhance wetland functions and values at the watershed scale less than restoration of buffers at Tier 1 and Tier 2 sites. Tier 3 sites are broadly distributed, but tend to be most common in suburban and rural areas of the watershed (Fig. 5); they never directly border lakes, ponds, or stream channels. Seven of the 96 Tier 3 sites are publicly owned (Table 9).

Clusters of Tier 1 and Tier 2 Buffer Restoration Sites

Upland vegetation removal sites are more numerous and more widely dispersed throughout the watershed than wetland fill sites, but there are some obvious

concentrations. Several clusters occur in association with clusters of fill sites identified above. Examples include:

- ***Lower Woonasquatucket Main Stem***
  - *Town(s)*: Providence, North Providence, Johnston
  - *Sites and tiers*: Tier 1- 79, 80, 82, 83, 85, 87, 88, 96, 635, 641, 643; Tier 2- 137, 636, 639, 640
  - *General features*: Includes more than one-quarter of all Tier 1 buffer restoration sites in watershed; sites border river channel or are close by; adjacent uplands highly developed or disturbed.
- ***Woonasquatucket Headwaters***
  - *Town(s)*: North Smithfield
  - *Sites and tiers*: Tier 1- 546, 547, 549; Tier 2- 548, 550, 552
  - *General features*: Cluster of 6 upland vegetation removal sites associated with 10 fill sites; impacts related primarily to gravel mining; cedar swamp and bog or fen at two sites.
- ***Mountaindale Reservoir***
  - *Town(s)*: Smithfield
  - *Sites and tiers*: Tier 1- 174, 177; Tier 2- 173, 176, 178
  - *General features*: Five upland vegetation removal sites associated with 8 fill sites; major land disturbance along open water or contiguous wetlands; land uses are mining and commercial.

Integrating restoration of buffer zones with restoration of filled wetlands at these locations would be an effective approach to replacing lost wetland functions and values in those areas of the watershed.

Clusters of Tier 1 and Tier 2 buffer restoration sites also occur more or less independently of fill sites. A few examples are:

- ***Allendale Pond to Georgiaville Pond***
  - *Town(s)*: Johnston, North Providence, Smithfield
  - *Sites and tiers*: Tier 1- 131, 132, 134, 135, 169, 170; Tier 2- 133, 136, 168, 171, 172
  - *General features*: Major string of 11 potential buffer restoration sites along the Woonasquatucket River channel; diversity of land uses, including mining, industrial, residential, commercial, and recreation; urban to suburban setting.

- ***Stillwater Pond***
  - *Town(s)*: Smithfield
  - *Sites and tiers*: Tier 2- 613, 615, 670, 671, 674, 677, 691, 694
  - *General features*: Loose cluster of 8 potential buffer restoration sites in a mostly rural setting within 1/2 mile of the pond; residential, commercial, agricultural, and abandoned land bordering a variety of wetland types.
- ***Harris Pond***
  - *Town(s)*: Smithfield
  - *Sites and tiers*: Tier 2- 596, 599, 600, 601, 602
  - *General features*: Five sites southeast of the pond and I-295; cropland, pasture, and abandoned fields bordering forested swamps and marshes; rural setting.

Glocester contains 22 Tier 2 sites and 1 Tier 1 site; nearly all of them are associated with agricultural land. Included are a few small clusters of up to five sites which are often centered around individual farms.

Wetland Restoration Feasibility Profiles

Wetland restoration feasibility analyses were conducted at three sites, including two Tier 2 sites (248, 370) and one Tier 1 site (455); all are publicly owned. Site diagrams and detailed feasibility profiles for these sites can be found at the end of the Results section.

Site 248, located in the southern part of Deerfield Park in Smithfield (Fig. 6) is the most straightforward of the three wetland restoration opportunities. The wetland was filled as a result of grading associated with a former gravel mining operation. Deerfield Park now occupies the bulk of the area that was mined; residential development has occurred on upland and on filled wetland immediately south of Site 248. Slightly more than 1 acre in size, the fill site is now forested. Fill depths average about 3.5 feet. Once restored, this site and its history, both ecological and cultural, could have high educational and aesthetic value for visitors to Deerfield Park. The major constraint is the need to provide a buffer between the restored wetland and residential yards to the south. Some fill may have to be left in place to achieve this.

The second wetland feasibility site, Site 370, is located at the western edge of Deerfield Park (Fig. 7). Currently forested, this fill site occupies the eastern half of a former pond; the western half is now residential property. The fill deposit is long and narrow and is bordered on the east by bare sand, a remnant of the former gravel pit. Wetland restoration at this site would require removal of the forest and fill, and creation of an upland buffer on the eastern side, where no vegetation and no loam or topsoil currently exist. The upland forest that occupies the fill site serves as an effective buffer between the former gravel pit and the residential property to the west. The benefits of this forest must be carefully weighed against its removal to restore a narrow, 0.5-acre wetland at this location. Consequently, this should be viewed as a marginal restoration opportunity.

Site 455 is located directly adjacent to the Woonasquatucket River at the western end of the Lincoln Lace brownfield site (Fig. 8). Formerly a mill pond, this site later became a landfill. Since abandonment of the landfill, it has become forested. At 1.62 acres, Site 455 represents a significant wetland restoration opportunity, particularly in light of its urban setting. Given its size and depth of fill (10 ft, on average), this would be the most expensive of the three fill sites to restore. The possible presence of contaminants is the major restoration constraint.

Buffer Restoration Feasibility Profiles

Buffer restoration feasibility analyses were carried out at 10 Tier 2 upland vegetation removal sites. Six of the sites (168, 171, 172, 173, 690, 695) are in Smithfield, three (511, 512, 513) are in Glocester, and one (640) is in Providence. All of the Smithfield sites are owned by the Town. The Providence site is jointly owned by the City and a realty company. The Glocester sites are part of the Newman Preserve, which is owned by the Audubon Society of Rhode Island, and subject to a life estate. Site diagrams and feasibility profiles for these sites can be found at the end of the Results section.

Site 168 is located just north of the Smithfield Sewage Treatment Plant (Fig. 9). It consists of two parts: a north-south leg on the west side of the Woonasquatucket River

just south of Esmond Mill Drive, and an east-west leg that borders the northern edge of a small tributary stream that enters the Woonasquatucket from the west. Together, the two legs total more than 600 feet in length. Currently, there is a very narrow (10-20 ft) forested buffer in these areas, bordered by a well maintained lawn and scattered shade trees. The goal of this restoration would be to widen the existing buffer to a minimum of 50 feet.

Sites 171 and 172 are located at the Whipple Field athletic complex in Smithfield (Fig. 10). Site 171 runs for about 300 feet along the eastern side of the Woonasquatucket River between the river and one of the baseball fields. Site 172 runs for about 200 feet on the southern side of a tributary stream that enters the Woonasquatucket from the east at the northern edge of Town property; it separates the stream from the field entrance road and a small parking lot. The objective in both cases would be to widen the existing forested buffer and to increase its density by establishing thick understory plants. Space limitations between the river and baseball facilities limit the amount of expansion possible in that area.

Site 173 runs for 600 feet along the wetland edge just northeast of the Smithfield Department of Public Works facilities (Fig. 11). A narrow strip (20-30 ft) of upland trees and shrubs currently occupies part of that zone. The goal of the restoration project would be to widen the buffer to at least 50 feet. This would require the Town to sacrifice some of the space that is currently used for storing road construction and maintenance equipment. The major constraint may be a conflict with the Section 319 stormwater management project that has been approved for the same general area. Alternatively, this might be an opportunity to accomplish both goals at once.

Sites 511, 512, and 513 occur together on the Newman Preserve in Glocester (Fig. 12). They extend for more than 2,000 feet between either cattle pastures or hayfields and swamps or wet meadows flanking Nine Foot Brook. Currently, a woody upland buffer is lacking along the entire length of these three sites, and cattle wander without restraint

through the wetlands and stream. Buffer establishment would entail fencing to exclude the cattle and to allow woody vegetation to become established along the wetland edges. Special attention needs to be directed toward control of autumn olive (*Elaeagnus umbellata*), an invasive species which is already present at these sites.

Site 640 extends for more than 500 feet between the Woonasquatucket River and the Lincoln Lace brownfield site in Providence (Fig. 13). The restoration objective would be to expand the current narrow buffer (<20 ft of trees and shrubs) as much as possible. The major constraint may be the City of Providence's desire to construct soccer fields in this area. Buffer expansion would require removal of patches of asphalt and addition of loam and topsoil to the existing gravelly soil, much of which appears to be fill material. Ideally, buffer restoration at Site 640 could be accomplished in combination with wetland restoration at nearby fill site 455.

Site 690 is located along the southeastern edge of a forested wetland "island" created by gravel mining in the northeastern corner of Deerfield Park in Smithfield (Fig. 14). This buffer restoration opportunity is about 200 feet long. An upland forested buffer at least 50 feet wide surrounds all of this swamp except for this location, where it is less than 20 feet wide. The goal would be to maximize the forested buffer width in this area before more intensive use is made of the bordering vacant land. Addition of loam and topsoil, and possibly fertilization, will be needed because bare sand and gravel are now exposed at the ground surface.

Site 695 is located just northeast of fill site 370, along about 200 feet of the northern edge of the westernmost lobe of barren land in Deerfield Park (Fig. 15). The site is bordered by a forested swamp to the north and bare sand to the south. The Smithfield DPW is currently storing many truckloads of road sand in piles directly adjacent to Site 695. There is a relatively steep drop of several feet from the upland into the swamp, so that care will have to be taken to prevent sedimentation of the swamp during buffer

restoration. The objective here would be to maximize the width of the forested buffer. Addition of loam and topsoil and fertilization will be necessary here due to the sandy, droughty soils in the former gravel pit.

Restoration Database and Website

A computerized database created for the potential restoration sites includes GIS files of fill-site polygons and upland vegetation removal sites, attribute data files, and associated metadata (i.e., comprehensive lists and definitions of attributes). For each potential restoration site, the database includes attributes such as site ID; town; area or length of impact; priority level (tier); current status and next step in the restoration planning process; plat and lot numbers; landowner names, addresses, and telephone numbers; RIDEM enforcement status; functional assessment raw data, scores, and ranks; and associated 1939 and 1988 aerial photo ID numbers. This database may be accessed via the RIDEM website (www.state.ri.us/dem/programs/benviron/water/wetlands/wetplan.htm). The implementation plan laid out in the next section of this report should be used in conjunction with the on-line database, which contains more detailed information on each site.

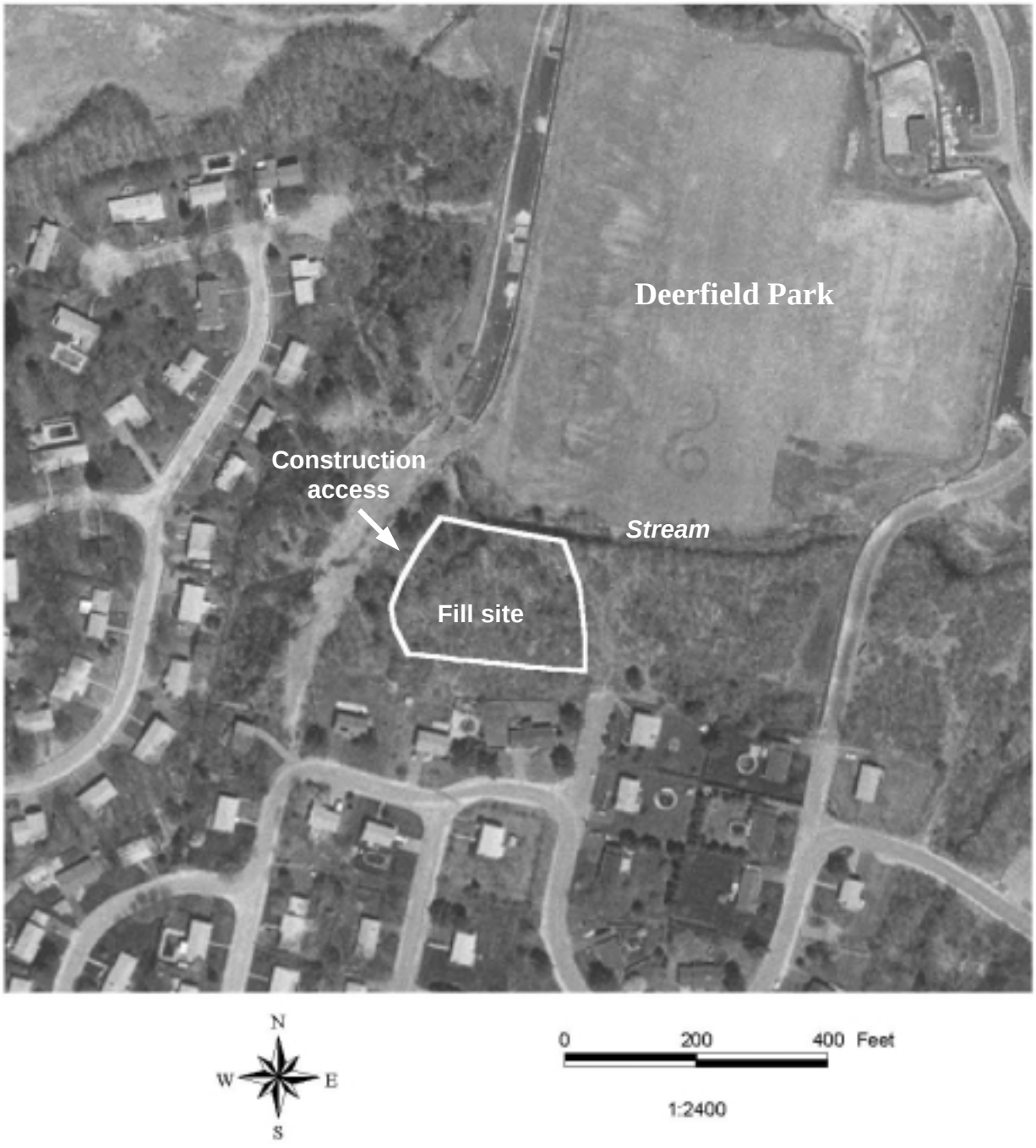

Figure 6. Wetland Feasibility Site 248, depicted on a 1997 digital orthophotographic image.

WETLAND RESTORATION FEASIBILITY PROFILE
(Fill Sites)

Site ID: 248 **Town:** Smithfield **Priority Tier:** 2

Plat: 44 **Lot:** 33 **Landowner:** Town of Smithfield

Existing Land Use/Vegetation

- *Fill site:* Early successional deciduous forest (red maple, Bebb's willow, trembling aspen); 25-35 trees; multiflora rose, autumn olive, tartarian honeysuckle, barberry, bittersweet.

- *Nearby upland:* Upland oak-red maple-white pine forest to the east; upland forest and residential yard to the south; upland oak-pine forest and sewer line/access road to the west.

- *Contiguous wetland:* Stream (excavated) runs along north edge of fill site; fill site contains small area of open water/shrub swamp in northwest quadrant (approx. 30' x 80'); a few *Phragmites* in pool.

- *Current shrub or forested buffer width:* Approx. 30' of buffer on north bank of stream (between stream and soccer fields); 50' of buffer to the east of fill site; 20-40' of buffer to the south of fill site, but it is on private land; 50' of buffer to the west of fill site.

Existing Slopes

- *Fill site:* Level except for local mounds of fill and 4' berm along southern side of stream.

- *Contiguous wetland:* N/A

- *Upland directly bordering fill:* Level.

- *Rest of nearby upland:* Generally flat.

Water Regime of Contiguous Wetland: Perennial water in stream, but little flow in late May, 2002; small pocket of wetland within fill site semi-permanently flooded.

Area of Fill (acres): 1.10 **Average Fill Depth (ft):** 3.5

Fill Material: Gravel, sand, boulders **Fill Depth Range (ft):** 0-6

Restoration Constraints:

- *Contaminants:* None detected.

- *Utilities:* Sewer line to the west of fill site lies outside of the extent of proposed excavation. No other utilities were observed in the immediate area of the fill site.

- *Construction access:* Best access is on the west side of fill site, via sewer line access road; in the north end of the western edge of the fill site there is a break in the upland forest that would permit access for construction with minimal impact to the existing buffer.

- *Fill disposal sites:* Possibly any one of the already barren areas within Deerfield Park (e.g., the area east of fill site 370, or the area southeast of buffer site 690).

- *Potential permitting issues:* If fill is excavated up to stream channel to the north, coffer dam may be required to minimize sedimentation in stream.

- *Estimated restoration cost:*

- Clearing & grubbing existing vegetation on fill	1.10 acres @ $5,000/acre	$5,500
- Cutting & disposing isolated trees (4"-24")	30 @ $270/each	8,100
- Earth excavation	6,211 cy @ $5.00/cy	31,055
- Rock excavation (assume 2 % of area)	124 cy @ $17.00/cy	2,108
- Baled hay	400 lf x $3.50/lf	1,400
- High organic soil	5,324 sy x $4.00/sy	21,296
- Wetland seed mix	5,324 sy x $1.00/sy	5,324
- Wetland plantings	Lump Sum	5,000
	Subtotal	$79,783
- Miscellaneous (10% ±)		7,978
	Total	$87,761

Overall Feasibility Assessment: Excellent restoration opportunity. Target elevations for the restored wetland should be based on the substrate elevations within the existing small pocket of wetland in the northwest corner of the fill site.

Activities Needed for Successful Restoration: Fill removal; protection of stream and existing wetland from sedimentation; invasive species control; re-establishment of buffer where construction access was located; annual monitoring and adaptive management for at least 5 years. Because the fill site borders a residential yard to south, some fill may need to remain so that an adequate buffer can be created.

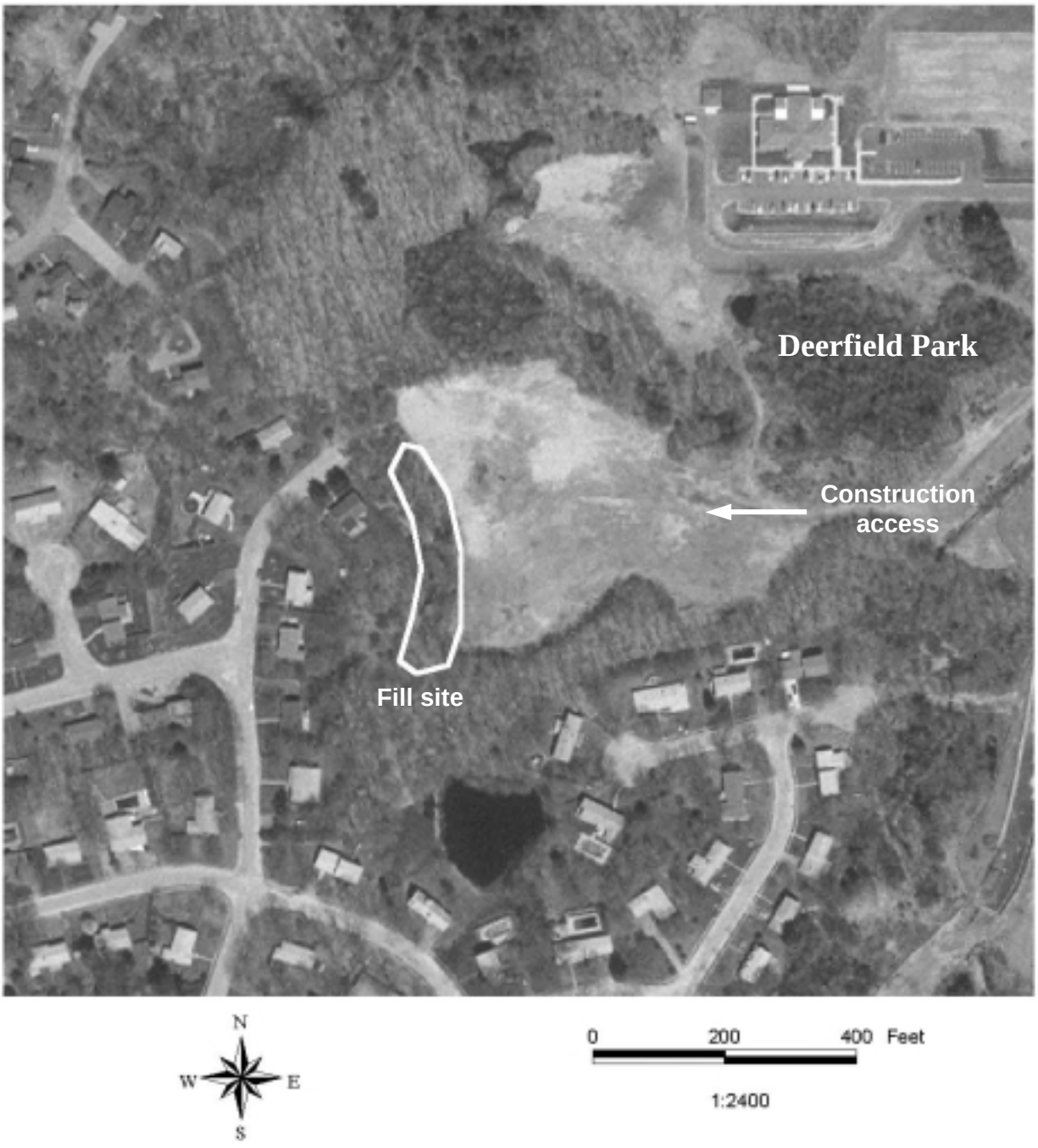

Figure 7. Wetland Feasibility Site 370, depicted on a 1997 digital orthophotographic image.

WETLAND RESTORATION FEASIBILITY PROFILE
(Fill Sites)

Site ID: 370 **Town:** Smithfield **Priority Tier:** 2

Plat: 44 **Lot:** 33 **Landowner:** Town of Smithfield

Existing Land Use/Vegetation

- *Fill site:* Mixed forest; approximately 15 trees.
- *Nearby upland:* Upland forest and residential yard to the west of fill site; barren land to the east of fill site (used as storage for Smithfield DPW road sand).
- *Contiguous wetland:* None.
- *Current shrub or forested buffer width:* At least 30-50' of upland area around fill site is on public land; east of fill site is currently barren area, but rest of fill site is buffered by upland forest.

Existing Slopes

- *Fill site:* Gentle slope from north to south.
- *Contiguous wetland:* N/A
- *Upland directly bordering fill:* Level.
- *Rest of nearby upland:* Slight rise in elevation to northwest and south.

Water Regime of Contiguous Wetland: N/A

Area of Fill (acres): 0.51 **Average Fill Depth (ft):** 4

Fill Material: Coarse sand and gravel **Fill Depth Range (ft):** 3.5-4.5

Restoration Constraints:

- *Contaminants:* None detected.

- *Utilities:* None observed.

- *Construction access:* Best access is on the east side of fill site, via barren area of Deerfield Park that is currently being used to store Smithfield DPW road sand.

- *Fill disposal sites:* Possibly any one of the already barren areas within Deerfield Park (e.g., the barren area east of this fill site, or the area southeast of buffer site 690).

- *Potential permitting issues:* No permit necessary; not wetland.

- *Estimated restoration cost:*

- Clearing & grubbing existing vegetation on fill	0.51 acre @ $5,000/acre	$2,550
- Cutting & disposing isolated trees (4"-24")	15 @ $270/each	4,050
- Earth excavation	3,291 cy @ $5.00/cy	16,455
- Rock excavation (assume 2 % of area)	66 cy @ $17.00/cy	1,122
- Baled hay	0 lf x $3.50/lf	0
- High organic soil	2,468 sy x $4.00/sy	9,872
- Wetland seed mix	2,468 sy x $1.00/sy	2,468
- Wetland plantings	Lump Sum	5,000
	Subtotal	$41,517
- Miscellaneous (10% ±)		4,017
	Total	$45,534

Overall Feasibility Assessment: Marginal opportunity; site of filled pond now a narrow strip of forested upland which buffers residence from open gravel area to east. Restoration would remove residential buffer almost entirely; buffer would have to be re-created to east, in current barren area.

Activities Needed for Successful Restoration: Removal of existing vegetation (trees and shrubs); excavation of fill; creation of a substantial forested buffer in barren areas on east side of fill site; erosion and sedimentation control along upland edges of restored wetland; invasive species control; annual monitoring and adaptive management for at least 5 years.

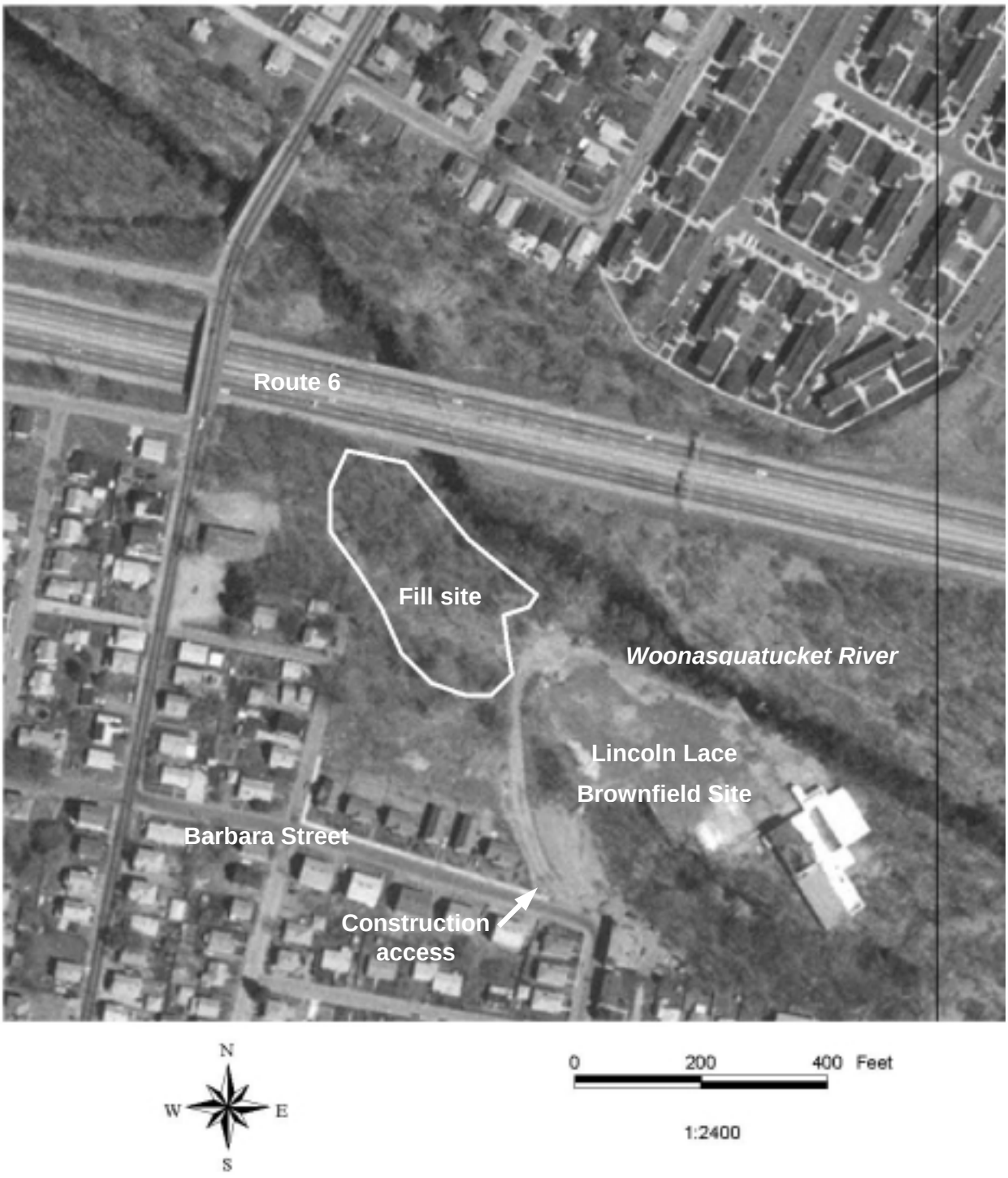

Figure 8. Wetland Feasibility Site 455, depicted on a 1997 digital orthophotographic image.

WETLAND RESTORATION FEASIBILITY PROFILE
(Fill Sites)

Site ID: 455 **Town:** Providence **Priority Tier:** 1

Plat:	**Lot:**	**Landowners:**
113.0	429.0	City of Providence
113.0	440.0	Trust for Public Land
No plat no.	No lot no.	RIDOT

Existing Land Use/Vegetation

- *Fill site:* Deciduous forest; 50-60 trees.

- *Nearby upland:* Upland forest and residential to the south and west; Route 6 to the north; Woonasquatucket River to the northeast; and barren land (Lincoln Lace brownfield site) to the southeast.

- *Contiguous wetland:* Woonasquatucket River along the northeast boundary of the fill site.

- *Current shrub or forested buffer width:* >50' forested buffer from the south end of the fill site along western edge to Route 6 (some of this buffer is privately owned). Public land southeast of fill site currently barren.

Existing Slopes

- *Fill site:* Fairly steep slope down toward the Woonasquatucket River; fill is 7-8' thicker on south end of fill site than along the river.

- *Contiguous wetland:* N/A

- *Upland directly bordering fill:* Very steep slopes upward to the south and west of the fill site.

- *Rest of nearby upland:* Land rises 30-40' to south and west of fill site.

Water Regime of Contiguous Wetland: Perennial stream.

Area of Fill (acres): 1.62 **Average Fill Depth (ft):** 10

Fill Material: Unknown (landfill) **Fill Depth Range (ft):** 7-15

Restoration Constraints:

- *Contaminants:* This site was historically a mill pond for the Lincoln Lace Mill and was subsequently used as a landfill; contamination is likely.

- *Utilities:* None.

- *Construction access:* Best access is into the south and east of the fill site via the access road to the old mill. The access road is off Barbara Street.

- *Fill disposal sites:* Johnston landfill?

- *Potential permitting issues:* Probable contamination of fill material; sedimentation of the Woonasquatucket River and related downstream water quality impacts; erosion during excavation process.

- *Estimated restoration cost:*

- Clearing & grubbing existing vegetation on fill	1.62 acres @ $5,000/acre	$8,100
- Cutting & disposing isolated trees (4"-24")	55 @ $270/each	14,850
- Earth excavation	26,136 cy @ $5.00/cy	130,680
- Rock excavation (assume 2 % of area)	523 cy @ $17.00/cy	8,891
- Baled hay	400 lf x $3.50/lf	1,400
- High organic soil	7,841 sy x $4.00/sy	31,364
- Wetland seed mix	7,841 sy x $1.00/sy	7,841
- Wetland plantings	Lump Sum	5,000
	Subtotal	$208,126
- Miscellaneous (10% ±)		20,813
	Total	$228,939

Overall Feasibility Assessment: Unusually good opportunity for significant wetland restoration in highly urbanized area; removal of contaminants from area near river also a plus; site has potential to perform at least four major wetland functions.

Activities Needed for Successful Restoration: Removal of large quantity of fill and waste material down to original wetland soil elevation or that of nearby swamp along river; containment of sediment and effluent from site throughout fill removal process to protect water quality of Woonasquatucket River; securing an approved fill disposal site; invasive species control; annual monitoring and adaptive management for at least 5 years.

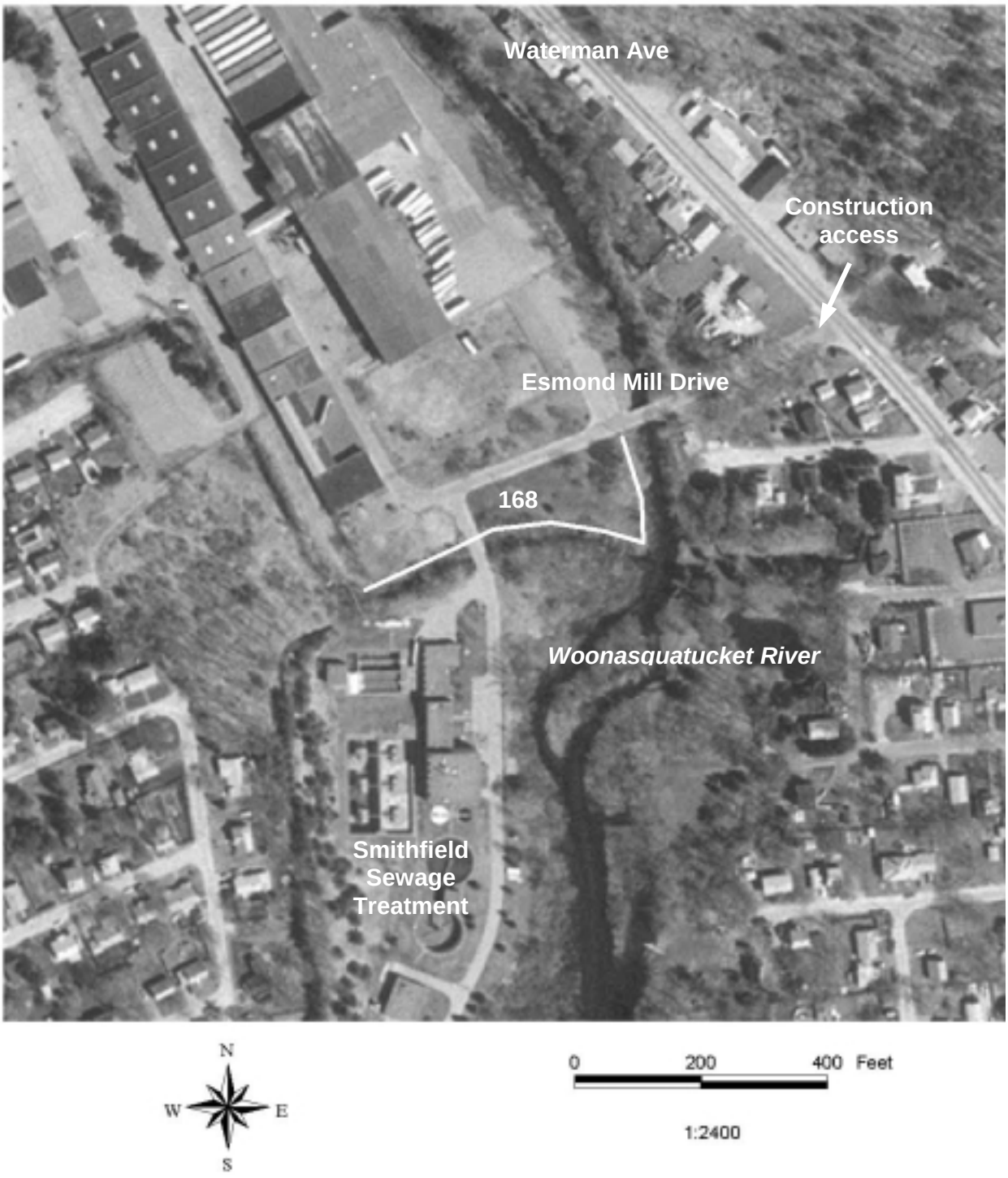

Figure 9. Buffer Feasibility Site 168, depicted on a 1997 digital orthophotographic image.

BUFFER RESTORATION FEASIBILITY PROFILE
(Upland Vegetation Removal Sites)

Site ID: 168 **Town:** Smithfield **Priority Tier:** 2

Plat: 26 **Lot:** 139 **Landowner:** Town of Smithfield

Existing Land Use/Vegetation

- *Wetland:* Woonasquatucket River and a small tributary stream to west.
- *Upland:* Lawn with a few scattered trees.
- *Current shrub or forested buffer width (ft):* 10-20
- *Length of upland vegetation removal (ft):* 640

Existing Slopes

- *Wetland:* N/A
- *Upland directly bordering wetland:* Level.
- *Rest of nearby upland:* Generally level in floodplain north and south of site; land rises west of proposed restoration site.

Wetland Water Regime: Perennial stream; tributary flow limited during extended periods without runoff.

Restoration Constraints

- *Contaminants:* None detected.
- *Upland land use:* Urban open space: primarily a well-maintained lawn at the entrance to the Smithfield sewage treatment plant.
- *Construction access:* Esmond Mill Drive (off Waterman Ave).
- *Potential permitting issues:* Erosion and sedimentation in streams if soil is disturbed for planting.

- *Size of area to be restored:*

	Width (ft)	Length (ft)	Area (sq ft)
Minimum	30	640	19,200
Maximum	40	640	25,600

Overall Feasibility Assessment: Relatively easy to accomplish; key issue is whether Town will agree to sacrifice the lawn area.

Activities Needed for Successful Restoration: Planting of trees and shrubs and fencing (e.g., split-rail) to deter future disturbance of buffer; annual monitoring and invasive species control, if necessary.

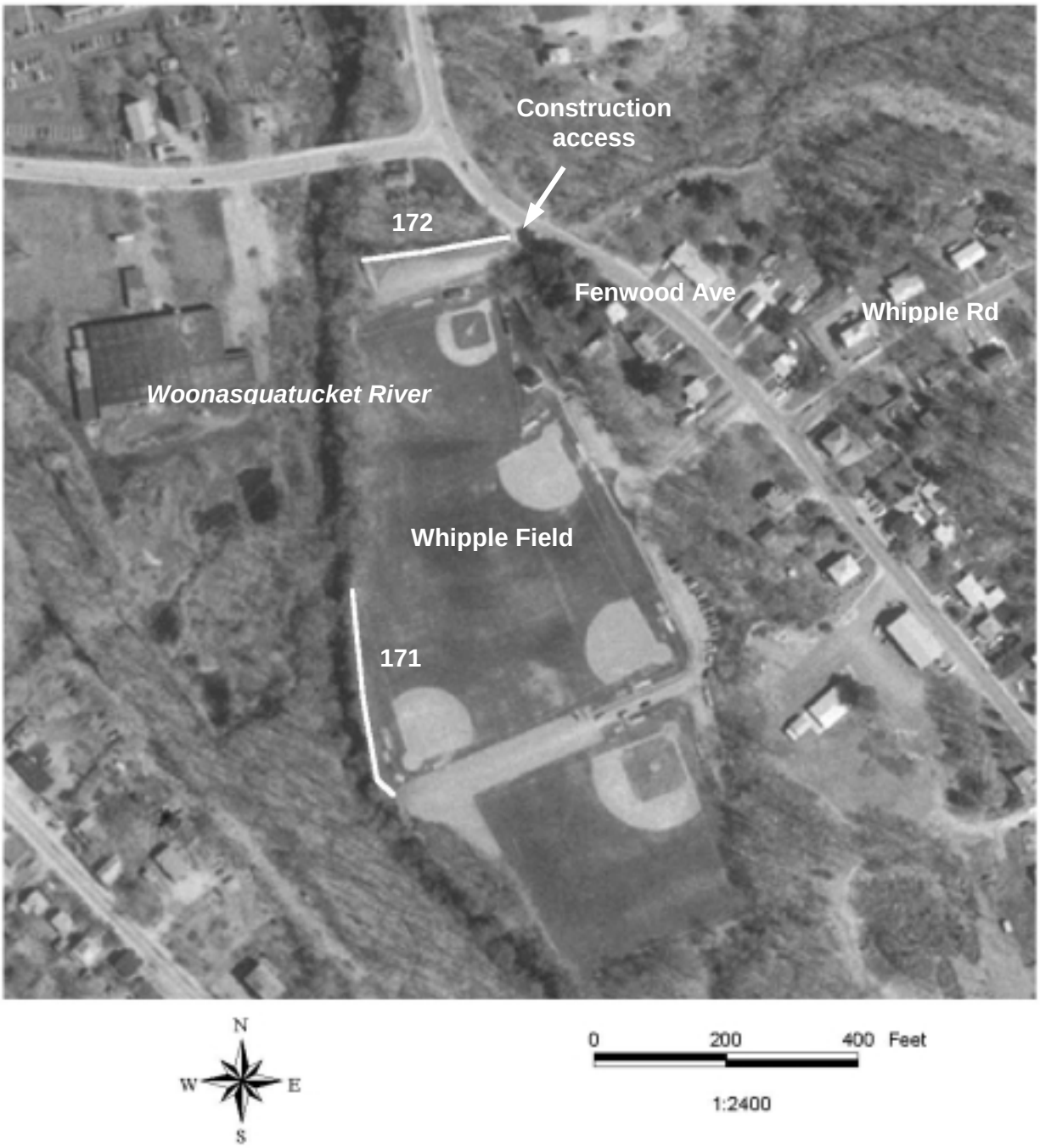

Figure 10. Buffer Feasibility Sites 171 and 172, depicted on a 1997 digital orthophotographic image.

BUFFER RESTORATION FEASIBILITY PROFILE
(Upland Vegetation Removal Sites)

Site ID: 171,172 **Town:** Smithfield **Priority Tier:** 2

Plat: 23.0 **Lot:** 70.1 **Landowners:** Town of Smithfield
24.0 61.3

Existing Land Use/Vegetation

- *Wetland:* Woonasquatucket River (Site 171) and a small tributary from the east (Site 172).

- *Upland:* Site 171: Lawn with a few scattered trees, but little or no understory, bordering an athletic field; southern 100' of impact has almost no woody vegetation. Site 172: opportunity is within a 20' swath along the entire length of impact that lies between the stream channel and an actively used parking lot. The buffer area currently consists of scattered evergreen trees w/ mowed understory; ground cover is patchy in some places.

- *Current shrub or forested buffer width (ft):* 0-20

- *Length of upland vegetation removal (ft):* Site 171: 320; Site 172: 230

Existing Slopes

- *Wetland:* N/A

- *Upland directly bordering wetland:* Level field and parking lot; edge of lawn drops from a few inches to 2-3' to stream level.

- *Rest of nearby upland:* Generally level; small rise to north of Site 172.

Wetland Water Regime: Site 171: Perennial stream; Site 172: Semipermanent stream.

Restoration Constraints

- *Contaminants:* None detected.

- *Upland land use:* Athletic fields (Whipple Field).

- *Construction access:* From Fenwood Avenue.

- *Potential permitting issues:* Erosion and sedimentation in streams during soil preparation for planting.

- *Size of area to be restored:*

	Width (ft)	Length (ft)	Area (sq ft)
Site 171	15	320	4,800
Site 172	20	230	4,600

Overall Feasibility Assessment: Relatively straightforward. Chain-link fence and bleachers associated with the baseball field at Site 171 are within 30-40' of river, so current buffer might be expanded by only about 15-20' for most of the length of the impact. Increasing buffer width and density at Site 172 should be possible without sacrificing any significant recreational space.

Activities Needed for Successful Restoration: Fencing and cessation of mowing would be sufficient, but planting of shrubs and trees would expedite buffer development; monitoring and invasive species control, if necessary. Buffer width should be maximized, but still allow for unimpeded pedestrian travel between buffer and chain-link fence or bleachers.

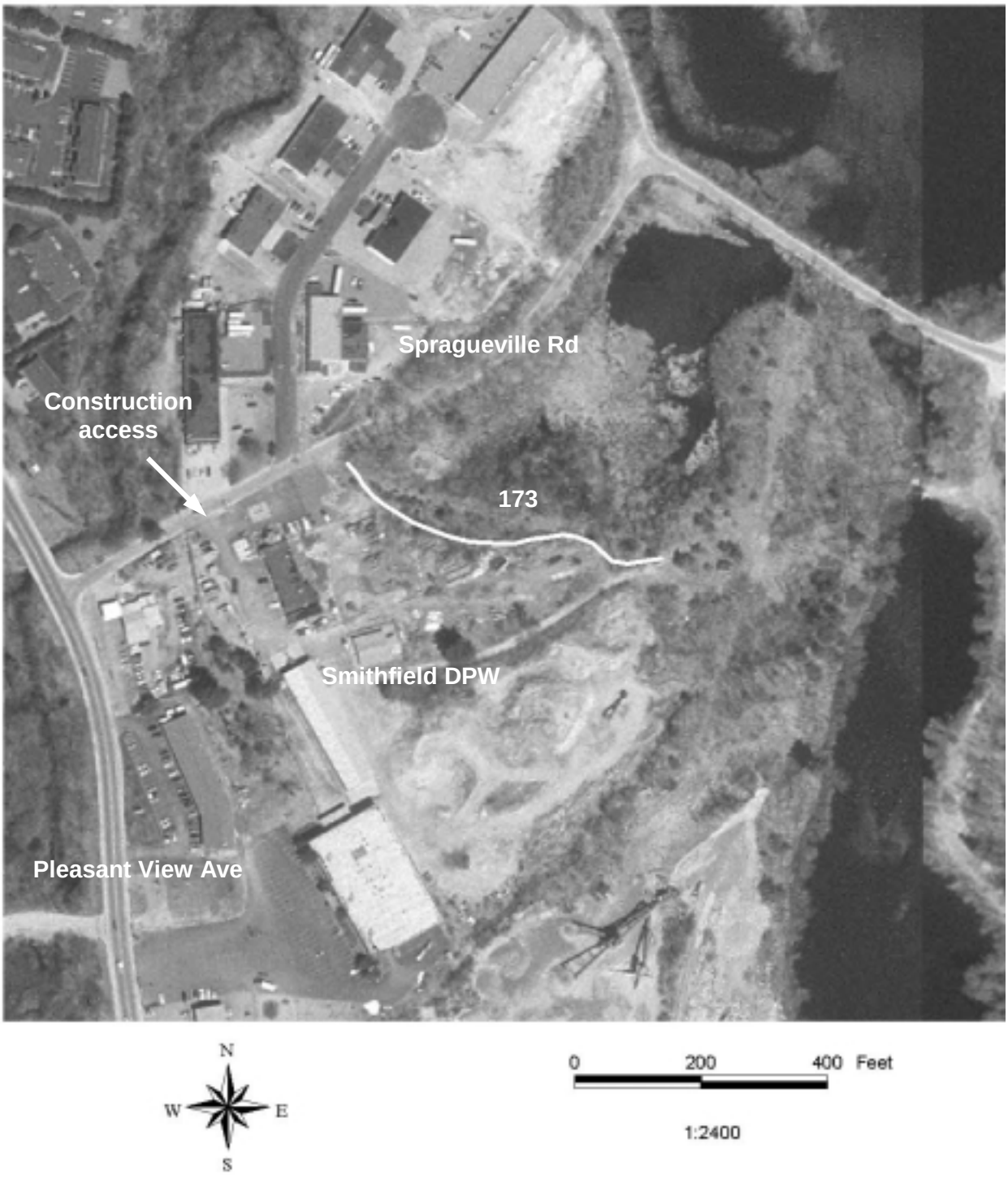

Figure 11. Buffer Feasibility Site 173, depicted on a 1997 digital orthophotographic image.

BUFFER RESTORATION FEASIBILITY PROFILE
(Upland Vegetation Removal Sites)

Site ID: 173 **Town:** Smithfield **Priority Tier:** 2

Plat: 17.0 **Lot:** 4.0 **Landowners:** Town of Smithfield
17.0 5.0

Existing Land Use/Vegetation

- *Wetland:* Deciduous forested swamp.
- *Upland:* Storage yards (unpaved) for the Smithfield Dept. of Public Works.
- *Current shrub or forested buffer width (ft):* 20-30
- *Length of upland vegetation removal (ft):* 600

Existing Slopes

- *Wetland:* Level
- *Upland directly bordering wetland:* Short, steep slope up to storage yards.
- *Rest of nearby upland:* Relatively flat; gradual rise to the west.

Wetland Water Regime: Seasonally saturated to seasonally flooded.

Restoration Constraints

- *Contaminants:* None detected.
- *Upland land use:* Area is currently being used as storage area for road construction and maintenance equipment.
- *Construction access:* From Spragueville Road into Smithfield DPW.
- *Potential permitting issues:* Soil erosion and sedimentation at wetland edge.

- *Size of area to be restored:*

	Width (ft)	Length (ft)	Area (sq ft)
Minimum	20	600	12,000
Maximum	30	600	18,000

Overall Feasibility Assessment: Straightforward project, as long as it does not conflict with Section 319 stormwater management project recently approved by State for same area; another issue is whether Town will agree to sacrifice part of the storage area.

Activities Needed for Successful Restoration: Planting of shrubs and trees would be the best alternative; fencing should be installed to deter future disturbance. Loam and topsoil may need to be supplied if existing soil proves to be too coarse and droughty to support native trees and shrubs.

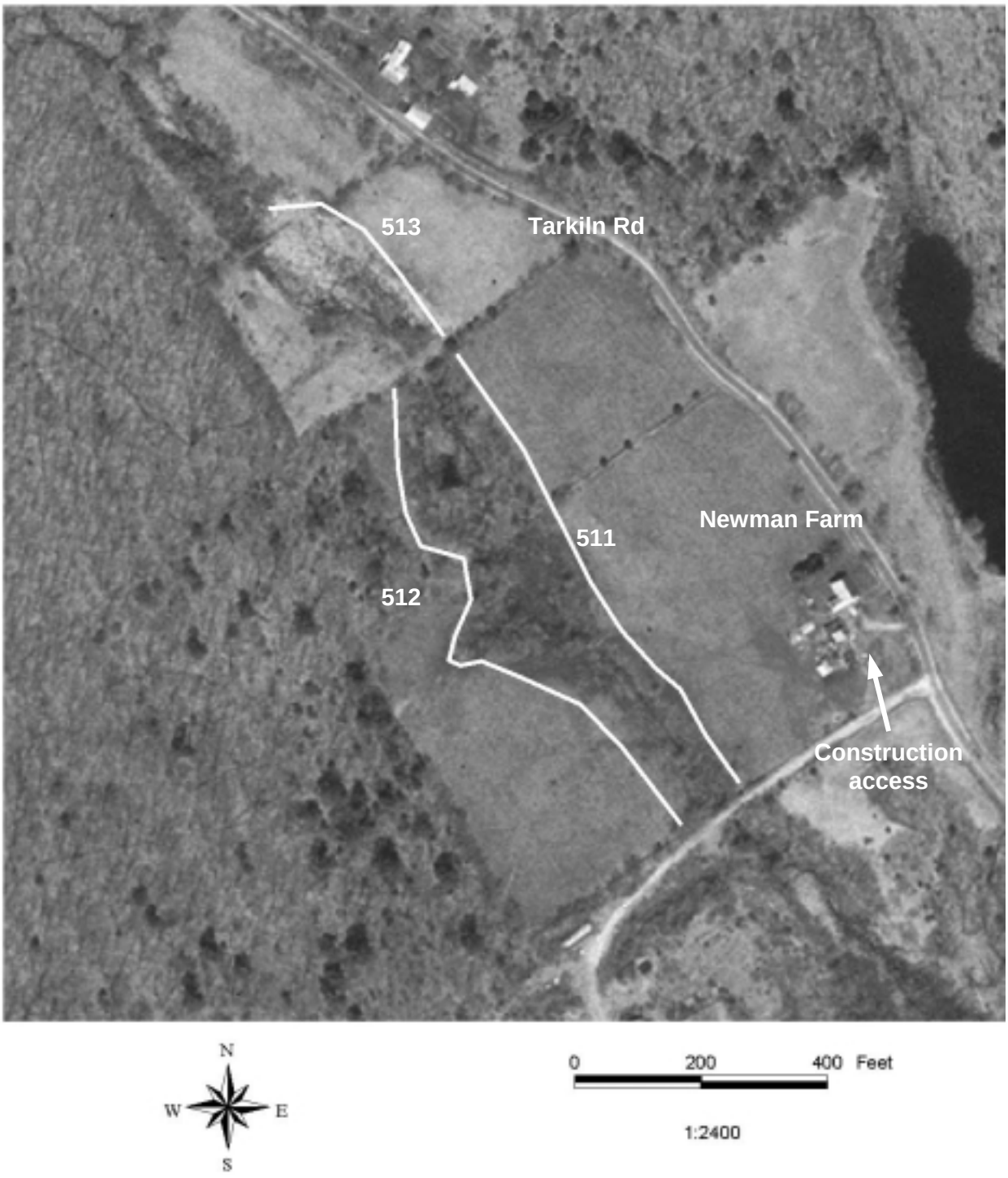

Figure 12. Buffer Feasibility Sites 511, 512, and 513, depicted on a 1997 digital orthophotographic image.

BUFFER RESTORATION FEASIBILITY PROFILE
(Upland Vegetation Removal Sites)

Site ID: 511, 512, 513 **Town:** Glocester **Priority Tier:** 2

Plat: 16.0 **Lot:** 62.0 **Landowners:** Audubon Society of R.I.
16.0 64.0 (Wilson Newman Life Estate)

Existing Land Use/Vegetation

- *Wetland:*
  Sites 511, 512: Deciduous forested swamp and shrub swamp.
  Site 513: Wet meadow.

- *Upland:*
  Sites 511, 512: Cattle pasture.
  Site 513: Hayfield.

- *Current shrub or forested buffer width (ft):* None.

- *Length of upland vegetation removal (ft):*
  Site 511: 800
  Site 512: 950
  Site 513: 370

Existing Slopes

- *Wetland:* Level.

- *Upland directly bordering wetland:* Gentle slope toward wetland.

- *Rest of nearby upland:* Moderate slope from east and west toward wetland.

Wetland Water Regime: Seasonally flooded; Nine Foot Brook, which drains this wetland complex, is likely intermittent.

Restoration Constraints

- *Contaminants:* None detected.

- *Upland land use:*
  Sites 511, 512: Upland is grazed to the wetland edge along the entire length of the impacts. In addition, grazing is also occurring within the wetland; cattle wander freely in the stream that runs through the center of the wetland.

  Site 513: Hay production.

- *Construction access:* From Tarkiln Road, just north of the road to the old Glocester landfill.

- *Potential permitting issues:* Erosion and sedimentation control if soil is disturbed.

- *Size of area to be restored:*

	Width (ft)	Length (ft)	Area (sq ft)
511	50	800	40,000
512	50	950	47,500
513	50	370	18,500

Overall Feasibility Assessment: Straightforward opportunities.

Sites 511, 512: The cattle are clearly having a negative impact by grazing directly in the wetland and contributing to nutrient loading in the stream. Grazing will most likely terminate when Audubon assumes full ownership.

Site 513: This impact is of less concern than that at the other 2 sites; although the frequency of haying is not known, it probably is not impacting the adjacent wet meadow to an extent that would warrant immediate action.

Activities Needed for Successful Restoration: The primary focus should be to fence off a substantial area (50' minimum) of upland adjacent to each wetland edge to prevent the cattle from wandering into the wetland and to allow buffer vegetation to develop fully. Planting to expedite buffer development is optional; however, efforts should be made to eradicate autumn olive (*Eleagnus umbellata*) which is scattered about near the wetland edge.

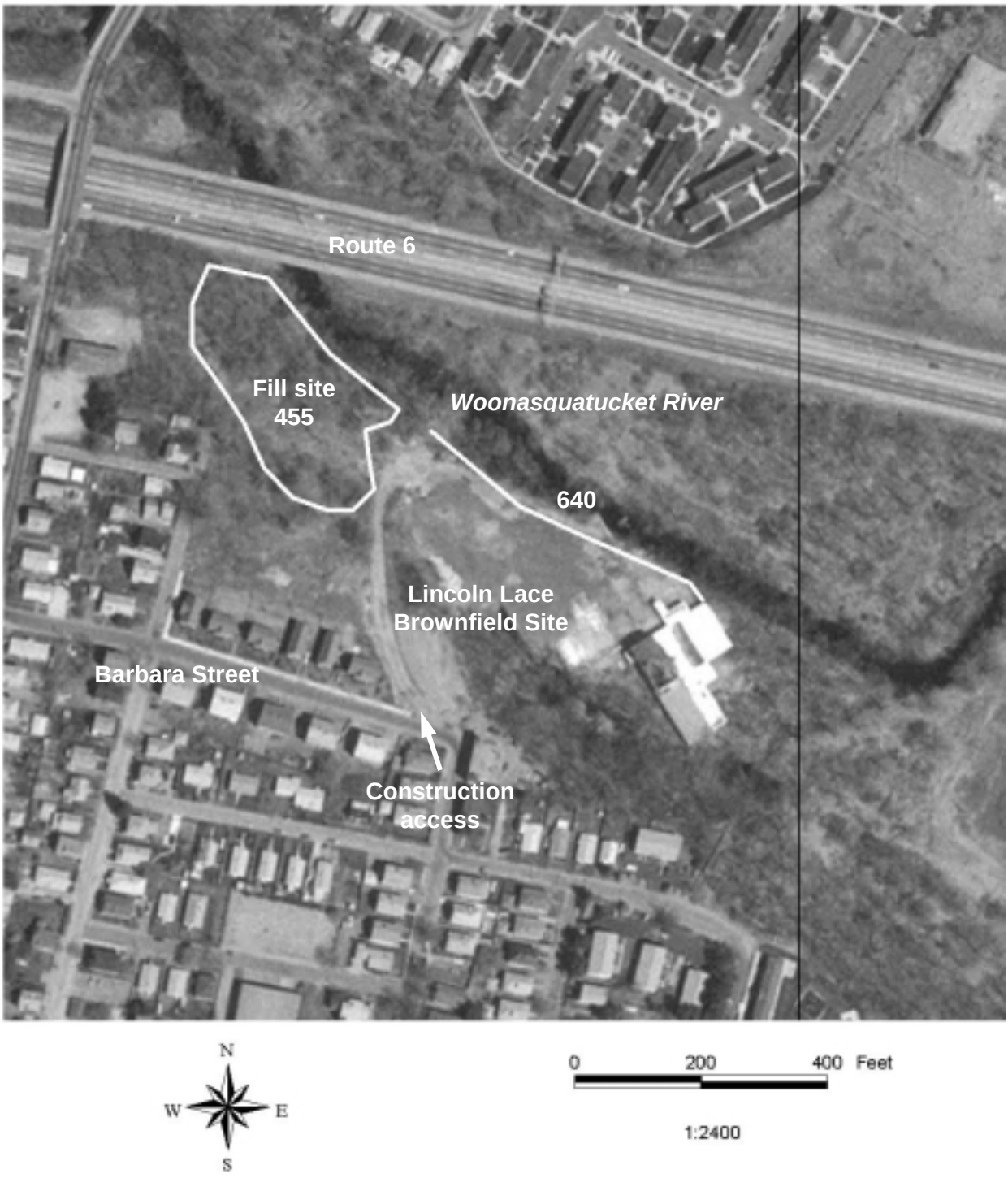

Figure 13. Buffer Feasibility Site 640, depicted on a 1997 digital orthophotographic image.

BUFFER RESTORATION FEASIBILITY PROFILE
(Upland Vegetation Removal Sites)

Site ID: 640 **Town:** Providence **Priority Tier:** 2

Plat:	**Lot:**	**Landowners:**
113.0	305.0	Ponaganset Realty Association, LTD
113.0	429.0	City of Providence

Existing Land Use/Vegetation

- *Wetland:* Woonasquatucket River.
- *Upland:* Abandoned mill site (Lincoln Lace Brownfield site).
- *Current shrub or forested buffer width (ft):* 10-20
- *Length of upland vegetation removal (ft):* 510

Existing Slopes

- *Wetland:* N/A
- *Upland directly bordering wetland:* Very gradual slope toward river, then abrupt drop of 2-4' to stream level.
- *Rest of nearby upland:* Relatively flat across old mill site; steep slope to east of that.

Wetland Water Regime: Perennial stream.

Restoration Constraints

- *Contaminants:* Check RIDEM files.
- *Upland land use:* Area is currently abandoned, with some patches of old asphalt pavement within 100' of the river.
- *Construction access:* Best access is from the south via Barbara Street.
- *Potential permitting issues:* Erosion and sedimentation in the river if soil is disturbed.

- *Size of area to be restored:*

	Width (ft)	Length (ft)	Area (sq ft)
Minimum	30	510	15,300
Maximum	40	510	20,400

Overall Feasibility Assessment: Given that the site directly borders the Woonasquatucket River, and that much of the impact is on public land, this is a good opportunity to extend the buffer zone to 100' or more. Because the City of Providence apparently has plans to create soccer fields in this area, compromise on buffer width may be needed.

Activities Needed for Successful Restoration: Planting or seeding would be the best alternatives for restoration, given the lack of existing vegetation. Some asphalt pavement may need to be removed, and loam may need to be brought in if soil in the area is too coarse and droughty to support native trees and shrubs.

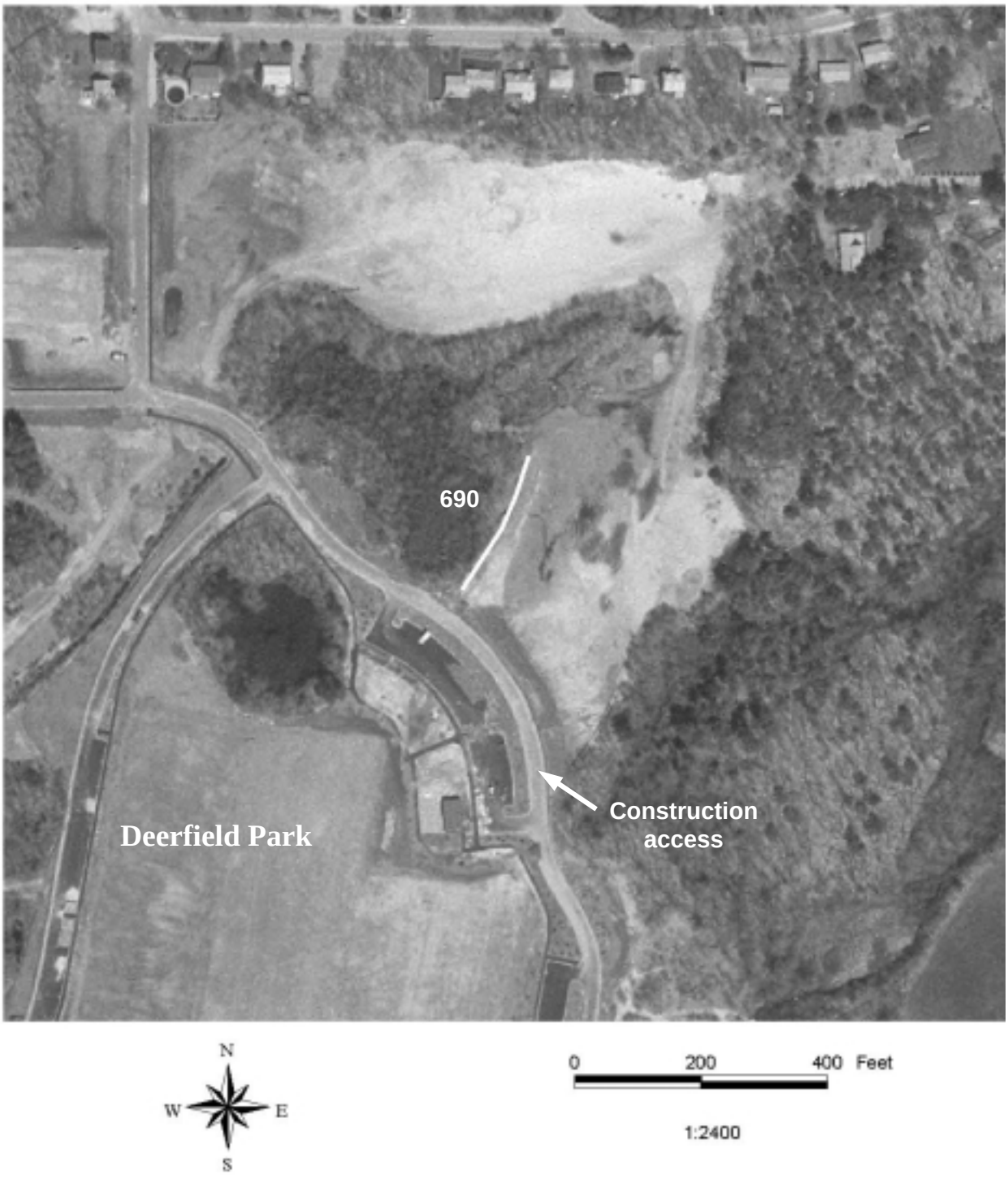

Figure 14. Buffer Feasibility Site 690, depicted on a 1997 digital orthophotographic image.

BUFFER RESTORATION FEASIBILITY PROFILE
(Upland Vegetation Removal Sites)

Site ID: 690 **Town:** Smithfield **Priority Tier:** 2

Plat: 44.0 **Lot:** 33.0 **Landowners:** Town of Smithfield
44.0 34.0

Existing Land Use/Vegetation

- *Wetland:* Deciduous forested swamp.
- *Upland:* Barren sandy area in the northeastern corner of Deerfield Park.
- *Current shrub or forested buffer width (ft):* 10-20
- *Length of upland vegetation removal (ft):* 220

Existing Slopes

- *Wetland:* Gradual near upland edge; level in swamp interior.
- *Upland directly bordering wetland:* Short, steep slope to wetland.
- *Rest of nearby upland:* Moderate slope to north and east from buffer restoration site.

Wetland Water Regime: Seasonally saturated to seasonally flooded.

Restoration Constraints

- *Contaminants:* None detected.
- *Upland land use:* Potential buffer restoration area shows no sign of land use, although area just northeast of the site is being used to store landscaping materials (bark mulch).
- *Construction access:* From Deerfield Park perimeter road.
- *Potential permitting issues:* Soil erosion and sedimentation in wetland if soil is disturbed or if loam or topsoil is added; fertilizer runoff into swamp.

- *Size of area to be restored:*

	Width (ft)	Length (ft)	Area (sq ft)
Minimum	30	220	6,600
Maximum	40	220	8,800

Overall Feasibility Assessment: Straightforward opportunity; land adjacent to wetland is currently unused. Maximum buffer development is possible.

Activities Needed for Successful Restoration: Planting and seeding would be the best alternatives for restoration. Loam, and perhaps topsoil, would need to be added to the sand currently exposed at the surface of the ground; fertilization also would be in order due to the sterile soils.

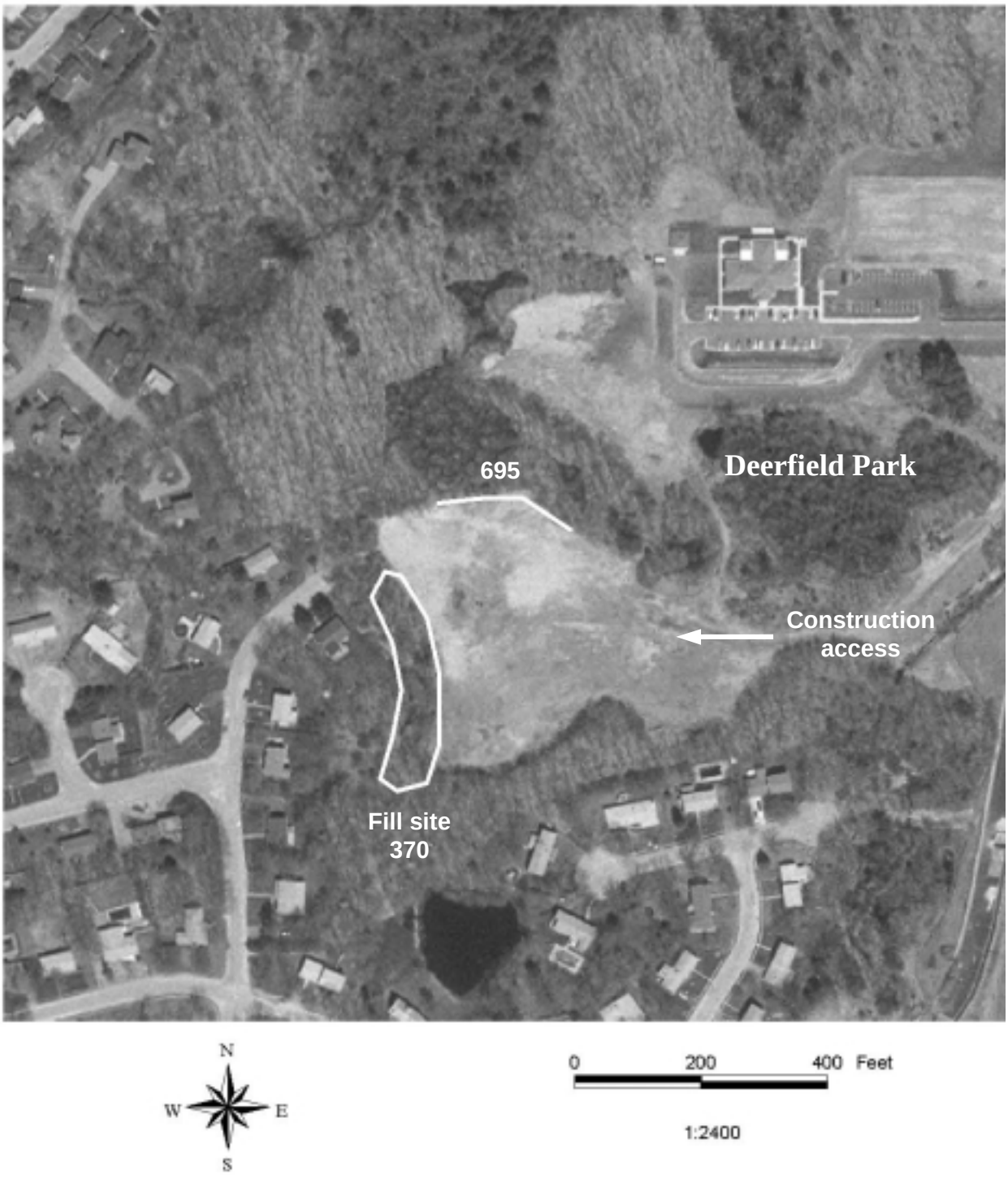

Figure 15. Buffer Feasibility Site 695, depicted on a 1997 digital orthophotographic image.

BUFFER RESTORATION FEASIBILITY PROFILE
(Upland Vegetation Removal Sites)

Site ID: 695 **Town:** Smithfield **Priority Tier:** 2

Plat: 44.0 **Lot:** 33.0 **Landowners:** Town of Smithfield

Existing Land Use/Vegetation

- *Wetland:* Deciduous forested swamp.
- *Upland:* Barren sandy area on the western end of Deerfield Park; many truckloads of sand stored directly adjacent to site by Smithfield DPW.
- *Current shrub or forested buffer width (ft):* 0-20
- *Length of upland vegetation removal (ft):* 230

Existing Slopes

- *Wetland:* Level.
- *Upland directly bordering wetland:* Short, steep drop of several feet into swamp from edge of old gravel pit.
- *Rest of nearby upland:* Slight to moderate; steep where truckloads of sand slope to wetland edge.

Wetland Water Regime: Seasonally flooded.

Restoration Constraints

- *Contaminants:* None detected.
- *Upland land use:* Area of proposed buffer restoration is contiguous with an area that is currently being used as storage for Smithfield DPW road sand.
- *Construction access:* From northwestern corner of Deerfield Park.
- *Potential permitting issues:* Soil erosion and sedimentation of wetland along steep slope at wetland edge.

- *Size of area to be restored:*

	Width (ft)	Length (ft)	Area (sq ft)
Minimum	30	230	6,900
Maximum	50	230	11,500

Overall Feasibility Assessment: The sand storage for Smithfield DPW is apparently a short-term arrangement. Given that, this restoration should be straightforward. Maximum buffer width (100' or more) is possible because site is unused except for sand storage.

Activities Needed for Successful Restoration: Planting and seeding would be the best alternatives for restoration, given the lack of existing vegetation. Addition of loam and topsoil and fertilization all would be necessary because of the coarse, sandy nature of the soil.

IMPLEMENTATION

Overview

Restoration of wetland functions and values in the Woonasquatucket River watershed will require completion of a series of tasks, some performed sequentially but many simultaneously. Because wetlands, land use, and land ownership all are dynamic, both the restoration plan and the implementation process will need periodic updating and adjustment. This section of the restoration plan provides a framework for using the results presented above to pursue on-the-ground restoration projects and for additional planning.

Steps to Wetland Restoration

Restoration of destroyed (i.e., filled or drained) wetlands generally will provide greater benefits to society than restoration of degraded wetlands because wetland functions are being re-created where none currently exist (Miller and Golet 2001). We recommend that restoration be pursued first at the fill sites where feasibility studies have indicated good prospects for success, then at the other Tier 1 and Tier 2 sites, and finally at the Tier 3 sites. Within a tier, ideally sites should be selected for restoration in order of their functional potential (i.e., from top to bottom of Tables 3-5). Generally, sites that have the potential to perform multiple functions should be given priority over those that are likely to perform a single function; however, single-function sites might be excellent choices for restoration in areas of the watershed where that function is in short supply and desperately needed (e.g., sites with flood storage potential in an area where severe flooding problems exist). We also recommend that, whenever possible, clusters of restorable wetlands be targeted to maximize benefits in local geographic areas of the watershed and to minimize costs.

Wetland Restoration Feasibility Sites

The three fill sites for which feasibility studies have been done (Sites 248, 370, and 455) currently are the closest to on-the-ground restoration. For these sites, the following steps

should be taken as soon as possible. Steps requiring the services of a professional wetland scientist are identified by an asterisk.

A1. Seek cooperation of the landowner in wetland restoration. If cooperation is obtained and a legally binding agreement effected, then the following steps should be taken.

A2. Review site characteristics and constraints as outlined under "Wetland Restoration Feasibility Profiles" (see Results) above, as well as functional assessment results for each site (see Appendix G).

A3. Secure funds for preliminary construction design (see Appendix J for possible sources of funds).

A4.* Hire professionals to accurately determine the spatial limits and volume of fill at the site and to test the material for contaminants.

A5.* If contaminants are not an issue, prepare a draft design for each site, using contiguous or nearby wetlands as reference sites for elevational data, water regimes, and vegetation. Hire a professional wetland scientist to draft the design unless it is initiated by an agency with qualified staff (e.g., RIDEM, Natural Resources Conservation Service). The design should provide for substantial (50- to 150-ft) vegetated upland buffers, as well as gentle slopes at the wetland edge.

A6. Secure an approved disposal site for the fill material.

A7.* Request a preliminary determination from the RIDEM Wetlands Permitting Program; identify any substantive issues and seek solutions that would increase the likelihood of permitting. File an Application to Alter, if required.

A8. If RIDEM approves the proposal, notify abutting landowners of the intent to restore wetland. (*Note*: This would be done during the permit process if an Application to Alter is required.)

A9.* Generate an accurate cost estimate for the construction phase (see Appendix E for general guidelines) and seek funds for construction (see Appendix J for sources).

A10.* If funded, hire a contractor (with previous wetland construction experience, if possible) and a professional wetland scientist to oversee the project and commence work.

A11.* When the construction is completed, monitor water levels, vegetation, and wildlife use annually for the first 5 years and biannually for the next 10 years.

A12.* Institute corrective measures (with RIDEM approval) where needed (e.g., modification of hydrologic regime, invasive species control).

Other Potential Wetland Restoration Sites

Besides the wetland feasibility sites, Tiers 1 and 2 include other good to excellent restoration opportunities. At the time of this writing, however, these sites could not be pursued due to unresolved enforcement actions or lack of landowner contact and site visits. The same holds for the Tier 3 sites. All of these sites have been identified on aerial photographs as potential wetland restoration sites, but field checks are needed to confirm the presence of a restoration opportunity. Typically, Tier 3 sites are small and isolated from existing wetlands; many occur in highly urbanized areas of the watershed. As a result, restoration of Tier 3 sites cannot be expected to provide as many benefits on a watershed scale as restoration of Tier 1 or Tier 2 sites. However, restoration of Tier 3 sites may be highly beneficial locally, especially if it can be coupled with restoration of other sites nearby. Pursuit of these potential restoration opportunities under Tiers 1, 2, and 3 should proceed as outlined below. Steps requiring the services of a professional wetland scientist are identified by an asterisk.

B1. Check with the RIDEM Office of Compliance and Inspection to determine the current status of those sites with enforcement flags, starting with those sites with the highest priority. Address Tier 1 sites first, then Tier 2 sites, then Tier 3 sites.

B2. At the same time, attempt to obtain telephone numbers or other means of contact for those landowners with whom contact could not be made during development of this plan (see Tables 3-5).

B3. For those sites with landowner contact information and no RIDEM enforcement flags, seek landowner permission for a site visit. If permission is obtained, the following steps should be taken.

B4.* Visit the site to verify that there is a viable wetland restoration opportunity (see "Field Verification" section of Methods).

B5.* If there is a viable opportunity, do a feasibility analysis (see "Feasibility Analyses" section of Methods).

B6. Prioritize sites for which feasibility studies have been done, based on tier (1, 2, 3—in that order); functional assessment scores; size; cost; other constraints; and location with respect to other viable restoration opportunities in the immediate area.

B7. Proceed with steps A1-A12 under "Wetland Restoration Feasibility Sites" in this section.

Steps to Buffer Restoration

The presence of an upland vegetated zone between a wetland and adjacent land use contributes to certain wetland functions and values and helps to protect the wetland from degradation (Desbonnet et al. 1994). Generally, science has shown that the wider these "buffer zones" are, the more effective they are from both standpoints (Desbonnet et al. 1994). Vegetation that is tall and dense (e.g., trees and tall shrubs) is particularly effective in reducing the direct impact of human activities and noise on wetland wildlife and in providing a visual screen that is beneficial to wildlife and the site's aesthetic value. Buffer zone width and vegetation density also have a major influence on removal rates for sediment and chemical pollutants such as nitrates and phosphates (Desbonnet et al. 1994). Re-creation of vegetated buffers, where they have been removed, and expansion of buffer width, where adjacent land use permits, may contribute significantly to the restoration of wetland functions and values and to the quality of water throughout the Woonasquatucket River watershed. In most cases, buffer restoration will be less costly and less technically complex than restoration of filled wetlands; however, such projects still must be approved by RIDEM, and they should be supervised by a professional wetland scientist.

In this project, the focus was primarily on opportunities for buffer restoration on public lands simply because there was ready access to most of those sites, and there was insufficient time to contact private landowners. For these reasons, we recommend that buffer restoration opportunities on public lands be pursued first and that sites be selected according to their priority ranking (Tier 1, then Tier 2, then Tier 3), based on wetland sensitivity and the intensity of the adjacent land use (see Tables 7-9). Immediate attention should be directed toward the public sites where feasibility analyses have been conducted.

Buffer Restoration Feasibility Sites

All but one Tier 1 and Tier 2, publicly owned, upland vegetation removal sites were examined in the field; feasibility analyses were conducted at seven of the Tier 2 sites (168, 171, 172, 173, 640, 690, 695**)** where there appeared to be a realistic opportunity for

buffer restoration. We also did a feasibility analysis for the Newman Preserve (Sites 511, 512, 513), which is owned by the Audubon Society of Rhode Island and subject to a life estate. The following steps should be taken as soon as possible for these sites. Steps requiring the services of a professional wetland scientist are identified by an asterisk.

C1. Check all feasibility sites against the RIDEM Office of Compliance and Inspection's records (if status is not already known) to identify any sites with enforcement flags.

C2. For sites with enforcement flags, periodically check with RIDEM to ascertain if the cases have been resolved.

C3. For sites with no enforcement problems, seek landowner cooperation for on-the-ground buffer restoration. Sites should be pursued in order of their priority ranking (Tier 1, then Tier 2, then Tier 3).

C4. If cooperation is obtained, then a written agreement should be drafted and signed by the owner and the restoration sponsor. This agreement should stipulate who will be responsible for planning, design, and creation of the buffer; for restoration costs; for maintenance; for monitoring; and for restitution should the buffer be altered in the future.

C5. Review site characteristics and constraints as outlined under "Buffer Restoration Feasibility Profiles" above (see Results).

C6. Secure funds for preliminary construction design and permitting (see Appendix J for sources of funds).

C7.* Hire a surveyor and professional wetland scientist to prepare a preliminary design, including modification of land contours, soil amendment, planting, and fencing, and to request a preliminary determination from the RIDEM Wetlands Permitting Program.

C8. If RIDEM approves the proposal, notify abutting landowners of the intent to restore the buffer zone.

C9.* Generate an estimate of construction costs and secure funds for construction (see Appendix J).

C10.* If funded, hire a contractor to do the work and a professional wetland scientist to oversee it. Alternatively, the landowner (e.g., municipality) or a third party may agree to donate equipment and personnel to accomplish the restoration.

C11.* Monitor erosion, sedimentation, vegetation development, and human impacts on the buffer zone annually for 10 years.

C12.* Institute corrective measures (with RIDEM approval) where needed (e.g., stabilization of soil, invasive species control).

Other Potential Buffer Restoration Sites

Landowners were identified for the Tier 1 and remaining Tier 2 potential buffer restoration sites—all but one of which are on private land—but sites were not visited, and no feasibility studies were conducted. Aerial photographic analysis suggested that there might be some excellent buffer restoration opportunities at these sites; for that reason, we strongly recommend that they be pursued at the same time that on-the-ground restoration is being undertaken at the public feasibility sites. Pursuit of opportunities at these Tier 1, Tier 2, and Tier 3 sites should proceed as outlined below. Steps requiring the services of a professional wetland scientist are identified by an asterisk.

D1. Identify landowners (see "Landowner Research" section of Methods), if not already known.

D2. Check all sites against the RIDEM Office of Compliance and Inspection's records (if status is not already known) to identify any sites with enforcement flags.

D3. For sites with enforcement flags, periodically check with RIDEM to ascertain if the cases have been resolved. If RIDEM requires the landowner to re-create or widen an upland buffer as part of the consent agreement, then proactive buffer restoration may not need to be pursued.

D4. For those sites with no enforcement problems, attempt to obtain telephone numbers or other means of landowner contact.

D5. Seek landowner permission for a site visit.

D6.* Visit eligible sites to determine if there is a viable buffer restoration opportunity (see "Field Verification" section of Methods).

D7.* If there is a viable opportunity, do a feasibility analysis (see "Feasibility Analyses" section of Methods).

D8. For all sites where buffer restoration appears to be feasible, seek landowner cooperation for on-the-ground restoration.

D9. Proceed with steps C4-C12 under "Buffer Restoration Feasibility Sites" in this section.

Some Key Ingredients for Success

Early Site Visits

Attempts should be made to visit the sites of potential restoration opportunities as soon as possible. Identification of potential restoration sites using aerial photographs, digital orthophotography, and RIGIS wetlands and soils coverages is only the first step, and it is

subject to error. In some cases, it is not possible to conclusively determine whether wetland was present historically at a particular site, either because of poor quality photographs or lack of stereoscopic (3-D) coverage. Photographic "signatures" for relatively dry wetlands may be especially difficult to interpret. In addition, natural plant successional processes and changes in land use may cause significant changes in site conditions even since recent photography was taken. Areas identified as upland vegetation removal sites on photographs taken 10 or 15 years ago now may support shrubs or even trees. Other sites now may contain utility lines, storm drain systems, or sewer lines. Filled wetlands that formerly were vacant land now may support development. For all of these reasons, it is critically important to visit each potential restoration site at the outset to verify that the site is, indeed, a viable restoration opportunity.

Landowner permission should be obtained before entering sites; however, the process of contacting landowners may be extremely time consuming. Therefore, efforts should be made to view sites from nearby roads and other public access points even before landowner contacts are attempted. If a site is determined to be nonviable by such means, landowner contact may be unnecessary and considerable time and energy may be saved.

Effective Landowner Contact Methods

In those cases where it is impossible to determine the viability of a potential restoration site without a visit to the site itself, every possible means should be pursued to obtain landowner permission for access. We recommend that, as soon as they are identified, landowners be sent a letter to introduce the concept of proactive restoration and to solicit their cooperation. The letter should be accompanied by a returnable postcard on which the landowner can indicate his or her willingness to discuss the topic further (or not) and provide a telephone number and optimal time for a telephone call. Before sending the letter to the landowner, the site and lot numbers should be written on the postcard; in this way, the landowner can be identified without having to write his or her name on the card.

Landowners should be called to request permission for a site visit as soon as the postcards are returned, and they should be given an opportunity to ask questions. If postcards are not returned, attempts should be made to obtain the landowners' telephone numbers and to contact them by phone. If telephone numbers are unavailable, attempts should be made to contact the landowners in person at their residences, preferably during the evening or on weekends. If even that approach fails, abutting landowners might be asked, in person, if they know how to contact the landowners in question.

Realistic Expectations

A review of the functional assessment results for wetland restoration sites shows that sites located in a rural setting generally can be expected to perform the widest variety of functions after restoration. Urban sites may be exceedingly important, and effective, for flood abatement, water quality improvement, nature education, and open space, but may offer little in the way of quality wildlife habitat, fish habitat, or biodiversity support. Rural sites may provide good habitat for fish and wildlife; provide high-quality recreation areas; and contribute significantly to flood abatement and, in agricultural landscapes, water quality improvement downstream. However, the open space value of rural wetlands might not be as great as for sites in an urban setting. In short, the benefits that wetland restoration provides are heavily influenced by context. This point should be carefully considered in planning individual restoration projects to insure that expectations are appropriate for the location (Ehrenfeld 2000).

Funding

This restoration plan will only be successful if funds and technical assistance for restoration planning, construction, and evaluation are aggressively pursued. Funds and technical assistance for restoration may be obtained directly from a variety of federal agencies, from federal agencies via state agencies, and from private foundations, companies, or partnerships. The size of grants ranges widely but, more than likely, several sources of funds and technical assistance may be needed to cover the costs of a single fill removal project; buffer restoration projects should be far less expensive, unless

they are very large. To qualify for assistance under each program, specific criteria must be met. For example, some of the USDA programs provide funds specifically for farmers, while many of the nongovernmental sources grant funds only to nonprofit organizations. Some programs are designed specifically to fund wetland restoration; others fund the creation, enhancement, restoration, or acquisition of habitats for fish and wildlife; still other programs target certain land use problems such as nonpoint source pollution or impacts of highway construction. All federal grants and most state grants require that the recipient share the cost of restoration; matching funds typically are not required by private funding organizations.

Table 12 lists some of the most likely sources of support for freshwater wetland restoration and buffer restoration projects that might be undertaken in the Woonasquatucket River watershed. A brief profile of each source appears in Appendix J. The contact people and websites that are listed there should be consulted to learn more about each source before applying for funds or technical assistance.

Landowner Incentives

Filled wetlands frequently have high real estate value as building land and, unless private landowners can benefit financially from restoration, many may be unwilling to cooperate. For that reason, municipal governments, state and federal agencies, and nongovernmental organizations which are interested in restoring wetlands on private land must be ready to either purchase sites outright or to develop other strong incentives for landowner participation. Conservation easements coupled with tax relief might be a reasonable approach for small sites with limited real estate value, but restoration sponsors should aggressively pursue acquisition of large sites with high restoration potential before they are developed. Many of the most promising restoration sites in the Woonasquatucket River watershed are privately owned.

Avoidance of Marginal Restoration Opportunities

Wetland restoration at fill sites should involve not only re-creation of wetland but also creation of a vegetated upland buffer zone surrounding the wetland. To be effective, such

Table 12. Potential sources of restoration funding or technical assistance.

FEDERAL PROGRAMS

U.S. Department of Agriculture

Farm Service Agency
Conservation Reserve Program

Forest Service
Forestland Enhancement Program
Watershed and Air Management Cost Share

Natural Resources Conservation Service
Conservation Technical Assistance
Environmental Quality Incentives Program
Resource Conservation and Development
Small Watershed Program and Flood Prevention Program
Wetlands Reserve Program
Wildlife Habitat Incentives Program

U.S. Department of Commerce

National Oceanic and Atmospheric Administration
Community-based Restoration Program

U.S. Department of Defense

Army Corps of Engineers
Aquatic Ecosystem Restoration
Planning Assistance to the States
Project Modification for Improvement of the Environment

U.S. Department of the Interior

Fish and Wildlife Service
National Fish and Wildlife Foundation Grants – Challenge and Small Grants
National Fish and Wildlife Foundation Grants – Special Grants
North American Wetlands Conservation Act Grants
Partners for Fish and Wildlife Habitat Restoration

(Continued)

Table 12. (Concluded).

U.S. Environmental Protection Agency

Office of Water
Five-Star Restoration Program

FEDERALLY SUPPORTED STATE PROGRAMS

Rhode Island Department of Environmental Management

Clean Water State Revolving Fund (USEPA)
Land and Water Conservation Fund Grants (USDI)
Nonpoint Source Implementation (USEPA)
Water Quality Grants (USEPA)
Wetlands Program Development Grants (USEPA)

Rhode Island Department of Transportation

Transportation Enhancements Plan (USDOT)

NONGOVERNMENTAL PROGRAMS

Acorn Foundation Grants
Bafflin Foundation Grants
Corporate Wetlands Restoration Partnership
Davis Conservation Foundation Grants
FishAmerica Foundation Grants
Norcross Wildlife Foundation Grants
Orvis Conservation Projects
Prospect Hill Foundation Grants
Small Grants Program for New England Activists

a buffer zone should be at least 50 feet wide; 100 feet or more would be preferable for most purposes (Desbonnet et al. 1994). In those cases where a filled wetland is small or very narrow, there may not be enough space to create both a functioning wetland and an adequate buffer zone around it. When such a fill site also currently supports a well developed upland forest or shrub community which has significant value as wildlife habitat or as a development buffer, one might argue that removal of the existing vegetation and restoration of wetland might not be in the public's best interests. In this study, we have intentionally avoided setting a minimum size below which a restoration opportunity might not be worth pursuing because, on a cumulative basis, even very small restorations may contribute significantly to a watershed's integrity. Nevertheless, occasions may arise where one restoration opportunity should be passed over in favor of another where the benefits are clearer.

LITERATURE CITED

Adamus, P.R., E.J. Clairain, Jr., R.D. Smith, and R.E. Young. 1987. Wetland evaluation technique (WET). Volume II: Methodology. Operational Draft Technical Report Y-87-_. U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. 206 pp. + appendices.

Adamus, P.R., L.T. Stockwell, E.J. Clairain, Jr., M.E. Merrow, L.P. Rozas, and R.D. Smith. 1991. Wetland evaluation technique (WET). Volume I: Literature review and evaluation rationale. U.S. Army Corps of Engineers Waterways Experiment Station, Wetlands Research Program Technical Report WRP-DE-2. Vicksburg, Mississippi. 280 pp.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service, Biological Services Program, FWS/OBS-79/31. 131 pp.

Dahl, T.E. 1990. Wetlands losses in the United States: 1780's to 1980's. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 21 pp.

Desbonnet, A., P. Pogue, V. Lee, and N. Wolff. 1994. Vegetated buffers in the coastal zone--A summary review and bibliography. University of Rhode Island Graduate School of Oceanography Coastal Resources Center Technical Report No. 2064, Narragansett, Rhode Island. 72 pp.

Ehrenfeld, J.G. 2000. Defining the limits of restoration: The need for realistic goals. Restoration Ecology 8:2-9.

Greeson, P.E., J.R. Clark, and J.E. Clark, eds. 1979. Wetland functions and values: The state of our understanding. American Water Resources Association, Minneapolis, Minnesota. 674 pp.

Kusler, J.A., and M.E. Kentula. 1990. Executive summary. Pages xvii-xxv *in* J.A. Kusler and M.E. Kentula (eds.). Wetland creation and restoration: The status of the science. Island Press, Washington, D.C.

Miller, N.A., and F.C. Golet. 2001. Development of a Statewide freshwater wetland restoration strategy: Site identification and prioritization methods. Final Research Report prepared for R.I. Department of Environmental Management, Office of Water Resources, and U.S. Environmental Protection Agency, Region 1. University of Rhode Island Department of Natural Resources Science, Kingston. 153 pp.

Mitsch, W.J., and J.G. Gosselink. 2000. Wetlands. John Wiley and Sons, New York. 920 pp.

National Research Council. 1992. Restoration of aquatic ecosystems: Science, technology, and policy. National Academy Press, Washington, D.C.

Rector, D. 1981. Soil survey of Rhode Island. U.S. Department of Agriculture, Soil Conservation Service, in cooperation with Rhode Island Agricultural Experiment Station. Warwick, R.I.

Tiner, R.W. 1995. Wetland restoration and creation. Pages 517-534 *in* W.A. Nierenberg (ed.). Encyclopedia of Environmental Biology. Volume 3. Academic Press, N.Y.

U.S. Army Corps of Engineers. 1995. The highway methodology workbook supplement: Wetland functions and values--A descriptive approach. New England Division, Corps of Engineers, Waltham, Massachusetts. 32 pp.

Zedler, J.B., and J.C. Calloway. 1999. Tracking wetland restoration: Do mitigation sites follow desired trajectories? Restoration Ecology 7:69-73.

Appendix A. Detailed methods for identification and prioritization of potential restoration sites.

Identification of Potential Restoration Sites

Miller and Golet (2001) identified nine wetland impact types in a 12-square mile study area within the Woonasquatucket River watershed; they were: filling, drainage, stream channelization, impedance of surface flow, removal of wetland vegetation, removal of adjacent upland vegetation, trash dumping, invasive species, and sedimentation. The present study focuses on the two major wetland impact types: filling, which destroys wetlands, and removal of adjacent upland vegetation, which degrades them. These impact types were selected because of their prevalence and because impact removal would result in maximum gains of wetland functions. The opportunity for wetland restoration is, in large part, dependent upon current land use; for that reason, sites that had active land uses (e.g., buildings, roads, parking lots, athletic fields) were not considered to be potential restoration opportunities, unless the area was obviously abandoned.

Identification of Filled Wetlands

A time-lapse approach was used to identify potential restoration sites where wetland had been destroyed as a result of filling between 1939 and 1997. The primary strategy was to compare images on 1939 aerial photography, which is the State's oldest data source, to the most recent GIS data, which included 1997 digital orthophotography and the 1988 RIGIS wetlands coverage. The GIS data were viewed in ArcView at the same scale as the 1939 photography (1:7,920). Where possible, the 1939 photographs were viewed through a Topcon mirror stereoscope to enhance the interpretation process. The 1939 photography and the GIS data were compared in a systematic fashion throughout the watershed in order to locate wetlands that had changed in size or shape or that had been lost entirely. In some cases, it was possible to identify wetland that had been filled between 1988 and 1997 because the 1997 orthophotography showed a disturbance within the 1988 wetland boundary.

Several additional data sources were used to enhance the identification process. In many cases, stereoscopic (3-dimensional) examination of the 1988 aerial photographs, which bear the original RIGIS wetland delineations, helped greatly. The 1988 photos, along with the 1997 orthophotography, also were used to determine the land use of an impacted area and, consequently, whether or not that area represented a viable restoration opportunity. The RIGIS soils coverage, derived from the Rhode Island Soil Survey (Rector 1981), also was useful. We used ArcView to select out the Udorthent (UD) and Urban Land (Ur) soil types—which indicate filling or excavation to at least 2 feet—and viewed those types simultaneously with the RIGIS wetlands coverage to confirm potential restoration sites that had been identified during the initial time-lapse analysis and to identify possible wetland filling prior to 1939. Those areas where UD or Ur soil types were adjacent to wetlands were considered possible wetland fill sites. In all cases, additional sources (e.g., the 1988 photos) had to be consulted to confirm that those soil types represented filling, as opposed to excavation. The usefulness of this method was somewhat limited by the minimum mapping unit of 5 acres for the UD and Ur soil types (Rector 1981). ArcView also was used to select out the hydric (wetland) soils from the soils data and to view them simultaneously with the RIGIS wetlands. This method permitted identification of areas that had hydric soils in 1981 but that were not mapped as wetland in 1988. Where the 1997 orthophotography showed evidence of disturbance within these areas, we concluded that wetland filling was likely.

The approximate boundaries of fill sites were delineated and digitized to create a GIS polygon coverage so that fill areas could be estimated and sites could be more easily located and assessed in the field. For each of the fill sites that we identified, the extent of the 1939 wetlands in the area was delineated on acetate overlying the 1939 aerial photography; at the same time, we delineated any roads that could function as control features. The acetate was then fixed to a computer screen so that the delineations could be viewed simultaneously with the 1997 orthophotography and the 1988 RIGIS wetland boundaries. After adjusting the orientation of the acetate delineations and the scale of the orthophotography to obtain a good alignment of the roads, we identified those areas of

1939 wetland that had been converted to upland. Those areas were then heads-up digitized to create a GIS polygon coverage of potential restoration sites.

Identification of Upland Vegetation Removal Sites

Identification of wetlands that have been degraded as a result of the removal of adjacent upland vegetation, mainly trees and shrubs, was accomplished primarily by stereoscopically viewing the 1988 aerial photographs that bear the RIGIS wetland delineations. The presence of the wetland delineations, combined with the ability to systematically examine the upland-wetland interface in stereo, greatly expedited the identification process. Additional sites were identified by simultaneously viewing the 1997 orthophotography and the RIGIS wetlands coverage in ArcView. This method was not as reliable as the stereoscopic inspection of the 1988 aerial photos because the orthophotography could not be viewed in stereo; however, it provided a means of detecting wetland impacts that had occurred since 1988.

While identifying upland vegetation removal impacts, we created a GIS line coverage to depict the location and extent of vegetation removal. As each potential restoration site was identified on the 1988 aerial photos, we viewed the same area in ArcView with the RIGIS wetland delineations drawn over the 1997 orthophotography. We then heads-up digitized lines in ArcView that represented the extent of the impact seen through the stereoscope. For those impacts occurring after 1988 (i.e., identified on the 1997 orthophotography), we simply heads-up digitized the extent of the impact directly.

Prioritization of Potential Restoration Sites

Because of the potentially large number of restoration opportunities, the scarcity of funding, and the reality that wetland restoration will proceed slowly in most watersheds, we developed methods to prioritize restoration opportunities at wetland fill sites and upland vegetation removal sites.

Functional Assessment and Ranking of Filled Wetlands

The first step toward prioritization of filled-wetland restoration sites was an assessment of the capacity of each site, if restored, to perform one or more of five wetland functions: flood abatement, water quality improvement, wildlife habitat, fish habitat, and heritage. The criteria used to assess these functions (Table 1) were generated from the experience of the authors and a review of wetland functional assessment methods developed by Adamus et al. (1987) and the U.S. Army Corps of Engineers (1995). Rationale for these criteria, as well as methods for assessing them, are described in Appendix B. The area of land that was assessed at each site was labeled the "restoration assessment unit" (RAU) (Table 1). Where the fill site bordered directly on existing wetland, the assessment unit was the combined area of the fill site and the wetland; if there was no contiguous wetland, then the assessment unit was the fill site alone.

Some modifications to the functional assessment method developed by Miller and Golet (2001) were made during this second phase of research, mainly to take greater advantage of remotely sensed GIS data. These changes dramatically reduced the amount of field time required to conduct the assessment. Following a recommendation by Miller and Golet (2001), we also consulted with personnel from the RIDEM Division of Fish and Wildlife and reworked the criteria for the assessment of the fish habitat function.

Data were collected in the field and in the lab to determine which criteria were met for each function (Appendix B). Each criterion was designated as an "opportunity," "effectiveness," or "social significance" criterion; these terms were borrowed from Adamus et al. (1987). *Opportunity* criteria indicate whether a wetland has the chance to perform a certain function. For example, wetlands surrounded by impervious surfaces receive large quantities of surface runoff during storms; those wetlands have the opportunity to store that water and abate downstream flooding problems. *Effectiveness* criteria assess the capacity of a wetland to perform a specified function, based on the wetland's characteristics. For example, wetlands that occur in basins are more effective at temporarily storing floodwaters than wetlands that occur on slopes. *Social significance* criteria indicate whether performance of a certain function at a particular site would have

clear benefits to society. For example, the flood abatement function of a wetland has social significance if the wetland lies upstream of developed, flood-prone areas. In cases where the entire wetland was destroyed, the RAU was the fill site itself and, since it was no longer wetland, there were several criteria that could not be evaluated (Table 1).

We used opportunity (O) and effectiveness (E) criteria to calculate the probability that a restoration assessment unit (RAU) could perform a certain function. This probability was simply the proportion of the total number of O and E criteria that were satisfied. Scores were increased by 0.1 for each RAU where at least one of the social significance criteria also was met. Wildlife habitat and fish habitat functions do not have social significance criteria because the functions are always considered to be socially significant. RAU scores for those functions were automatically increased by 0.1. For each function, all RAUs that had an O-E-S score of 0.6 or greater were included in the ranking process (see below); all other sites were excluded from the ranking process for that function. Therefore, only RAUs with a high probability of performing a given function were considered further.

In order to obtain final scores for individual fill sites, we multiplied the O-E-S score by a size factor that was based on the acreage of the fill site (rather than the acreage of the entire RAU, of which the fill site was a part). O-E-S scores for sites smaller than 0.5 acres were multiplied by 1.0; scores for sites between 0.5 and 2.0 acres were multiplied by 1.5; and scores for sites larger than 2.0 acres were multiplied by 2.0. Sites were then ranked for each function according to their final scores, which ranged from 0.6 to 2.2. Where ties existed, the sites were further ranked by absolute size. Appendix D provides an example of final score calculation for a single wetland function at one of the wetland fill sites.

For each site, we also determined the number of functions that had a high probability of being performed (i.e., those functions that had an O-E-S score of 0.6 or higher). The number of functions was then multiplied by the appropriate size factor (see paragraph above). Because size factors ranged from 1.0 to 2.0 and the possible number of functions

ranged from 0 to 5, final scores could range from 0 to 10. Sites were ranked by sorting their final scores from highest to lowest. Where ties existed, sites were further ranked by absolute size. Appendix D provides an example of final score calculation for multiple wetland functions at one of the wetland fill sites.

Tiering of Wetland Fill Sites

The functional assessment and ranking process generated six ranked lists of wetland fill sites that potentially could be restored, one list for each of the five functions and one list for multiple functions. Ranking sites by their ability to perform individual functions allows users with special interests to target specific functions; for example, wildlife conservation agencies or organizations may wish to target restoration sites where waterbird habitat could be improved. The ranked list that is based on multiple functions allows users to identify sites that have the greatest potential to provide a wide range of functions. Ultimately, the results from the six lists were combined to produce three tiers of sites, each tier comprising roughly one-third of the total pool.

- Tier 1 included (1) the top 18 sites from the multi-function list (i.e., all of the sites that were >0.5 acres and that had the potential to perform at least 4 of the 5 functions) and (2) the upper one-sixth of the sites from each of the five single-function lists.
- Tier 2 included sites that ranked approximately in the upper one-third of one or more of the single-function lists, unless the site had already been assigned to Tier 1.
- Tier 3 included those sites that did not qualify for either of the first two tiers.

Tiering of Upland Vegetation Removal Sites

Upland vegetation removal sites were ranked based on the answers to two questions: (1) was the site vulnerable to major human impacts, based on context; and 2) was the contiguous wetland type highly sensitive to such impacts? Sites that were adjacent to roads, industry, commercial centers, high-density residential development, or other land uses (e.g., gravel mining, cattle grazing) that might contribute to further wetland degradation were considered vulnerable. Highly sensitive wetland types included bogs, fens, marshes or wet meadows, standing or flowing water bodies, and Atlantic white cedar (*Chamaecyparis thyoides*) swamps.

- Tier 1 included sites where the answer to both questions was “yes.”
- Tier 2 included sites where the answer to one question was “yes” and the answer to the other question was “no.”
- Tier 3 included sites where the answer to both questions was “no.”

Within these priority groups, sites were further ranked by the total length of the upland vegetation removal impact (<400 ft, 400-800 ft, and >800 ft).

Appendix B. Functional assessment criteria for potential wetland restoration sites: Rationale and data collection methods.

Introduction

This appendix provides the rationale behind each of the functional assessment criteria listed in Table 1; it also describes the procedures used in collecting data for the assessments. Descriptions are provided for field and lab assessments of individual criteria. In each case, field and lab techniques have been designated as the primary, secondary, or sole source of information. Primary sources provided the bulk of the assessment data, while secondary sources were used to augment—or as a check upon—primary sources. Whenever conflicts occurred between field observations and lab data, field observations always took precedence. Certain criteria were designated as "necessary to the function" (see below, and see Table 1). If one of those criteria was not satisfied, then the function could not be provided at that site and assessment was discontinued. In an individual assessment, the restoration assessment unit (RAU) was either (1) the potential restoration site (PRS) and its contiguous wetland unit (WU) or (2) just the PRS (if no contiguous wetland was present).

Function: FLOOD ABATEMENT

FA1: Impervious surfaces cover > 20% of land within 500 feet of RAU

Rationale: Wetlands bordered by impervious surfaces (e.g., roads, sidewalks, paved parking lots, buildings) are likely to receive significant amounts of runoff during storm events. As a result, these wetlands have a great opportunity to desynchronize floodwaters.

Lab assessment (primary source): Arc/Info was used to generate 500-foot buffer regions for each assessment unit. Buffer regions were intersected with the RIGIS land use coverage to determine the percentage of impervious land use types (Appendix C).

Field assessment (secondary source): Field notes were recorded on the presence or absence of impervious surfaces in the vicinity of the assessment unit. Particular attention was paid to impervious surfaces that may have been constructed since 1995 (the date of the RIGIS land use data).

FA2: Slopes within 500 feet of RAU are > 15%

Rationale: Wetlands bordered by steep slopes are likely to receive significant amounts of surface runoff during storm events. These wetlands have a great opportunity to desynchronize floodwaters.

Lab assessment (primary source): The RIGIS soils coverage, assessment units with 500-foot buffers, and 1997 orthophotos were viewed simultaneously in ArcView. Soil map units coded as "D" (i.e., soils with slopes > 15 %) that occurred within 500 feet of assessment units were

identified. If any such soil map units were encountered, the criterion was considered to be satisfied. Where the aspect of the slope was unclear, collateral data sources (e.g., topographic maps or stereopairs of aerial photos) were consulted.

Field assessment (secondary source): Field notes were recorded on the slope of land bordering the assessment units.

FA3: Point-source discharge or concentrated stormwater flow into RAU

Rationale: Surface water that has been routed into a wetland (e.g., from roads, parking lots, or point-source discharges) increases the opportunity for that wetland to desynchronize floodwaters.

Lab assessment (primary source): Assessment units that receive point-source discharges were identified by viewing orthophotos, assessment units, and the RIGIS coverage of point-source discharges in ArcView. In addition, 1988 aerial photos were interpreted in stereo to determine where channels have been constructed between roads or parking lots and wetlands.

Field assessment (secondary source): Field inspections were necessary whenever lab assessment was inconclusive.

FA4: RAU borders or contains a lower perennial stream

Rationale: Wetlands that contain, or are adjacent to, lower perennial streams have an opportunity to receive floodwaters via overbank flow.

Field assessment (primary source): The presence or absence of stream floodplains was determined in the field.

Lab assessment (secondary source): Aerial photos were viewed in stereo to determine the presence of lower perennial streams in, or adjacent to, assessment units.

FA5: RAU occurs within a basin

Rationale: Wetlands occurring in basins can effectively store floodwater; slope wetlands cannot. This criterion was considered "necessary to the function." Potential restoration sites that lacked contiguous wetland were assumed to occur within a basin.

Field assessment (primary source): Field observations were made to determine whether wetland units occurred in basins or on slopes.

Lab assessment (secondary source): 1988 aerial photos were interpreted in stereo to determine whether wetland units occurred in basins or on slopes.

FA6: More than 50% of WU area is dominated by dense, persistent vegetation (EM, SS, or FO)

Rationale: Dense wetland vegetation can reduce downstream flood levels and delay flood crests by reducing floodwater velocity. Persistent vegetation (e.g., woody plants, persistent emergents) can perform this function even outside of the growing season.

Lab assessment (primary source): Wetland types and their corresponding areas were determined from the RIGIS wetlands database.

Field assessment (secondary source): The presence of dense, persistent, wetland vegetation was noted in the field. Where conflicts with the RIGIS wetlands database existed, field observations always overrode lab assessments.

FA7: Developed flood-prone areas within 5 miles downstream of RAU (connection by stream or floodway required)

Rationale: The flood abatement function for wetlands is socially significant if there are developed flood-prone areas downstream. For purposes of this assessment, the assessment unit must be connected to developed flood-prone areas by surface water at the time of flooding.

Lab assessment (sole source): Orthophotos, RIGIS land use and FEMA coverages, and assessment units were inspected in ArcView to determine the presence of developed flood-prone areas and to measure the distance between those areas and the assessment unit in question.

Field assessment: This criterion was not assessed in the field.

Function: WATER QUALITY IMPROVEMENT

WQ1: Point-source discharge or concentrated stormwater flow into RAU

Rationale: Wetlands that receive pollution from point-source discharges or concentrated runoff from roads and parking lots have greater opportunity to improve water quality than wetlands not receiving such inputs.

Lab assessment (primary source): Assessment units that receive point-source discharges were identified by viewing orthophotos, assessment units, and the RIGIS coverage of point-source discharges in ArcView. In addition, 1988 aerial photos were interpreted in stereo to determine where channels have been constructed between roads or parking lots and wetlands.

Field assessment (secondary source): The presence of point-source discharges or concentrated stormwater inflow was noted at all sites visited in the field.

WQ2: Impervious surfaces, active agricultural land, or barren land comprise > 20% of land within 500 feet of RAU

Rationale: Impervious surfaces, active agricultural land, and barren land have high potential to add nutrients, sediment, and other pollutants to surface water and groundwater. Wetlands receiving these inputs therefore have the opportunity to improve water quality.

Lab assessment (primary source): Arc/Info was used to generate 500-foot buffer regions for each assessment unit. Buffer regions were intersected with the RIGIS land use coverage to determine the percentage of impervious surfaces, active agricultural land, and barren land (Appendix C).

Field assessment (secondary source): Field notes were recorded on the presence or absence of impervious surfaces, active agricultural land, or barren land in the vicinity of the assessment unit. Particular attention was paid to land use changes since 1995 (the date of the RIGIS land use data).

WQ3: More than 50% of WU area is dominated by dense, persistent vegetation (EM, SS, or FO)

Rationale: Dense wetland vegetation can serve as a filter for pollutants and can also impede the flow of water, causing sediments and associated pollutants to drop out of suspension. Persistent vegetation (e.g., woody plants, persistent emergent species) can perform this function even outside of the growing season.

Lab assessment (primary source): Wetland types and their corresponding areas were determined from the RIGIS wetlands database.

Field assessment (secondary source): The presence of dense, persistent, wetland vegetation was noted in the field. Where conflicts with the RIGIS wetlands database existed, field observations always overrode lab assessments.

WQ4: RAU occurs within a basin

Rationale: Basin wetlands retain greater volumes of water for longer periods of time than slope wetlands. Greater retention time permits increased interaction between plants or soil and pollutants, as well as settling of suspended solids.

Field assessment (primary source): Field observations were made to determine whether wetland units occurred in basins or on slopes.

Lab assessment (secondary source): 1988 aerial photos were interpreted in stereo to determine whether wetland units occurred in basins or on slopes.

WQ5: RAU has a constricted outlet

Rationale: Wetlands with constricted outlets have the potential to retain polluted water for extended periods of time. Long retention times allow for increased interaction between plants or soil and pollutants, as well as settling of suspended solids.

Lab assessment (primary source): Assessment units, orthophotos, and RIGIS stream coverages were viewed simultaneously in ArcView. Stereo interpretation of aerial photos also was useful.

Field assessment (secondary source): The presence and relative size of outlets was noted in the field, particularly in cases where no outlet was detected during the lab analysis.

WQ6: RAU is within a wellhead protection area

Rationale: Wetlands within wellhead protection areas are in a position to improve the quality of groundwater used for drinking. Therefore, there is social significance to restoration of such wetlands.

Lab assessment (sole source): Assessment units, orthophotos, and RIGIS wellhead protection areas were viewed simultaneously in ArcView.

Field assessment: This criterion was not assessed in the field.

WQ7: RAU borders or contains a water body that is on the Rhode Island List of Impaired Waters

Rationale: Wetlands that border or contain Impaired Waters are in a position to improve the quality of those waters. For that reason, these wetlands are socially significant.

Lab assessment (sole source): Assessment units, orthophotos, and State-listed Impaired Waters (identified as a subset of RIGIS water bodies) were viewed simultaneously in ArcView.

Field assessment: This criterion was not assessed in the field.

Function: WILDLIFE HABITAT

WH1: Wetlands and deepwater habitats comprise > 15% of land within 1 mile of RAU

Rationale: Wetlands that are in close proximity to other wetlands, or that are part of large wetland complexes, are more effective than isolated wetlands at providing habitat for wetland wildlife. Where wetlands are abundant, many species of wildlife are able to move among them to satisfy their diverse habitat requirements.

Lab assessment (sole source): The RIGIS wetland coverage was converted to a grid with 10-x10-meter cells. An .aml was run in ArcGrid to determine the number of cells within 1 mile of each assessment unit that were designated as wetland or deepwater habitat. Values were then converted to percentages.

Field assessment: This criterion was not assessed in the field.

WH2: RAU is contiguous with > 400 acres of moderate to high quality habitat (wetland or deepwater habitat, upland forest or shrubland, abandoned field, or agricultural land)

Rationale: Some wetland wildlife species can breed successfully in small patches of habitat. However, certain "interior" species are only successful in wetlands surrounded by extensive natural habitat; other species (e.g., deer, otter) have large home ranges and also require extensive natural areas. Contiguity of natural habitats also enables wildlife dispersal among wetlands; successful dispersal, in turn, ensures genetic diversity and lessens the chance of localized extirpations. To provide habitat for interior species and species with large home ranges, restoration efforts should focus on wetlands that are contiguous with extensive, moderate to high quality habitat.

Lab assessment (sole source): An Arc/Info coverage of moderate to high quality wildlife habitat was created by intersecting RIGIS land use data and road data (major roads were considered habitat edges). Wildlife habitat polygons > 400 acres were viewed along with assessment units in ArcView, and contiguity was assessed.

Field assessment: This criterion was not assessed in the field.

WH3: RAU > 5 acres

Rationale: Large wetlands are capable of supporting larger—and, therefore, more viable—wetland-dependent wildlife populations. Large wetlands also better satisfy the habitat requirements of wetland-dependent species with large home ranges.

Lab assessment (sole source): The attribute table for the assessment units was queried to determine unit area.

Field assessment: This criterion was not assessed in the field.

WH4: RAU contains wetland-dependent wildlife habitat (OW, marsh, bog, or fen)

Rationale: Wetlands that contain open water, marsh, bog, or fen are more likely to support wetland-dependent wildlife than wetlands without these habitats. For the purpose of this assessment, wetlands that were dominated by invasive plant species were not considered to be viable wetland-dependent wildlife habitat.

Lab assessment (primary source): Wetland habitat types were determined by viewing the RIGIS wetlands coverage, which has a minimum map unit of 0.25 acres.

Field assessment (secondary source): The presence of wetland-dependent wildlife habitat was noted during field work. When conflicts with the RIGIS database occurred, field observations always overrode lab assessments.

WH5: No point-source discharge or concentrated stormwater flow into RAU

Rationale: To remain healthy and viable, wildlife populations require clean water. Restoration success for the wildlife habitat function is likely to be greater if water quality is good.

Lab assessment (primary source): Assessment units that receive point-source discharges were identified by viewing orthophotos, assessment units, and the RIGIS coverage of point-source discharges in ArcView. In addition, 1988 aerial photos were interpreted in stereo to determine where channels have been constructed between roads or parking lots and wetlands.

Field assessment (secondary source): The presence of point-source discharges or concentrated stormwater inflow was noted at all sites visited in the field.

WH6: Less than 0.25 acres of invasive plants in WU

Rationale: Wetlands containing invasive plant species, such as *Phragmites australis* and *Lythrum salicaria,* are limited in their ability to provide foraging, roosting, or nesting habitat for native wildlife species. Where invasive species are already established in contiguous wetland, they are highly likely to colonize newly restored wetlands.

Field assessment (primary source): Stands of invasive species were sought out and catalogued in the field.

Lab assessment (secondary source): Lab analyses expedited field identification of invasive plant stands. The RIGIS wetlands database was used to identify wetland units that contained EM or SS wetland types, which are prone to colonization by invasive plants. In addition, orthophotos were used to view the perimeter of wetland units and to identify areas of disturbance, which offer prime colonization sites for invasives.

WH7: Moderate to high quality habitat (wetland or deepwater habitat, upland forest or shrubland, abandoned field, or agricultural land) comprise > 70% of land within 500 feet of RAU

Rationale: This criterion considers the immediate context of the assessment unit. Wetlands surrounded by the habitats listed above are more likely to support healthy wildlife populations.

Such areas are less prone to pollution or disturbance of wildlife due to human activity. Natural surroundings also may provide important foraging, nesting, or roosting habitat for wetland wildlife such as waterfowl, turtles, wading birds, and certain birds of prey.

Lab assessment (primary source): Arc/Info was used to generate 500-foot buffer regions for each assessment unit. Buffer regions were intersected with the RIGIS land use coverage in order to determine the percentage of moderate to high quality wildlife habitats present.

Field assessment (secondary source): The presence or absence of these habitats was noted in the field. Particular attention was paid to changes in land use that occurred since 1995 (the date of the RIGIS land use data).

WH8: Social significance assumed to be present

Rationale: Wetland wildlife has social significance because of its value for recreation, aesthetics, biodiversity, education, and research. These heritage values were assessed separately (see below), but social significance was assumed to be present in every case under the wildlife habitat function as well.

Function: FISH HABITAT

FH1: Permanent pond or lower perennial stream is present in RAU

Rationale: This criterion is necessary to the fish habitat function. Wetlands that contain perennial surface water have the opportunity to provide permanent habitat for fish. Wetlands adjacent to ponds, lakes, or lower perennial streams (Cowardin et al. 1979) have the opportunity to provide fish habitat during times of overbank flow.

Field assessment (primary source): Perennial surface water and lower perennial stream determinations were made in the field.

Lab assessment (secondary source): Although the RIGIS wetland and stream databases were useful for identifying the presence of ponds, lakes, and perennial streams, assessment of this criterion was most reliable in the field.

FH2: No point-source discharge or concentrated stormwater flow into RAU

Rationale: To remain healthy and viable, fish populations require clean water. Restoration success for the fish habitat function is likely to be greater if water quality is good.

Lab assessment (primary source): Assessment units that receive point-source discharges were identified by viewing orthophotos, assessment units, and the RIGIS coverage of point-source

discharges in ArcView. In addition, 1988 aerial photos were interpreted in stereo to determine where channels have been constructed between roads or parking lots and wetlands.

Field assessment (secondary source): The presence of point-source discharges or concentrated stormwater inflow was noted at all sites visited in the field.

FH3: Permanent pond or lower perennial stream within RAU is bordered by trees or shrubs for > 75% of its length

Rationale: Trees or shrubs that border a pond or stream provide shade and help to maintain cooler water temperatures. Such vegetation also contributes organic detritus which supports invertebrate prey items.

Lab assessment (primary source): Orthophotos were used to make a visual estimate of the percentage of pond edge or stream length that was bordered by trees or shrubs.

Field assessment (secondary source): Changes in vegetation extent that may have occurred since the date of the orthophotos (1997) were noted in the field.

FH4: Impervious surfaces cover < 20% of land within 500 feet of RAU

Rationale: Stormwater runoff from impervious surfaces (e.g., roads, sidewalks, paved parking lots, buildings) can significantly elevate the temperature of ponds and streams, adversely impacting fish populations. The extent of this problem should be related to the extent of impervious surfaces around the water body.

Lab assessment (primary source): Arc/Info was used to generate 500-foot buffer regions for each assessment unit. Buffer regions were intersected with the RIGIS land use coverage to determine the percentage of impervious land use types (Appendix C).

Field assessment (secondary source): Field notes were recorded on the presence or absence of impervious surfaces in the vicinity of the assessment unit. Particular attention was paid to impervious surfaces that may have been constructed since 1995 (the date of the RIGIS land use data).

FH5: Open water, if present in RAU, > 2 acres

Rationale: Large water bodies are capable of supporting large fish populations. They can also contain a great diversity of fish habitat, which can increase fish species diversity.

Lab assessment (sole source): The attribute table for assessment units was queried to determine open water area.

Field assessment: This criterion was not assessed in the field.

FH6: Social significance assumed to be present

Rationale: Fish have social significance because of their value for recreation, aesthetics, biodiversity, education, and research. These heritage values were assessed separately (see below), but social significance was assumed to be present in every case under the fish habitat function as well.

Function: HERITAGE

H1: RAU is physically or visually accessible

Rationale: Physical access to a wetland is necessary for recreation, research, and educational purposes. Aesthetic value can be appreciated from outside the wetland, as long as the site is visually accessible (e.g., from a nearby road or other prominent position on the landscape). Still other heritage values, such as open space and biodiversity, require neither physical or visual access.

Field assessment (sole source): If the wetland could be reached by a public road or viewed from the surrounding landscape, it was considered to be physically or visually accessible.

Lab assessment: This criterion was not assessed in the lab.

H2: RAU borders or contains public land

Rationale: Wetlands that are located on property that is open to the public are more likely to be visited for recreation, nature study, or research purposes than wetlands on private land.

Lab assessment (primary source): Assessment units were viewed along with RIGIS open space coverages in ArcView to determine which units fell within or bordered public land.

Field assessment (secondary source): Field observations were helpful for identifying recreation areas that have been established since the RIGIS coverages were created.

H3: RAU contains open water

Rationale: Sites containing open water may support swimming, fishing, waterfowl hunting, canoeing, or other popular water sports.

Lab assessment (primary source): The presence of open water was determined by viewing the RIGIS wetlands coverage. Stereo-interpretation of 1988 aerial photos and viewing of orthophotos also were helpful.

Field assessment (secondary source): The presence of open water bodies was noted during field work. Where conflicts with the RIGIS wetlands database existed, field observations always overrode lab assessments.

H4: No point-source discharge or concentrated stormwater flow into RAU

Rationale: The discharge of polluted water into a wetland can impair virtually all of the heritage values listed in Table 1.

Lab assessment (primary source): Assessment units that receive point-source discharges were identified by viewing orthophotos, assessment units, and the RIGIS coverage of point-source discharges in ArcView. In addition, 1988 aerial photos were interpreted in stereo to determine where channels have been constructed between roads or parking lots and wetlands.

Field assessment (secondary source): The presence of point-source discharges or concentrated stormwater inflow was noted at all sites visited in the field.

H5: No evidence of noise pollution or trash in RAU

Rationale: Restoration of the heritage function will be most effective in wetlands where degradation does not continue after restoration efforts are completed. Several of the heritage values listed in Table 1 would be impaired by excessive noise or trash.

Field assessment (sole source): Evidence of trash and excessive noise in and surrounding the assessment unit was recorded during site visits.

Lab assessment: This criterion was not assessed in the lab.

H6: RAU contains 3 or more wetland types

Rationale: Within a wetland, diversity in wetland types may contribute to increased aesthetic value, heightened educational and research opportunities, and greater biodiversity.

Lab assessment (primary source): The number of wetland types was determined by viewing the RIGIS wetlands coverage.

Field assessment (secondary source): The number of wetland types was noted during field work. Where conflicts with the RIGIS wetlands database existed, field observations always overrode lab assessments.

H7: Uncommon wetland type (bog, fen, marsh, wet meadow, or cedar swamp) is present in RAU

Rationale: Uncommon wetland types (i.e., bog, fen, marsh, wet meadow, or cedar swamp) are especially important for biodiversity, research, education, and aesthetics.

Lab assessment (primary source): Uncommon wetland types were assessed by viewing the RIGIS wetlands coverage.

Field assessment (secondary source): During site visits, the presence of uncommon wetland types was noted. Wetland types that were dominated by invasive plant species were not considered to be uncommon.

H8: Waterbird habitat (OW or marsh) is present in the WU

Rationale: The presence of waterbirds (e.g., waders, waterfowl, terns) in a wetland can be aesthetically pleasing, can promote recreation (e.g., through hunting, birdwatching), and can provide a key focus for educational field trips. Wetlands that contain open water or marsh have the potential to support waterbird populations.

Lab assessment (primary source): The presence of open water and marsh was assessed by viewing the RIGIS wetlands coverage.

Field assessment (secondary source): During site visits, the presence of open water and marsh habitats was noted. Marshes that were dominated by invasive plant species were not considered to be viable waterbird habitat.

H9: Moderate to high quality habitat (wetland or deepwater habitat, upland forest or shrubland, abandoned field, or agricultural land) comprises < 50% of land within 1 mile of RAU

Rationale: This criterion assesses the abundance of natural or semi-natural open space in the region surrounding an assessment unit. The open space value of wetlands will be greater in areas of the landscape where open space is scarce.

Lab assessment (sole source): The RIGIS land use coverage was converted to a grid with 10-x10-meter cells. An .aml was then run in ArcGrid to determine the number of cells within 1 mile of each assessment unit that was designated as wetland or deepwater habitat, upland forest or shrubland, abandoned field, or agricultural land. Values were converted to percentages.

Field assessment: This criterion was not assessed in the field.

H10: Wetlands and deepwater habitats comprise < 10% of land within 1 mile of RAU

Rationale: Wetland restorations that are accomplished in areas of the landscape where wetlands are scarce will have a positive effect on heritage values (aesthetics, recreation, education, research, open space, and biodiversity).

Lab assessment (sole source): The RIGIS wetland coverage was converted to a grid with 10-x10-meter cells. An .aml was then run in ArcGrid to determine the number of cells within 1 mile of each assessment unit that were designated as wetland or deepwater habitat. Values were converted to percentages.

Field assessment: This criterion was not assessed in the field.

H11: RAU is located within 1 mile of a school or college

Rationale: Wetlands that are close to schools or colleges are more likely to be used for education and research purposes.

Lab assessment (sole source): Points within the RIGIS schools coverage were buffered by 1 mile and viewed in ArcView along with assessment units and orthophotos.

Field assessment: This criterion was not assessed in the field.

Appendix C. RIGIS land use types categorized as impervious, active agricultural, or barren land for functional assessment.

RIGIS code	Description	Impervious	Active agricultural land	Barren land
111	High Density Residential (<1/8-acre lots)	X		
112	Medium High Density Residential (1/4- to 1/8-acre lots)	X		
120	Commercial (sale of products and services)	X		
130	Industrial (manufacturing, design, assembly, etc.)	X		
141	Roads (divided highways >200 ft plus related facilities)	X		
142	Airports (and associated facilities)	X		
143	Railroads (and associated facilities)	X		
144	Water and Sewage Treatment	X		
145	Waste Disposal (landfills, junkyards, etc.)	X		
147	Other Transportation (terminals, docks, etc.)	X		
150	Commercial/Industrial Mixed	X		
170	Institutional (schools, hospitals, churches, etc.)	X		
210	Pasture (livestock)		X	
220	Cropland (tillable)		X	
720	Sandy Areas (not beaches)			X
740	Mines, Quarries and Gravel Pits			X
760	Mixed Barren Areas			X

Appendix D. Scoring and ranking methodology for potential wetland restoration sites.

Ranking sites by individual functions:

1. Field and lab assessments were conducted (see Table 1) to calculate functional probability scores, based on opportunity and effectiveness criteria (after Adamus et al. 1987). Opportunity criteria indicate the chance that a wetland has to perform a function; effectiveness criteria are related to the ability of a wetland to perform a function, based on its characteristics. To generate probability scores, the number of "O" and "E" criteria that were met were divided by the total number of relevant "O" and "E" criteria for each function.

   Example: Site #256 was filled. Four of the six "O" and "E" criteria for the flood abatement function were met (including the requirement that the assessment unit occurs within a basin), so the probability that the site would be able to perform this function after restoration was 0.67.

2. Scores were increased by 0.1 for sites where performance of the function was socially significant (i.e., sites for which at least one of the social significance ["S"] criteria was met). Wildlife habitat and fish habitat functions do not have social significance criteria; site scores for these functions were automatically increased by 0.1.

   Example: Restoration at Site #256 would be socially significant for flood abatement because developed flood-prone areas lie within 5 miles downstream. Therefore, the flood abatement score for the site was increased from 0.67 to 0.77.

3. For each function, all sites that had an O-E-S score of 0.6 or greater were included in the remainder of the ranking process. Sites with O-E-S scores below 0.6 were removed from the ranking process for that function.

   Example: Site #256 was included in the remainder of the ranking process for the flood abatement function because the O-E-S score for that function was greater than 0.6.

4. O-E-S scores for all of the sites that were retained were multiplied by a factor based on area:

Area (acres)	Factor
< 0.50	1.0
0.50 - 2.00	1.5
> 2.00	2.0

   Example: Site #256 is 4.73 acres; therefore, the final flood abatement score was 0.77 x 2.0 = 1.54 (see Appendix G1).

5. Sites were then ranked for each function according to their final scores, which could range from 0.6 to 2.2. Where ties existed, sites were further ranked by absolute area.

   Example: Site #256 was ranked 9th among the 61 sites with O-E-S scores of at least 0.6 for flood abatement because there were eight sites with final scores greater than 1.54, and Site #256 was the largest of the six sites with that score (see Appendix G1).

Ranking sites by the total number of functions performed:

1. Field and lab assessments were conducted to calculate functional probability scores (ranging from 0.0 to 1.0), as above.

2. The scores were then modified for social significance, as above, if appropriate.

3. For each site, the number of functions with an O-E-S score of at least 0.6 was multiplied by an area factor:

Area (acres)	Factor
< 0.50	1.0
0.50 - 2.00	1.5
> 2.00	2.0

   Example: Four of the five functions at Site #256 had O-E-S scores of at least 0.6. Therefore, the number of functions (i.e., 4) was multiplied by the area factor (i.e., 2.0) to produce a final score of 8.0 (see Appendix G6).

4. Sites were then ranked according to their final scores, which could range from 0 to 10. Where ties existed, sites were further ranked by absolute area.

   Example: Site #256 was ranked 5th among the 77 potential wetland restoration sites in terms of multi-function scores because there were four sites with scores greater than 8.0 and Site #256 was the largest of the four sites with that score (see Appendix G6).

Appendix E. Guidelines for wetland restoration construction cost estimates
(assuming clean fill to be removed; dollars based on RIDOT distribution of quantities with federal wage rates).

Assume depth of fill to be removed is 5 feet over an acre:

-	Clearing & grubbing existing vegetation on fill	1 acre @ $5,000/acre	$5,000
-	Cutting & disposing isolated trees (4"-24")	25 @ $270/each	6,750
-	Earth excavation (43,560 sf x 5 ft ÷ 27)	8,067 cy @ $5.00/cy	40,335
-	Rock excavation (assume 2 % of area)	160 cy @ $17.00/cy	2,720
-	Baled hay (110)	738 lf x $3.50/lf	2,583
-	High organic soil (43,560 sf ÷ 9)	4,840 sy x $4.00/sy	19,360
-	Wetland seed mix	4,840 sy x $1.00/sy	4,840
-	Wetland plantings	Lump Sum	5,000
		Subtotal	$86,588
-	Miscellaneous (10% ±)		8,712
			$95,300

Approximate cost ~ $100,000/acre ($2.30/sf) if 5 ft deep

Assume depth of fill is 2.5 feet over an acre:

- ($86,588 [subtotal above] – $20,168 [½ of earth excavation above]) x 1.10 ≅ $73,062

  Approximate cost ~ $75,000/acre ($1.70/sf) if 2.5 feet deep

Assume depth of fill is 7.5 feet over an acre:

- ($86,588 + $20,168) x 1.10 = $117,410

  Approximate cost ~ $120,000/acre ($2.75/sf) if 7.5 feet deep

---

Appendix F. Plat and lot numbers for potential wetland restoration sites.

Town	Site ID	Plat	Lot	Ownership	OCI*
Johnston	22	36.0	7.0	Private	X
Johnston	22	36.0	8.0	Private	X
Johnston	22	36.0	9.0	Private	X
Johnston	22	36.0	37.0	Private	X
Johnston	22	36.0	38.0	Private	X
Johnston	24	37.0	9.0	Private	X
Johnston	24	37.0	63.0	Private	X
Johnston	25	48.2	11.0	Public	
Johnston	50	39.0	113.0	Private	X
Johnston	53	35.0	31.0	Private	
Johnston	53	35.0	35.0	Private	
Johnston	53	35.0	184.0	Private	
Johnston	55	34.0	282.0	Private	X
Johnston	66	35.0	9.0	Private	
Johnston	203	48.3	152.0	Public	
Johnston	214	39.0	53.0	Private	
Johnston	214	39.0	54.0	Private	
Johnston	216	35.0	188.0	Private	
Johnston	221	35.0	188.0	Private	
Johnston	258	13.0	219.0	Private	X
Johnston	258	13.0	261.0	Private	X
Johnston	258	13.0	262.0	Private	X
Johnston	258	13.0	263.0	Private	X
Johnston	258	13.0	264.0	Private	X
Johnston	258	13.0	265.0	Private	X
Johnston	258	13.0	266.0	Private	X
Johnston	258	13.0	280.0	Private	X
Johnston	258	13.0	281.0	Private	X
Johnston	258	13.0	282.0	Private	X
Johnston	258	13.0	291.0	Private	X
Johnston	258	13.0	299.0	Private	X
Johnston	258	13.0	321.0	Private	X
Johnston	258	13.0	417.0	Private	X
Johnston	258	13.0	425.0	Private	
Johnston	349	21.0	494.0	Private	X
Johnston	349	21.0	496.0	Private	X
Johnston	349	21.0	498.0	Private	X
Johnston	349	21.0	500.0	Private	X
Johnston	349	21.0	502.0	Private	X
Johnston	349	21.0	504.0	Private	X
Johnston	349	21.0	506.0	Private	X
Johnston	349	21.0	508.0	Private	X

(Continued)

Appendix F. (Continued).

Town	Site ID	Plat	Lot	Ownership	OCI*
Johnston	349	21.0	514.0	Private	X
Johnston	349	21.0	515.0	Private	X
Johnston	350	20.1	36.0	Private	X
Johnston	396	61.0	248.0	Private	
Johnston	399	60.0	13.0	Private	
Johnston	427	13.0	397.0	Private	
Johnston	427	13.0	401.0	Private	
Johnston	427	13.0	404.0	Private	X
Johnston	427	13.0	405.0	Private	X
Johnston	427	13.0	406.0	Private	X
Johnston	427	13.0	449.0	Private	X
Johnston	427	13.0	450.0	Private	X
Johnston	427	13.0	451.0	Private	X
Johnston	427	13.0	452.0	Private	X
Johnston	427	13.0	453.0	Private	X
Johnston	427	13.0	454.0	Private	
Johnston	427	13.0	455.0	Private	
Johnston	427	13.0	459.0	Private	
Johnston	427	13.0	460.0	Private	
Johnston	427	13.0	461.0	Private	
Johnston	427	13.0	462.0	Private	
Johnston	427	13.0	463.0	Public	
Johnston	427	13.0	464.0	Private	X
Johnston	427	13.0	465.0	Private	X
Johnston	427	13.0	466.0	Private	X
Johnston	427	13.0	467.0	Private	X
Johnston	427	13.0	468.0	Private	X
Johnston	427	13.0	484.0	Private	
Johnston	427	13.0	485.0	Private	X
Johnston	427	13.0	491.0	Private	
North Providence	47	15.0	192.0	Private	X
North Providence	47	15.0	193.0	Private	X
North Providence	47	16.0	51.0	Unknown	
North Providence	47	16.0	120.0	Private	
North Providence	47	16.0	121.0	Private	
North Providence	47	16.0	122.0	Private	
North Providence	47	16.0	123.0	Private	
North Providence	250	17.0	3.0	Private	X
North Providence	250	17.0	4.0	Private	X
North Providence	250	17.0	229.0	Private	
North Providence	379	21.0	785.0	Public	X
North Providence	379	25.1	808.0	Private	

(Continued)

Appendix F. (Continued).

Town	Site ID	Plat	Lot	Ownership	OCI*
North Providence	380	21.0	785.0	Public	X
North Providence	380	21.0	999.0	Private	
North Providence	380	25.1	852.0	Private	X
North Providence	423	21.1	804.0	Unknown	
North Providence	424	9.0	338.0	Public	
North Providence	449	10.0	91.0	Private	X
North Providence	451	20.0	642.0	Private	
North Providence	452	20.0	21.0	Private	
North Smithfield	264	11.0	102.0	Private	
North Smithfield	272	19.0	3.0	Private	X
North Smithfield	274	19.0	3.0	Private	X
North Smithfield	278	15.0	49.0	Private	X
North Smithfield	278	15.0	50.0	Private	X
North Smithfield	278	15.0	51.0	Private	X
North Smithfield	278	15.0	52.0	Private	X
North Smithfield	286	14.0	8.0	Private	
North Smithfield	287	14.0	8.0	Private	
North Smithfield	287	14.0	13.0	Private	X
North Smithfield	288	14.0	7.0	Private	X
North Smithfield	340	19.0	86.0	Public	X
North Smithfield	442	15.0	50.0	Private	X
North Smithfield	442	15.0	51.0	Private	X
North Smithfield	443	15.0	51.0	Private	X
North Smithfield	443	15.0	53.0	Private	X
North Smithfield	443	15.0	54.0	Private	X
North Smithfield	444	15.0	48.0	Private	X
North Smithfield	444	15.0	49.0	Private	X
North Smithfield	445	15.0	24.0	Private	X
North Smithfield	445	15.0	166.0	Private	
North Smithfield	446	19.0	53.0	Private	X
North Smithfield	447	19.0	40.0	Private	
North Smithfield	447	19.0	54.0	Private	X
North Smithfield	448	19.0	40.0	Private	
Providence	256	34.0	381.0	Private	
Providence	259	114.0	18.0	Private	
Providence	259	114.0	64.0	Private	
Providence	259	114.0	66.0	Private	
Providence	259	114.0	92.0	Private	
Providence	259	114.0	93.0	Private	
Providence	259	114.0	442.0	Private	
Providence	259	114.0	448.0	Private	
Providence	425	34.0	48.0	Private	X

(Continued)

Appendix F. (Continued).

Town	Site ID	Plat	Lot	Ownership	OCI*
Providence	425	34.0	381.0	Private	
Providence	427	114.0	26.0	Private	X
Providence	427	114.0	27.0	Private	X
Providence	427	114.0	28.0	Private	X
Providence	427	114.0	29.0	Private	X
Providence	427	114.0	30.0	Private	X
Providence	427	114.0	31.0	Private	X
Providence	427	114.0	49.0	Private	X
Providence	427	114.0	330.0	Private	X
Providence	427	114.0	331.0	Private	X
Providence	427	114.0	332.0	Private	X
Providence	427	114.0	363.0	Private	
Providence	427	114.0	364.0	Private	
Providence	427	114.0	365.0	Private	
Providence	427	114.0	366.0	Private	X
Providence	427	114.0	367.0	Private	X
Providence	427	114.0	368.0	Private	X
Providence	427	114.0	369.0	Private	X
Providence	427	114.0	370.0	Private	X
Providence	427	114.0	371.0	Private	X
Providence	427	114.0	372.0	Private	X
Providence	427	114.0	373.0	Private	X
Providence	427	114.0	374.0	Private	X
Providence	427	114.0	375.0	Private	X
Providence	427	114.0	376.0	Private	X
Providence	427	114.0	377.0	Private	X
Providence	427	114.0	378.0	Private	X
Providence	427	114.0	379.0	Private	X
Providence	427	114.0	380.0	Private	X
Providence	427	114.0	381.0	Private	X
Providence	427	114.0	382.0	Private	X
Providence	427	114.0	383.0	Private	X
Providence	427	114.0	384.0	Private	X
Providence	427	114.0	458.0	Private	
Providence	430	129.0	22.0	Public	
Providence	454	62.0	301.0	Private	
Providence	455	113.0	429.0	Public	
Providence	455	113.0	440.0	Public	
Providence	455	NA**	NA**	Public	
Smithfield	2	31.0	36.0	Private	
Smithfield	2	31.0	38.0	Private	
Smithfield	5	29.0	67.0	Private	X

(Continued)

Appendix F. (Continued).

Town	Site ID	Plat	Lot	Ownership	OCI*
Smithfield	5	29.0	93.0	Private	X
Smithfield	8	25.0	43.0	Private	X
Smithfield	34	16.0	5.0	Private	X
Smithfield	36	16.0	7.0	Private	X
Smithfield	41	43.0	24.1	Private	X
Smithfield	43	42.0	91.0	Public	
Smithfield	43	42.0	93.0	Private	
Smithfield	67	29.0	31.0	Private	X
Smithfield	67	29.0	31.1	Private	X
Smithfield	67	29.0	52.0	Private	X
Smithfield	67	29.0	53.0	Private	X
Smithfield	67	29.0	70.0	Private	X
Smithfield	67	29.0	71.0	Private	X
Smithfield	160	35.0	21.0	Private	
Smithfield	187	16.0	5.0	Private	X
Smithfield	187	16.0	7.0	Private	X
Smithfield	188	16.0	5.0	Private	X
Smithfield	188	16.0	7.0	Private	X
Smithfield	189	16.0	5.0	Private	X
Smithfield	189	16.0	7.0	Private	X
Smithfield	193	35.0	13.0	Private	
Smithfield	193	35.0	21.0	Private	
Smithfield	194	35.0	21.0	Private	
Smithfield	230	50.0	9.2	Private	X
Smithfield	234	49.0	177.0	Public	
Smithfield	234	49.0	192.0	Private	
Smithfield	236	49.0	134.0	Private	
Smithfield	236	49.0	134.1	Private	X
Smithfield	236	49.0	188.0	Private	X
Smithfield	237	46.0	75.0	Private	
Smithfield	239	46.0	74.0	Private	X
Smithfield	239	46.0	75.0	Private	
Smithfield	239	46.0	75.4	Private	X
Smithfield	239	46.0	76.0	Private	X
Smithfield	243	48.0	4.3	Private	X
Smithfield	248	44.0	33.0	Public	
Smithfield	289	50.0	9.0	Private	X
Smithfield	289	50.0	27.1	Private	X
Smithfield	290	50.0	9.0	Private	X
Smithfield	343	46.0	64.0	Private	X
Smithfield	343	46.0	64.2	Private	
Smithfield	343	46.0	260.0	Private	

(Continued)

Appendix F. (Concluded).

Town	Site ID	Plat	Lot	Ownership	OCI*
Smithfield	370	44.0	33.0	Public	
Smithfield	406	47.0	53.0	Private	
Smithfield	435	43.0	38.0	Private	
Smithfield	437	43.0	18.0	Private	X
Smithfield	438	43.0	17.4	Private	X
Smithfield	438	43.0	37.0	Private	X
Smithfield	440	44.0	12.1	Private	X

* An "X" indicates the presence of a RIDEM Office of Compliance and Inspection wetland enforcement flag.

** RIDOT land, which does not have plat or lot numbers.

Appendix G1. Flood abatement scores for potential wetland restoration sites.*

Site ID	Town	Area (acres)	Functional probability score	O-E-S score	Area factor	Final score	Rank
22	Johnston	4.55	1.00	1.10	2.0	2.20	1
239	Smithfield	21.84	1.00	1.00	2.0	2.00	2
243	Smithfield	3.13	1.00	1.00	2.0	2.00	3
448	North Smithfield	3.84	0.83	0.93	2.0	1.86	4
443	North Smithfield	3.35	0.83	0.93	2.0	1.86	5
53	Johnston	1.91	1.00	1.10	1.5	1.65	6
214	Johnston	0.54	1.00	1.10	1.5	1.65	7
258	Johnston	4.92	0.80	0.80	2.0	1.60	8
256	Providence	4.73	0.67	0.77	2.0	1.54	9
290	Smithfield	4.09	0.67	0.77	2.0	1.54	10
425	Providence	3.42	0.67	0.77	2.0	1.54	11
278	North Smithfield	3.03	0.67	0.77	2.0	1.54	12
449	North Providence	2.91	0.67	0.77	2.0	1.54	13
349	Johnston	2.06	0.67	0.77	2.0	1.54	14
237	Smithfield	1.37	1.00	1.00	1.5	1.50	15
67	Smithfield	0.75	1.00	1.00	1.5	1.50	16
5	Smithfield	0.59	1.00	1.00	1.5	1.50	17
455	Providence	1.62	0.83	0.93	1.5	1.40	18
272	North Smithfield	1.59	0.83	0.93	1.5	1.40	19
236	Smithfield	1.13	0.83	0.93	1.5	1.40	20
248	Smithfield	0.89	0.80	0.90	1.5	1.35	21
427	Johnston/Prov	4.75	0.67	0.67	2.0	1.34	22
250	North Providence	2.46	0.67	0.67	2.0	1.34	23
43	Smithfield	2.08	0.67	0.67	2.0	1.34	24
193	Smithfield	1.30	0.83	0.83	1.5	1.25	25
370	Smithfield	0.51	0.83	0.83	1.5	1.25	26
47	North Providence	0.60	0.80	0.80	1.5	1.20	27
343	Smithfield	3.04	0.50	0.60	2.0	1.20	28
289	Smithfield	1.59	0.67	0.77	1.5	1.16	29
187	Smithfield	1.26	0.67	0.77	1.5	1.16	30
442	North Smithfield	0.71	0.67	0.77	1.5	1.16	31
350	Johnston	0.64	0.67	0.77	1.5	1.16	32
216	Johnston	0.26	1.00	1.10	1.0	1.10	33
452	North Providence	0.25	1.00	1.10	1.0	1.10	34
451	North Providence	0.18	1.00	1.10	1.0	1.10	35
221	Johnston	0.13	1.00	1.10	1.0	1.10	36
423	North Providence	1.08	0.67	0.67	1.5	1.01	37
438	Smithfield	0.73	0.67	0.67	1.5	1.01	38
24	Johnston	0.43	1.00	1.00	1.0	1.00	39

(Continued)

Appendix G1. (Concluded).

Site ID	Town	Area (acres)	Functional probability score	O-E-S score	Area factor	Final score	Rank
445	North Smithfield	0.37	0.83	0.93	1.0	0.93	40
447	North Smithfield	0.32	0.83	0.93	1.0	0.93	41
8	Smithfield	0.13	0.83	0.93	1.0	0.93	42
430	Providence	1.83	0.60	0.60	1.5	0.90	43
194	Smithfield	0.49	0.83	0.83	1.0	0.83	44
379	North Providence	0.35	0.83	0.83	1.0	0.83	45
287	North Smithfield	0.25	0.83	0.83	1.0	0.83	46
188	Smithfield	0.43	0.67	0.77	1.0	0.77	47
36	Smithfield	0.34	0.67	0.77	1.0	0.77	48
435	Smithfield	0.32	0.67	0.77	1.0	0.77	49
189	Smithfield	0.26	0.67	0.77	1.0	0.77	50
55	Johnston	0.11	0.60	0.70	1.0	0.70	51
66	Johnston	0.42	0.67	0.67	1.0	0.67	52
25	Johnston	0.40	0.67	0.67	1.0	0.67	53
437	Smithfield	0.35	0.67	0.67	1.0	0.67	54
203	Johnston	0.31	0.67	0.67	1.0	0.67	55
440	Smithfield	0.45	0.50	0.60	1.0	0.60	56
446	North Smithfield	0.41	0.60	0.60	1.0	0.60	57
399	Johnston	0.31	0.50	0.60	1.0	0.60	58
340	North Smithfield	0.27	0.50	0.60	1.0	0.60	59
274	North Smithfield	0.23	0.60	0.60	1.0	0.60	60
380	North Providence	0.23	0.60	0.60	1.0	0.60	61
424	North Providence	0.96	0.50	0.50	1.5	NA**	NA
286	North Smithfield	0.87	0.50	0.50	1.5	NA**	NA
288	North Smithfield	0.74	0.50	0.50	1.5	NA**	NA
264	North Smithfield	0.49	0.50	0.50	1.0	NA**	NA
396	Johnston	0.33	0.50	0.50	1.0	NA**	NA
160	Smithfield	0.19	0.50	0.50	1.0	NA**	NA
230	Smithfield	0.10	0.50	0.50	1.0	NA**	NA
234	Smithfield	0.69	0.33	0.43	1.5	NA**	NA
259	Providence	1.88	0.40	0.40	1.5	NA**	NA
50	Johnston	0.56	0.40	0.40	1.5	NA**	NA
41	Smithfield	0.52	0.33	0.33	1.5	NA**	NA
444	North Smithfield	0.33	0.33	0.33	1.0	NA**	NA
34	Smithfield	0.56	0.20	0.20	1.5	NA**	NA
406	Smithfield	0.32	0.17	0.17	1.0	NA**	NA
454	Providence	2.07	NA†	NA	2.0	NA	NA
2	Smithfield	1.37	NA†	NA	1.5	NA	NA

* See Appendix D for definitions of terms and scoring procedures.

** O-E-S score < 0.60; site not likely to perform the function.

† Not a basin wetland.

Appendix G2. Water quality improvement scores for potential wetland restoration sites.*

Site ID	Town	Area (acres)	Functional probability score	O-E-S score	Area factor	Final score	Rank
22	Johnston	4.55	1.00	1.10	2.0	2.20	1
343	Smithfield	3.04	1.00	1.10	2.0	2.20	2
239	Smithfield	21.84	1.00	1.00	2.0	2.00	3
258	Johnston	4.92	1.00	1.00	2.0	2.00	4
448	North Smithfield	3.84	1.00	1.00	2.0	2.00	5
443	North Smithfield	3.35	1.00	1.00	2.0	2.00	6
243	Smithfield	3.13	1.00	1.00	2.0	2.00	7
349	Johnston	2.06	1.00	1.00	2.0	2.00	8
256	Providence	4.73	0.80	0.90	2.0	1.80	9
290	Smithfield	4.09	0.80	0.90	2.0	1.80	10
425	Providence	3.42	0.80	0.90	2.0	1.80	11
278	North Smithfield	3.03	0.80	0.90	2.0	1.80	12
449	North Providence	2.91	0.80	0.90	2.0	1.80	13
53	Johnston	1.91	1.00	1.10	1.5	1.65	14
455	Providence	1.62	1.00	1.10	1.5	1.65	15
67	Smithfield	0.75	1.00	1.10	1.5	1.65	16
5	Smithfield	0.59	1.00	1.10	1.5	1.65	17
214	Johnston	0.54	1.00	1.10	1.5	1.65	18
427	Johnston/Prov	4.75	0.80	0.80	2.0	1.60	19
250	North Providence	2.46	0.80	0.80	2.0	1.60	20
272	North Smithfield	1.59	1.00	1.00	1.5	1.50	21
237	Smithfield	1.37	1.00	1.00	1.5	1.50	22
193	Smithfield	1.30	1.00	1.00	1.5	1.50	23
236	Smithfield	1.13	1.00	1.00	1.5	1.50	24
423	North Providence	1.08	1.00	1.00	1.5	1.50	25
248	Smithfield	0.89	1.00	1.00	1.5	1.50	26
350	Johnston	0.64	1.00	1.00	1.5	1.50	27
289	Smithfield	1.59	0.80	0.90	1.5	1.35	28
187	Smithfield	1.26	0.80	0.90	1.5	1.35	29
442	North Smithfield	0.71	0.80	0.90	1.5	1.35	30
424	North Providence	0.96	0.80	0.80	1.5	1.20	31
370	Smithfield	0.51	0.80	0.80	1.5	1.20	32
43	Smithfield	2.08	0.60	0.60	2.0	1.20	33
430	Providence	1.83	0.75	0.75	1.5	1.13	34
47	North Providence	0.60	0.75	0.75	1.5	1.13	35
452	North Providence	0.25	1.00	1.10	1.0	1.10	36
451	North Providence	0.18	1.00	1.10	1.0	1.10	37
438	Smithfield	0.73	0.60	0.70	1.5	1.05	38
234	Smithfield	0.69	0.60	0.70	1.5	1.05	39

(Continued)

Appendix G2. (Concluded).

Site ID	Town	Area (acres)	Functional probability score	O-E-S score	Area factor	Final score	Rank
194	Smithfield	0.49	1.00	1.00	1.0	1.00	40
24	Johnston	0.43	1.00	1.00	1.0	1.00	41
66	Johnston	0.42	1.00	1.00	1.0	1.00	42
445	North Smithfield	0.37	1.00	1.00	1.0	1.00	43
447	North Smithfield	0.32	1.00	1.00	1.0	1.00	44
216	Johnston	0.26	1.00	1.00	1.0	1.00	45
221	Johnston	0.13	1.00	1.00	1.0	1.00	46
55	Johnston	0.11	1.00	1.00	1.0	1.00	47
188	Smithfield	0.43	0.80	0.90	1.0	0.90	48
36	Smithfield	0.34	0.80	0.90	1.0	0.90	49
435	Smithfield	0.32	0.80	0.90	1.0	0.90	50
189	Smithfield	0.26	0.80	0.90	1.0	0.90	51
8	Smithfield	0.13	0.80	0.90	1.0	0.90	52
286	North Smithfield	0.87	0.60	0.60	1.5	0.90	53
34	Smithfield	0.56	0.50	0.60	1.5	0.90	54
41	Smithfield	0.52	0.60	0.60	1.5	0.90	55
440	Smithfield	0.45	0.80	0.80	1.0	0.80	56
25	Johnston	0.40	0.80	0.80	1.0	0.80	57
379	North Providence	0.35	0.80	0.80	1.0	0.80	58
203	Johnston	0.31	0.80	0.80	1.0	0.80	59
287	North Smithfield	0.25	0.80	0.80	1.0	0.80	60
437	Smithfield	0.35	0.60	0.70	1.0	0.70	61
340	North Smithfield	0.27	0.60	0.70	1.0	0.70	62
264	North Smithfield	0.49	0.60	0.60	1.0	0.60	63
396	Johnston	0.33	0.60	0.60	1.0	0.60	64
399	Johnston	0.31	0.60	0.60	1.0	0.60	65
160	Smithfield	0.19	0.60	0.60	1.0	0.60	66
230	Smithfield	0.10	0.60	0.60	1.0	0.60	67
259	Providence	1.88	0.50	0.50	1.5	NA**	NA
50	Johnston	0.56	0.50	0.50	1.5	NA**	NA
446	North Smithfield	0.41	0.50	0.50	1.0	NA**	NA
444	North Smithfield	0.33	0.40	0.50	1.0	NA**	NA
274	North Smithfield	0.23	0.50	0.50	1.0	NA**	NA
380	North Providence	0.23	0.50	0.50	1.0	NA**	NA
2	Smithfield	1.37	0.40	0.40	1.5	NA**	NA
288	North Smithfield	0.74	0.40	0.40	1.5	NA**	NA
406	Smithfield	0.32	0.40	0.40	1.0	NA**	NA
454	Providence	2.07	0.20	0.30	2.0	NA**	NA

* See Appendix D for definitions of terms and scoring procedures.

** O-E-S score < 0.60; site not likely to perform the function.

Appendix G3. Wildlife habitat scores for potential wetland restoration sites.*

Site ID	Town	Area (acres)	Functional probability score	O-E-S score	Area factor	Final score	Rank
448	North Smithfield	3.84	0.71	0.81	2.0	1.62	1
443	North Smithfield	3.35	0.71	0.81	2.0	1.62	2
343	Smithfield	3.04	0.71	0.81	2.0	1.62	3
278	North Smithfield	3.03	0.71	0.81	2.0	1.62	4
239	Smithfield	21.84	0.57	0.67	2.0	1.34	5
290	Smithfield	4.09	0.57	0.67	2.0	1.34	6
272	North Smithfield	1.59	0.71	0.81	1.5	1.22	7
286	North Smithfield	0.87	0.71	0.81	1.5	1.22	8
442	North Smithfield	0.71	0.71	0.81	1.5	1.22	9
289	Smithfield	1.59	0.57	0.67	1.5	1.01	10
237	Smithfield	1.37	0.57	0.67	1.5	1.01	11
187	Smithfield	1.26	0.57	0.67	1.5	1.01	12
399	Johnston	0.31	0.86	0.96	1.0	0.96	13
340	North Smithfield	0.27	0.86	0.96	1.0	0.96	14
445	North Smithfield	0.37	0.71	0.81	1.0	0.81	15
447	North Smithfield	0.32	0.71	0.81	1.0	0.81	16
406	Smithfield	0.32	0.71	0.81	1.0	0.81	17
230	Smithfield	0.10	0.71	0.81	1.0	0.81	18
264	North Smithfield	0.49	0.57	0.67	1.0	0.67	19
188	Smithfield	0.43	0.57	0.67	1.0	0.67	20
36	Smithfield	0.34	0.57	0.67	1.0	0.67	21
444	North Smithfield	0.33	0.57	0.67	1.0	0.67	22
435	Smithfield	0.32	0.57	0.67	1.0	0.67	23
189	Smithfield	0.26	0.57	0.67	1.0	0.67	24
22	Johnston	4.55	0.43	0.53	2.0	NA**	NA
449	North Providence	2.91	0.43	0.53	2.0	NA**	NA
43	Smithfield	2.08	0.43	0.53	2.0	NA**	NA
454	Providence	2.07	0.43	0.53	2.0	NA**	NA
53	Johnston	1.91	0.43	0.53	1.5	NA**	NA
455	Providence	1.62	0.43	0.53	1.5	NA**	NA
2	Smithfield	1.37	0.43	0.53	1.5	NA**	NA
236	Smithfield	1.13	0.43	0.53	1.5	NA**	NA
438	Smithfield	0.73	0.43	0.53	1.5	NA**	NA
234	Smithfield	0.69	0.43	0.53	1.5	NA**	NA
214	Johnston	0.54	0.43	0.53	1.5	NA**	NA
41	Smithfield	0.52	0.43	0.53	1.5	NA**	NA
25	Johnston	0.40	0.43	0.53	1.0	NA**	NA
437	Smithfield	0.35	0.43	0.53	1.0	NA**	NA
396	Johnston	0.33	0.43	0.53	1.0	NA**	NA

(Continued)

Appendix G3. (Concluded).

Site ID	Town	Area (acres)	Functional probability score	O-E-S score	Area factor	Final score	Rank
451	North Providence	0.18	0.43	0.53	1.0	NA**	NA
446	North Smithfield	0.41	0.40	0.50	1.0	NA**	NA
274	North Smithfield	0.23	0.40	0.50	1.0	NA**	NA
427	Johnston/Prov	4.75	0.29	0.39	2.0	NA**	NA
256	Providence	4.73	0.29	0.39	2.0	NA**	NA
425	Providence	3.42	0.29	0.39	2.0	NA**	NA
243	Smithfield	3.13	0.29	0.39	2.0	NA**	NA
349	Johnston	2.06	0.29	0.39	2.0	NA**	NA
424	North Providence	0.96	0.29	0.39	1.5	NA**	NA
67	Smithfield	0.75	0.29	0.39	1.5	NA**	NA
350	Johnston	0.64	0.29	0.39	1.5	NA**	NA
5	Smithfield	0.59	0.29	0.39	1.5	NA**	NA
440	Smithfield	0.45	0.29	0.39	1.0	NA**	NA
24	Johnston	0.43	0.29	0.39	1.0	NA**	NA
452	North Providence	0.25	0.29	0.39	1.0	NA**	NA
287	North Smithfield	0.25	0.29	0.39	1.0	NA**	NA
160	Smithfield	0.19	0.29	0.39	1.0	NA**	NA
259	Providence	1.88	0.20	0.30	1.5	NA**	NA
248	Smithfield	0.89	0.20	0.30	1.5	NA**	NA
34	Smithfield	0.56	0.20	0.30	1.5	NA**	NA
50	Johnston	0.56	0.20	0.30	1.5	NA**	NA
380	North Providence	0.23	0.20	0.30	1.0	NA**	NA
250	North Providence	2.46	0.14	0.24	2.0	NA**	NA
423	North Providence	1.08	0.14	0.24	1.5	NA**	NA
288	North Smithfield	0.74	0.14	0.24	1.5	NA**	NA
370	Smithfield	0.51	0.14	0.24	1.5	NA**	NA
203	Johnston	0.31	0.14	0.24	1.0	NA**	NA
216	Johnston	0.26	0.14	0.24	1.0	NA**	NA
221	Johnston	0.13	0.14	0.24	1.0	NA**	NA
8	Smithfield	0.13	0.14	0.24	1.0	NA**	NA
258	Johnston	4.92	0.00	0.10	2.0	NA**	NA
430	Providence	1.83	0.00	0.10	1.5	NA**	NA
193	Smithfield	1.30	0.00	0.10	1.5	NA**	NA
47	North Providence	0.60	0.00	0.10	1.5	NA**	NA
194	Smithfield	0.49	0.00	0.10	1.0	NA**	NA
66	Johnston	0.42	0.00	0.10	1.0	NA**	NA
379	North Providence	0.35	0.00	0.10	1.0	NA**	NA
55	Johnston	0.11	0.00	0.10	1.0	NA**	NA

* See Appendix D for definitions of terms and scoring procedures.

** O-E-S score < 0.60; site not likely to perform the function.

Appendix G4. Fish habitat scores for potential wetland restoration sites.*

Site ID	Town	Area (acres)	Functional probability score	O-E-S score	Area factor	Final score	Rank
278	North Smithfield	3.03	0.80	0.90	2.0	1.80	1
43	Smithfield	2.08	0.80	0.90	2.0	1.80	2
454	Providence	2.07	0.80	0.90	2.0	1.80	3
239	Smithfield	21.84	0.60	0.70	2.0	1.40	4
256	Providence	4.73	0.60	0.70	2.0	1.40	5
448	North Smithfield	3.84	0.60	0.70	2.0	1.40	6
425	Providence	3.42	0.60	0.70	2.0	1.40	7
443	North Smithfield	3.35	0.60	0.70	2.0	1.40	8
442	North Smithfield	0.71	0.80	0.90	1.5	1.35	9
455	Providence	1.62	0.60	0.70	1.5	1.05	10
272	North Smithfield	1.59	0.60	0.70	1.5	1.05	11
237	Smithfield	1.37	0.60	0.70	1.5	1.05	12
187	Smithfield	1.26	0.60	0.70	1.5	1.05	13
438	Smithfield	0.73	0.60	0.70	1.5	1.05	14
444	North Smithfield	0.33	0.80	0.90	1.0	0.90	15
396	Johnston	0.33	0.80	0.90	1.0	0.90	16
399	Johnston	0.31	0.80	0.90	1.0	0.90	17
264	North Smithfield	0.49	0.60	0.70	1.0	0.70	18
24	Johnston	0.43	0.60	0.70	1.0	0.70	19
188	Smithfield	0.43	0.60	0.70	1.0	0.70	20
25	Johnston	0.40	0.60	0.70	1.0	0.70	21
445	North Smithfield	0.37	0.60	0.70	1.0	0.70	22
437	Smithfield	0.35	0.60	0.70	1.0	0.70	23
36	Smithfield	0.34	0.60	0.70	1.0	0.70	24
447	North Smithfield	0.32	0.60	0.70	1.0	0.70	25
406	Smithfield	0.32	0.60	0.70	1.0	0.70	26
435	Smithfield	0.32	0.60	0.70	1.0	0.70	27
189	Smithfield	0.26	0.60	0.70	1.0	0.70	28
287	North Smithfield	0.25	0.60	0.70	1.0	0.70	29
160	Smithfield	0.19	0.60	0.70	1.0	0.70	30
230	Smithfield	0.10	0.60	0.70	1.0	0.70	31
22	Johnston	4.55	0.40	0.50	2.0	NA**	NA
449	North Providence	2.91	0.40	0.50	2.0	NA**	NA
53	Johnston	1.91	0.40	0.50	1.5	NA**	NA
67	Smithfield	0.75	0.40	0.50	1.5	NA**	NA
234	Smithfield	0.69	0.40	0.50	1.5	NA**	NA
5	Smithfield	0.59	0.40	0.50	1.5	NA**	NA
214	Johnston	0.54	0.40	0.50	1.5	NA**	NA
216	Johnston	0.26	0.40	0.50	1.0	NA**	NA

(Continued)

Appendix G4. (Concluded).

Site ID	Town	Area (acres)	Functional probability score	O-E-S score	Area factor	Final score	Rank
452	North Providence	0.25	0.40	0.50	1.0	NA**	NA
451	North Providence	0.18	0.40	0.50	1.0	NA**	NA
221	Johnston	0.13	0.40	0.50	1.0	NA**	NA
370	Smithfield	0.51	0.20	0.30	1.5	NA**	NA
8	Smithfield	0.13	0.20	0.30	1.0	NA**	NA
258	Johnston	4.92	NA†	NA	2.0	NA	NA
427	Johnston/Prov	4.75	NA†	NA	2.0	NA	NA
290	Smithfield	4.09	NA†	NA	2.0	NA	NA
243	Smithfield	3.13	NA†	NA	2.0	NA	NA
343	Smithfield	3.04	NA†	NA	2.0	NA	NA
250	North Providence	2.46	NA†	NA	2.0	NA	NA
349	Johnston	2.06	NA†	NA	2.0	NA	NA
259	Providence	1.88	NA†	NA	1.5	NA	NA
430	Providence	1.83	NA†	NA	1.5	NA	NA
289	Smithfield	1.59	NA†	NA	1.5	NA	NA
2	Smithfield	1.37	NA†	NA	1.5	NA	NA
193	Smithfield	1.30	NA†	NA	1.5	NA	NA
236	Smithfield	1.13	NA†	NA	1.5	NA	NA
423	North Providence	1.08	NA†	NA	1.5	NA	NA
424	North Providence	0.96	NA†	NA	1.5	NA	NA
248	Smithfield	0.89	NA†	NA	1.5	NA	NA
286	North Smithfield	0.87	NA†	NA	1.5	NA	NA
288	North Smithfield	0.74	NA†	NA	1.5	NA	NA
350	Johnston	0.64	NA†	NA	1.5	NA	NA
47	North Providence	0.60	NA†	NA	1.5	NA	NA
34	Smithfield	0.56	NA†	NA	1.5	NA	NA
50	Johnston	0.56	NA†	NA	1.5	NA	NA
41	Smithfield	0.52	NA†	NA	1.5	NA	NA
194	Smithfield	0.49	NA†	NA	1.0	NA	NA
440	Smithfield	0.45	NA†	NA	1.0	NA	NA
66	Johnston	0.42	NA†	NA	1.0	NA	NA
446	North Smithfield	0.41	NA†	NA	1.0	NA	NA
379	North Providence	0.35	NA†	NA	1.0	NA	NA
203	Johnston	0.31	NA†	NA	1.0	NA	NA
340	North Smithfield	0.27	NA†	NA	1.0	NA	NA
274	North Smithfield	0.23	NA†	NA	1.0	NA	NA
380	North Providence	0.23	NA†	NA	1.0	NA	NA
55	Johnston	0.11	NA†	NA	1.0	NA	NA

* See Appendix D for definitions of terms and scoring procedures.

** O-E-S score < 0.60; site not likely to perform the function.

† Did not contain open water or lower perennial stream.

Appendix G5. Heritage scores for potential wetland restoration sites.*

Site ID	Town	Area (acres)	Functional probability score	O-E-S score	Area factor	Final score	Rank
22	Johnston	4.55	0.75	0.85	2.0	1.70	1
278	North Smithfield	3.03	0.75	0.85	2.0	1.70	2
438	Smithfield	0.73	0.88	0.98	1.5	1.47	3
239	Smithfield	21.84	0.63	0.73	2.0	1.46	4
256	Providence	4.73	0.63	0.73	2.0	1.46	5
448	North Smithfield	3.84	0.63	0.73	2.0	1.46	6
425	Providence	3.42	0.63	0.73	2.0	1.46	7
443	North Smithfield	3.35	0.63	0.73	2.0	1.46	8
343	Smithfield	3.04	0.63	0.73	2.0	1.46	9
449	North Providence	2.91	0.63	0.73	2.0	1.46	10
454	Providence	2.07	0.63	0.73	2.0	1.46	11
53	Johnston	1.91	0.75	0.85	1.5	1.28	12
187	Smithfield	1.26	0.75	0.85	1.5	1.28	13
442	North Smithfield	0.71	0.75	0.85	1.5	1.28	14
34	Smithfield	0.56	0.75	0.85	1.5	1.28	15
43	Smithfield	2.08	0.50	0.60	2.0	1.20	16
349	Johnston	2.06	0.50	0.60	2.0	1.20	17
455	Providence	1.62	0.63	0.73	1.5	1.10	18
272	North Smithfield	1.59	0.63	0.73	1.5	1.10	19
237	Smithfield	1.37	0.63	0.73	1.5	1.10	20
236	Smithfield	1.13	0.63	0.73	1.5	1.10	21
234	Smithfield	0.69	0.63	0.73	1.5	1.10	22
214	Johnston	0.54	0.63	0.73	1.5	1.10	23
370	Smithfield	0.51	0.63	0.73	1.5	1.10	24
437	Smithfield	0.35	0.88	0.98	1.0	0.98	25
396	Johnston	0.33	0.88	0.98	1.0	0.98	26
340	North Smithfield	0.27	0.88	0.98	1.0	0.98	27
452	North Providence	0.25	0.88	0.98	1.0	0.98	28
259	Providence	1.88	0.50	0.60	1.5	0.90	29
430	Providence	1.83	0.50	0.60	1.5	0.90	30
2	Smithfield	1.37	0.50	0.60	1.5	0.90	31
423	North Providence	1.08	0.50	0.60	1.5	0.90	32
424	North Providence	0.96	0.50	0.60	1.5	0.90	33
248	Smithfield	0.89	0.50	0.60	1.5	0.90	34
350	Johnston	0.64	0.50	0.60	1.5	0.90	35
50	Johnston	0.56	0.50	0.60	1.5	0.90	36
264	North Smithfield	0.49	0.88	0.88	1.0	0.88	37
188	Smithfield	0.43	0.75	0.85	1.0	0.85	38
36	Smithfield	0.34	0.75	0.85	1.0	0.85	39

(Continued)

Appendix G5. (Concluded).

Site ID	Town	Area (acres)	Functional probability score	O-E-S score	Area factor	Final score	Rank
435	Smithfield	0.32	0.75	0.85	1.0	0.85	40
189	Smithfield	0.26	0.75	0.85	1.0	0.85	41
380	North Providence	0.23	0.75	0.85	1.0	0.85	42
406	Smithfield	0.32	0.75	0.75	1.0	0.75	43
399	Johnston	0.31	0.75	0.75	1.0	0.75	44
25	Johnston	0.40	0.63	0.73	1.0	0.73	45
445	North Smithfield	0.37	0.63	0.73	1.0	0.73	46
447	North Smithfield	0.32	0.63	0.73	1.0	0.73	47
451	North Providence	0.18	0.63	0.73	1.0	0.73	48
8	Smithfield	0.13	0.63	0.73	1.0	0.73	49
230	Smithfield	0.10	0.63	0.63	1.0	0.63	50
24	Johnston	0.43	0.50	0.60	1.0	0.60	51
446	North Smithfield	0.41	0.50	0.60	1.0	0.60	52
274	North Smithfield	0.23	0.50	0.60	1.0	0.60	53
160	Smithfield	0.19	0.50	0.60	1.0	0.60	54
286	North Smithfield	0.87	0.50	0.50	1.5	NA**	NA
243	Smithfield	3.13	0.38	0.48	2.0	NA**	NA
250	North Providence	2.46	0.38	0.48	2.0	NA**	NA
440	Smithfield	0.45	0.38	0.48	1.0	NA**	NA
66	Johnston	0.42	0.38	0.48	1.0	NA**	NA
444	North Smithfield	0.33	0.38	0.48	1.0	NA**	NA
288	North Smithfield	0.74	0.38	0.38	1.5	NA**	NA
258	Johnston	4.92	0.25	0.35	2.0	NA**	NA
193	Smithfield	1.30	0.25	0.35	1.5	NA**	NA
47	North Providence	0.60	0.25	0.35	1.5	NA**	NA
41	Smithfield	0.52	0.25	0.35	1.5	NA**	NA
194	Smithfield	0.49	0.25	0.35	1.0	NA**	NA
379	North Providence	0.35	0.25	0.35	1.0	NA**	NA
203	Johnston	0.31	0.25	0.35	1.0	NA**	NA
55	Johnston	0.11	0.25	0.35	1.0	NA**	NA
290	Smithfield	4.09	0.25	0.25	2.0	NA**	NA
289	Smithfield	1.59	0.25	0.25	1.5	NA**	NA
287	North Smithfield	0.25	0.25	0.25	1.0	NA**	NA
427	Johnston/Prov	4.75	0.13	0.23	2.0	NA**	NA
67	Smithfield	0.75	0.13	0.23	1.5	NA**	NA
5	Smithfield	0.59	0.13	0.23	1.5	NA**	NA
216	Johnston	0.26	0.13	0.23	1.0	NA**	NA
221	Johnston	0.13	0.13	0.23	1.0	NA**	NA

* See Appendix D for definitions of terms and scoring procedures.

** O-E-S score < 0.60; site not likely to perform the function.

Appendix G6. Multi-function scores for potential wetland restoration sites.*

Site ID	Town	Area (acres)	Flood abatement	Water quality	Wildlife habitat	Fish habitat	Heritage	No. of functions	Area factor	Final score	Rank
239	Smithfield	21.84	X	X	X	X	X	5	2.0	10.0	1
448	North Smithfield	3.84	X	X	X	X	X	5	2.0	10.0	2
443	North Smithfield	3.35	X	X	X	X	X	5	2.0	10.0	3
278	North Smithfield	3.03	X	X	X	X	X	5	2.0	10.0	4
256	Providence	4.73	X	X		X	X	4	2.0	8.0	5
425	Providence	3.42	X	X		X	X	4	2.0	8.0	6
343	Smithfield	3.04	X	X	X		X	4	2.0	8.0	7
43	Smithfield	2.08	X	X		X	X	4	2.0	8.0	8
272	North Smithfield	1.59	X	X	X	X	X	5	1.5	7.5	9
237	Smithfield	1.37	X	X	X	X	X	5	1.5	7.5	10
187	Smithfield	1.26	X	X	X	X	X	5	1.5	7.5	11
442	North Smithfield	0.71	X	X	X	X	X	5	1.5	7.5	12
455	Providence	1.62	X	X		X	X	4	1.5	6.0	13
438	Smithfield	0.73	X	X		X	X	4	1.5	6.0	14
22	Johnston	4.55	X	X			X	3	2.0	6.0	15
290	Smithfield	4.09	X	X	X			3	2.0	6.0	16
449	North Providence	2.91	X	X			X	3	2.0	6.0	17
349	Johnston	2.06	X	X			X	3	2.0	6.0	18
188	Smithfield	0.43	X	X	X	X	X	5	1.0	5.0	19
445	North Smithfield	0.37	X	X	X	X	X	5	1.0	5.0	20
36	Smithfield	0.34	X	X	X	X	X	5	1.0	5.0	21
447	North Smithfield	0.32	X	X	X	X	X	5	1.0	5.0	22
435	Smithfield	0.32	X	X	X	X	X	5	1.0	5.0	23
399	Johnston	0.31	X	X	X	X	X	5	1.0	5.0	24
189	Smithfield	0.26	X	X	X	X	X	5	1.0	5.0	25
53	Johnston	1.91	X	X			X	3	1.5	4.5	26
430	Providence	1.83	X	X			X	3	1.5	4.5	27
289	Smithfield	1.59	X	X	X			3	1.5	4.5	28
236	Smithfield	1.13	X	X			X	3	1.5	4.5	29
423	North Providence	1.08	X	X			X	3	1.5	4.5	30
248	Smithfield	0.89	X	X			X	3	1.5	4.5	31
350	Johnston	0.64	X	X			X	3	1.5	4.5	32
214	Johnston	0.54	X	X			X	3	1.5	4.5	33
370	Smithfield	0.51	X	X			X	3	1.5	4.5	34
264	North Smithfield	0.49		X	X	X	X	4	1.0	4.0	35
24	Johnston	0.43	X	X		X	X	4	1.0	4.0	36
25	Johnston	0.40	X	X		X	X	4	1.0	4.0	37
437	Smithfield	0.35	X	X		X	X	4	1.0	4.0	38
340	North Smithfield	0.27	X	X	X		X	4	1.0	4.0	39

(Continued)

Appendix G6. (Concluded).

Site ID	Town	Area (acres)	Flood abatement	Water quality	Wildlife habitat	Fish habitat	Heritage	No. of functions	Area factor	Final score	Rank
230	Smithfield	0.10		X	X	X	X	4	1.0	4.0	40
258	Johnston	4.92	X	X				2	2.0	4.0	41
427	Johnston/Prov	4.75	X	X				2	2.0	4.0	42
243	Smithfield	3.13	X	X				2	2.0	4.0	43
250	North Providence	2.46	X	X				2	2.0	4.0	44
454	Providence	2.07				X	X	2	2.0	4.0	45
396	Johnston	0.33		X		X	X	3	1.0	3.0	46
406	Smithfield	0.32			X	X	X	3	1.0	3.0	47
452	North Providence	0.25	X	X			X	3	1.0	3.0	48
287	North Smithfield	0.25	X	X		X		3	1.0	3.0	49
160	Smithfield	0.19		X		X	X	3	1.0	3.0	50
451	North Providence	0.18	X	X			X	3	1.0	3.0	51
8	Smithfield	0.13	X	X			X	3	1.0	3.0	52
193	Smithfield	1.30	X	X				2	1.5	3.0	53
424	North Providence	0.96		X			X	2	1.5	3.0	54
286	North Smithfield	0.87		X	X			2	1.5	3.0	55
67	Smithfield	0.75	X	X				2	1.5	3.0	56
234	Smithfield	0.69		X			X	2	1.5	3.0	57
47	North Providence	0.60	X	X				2	1.5	3.0	58
5	Smithfield	0.59	X	X				2	1.5	3.0	59
34	Smithfield	0.56		X			X	2	1.5	3.0	60
194	Smithfield	0.49	X	X				2	1.0	2.0	61
440	Smithfield	0.45	X	X				2	1.0	2.0	62
66	Johnston	0.42	X	X				2	1.0	2.0	63
446	North Smithfield	0.41	X				X	2	1.0	2.0	64
379	North Providence	0.35	X	X				2	1.0	2.0	65
444	North Smithfield	0.33			X	X		2	1.0	2.0	66
203	Johnston	0.31	X	X				2	1.0	2.0	67
216	Johnston	0.26	X	X				2	1.0	2.0	68
274	North Smithfield	0.23	X				X	2	1.0	2.0	69
380	North Providence	0.23	X				X	2	1.0	2.0	70
221	Johnston	0.13	X	X				2	1.0	2.0	71
55	Johnston	0.11	X	X				2	1.0	2.0	72
259	Providence	1.88					X	1	1.5	1.5	73
2	Smithfield	1.37					X	1	1.5	1.5	74
50	Johnston	0.56					X	1	1.5	1.5	75
41	Smithfield	0.52		X				1	1.5	1.5	76
288	North Smithfield	0.74						0	1.5	0.0	77

* See Appendix D for definitions of terms and scoring procedures.

Appendix H. Plat and lot numbers for potential buffer restoration sites.

Town	Site ID	Plat	Lot	Ownership	OCI*
Glocester	511	unkn.	unkn.	Private	unkn.
Glocester	512	unkn.	unkn.	Private	unkn.
Glocester	513	unkn.	unkn.	Private	unkn.
Glocester	514	unkn.	unkn.	unkn.	unkn.
Glocester	515	unkn.	unkn.	unkn.	unkn.
Glocester	516	unkn.	unkn.	unkn.	unkn.
Glocester	518	20.0	8.0	Private	unkn.
Glocester	522	16.0	65.1	Private	unkn.
Glocester	522	16.0	66.0	Private	unkn.
Glocester	523	16.0	65.0	unkn.	unkn.
Glocester	524	unkn.	unkn.	unkn.	unkn.
Glocester	525	17.0	46.0	Private	unkn.
Glocester	525	17.0	47.0	Private	unkn.
Glocester	525	17.0	50.0	Private	unkn.
Glocester	526	unkn.	unkn.	unkn.	unkn.
Glocester	527	unkn.	unkn.	unkn.	unkn.
Glocester	528	unkn.	unkn.	unkn.	unkn.
Glocester	529	unkn.	unkn.	unkn.	unkn.
Glocester	530	unkn.	unkn.	unkn.	unkn.
Glocester	531	unkn.	unkn.	unkn.	unkn.
Glocester	532	unkn.	unkn.	unkn.	unkn.
Glocester	533	unkn.	unkn.	unkn.	unkn.
Glocester	534	unkn.	unkn.	unkn.	unkn.
Glocester	535	19.0	31.0	Private	unkn.
Glocester	536	unkn.	unkn.	unkn.	unkn.
Glocester	537	unkn.	unkn.	unkn.	unkn.
Glocester	541	unkn.	unkn.	unkn.	unkn.
Glocester	542	unkn.	unkn.	unkn.	unkn.
Glocester	543	unkn.	unkn.	unkn.	unkn.
Glocester	645	unkn.	unkn.	unkn.	unkn.
Glocester	646	16.0	123.0	Private	unkn.
Glocester	647	16.0	67.0	Private	unkn.
Glocester	648	unkn.	unkn.	unkn.	unkn.
Glocester	650	unkn.	unkn.	unkn.	unkn.
Glocester	651	unkn.	unkn.	unkn.	unkn.
Glocester	652	unkn.	unkn.	unkn.	unkn.
Glocester	653	unkn.	unkn.	unkn.	unkn.
Glocester	654	unkn.	unkn.	unkn.	unkn.
Glocester	655	unkn.	unkn.	unkn.	unkn.
Glocester	656	unkn.	unkn.	unkn.	unkn.
Glocester	681	17.0	35.0	Private	unkn.
Glocester	682	17.0	35.0	Private	unkn.

(Continued)

Appendix H. (Continued).

Town	Site ID	Plat	Lot	Ownership	OCI*
Johnston	79	34.0	259.0	Private	unkn.
Johnston	80	17.0	224.0	Private	unkn.
Johnston	83	35.0	185.0	Private	unkn.
Johnston	85	35.0	184.0	Private	unkn.
Johnston	91	unkn.	unkn.	unkn.	unkn.
Johnston	92	unkn.	unkn.	unkn.	unkn.
Johnston	95	unkn.	unkn.	unkn.	unkn.
Johnston	96	34.0	407.0	Private	unkn.
Johnston	96	34.0	414.0	Private	unkn.
Johnston	97	17.0	210.0	Private	unkn.
Johnston	97	17.0	211.0	Private	unkn.
Johnston	98	47.1	131.0	Public	X
Johnston	99	unkn.	unkn.	unkn.	unkn.
Johnston	100	unkn.	unkn.	unkn.	unkn.
Johnston	101	unkn.	unkn.	unkn.	unkn.
Johnston	131	36.0	37.0	Private	unkn.
Johnston	131	36.0	77.0	Private	unkn.
Johnston	131	36.0	104.0	Private	unkn.
Johnston	131	38.0	245.0	Private	unkn.
Johnston	132	38.0	245.0	Private	unkn.
Johnston	133	38.0	138.0	Private	unkn.
Johnston	134	39.0	53.0	Private	O
Johnston	134	39.0	54.0	Private	O
Johnston	134	39.0	338.0	Private	unkn.
Johnston	136	40.0	142.0	Public	unkn.
Johnston	136	40.0	240.0	Private	unkn.
Johnston	137	35.0	188.0	Private	O
Johnston	138	48.2	232.0	Private	O
Johnston	138	48.3	561.0	Private	unkn.
Johnston	139	48.2	540.0	Private	X
Johnston	140	48.3	15.0	Private	unkn.
Johnston	141	unkn.	unkn.	unkn.	unkn.
Johnston	142	NA**	NA**	Public	unkn.
Johnston	143	48.3	152.0	Public	O
Johnston	143	unkn.	unkn.	unkn.	unkn.
Johnston	144	unkn.	unkn.	unkn.	unkn.
Johnston	145	48.2	358.0	Private	unkn.
Johnston	146	unkn.	unkn.	unkn.	unkn.
Johnston	147	unkn.	unkn.	unkn.	unkn.
Johnston	148	unkn.	unkn.	unkn.	unkn.
Johnston	149	unkn.	unkn.	unkn.	unkn.
Johnston	150	unkn.	unkn.	unkn.	unkn.

(Continued)

Appendix H. (Continued).

Town	Site ID	Plat	Lot	Ownership	OCI*
Johnston	151	51.0	15.0	Private	unkn.
Johnston	152	unkn.	unkn.	unkn.	unkn.
Johnston	153	unkn.	unkn.	unkn.	unkn.
Johnston	182	61.0	178.0	Private	unkn.
Johnston	183	61.0	178.0	Private	unkn.
Johnston	184	61.0	237.0	Private	unkn.
Johnston	185	unkn.	unkn.	Public	unkn.
Johnston	186	60.0	13.0	Private	O
Johnston	227	37.0	9.0	Private	X
Johnston	227	37.0	63.0	Private	X
Johnston	591	unkn.	unkn.	unkn.	unkn.
Johnston	592	60.0	2.0	Private	unkn.
Johnston	593	60.0	2.0	Private	unkn.
Johnston	594	unkn.	unkn.	unkn.	unkn.
Johnston	644	20.1	36.0	Private	X
Johnston	692	55.0	25.0	Private	unkn.
Johnston	692	55.0	63.0	Private	unkn.
Johnston	693	50.0	71.0	Private	unkn.
North Providence	77	unkn.	unkn.	unkn.	unkn.
North Providence	78	unkn.	unkn.	unkn.	unkn.
North Providence	82	10.0	68.0	Private	unkn.
North Providence	82	10.0	74.0	Private	unkn.
North Providence	87	11.0	13.0	Private	unkn.
North Providence	87	11.0	556.0	Private	unkn.
North Providence	88	12.0	560.0	Private	unkn.
North Providence	88	12.0	669.0	Public	unkn.
North Providence	135	20.0	32.0	Private	unkn.
North Providence	630	21.1	779.0	Private	unkn.
North Providence	631	21.1	779.0	Private	unkn.
North Providence	679	17.0	4.0	Private	X
North Providence	679	17.0	228.0	Private	unkn.
North Smithfield	500	unkn.	unkn.	unkn.	unkn.
North Smithfield	501	10.0	40.0	Private	unkn.
North Smithfield	503	14.0	13.0	Private	X
North Smithfield	504	unkn.	unkn.	unkn.	unkn.
North Smithfield	544	unkn.	unkn.	unkn.	unkn.
North Smithfield	545	15.0	8.0	Private	unkn.
North Smithfield	545	15.0	10.0	Private	unkn.
North Smithfield	545	15.0	11.0	Private	unkn.
North Smithfield	546	15.0	48.0	Private	X
North Smithfield	546	15.0	49.0	Private	X
North Smithfield	546	15.0	50.0	Private	X

(Continued)

Appendix H. (Continued).

Town	Site ID	Plat	Lot	Ownership	OCI*
North Smithfield	546	15.0	51.0	Private	X
North Smithfield	547	15.0	49.0	Private	X
North Smithfield	547	15.0	50.0	Private	X
North Smithfield	548	unkn.	unkn.	unkn.	unkn.
North Smithfield	549	15.0	140.0	Private	unkn.
North Smithfield	549	15.0	155.0	Private	unkn.
North Smithfield	550	15.0	48.0	Private	X
North Smithfield	550	15.0	49.0	Private	X
North Smithfield	550	15.0	50.0	Private	X
North Smithfield	550	15.0	51.0	Private	X
North Smithfield	551	unkn.	unkn.	unkn.	unkn.
North Smithfield	552	19.0	53.0	Private	X
Providence	632	unkn.	unkn.	Public	unkn.
Providence	633	unkn.	unkn.	unkn.	unkn.
Providence	634	121.0	4.0	Public	unkn.
Providence	635	80.0	866.0	Private	unkn.
Providence	636	34.0	381.0	Private	unkn.
Providence	639	114.0	52.0	Private	unkn.
Providence	639	114.0	53.0	Private	unkn.
Providence	639	114.0	54.0	Private	unkn.
Providence	639	114.0	102.0	Private	unkn.
Providence	639	114.0	103.0	Private	unkn.
Providence	639	114.0	112.0	Private	unkn.
Providence	639	114.0	113.0	Private	unkn.
Providence	639	114.0	166.0	Private	unkn.
Providence	639	114.0	167.0	Private	unkn.
Providence	639	NA**	NA**	Public	unkn.
Providence	640	113.0	305.0	Private	O
Providence	640	113.0	429.0	Public	O
Providence	641	62.0	301.0	Private	O
Providence	641	62.0	393.0	Private	unkn.
Providence	641	62.0	397.0	Private	unkn.
Providence	643	63.0	326.0	Public	unkn.
Providence	643	63.0	574.0	Public	unkn.
Providence	643	63.0	575.0	Private	unkn.
Smithfield	72	42.0	91.0	Public	O
Smithfield	155	unkn.	unkn.	unkn.	unkn.
Smithfield	156	31.0	38.0	Private	O
Smithfield	157	unkn.	unkn.	unkn.	unkn.
Smithfield	158	31.0	38.0	Private	O
Smithfield	159	unkn.	unkn.	unkn.	unkn.
Smithfield	164	43.0	21.1	Private	unkn.

(Continued)

Appendix H. (Continued).

Town	Site ID	Plat	Lot	Ownership	OCI*
Smithfield	165	NA**	NA**	Public	unkn.
Smithfield	166	NA**	NA**	Public	unkn.
Smithfield	167	NA**	NA**	Public	unkn.
Smithfield	168	26.0	139.0	Public	O
Smithfield	169	25.0	79.0	Private	unkn.
Smithfield	169	26.0	138.0	Private	unkn.
Smithfield	170	25.0	43.0	Private	X
Smithfield	170	26.0	35.0	Private	unkn.
Smithfield	170	26.0	35.2	Private	unkn.
Smithfield	171	23.0	70.1	Public	unkn.
Smithfield	171	24.0	61.3	Public	unkn.
Smithfield	172	24.0	61.3	Public	unkn.
Smithfield	173	17.0	4.0	Public	O
Smithfield	173	17.0	5.0	Public	O
Smithfield	174	17.0	11.0	Private	unkn.
Smithfield	176	43.0	17.0	unkn.	unkn.
Smithfield	176	43.0	17.4	Private	unkn.
Smithfield	177	43.0	37.0	Private	X
Smithfield	178	43.0	18.0	Private	X
Smithfield	178	43.0	37.0	Private	X
Smithfield	179	43.0	12.1	Private	unkn.
Smithfield	179	43.0	94.0	Private	unkn.
Smithfield	179	43.0	99.0	Private	unkn.
Smithfield	179	43.0	104.0	Private	unkn.
Smithfield	180	43.0	10.0	Private	unkn.
Smithfield	191	43.0	21.3	Private	unkn.
Smithfield	191	43.0	21.4	Private	unkn.
Smithfield	191	43.0	132.0	Private	unkn.
Smithfield	374	46.0	76.0	Private	X
Smithfield	505	50.0	27.2	Private	unkn.
Smithfield	506	50.0	27.2	Private	unkn.
Smithfield	507	50.0	27.2	Private	unkn.
Smithfield	507	50.0	29.0	Private	unkn.
Smithfield	510	unkn.	unkn.	unkn.	unkn.
Smithfield	517	unkn.	unkn.	unkn.	unkn.
Smithfield	555	unkn.	unkn.	unkn.	unkn.
Smithfield	556	unkn.	unkn.	unkn.	unkn.
Smithfield	557	unkn.	unkn.	unkn.	unkn.
Smithfield	558	50.0	54.0	Private	unkn.
Smithfield	558	50.0	54.1	Private	unkn.
Smithfield	559	49.0	154.0	Private	unkn.
Smithfield	560	49.0	67.4	Private	O

(Continued)

Appendix H. (Continued).

Town	Site ID	Plat	Lot	Ownership	OCI*
Smithfield	560	49.0	152.0	Private	O
Smithfield	561	49.0	224.0	Private	O
Smithfield	564	unkn.	unkn.	unkn.	unkn.
Smithfield	565	unkn.	unkn.	unkn.	unkn.
Smithfield	566	unkn.	unkn.	unkn.	unkn.
Smithfield	567	unkn.	unkn.	unkn.	unkn.
Smithfield	568	unkn.	unkn.	unkn.	unkn.
Smithfield	569	unkn.	unkn.	unkn.	unkn.
Smithfield	570	46.0	9.0	Private	unkn.
Smithfield	571	47.0	41.0	Private	unkn.
Smithfield	573	unkn.	unkn.	unkn.	unkn.
Smithfield	574	unkn.	unkn.	unkn.	unkn.
Smithfield	575	43.0	124.0	Private	unkn.
Smithfield	575	46.0	150.0	Private	unkn.
Smithfield	578	unkn.	unkn.	unkn.	unkn.
Smithfield	579	unkn.	unkn.	unkn.	unkn.
Smithfield	580	47.0	53.0	Private	O
Smithfield	581	unkn.	unkn.	unkn.	unkn.
Smithfield	582	unkn.	unkn.	unkn.	unkn.
Smithfield	585	unkn.	unkn.	unkn.	unkn.
Smithfield	586	unkn.	unkn.	unkn.	unkn.
Smithfield	587	unkn.	unkn.	unkn.	unkn.
Smithfield	588	unkn.	unkn.	unkn.	unkn.
Smithfield	589	unkn.	unkn.	unkn.	unkn.
Smithfield	590	unkn.	unkn.	unkn.	unkn.
Smithfield	595	unkn.	unkn.	unkn.	unkn.
Smithfield	596	unkn.	unkn.	unkn.	unkn.
Smithfield	597	unkn.	unkn.	unkn.	unkn.
Smithfield	599	unkn.	unkn.	unkn.	unkn.
Smithfield	600	unkn.	unkn.	unkn.	unkn.
Smithfield	601	unkn.	unkn.	unkn.	unkn.
Smithfield	602	unkn.	unkn.	unkn.	unkn.
Smithfield	603	45.0	47.0	Public	O
Smithfield	603	unkn.	unkn.	unkn.	unkn.
Smithfield	604	unkn.	unkn.	unkn.	unkn.
Smithfield	605	unkn.	unkn.	unkn.	unkn.
Smithfield	606	unkn.	unkn.	unkn.	unkn.
Smithfield	607	unkn.	unkn.	unkn.	unkn.
Smithfield	608	unkn.	unkn.	unkn.	unkn.
Smithfield	609	unkn.	unkn.	unkn.	unkn.
Smithfield	610	unkn.	unkn.	unkn.	unkn.
Smithfield	611	49.0	102.3	Private	unkn.

(Continued)

Appendix H. (Continued).

Town	Site ID	Plat	Lot	Ownership	OCI*
Smithfield	611	49.0	102.5	Private	unkn.
Smithfield	612	unkn.	unkn.	unkn.	unkn.
Smithfield	613	unkn.	unkn.	unkn.	unkn.
Smithfield	614	unkn.	unkn.	unkn.	unkn.
Smithfield	615	46.0	116.0	Private	unkn.
Smithfield	618	unkn.	unkn.	unkn.	unkn.
Smithfield	619	unkn.	unkn.	unkn.	unkn.
Smithfield	620	unkn.	unkn.	unkn.	unkn.
Smithfield	621	unkn.	unkn.	unkn.	unkn.
Smithfield	622	unkn.	unkn.	unkn.	unkn.
Smithfield	623	unkn.	unkn.	unkn.	unkn.
Smithfield	624	unkn.	unkn.	unkn.	unkn.
Smithfield	625	unkn.	unkn.	unkn.	unkn.
Smithfield	626	unkn.	unkn.	unkn.	unkn.
Smithfield	627	unkn.	unkn.	unkn.	unkn.
Smithfield	628	unkn.	unkn.	unkn.	unkn.
Smithfield	629	unkn.	unkn.	unkn.	unkn.
Smithfield	657	44.0	7.0	Private	unkn.
Smithfield	658	46.0	260.0	Private	O
Smithfield	658	unkn.	unkn.	unkn.	unkn.
Smithfield	659	unkn.	unkn.	unkn.	unkn.
Smithfield	660	unkn.	unkn.	unkn.	unkn.
Smithfield	661	unkn.	unkn.	unkn.	unkn.
Smithfield	662	50.0	21.1	Private	unkn.
Smithfield	662	50.0	22.0	Private	unkn.
Smithfield	665	unkn.	unkn.	unkn.	unkn.
Smithfield	666	unkn.	unkn.	unkn.	unkn.
Smithfield	667	unkn.	unkn.	unkn.	unkn.
Smithfield	668	unkn.	unkn.	unkn.	unkn.
Smithfield	669	unkn.	unkn.	unkn.	unkn.
Smithfield	670	46.0	66.1	Private	unkn.
Smithfield	671	46.0	90.0	Private	unkn.
Smithfield	672	unkn.	unkn.	unkn.	unkn.
Smithfield	673	unkn.	unkn.	unkn.	unkn.
Smithfield	674	unkn.	unkn.	unkn.	unkn.
Smithfield	676	unkn.	unkn.	Public	unkn.
Smithfield	677	unkn.	unkn.	unkn.	unkn.
Smithfield	678	unkn.	unkn.	unkn.	unkn.
Smithfield	680	48.0	2.0	Private	unkn.
Smithfield	683	unkn.	unkn.	unkn.	unkn.
Smithfield	684	46.0	91.1	Private	unkn.
Smithfield	684	46.0	350.0	Private	unkn.

(Continued)

Appendix H. (Concluded).

Town	Site ID	Plat	Lot	Ownership	OCI*
Smithfield	685	unkn.	unkn.	unkn.	unkn.
Smithfield	686	50.0	54.0	Private	unkn.
Smithfield	687	unkn.	unkn.	unkn.	unkn.
Smithfield	688	unkn.	unkn.	unkn.	unkn.
Smithfield	689	unkn.	unkn.	unkn.	unkn.
Smithfield	690	44.0	33.0	Public	O
Smithfield	690	44.0	34.0	Public	O
Smithfield	691	20.0	2.0	Private	unkn.
Smithfield	691	20.0	3.0	Private	unkn.
Smithfield	694	46.0	91.0	Private	O
Smithfield	694	46.0	350.0	Private	unkn.
Smithfield	695	44.0	33.0	Public	O

* An "X" indicates the presence of a RIDEM Office of Compliance and Inspection wetland enforcement flag; an "O" indicates that no wetland enforcement flags were found.

** RIDOT land, which does not have plat or lot numbers.

Appendix I. Adjacent land use and wetland type at potential buffer restoration sites by priority level.

Site ID	Town	Priority	Land use*	Wetland type**
79	North Providence	Tier 1	Residential (<0.25-acre lots)	Marsh or wet meadow
80	Johnston	Tier 1	Barren area	River
82	North Providence	Tier 1	Residential (<0.25-acre lots)	River
83	Johnston	Tier 1	Industrial	River
85	Johnston	Tier 1	Mine or gravel pit	River
87	North Providence	Tier 1	Industrial	River
88	North Providence	Tier 1	Commercial	Stream
96	Johnston	Tier 1	Commercial	Stream
97	Johnston	Tier 1	Industrial	Stream
131	Johnston	Tier 1	Mine or gravel pit	River
132	Johnston	Tier 1	Residential (<0.25-acre lots)	Stream
134	Johnston	Tier 1	Industrial	River
135	North Providence	Tier 1	Industrial	Stream
169	Smithfield	Tier 1	Industrial	Stream
170	Smithfield	Tier 1	Industrial	River
174	Smithfield	Tier 1	Mine or gravel pit	Pond
177	Smithfield	Tier 1	Commercial	Marsh or wet meadow
180	Smithfield	Tier 1	Barren area	Cedar swamp
191	Smithfield	Tier 1	Commercial	Stream
227	Johnston	Tier 1	Commercial	Pond
374	Smithfield	Tier 1	Mine or gravel pit	Stream
505	Smithfield	Tier 1	Junkyard	Shrub bog or fen
506	Smithfield	Tier 1	Junkyard	Shrub bog or fen
544	North Smithfield	Tier 1	Cropland	Marsh or wet meadow
545	North Smithfield	Tier 1	Mine or gravel pit	Cedar swamp
546	North Smithfield	Tier 1	Mine or gravel pit	Shrub bog or fen
547	North Smithfield	Tier 1	Mine or gravel pit	Cedar swamp
549	North Smithfield	Tier 1	Mine or gravel pit	Pond
570	Smithfield	Tier 1	Mine or gravel pit	Pond
573	Smithfield	Tier 1	Residential (<0.25-acre lots)	Marsh or wet meadow
575	Smithfield	Tier 1	Mine or gravel pit	Lake
581	Smithfield	Tier 1	Cropland	Marsh or wet meadow
611	Smithfield	Tier 1	Commercial	Cedar swamp
635	Providence	Tier 1	Commercial	River
641	Providence	Tier 1	Industrial	River
643	Providence	Tier 1	Industrial	River
680	Smithfield	Tier 1	Mine or gravel pit	Cedar swamp
681	Glocester	Tier 1	Cropland	Pond
692	Johnston	Tier 1	Commercial	Stream
693	Johnston	Tier 1	Barren area	Pond

(Continued)

Appendix I. (Continued).

Site ID	Town	Priority	Land use*	Wetland type**
72	Smithfield	Tier 2	Junkyard	Shrub swamp
99	Johnston	Tier 2	Cropland	Forested swamp
100	Johnston	Tier 2	Cropland	Forested swamp
101	Johnston	Tier 2	Cropland	Forested swamp
133	Johnston	Tier 2	Commercial	Forested swamp
136	Johnston	Tier 2	Developed recreation	River
137	Johnston	Tier 2	Mine or gravel pit	Forested swamp
138	Johnston	Tier 2	Mine or gravel pit	Forested swamp
139	Johnston	Tier 2	Vacant land	Pond
145	Johnston	Tier 2	Residential (>0.25-acre lots)	Pond
151	Johnston	Tier 2	Vacant land	Pond
153	Johnston	Tier 2	Barren area	Forested swamp
155	Smithfield	Tier 2	Vacant land	Marsh or wet meadow
156	Smithfield	Tier 2	Cropland	Forested swamp
157	Smithfield	Tier 2	Cropland	Shrub swamp
158	Smithfield	Tier 2	Cropland	Forested swamp
164	Smithfield	Tier 2	Barren area	Shrub swamp
165	Smithfield	Tier 2	Vacant land	Pond
166	Smithfield	Tier 2	Vacant land	Stream
167	Smithfield	Tier 2	Vacant land	Stream
168	Smithfield	Tier 2	Vacant land	Stream
171	Smithfield	Tier 2	Developed recreation	River
172	Smithfield	Tier 2	Developed recreation	River
173	Smithfield	Tier 2	Commercial	Forested swamp
176	Smithfield	Tier 2	Commercial	Forested swamp
178	Smithfield	Tier 2	Commercial	Forested swamp
179	Smithfield	Tier 2	Commercial	Forested swamp
182	Johnston	Tier 2	Residential (>0.25-acre lots)	Pond
183	Johnston	Tier 2	Residential (>0.25-acre lots)	Pond
184	Johnston	Tier 2	Residential (>0.25-acre lots)	Pond
186	Johnston	Tier 2	Residential (>0.25-acre lots)	Marsh or wet meadow
501	North Smithfield	Tier 2	Residential (>0.25-acre lots)	Cedar swamp
503	North Smithfield	Tier 2	Power line corridor	Cedar swamp
507	Smithfield	Tier 2	Junkyard	Forested swamp
511	Glocester	Tier 2	Pasture	Shrub swamp
512	Glocester	Tier 2	Pasture	Forested swamp
513	Glocester	Tier 2	Hayfield	Marsh or wet meadow
514	Glocester	Tier 2	Hayfield	Stream
518	Glocester	Tier 2	Hayfield	Pond
522	Glocester	Tier 2	Vacant land	Marsh or wet meadow
523	Glocester	Tier 2	Vacant land	Marsh or wet meadow

(Continued)

Appendix I. (Continued).

Site ID	Town	Priority	Land use*	Wetland type**
524	Glocester	Tier 2	Hayfield	Pond
525	Glocester	Tier 2	Residential (>0.25-acre lots)	Cedar swamp
526	Glocester	Tier 2	Cropland	Forested swamp
527	Glocester	Tier 2	Cropland	Shrub swamp
528	Glocester	Tier 2	Cropland	Forested swamp
529	Glocester	Tier 2	Cropland	Forested swamp
531	Glocester	Tier 2	Cropland	Shrub swamp
534	Glocester	Tier 2	Residential (>0.25-acre lots)	Marsh or wet meadow
535	Glocester	Tier 2	Residential (>0.25-acre lots)	Pond
537	Glocester	Tier 2	Vacant land	Marsh or wet meadow
542	Glocester	Tier 2	Orchard or nursery	Marsh or wet meadow
548	North Smithfield	Tier 2	Hayfield	Marsh or wet meadow
550	North Smithfield	Tier 2	Mine or gravel pit	Forested swamp
552	North Smithfield	Tier 2	Junkyard	Shrub swamp
557	Smithfield	Tier 2	Hayfield	Marsh or wet meadow
558	Smithfield	Tier 2	Residential (>0.25-acre lots)	Stream
559	Smithfield	Tier 2	Industrial	Forested swamp
560	Smithfield	Tier 2	Industrial	Forested swamp
561	Smithfield	Tier 2	Commercial	Forested swamp
564	Smithfield	Tier 2	Abandoned agriculture	Marsh or wet meadow
571	Smithfield	Tier 2	Orchard or nursery	Lake
574	Smithfield	Tier 2	Residential (<0.25-acre lots)	Forested swamp
579	Smithfield	Tier 2	Orchard or nursery	Marsh or wet meadow
585	Smithfield	Tier 2	Cropland	Forested swamp
586	Smithfield	Tier 2	Cropland	Forested swamp
587	Smithfield	Tier 2	Cropland	Forested swamp
589	Smithfield	Tier 2	Orchard or nursery	Marsh or wet meadow
592	Johnston	Tier 2	Orchard or nursery	Emergent bog or fen
593	Johnston	Tier 2	Orchard or nursery	Cedar swamp
596	Smithfield	Tier 2	Abandoned agriculture	Marsh or wet meadow
599	Smithfield	Tier 2	Cropland	Forested swamp
600	Smithfield	Tier 2	Pasture	Forested swamp
601	Smithfield	Tier 2	Cropland	Forested swamp
602	Smithfield	Tier 2	Pasture	Forested swamp
613	Smithfield	Tier 2	Vacant land	Stream
615	Smithfield	Tier 2	Pasture	Forested swamp
622	Smithfield	Tier 2	Hayfield	Marsh or wet meadow
624	Smithfield	Tier 2	Hayfield	Marsh or wet meadow
625	Smithfield	Tier 2	Commercial	Forested swamp
626	Smithfield	Tier 2	Pasture	Forested swamp
628	Smithfield	Tier 2	Pasture	Forested swamp

(Continued)

Appendix I. (Continued).

Site ID	Town	Priority	Land use*	Wetland type**
636	Providence	Tier 2	Vacant land	River
639	Providence	Tier 2	Industrial	Forested swamp
640	Providence	Tier 2	Vacant land	River
646	Glocester	Tier 2	Hayfield	Shrub bog or fen
647	Glocester	Tier 2	Residential (>0.25-acre lots)	Shrub bog or fen
650	Glocester	Tier 2	Pasture	Forested swamp
657	Smithfield	Tier 2	Commercial	Forested swamp
662	Smithfield	Tier 2	Hayfield	Stream
670	Smithfield	Tier 2	Commercial	Forested swamp
671	Smithfield	Tier 2	Residential (>0.25-acre lots)	Pond
674	Smithfield	Tier 2	Orchard or nursery	Marsh or wet meadow
677	Smithfield	Tier 2	Pasture	Shrub swamp
679	North Providence	Tier 2	Residential (<0.25-acre lots)	Forested swamp
682	Glocester	Tier 2	Orchard or nursery	Stream
683	Smithfield	Tier 2	Hayfield	Marsh or wet meadow
685	Smithfield	Tier 2	Abandoned agriculture	Marsh or wet meadow
686	Smithfield	Tier 2	Hayfield	Stream
690	Smithfield	Tier 2	Barren area	Forested swamp
691	Smithfield	Tier 2	Residential (>0.25-acre lots)	Lake
694	Smithfield	Tier 2	Vacant land	Stream
695	Smithfield	Tier 2	Barren area	Forested swamp
77	North Providence	Tier 3	Vacant land	Forested swamp
78	North Providence	Tier 3	Vacant land	Forested swamp
91	Johnston	Tier 3	Vacant land	Forested swamp
92	Johnston	Tier 3	Residential (>0.25-acre lots)	Forested swamp
95	Johnston	Tier 3	Vacant land	Forested swamp
98	Johnston	Tier 3	Vacant land	Forested swamp
140	Johnston	Tier 3	Hayfield	Shrub swamp
141	Johnston	Tier 3	Abandoned agriculture	Forested swamp
142	Johnston	Tier 3	Vacant land	Shrub swamp
143	Johnston	Tier 3	Vacant land	Forested swamp
144	Johnston	Tier 3	Residential (>0.25-acre lots)	Forested swamp
146	Johnston	Tier 3	Hayfield	Forested swamp
147	Johnston	Tier 3	Hayfield	Forested swamp
148	Johnston	Tier 3	Abandoned agriculture	Forested swamp
149	Johnston	Tier 3	Abandoned agriculture	Forested swamp
150	Johnston	Tier 3	Vacant land	Forested swamp
152	Johnston	Tier 3	Abandoned agriculture	Forested swamp
159	Smithfield	Tier 3	Residential (>0.25-acre lots)	Forested swamp
185	Johnston	Tier 3	Vacant land	Shrub swamp
500	North Smithfield	Tier 3	Residential (>0.25-acre lots)	Forested swamp

(Continued)

Appendix I. (Continued).

Site ID	Town	Priority	Land use*	Wetland type**
504	North Smithfield	Tier 3	Residential (>0.25-acre lots)	Forested swamp
510	Smithfield	Tier 3	Vacant land	Forested swamp
515	Glocester	Tier 3	Hayfield	Forested swamp
516	Glocester	Tier 3	Hayfield	Shrub swamp
517	Smithfield	Tier 3	Vacant land	Forested swamp
530	Glocester	Tier 3	Hayfield	Forested swamp
532	Glocester	Tier 3	Developed recreation	Forested swamp
533	Glocester	Tier 3	Abandoned agriculture	Forested swamp
536	Glocester	Tier 3	Vacant land	Shrub swamp
541	Glocester	Tier 3	Vacant land	Forested swamp
543	Glocester	Tier 3	Orchard or nursery	Forested swamp
551	North Smithfield	Tier 3	Hayfield	Shrub swamp
555	Smithfield	Tier 3	Orchard or nursery	Forested swamp
556	Smithfield	Tier 3	Residential (>0.25-acre lots)	Forested swamp
565	Smithfield	Tier 3	Abandoned agriculture	Forested swamp
566	Smithfield	Tier 3	Abandoned agriculture	Shrub swamp
567	Smithfield	Tier 3	Abandoned agriculture	Forested swamp
568	Smithfield	Tier 3	Orchard or nursery	Forested swamp
569	Smithfield	Tier 3	Orchard or nursery	Forested swamp
578	Smithfield	Tier 3	Orchard or nursery	Forested swamp
580	Smithfield	Tier 3	Vacant land	Forested swamp
582	Smithfield	Tier 3	Hayfield	Forested swamp
588	Smithfield	Tier 3	Vacant land	Forested swamp
590	Smithfield	Tier 3	Orchard or nursery	Forested swamp
591	Johnston	Tier 3	Hayfield	Forested swamp
594	Johnston	Tier 3	Residential (>0.25-acre lots)	Forested swamp
595	Smithfield	Tier 3	Abandoned agriculture	Forested swamp
597	Smithfield	Tier 3	Abandoned agriculture	Forested swamp
603	Smithfield	Tier 3	Hayfield	Forested swamp
604	Smithfield	Tier 3	Hayfield	Forested swamp
605	Smithfield	Tier 3	Hayfield	Shrub swamp
606	Smithfield	Tier 3	Hayfield	Shrub swamp
607	Smithfield	Tier 3	Hayfield	Shrub swamp
608	Smithfield	Tier 3	Hayfield	Shrub swamp
609	Smithfield	Tier 3	Vacant land	Forested swamp
610	Smithfield	Tier 3	Hayfield	Shrub swamp
612	Smithfield	Tier 3	Vacant land	Forested swamp
614	Smithfield	Tier 3	Hayfield	Forested swamp
618	Smithfield	Tier 3	Hayfield	Forested swamp
619	Smithfield	Tier 3	Vacant land	Shrub swamp
620	Smithfield	Tier 3	Vacant land	Shrub swamp

(Continued)

Appendix I. (Concluded).

Site ID	Town	Priority	Land use*	Wetland type**
621	Smithfield	Tier 3	Vacant land	Forested swamp
623	Smithfield	Tier 3	Hayfield	Shrub swamp
627	Smithfield	Tier 3	Hayfield	Forested swamp
629	Smithfield	Tier 3	Hayfield	Forested swamp
630	North Providence	Tier 3	Vacant land	Forested swamp
631	North Providence	Tier 3	Vacant land	Shrub swamp
632	Providence	Tier 3	Developed recreation	Forested swamp
633	Providence	Tier 3	Hayfield	Forested swamp
634	Providence	Tier 3	Vacant land	Forested swamp
644	Johnston	Tier 3	Abandoned agriculture	Forested swamp
645	Glocester	Tier 3	Hayfield	Forested swamp
648	Glocester	Tier 3	Residential (>0.25-acre lots)	Forested swamp
651	Glocester	Tier 3	Hayfield	Shrub swamp
652	Glocester	Tier 3	Residential (>0.25-acre lots)	Shrub swamp
653	Glocester	Tier 3	Residential (>0.25-acre lots)	Forested swamp
654	Glocester	Tier 3	Hayfield	Forested swamp
655	Glocester	Tier 3	Residential (>0.25-acre lots)	Forested swamp
656	Glocester	Tier 3	Residential (>0.25-acre lots)	Forested swamp
658	Smithfield	Tier 3	Residential (>0.25-acre lots)	Forested swamp
659	Smithfield	Tier 3	Abandoned agriculture	Forested swamp
660	Smithfield	Tier 3	Hayfield	Forested swamp
661	Smithfield	Tier 3	Residential (>0.25-acre lots)	Forested swamp
665	Smithfield	Tier 3	Power line corridor	Shrub swamp
666	Smithfield	Tier 3	Power line corridor	Shrub swamp
667	Smithfield	Tier 3	Residential (>0.25-acre lots)	Forested swamp
668	Smithfield	Tier 3	Power line corridor	Shrub swamp
669	Smithfield	Tier 3	Power line corridor	Shrub swamp
672	Smithfield	Tier 3	Residential (>0.25-acre lots)	Forested swamp
673	Smithfield	Tier 3	Orchard or nursery	Forested swamp
676	Smithfield	Tier 3	Hayfield	Forested swamp
678	Smithfield	Tier 3	Hayfield	Forested swamp
684	Smithfield	Tier 3	Orchard or nursery	Forested swamp
687	Smithfield	Tier 3	Abandoned agriculture	Shrub swamp
688	Smithfield	Tier 3	Power line corridor	Shrub swamp
689	Smithfield	Tier 3	Power line corridor	Shrub swamp

* Based on 1995 data from RIGIS.

** Based on 1988 data from RIGIS. *Note*: Rivers were mapped as polygons in RIGIS, while streams were mapped as lines.

Appendix J. Profiles of potential sources of restoration funding or technical assistance.

FEDERAL PROGRAMS

Title: *Aquatic Ecosystem Restoration*
Lead Agency or Organization: U.S. Dept. of Defense, Army Corps of Engineers
Restoration Activities Supported: Construction, planning, wetland restoration not related to former USACE projects
Habitats Addressed: Wetland
Assistance Provided: Grants
Size of Awards: Up to $5 million; however, projects with an estimated Federal cost of $300,000 or less may be expedited.
Eligible Recipients: State or local agency
Recipient Cost Share: 35%
Application Deadline: Continuous by request letter
Web Address: http://www.usace.army.mil/inet/usace-docs/eng-pamphlets/ep1165-2-502/entire.pdf
Contact Person: Larry Oliver
U.S. Army Corps of Engineers
696 Virginia Rd.
Concord, MA 01742
978-318-8347
Lawrence.R.Oliver@nae02.usace.army.mil

Title: *Community-based Restoration Program*
Lead Agency or Organization: U.S. Dept. of Commerce, NOAA
Restoration Activities Supported: Project design, engineering services, permitting, construction, on-the-ground restoration
Habitats Addressed: Marine, estuarine, and riparian habitat
Assistance Provided: Grants and technical assistance
Size of Awards: $20,000-$250,000; average $20,000-$30,000
Eligible Recipients: Nonprofits, commercial organizations, state and local governments
Recipient Cost Share: 50% for CRP funds requested to complete the proposed project
Application Deadline: Variable; typically between March and July
Web Address:
http://www.nmfs.noaa.gov/habitat/restoration/community/callforprojectsmay2.html
Contact Person: James Turek, Assistant Northeast Coordinator
NOAA Restoration Center
28 Tarzwell Dr.
Narragansett, RI 02882
401-782-3338
James.G.Turek@noaa.gov

Title: *Conservation Reserve Program*
Lead Agency or Organization: USDA, Farm Service Agency
Restoration Activities Supported: Plant cover creation to improve soil, water, and wildlife resources
Habitats Addressed: Planted cropland (wetland), marginal pastureland, or riparian buffers
Assistance Provided: Grants and technical assistance
Size of Awards: $50-$50,000 per fiscal year; average $4,000
Eligible Recipients: States, local agencies, individuals
Recipient Cost Share: 50% for cover, 75% for wetland hydrology restoration
Application Deadline: Continuous signup available
Web Address: http://www.fsa.usda.gov/pas/publications/facts/html/crp02.htm
http://aspe.os.dhhs.gov/cfda/p10069.htm
Contact Person: Marilu Soileau
Rhode Island State FSA Office
60 Quaker Lane
West Bay Office Complex, Room 40
Warwick, RI 02886-0111
401-828-3120
Marilu.Soileau@ri.usda.gov

Title: *Conservation Technical Assistance*
Lead Agency or Organization: USDA, Natural Resources Conservation Service
Restoration Activities Supported: Planning and implementation
Habitats Addressed: Wetland and upland
Assistance Provided: Technical assistance
Size of Awards: N/A
Eligible Recipients: States, individuals, communities, conservation districts
Recipient Cost Share: None required
Application Deadline: Continuous technical assistance available
Web Address: http://www.nrcs.usda.gov/programs/cta/index.html
Contact Person: Vicky Drew
NRCS
RI State Office & Service Center
60 Quaker Lane, Suite 46
Warwick, RI 02886
401-828-1300

Title: *Environmental Quality Incentives Program*
Lead Agency or Organization: Title: Small Watershed Program and Flood Prevention Program
Restoration Activities Supported: Construction, preservation
Habitats Addressed: Cropland, rangeland, pasture, private non-industrial forestland, and other farm or ranch lands
Assistance Provided: Grants and technical assistance
Size of Awards: Up to $450,000 per recipient
Eligible Recipients: Producers engaged in livestock or crop production (farmers and ranchers)
Recipient Cost Share: 10-50%
Application Deadline: Applications taken continuously throughout the year
Web Address: http://www.nrcs.usda.gov/programs/eqip/
Contact Person: Vicky Drew
NRCS
RI State Office & Service Center
60 Quaker Lane, Suite 46
Warwick, RI 02886
401-828-1300

Title: *Five-Star Restoration Challenge Grants*
Lead Agency or Organization: USEPA, Office of Water
The National Association of Counties, the National Fish and Wildlife Foundation, the Wildlife Habitat Council, and the Community-Based Restoration Program within NOAA Fisheries
Restoration Activities Supported: Restoration, education, outreach, community stewardship
Habitats Addressed: Wetland, riparian
Assistance Provided: Grants
Size of Awards: $5,000-$20,000; average $10,000
Eligible Recipients: Schools or youth organizations, state or local governments, local businesses, conservation organizations, citizen groups, foundations; each project must have 5 partner organizations.
Recipient Cost Share: 20%; each of five organizations contributes $1 for every $1 EPA provides.
Application Deadline: March 1
Web Address: http://nfwf.org/programs/5star-rfp.htm
Contact Person: Peter Holmes
USEPA
1 Congress Street
Boston, MA 02203
617-918-1397
peter.holmes@epa.gov

Title: *Forestland Enhancement Program*
Lead Agency or Organization: USDA, Forest Service
Restoration Activities Supported: Restoration, use, and enhancement of forested wetlands and riparian areas, and protection of water quality and watersheds through state-developed best management practices; rules have not yet been promulgated for this program.
Habitats Addressed: Upland, wetland
Assistance Provided: Not yet available
Size of Awards: Not yet available
Eligible Recipients: Landowners
Recipient Cost Share: 25%
Application Deadline: Not yet available
Web Address: Not available
Contact Person: Tom Abbott
RIDEM Division of Forest Environment
1037 Hartford Pike
North Scituate, RI 02857
401-539-1052

Title: *National Fish and Wildlife Foundation Grants – Challenge Grants, Small Grants*
Lead Agency or Organization: U.S. Dept. of the Interior, Fish and Wildlife Service
Restoration Activities Supported: Promoting fish and wildlife conservation and the habitats on which they depend
Habitats Addressed: Wetland, upland
Assistance Provided: Grants
Size of Awards: $10,000-$150,000 (Small grants $5,000 or less)
Eligible Recipients: State and local governments, educational institutions, and nonprofit conservation organizations (small grants can only be applied for by nonprofits)
Recipient Cost Share: 33%
Application Deadline: Three deadlines throughout year; applications taken continuously
Web Address: http://www.nfwf.org/programs/guidelines.htm
Contact Person: Greg Mannesto
U.S. Fish & Wildlife Service
Shoreline Plaza
Route 1A, P.O. Box 307
Charlestown, RI 02813
401-364-9124

Title: *National Fish and Wildlife Foundation Grants – Special Grants*
Lead Agency or Organization: U.S. Dept. of the Interior, Fish and Wildlife Service
Possible Grants: Bring Back the Natives, FMC Corporation Bird and Habitat Conservation Fund, Migratory Bird Conservancy, Native Plant Conservation Initiative, Natural Resources Conservation Service: Conservation on Private Lands, Partnerships with the Corps of Engineers, Partners in Amphibian and Reptile Conservation (PARC), Pulling Together Initiative
Restoration Activities Supported: Fish and wildlife habitat restoration, non-structural flood control opportunities, wetland restoration
Habitats Addressed: Upland, wetland
Assistance Provided: Grants
Size of Awards: $25,000-$75,000, on average
Eligible Recipients: Not specifically stated, but most likely state and local governments, educational institutions, and nonprofit conservation organizations
Recipient Cost Share: 1:1 matching funds; prefer (some require) a 2:1 matching ratio
Application Deadline: Variable throughout year; see website
Web Address: http://www.nfwf.org/programs/grant_apply.htm
Contact Person: James Turek, Assistant Northeast Coordinator
NOAA Restoration Center
28 Tarzwell Dr.
Narragansett, RI 02882
401-782-8338
James.G.Turek@noaa.gov

Title: *North American Wetlands Conservation Act Grants*
Lead Agency or Organization: U.S. Dept. of the Interior, Fish and Wildlife Service
Restoration Activities Supported: Conservation of wetlands and wetlands-dependent fish and wildlife through acquisition (including easements and land title donations), restoration, and enhancement
Habitats Addressed: Wetland, upland
Assistance Provided: Grants
Size of Awards: $51,000-$1,000,000; small grants up to $50,000
Eligible Recipients: Any person, group, or organization capable of conducting wetland conservation
Recipient Cost Share: 50%
Application Deadline: March 1 & July 26 (for 2002)
Web Address: http://northamerican.fws.gov/NAWCA/USstandgrants.html
Contact Person: Charles Hayes, Assistant Joint Venture Coordinator
U.S. Fish and Wildlife Service
Shoreline Plaza
Route 1-A, P.O. Box 307
Charlestown, RI 02813
401-364-9124

Title: *Partners for Fish and Wildlife Habitat Restoration*
Lead Agency or Organization: U.S. Dept. of the Interior, Fish and Wildlife Service
Restoration Activities Supported: Habitat restoration
Habitats Addressed: Wetland, upland
Assistance Provided: Grants
Size of Awards: Up to $10,000; $2,000-$3,000 average
Eligible Recipients: State and local agencies, private organizations, corporations, schools
Recipient Cost Share: 50%, but is flexible
Application Deadline: Continuous enrollment
Web Address: http://partners.fws.gov/index.htm
Contact Person: Greg Mannesto
U.S. Fish & Wildlife Service
Shoreline Plaza
Route 1A, P.O. Box 307
Charlestown, RI 02813
401-364-9124

Title: *Planning Assistance to the States*
Lead Agency or Organization: U.S. Dept. of Defense, Army Corps of Engineers
Restoration Activities Supported: Planning, design, studies
Habitats Addressed: Upland, wetland
Assistance Provided: Technical and financial assistance
Size of Awards: Up to $500,000
Eligible Recipients: States
Recipient Cost Share: 50%
Application Deadline: Requests accepted continuously
Web Address: http://www.cfda.gov/public/viewprog.asp?progid=250
Contact Person: Larry Oliver
U.S. Army Corps of Engineers
696 Virginia Rd.
Concord, MA 01742
978-318-8347
Lawrence.R.Oliver@nae02.usace.army.mil

Title: *Project Modification for the Improvement of the Environment*
Lead Agency or Organization: U.S. Dept. of Defense, Army Corps of Engineers
Restoration Activities Supported: Restoration of ecological resources and modification of former USACE projects
Habitats Addressed: Wetland, upland, riparian
Assistance Provided: Grants
Size of Awards: Not limited, with specific authorization from Congress
Eligible Recipients: State and local governments
Recipient Cost Share: 25%
Application Deadline: Continuously by request letter
Web Address: http://www.usace.army.mil/inet/usace-docs/eng-pamphlets/ep1165-2-502/entire.pdf
Contact Person: Larry Oliver
US Army Corps of Engineers
696 Virginia Rd.
Concord, MA 01742
978-318-8347
Lawrence.R.Oliver@nae02.usace.army.mil

Title: *Resource Conservation and Development*
Lead Agency or Organization: USDA, Natural Resources Conservation Service
Restoration Activities Supported: Conservation, development, and utilization of natural resources; could include restoration
Habitats Addressed: Upland, wetland
Assistance Provided: Technical assistance
Size of Awards: N/A
Eligible Recipients: States, tribes, local governments, local nonprofit organizations
Recipient Cost Share: None required
Application Deadline: Assistance available continuously throughout year
Web Address: http://www.nrcs.usda.gov/programs/rcd/
Contact Person: Dexter Miller, RC&D Project Coordinator
RI State Office & Service Center
60 Quaker Lane, Suite 46
Warwick, RI 02886
401-949-4418
Dexter.Miller@ri.usda.gov

Title: *Small Watershed Program and Flood Prevention Program*
Lead Agency or Organization: USDA, Natural Resources Conservation Service
Title: Small Watershed Program and Flood Prevention Program
Restoration Activities Supported: Conserve and develop water and land resources through construction, design, and planning
Habitats Addressed: Watersheds (wetland and upland)
Assistance Provided: Grants and technical assistance
Size of Awards: Up to $5,000,000 without requiring Congressional committee approval
Eligible Recipients: Federal, State, and local agencies; local government sponsors; tribal governments; landowners
Recipient Cost Share: Requires local and state funding contribution
Application Deadline: Continuous application process
Web Address: http://www.nrcs.usda.gov/programs/watershed/index.html
Contact Person: Joe Bachand
NRCS
RI State Office & Service Center
60 Quaker Lane, Suite 46
Warwick, RI 02886
401-828-1300
Joseph.Bachand@ri.usda.gov

Title: *Watershed and Air Management Cost Share*
Lead Agency or Organization: USDA, Forest Service
Restoration Activities Supported: This is a new grant, for which information is not yet available.
Habitats Addressed: Not yet available
Assistance Provided: Not yet available
Size of Awards: Not yet available
Eligible Recipients: Not yet available
Recipient Cost Share: Not yet available
Application Deadline: Not yet available
Web Address: Not yet available
Contact Person: Joe Bachand
NRCS
RI State Office & Service Center
60 Quaker Lance, Suite 46
Warwick, RI 02886
401-828-1300
Joseph.Bachand@ri.usda.gov

Title: *Wetlands Reserve Program*
Lead Agency or Organization: USDA, Natural Resources Conservation Service
Restoration Activities Supported: Construction, restoration
Habitats Addressed: Wetland, upland
Assistance Provided: Grants and technical assistance
Size of Awards: Dependent on size of land and enrollment option
Eligible Recipients: Landowner
Recipient Cost Share: 0- 25%, depending on enrollment option
Application Deadline: Continuous enrollment
Web Address: http://www.nrcs.usda.gov/programs/farmbill/2002/pdf/WRPFct.pdf
Contact Person: Joe Bachand
NRCS
RI State Office & Service Center
60 Quaker Lane, Suite 46
Warwick, RI 02886
401-828-1300
Joseph.Bachand@ri.usda.gov

Title: *Wildlife Habitat Incentives Program*
Lead Agency or Organization: USDA, Natural Resources Conservation Service
Restoration Activities Supported: Creating, restoring, and enhancing wildlife habitat
Habitats Addressed: Upland, wetland, riparian
Assistance Provided: Technical assistance and grants
Size of Awards: No limit; grants approved in RI up to $100,000
Eligible Recipients: Landowners, state or local government
Recipient Cost Share: 25%
Application Deadline: Continuous application
Web Address: http://www.nrcs.usda.gov/programs/whip/
Contact Person: Joe Bachand
NRCS
RI State Office & Service Center
60 Quaker Lane, Suite 46
Warwick, RI 02886
401-828-1300
Joseph.Bachand@ri.usda.gov

FEDERALLY SUPPORTED STATE PROGRAMS

Title: *Clean Water State Revolving Fund*
Lead Agency or Organization: RIDEM /RI Clean Water Finance Agency (USEPA)
Restoration Activities Supported: Water pollution abatement; can include restoration
Habitats Addressed: Upland, wetland
Assistance Provided: Loans (interest rate is 1/3 off community marked borrowing rate)
Size of Awards: $150,000-$163 million; $1 million average
Eligible Recipients: Local governments
Recipient Cost Share: N/A
Application Deadline: Applications accepted continuously
Web Address: http://aspe.os.dhhs.gov/cfda/p66458.htm
Contact Person: Jay Manning
RI Dept. Environmental Management
Office of Water Resources
235 Promenade Street
Providence, RI 02908
401-222-4700
jmanning@dem.state.ri.us

Title: *Land and Water Conservation Fund Grants*
Lead Agency or Organization: RIDEM (U.S. Dept. of Interior)
Restoration Activities Supported: Acquisition and development of public outdoor recreation areas
Habitats Addressed: Upland or wetland in recreation areas
Assistance Provided: Grants
Size of Awards: Unknown
Eligible Recipients: State and local governments
Recipient Cost Share: None required
Application Deadline: Mid-July
Web Address: www.ncrc.nps.gov/PROGRAMS/LWCF/index.html
Contact Person: Joe Dias
Department of Environmental Management
Office of Planning and Development
235 Promenade Street
Providence, RI 02908
401-222-4700
jdias@dem.state.ri.us

Title: *Nonpoint Source Implementation*
Lead Agency or Organization: RIDEM (USEPA: Section 319)
Restoration Activities Supported: Activities related to watershed restoration work
Habitats Addressed: Upland, wetland
Assistance Provided: Grants
Size of Awards: $50,000-$200,000
Eligible Recipients: State and local governments, interstate agencies, public and private nonprofit organizations, institutions
Recipient Cost Share: 40%
Application Deadline: Projects are solicited throughout year.
Web Address: http://aspe.os.dhhs.gov/cfda/p66460.htm
Contact Person: Jim Riordan
Department of Environmental Management
Office of Water Resources
235 Promenade Street
Providence, RI 02908
401-222-4700
jriordan@dem.state.ri.us

Title: *Transportation Enhancements Plan*
Lead Agency or Organization: RIDOT (USDOT)
Restoration Activities Supported: Environmental mitigation to improve water quality and wildlife habitat
Habitats Addressed: Upland, wetland
Assistance Provided: Grants
Size of Awards: Not available
Eligible Recipients: State and local governments
Recipient Cost Share: 5%-20%
Application Deadline: Applications accepted once a year, or every 2 years
Web Address: www.fhwa.dot.gov/environment/te_final.htm
Contact Person: Lori Capaldi
Rhode Island Department of Transportation
Office of Environmental Programs
2 Capitol Hill, Room 230
Providence, RI 02903
401-222-2023
lcapaldi@dot.state.ri.us

Title: *Water Quality Grants*
Lead Agency or Organization: RIDEM (USEPA: Section 104(b)(3))
Restoration Activities Supported: Experiments and demonstrations of restoration
Habitats Addressed: Upland, wetland
Assistance Provided: Grants
Size of Awards: Not available
Eligible Recipients: State and interstate agencies and other nonprofit institutions, organizations, individuals
Recipient Cost Share: None
Application Deadline: Applications taken continuously; decisions made in July
Web Address: www.epa.gov/owm/cwfinance/waterquality.htm
Contact Person: Peter Holmes
USEPA
1 Congress Street
Boston, MA 02203
617-918-1397
peter.holmes@epa.gov

Title: *Wetlands Program Development Grants*
Lead Agency or Organization: RIDEM (USEPA: Section 104(b)(3))
Restoration Activities Supported: Planning, design, permitting, construction, education
Habitats Addressed: Freshwater and coastal wetlands, floodplains, riparian zones, coastal waters
Assistance Provided: Grants
Size of Awards: $10,000-$500,000
Eligible Recipients: States, federally recognized tribes, local governments, and intergovernmental organizations
Recipient Cost Share: 25%
Application Deadline: December 31
Web Address: www.epa.gov/owow/wetlands/2002grant/
Contact Person: Peter Holmes
USEPA
1 Congress Street
Boston, MA 02203
617-918-1397
peter.holmes@epa.gov

NONGOVERNMENTAL PROGRAMS

Title: *Acorn Foundation Grants*
Lead Agency or Organization: Common Counsel Foundation
Restoration Activities Supported: Preserve and restore habitats supporting biological diversity and wildlife; prevent or remedy toxic pollution
Habitats Addressed: Upland, wetland
Assistance Provided: Grants
Size of Awards: $5,000-$10,000
Eligible Recipients: Nonprofit organizations
Recipient Cost Share: None required
Application Deadline: January and June 15th of each year
Web Address: www.commoncounsel.org/pages/foundation.html
Contact Person: Common Counsel Foundation
1221 Preservation Park Way
Oakland, CA 94612
510-834-2995
ccouncil@igc.org

Title: *Bafflin Foundation Grants*
Lead Agency or Organization: Bafflin Foundation
Restoration Activities Supported: Animal and land conservation
Habitats Addressed: Upland, wetland
Assistance Provided: Grants
Size of Awards: Will consider all amounts
Eligible Recipients: All groups
Recipient Cost Share: Not required
Application Deadline: Continuously by application letter
Web Address: None
Contact Person: Paul Silver
c/o Hinkley, Allen & Snyder
1500 Fleet Center
Providence, RI 02903
401-274-2000

Title: *Davis Conservation Foundation Grants*
Lead Agency or Organization: Davis Conservation Foundation
Restoration Activities Supported: Wildlife habitat restoration; preference given to northern New England projects
Habitats Addressed: Wetland, upland
Assistance Provided: Grants
Size of Awards: $1,500-$15,000
Eligible Recipients: Not limited
Recipient Cost Share: None required
Application Deadline: Ongoing
Web Address: None
Contact Person: Nancy Winslow, Executive Director
Davis Conservation Foundation
4 Fundy Rd.
Falmouth, ME 04105
207-781-5504

Title: *FishAmerica Foundation Grants*
Lead Agency or Organization: American Sportfishing Association
Restoration Activities Supported: Restoration of marine, estuarine, or anadromous fish habitats, particularly for sportfish
Habitats Addressed: Wetland
Assistance Provided: Grants
Size of Awards: $5,000-$30,000; average $7,500
Eligible Recipients: Nonprofit organizations, state agencies (less often)
Recipient Cost Share: Not required
Application Deadline: From May 1 to July 1 each year
Web Address: www.fishamerica.org/content/conservation/fishamerica/faf_grant.cfm
Contact Person: Tom Marshall, Managing Director
FishAmerica Foundation
1033 North Fairfax Street, Suite 200
Alexandria, VA 22314
703-548-6338
jdegroff@asafishing.org

Title: *Norcross Wildlife Foundation Grants*
Lead Agency or Organization: Norcross Wildlife Foundation
Restoration Activities Supported: Wetland, wildlife habitat restoration
Habitats Addressed: Upland, wetland
Assistance Provided: Grants
Size of Awards: $1,000-$50,000; average $5,000-$7,000
Eligible Recipients: Nonprofit organizations
Recipient Cost Share: Not required
Application Deadline: Reviewed quarterly
Web Address: http://www.norcrossws.org/
Contact Person: Richard Reagon, Managing Director
Norcross Wildlife Foundation
P.O. Box 269
Wales, MA 01081
NY Office: 212-362-4831
norcross_wf_po@prodigy.net

Title: *Orvis Conservation Projects*
Lead Agency or Organization: Orvis Company
Restoration Activities Supported: Restoration or enhancement and long-term protection of native fish and wildlife habitat
Habitats Addressed: Upland, wetland
Assistance Provided: Grants
Size of Awards: Average $100,000-$150,000
Eligible Recipients: Nonprofit organizations
Recipient Cost Share: None required
Application Deadline: August 1
Web Address: http://www.orvis.com/intro.asp?dir_id=&Group_ID=&subject=7
Contact Person: Ryan Shadrin
The Orvis Company
Conservation Program Historic
Route 7A
Manchester, VT 05254
ShadrinR@ORVIS.com

Title: *Prospect Hill Foundation Grants*
Lead Agency or Organization: Prospect Hill Foundation
Restoration Activities Supported: Land conservation and water quality improvement
Habitats Addressed: Upland, wetland
Assistance Provided: Grants
Size of Awards: $5,000-$65,000; average $15,000
Eligible Recipients: Nonprofit organizations
Recipient Cost Share: Not required, but recommended to obtain support from additional sources
Application Deadline: Continuously reviewed
Web Address: http://fdncenter.org/grantmaker/prospecthill/prog.html
Contact Person: Constance Eisman
The Prospect Hill Foundation
99 Park Avenue, Suite 2220
New York, New York 10016
212-370-1165

Title: *Rhode Island Corporate Wetlands Restoration Partnership*
Lead Agency or Organization: R.I. Corporate Wetlands Restoration Partnership
Restoration Activities Supported: Wetland restoration
Habitats Addressed: Wetland and upland
Assistance Provided: Grants and technical support
Size of Awards: Project-dependent
Eligible Recipients: State agencies working with nonprofits
Recipient Cost Share: None at this time
Application Deadline: Ongoing
Web Address: http://www.coastalamerica.gov/text/cwrp.html
Contact Person: Richard Kleiman
Environmental Science Services
888 Worcester St., Suite 240
Wellesley, MA 02482
781-431-0500
rkleiman@essgroup.com

Title: *Small Grants Program for New England Activists*
Lead Agency or Organization: New England Grassroots Environmental Fund
Restoration Activities Supported: Any environmental work related to water quality, watershed management, wetlands, or wildlife
Habitats Addressed: Upland, wetland
Assistance Provided: Grants
Size of Awards: $500-$2,500
Eligible Recipients: Nonprofit organizations
Recipient Cost Share: None required
Application Deadline: January 15, May 1, and September 15
Web Address: http://www.grassrootsfund.org/
Contact Person: Cheryl King Fischer
New England Grassroots Environment Fund
P.O. Box 1057
Montpelier, VT 05601
802-223-4622
fischer@grassrootsfund.org

OTHER SOURCES OF INFORMATION

http://www.rivernetwork.org/library/libfundir.cfm - Directory of grants

http://www.rivernetwork.org/howwecanhelp/howwag.cfm#wag - River Network makes grants available to local watershed partnerships to support their organizational development and long-term effectiveness.

http://fdncenter.org/fc_stats/listing.html - Tables of grantmakers and topics

http://philanthropy.com/ - Information on grants to subscribers

http://www.cos.com/ - Information on grants to subscribers

http://fdncenter.org/ - Information on grants to subscribers

http://www.fundsnetservices.com/ - Information on funding opportunities, fundraising, and grant writing

http://www.environmentalgrants.com/ - This organization publishes the Environmental Grantmaking Foundations directory for sale from its website.

http://www.epa.gov/OWOW/watershed/wacademy/fund.html - A listing of grants for watershed protection and other resources

http://restoration.nos.noaa.gov/htmls/resources/funding.html - An online booklet of grants for habitat restoration

http://www.state.ma.us/envir/mwrp/publications.htm - A listing of federal and state funding sources for restoring wetlands can be ordered from this site.
