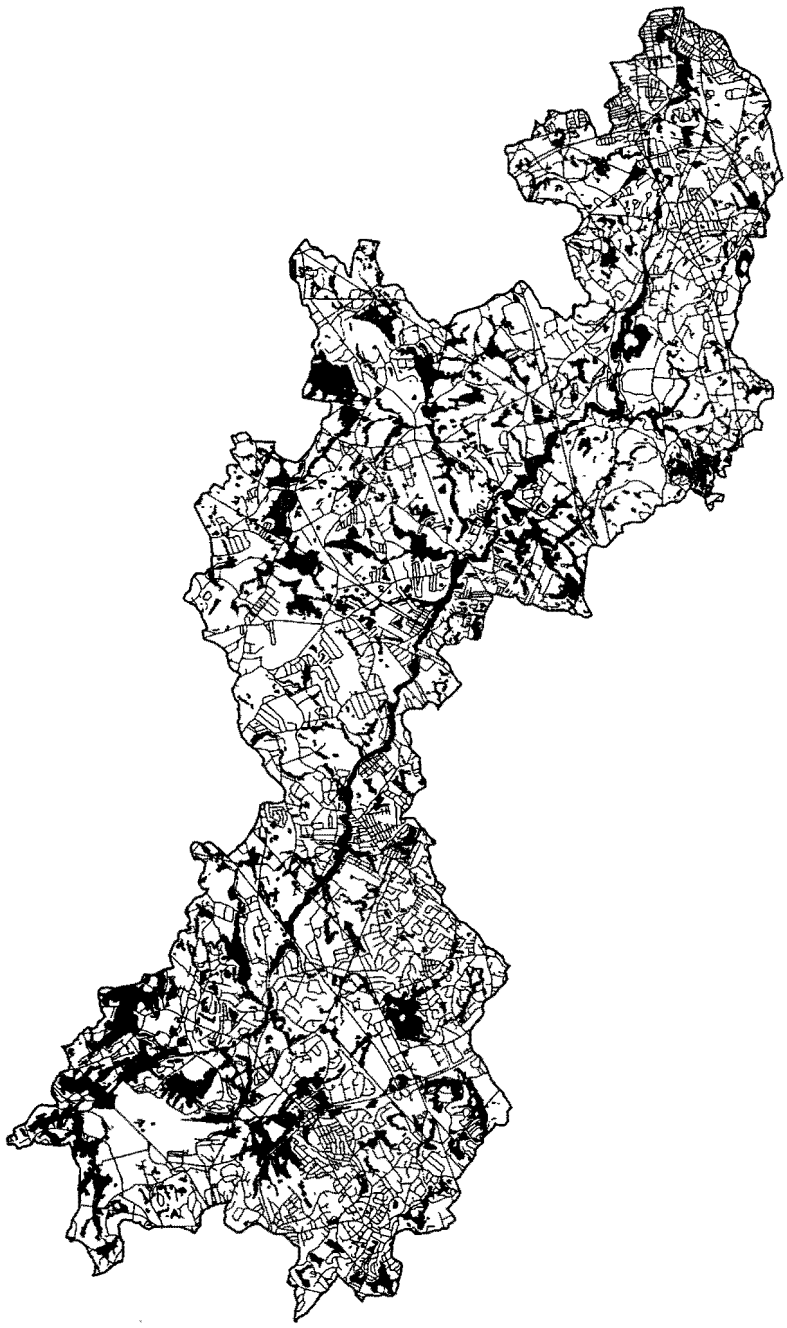
Wetlands and Potential Wetland Restoration Sites for the Shawsheen Watershed



A Cooperative University of Massachusetts and U.S. Fish and Wildlife Service Report
April 2000

Wetlands and Potential Wetland Restoration Sites for the Shawsheen Watershed

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Produced for the Massachusetts Wetlands Restoration & Banking Program,
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ATTENTION: The appendices are not included in this copy of the report. For these data and other information about the Massachusetts Wetlands Restoration Program (MWRP), visit the MWRP website at: http://www.state.ma.us/envir/mwrp/ or contact them via email at: wetlands.restoration@state.ma.us or by phone at 617-626-1177.

Introduction

The Massachusetts Wetlands Restoration & Banking Program is conducting wetland restoration planning on a watershed basis. The initial phase of this process is an inventory of wetlands and potential wetland restoration sites in the watershed. This is followed by an assessment of potential watershed deficits (problems due to flooding, poor water quality, fish and wildlife habitat degradation, etc.), preparation of a draft watershed plan for wetland restoration, public review and comment on the draft plan, and preparation of the final plan.

Subject Area

The Shawsheen watershed is a 78-square mile drainage area in northeastern Massachusetts. The river itself is 25 miles long, beginning in Bedford and emptying into the Merrimack River (Bickford and Dymon 1990). The watershed includes parts of Middlesex and Essex Counties, with 75 percent of the watershed in the former county and 25 percent in the latter. The Shawsheen watershed encompasses parts of 13 towns: Andover, Bedford, Billerica, Burlington, Concord, Lawrence, Lexington, Lincoln, North Andover, North Reading, Tewksbury, Wilmington, and Woburn (Figure 1). The acreage of each town within the watershed and the percent of the watershed it represents are shown in Table 1.

Table 1. Coverage of the Shawsheen watershed by town.

Town	Acreage	% of Watershed
Andover	10,320	21
Bedford	6,570	13
Billerica	7,822	16
Burlington	4,069	8
Concord	836	2
Lawrence	950	2
Lexington	5,360	11
Lincoln	1,229	2
North Andover	1,279	3
North Reading	4	-
Tewksbury	9,712	19
Wilmington	1,566	3
Woburn	238	-

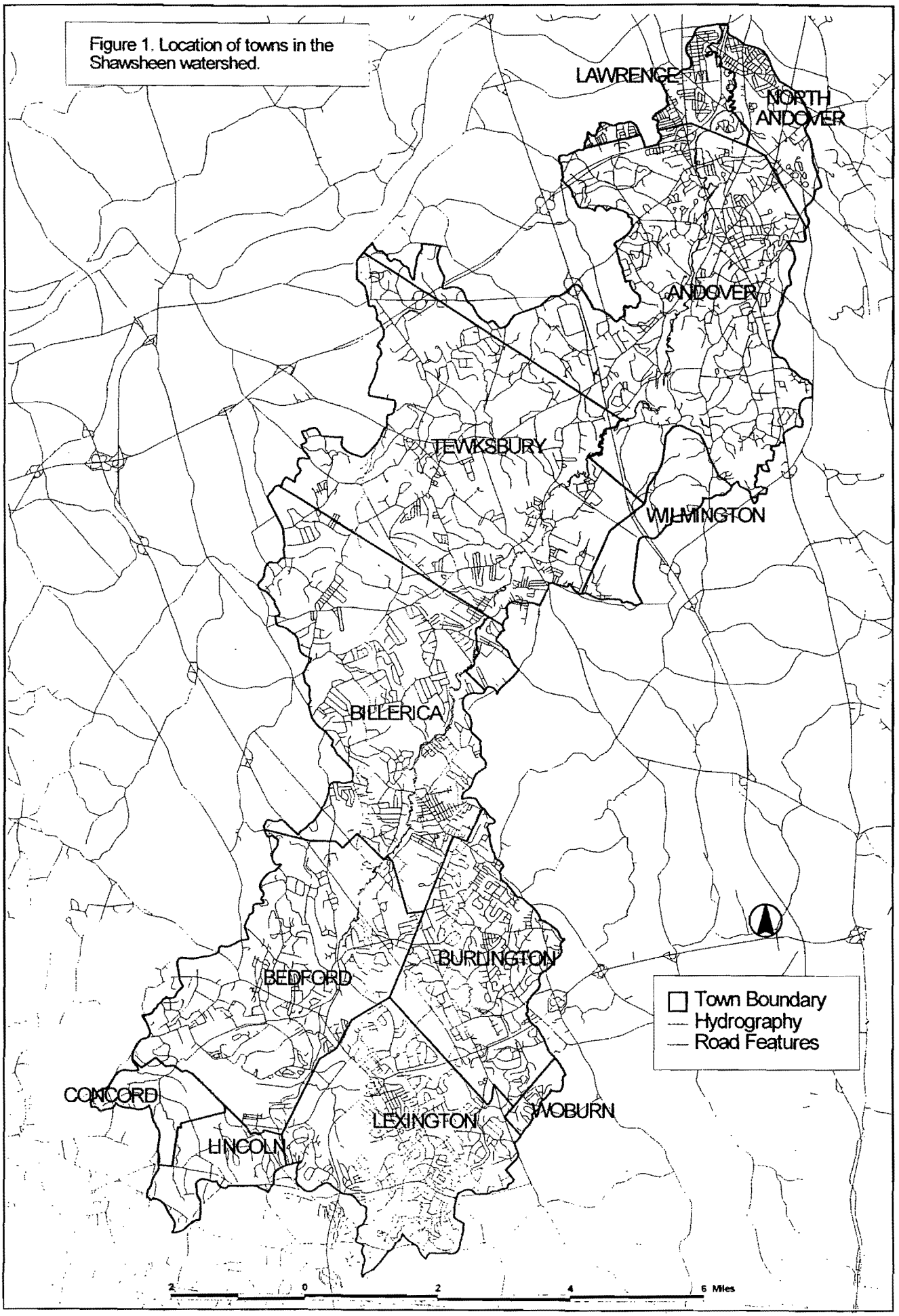

Figure 1. Location of towns in the Shawsheen watershed.

Methods

Wetlands and deepwater habitats were mapped following the U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI) mapping procedures. These features were classified according to "Classification of Wetlands and Deepwater Habitats of the United States" (Cowardin et al. 1979), the official federal classification system for monitoring the status and trends of the nation's wetlands. Using this system, wetlands and deepwater habitats were classified to system, subsystem, class, subclass, water regime, and other modifiers (see Table 2 for common types). Identification and classification of wetlands and deepwater habitats were done through conventional wetland photointerpretation techniques by personnel at the University of Massachusetts' Natural Resources Assessment Group (NRAG) in the Department of Plant & Soil Sciences, Amherst. The source imagery for this project was 1:40,000 color infrared photography captured on April 4, 1991 for the National Aerial Photography Program. NRAG staff also interpreted and delineated potential wetland restoration sites from this photography. Sites were first identified as either a Type 1 restoration site (former wetland now longer functioning as a wetland) or a Type 2 site (significantly impaired existing wetland). Potential wetland restoration sites were then characterized by the type of perturbation (adverse impact) such as diked/impounded, excavated, partly drained, or external influences (e.g., leachates, exposed soils, turf runoff, or sand/gravel operation). The former three categories were identified during the wetlands inventory phase of the project. External influences were detected later by re-examining the source imagery. Wetlands potentially adversely affected by runoff from impervious surfaces were also identified, but were not included as potential restoration sites due to the lack of likely restoration opportunities. Data on the extent of wetlands possibly affected by impervious surfaces were tabulated for this report.

Field work was conducted to confirm results of photointerpretation and to collect data on "reference wetlands" in the watershed. The latter represent wetlands typical of the watershed and serve as references for considering the type of vegetation that could be established or expected to become established at restoration sites. Information on plant species composition, areal cover, density (for trees and saplings), general soil properties, and signs of hydrology were recorded.

Upon completion of photointerpretation, overlays were made to match existing large-scale (1:25,000) U.S. Geological Survey topographic maps. Later, these overlays were digitized to create a data layer for geographic information system (GIS) analysis. The U.S. Fish and Wildlife Service's NWI Program (Northeast Region) utilized the digital data to summarize statistics on wetlands and potential wetland restoration sites for the watershed and to generate thematic maps for data analysis and presentation. NRAG staff compiled a matrix profiling individual potential wetland restoration sites. Data from MassGIS were used to characterize the general land use surrounding potential restoration sites, while soil data were obtained from the U.S.D.A. Natural Resources Conservation Service. NWI personnel analyzed the matrix results and aggregated potential sites into a manageable list due to their location and requirements for restoration. Individual wetland sites range in size from large hydrologically connected complexes to small isolated wetlands.

Table 2. Wetland types for the Shawsheen watershed and their classification (following Cowardin et al. 1979) and corresponding map codes. (Note: The map codes are not complete since water regime and other modifiers appear in the digital database; water regime modifiers: A - temporarily flooded, B - saturated, C- seasonally flooded, E- seasonally flooded/saturated, F - semipermanently flooded, and H - permanently flooded; other modifiers: x - excavated, d - partly drained, f - farmed, g - organic soil that was used to designate Atlantic white cedar wetlands, h - diked/impounded, and b - beaver-modified.)

Common Name	Technical Classification (Map Code)
Wooded Swamp	Palustrine Forested Wetland (PFO)
	Broad-leaved Deciduous (PFO1)
	Needle-leaved Evergreen (PFO4)
	Mixed (PFO1/4; PFO4/1)
	Dead (PFO5)
Shrub Swamp	Palustrine Scrub-Shrub Wetland (PSS)
	Broad-leaved Deciduous (PSS1)
	Broad-leaved Evergreen (PSS3)*
Shrub Bog	See * above (PSS3B, etc.)
Marsh	Palustrine Emergent Wetland (PEM)
	Semipermanently Flooded (PEM1F)
	Seasonally Flooded/Saturated (PEM1E)
Wet Meadow	Palustrine Emergent Wetland (PEM)
	Saturated (PEM1B)
	Temporarily Flooded (PEM1A)
Aquatic Bed	Palustrine Aquatic Bed (PAB)
Pond	Palustrine Unconsolidated Bottom (PUB)
	Palustrine Unconsolidated Shore (PUS)
Mixed Wetlands	Palustrine Emergent/Scrub-Shrub Wetland (PEM/SS; PSS/EM)
	Palustrine Scrub-Shrub/Forested Wetland (PSS/FO; PFO/SS)

Results

Interpretation of Results

The study is based on remote sensing techniques with limited field work. It is a screening process which attempts to identify existing wetlands that are or may be significantly altered in various ways and former wetlands that may be suitable for restoration. In the future, these potential sites will be evaluated by others on the ground and with input from individuals with local knowledge of wetland resources in the watershed. The identification of potential wetland restoration sites by remote sensing, therefore, does not supplant the need for field evaluation, but rather it is a first-step in the evaluation process.

While the study attempted to identify potential wetland restoration sites, it is not expected that all sites identified in this study are valid candidates for restoration due to limitations of remote sensing techniques and the age of the aerial photos. Remember that the aerial photography used to identify potential sites represents conditions in April 1991. Sites with external land uses that were identified as likely sources of negative impacts may have changed. In particular, areas designated as Type 2 sites due to exposed soils should be vegetated or developed by now. The status of potential Type 1 sites may have changed also (e.g., an herbaceous site may now be developed). Future evaluations by the Wetlands Restoration & Banking Program and local experts will determine the current condition of such sites.

The condition of Type 2 sites may also be somewhat different than reported, although it is expected that their condition was less likely to change due to strict enforcement of wetland regulations. There are, however, limitations inherent in the techniques used to identify Type 2 potential wetland restoration sites that readers of this report should be made aware of. All partly drained wetlands (with "d"-modifier applied) were identified as potential candidates for restoration. The magnitude and effect of such drainage needs to be considered on a case-by-case basis when determining whether such sites really need restoration. In general, wetlands mapped with the "d"-modifier and with drier water regimes (e.g., PFO1Ad), especially temporarily flooded ("A"-modifier), seasonally flooded ("C"-modifier), and saturated ("B"-modifier), are more likely to have experienced significant alterations due to modified hydrology. They should be considered higher priority sites for restoration than partly drained, seasonally flooded/saturated wetlands (e.g. PFO1Ed) which should still have an abundance of water. Also, all excavated wetlands (with the "x"-modifier) were identified as potential restoration sites. It was not possible to differentiate those that were created from nonwetlands from others that were excavated from an isolated wetland basin, since this would require examination of historical aerial photos to determine. Excavated wetlands occurring within or contiguous with an existing wetland may be better candidates for restoration of vegetated wetlands than excavated wetlands standing by themselves surrounded by upland as the latter are likely to include some created wetlands. This situation generally applies to impounded wetlands. All wetlands associated with impoundments were identified as potential wetland restoration sites, yet when considering whether restoration is desirable, one first needs to consider the purpose of the impoundment and whether such function

is more beneficial than restoration of a vegetated wetland. Remember that open water is an important feature of many wetland ecosystems and one that is particularly important to a host of fish and wildlife species.

Watershed Statistics

Aquatic Resources

As of April 1991, approximately 15.4 percent of the Shawsheen watershed was represented by wetlands and deepwater habitats (excluding acreage of linear streams and wetlands). Wetlands were more abundant than deepwater habitats, with 7,300 acres of the former vs. 409 acres of the latter. Wetlands alone represented 14.6 percent of the watershed (Figure 2). Forested wetlands were the most abundant wetland type in the watershed, accounting for 64 percent of the wetlands. Shrub wetlands were second-ranked comprising 18 percent of the wetlands, while emergent wetlands were next at 11 percent. Nearly all of the deepwater habitats were associated with the lacustrine system (in this case, reservoirs and the dammed portions of the Shawsheen River). The extent of individual wetland types (classified to the subclass level) and deepwater habitats is summarized below (see Appendix A for detailed statistics).

Wetland/Deepwater Habitat Type	Acreage
Palustrine Aquatic Bed	1.3
Palustrine Emergent Wetland	869.0
Palustrine Farmed Wetland	2.6
Palustrine Forested Wetland	4667.4
Deciduous	(4277.6)
Evergreen	(87.2)
Mixed	(251.0)
Dead	(51.6)
Palustrine Forested/Shrub Wetland	200.5
Palustrine Emergent/Shrub Wetland	8.1
Palustrine Scrub-Shrub Wetland	1310.7
Deciduous	(1251.7)
Evergreen	(59.0)
Palustrine Unconsolidated Bottom	232.1
Palustrine Unconsolidated Shore	8.5
Total Wetlands	*7300.2 (excluding linear wetlands)*
Lacustrine Unconsolidated Bottom	397.5 (*including dammed river sections*)
Riverine Unconsolidated Bottom	11.8
Total Deepwater Habitats	*409.3 (excluding linear rivers/streams)*

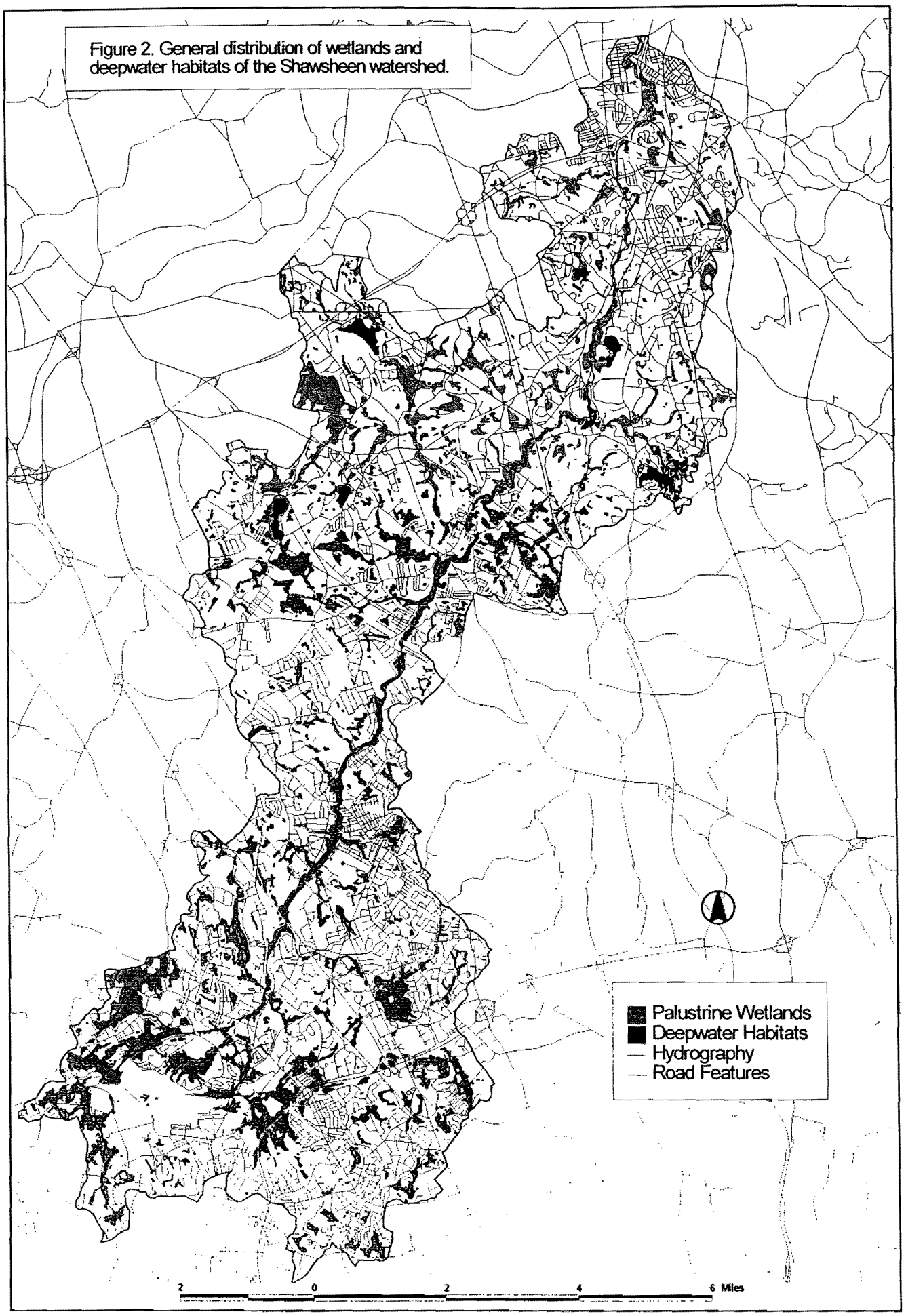

Figure 2. General distribution of wetlands and deepwater habitats of the Shawsheen watershed.

Altered Wetlands

Given that the Shawsheen watershed is quite developed, many wetlands have been altered. Major alterations include: 1) partial drainage through ditching, 2) impoundment, and 3) excavation, while a minimal amount of altered wetland is farmed. Nearly 60 percent of the existing wetlands in the watershed have been significantly modified.

Altered Wetland Type	Acreage in Watershed*	% of Wetlands
Partly Drained Wetland	2832.9	38.8
Excavated Wetland	32.1	0.4
Diked/Impounded Wetland	1497.9	20.5
Farmed	2.6	-
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Total	4365.5**	59.8**

*Some wetlands were altered in more than one way and were therefore reported in two or more categories (90.3 acres of partly drained and impounded).
**4275.2 acres of individual wetlands were actually altered (no double-counting); this represented 58.6% of Shawsheen wetlands.

Wetlands Possibly Adversely Affected By Runoff from Adjacent Uplands

Many Shawsheen wetlands are located adjacent to land uses where runoff may adversely affect the quality of the wetland. Examples include wetlands where surface water runoff from impervious surface (especially road runoff from storm drains), exposed soils, or residential lawns and golf courses may be degrading the water quality. Leachates from landfills adjacent to wetlands may also negatively impact the wetlands and water quality.

Runoff Type	Potential Wetland Acreage Affected in Watershed*	% of Shawsheen Wetlands
Impervious Surface	3495.2	47.9
Leachates from Landfill	372.6	5.1
Sand & Gravel Operations	75.0	1.0
Lawn & Turf	179.1	2.5
Agriculture	112.0	1.5
Exposed Soils	106.7	1.5

*Some wetlands were affected by more than one type of runoff or by other impacts (e.g., ditching, impoundment, or excavation), such as impervious surface/sand&gravel operations (29.4 acres) and impervious surface/lawn&turf (7.4 acres). See Appendix B for details.

Nearly half of the wetland acreage in the Shawsheen watershed may be adversely affected by runoff from impervious surfaces.

Reference Wetlands

Reference wetlands represent a collection of typical wetlands found in the watershed. They are not intended to be the most natural or undisturbed types, but simply typical plant communities. Seventeen wetlands in the Shawsheen watershed were evaluated for their vegetation, soils, and signs of hydrology. Plant data are summarized in Table 3. Completed data forms were given to the Massachusetts Wetland Restoration & Banking Program and are not included in this report. The location of reference wetlands is shown in Figure 3 (note that two of the reference wetlands, R7 and R8, are actually located just outside the watershed).

Since the Shawsheen watershed is quite developed, the occurrence of invasive species was expected. Four invasive species were common in some of the reference wetlands examined: 1) purple loosestrife (Lythrum salicaria), 2) reed canary grass (Phalaris arundinacea), 3) European buckthorn (Rhamnus frangula), and 4) Japanese barberry (Berberis thunbergii). Purple loosestrife is abundant in many emergent wetlands, while reed canary grass is common but in lesser amounts. European or glossy buckthorn is common in shrub wetlands and forested wetlands in this watershed and much of eastern Massachusetts. Japanese barberry seems to occur in forested wetlands in lesser abundance. Other invasives reported in wetlands were multiflora rose (Rosa multiflora) in a shrub swamp (Billerica), common reed (Phragmites australis) in a shrub swamp (Billerica) and emergent wetland (Lexington), and Asiatic or oriental bittersweet (Celastrus orbiculatus) in a forested wetland (Andover).

Besides the occurrence of the above invasives, the reference wetlands had species typical of eastern Massachusetts wetlands. Frequently observed herbaceous species included bur-reed (Sparganium sp.), broad-leaved cattail (Typha latifolia), skunk cabbage (Symplocarpus foetidus), rice cutgrass (Leersia oryzoides), bluejoint grass (Calamagrostis canadensis), tussock sedge (Carex stricta), fringed sedge (Carex crinita), sensitive fern (Onoclea sensibilis), royal fern (Osmunda regalis), cinnamon fern (Osmunda cinnamomea), false nettle (Boehmeria cylindrica), water pepper (Polygonum hydropiperoides), duckweed (Lemna sp.), water smartweed (Polygonum amphibium/coccineum), dye bedstraw (Galium tinctorium), golden saxifrage (Chrysosplenium americanum), Canada mayflower (Maianthemum canadense), blue flag (Iris versicolor), jewelweed (Impatiens capensis), grass-leaved goldenrod (Euthamia graminifolia), and giant goldenrod (Solidago gigantea). Characteristic shrubs include buttonbush (Cephalanthus occidentalis; in semipermanently flooded [shallow-water] wetlands), leatherleaf (Chamaedaphne calyculata; in saturated bogs), speckled alder (Alnus rugosa), common winterberry (Ilex verticillata), northern arrowwood (Viburnum recognitum), sweet pepperbush (Clethra alnifolia), swamp azalea (Rhododendron viscosum), poison sumac (Toxicodendron vernix), and highbush blueberry (Vaccinium corymbosum). Typical trees in Shawsheen wetlands include red maple

(Acer rubrum), American elm (Ulmus americana), white pine (Pinus strobus), and either white ash (Fraxinus americana) or green ash (F. pennsylvanica). Pitch pine (P. rigida) was common in one of the forested wetlands examined and northern red oak (Quercus borealis), a species more characteristic of uplands, was also observed. Other common plants of the forested wetlands include grape (Vitis sp.), poison ivy (Toxicodendron radicans), and peat moss (Sphagnum sp.).

Table 3. Plant community data for reference wetlands in the Shawsheen watershed. All wetlands are palustrine types: emergent (PEM), scrub-shrub (PSS), and forested (PFO). Species marked by an asterisk (*) are dominant species in the stratum; species are listed in order of abundance within sampling strata, and species listed are those with 5% or more cover in the sample plot. Some seedlings of woody species were common in the herb stratum and are listed under herbs. Note: White ash was recorded by field personnel on field forms, but the plants could be green ash as these two species are commonly misidentified.

Wetland Type	Plant Community
PEM1F	herbs: purple loosestrife*, water pepper*, bur-reed
PEM1E	herbs: red canary grass*, false nettle, water smartweed
PEM1E	herbs: broad-leaved cattail*, skunk cabbage*, jewelweed, purple loosestrife, bluejoint grass
PEM1Ed	herbs: sensitive fern*, skunk cabbage, broad-leaved cattail, grass-leaved goldenrod, and giant goldenrod
PSS1F	shrubs: buttonbush* (2 sites)
PSS1E	shrubs: speckled alder*, European buckthorn, common winterberry
PSS1E	shrubs: buttonbush*, sweet gale*, willow herbs: purple loosestrife*, reed canary grass*, false nettle, royal fern
PSS1Eh	shrubs: red maple*, European buckthorn, speckled alder herbs: purple loosestrife*, rice cutgrass*, tussock sedge, duckweed, sedge, blue flag, false nettle, dye bedstraw
PSS3Ba	shrubs: leatherleaf* herbs: grass others: peat moss
PFO1C	trees: red maple* saplings: European buckthorn*, white ash

	herbs: skunk cabbage*
PFO1C	trees: red maple*, pitch pine saplings: red maple* shrubs: northern arrowwood* herbs: false nettle*, jewelweed*, fringed sedge woody vines: grape*
PFO1E	trees: red maple*, white ash*, American elm saplings: American elm*, white ash* shrubs: common winterberry*, European buckthorn*, Japanese barberry; herbs: skunk cabbage*, poison ivy, sensitive fern woody vines: poison ivy* others: peat moss
PFO1E	trees: red maple* saplings: red maple* shrubs: sweet pepperbush*, swamp azalea*, highbush blueberry herbs: swamp azalea*, sweet pepperbush* others: peat moss*
PFO1E	trees: red maple*, American elm* saplings: American elm*, red maple* shrubs: sweet pepperbush*, northern arrowwood herbs: jewelweed*, golden saxifrage, grass
PFO1Ed	trees: red maple*, white pine shrubs: European buckthorn* herbs: Canada mayflower*, European buckthorn*, highbush blueberry
PFO1B	trees: red maple*, northern red oak saplings: red maple* shrubs: poison sumac*, northern arrowwood*, common winterberry herbs: cinnamon fern*, skunk cabbage*, aster

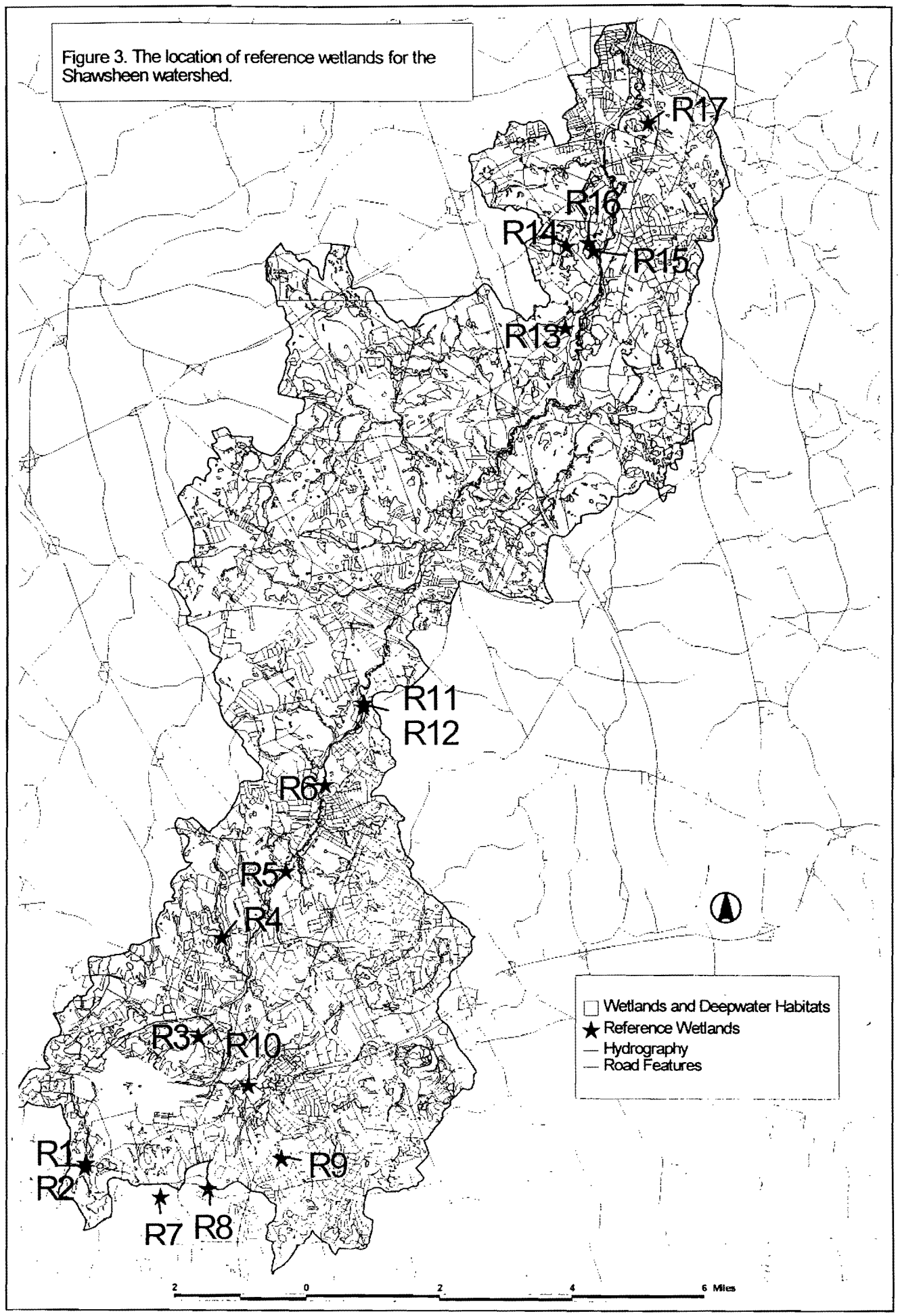

Figure 3. The location of reference wetlands for the Shawsheen watershed.

Potential Wetland Restoration Sites

The wetlands of the Shawsheen watershed are clearly subjected to a multitude of human-induced stressors due to the amount and nature of development in the watershed. A total of 6,069 acres of wetlands or 83 percent of the Shawsheen wetlands have either direct impacts (e.g., altered by ditching, excavation, impoundment, or farmed) or indirect impacts from runoff from areas subject to certain land use practices (Appendix B). Since nearly half of the Shawsheen wetland acreage is subjected to runoff from impervious surfaces and the extent of this impact is likely to increase in the future, wetlands solely affected by runoff from impervious surfaces were not considered candidates for wetland restoration. A total of 1480 acres of wetlands fell into this category. If one wants to consider mitigating these effects, on-site investigation should be conducted to identify stormwater discharge drains that may be diverted to a holding pond for treatment if space is available for such structure.

In considering potential wetland restoration sites, this study attempted to emphasize former wetlands that may be restorable (called Type 1 restoration sites) and existing wetlands that were functionally impaired and that may be restorable (Type 2 sites). Farmed wetlands were included in the former category because they provide only the most minimal wetland functions due to drainage and cultivation. The Type 2 sites included wetlands that have been diked, ditched, and excavated where restoration of vegetated wetlands may be possible plus wetlands adjacent to certain land uses where mitigation of potential adverse effects may be possible (e.g., establishing vegetated buffers to reduce runoff from exposed surfaces, agricultural fields, lawns and golf courses, and sand&gravel operations or by removing chemical contaminants from point sources like a landfill). Sites identified as potential wetland restoration sites need to be examined on the ground to see if restoration is truly warranted or even possible. The use of remote sensing techniques is a useful process for identifying potential candidates, but it does not replace the need for field investigations. Also remember that the source imagery for this analysis was April 1991 and it is likely that some land uses have changed in areas surrounding wetlands. For example, areas that were designated as subjected to runoff from exposed soils probably have different conditions today (e.g., perhaps the site is a residential lawn or commercial facility). The data provided, however, are a good starting point for considering possible wetland restoration opportunities in the watershed and provide a framework for this initiating the process of restoration.

A total of 294 sites were identified as potential wetland restoration sites. These sites represent about 4,700 acres of the Shawsheen watershed or 64 percent of the wetlands. Of these, 26 sites or 108 acres were classified as Type 1 sites (former wetlands that may be restorable, including 2.6 acres of farmed wetlands), while 268 sites or about 4,590 acres were listed as Type 2 sites (impaired wetlands that may be suitable for restoration of some kind). Recall that many of the sites are rather large complexes hydrologically connected and sharing similar problems re: restoration. Figure 4 shows the location of the numbered sites in the watershed, while data are summarized below and in Appendix B. A digital database containing pertinent information for restoration was prepared and given to the Massachusetts Wetlands Restoration & Banking Program, but is not included in this report.

Restoration Site Type	Impact	Acreage	Restoration Needed
1*	Fill	69.2	Elevation/Vegetation
	Drained	39.3	Hydrology
2**	Partly Drained	2,832.9	Hydrology
	Excavated	32.1	Elevation/Vegetation
	Diked/Impounded	1,497.9	Hydrology/Vegetation
	Lawn&Turf Runoff	179.1	Vegetated Buffer
	Sand&Gravel Runoff	75.0	Vegetated Buffer***
	Leachate Runoff	372.6	Chemical Integrity
	Agricultural Runoff	112.0	Vegetated Buffer***
	Exposed Soil Runoff	106.7	Vegetated Buffer***

*Any difference in Type 1 totals vs. numbers in Appendices relate to rounding off.
**Many wetlands experienced multiple impacts, so there is double counting for Type 2 sites. In all, 4,588.6 acres of wetlands were designated as Type 2 sites (including sites less than 1 acre in size); 4542.7 acres were represented by the numbered sites, with the remainder being the total of the small sites.
***May also be sedimentation problems that were not detected by photointerpretation.

Invasive Species

A few invasive species were detected during field work (see discussion under "Reference Wetlands"). This study did not inventory sites where invasive species posed problems to "natural" wetlands as it would require use of specially-timed aerial photography and extensive field work, well beyond the scope of the project. The top two invasive species in the Shawsheen watershed may be purple loosestrife and European buckthorn. Purple loosestrife dominates many emergent wetlands in eastern Massachusetts, while European buckthorn is common in both forested wetlands and shrub swamps. Of the two, purple loosestrife is the easiest to detect through remote sensing. To identify the extent of purple loosestrife, an aerial survey in early August should be conducted to locate colonies of purple loosestrife and sites of recent establishment. At this time, the species is in full bloom and readily observed. This species is particularly widespread in northeastern Massachusetts and will require a monumental effort to control, especially in established stands. Restoration efforts may want to focus on preventing colonization of wetlands not yet invaded. The aerial survey should therefore include detection of new colonies of purple loosestrife where control measures should be immediately employed. The Wetlands Restoration & Banking Program may want to consider creating a volunteer network ("Loosestrife Liberators") to remove unwanted invasive plants from new sites.

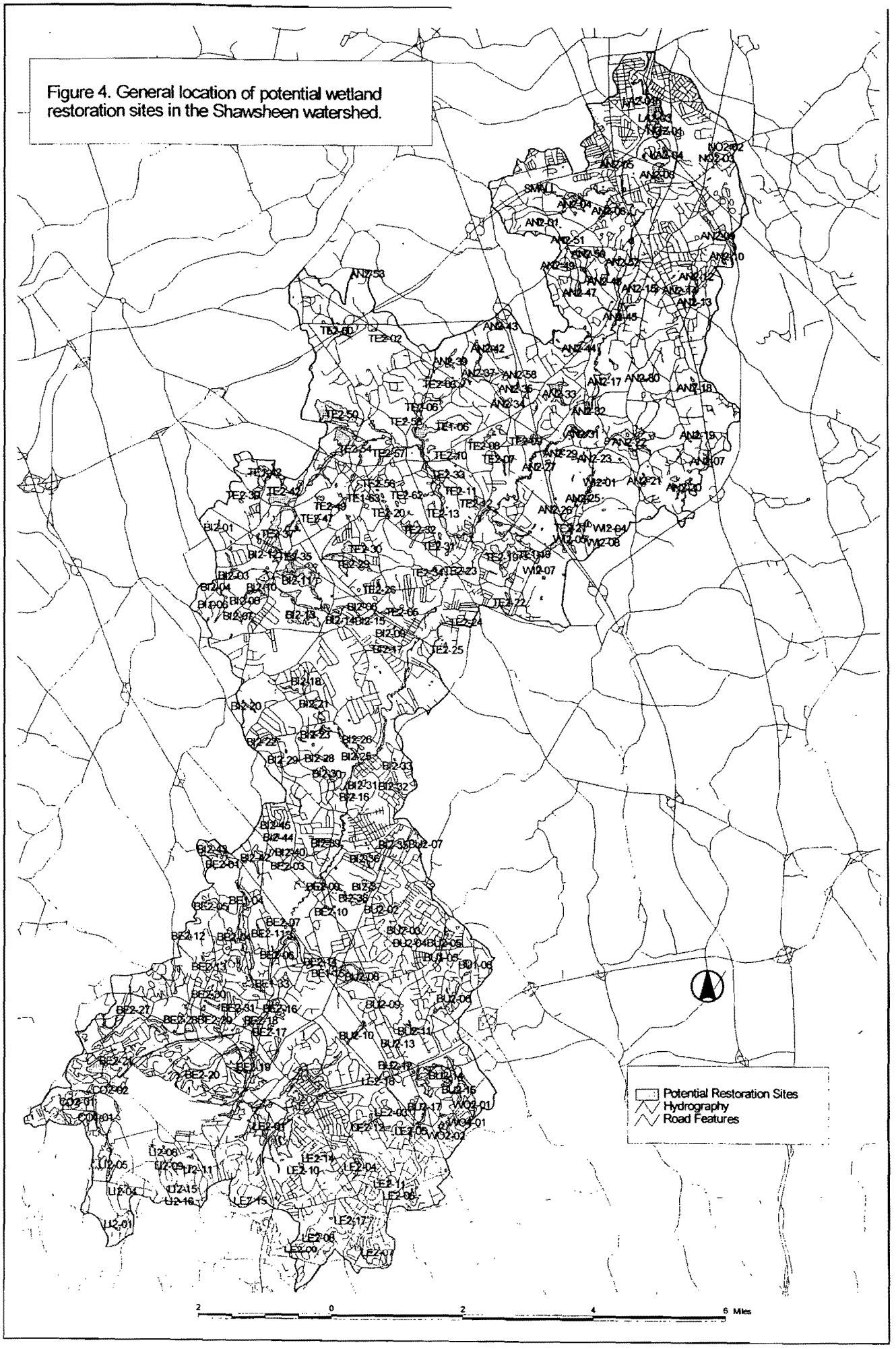

Figure 4. General location of potential wetland restoration sites in the Shawsheen watershed.

Historical Wetland Resources

While it is impossible to reconstruct a detailed map of the watershed's past landscape patterns, it is possible to examine historical information on soils to assess the general extent of wetlands today versus historical numbers. The Shawsheen watershed occurs in Essex and Middlesex Counties (25% in the former and 75% percent in the latter). In the 1920s, the U.S. Department of Agriculture produced the first county soil survey reports for these counties (Latimer and Lanphear 1925, 1924, respectively). By reviewing these reports for the acreage of soils associated with nontidal wetlands, we can estimate the extent of wetlands in the 1920s for the Shawsheen watershed. Soil map units associated with these wetlands included the following: 1) meadow, 2) muck, 3) peat, and 4) Whitman loam (and stony loam). For Essex County, these soil map units represented 16.4 percent of the county, whereas for Middlesex County, they totaled 19.7 percent. Based on these statistics, the Shawsheen watershed probably had about 19 percent of its land area occupied by wetlands. Since the current survey found 14.6 percent of the watershed occupied by wetlands, the watershed appears to have lost nearly one-quarter of its wetlands between the early 1900s and the 1980s.

Townwide Statistics

Aquatic Resources

A summary of wetlands and deepwater habitats in the Shawsheen watershed by town is provided below. Most of the Shawsheen wetlands occur in the towns of Tewksbury, Bedford, Andover, and Billerica. These towns collectively encompass 72 percent of the watershed's wetlands. Tewksbury alone accounts for 25 percent of the wetlands, while Bedford has about 20 percent of the Shawsheen wetlands. Most of the Shawsheen deepwater habitats are in Andover and Tewksbury. Note that much of the Shawsheen River is represented by either dammed sections of open water or by linear channels that were too small to map, and therefore only the former sections are included in the acreage summaries below. More detailed summaries for each town are provided in Appendix C.

Town	Deepwater Habitat Acreage*	Wetland Acreage*	Town Acres in Watershed
Andover	240.0	997.8	10320.3
Bedford	-	1451.7	6570.2
Billerica	-	973.9	7822.0
Burlington	-	482.6	4068.7
Concord	-	241.7	835.7
Lawrence	7.0	87.7	949.8
Lexington	-	728.7	5360.1
Lincoln	-	143.2	1229.0
North Andover	-	70.3	1279.3
North Reading	-	-	3.8
Tewksbury	161.3	1848.9	9712.0
Wilmington	0.9	223.2	1566.4
Woburn	-	50.4	238.0

*Excludes linear stream and wetland acreage (not mapped).

Potential Wetland Restoration Sites

Listed below are sites that may have some potential for wetland restoration by town. Table 4 outlines Type 1 sites individually by town. Filled sites require remove of fill to restore elevations and will often also involve replanting desired wetland plants. Drained sites need the hydrology restored and may or may not need replanting of wetland species. More detailed summaries are given in Appendix D (for Type 1 sites by town) and E (for Type 2 sites).

Town	# of Type 1 Sites	Type 1 Acreage*	# of Type 2 Sites	Type 2 Acreage**
Andover	1	0.2	57	475.7
Bedford	4	9.3	31	1197.0
Billerica	5	29.4	45	547.3
Burlington	4	14.2	18	227.0
Concord	1	5.2	1	231.1
Lawrence	0	0	6	61.8
Lexington	0	0	18	629.1
Lincoln	0	0	16	86.7
North Andover	0	0	4	32.3
Tewksbury	8	43.4	62	991.4
Wilmington	2	1.7	8	61.4
Woburn	1	4.8	2	48.0

*Any difference between these totals and the sum of the numbers in Table 3 and Appendix D is due to rounding off procedures.
**Includes a few small unnumbered sites that were less than 1 acre in size.

Table 3. Summary of Type 1 potential wetland restoration sites by town for the Shawsheen watershed.

Town	Site No.	Acreage	Impact	Restoration Required
Andover	AN1-58	0.2	Drained	Hydrology
Bedford	BE1-04	1.5	Drained	Hydrology
	BE1-15	4.9	Drained	Hydrology
	BE1-19	1.4	Fill	Elevation/Vegetation
	BE1-33	1.6	Drained	Hydrology
Billerica	BI1-03	4.3	Fill	Elevation/Vegetation
	BI1-06	6.4	Fill	Elevation/Vegetation
	BI1-10	9.7	Fill	Elevation/Vegetation
	BI1-13	4.6	Drained	Hydrology
	BI1-37	4.5	Drained	Hydrology
Burlington	BU1-05	8.6	Drained	Hydrology
	BU1-06	2.6	Drained	Hydrology
	BU1-11	1.8	Fill	Elevation/Vegetation
	BU1-14	1.1	Fill	Elevation/Vegetation
Concord	CO1-01	5.2	Drained	Hydrology
Tewksbury	TE1-06	6.1	Fill	Elevation/Vegetation
	TE1-19	14.9	Fill	Elevation/Vegetation
	TE1-32	2.6	Fill	Elevation/Vegetation
	TE1-42	2.5	Fill	Elevation/Vegetation
	TE1-50	15.3	Fill	Elevation/Vegetation
	TE1-56	0.8	Drained	Hydrology
	TE1-57	1.0	Fill	Elevation/Vegetation
	TE1-63	0.4	Fill	Elevation/Vegetation
Wilmington	WI1-06	0.4	Fill	Elevation/Vegetation
	WI1-09	1.3	Fill	Elevation/Vegetation
Woburn	WO1-01	4.8	Drained	Hydrology

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