

Nashua, Squannacook & Nissitissit Rivers

Wild & Scenic River Study Committee

Outstandingly Remarkable Resource Values

Case Statement - February 21, 2017

Some value the river for its enriching qualities, and some for its abundant water power, and some because they can idle away their time in catching pout and pickerel. There are some also who delight in it as a "thing of beauty" and a "joy forever". They love to wander on its banks, to plunge into its depths and float upon its surface. They return again and again to gaze on its flow when it shimmers in the sun, or is mottled by the rain-drops, or ruffled by the breeze. They are never tired of watching it from some high bank, ...or crumbling bluffs, and see it winding back and forth in the broad valley, like the convolutions of a mighty serpent, gleaming in the light with silvery scales. History of Lancaster, Rev. Abijah Marvin, 1879

PREAMBLE -- THE RIVERS AS CORRIDORS

Benton MacKaye is one of several luminaries whose views were shaped by our study area. MacKaye is well known as the visionary inspiration behind and proponent of the Appalachian Trail, his home terrain in Shirley Center provided the model and the muse for many of his ideas about recreational trails, regional planning, conservation, transportation, wilderness preservation, and habitable and sustainable communities. Nearly 100 years ago MacKaye urged Massachusetts state officials and conservationists to develop a linear park along the full length of the Squannacook River and Willard Brook, one of the Squannacook's main tributaries. He proposed a south-north recreational greenbelt that he called a "Wachusett/Watatic Wilderness Way." As a consultant for the 1929 Governor's Committee on the Needs and Uses of Open Spaces he promoted a state-wide network of such wilderness ways that would serve "to control the flow of metropolitan civilization."

"A most important element of MacKaye's ideas and visions that are well worth heeding today, is the notion of using corridors following natural features, such as linear mountain ranges and rivers, ... for controlling and limiting growth, while providing recreational opportunities and protecting natural resources. Greenways, the conversion of abandoned railroad beds to trails, urban growth boundaries, the activities of local land trusts, and, of course, the creation of heritage areas exemplify today's approach to 'linking up' separate corridor projects into larger regional networks. In combination these river corridors form not just a key habitat network but more importantly provide for landscape-level ecosystem requirements." (Larry Anderson,

The Nashua, Squannacook and Nissitissit Rivers are biological corridors; animals use them as habitat and to pass through. The river valleys are both wildlife habitat corridors and natural south-north migration routes for terrestrial and aquatic fauna and flora set within a context of contiguous undeveloped, and, in many cases permanently protected, land. (Massachusetts Audubon Society, Focus Areas for Wildlife Habitat Protection in the Nashua River Watershed, September 2000) Our study area is one where efforts to protect major tracts of riparian land have already met with significant success. The various conservation lands in our study area are crucial stepping stones for wildlife movement north from the anchor that is the Oxbow National Wildlife Refuge (ONWR)¹.

“The ‘Oxbow/Intervale/Bolton Flats’ area is also cited in a report, Focus Areas for Wildlife Habitat Protection in the Nashua River Watershed, as a large wildlife habitat focus area of ~8,500 acres. These areas with large amounts of little-disturbed interior are ‘cornerstones of a habitat reserve design for the Nashua River Watershed.’ The report notes, ‘Tracks of bobcat, black bear and moose have been recorded within this focus area. Bobcats are particularly sensitive to human disturbance and their presence in an area is a very strong indicator of high quality habitat.’” (Harvard Open Space and Recreation Plan, page 35)

In addition to the Oxbow National Wildlife Refuge, the Nashua, Squannacook and Nissitissit River corridors provide linear linkages among several other sizeable public conservation lands in our study area, notably: J. Harry Rich State Forest, Groton Town Forest, General Field/Surrenden Farm, Sabine Woods, Ayer State Game Area, Squannacook and Nissitissit River Wildlife Management Areas, and Townsend State Forest.

Much of the remaining unprotected riparian land enjoys partial protection under the 1996 MA Rivers Protection Act and under local floodplain zoning bylaws. These three largely protected river corridors do not abruptly end at the New Hampshire state line, rather they are continued by the holdings of the Brookline Conservation Commission, Nissitissit River Land Trust and Beaver Brook Association (~2,200 acres) in Hollis and Brookline, NH. [Note to reader: information on ORRVs in New Hampshire will be forthcoming as appropriate. For example, as far back as 1963 the New Hampshire Natural Preserves Forum wrote “An attempt should be made to protect this [Nissitissit]

¹ For example, the ONWR beneath the bridge carrying Route 2 over the Nashua River is one of the few locations for wildlife to cross the barrier created by that heavily trafficked highway.

river in a joint project with Massachusetts. On a small scale this would be comparable to some of the `Wild River` projects of the national government.”]

This pattern of extensive open spaces connected by riparian corridors creates a synergistically larger, unified entity from what would otherwise be fragmented areas². In other words, maintaining the connectivity of open spaces and habitats is important at the regional scale because connectivity lends the components of our shared landscape the resilience needed to survive challenges, such as climate change, better than isolated areas can. In the 1992 Survey and Evaluation of Wetlands and Wildlife Habitat, Fort Devens, MA, the US Fish & Wildlife Service stated "... the value of large, contiguous undeveloped areas for species long term protection outweighs exponentially that of an equal area of disjunct refugia spread among suburban environs" (pg. 71). The quantity of rare species found in our study area confirms this.

As the science of landscape ecology tells us: where lands are still interconnected, ecological processes are more likely to persist in a continuous system to provide 1) dispersal corridors -- thereby protecting local populations from chance extinction events – and, 2) opportunities for regional recolonization and genetic flow to outside populations; here, that is primarily to the north and south³. Our study area has high ecological integrity, resource rich unit that has been state-recognized as three unique Areas of Critical Environmental Concern (ACEC): the *Central Nashua River Valley*, *Squannassit* and *Petapawag* ACECs. These three contiguous ACECs together comprise ~76,000 acres or 118 square miles. [Note: ACECs are a formal designation made by the MA Secretary of Environmental Affairs to protect and preserve areas of environmental significance. The designation notifies regulatory agencies and the public that most development activities under State jurisdiction within ACEC's must meet high environmental quality standards. The fundamental reason for these designations was the need to protect both open spaces and the interconnections that are essential to maintaining the biological diversity of the entire region www.mass.gov/eea/agencies/dcr/conservation/ecology-acec/areas-of-critical-environmental-concern-acec.html].]

² *The Role of Riparian Corridors in Maintaining Regional Biodiversity*, Naiman, 1993

³ South to north corridors in New England are particularly important in a time of climate warming as species must evolve their ranges northward; see <https://climateactiontool.org>

Efforts to protect our key resources go back many decades. Prepared by the Nashua River Watershed Association (NRWA) in 1970, the first Regional Plan for the Nashua River Greenway called for: “*protecting the watershed; providing habitat for wildlife; conserving the ecology; preventing future river pollution; providing open space and outdoor recreation opportunities; maintaining high water quality; increasing property values; enhancing the general economy; and providing a population buffer zone*”: the last reminiscent of Benton MacKaye’s “dams and levees”. Indeed, William P. Wharton – of Groton MA, contemporary and friend of Benton MacKaye, incorporator of both the Nashua River Watershed Association and the New England Forestry Foundation, and President of the National Parks Association – was an advocate of numerous local as well as national conservation projects.

More contemporaneously, Marion Stoddart, also of Groton MA, was handed the baton to carry on the good work of both land and water conservation, and has done so outstandingly for the past half-century. And every year Congresswoman Tsongas holds an annual “Rivers Day” in her district; in 2012 she hosted her sixth Rivers Day event on the Nashua River in Groton; in 2016 she hosted her tenth Rivers Day event on the Nashua River at the newly-opened Bill Ashe Visitor Facility-Oxbow National Wildlife Refuge in Devens that featured a paddle on that river.

OUTSTANDINGLY REMARKABLE RESOURCE VALUES

To be included in the National Wild and Scenic Rivers System, a river must meet certain eligibility criteria, including possessing at least one Outstandingly Remarkable Resource Value (ORRV). An ORRV must be natural, cultural or recreational in character, river-dependent, and have unique, rare or exemplary qualities on a regional or national scale. The Nashua, Squannacook and Nissitissit Rivers possess a great many such resources that meet these criteria which are enumerated below and include aspects of: biological and ecological diversity; recreational and scenic values; and, historic and cultural resources.

The Shaping Forces: Geology, Aquifers and Ecoregions

Geology: The bedrock underpinning of our study area is made up of two types of rock: granite and other igneous types, and metamorphic, primarily schist and gneiss. Over ten thousand years ago, the Nashua River valley was carved by moving glacial ice that was over one mile thick. The Nashua

River itself was once Glacial Lake Nashua, an enormous lake that extended from Boylston, Massachusetts north to Nashua, New Hampshire. At that time, the mainstem river flowed southward through the Worcester area.

Bedrock and a thin layer of glacial till “hardpan” dominate the higher elevations of the watershed, especially to the west and northwest, where the main tributaries to the mainstem Nashua River rise (Squannacook and Nissitissit as well the Quinapoxet, Stillwater, and North Nashua Rivers). These relatively cooler, higher-gradient rivers all flow from the northwest to the southeast and meet the Nashua River at sharp angles, turning to join the mainstem which flows in a northeasterly direction. The flow of the tributaries is additional evidence that the Nashua River used to flow south. The river’s course was reversed as the edge of the last ice age glacier melted away, leaving Glacial Lake Nashua to drain to the north. There are many sand and gravel deposits dating from the glacial period in the central part of the valley. These porous deposits often have accessible groundwater used as municipal water supplies.

There is considerable landscape-level geomorphologic variation within our study area, which is characterized by topography dominated by glacially-shaped geological forms and river valleys underlain by aquifers. Not surprisingly it has many glacial artifacts: kettlehole ponds with fluctuating water levels, spruce bogs, kame terraces and eskers, and sandy outwash soils. Such soil acts as a recharge area in large floodplains, which support many types of rare flora. Not only is the area especially rich in diverse wetland habitats because of the meandering Nashua River, but there is also an unusual amount of field, floodplain grassland and wet meadow habitat due to the river's oxbows and wide floodplains. (see Map #x for % of ag land use in each) *[Note: There are other considerable “ecosystem service” benefits associated with wetlands and floodplain grasslands: because of their high rates of production they are second only to rainforests in removing carbon from the atmosphere, thereby moderating global warming; (i.e: sedges, rushes, forbs and grasses), removing surplus nutrients from overland runoff and preventing these and other pollutants from entering our rivers.]*

Aquifers: High-yield, high- productivity aquifers – defined as more than 300 gallons per minute -- are found under several of our study area towns and are tapped as municipal sources of public drinking supplies. For example, Pepperell depends on groundwater for both public and private wells,

with 80% of the households dependent on its three municipal public wells. The West Groton Water Supply District operates wells on the bank of the Squannacook River. The Shirley Water District is Massachusetts' first ever Water District; it manages four gravel packed wells, supplying over 150 million gallons per year to over 4,500 customers in Shirley and surrounding communities. In Townsend, recognition of the importance of its high-yield aquifer came with the passage of the 1986 Aquifer Protection Overlay District Bylaw which protects the aquifer from new structures and uses considered hazardous. The Wekepeke aquifer under portions of Lancaster is another high-yield aquifer which provides a municipal backup well and could be a potential public water source for the larger region.

As a major aquifer recharge area, the Nashua River valley stores floodwaters and precipitation in its numerous wetlands and sandy glacial soils. Maintaining flood storage capacity within the Nashua River valley is critical to preventing flooding downstream. Where the valley broadens, the river and stream beds have a flatter slope than areas upstream, and the floodplains and associated wetlands widen, the permeable sand and gravel floodplains percolate the floodwaters and act as a giant holding tank, minimizing flood damage downstream. (*Central Nashua River Valley ACEC Nomination Report*; pgs 5-6) *<Is it worth quantifying the value of the protection of undeveloped lands downstream associated with the detention and retention of these floodwaters?>*

Ecoregions: Our study area occurs in an area of overlap of two major forest groups: the Northern (a mixed group of sugar maple, ash, beech, and birch) and Central (dominated by oaks with some hickories) Hardwoods regions. The forest vegetation of the study area is a mix of northern and central hardwoods interspersed with hemlock and white pine. These two forest types now mingle in the Nashua watershed in what is called the transition zone, giving us a wonderfully diverse array of forest types to enjoy today. Additionally, the varied topography ranges from the “Worcester Monadnock Plateau” subecoregion -- areas with a distinctive ecology and physical landscape -- in the steeper headwater sections to more gently rolling terrain to generally flat lowland river valleys in the east: The large "Gulf of Maine Coastal Plain Ecoregion" subecoregion. Because of this elevational and topographical difference, the change in habitat over a small distance can be dramatic.

Grassland habitats decreased in New England with farm abandonment in the 1800s and have become increasingly less common with suburban sprawl and the regeneration of our forests. But within

portions of our study area, especially along the Nashua and Squannacook River floodplains, open fields are relatively widespread because farming is still active. (see Map or Figure #x for % of agricultural land use in each). For example, Flats Mentor Farm -- located on a 70-acre river bottom parcel in Lancaster -- assists and supports immigrant small truck farmers of specialty vegetables who hail from diverse ethnic backgrounds; most other farm fields in our study area are planted to hay or corn crops. Other areas are deliberately maintained as early successional habitats in order to preserve wildlife diversity; examples of this can be found in several conservation parcels in our focus area that are mowed annually to maintain an herbaceous community.

ORRV #1 - Biological and Ecological Diversity

Biodiversity: Another consequence of this combination of factors – the confluence of distinct ecoregions and transitions between them – is that our study area supports outstanding overall biodiversity. Biological diversity in the study corridor can be measured by the sheer number of species, and also by the number of species assemblages (natural communities of plant and animal species that share a common environment and occur together repeatedly on the landscape). Abundant wetlands, grasslands and uplands shelter many rare species, most of which need more than one habitat to survive, or depend upon increasingly rare habitats. *[Note: Another benefit of the protected areas around our study area’s several aquifers is that many NHESP Priority and Estimated Habitats are found overlying them.]* Having a high number of state-rare species in the watershed is largely a function of the existence of intact special habitats/natural communities and the large extent of contiguous open space.. The Nashua, Nissitissit and Squannacook Rivers --as well as Unkety Brook-- are described by NHESP in its 2012 BioMap 2 report as:

“...the watery framework for a complex landscape that supports an exceptionally high number of rare and uncommon species. Forty-one such turtles, dragonflies, freshwater mussels, salamanders, plants and other species inhabit these rivers, brooks, and vernal pools. Good populations of the globally rare Brook Floater mussel inhabit the Nissitissit River, while the equally rare Ringed Boghaunter dragonfly can be found in four boggy sites across this large Core Habitat.”

Priority Natural Communities: The Nashua River corridor consists of significant portions of terrestrial habitat designated by the BioMap2 project as “core habitat”, representing the highest priority for biodiversity conservation and protection www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/land-protection-and-management/biomap2/). Additionally, six NHESP exemplary or

“Priority Natural Communities” occur along the Nashua River: Kettlehole Level Bog (Groton); Pitch Pine – Scrub Oak (PP/SO) Community (Lancaster); Red Maple- Black Ash Swamp (Ayer); Alluvial Red Maple Swamp (Harvard); Small-river Floodplain Forest (Ayer); and High-terrace Floodplain Forest (Bolton and Lancaster). Since few intact floodplain forests remain in New England, these are considered by The Nature Conservancy to be “arguably the rarest forest type in the region.” Also, MassWildlife has made the Pine Hill area adjacent to the Nashua River in Lancaster a priority to preserve and to protect because it has some of Central Massachusetts last remaining Pitch Pine – Scrub Oak (PP/SO) patches. PP/SOs are a unique habitat -- threatened by forest fragmentation – that occur on outwash sandplains, which are themselves much reduced in the study area (and state wide) because of ease of development, and for being attractive for sand and gravel mining.

ACECs: There are three Areas of Critical Environmental Concern (ACEC) in our Study area: the Central Nashua River Valley ACEC (12,900 acres, 1996), the Squannassit ACEC (37,420 acres, 2002), and Petapawag ACEC -- “swamps on a hill” -- (25,680 acres, 2002). Massachusetts’s ACEC’s “...receive special recognition because of the quality, uniqueness and significance of their natural and cultural resource.” For example, Petapawag ACEC is most important for the diversity of wildlife and rare species: the NHESP database indicates that there are sixteen state-listed rare species and one federally-listed threatened species in this one ACEC.

More specifically, within the Squannassit ACEC the Nissitissit River watershed includes sightings of American Bittern (endangered), Brook Snaketail (dragonfly, special concern), Spotted Turtle (special concern), and Wood Turtle (special concern). The Squannacook River corridor has several records of rare species including the Marble Salamander (threatened), Blanding’s Turtle (threatened), Creeper (mussels, special concern), Bridle Shiner (minnow, special concern), and Wood Turtles (special concern). [Note: According to Mike Jones, State Herpetologist: “*the Nashua [River] is also the site of some of the earliest scientific observations on wood turtles, which need restoration efforts....Beginning in 1854, Sanborn Tenney and Louis Agassiz studied a population in Lancaster, described in Agassiz’ Contributions to the Natural History of the United States” (personal communication December 19, 2016)]. The Nashua River corridor provides breeding and migration habitat for listed bird species such as King Rail, Pied-billed Grebes, and Common Moorhens, and provides potential habitat for American and Least Bittern.*

Add in the blue spotted salamander and the water shrew, both of which are dependent on the interspersed wetland and terrestrial habitats.

Turtles: Our study area is also the home of the largest known population of state-listed Blanding's turtle: according to herpetologist Brian Butler ours is the only core Blanding's habitat in Massachusetts, Mike Jones, State Herpetologist, writes "the Nashua River watershed supports the largest contiguous and unfragmented population of Blanding's in Massachusetts" (personal communication December 19, 2016), and NHESP calls it "...a very significant population, possibly the largest in New England". (www.mass.gov/eea/docs/dcr/stewardship/acec/acecs/cnr-des.pdf pg. 5) According to BioMap2, Blanding's turtles use many parts of this landscape throughout their decades-long lives, from feeding and over-wintering in deep vernal pools and buttonbush shrub swamps to nesting in open, sunny, well-drained fields and abandoned gravel pits. Because of their extensive movements over the course of the year, Blanding's turtles require larger landscapes than many other turtle species. (www.fws.gov/northeast/ecologicalservices/turtle/species/blandingsturtle.html)

Loss of only a few adults annually can cause populations to decline as they do not reproduce until late in life (14-20 years), and have low replacement rates due to low nest and juvenile survivorship. Roads are the primary cause of adult mortality. Despite concerns about the ongoing decline attributable to the lack of suitable nesting sites and continued road mortality, this local population appears to be healthy and growing *<support for this statement?>* – it is a regional stronghold -- and will continue to do so as long as their travel corridors and habitats are protected.

Indeed, in 2002 the region was being considered as one of a handful of "state herpetofauna reserves" due to the "presence of multiple rare herptile species, relative lack of habitat fragmentation, and diversity of wetland types." (<http://www.mass.gov/eea/docs/dcr/stewardship/acec/acecs/petwag.pdf>) Additionally, two dozen other state-listed threatened, endangered or species of special concern exist in this region. The majority of fauna on the MA List of Endangered, Threatened or Special Concern Species are so designated because of loss of habitat to development. Without places to breed, nest and find food, they have little chance of long-term survival. Part of the purpose of this study effort is to educate the public about the need to identify and protect large contiguous areas of undeveloped land as wildlife habitat.

Fishery and Mussels: The Nissitissit River and its tributaries -- Mine Brook and Sucker Brook -- are cold-water fishery resources (“CFR”; MassDFG 2015) containing native Eastern Brook Trout. There are nineteen tributaries to the Nashua, Squannacook and Nissitissit Rivers that are state-defined cold-water fishery resources—as are the Squannacook and Nissitissit Rivers themselves – especially notable are: the Squannacook River is which supports a native trout population in its upper end, and its tributaries -- Willard, Trapfalls and Locke Brooks – which support native Eastern Brook Trout. It is likely that some of these trout find their way into the mainstem Nashua River. (USFWS Oxbow National Wildlife Refuge, Final Comprehensive Conservation Plan, Feb. 2005)

The Squannacook-Nissitissit Rivers Sanctuary Act (MGL 132A:17, 1975) was passed to protect the Outstanding Resource Waters (ORWs) of these two rivers and associated named tributaries from degradation by new discharges of pollution. Therese Beaudoin, MA Department of Environmental Protection Watershed Coordinator, stated:

*“The Massachusetts Department of Environmental Protection has studied water quality in the Nashua Watershed since the late 1960s. The Squannacook River has provided an ideal location for establishing least impacted conditions for both water quality and flow, and has **served as a reference river for decades**. A **long term monitoring station** was established here in 1998, with sampling conducted every two months; available data show that water quality and aesthetics in the Squannacook River have been consistently among the cleanest in Central Massachusetts.”(emphasis added)*

In 1974 a stream survey of the Nashua River system found only aquatic species most tolerant of pollution. Today, the Nashua River supports a substantial warm water game fishery (including large-mouth bass, chain pickerel, brown trout, fallfish, carp, brown bullhead, yellow perch and bluegill) which is heavily used by recreational fishermen is also “fished” by mink, otter, mergansers, bald eagles, osprey and great blue heron. Brook trout spawn in the tributaries and travel to the Nashua River for part of each year. The burgeoning fish population in the mainstem Nashua River is sustained by all the surrounding open water wetlands. American Eel exist in the Nashua and Squannacook Rivers, and upstream eel passage has been installed at Ice House Dam on the Nashua River.

The Nissitissit River is home to six species of freshwater mussel -- one of the most highly endangered animal groups in North America -- which require clear water. In Massachusetts, freshwater mussels are a Species of Greatest Conservation Need (SGCN) by MassWildlife and good sites need to be protected. (personal communication with Pat Swain, 2016) Two listed under the MA

Endangered Species Act (MESA) are: the Creeper (Special Concern); and, the Endangered Brook Floater, notable as one of just four populations in the Commonwealth. In fact, “the Nissitissit River was ranked as a conservation priority stream based on its relatively healthy *A. varicosa* population [Brook Floater]” [and additionally] “...named as a conservation priority because of immediate threats to *A. varicosa* populations.” (*Confirmed Occurrences and Population Assessment of the Brook Floater in Massachusetts*, Feb. 4, 2016) The recent 2015 removal of the Millie Turner Dam on the Nissitissit River in Pepperell is assumed to have a beneficial impact on the mussels in the river as it will both cool the water and reconnect populations up and downstream of the former dam.

Eastern Pearlshell in the Nissitissit River and the Creeper mussel present in the Squannacook River in Townsend are listed as species of conservation need in the MA State Wildlife Action Plan. And the Creeper mussel (Special Concern) is present in the Nashua River (*Freshwater Mussel Survey in the Nashua River in the Bypass Reach, Tailrace, and Impoundment of the East Pepperell Dam Pepperell, MA*, Biodiversity, May 2013, pg. 1)

As part of the Trout Unlimited Brook Trout Initiative, the Squannacook chapter of Trout Unlimited is currently conducting an assessment of the Nissitissit River and its tributaries to identify areas where restoration or protection efforts would most help protect the native brook trout populations.

Dragonflies: Seven species of state-listed dragonfly species -- Brook Snaketail; Comet Darner; Forcipate Emerald; Kennedy's Emerald; Spatterdock Darner; Spine-crowned Clubtail; and Umber Shadowdragon -- occur in the Squannacook River corridor. Such a multiplicity of dragonflies and freshwater mussels species present in the Squannacook emphasize the high water quality of that river, and its importance in providing habitat for a variety of other species, common and rare. (*Townsend Open Space and Recreation Plan*, 2013, pg. 29)

“Ophiogomphus aspersus, the Brook Snaketail, is an indicator of high quality small/medium sized rivers/streams. I have collected this species in both the Nissitissit and Squannacook Rivers. This species is characteristic of clean, sandy bottomed rivers and streams that flow through forests and they thrive in medium gradient rivers/streams with abundant riffles and sandy substrate....The Bertozzi Wildlife Management Area has been well known among Odonotists in Mass. for its odonate diversity, there are records going back decades. It's hard to find a single location in MA where one can find as many species of odonates in one day during late spring/early summer when the adult odonates are at their peak abundance. I have personally

collected 71 species of odonates either on the Squannacook River proper or in adjacent wetlands, and likewise 57 species on the Nissitissit.” (personal communication Dec. 19, 2016)

Birds: During the spring and fall bird migrations, the Nashua River is the second most commonly followed flyway in Massachusetts, after Plum Island. This migratory bird mecca has over 230 bird species, half of them nesting. (Harold Herrill "*Fall and Winter Birds of the Lancaster Area*", Vol. 5, No. 6 The Bird Observer of Eastern Massachusetts, 1977) In particular, the open field grassland habitat -- found at Bolton Flats Wildlife Management Area, Fort Devens, Moore Airfield and Shepley Landfill -- provides nesting sites for the state endangered Upland Sandpiper and the threatened Grasshopper Sparrow. (NHESP, *An Action Plan for the Conservation of State-listed Obligate Grassland Birds in Massachusetts*, 2013) Additionally, the Pine Hill area in Lancaster mentioned above in regard to its exemplary Pitch Pine – Scrub Oak natural community has documented Vesper and Grasshopper Sparrow territories on it according to Chris Buelow, NHESP Restoration Ecologist (June 19, 2014 email).

SOME KEY FINDINGS ON THE EXEMPLARY STATUS OF BIODIVERSITY & ECOLOGICAL ORRVs

- The Oxbow National Wildlife Refuge, covers 1,667 acres and ~8 miles of the Nashua River frontage, is the crown jewel of xxx acres of permanently protected land in our study area.
- The Nashua River corridor consists of significant portions of terrestrial habitat designated by the state BioMap2 project as “core habitat”, representing the highest priority for biodiversity conservation and protection. There are eight “Priority Natural Communities” along the Nashua River, according to MA Natural Heritage and Endangered Species (NHESP) Program.
- Three state-designated Areas of Critical Environmental Concern (ACEC) are in our study area covering a total of ~76,000 acres: the Central Nashua River Valley, Squannassit, and Petapawag ACECs. Together these three contiguous ACEC’s comprise ~28% of total existing ACEC’s throughout the Commonwealth.
- The Squannacook-Nissitissit Rivers Sanctuary Act was passed in 1975 to protect the Outstanding Resource Waters (ORWs) of these two rivers and associated named tributaries from degradation by new discharges of pollution.
- The Squannacook River has served as a reference (or “baseline”) river for decades. A long term monitoring station was established there in 1998, with sampling conducted every two months; available data show that water

quality and aesthetics in the Squannacook River have been consistently among the cleanest in Central Massachusetts.

- The Nissitissit River is unique in eastern Massachusetts in having both a "fly fishing only" and "catch & release" section and was improved with the recent removal of the Millie Turner dam in Pepperell, which is expected to improve flows and benefit the river's wild brook trout population. Further, due to conservation efforts, nearly 50% of the entire length of the Nissitissit River has a 300 foot vegetated buffer strip.
- There are nineteen tributaries to the Nashua, Squannacook & Nissitissit Rivers that are MA cold-water fishery resources (CFR), as are the Squannacook and Nissitissit Rivers.
- USFWS has stocked Alewife and American Shad in an impounded pond on the Nissitissit River in New Hampshire and is pursuing a goal to reintroduce same species to the Nashua River in the next ten years. The Nashua River is listed as part of the North American Atlantic Salmon Anadromous Fish Program.
- The Nashua River is the second most commonly followed flyway in Massachusetts, after the coast (Dunstable OSR Plan 2010-2017). Oxbow National Wildlife Refuge, is listed as a priority for protection under the North American Waterfowl Management Plan and the Emergency Wetlands Resources Act of 1986.
- As a major aquifer recharge area, the Nashua River valley stores floodwaters and precipitation in its numerous wetlands and sandy glacial soils. Another benefit of our study area's several aquifers is that many NHESP Priority and Estimated Habitats are found overlying them.
- Some two dozen state-listed MA NHESP threatened, endangered or species of special concern exist in this region. Seven species of state-listed dragonfly species occur in the Squannacook River corridor. The Nissitissit River is home to six species of freshwater mussel -- one of the most highly endangered animal groups in North America -- which require clear water, and was ranked as a conservation priority stream because of such. The entire length of the Nissitissit in Massachusetts is identified as Natural Heritage Priority Habitat for five listed species. Such a multiplicity of dragonflies and freshwater mussels species present in the Squannacook and Nissitissit emphasize the high water quality of those rivers.
- Our study area is also the home of the largest known population of state-listed Blanding's turtle: MA NHESP calls it "...a very significant population, possibly the largest in New England."
- Nearly the entire Nashua River watershed has been included as the "Nashua River Greenway Forest Legacy Area" under the US Forest Service administered Forestry Legacy Program in partnership with MA Department of Conservation and Recreation's Bureau of Forestry. Two outstanding tracts protected by Forest Legacy in our study area are the Belmont Springs tract (255 acres in Pepperell) and the Pumpkin Brook Link tract (174 acres in Shirley).

ORRV #2 - Recreational and Scenic Values

Today, river-related recreational pursuits are greatly valued in our study area due to the significant recovery of the Nashua River. In the 1960s, foul smells and excessive water pollution kept recreationalists far from the Nashua River corridor. Today, high quality water supports water-based recreation as well as the enjoyment of numerous greenway trails along and close to the banks of our surface waters.

The Nashua, Squannacook and Nissitissit Rivers and their adjacent trails offer the populace within the greater Boston, Nashua and Worcester metropolitan area a host of recreational opportunities including: hiking, biking, horseback riding, birding, wildlife viewing, photography, fishing, hunting, leaf pepping, agri-tourism, dog walking, boating, and snowmobiling. (Note: Most municipal and some land trust conservation lands prohibit motorized vehicle use.)

Hiking Adjacent Conserved Lands: Among the many major riparian conservation lands (“open spaces”) are: Oxbow National Wildlife Refuge (1,667-acres with almost eight miles of Nashua River frontage), Bolton Flats State Wildlife Management Area (~1,000 acres), Squannacook River State Wildlife Management Area (xxx acres), Nissitissit River State Wildlife Management Area (xxx acres), Townsend State Forest (xxx acres), Nashua River Rail Trail (11 linear miles one-way), and J. Harry Rich State Forest (~500 acres), which was the first state-owned tree farm in the nation and the most intensively managed forest acreage in New England according to Hugh Putnam, former chief forester for the New England Forestry Foundation. And significantly, there are more than one thousand additional acres of locally-owned land trust and municipal conservation properties such as Groton Town Forest (~500 acres). The Montachusett Regional Planning Commission (MRPC) has put considerable effort into creating an interactive web mapping application “MR Mapper” which has more than a dozen datalayers including all existing formal trails (and trailhead parking) in six of our subject area towns. This information valuable is available on mobile devices for locational use in the field.

[Note: There will be a more extensive section on the role of our many local and regional land trusts. A fact contributing to the success of so much protected land in the study area is the large number of varied organizations with different focuses working here to protect land. These organizations range from federal USFW (Oxbow NWR) to state (Department of Fish & Game/Division of Fisheries &

Wildlife –wildlife management areas), (Department of Conservation & Recreation – state forests & rail trails), (Department of Agricultural Resources – agricultural preservation restrictions) to municipal (Conservation Commissions) and regional and local land trusts (Trustees of Reservations & New England Forestry Foundation –fee owned and conservation restrictions/easements, MA Audubon (Snake Hill), Nashua River Watershed Association (coordinating Forest Legacy Grants and facilitating protection by others), Dunstable Rural Land Trust, Nissitissit River Land Trust, Nashoba Conservation Land Trust, Townsend Land Trust, and others.]

On-Water Environmental Education: Additionally, the numerous open spaces and waterways provide educational venues such as River Classroom®, which brings approximately 3,000 students and adults every year to the Nashua and Squannacook Rivers. River Classroom® housed at the Nashua River Watershed Association (NRWA) is an environmental education program that has received the Massachusetts Executive Office of Environmental Affairs Secretary’s Award for Excellence in Environmental Education.

Riparian Rail Trails for Biking and Horseback Riding: Many dozens of miles of trails are located along these three rivers (see Map #x). Most prominently, the singularly popular Nashua River Rail Trail (NRRT), owned by the MA Department of Conservation and Recreation, which runs more than 11 miles from Ayer north to the state line, travels parallel to the Nashua River for a considerable distance. User counts taken in 2008 indicate that more than one thousand people take advantage of the NRRT on a typical summer weekend. Also, in development for more than a decade, a Squannacook River Rail Trail, is scheduled to be constructed in 2017. Phase one will travel approximately four miles in close proximity to the Squannacook River from Groton to Townsend Center MA. And, there is an abandoned rail bed turned walking trail along much of the Nissitissit River in the eponymous state wildlife management area.

Boating: The Nashua River for the most part flows relatively slowly, and so is generally appropriate for boaters, including beginners. A local boat rental, Nashoba Paddler -- an economically successful, family-owned business -- on the Nashua River in West Groton rents boats to over 8,000 unique visitors each year: their customers come from near and far. Nashoba Paddler also offers tours and a summer River Camp. It is also possible to launch one’s own car-top boat at over a dozen access points; several of these sites are boat ramps suitable for trailered boats. (See listing of such in

appendix below and on website). The NRWA's Canoe and Kayak Guide 6th Edition, updated and republished in 2017, is a greatly in demand, pocket-sized book that provides maps and descriptions for river outings on 72 miles of the Nashua and its main tributaries, including access points and portages.

Additionally, the Veterans of Foreign Wars hold an annual canoe race on the Squannacook River and groups often hold an annual canoe race on the Nashua River. The Groton School has always used the Nashua River for their crew team. The Groton Greenway Committee puts on an annual spring Greenway Festival at which a featured event is a cardboard boat race. The Lancaster Friends of the Nashua River had been holding an annual festival at which Nashoba Paddler had offered free boat rentals.

Fishing: Nissitissit River and two of its tributaries --Sucker and Gulf Brooks --are stocked with brown, brook and rainbow trout by MassWildlife; as is Unkety Brook – a tributary to the Nashua River-- in Dunstable. Some of these stocked trout are known to reproduce and persist in the cold-water sections of our study rivers.

Several groups such as Yankee Bassmasters and Freedom Bass sponsor annual fishing tournaments in Pepperell Pond on the Nashua River. Largemouth bass are found in the Nashua River with many 6 pounders caught. The Nissitissit and Squannacook Rivers are widely regarded as providing some of the best fly-fishing within reach of metro-Boston anglers. [Note: The NRWA's 1984 Squannacook River Protection Plan, says: "Although readily accessible from major roads and population centers, the Squannacook River is considered by MDFW to be 'one of the three best trout fishing streams in eastern Massachusetts' and is heavily stocked" (pg. 6) – the Nissitissit being one of the other three rivers -- as it continues to be to this day.] Of course, the high-water quality is in very large part attributable to high-percentage of forest in their respective watersheds.

The Squan-A-Tissit Chapter of Trout Unlimited (TU) has a strong presence in the watershed including constructing a universal access facility on the Squannacook River, and assisting MassWildlife staff when they conduct electro-shocking and fish sampling. The Squan-a-Tissit TU chapter has also adopted the Nissitissit River under the Massachusetts Adopt-A-Stream program. In the early 1990's, the Chapter was instrumental in the designation of the Henry Colombo area, a

nearly two mile reach of the river that extends from the New Hampshire border to the Prescott Street Bridge in Pepperell, as a Fly-fishing only – Catch and Release area (Massachusetts’ first so designated); and Chapter members have long been active in the NRWA volunteer monitoring program and the UMASS Acid Rain Monitoring Program. As part of the Trout Unlimited Brook Trout Initiative, the Squan-a-Tissit chapter is currently conducting an assessment of the Nissitissit River and its tributaries to identify areas where restoration or protection efforts would most help protect the native brook trout populations. This assessment includes a reconnaissance survey of tributaries to identify reaches with native brook trout, a temperature survey of the Nissitissit and its tributaries, and an assessment of the connectivity of the tributaries to the mainstem.

<http://easternbrooktrout.org/news/newsletters/2008/ebtjv-northeast-april-2008>

Hunting: Pepperell Pond is a much frequented waterfowl hunting location: Nashua River chapter of Ducks Unlimited chapter is a proponent for hunting on this river segment. The Townsend Rod and Gun Club (~300 acres), South Fitchburg Hunting & Fishing Club (68 acres) on tributaries to such, and the Shirley Rod and Gun Club (~200 acres) is situated on the Squannacook River⁴.

Scenic Views: The Massachusetts legislature passed the Scenic and Recreational Rivers Act in 1971. [Note: The driving motivation behind this program was to protect, preserve and acknowledge the rivers as significant recreational and scenic resources. Under this law, land development is restricted within designated river corridors, to safeguard water quality on and along the watercourses, maintain a healthy and safe environment, and enhance recreational opportunities for people.] The MA Department of Environmental Management (now Department of Conservation and Recreation) Scenic Rivers Program prioritized the Nashua and Squannacook Rivers as needing protection. In order to attain this Scenic River status, it was necessary for the governing bodies of the riverfront communities to approve the goals of the 1984 *Nashua River Greenway Management Plan*. Local approval was gained through a series of public meetings held by the Selectmen of each river town. To this day, these rivers’ shorelines are remarkably undeveloped, their scenery is exquisite.

One of the most famous views in central Massachusetts is of the Nashua River valley from Prospect Hill at Fruitlands Museum – it looks much as it might have a century ago -- and is listed in the 1982

⁴ The beginning of the Squannacook River Wildlife Management Area was created when the Middlesex League of Sportsmen’s Clubs purchased and donated 259 acres along the river to the state in 1966.

Massachusetts Scenic Landscape Inventory. [Note: This Inventory, which focused on the Commonwealth's very best landscapes, found that high scenic quality often coincides with, and depends on, the presence of a healthy natural environment, agriculture, historic features, and a lack of intensive, uncontrolled contemporary development. It advised: "*Existing or future efforts in these areas should be linked with a program for regional preservation*" (pg. 17).] Long stretches of the Squannacook and Nashua Rivers are rated as "distinctive scenic resources" in the Inventory. Just below the confluence of the Nissitissit and Nashua Rivers is a scenic, historic attraction that many tourists photograph each year: Pepperell's "Chester Waterous Covered Bridge", which stands at the site of Blood's Fordway, where a bridge has spanned the river since 1742. (*Pepperell Open Space and Recreation Plan*, page 42-3) It is the only covered bridge -- first erected in 1846 -- in Massachusetts east of the Connecticut River. ("Pepperell Greenway and Conservation Plan", NRWA, 1982, pg. 38)

SOME KEY FINDINGS ON THE EXEMPLARY STATUS OF RECREATIONAL AND SCENIC ORRVs

- Eight thousand unique visitors use canoes & kayaks from Nashoba Paddlers LLC -- a locally owned outfitter – to explore the Nashua and Squannacook Rivers each year, in addition to the many who bring their own boats to x access sites. Nashoba Paddlers additionally offers tours and a summer River Camp.
- Award-winning River Classroom®, an environmental education program housed at the NRWA, brings approximately three thousand students and adults every year to the Nashua and Squannacook Rivers.
- The Nissitissit and Squannacook Rivers are widely regarded as providing some of the best fly-fishing within reach of metro-Boston anglers.
- Several bass fishing clubs annually hold tournaments on the Nashua River.
- The Groton School has always used the Nashua River for their crew team. The Groton Greenway Committee puts on an annual spring Greenway Festival at which a featured event is a cardboard boat race. The Veterans of Foreign Wars holds an annual canoe race on the Squannacook River.
- The eleven mile Nashua River Rail Trail paralleling river for several miles receives more than one thousand users on any given summer weekend day, with people enjoying walking, running, bicycling, roller-blading, and horseback riding.
- The xx acres of permanently conserved lands that abut the rivers provide unparalleled opportunities for hiking and wildlife viewing, and in many areas hunting. The Nashua River is a prime area of hunting waterfowl in season.
- The Massachusetts Scenic Rivers Program in the 1980’s prioritized the Nashua and Squannacook Rivers as scenic rivers in need of protection. The 1982 Massachusetts Scenic Landscape Inventory included long stretches of the Squannacook and Nashua Rivers as “distinctive scenic resources” including Pepperell’s much photographed “Chester Waterous Covered Bridge”. (see Pepperell 2016 Open Space and Recreation Plan, pg 48).
- The 155 miles of permanently protected greenway along the river provide recreationists on shore or water with a serene and breathtakingly beautiful “wilderness” experience within an hour’s drive of three metropolitan cities with a combined population of over 3,000,000. (“Nissitissit River NH and MA - A Preliminary Report on Proposals to Preserve”, NH DRED, 1967)

ORRV #3 - Historical and Cultural Resources

The riverine environmental setting of the general area would have made it an ideal location for groups of prehistoric hunter-gatherers. This type of ecozone with its riverine fall lines, open river meadow/marsh, natural ponds, and tributary streams entering the flood plain from upland areas, is an

example of a setting with high resource potential." (Appendix 2 -Fort Devens Supplemental Environmental Information for Fort Devens Realignment III-c-45).

Early Settlers: Abundant food sources and their usefulness for travel made these rivers important to Native Americans, whose occupation is documented by numerous streamside archaeological sites including: the site of a large semi-permanent Nashaway village just south of the Meeting of the Waters where the North and South Branch of the Nashua join, which is considered a major prehistoric resource; and, a native encampment along the Nashua River in Pepperell, near its confluence with the Nissitissit River.

It has been suggested that the region's geography resulted in unique human settlement patterns. Former Archeological Curator of Fruitlands Museum, Mike Volmar, described the extensive, 1,000+ acre freshwater estuary at the present Oxbow National Wildlife Refuge as being communally used for hunting and gathering by Native Americans; the natural resources – including seasonal shad, salmon, and alewife fish runs -- were so abundant as to be a place where different bands could utilize such without concern for the usual territorial boundaries. There is a high probability of potential native American archeologic sites in the subject focus area.

Due to the presence of prime agricultural soils in the large floodplains along the banks of the river, there is a long-term agricultural history. Agrarian history dates back to the prehistoric Late Woodland Period. The "First Peoples" burned the land to keep it open, which made it attractive to European settlers who arrived in the 17th century.

First Towns and Mills: For example, Lancaster is a long settled place, one of the first inland towns established in Colonial America, when a Native American trading post was set up near the river in 1643. Soon after European settlers followed to farm the rich soils of the Nashua Valley. However, the Natives did not relinquish this land readily and there were many struggles. The first book written by a woman in America -- The Narrative of Mrs. Rowlandson -- records her experience as an "Indian" captive taken from Lancaster MA to Canada.

In 1653, the first grant to buy land for a town (Lancaster) was along the Nashua River from the Nipmuck Tribe, known as the "fresh water people." This tribe was associated with the Nashua, or the Nashaway, the "river with the beautiful pebbled bottom." Originally it was "first begun for love

of the Indians' trade, but since the fertility of the soil and pleasantness of the river hath invited many more." (MHC, Historic & Archaeological Resources of Central Massachusetts, 1985, pg. 62) By the 1770's, Lancaster was the wealthiest agricultural town in the area, as a result of the productive lands of the "Nashua intervale": the rich bottom lands along the river.

The Nashua River served as barrier to westward settlement for 100 years after the Pilgrims arrived. A monument near the river in Pepperell marks the site of the last Indian attack in the area in 1745. The Petapawag Canoe Launch land in Groton protects the site of another Native American settlement. The same spot was later a trading post and witnessed the 1609 skirmish between English settlers and First Peoples. A trading post in the vicinity dates back to 1656, where the owner John Tinker would use the river to transport goods from his home upriver in Lancaster. Groton's first European settlement was located in the nearby J. Harry Rich State Forest, and numerous cellar holes remain from that time. The old stagecoach road from Boston to Keene, NH ran through the forest to a ford in the river known as the "Stoney-wading-place."

The Nashua River provided the original impetus for Pepperell's growth, when in 1730 a gristmill was established at Babbittasset Falls, site of the present dam. Since 1835, paper mills have been operating continuously at this site until 2002. The first bridge in Groton to span the Nashua River in 1725 is near the current Fitch's Bridge. It carried the old county road: one of the oldest westward trails, leading to the wilderness of New York.

National Noteworthy Social Experiments and Efforts: Fruitlands Museum, a regional resource set on 210 acres in Harvard, abuts Oxbow National Wildlife Refuge – a state and National Historic Landmark on the site of a former Transcendentalist community: the site of Bronson Alcott's short-lived utopian experiment in agriculture and intellectual living. A Shaker Village existed along Nashua River in Shirley from the late 1700s to the early 1900s. There is a Historic District along the Squannacook River in Townsend Harbor known as a "safe harbor" due to the local Abolitionists that participated within the Underground Railroad network (see Conant House reputed to be the oldest in Townsend). Earlier, a sawmill was established at the Harbor in 1733, and a grist mill was added shortly thereafter. In Ayer, circa 1770, a grist and sawmill (Pierce's) was built on Nonacoicus Brook. Other early mills include a 1739 clothier mill on the Squannacook River.

Historic Properties and Districts: Harvard has three properties that are listed in the National Register of Historic Places: Fruitlands Museum (which is also a National Historic Landmark), Still River Baptist Church, and the Fiske Warren House, now part of St Benedict's Abbey abutting the Nashua River. There are four National Register Districts: Vicksburg Square at Fort Devens, Fruitlands, Harvard Center and Shaker Village. Harvard has two local historic districts, Harvard Center and Shaker Village. Another National Register District is the Shirley Shaker Village (now part of MCI-Shirley) near the banks of the Nashua River. Shirley named "the Most Historic Small Town in the Nation." (www.shirleyhistory.org/mosthistoric.htm)

In regard to 20th century cultural history, parts of Ayer, Harvard, Lancaster and Shirley were chosen as US Army Post Fort "Camp" Devens during First World War, where over 100,000 soldiers were trained. It was substantially expanded during World War II to approximately 5,220 acres to become the largest military installation in New England. Notoriously, Fort Devens was the epi-center of the 1918 Influenza Pandemic. While Fort Devens was active, the US Government conducted many studies of Devens and the surrounding region: indeed, Plow Shop Pond in Ayer is considered one of the most well documented ponds in the country (*Ayer Open Space and Recreation Plan*, 2015, pg. x) According to MassDevelopment, the US Army has spent approximately \$160,000,000 to date in the environmental cleanup of Fort Devens.

[Note: Interestingly, in 1846 the Nashua River valley becomes a railroad corridor to New Hampshire from Ayer and Worcester. Similarly, in 1847, the Peterborough and Shirley Branch Railroad was opened through the Squannacook River corridor. Several decades later, a railroad from Massachusetts to Milford, New Hampshire was built along the Nissitissit River over which, in the days before refrigeration, two daily shipments of ice were transported from Lake Potanipo in Brookline, New Hampshire to Boston.]

"The Marion Stoddart Story" of River Restoration: Fifty years ago in the 1960's when there were no laws against dumping pollutants into waterways a group of concerned citizens set out to restore the Nashua River: one of the nation's ten most polluted rivers. They dared to envision the unthinkable; "sparkling blue water with a ribbon of green along its banks". They advocated for a revitalized river corridor safe for people and wildlife alike. Led by Marion Stoddart, they galvanized the attention of

towns, government agencies, businesses, and other residents—and soon all joined in pursuing the ambitious restoration goal.

Although the Nashua is a native word for “river with a clear-bottom”, by the 1960’s its recovery seemed an impossible task as the river -- known locally as the "Nauseous River" because of its awful smell -- was all but biologically dead. One could smell the river from more than a mile away, riparian real estate was worthless, it notoriously ran various colors from dyes dumped into the river by the paper mills, the only wildlife were rats and sewage worms. There were sludge banks along the Nashua exceeding five-foot depth in places.

Visually, the Nashua is, in short, revolting. Sludge and scum fill the stream, and discoloration and turbidity resulting from paper mill discharges and other wastes can be found throughout most of the river’s length. Fermentation bubbles are ubiquitous and obnoxious odors constitute a widespread nuisance. (Plan for the Nashua River Watershed, NRWA, 1972, pg. 40)

The river was so grossly polluted in 1969 that Fort Devens military personnel were warned to stay away from it. It had a “U” designation signifying “unacceptable” meaning its condition did not meet any of the existing water quality standards classifications.⁵

Marion Stoddart’s activism took many forms; for example, she had children bring jars of dirty river water to the politicians and told them "we just want this river the way it was when you were kids. You could swim in it. You could fish in it." Represented by the Nashua River Watershed Association, her activism led to the passage of laws to stop the paper mills from dumping pollutants into the river including the Clean Water Act. In 1965, the federal Water Pollution Control Act passed and Massachusetts was the first state to pass similar legislation, with the Clean Water Protection Act in 1966⁶. As importantly these laws provided state and federal money to build eight municipal waste water treatment facilities to improve Nashua River system water quality at a cost of more than \$250 million⁷.

⁵ “Class A waters were designated as sources of public water supply. Class B waters were designated for aquatic life, recreation (swimming and boating) and aesthetics. Class C waters were designated for indigenous aquatic life, limited recreation (boating) and aesthetics. Class D waters were designated for aesthetic enjoyment only.” From below Appendix A: Warren Kimball, History of Water Quality, October 2016

⁶ In 1964, the Town of Hollis was the first in NH to form a Conservation Commission.

⁷ In 2012 the City of Fitchburg City Council voted to expend over \$70 million to separate sewers and upgrade its treatment facility.

“Changing values and attitudes, diligent enforcement of environmental laws and regulations, educational programs by schools and NGOs, the shift from manufacturing to service industries initiated the process of ecological recovery. The rate of recovery in the well-watered temperate climate of southern New England has been nothing short of remarkable.” (Paul Barten, et al, *Land Conservation, Restoration, and Stormwater Management for the Squannacook and Nissitissit River Watersheds, MA & NH*, 2001) It took a quarter of a century to clean up a river that was "too thick to pour, too thin to plow." (*Plan for the Nashua River Watershed*, NRWA, 1972, pg. ii) Today, a sparkling blue Nashua River runs from central Massachusetts to southern New Hampshire. It hosts some of the state’s best fishing tournaments. Flora and fauna thrive in it, canoeists revel in it, and swimmers splash in some sections of it. It is now a nationally recognized example of river restoration. [*See below Appendix A; Warren Kimball’s History of Water Quality, October 2016, unpublished*]

This inspiring tale has been retold in *A River Ran Wild: An Environmental History* by Lynne Cherry: a children’s non-fiction book frequently used in school curriculums throughout the nation to address human effects on the environment and to show the changes of pollution throughout history, and how people in each period affected the Nashua River. In 1993 the National Geographic Magazine spotlighted the Nashua’s recovery in an article "The Promise of Restoration: New Ideas, New Understanding, New Hope " in its Special Edition: *The Power, Promise, and Turmoil of North America’s Fresh Water* and which provided us the dramatic before and after images that attract the most attention at the NRWA River Resource Center. In 1987 the United Nations honored Ms. Stoddart, naming her to the “Global 500 Roll of Honor”. National Geographic’s 2010 *Written in Water: Messages of Hope for Earth’s Most Precious Resource* contains an essay on the Nashua River cleanup by Ms. Stoddart. Most recently, the story of Ms. Stoddart and the Nashua River was made into an independent, critically acclaimed, call to action documentary film *The Work of 1000* which speaks to a model for effective leadership and advocacy, grassroots organizing and coalition building to achieve one’s vision. Our locally celebrated natural resources are also a symbol of success.

Recovery has sparked recreational use of the river at places like the Oxbow National Wildlife Refuge, J. Harry Rich State Forest, Townsend State Forest, Bolton Flats State, Squannacook River and Nissitissit River Wildlife Management Areas, Groton and Shirley Town Forests, to name but some of the conserved lands abutting the rivers and protecting their shorelines.

SOME KEY FINDINGS ON THE EXEMPLARY STATUS OF CULTURAL & HISTORICAL

The story of the clean-up of the Nashua River has merited international acclaim and has served as has served as a model for watershed groups across the nation. The Nashua River, once one of the top ten most polluted rivers in the country, was revitalized due to the efforts of internationally recognized Marion Stoddart and others.

- The polluted “before” and revitalized “after” iconic photos of the river instantly communicate this story, which has been recounted in the children’s book “A River Ran Wild Ran” by Lynne Cherry. The book has sold over 1,000,000 copies and is often used in classroom curriculums.
- The story of the clean-up was feature in National Geographic.
- Marion Stoddart was recognized by the United Nations in 1987.
- The story of the clean-up and Marion’s role was documented award-winning film “Work of 1000,” which has been shown in over two dozen film festivals across the country.
- High-yield, high- productivity aquifers found under several of our study area towns and tapped as municipal sources of public drinking supplies.
- Parts of Ayer, Harvard, Lancaster and Shirley were chosen as US Army Post Fort “Camp” Devens during First World War and expanded during World War II to ~5,220 acres to become the largest military installation in New England.
- Fruitlands Museum is a regional resource set on 210 acres in Harvard that abuts Oxbow National Wildlife Refuge – it’s a state and National Historic Landmark on the site of a former Transcendentalist community: the site of Bronson Alcott’s short-lived utopian experiment in agriculture and intellectual living.
- The Nashua, Squannacook and Nissitissit Rivers are all included in the federally-designated Freedom’s Way National Heritage Area. A few of the many outstanding resources acknowledged by this designation:
 - The site of a major prehistoric resource - a Nashaway village – by the Meeting of the Waters where the North and South Branch of the Nashua join; and, a native encampment near the

confluence of the Nashua and Nissitissit Rivers in Pepperell. Also, the 1,000+ acre freshwater estuary at the present Oxbow National Wildlife Refuge is noteworthy as being so rich in natural resources as to be communally used for hunting and gathering by the indigenous Native Americans, irrespective of territorial boundaries.

- The first book written by a woman in America -- The Narrative of Mrs. Rowlandson -- records her experience as an “Indian” captive taken from Lancaster MA to Canada and later ransomed back home.
- The presence of prime agricultural soils in the large floodplains along the banks of the Nashua River were historically significant to the founding of the first colonial towns and are still heavily utilized to this day (see Flats Mentor Farm in Lancaster).
- A Shaker Village existed along Nashua River in Shirley from the late 1700s to the early 1900s.

FEDERAL INVOLVEMENT

The Nashua River as a tributary of the Merrimack River is listed as part of the North American Atlantic Salmon Anadromous Fish Program. The Nashua River is also recognized as having international importance as a migratory flyway as it provides breeding and migration habitat for migratory waterfowl in the form of open palustrine and emergent wetlands. The extensive and regionally significant wetlands occurring on and adjacent to the Oxbow National Wildlife Refuge (ONWR), including its associated tributary headwaters, have been listed as a priority for protection under the Emergency Wetlands Resources Act of 1986 (P.L.) 99-645 (100 Stat. 3582). It is also named as a priority for protection under the North American Waterfowl Management Plan, an agreement between Canada, Mexico, and the United States. Indeed the ONWR was initially created to support the national migratory bird management program. In 2016 the “Bill Ashe Visitor Facility” at ONWR and associated boat launch on the Nashua River were built.

The Nashua River is listed in the 1987 USEPA Priority Wetlands of New England, in recognition of the value of its wetland habitats to northeast waterfowl populations (*Central Nashua River ACEC Nomination Report*, pg. 10). As we understand it, the US Fish and Wildlife Service (USFWS) is pursuing a goal to reintroduce Alewife and American Shad to the Nashua River in the next ten years (personal communication with Michael Bailey, USFWS Assistant Project Leader, 2016) and has a

river herring restoration program in place on the Nashua River: passage for river herring may be required in the future. The Nashua River is listed as part of the North American Atlantic Salmon Anadromous Fish Program. The USFWS has already stocked Alewife and American Shad in Lake Potanipo, headwaters of the Nissitissit River in New Hampshire.

*“As part of the large scale plan for fish restoration in the Merrimack River, the Nashua River Watershed is a current and future release location for river herring. Anadromous fish restoration is a cooperative effort among state agencies including the Massachusetts Division of Marine Resources, MassWildlife, and federal agencies including the Service, National Marine Fisheries Service and U.S. Forest Service. The Nashua River is considered a self-sustaining river in that it has existing fish passage facilities at dams which need to be modified or improved as part of the plan. This watershed will also be monitored and evaluated to ensure effective and efficient upstream and downstream passage of fish. Fish that would benefit from this effort include the river herring (*Alosa pseudoharengus*), American shad (*Alosa sapidissima*) and American eel (*Anquilla rostrata*).”* USFWS Oxbow National Wildlife Refuge, Final Comprehensive Conservation Plan, Feb. 2005, pg. 33

Nearly the entire Nashua River watershed has been included as the “Nashua River Greenway Forest Legacy Area” under the US Forest Service administered Forestry Legacy Program in partnership with MA Department of Conservation and Recreation’s Bureau of Forestry (see <http://www.mass.gov/eea/docs/dcr/stewardship/forestry/other-reforest/nashua-river-greenway-expansion-2001.pdf>). [Note: This Forest Legacy Area met the eligibility criteria for a Forest Legacy

Area as follows:

1. Forests are threatened by immediate and future conversions to non-forest, house lots.
2. Individual landowners have been approached about selling conservation easements and are interested in selling easements.
3. Scenic resources ... are recognized as distinctive.
4. Public has traditionally utilized the ... areas for recreation and these are opportunities to extend the existing greenway systems.
5. Numerous private wells, six public water supply wells, and designated Zone 2 drinking water protection areas lie within the sections -- protection of the water supply sources.
6. Riparian habitat for fish, waterfowl and migratory songbirds, and associated forested wetland plants and animals.
7. Contain rare and endangered flora and fauna.
8. Provide river access to all types of passive recreation including fishing.
9. Contain significant historic sites and potential sites of archeologic importance.
10. Have highly productive floodplain soils for forestry and agriculture.]

There are two Forest Legacy protected tracts in our study area: Belmont Springs tract (bisected by Gulf Brook, a tributary to Nissitissit River; 255 acres in Pepperell) and Pumpkin Brook Link tract (tributary to Squannacook River; 174 acres in Shirley).

The Nashua, Squannacook and Nissitissit Rivers are all included in the federally-designated Freedom's Way National Heritage Area (FWNHA), which extends from the site of "the shot heard round the world" in Concord to Mount Wachusett, following Henry David Thoreau's famous 1842 walk there through Bolton and Lancaster. FWNHA describes itself as:

"...intimately tied to the character of the land as well as those who shaped and were shaped by it. Here landform and climate combined to create an environment propitious to settlement, with a network of natural features, including river systems and forests, sustaining successive generations of inhabitants. Like veins on a leaf, the paths of those who settled the region are connected, providing both tangible and intangible reminders of the past. Their stories can be found on village commons, along scenic roadways lined with stone walls, in diaries and artifacts, in a cabin by a pond, along a battle road or hidden deep within a secret glen by the bank of a meandering river. (<http://freedomsway.org/redesign2/>)

In regards to previous federal grant-awarded projects in our study area, the Environmental Protection Agency (EPA) Targeted Watersheds Grants program funded the Nashua River 2004-2007 "Protecting Today's Water for Tomorrow: Combating Threats to Source Water in the Squannacook Nissitissit Sub-basin of the Nashua River Watershed" project. The NRWA and three partner organizations -- Beaver Brook Association, New England Forestry Foundation, and the Trust for Public Land -- were one of only fourteen awarded nationwide to combat threats to drinking water and protecting key water resources by conserving key land parcels. The project was highlighted in The Trust for Public Land's *Source Protection Handbook Using Land Conservation to Protect Drinking Water Supplies*, 2005. This project built upon an earlier federal EPA 2001 Source Water Stewardship Project focused on the Squannacook-Nissitissit Rivers: one of four such sites awarded nationally.

Finally, there are two US Geologic Service (USGS) river gages in our subject area: one on the Nashua River in East Pepperell https://waterdata.usgs.gov/ma/nwis/uv/?site_no=01096500&PARAMeter_cd=00065,00060 and one on the Squannacook River in West Groton https://waterdata.usgs.gov/nwis/uv?site_no=01096000. The latter is considered by USGS to be a reference gage which is described as follows:

“long periods of unmodified streamflow, ... natural forest and wetland landcover with no water withdrawals, return flows, dams, or development. Few stations in southern New England meet these criteria, however, given population the density and history of land use in the region. GIS data for water withdrawals, water returns, dams, and land-use characteristics were evaluated to indicate difference in potential flow alteration in records for selected stations in MA.” Characteristics and classification of least altered streamflow in MA. Armstrong, D.S., Parker, G.W. and Richards, T.A. USGS Scientific Investigations Report 2007, pg 11

SUMMARY

In sum, the diversity of distinctive glacial features, ecosystem and wildlife species, unusual plant communities, and the unfragmented open space of the study area provide outstanding recreational opportunities. The Nashua, Squannacook and Nissitissit River corridors provide multiple benefits including but not limited to: wildlife sanctuary, floodplain storage, water quality protection, and aquifer recharge. The Joint Boards of Selectmen from Ayer, Harvard, Lancaster and Shirley said it best in their 1991 mission statement:

“We recognize the unique and valuable natural resources within the region. Future open space for scenic, natural resources, or recreational purposes is an integral part of our overall objectives. Natural resources, including wetlands, rivers, aquifers, soils and wildlife, are interconnected systems knowing no town borders. Development activities in one town can have dramatic impact on a neighboring town. Therefore, effective natural resource protection within reuse planning can only be achieved through multi-town cooperation.”

In conclusion, these many outstandingly remarkable resource values -- fisheries, rare fauna and flora, recreation, and rich cultural history - make the Nashua, Squannacook and Nissitissit Rivers a strong candidate for inclusion in the Partnership Wild and Scenic Rivers System. Benton MacKaye would strongly approve.

APPENDIX A - History of Water Quality

by Warren Kimball

Water Quality Standards

Water Quality Standards were first established for the Commonwealth of Massachusetts by the Division of Water Pollution Control (DWPC) in 1967. They created four inland water classifications as water quality goals. Class A waters were designated as sources of public water supply. Class B waters were designated for aquatic life, recreation (swimming and boating) and aesthetics. Class C waters were designated for indigenous aquatic life, limited recreation (boating) and aesthetics. Class D waters were designated for aesthetic enjoyment only. Table_ shows the original Classifications assigned to certain segments of the Nashua River Watershed in 1967. It also shows the current condition of these waters in the early 1970's as listed in the first DWPC Nashua River Basin Management Plan (1975). A "U" designation signified "unacceptable" meaning the current condition did not meet any of the existing Classifications. Waters in the Nashua River Watershed not listed here were Classified either A or B and were generally thought to meet those Classifications.

It can be seen that the current condition of the main body of the Nashua River was grossly polluted. Furthermore, the expectation for the river's future was below Class B. Class B coincided with the national "fishable/swimmable" goal established in the Federal Clean Water Act of 1972.

During the public hearing process for the 1967 Water Quality Standards, Mrs. Marion Stoddard testified on behalf of the Nashua River Clean-Up Committee. She presented a comprehensive package prepared by the Committee that showed overwhelming evidence for support of a B classification for the river. She also called for the elimination of Class D from the Standards. When the Water Quality Standards were revised in 1974 Class D was eliminated. Also, Class C segments on the main stem of the Nashua River, the South Branch and the lower Squannacook River were reclassified to a new Class B1 designation. Class B1 had all the same criteria as Class B except for dissolved oxygen, which was held at a Class C level. The North Branch of the River remained at Class C. The Standards were revised again in 1978 and in this revision all Class C and B1 segments

of the river were upgraded to Class B. This was to reflect the desire to attain the national “fishable/swimmable” goal and did not indicate the current condition of the river.

The Squannacook and Nissitissit Rivers are both designated Class B, cold water fisheries. This affords these rivers more stringent dissolved oxygen and temperature criteria within the B Classification. Other waters in this discussion are designated warm water fisheries and have less stringent criteria than cold water fisheries. Class C waters are not assigned a “fisheries” designation and have less stringent dissolved oxygen and temperature criteria than and warm water fisheries.

Water Quality Report Cards

In order to show the history of water quality of the Nashua River Watershed water quality report cards were created to graphically display the water quality of the river at a point in time. Four report cards were created in order to show the existing water quality during each decade from the early 1970’s to the early 2000’s. They display the results of water quality surveys conducted primarily by the DWPC (and its successor agencies) during this time. The information presented here singles out the historically polluted portions of the river including the South Branch, North Branch, and main stem of the Nashua River as well as two relatively clean tributaries; the Squannacook and Nissitissit Rivers. These rivers were divided into nine segments for the sake of discussion. Information on fish tissue was available only in the more recent assessments, and was spotty. Therefore, for the sake of trend analysis it is shown as “not assessed” on all the report cards in order to make the assessment more comparable.

For each of the nine segments, eight categories of pollutants are assessed for the aquatic life use and three categories of pollutants for the recreational uses. The level of pollution is color coded to verbal categories of “good”, “fair”, “poor” and “very poor”. “Good” means meeting Class B criteria and the other categories roughly coincide with Class C, Class D and U respectively. In order to provide a uniform basis of comparison, all water quality was assessed using criteria for a modern Class B water - meaning the criteria that would be used today.

Severity points were also assigned to these categories (1, 2 and 3 respectively) indicating the level of impacts depending on the degree to which Class B criteria are violated. Severity points in a segment can be totaled to compare with other segments or to the same segment over time. Total severity points can be further weighted by multiplying by the segment’s length. In this manner the number of

parameters violated, the severity of the violation and the river miles affected can be tallied to glean additional useful information.

Caution should be used in viewing the report cards so that they are not afforded a degree of precision that is unwarranted. Water quality is highly variable and the data sets used to fill out the report card were seldom uniformly comparable. In a few instances the information was contradictory. Additionally, the criteria used to assess the segments has changed over time as well as the Classifications of the waters. Considerable judgement was used in formulating the report cards. The use of broad verbal categories such as “good”, “fair” and “poor” water quality and “slight”, “moderate” and “severe” impacts is intentional and meant to envelop all the above considerations and sources for error. These same terms were often used in the source material to describe the river and the levels of pollution and therefore adds credibility to the judgements used in the report cards.

The report cards are aimed at showing the relative change in water quality over time, and for this purpose they are quite demonstrative.

Early Water Quality History

The Nashua River watershed was once settled by the Nashaway Indians members of the Algonquin Tribe. One commonly accepted translation for their name for the river is “the river with the beautiful pebbled bottom”. They harvested plentiful salmon and alewives from the river. The area was subsequently settled and cleared by Massachusetts Bay colonists for farming and raising livestock.

During the 19th century the watershed experienced extensive industrial development including grist mills, textile mills and paper manufacturing mills. It seems water quality at this time met the fishable/swimmable goal according to a nineteenth century account from the history of the Town of Lancaster: “Some value the river for its enriching qualities, and some for its abundant water power, and some because they can idle away their time catching pout and pickerel. There are some also who delight in it as “a thing of beauty” and a “joy forever”. They love to wander on its banks, to plunge into its depths and float upon its surface. They return again and again to gaze on its flow when its shimmers in the sun, or is mottled by the raindrops, or ruffled by the breeze”.

Unfortunately, the increased industrial development profoundly impacted the river. Paper manufacturing became the leading industry in the basin and numerous dams were built along the river and its tributaries to create storage impoundments for industrial process and cooling water and hydroelectric power. The paper mills discharged untreated process wastes to the river that coated the bottom with paper sludge. The use of dyes in the Fitchburg Mills made the river notorious for changing color downstream in accord with the color of paper being manufactured that day.

The City of Fitchburg installed one of the first wastewater treatment plants in the United States (1915). The plant provided secondary treatment- a degree of treatment rare at that time. In 1932 the City of Leominster installed an activated sludge treatment plant for its municipal wastes. But the industries did little or nothing to treat their discharges, largely negating the attempts by Fitchburg and Leominster to improve water quality. These two towns have combined sewer systems, a type that is purposely designed to overflow to the river during heavy rainfall, further exacerbating pollution problems. The severity of this pollution gave the river the dubious distinction of being the most polluted stream in Massachusetts.

By the 1970's The Division of Water Pollution Control listed 40 municipal and industrial discharges to the river and its tributaries. There were also numerous potential nonpoint sources of pollution such as urban storm water from Fitchburg, Leominster, Clinton and Ayer, agricultural runoff (apple orchards), malfunctioning on-site disposal systems as well as landfills and open dumps near the river banks. However nonpoint source pollution was largely masked by the much more prominent point sources of pollution.

The following is a ranking of the most significant pollutant loads to the river in the early 1970's:

Rank	Waste Load	Receiving Water
1	Fitchburg Paper Mills	North Branch
2	Fitchburg Wastewater Treatment Plant	North Branch
3.	Leominster Wastewater Treatment Plant	North Branch
4.	Clinton Wastewater Treatment Plant	South Branch
5.	Ayer Wastewater Treatment Plant	Main Stem

- | | | |
|----|----------------------------|--------------|
| 6. | Fitchburg Combined Sewers | North Branch |
| 7. | Pepperell Paper Mills | Main Stem |
| 8. | Leominster Combined Sewers | North Branch |

As can be seen, by the 1970's municipal treatment plants contributed high levels of pollution to the river. These treatment plants were antiquated and overloaded and provided inadequate treatment of municipal wastewater.

The North Branch of the Nashua is punctuated by eleven dams. Dams can increase water temperature, increase sedimentation of sludge, decrease oxygen levels and, in some cases, stimulate eutrophication. The South Branch has two dams. The Wachusett Reservoir Dam is the largest in the watershed and has been implicated in contributing to water quality problems due to the meager minimum release of water. The main Stem has two dams; the Ayer Ice Company Dam and the Pepperell Pond Dam. The Pepperell Pond impoundment is long (over 4 river miles) and shallow. River velocities slow in this segment and pollutants settle to the bottom and time is afforded for biochemical reactions.

Water Quality in the Early 1970's

Figure _ shows the Report Card for water quality in the Nashua River in the early 1970's. The information for this report card comes primarily from a water quality survey conducted by Massachusetts Division of Water Pollution Control 1973 and its Management Plan from 1975. It also draws from a 1975 Management Plan by Camp, Dresser and McKee Inc., prepared for New England Interstate Water Pollution Control Commission.

The water quality in the early 1970's serves as a picture before major cleanup efforts were initiated by state and federal programs. Municipal treatment plants in Fitchburg, Leominster, Clinton and Ayer were present, but they were antiquated and ineffective. Industrial pollution was largely unabated.

The report card shows that the Nashua River in the early 1970's was biologically dead. Fish could not live in the river. Dissolved oxygen, necessary for the survival of aquatic life, was depleted by oxygen demanding paper waste and sewage. Aquatic habitat was destroyed by the coating of the

river bottom with paper sludge and in the water column with turbidity. Even if fish could survive in the water column they would not be able to lay eggs and propagate in this degraded habitat. Domestic wastewater added levels of ammonia to the water column that were toxic to fish.

The most severe pollution was to the North Branch from the paper mills, municipal systems, and combined sewer overflows. The South Branch also had similar, but not quite as severe, water quality problems. Industrial cooling water discharges on the North and South Branches contributed to high instream water temperature; unsuitable for fish survival. Together the North and South Branches combined to pollute the Main Stem. The Main Stem shows signs of recovery along its length as the river's natural processes attempted to clean the river, only to be insulted again below Pepperell Pond by more paper mill wastewater.

Recreational uses on the river fared no better than the aquatic life. Bacteria from urban runoff and combined sewer overflows on the North Branch combined with dyes, turbidity, odors and paper sludge repelled people from the river. The South Branch contributed to bacterial problems because the Clinton Treatment Plant did not practice chlorination at the time. Together, the North and South Branches, again, combined to pollute the Main Stem with effects lingering through Pepperell Pond. Below Pepperell Pond more discharges of paper mill wastewater and malfunctioning onsite private septic systems contributed to more degraded conditions.

Compared with the Nashua River, the Squannacook and Nissitissit Rivers were relatively pristine. There were slight excursions from the stringent dissolved oxygen and temperature criteria for cold water fisheries and occasional elevated bacteria levels from faulty onsite septic systems. A paper company downstream on the Squannacook River provided generally good treatment for its wastewater but occasionally contributed to some slight turbidity. These rivers were considered fishable and swimmable in stark contrast to the rest of the assessed waters.

Water Quality in the Early 1980's

In 1975 the City of Fitchburg completed construction of two new wastewater treatment plants. The Westerly Plant was designed primarily to process paper manufacturing waste. The Easterly Plant

was designed to treat domestic wastewater at an advanced level that included both phosphorus removal and nitrification (ammonia removal). Leominster was rebuilding its treatment facility at the turn of the decade to increase its capacity and add phosphorus removal. Pepperell was also constructing a modern facility. Clinton and Ayer were planning upgrades to their facilities.

The upgrades of the Fitchburg treatment facilities made a huge difference in pollution loads to the North River. DWPC estimated that total suspended solids were decreased by 90% and oxygen demanding wastes were decreased by 50%. Bottom deposits of sludge were replaced by slime and pollution tolerant insects. The river's habitat was recovering but still not up to water quality goals. The dissolved oxygen levels began to recover in the lower portion of the North Branch but were again depressed when it joined the South Branch. They then recovered in Pepperell Pond and remained good in the lower portion of the river. Temperature problems in the river were largely eliminated.

Recreational uses of the river remained impaired. Urban runoff and combined sewer overflows kept bacterial levels high on the North Branch. In the South Branch bacterial levels remained high until the Clinton Treatment Plant added chlorination to its treatment process. Start-up problems with this upgrade, however, contributed to toxicity problems in the river. The removal of sludge in the North Branch reduced aesthetic nuisance conditions considerably. The North Branch recovered considerably in its lower segment and even the turbidity from South Branch did not quell the recovery. Aesthetic problems are less severe in the Main Stem. However, as Pepperell Pond recovers from one type of pollution it becomes susceptible to another. The abundance of nutrients compiled in the sediments contributed to severe eutrophication of the pond. Nuisance vegetation, such as duckweed, covered the surface of the impoundment, impairing recreational uses.

In the Squannacook River, nutrients in the lower part of the river created some slight aesthetic issues. Faulty septic systems continue to be an issue. The Nissitissit River is referred to by DWPC in 1977 as one of the cleanest rivers in the state. Minor temperature and bacteria excursions form criteria are noted in the survey data.

In the Nashua River Watershed, the recovery from the 1970's is evident. Two segments, the South Branch above Clinton and the Main Stem below Pepperell Pond, are largely fishable and approaching swimmable. The rest of the river is still not fishable/swimmable but improvements are evident. The total weighted severity points for the system dropped from 1027.9 to 808.4; an over 20% improvement. The appearance of more green areas on the report card shows that most of these improvements were to the aquatic life use.

Water Quality in the Mid 1990's

The information for this report card comes from a comprehensive survey conducted in 1978 by the Massachusetts Division of Watershed Management, the Massachusetts Water Resources Authority, the Nashua River Watershed Association and the U.S Environmental Protection Agency.

In the South Branch, urban runoff causes slight problems above the Clinton treatment plant but problems below the plant persist because of lack of instream dilution and high nutrient loadings from the facility. Recreational uses continue to be impaired by urban runoff. Remarkably the North Branch, once the most polluted system in the Nashua Watershed, now has recovered to pollution levels equal to or below other portions of the river. This can be seen by examining the total severity points in the various segments. Above Leominster the Two Fitchburg Facilities have drastically reduced pollution in the river but the combined sewer overflow problems have not been addressed. The aquatic life is impacted by apparent instream toxicity; perhaps from a legacy of pollutants trapped in the sediments. Recreational uses are impaired by the bacteria, turbidity and odors from the combined sewer overflows. Below Leominster, nutrients from the treatment facility and continued impacts by combined sewers impair uses.

In the main stem of the river carry over pollution from the North and South Branches and high nutrient levels from the Ayer treatment facility contribute to water quality problems above Pepperell Pond. Within the pond recycling of nutrients creates a highly eutrophic condition with the water becoming choked with nuisance vegetation. This, in turn, lowered benthic dissolved oxygen and adversely affected aquatic life. Very poor aesthetic conditions adversely affected recreation. In terms of total severity points Pepperell Pond now becomes the most polluted segment of the river. Below

Pepperell Pond carryover pollution from the pond and rapid flow fluctuations from the hydropower operation are sources of problems but these are characterized as slight.

Both the Nissitissit and the Squannacook Rivers have slight temperature and pH perturbations causing slight impacts to aquatic life. The water quality problems of the Nashua River are shifting from the impacts from paper companies and municipal wastewater on the North Branch to the impacts of CSO's on the North Branch. CSO's were once ranked sixth most important source of pollution. These impacts carry over to the main stem of the river. Nutrients remain high through most of the watershed due to inadequate removal at municipal facilities and from the CSO's. The focus of abatement actions in the watershed is shifting from the North Branch to the Clinton facility and to Pepperell Pond. The weighted severity points for the watershed show an approximate 50 % reduction in pollution from the early 1970's; a remarkable achievement.

Water Quality in the Early 2000's

The information for this report card comes primarily from the Massachusetts Department of Environmental Protection' 2003 Assessment Report or the Nashua River Watershed.

The South Branch above the Clinton wastewater facility was assessed as fishable/swimmable although there are some lingering concerns about flow releases from Wachusett Reservoir. Below the facility phosphorus concentrations are still high due to the discharge and there are slight impacts to recreational uses from urban runoff.

In the North Branch evidence of instream toxicity persists in the segment above Leominster, impairing aquatic life. Recreational uses suffer from the continued discharge of combined sewer overflows. Below Leominster nutrients levels are high due to municipal wastewater discharges and aesthetic concerns are derived from odors from CSO's. The severity points show that the pollution level on the North Branch is about a third of the level of the early 1970's.

In the Main Stem of the river nutrient levels remain high due to carry over from upstream sources and recycling from the sediments in Pepperell Pond. The adverse effect of these nutrients are largely shown in Pepperell Pond in the form of massive blooms of nuisance and nonnative vegetation. This

condition impairs both the aquatic life and recreational uses of the waterbody. Pepperell Pond continues to be the focus of pollution issues in the river with other sections of the Main Stem generally reaching fishable/swimmable status.

The most recent fish sampling both the Squannacook and Nissitissit Rivers displayed a lack of cold water species. This is disturbing for these rivers are thought to be relatively pristine. Water quality monitoring revealed higher than desired temperatures for cold water populations. The source of this impairment is unknown and suspected sources include, dams, beaver activity or climate change.

The South Branch, North Branch and Main Stem of the Nashua River have undergone an approximate 70% reduction in pollution levels during the period of the early 1970's to the early 2000's - as demonstrated by the weighted score on the report cards. This dramatic reduction was largely brought about by the treatment of industrial and municipal wastewater mandated by the NPDES permit program. The problems that persist are largely due to high phosphorus levels and untreated CSO's. The phosphorus levels are from several municipal wastewater sources but adverse effects are largely exerted in Pepperell Pond. The CSO's are on the North Branch but effects carry over to the Main Stem.

APPENDIX B - Special Designations in the Nashua River Watershed

by Warren Kimball

Outstanding Resource Waters (ORW's)

Outstanding Resource Waters are designated in the Massachusetts Surface Water Quality Standards [314 CMR 4.04(3)]. These waters are determined by the Massachusetts Department of Environmental Protection based on their outstanding socio-economic, recreational, ecological and/or aesthetic values. These are waters whose high quality will be protected and maintained. With minor exceptions new or increased discharges of pollutants are prohibited to these waters assuring that existing high water quality is preserved. In the Nashua River Watershed all public surface water supplies and their tributaries are designated as ORW's. In addition waters designated in the Squannacook and Nissitissit Rivers Sanctuary are designated as ORW's.

Coldwater Fisheries Resources (CFR's)

A Coldwater Fisheries Resource is a body of water that is used by coldwater fish species to fulfill one or more of their life history requirements. These species include trout and slimy sculpin, among others. These fish require cold, well oxygenated water and suitable habitat for spawning, feeding and refuges. These requirements make these habitats particularly sensitive to alterations or pollution. Changes in land and water use can reduce the ability of these waters to support coldwater fish. The Massachusetts Division of Fisheries and Wildlife identifies CFR's and maintains a list that is updated annually. Coldwater Fisheries are also designated in the Massachusetts Surface Water Quality Standards and are given more stringent Temperature and Dissolved Oxygen criteria than other inland waters. However, these regulations are updated less frequently and do not reflect the most recent information available from Fish and Wildlife. There are 90 CFR's in the Nashua River watershed but many are unnamed streams. It is a reasonable assumption that when a named waterbody is identified as a CFR, that its unnamed tributaries are also CFR's.

Areas of Critical Environmental Concern (ACEC's)

Areas of Critical Environmental Concern are designated by the Massachusetts Executive Office of Environmental Affairs pursuant to 301 CMR 12.00. ACEC's are those areas within the Commonwealth where unique clusters of natural and human resource values exist and which are worthy of a high level of concern and protection. The aim is to preserve and restore these areas and all EOEAs are directed to take actions with this in mind. Three ACEC's exist in the Nashua

River Watershed. The Squannassit ACEC includes over 37 thousand acres on the west side of the Nashua River in Ashby, Ayer, Groton, Harvard, Lancaster, Lunenburg, Pepperell, Shirley and Townsend. The Petapawag ACEC includes over 25 thousand acres in Ayer, Dunstable, Groton, Pepperell and Tyngsborough on the east side of the Nashua River. The Central Nashua River valley ACEC contains nearly 13 thousand acres in Bolton, Harvard, Lancaster and Leominster. Although designated separately it is important state that the Nashua River corridor is a central feature of all three ACEC's.

The Squannacook and Nissitissit Rivers Sanctuary

The Massachusetts General Laws Chapter 132A, Section 17 establishes the Squannacook and Nissitissit Rivers Sanctuary (SNRS). The sanctuary comprises the surface waters of both rivers and their tributaries. A small section of the Squannacook River is excluded: from the Hollingsworth and Vose Dam to the confluence with the Nashua River. In these waters no new discharge of treated or untreated sewage or other wastewater is permitted. Storm water discharges and conveyances must be approved by the planning board and conservation commissions of the affected towns. The Attorney General has the authority to enforce these rules. This sanctuary was subsequently designated as an ORW in the Surface Water Quality Standards underscoring the desire to preserve these waters.

APPENDIX C - List of Canoe Launches by Town

Directions and descriptions of these launch sites can be found in the NRWA Canoe and Kayak Guide. View launch locations and directions on Google map. [[hyperlink to google map](#)]

Massachusetts

Devens

On the Nashua River

Hospital Road/Oxbow National Wildlife Refuge Launch

Groton

On the Nashua River

Nashoba Paddler Private Launch

Petapawag Boat Launch

On the Squannacook River

West Groton Water Dept. Launch

Harvard

On the Nashua River

Still River Depot Road/ Oxbow National Wildlife Refuge Launch

Lancaster

On the Nashua River

Rt. 117/Seven Bridge Road Launch

On the North Nashua River

North Main Street Launch

Pellechia Canoe Launch

Main Street Bridge/Rt. 70 Launch

Pepperell

On the Nashua River

Rt. 119 Car-top Only Launch

Kemp Conservation Area Launch (future status unclear as of 2016)

Canal Street Launch

Downstream of Pepperell Dam Launch

On the Nissitissit River

Prescott Street Bridge Launch

Shirley

On the Nashua River

Walker Road Upstream of Ayer Ice House Dam Launch

Walker Road Downstream of Ayer Ice House Dam Launch

Sterling

On the Stillwater River

Moore's Corner Launch

Townsend

On the Squannacook River

Stone Bridge/Canal Street Launch

Off Elm Street Launch

Harbor Pond Church (above Harbor Pond Dam) Launch

Rt. 119/Main Street (below Harbor Pond Dam) Launch

New Hampshire

Brookline

On the Nissitissit River

Bond Street Launch

Rt. 13/Fire Road Launch

South Main Street Bridge Launch

Hollis

On the Nashua River

Rt. 111/Depot Road at Runnells Bridge

On the Nissitissit River

West Hollis Road Launch

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Table 1
Nashua River Watershed
Water Use Classifications

Segment Number	Description	River Miles	Classification			Early 1970's Condition
			1967	1974	1978	
1	South Branch Outlet Lancaster Mill Pond, Clinton, to Clinton WWTF, Clinton	3.0	B B	B		U
2	Clinton WWTF to confluence with North Nashua River, Lancaster	1.6	C B	B1		U
3	North Branch Fitchburg Paper Co. Dam #1, Fitchburg to Leominster WWTF, Leominster	8.4	C B	C		U
4	Leominster WWTF to confluence with the Main Stem Nashua River, Lancaster	9.9	C B	C		U
5	Main Stem Nashua River Confluence of North and South Branches, Lancaster to Confluence with Squannacook River, Shirley/Groton	13.5	C B	B1		U
6	Confluence with Squannacook River to Pepperell Pond Dam, Pepperell	8.8	C B	B1		U
7	Pepperell Pond Dam to New Hampshire State Line	3.7	C B	B1		U
8	Squannacook River Entire length	14.3	B/C B	B/B1		B/C
9	Nissitissit River Massachusetts portion	4.5	B B	B		B

Table 2
Nashua River Report Card
Severity Point Criteria

Indicator	1 slightly impacted	2 impacted	3 severely impacted
I. Aquatic Life			
A. Biology Invertebrates	Diversity-medium Density-low/medium 54-79% reference	Diversity-low Density-medium/high 21-50% reference	Diversity-low/absent Density-high/absent 17% reference
B. Chemistry Baseline Dissolved Oxygen minimum daily average Temperature maximum weekly average pH standard units	< 5.0 mg/l < 75% saturation > 80.6°F >75 °F 6.0-6.5 or 8.0-8.5	< 3.0 mg/l < 5.0 mg/l >83°F >77°F 5.5-6.0 or 8.5-9.0	< 2.0 mg/l > 90 °F < 5.5 > 9.0
Nutrients Total Phosphate-P	> 0.05 mg/l	> 0.10 mg/l	> 0.20 mg/l
Toxics Ammonia-N	> 0.5 mg/l	> 1.0 mg/l	> 2.0 mg/l
Sediments	> threshold effects	> probable effects	> 2 x probable effects
C. Hydrology	Criteria not available-BPJ		
D. Habitat Suspended Solids Sludge Deposits	> 10 mg/l rare	> 25 mg/l occasional	> 80 mg/l common
II. Recreation			
A. Bacteria (Geometric mean) Total Coliform Fecal Coliform E. coli	> 1000/100 ml > 200/100 ml > 126/100 ml	> 5,000/100 ml > 1000/100 ml > 630/100 ml	> 10,000/100ml > 2,000/100ml > 1260/100 ml
B. Aesthetics Color/odor/turbidity Nuisance conditions	rare	occasional	common
C. Fish Flesh	Limited Advisory	Full Advisory	Best Professional Judgment (BPJ)