2 WATER RESOURCES

This section provides an overview of water resources within the Town of Grantham including lakes, ponds, rivers, streams, and wetlands. Vernal pools, which have not been inventoried, are discussed as is the presence of aquifers and floodplains. These resources provide critical functions—wildlife habitat, flood storage, water supplies, recreation, and aesthetic values—that contribute to the rural character that defines Grantham.

Area/length measurements for water features are derived from GIS data based on standard 7.5-minute USGS quadrangles at 1:24,000 scale; digitized and distributed by Complex Systems Research Center (GRANIT: www.granit.sr.unh.edu)

2.1 WATERSHEDS

A watershed is the land that water flows across or through on its way to a common stream, river, or lake. The United States is divided and sub-divided into successively smaller watersheds, or hydrologic units. Each hydrologic unit is identified by a unique hydrologic unit code (HUC) based on the level of classification. A HUC 2 watershed covers the largest region and a HUC 12 is the smallest:

- HUC 2 = region;
- HUC 4 = subregion;
- HUC 6 = accounting unit;
- HUC 8 = cataloging unit;
- HUC 10 = watershed;
- And HUC 12 = subwatershed.

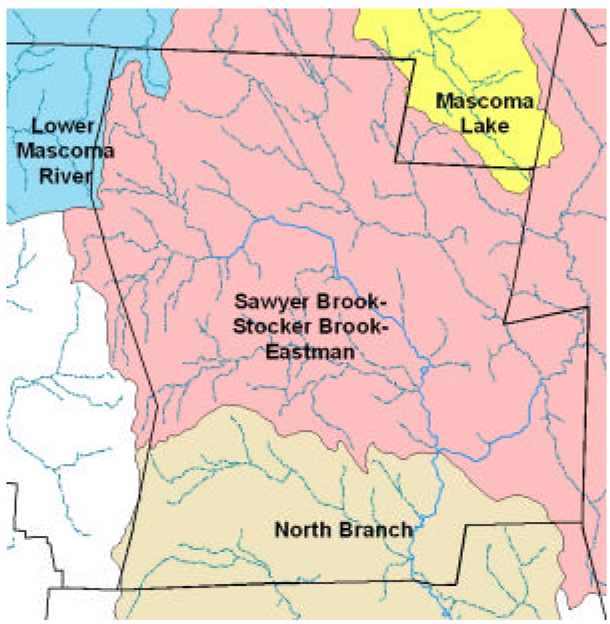

Figure 2-1 Sub watersheds.

The Town of Grantham lies completely within the HUC 6 Upper Connecticut River Watershed and mostly within the HUC 10 Sugar River Watershed. Within the Sugar River Watershed, 13,168 acres lie in the HUC 12 Sawyer Brook-Stocker Brook-Eastman subwatershed, and 4,290 acres in the HUC 12 North Branch subwatershed. Only 316 acres (excluding any major water bodies) fall within the HUC 10 Mascoma River Watershed, including small areas of the HUC 12 Lower Mascoma River and Mascoma Lake subwatersheds (Figure 2-1).

2.2 SURFACE WATERS

New Hampshire is fortunate to have an abundance of fresh water. Our fresh water resources provide drinking water supplies, recreation, economic resources, and wildlife habitat. Characteristic of the New Hampshire landscape, Grantham is interlaced with streams and brooks and mottled with small ponds and lakes. See Figure 2-2 (Appendix A) for identification and location of the surface waters discussed below.

The New Hampshire Comprehensive Shoreland Protection Act (CSPA), RSA 483-B, was first enacted on July 1, 1994 to protect shorelines by establishing a two-hundred, fifty foot protective buffer on all public waters. Public waters are defined in the CSPA as natural water bodies and artificial impoundments of ten acres or more in size and all rivers determined to be fourth order or higher. Currently, the town applies the CSPA rules, as dictated by the State, to its Shore Land and River Overlay District.

As of July 1, 2008, the CSPA implemented rules limiting impervious surface to no more than 20% of coverage within the two-hundred, fifty foot protected shoreline buffer. Studies have shown, however, that stream quality decreases when impervious surfaces reach just 10% (Kahl, 2007 and Magee, 2008). Impervious surface, as defined in the CSPA, "means any modified surface that cannot effectively absorb or infiltrate water," such as roofs, decks, parking or driveway areas, and walkways.

Lawn is not considered impervious in the CSPA (it is considered to be "altered"). Though lawns are more pervious than paved or other hard surfaces, such as roofs or paved roads, they often have similarities with impervious surfaces because of soil compaction. Compacted soils have a decreased ability to infiltrate water resulting in greater runoff and a higher input of fertilizers and pesticides. A pound of soil in a lawn has 24% less volume than forest soil and 15% less volume than pasture soils (Markham, 2003). A USGS study found that a lawn contributes up to seven times more phosphorus and ten times more nitrogen than a comparable area of forest (Markham, 2003). At this time there are no proposed amendments to the CSPA that would redefine impervious layers to include lawns.

Land Use Planning Techniques: A Handbook for Sustainable Development, from the New Hampshire Regional Environmental Planning Program (REPP), provides model ordinances and regulations on a number of innovative land use techniques including shoreland protection. This guide provides examples for extending the CSPA to water bodies not currently regulated and/or adopting more stringent regulations than the minimum CSPA rules. The Handbook may be found at http://des.nh.gov/organization/divisions/water/wmb/repp/innovative_land_use.htm.

According to CSPA rules, lots developed prior to July 1, 2008 are grandfathered and not required to meet current CSPA rules regarding impervious surface area. To protect the town's water resources, Grantham may consider requiring all lots to meet current standards at the time of sale (idea suggested by Kahl, 2007).

2.2.1 LAKES AND PONDS

RSA 233-A requires that the NHFGD provide public boat access to all public bodies of water. Public waters are defined as great ponds (natural water bodies of ten acres or more in size) and, in the boat access law, include artificial impoundments of ten acres or more in size. The New Hampshire Department of Environmental Services (NHDES) maintains a list of all public waters (http://www.des.state.nh.us/Dam/public_waters.htm). Public waters in Grantham include Anderson, Butternut, Leavitt, Miller, Stocker and Eastman Ponds. By law, each of these water bodies should have public boat access. Table 2-1 lists the named ponds and lakes in Grantham and public access, if available.

Table 2-1 Named ponds and lakes in Grantham.

Water Body	Size (Acres)	Public Access
Eastman Pond	319	Public Boat Ramp
Stocker Pond	63	None
Butternut Pond	44	Enfield WMA
Miller Pond	31	Grantham Town Forest
Chase Pond	23	Grantham Town Forest
Leavitt Pond	18	None
Anderson Pond	15	None
Walker Pond	9	None
Hog Box	6	None
Lily Pond	5	Grantham Town Forest

2.2.1.1 Eastman Pond

Eastman Pond is the largest body of water in Grantham. At the Center of the Eastman Community, Eastman Pond and its watershed is considerably developed. The Eastman Community Association covenants and bylaws, in addition to requiring lakefront property owners to abide by current CSPA requirements, prohibits dock construction on the lake and removal of trees or other vegetation without review and authorization from the Eastman Environmental Committee. The Eastman Community also supports the Eastman Community Lakes and Streams Committee which oversees water quality monitoring for the Eastman Lake watershed, promotes lakes and streams education and environmental stewardship, and sponsors the Lake Host and Voluntary Lake Assessment Programs. Concurrent to this study, The Upper Valley Lake Sunapee Regional Planning Commission is completing an Eastman Pond Watershed Management Plan. This watershed plan will include an inventory of lake features and an assessment of lake and watershed values in an effort to balance the protection of the watershed ecosystem with socio-economic uses.

Eastman Pond's water quality has improved in the last twenty years. In 1987, the lake was eutrophic, characterized by nutrient-rich water with an abundance of algae and low dissolved oxygen. By 1999, a lake survey by NHDES found a reduction in nutrients and an increase in oxygen levels. Phosphorus levels and chlorophyll-a concentrations have been declining and are at reasonable levels. However, conductivity levels remain high and spikes have been documented in phosphorus concentrations indicating "cultural disturbance" or non-point source pollution (see Section 7.6). Likely causes include lawn care, road salt, septic system failure, erosion, and other runoff into tributary streams or directly into the lake. A forested/natural vegetation buffer exists on a majority of the lakefront and along streams in the watershed but with steep terrain, runoff is a serious issue (Ruppel, 2009).

Eastman Pond

2.2.2 RIVERWAYS AND RIPARIAN CORRIDORS

A number of brooks and tributaries flow through the Town of Grantham (Table 2-2). The CSPA has jurisdiction over all streams fourth-order or higher. As of July 1, 2008, the order of a stream is determined using the New Hampshire hydrography dataset as developed by Complex Systems Research Center (GRANIT) in collaboration with NHDES. Sections of Skinner and Sawyer Brooks, not previously covered by CSPA, are now protected as fourth order streams. Stocker Brook and North Branch Sugar River are also protected under the jurisdiction of the CSPA.

Table 2-2 Named Streams in Grantham

Stream Name	Length Within the Town of Grantham (Miles)	Stream Order
Streams of Third-order or Less		
Ash Swamp Brook	1.4	1,2
Bog Brook	1.4	3
Butternut Brook	1.5	2, 3
Colcord Brook	0.1	2
Eastman Brook	1.5	3
Little Brook	0.2	1
Littlefield Brook	4.0	1,2
Sawyer Brook	3.8	1,2,3
Skinner Brook	1.6	1,2,3
Stone Brook	1.4	1
Stoney Brook	3.2	1,2,3
Stroing Brook	1.3	1,2
Walker Brook	1.0	1
Streams of Fourth-order or Greater		
Stocker Brook, entire reach	2.0	4
Skinner Brook, from the confluence of Skinner Brook and the Miller Pond outlet to the confluence with Sawyer Brook	4.3	4
Sawyer Brook, from the confluence of Skinner and Sawyer Brooks to the confluence of the Sugar River	.9	4
North Branch Sugar River, entire reach	2.1	5

In New Hampshire, stream order is based on the most commonly used classification system of stream/tributary relationships: Strahler's stream ordering system (Strahler, 1952). The uppermost tributaries in any drainage network are designated as first-order streams down to their first confluence. Where two first-order streams meet, a second-order stream is formed and so on. The intersection of a stream with another tributary of lower order does not raise the order of the stream below the intersection (e.g., a fourth-order stream intersecting with a second-order stream is still a fourth-order stream below the intersection). Figure 2-3 demonstrates how the Strahler method works using Sawyer Brook in Grantham as an example.

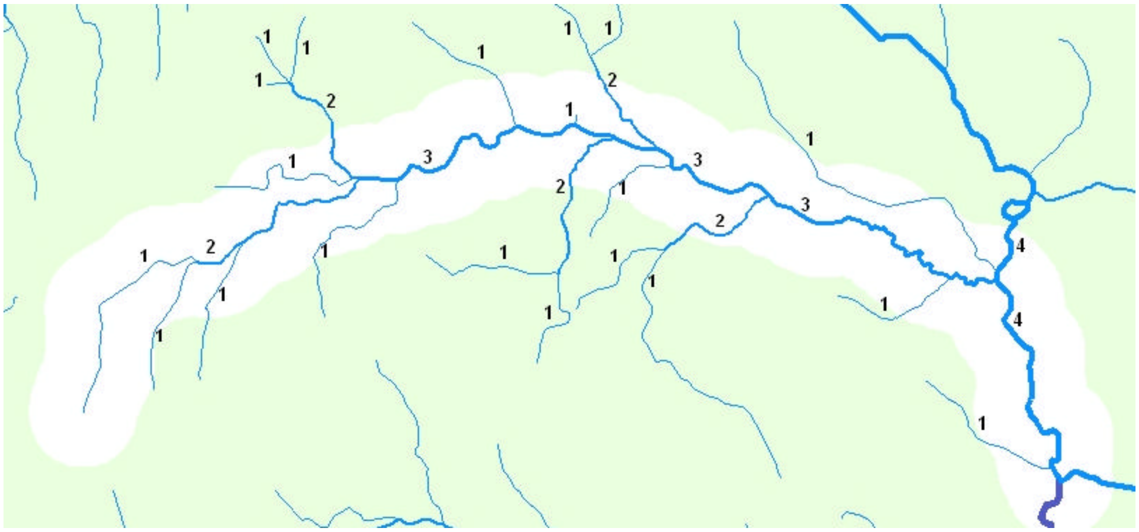

Figure 2-3 The Strahler stream ordering system is demonstrated on Sawyer Brook in Grantham; starting as a first-order stream, Sawyer Brook is joined by several tributaries until it eventually becomes a fourth-order stream before ending at the Sugar River.

Riparian corridor along the Sugar River.

The riparian corridor, the corridor along a river or stream, (Figure 5-2, Appendix A) is among the most valuable and fragile of our natural resources (Naiman et al. 1993). The diversity of habitat, species, and ecological processes in this vegetated area between the water body edge and the upland is unparalleled in any other ecosystem. The many different variables, including but not limited to flood regime, substrate, altitudinal climate differences, and adjacent upland result in an incredible species richness and life history strategies of plant, invertebrate, and vertebrate species. Roughly 70% of all vertebrate species may use riparian corridors in some significant way during their life cycle (Naiman et al. 1993) for breeding, foraging, hunting, travel corridors, etc.

First-order streams provide habitat, migration corridors, and forage opportunities for fish, insects and other wildlife species (NHFGD, 2008) and are crucial to the survival of brook trout (see Section 5.3.1). Recognition of riparian corridors as a significant landscape component is essential to effective landscape planning. The ecological integrity of these resources is threatened by development, transportation infrastructure, and dams (see Section 7). Consideration should be given to providing protection to third-order and lower streams not currently covered by the CSPA. The Connecticut River Joint Commissions offers community guidance for the protection of riparian buffers at http://www.crjc.org/riparianbuffers.htm and the REPP guide, *Land Use Planning Techniques,* includes riparian corridors in its chapter on shore land protection.

2.2.3 WETLANDS

Wetlands are defined as, "Those areas that are inundated or saturated by surface or ground water at a frequency and duration to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils. Wetlands generally include swamps, marshes, bogs, and similar areas" (Tiner, 1999). The value of a wetland, however small and insignificant it might look, should never be underestimated. Wetlands are among the most important and diverse habitats for wildlife. They provide recreation, educational or scientific value, and aesthetic worth. Perhaps less obvious to some, wetlands function as storage for floodwaters, provide sediment and nutrient retention services, act as groundwater recharge or discharge systems, and stabilize shorelines of open water bodies.

Wetlands shown in Figure 2-2 (Appendix A) are from the USGS National Wetland Inventory (NWI). These wetlands were mapped using aerial photography from various dates, at 1:24,000 scale. Based on current NWI data, there are approximately 1,210 acres of wetlands in Grantham representing about 7% of the total land mass. It is generally understood, however, that although an excellent reference, the NWI maps underestimate the number and size of existing wetlands, particularly forested wetlands (Van de Poll, 2005) (see Section 3.3 for further discussion). NWI maps should not be considered a complete inventory of wetlands.

The zoning ordinance in Grantham currently prohibits the inclusion of wetland soils in minimum lot sizes and bans septic systems within seventy-five feet of a wetland. Due to development pressures, additional wetland protection efforts are recommended. The town should begin by moving forward with a comprehensive wetland inventory with the eventual goal of designating prime wetlands. All projects that are in or adjacent to, a designated prime wetland are classified as a major project in the wetland permitting process. NH RSA 482-A: 15 and Chapter Env-Wt 700 provide criteria for the selection of prime wetlands. Typically, a natural resources consultant using the *Method for Comparative Evaluation of Nontidal Wetlands in New Hampshire* (1991) is hired to complete the inventory.

It is worth mentioning that the wetland complex associated with Bog Brook is potentially the most important wildlife area within the Town of Grantham, and is certainly the most important wetland area. South of McDaniel's Marsh where it begins, this wetland complex is partially protected in Springfield through a conservation easement by the

Eastman Village District. The complex snakes south through Grantham, where it empties into Stocker Pond. Evidenced by the high incidence of moose/vehicle collisions in the Stocker Pond area (Dakai, 2008) where I-89 fragments the wetland, the Bog Brook complex may be an important wildlife travel corridor for some species. These wetlands are also an important groundwater recharge/discharge system for the aquifer that lies beneath it. Regional cooperation with the Town of Springfield in recognizing the importance of this wetland complex to the landscape, and partnering in an effort to protect it, would be an exceptional accomplishment. The Bog Brook wetland complex is discussed in more detain in Section 5.4.3.1.

Bog Brook Wetland Complex

REPP's *Land Use Planning Techniques: A Handbook for Sustainable Development*, as mentioned above includes a chapter on wetland protection.

2.2.4 VERNAL POOLS

Vernal pools are valuable habitat for a wide range of species. Some animals, such as fairy shrimp, carry out their entire life cycle in one pool and other species, such as wood frogs or spotted salamanders, use vernal pools as critical breeding sites. Because vernal pools rarely hold water year round, they provide a unique habitat unable to support predatory fish, and thus provide a safer breeding ground for those animals known as "vernal pool species." In addition, vernal pools provide watering holes or feeding grounds for birds, snakes, turtles and some mammals. Bears often use vernal pools to cool off on a hot day and turtles may use them for hibernacula. While vernal pools provide vital habitat for local plants and animals, they are also important features in the landscape because groups of pools form stepping stones of hospitable habitat for wildlife that are dependent on wetlands to travel.

The New Hampshire Wildlife Action Plan lists vernal pool habitat in the highest risk category. Because vernal pools are easily overlooked due to size and seasonality, and because they historically received weaker regulatory oversight than larger permanent wetlands, they have been more likely to be filled during development. Vernal pools have not been adequately mapped, thus it is not known how many have been lost. Significant loss of vernal pool habitat can result in local extirpation of the obligate vernal pool species listed in Table 2-3.

Until recently, there had been no legal protection for vernal pools against fill and dredge activities. But, effective April 19, 2008, New Hampshire enacted administrative rule, Env-Wt 101.99 giving NHDES wetlands jurisdiction over vernal pools. In the rules, vernal pools are defined as:

> A surface water or wetland, including an area intentionally created for purposes of compensatory mitigation, which provides breeding habitat for amphibians and invertebrates that have adapted to the unique environments provided by such pools and which:

(a) Is not the result of on-going anthropogenic activities that are not intended to provide compensatory mitigation, including but not limited to:
  - (1) Gravel pit operations in a pit that has been mined at least every other year; and
  - (2) Logging and agricultural operations conducted in accordance with all applicable New Hampshire statutes and rules; and

(b) Typically has the following characteristics:
  - (1) Cycles annually from flooded to dry conditions, although the hydroperiod, size, and shape of the pool might vary from year to year;
  - (2) Forms in a shallow depression or basin;
  - (3) Has no permanently flowing outlet;
  - (4) Holds water for at least 2 continuous months following spring ice-out;
  - (5) Lacks a viable fish population; and
  - (6) Supports one or more primary vernal pool indicators or 3 or more secondary vernal pool indicators (as listed in Table 2-3).

Table 2-3 Vernal Pool Indicator Species

Common Name	**Scientific Name**
Primary	
wood frog	*Lithobates sylvaticus*
spotted salamander	*Ambystoma maculatum*
Jefferson/blue-spotted salamander complex	*Ambystoma sp.*
marbled salamander	*Ambystoma opacum*
fairy shrimp	Order *Anostraca*
Secondary (include but not limited to)	
Caddisflies	*Limnephilidae, Phyrganeidae,* or *Polycentropodidae*
fingernail clams	*Sphaeriidae*
Clam shrimp	*Laevicaudata* or *Spinicaudata*
aquatic beetle larvae	*Dytiscidae, Gyrinidae, Haliplidae,* and *Hydrophilidae*
dragonfly larvae	*Aeshnidae* or *Libellulidae*
spire-shaped snails	*Physidae* or *Lymnaeidae*
flat-spire snails	*Planorbidae*
damselfly larvae	*Coenagrionidae* or *Lestidae*
true fly larvae and pupae	*Cuculidae, Chaoboridae,* and *Chironomidae*

The vernal pool rules cite the NHFGD publication, *Identification and Documentation of Vernal Pools in New Hampshire*, second edition as the reference for identifying vernal pools in New Hampshire. This publication is now available for free download on the NHFGD Reptile and Amphibian Reporting Program webpage at: http://www.wildlife.state.nh.us/Wildlife/Nongame/reptiles_amphibians.htm

The New Hampshire Joint Board of Licensure and Certification has not yet incorporated the identification of vernal pools into the New Hampshire Wetland Scientist certification process. Experience in the year-round identification of vernal pools should be taken into account when hiring a natural resources professional to complete a comprehensive wetland inventory.

2.3 AQUIFERS

In general terms, an aquifer refers to groundwater. Stratified drift and bedrock aquifers are the two most common types of aquifers in New Hampshire. Stratified drift aquifers are glacial meltwater deposits moving through loose layers of gravel and sand. Because the loose makeup of the materials allows for a larger capacity of water storage and flow, stratified drift aquifers are commonly used for public water supply wells. Bedrock aquifers are deposits of water moving between fractured bedrock and tend to be deeper and have a lower yield. Because of the pressure build-up of the water moving between the rocks, bedrock aquifers are the source of artesian wells.

The threat of groundwater contamination, especially through nonpoint source pollution (see Section 7.6) is growing. Contaminants, such as pesticides or road runoff, have the potential to seep into the ground and pollute groundwater resources. Contaminated groundwater can take a few days or a few years to reach its discharge points, adding contaminated water to every well or spring it feeds. In contrast to surface water, groundwater does not continually dilute the contaminants. Cold temperatures, limited microbiological activity, lack of sunlight, and low oxygen levels slow or even stop the chemical breakdown of contaminants once they have passed through the root zone of the soil. Flushing contamination from groundwater may take many years.

As stated in the 2005 Town of Grantham Master Plan, there are two groundwater aquifers located in Grantham. The first follows the Bog Brook wetland complex and Stocker Pond; the second follows the North Branch Sugar River along Route 10. The area around Stocker Pond holds the highest yield potential. These stratified-drift aquifers represent the greatest potential groundwater source for the town, potentially providing fresh water sources for municipal purposes, and should be protected to ensure their future quality and availability. The town should take into consideration potential long term impacts to groundwater and use zoning or other measures to protect potential water supplies.

2.4 FLOODPLAINS

Floodplains hold excess water following substantial rain events. The floodplain slows the release of water into rivers or groundwater, mitigating flood damage and allowing time for sediment to settle out before reaching a water body. Moist soils in floodplains support a rich diversity of insects and amphibians which in turn provide prey for larger invertebrates. Floodplains may also provide a travel corridor for some species moving through the landscape.

The Stocker Pond/Bog Brook wetland complex retains the largest 100-year floodplain in Grantham. Other floodplains lie primarily in the Southeastern corner of town, along North Branch Sugar River, Stocker Brook, sections of Sawyer Brook and the southern tip of Skinner Brook. The section of Route 10 that runs south of I-89 along with Grantham's village center also lies within the floodplains. Grantham zoning ordinances currently control development within flood zone areas.

Officials in many areas are currently re-evaluating floodplain delineations in response to more intense precipitation events associated with climate change (Foss, 2009). Despite the recent acceptance of the county-wide digital flood insurance rate maps, Grantham may choose to look more closely at floodplain delineation within the town boundary or support re-evaluation on a regional scale.

2.5 SUMMARY OF RECOMMENDATIONS

- Complete a comprehensive wetland inventory to document all existing wetlands—including vernal pools—within town boundaries.
- Designate prime wetlands.
- Partner with the Town of Springfield to protect the Bog Brook wetland complex.
- Consider mandating that all lots meet current CSPA rules at time of sale.
- Review *Land Use Planning Techniques: A Handbook for Sustainable Development*, and consider extending CSPA rules to third order streams and less and/or adopting more stringent regulations.
- Establish protection for groundwater resources.
- Support re-evaluating floodplain delineations in response to climate change.