# Management Plan for
# Mink Brook Nature Preserve
## Hanover, New Hampshire

***2/18/2016***

HANOVER CONSERVANCY

*Protecting land & water in our community*

# Mink Brook Nature Preserve
## Hanover, New Hampshire

**Tax Map:** Map 19, Lot 32 **Current zoning:** Nature Preserve

**Location:** 11 Brook Road

**Size:** 111.5 acres

**Directions to the property:** From downtown Hanover, proceed south on Main Street to the junction of Brook Road. Turn left (east) and travel ¼ mile to the sharp bend in the road and the trailhead gate.

**Owner:** Hanover Conservancy, 16 Buck Road, Hanover NH 03755, (603) 643-3433, www.hanoverconservancy.org

**Previous owners:** Upper Valley Land Trust; Barrett and Ransmeier families

***This plan is an update of a plan adopted in 2009.***
**Current plan preparers**:
- Adair Mulligan, Executive Director, Hanover Conservancy
- Mink Brook Stewardship Committee of the Hanover Conservancy

**Date of acquisition**: 1999

**Deed Restrictions**: Held by the Upper Valley Land Trust

**Plan adopted**
- *Date* – by Mink Brook Stewardship Committee
- *January 20, 2016* – by Hanover Conservancy Stewardship Committee
- *[Date]* – by Upper Valley Land Trust

**Management Objectives**:
- Protect biological diversity and native plants and animals (both aquatic and terrestrial)
- Protect habitat integrity and the ecological processes which support it
- Provide the public with non-commercial access to the property for reflection, study, and low-impact recreational enjoyment
- Preserve an area of Native American cultural significance
- Protect water quality in Mink Brook

**Brief description of property use restrictions**:
- open to the public for foot travel only, except for wheelchair access on the Quinn Trail
- no bicycles
- no vehicles except by special permission
- no fires except as directed in this plan for vegetation management
- no disturbance of vegetation except as directed in this plan for vegetation management
- no hunting except by special permission
- no buildings or structures

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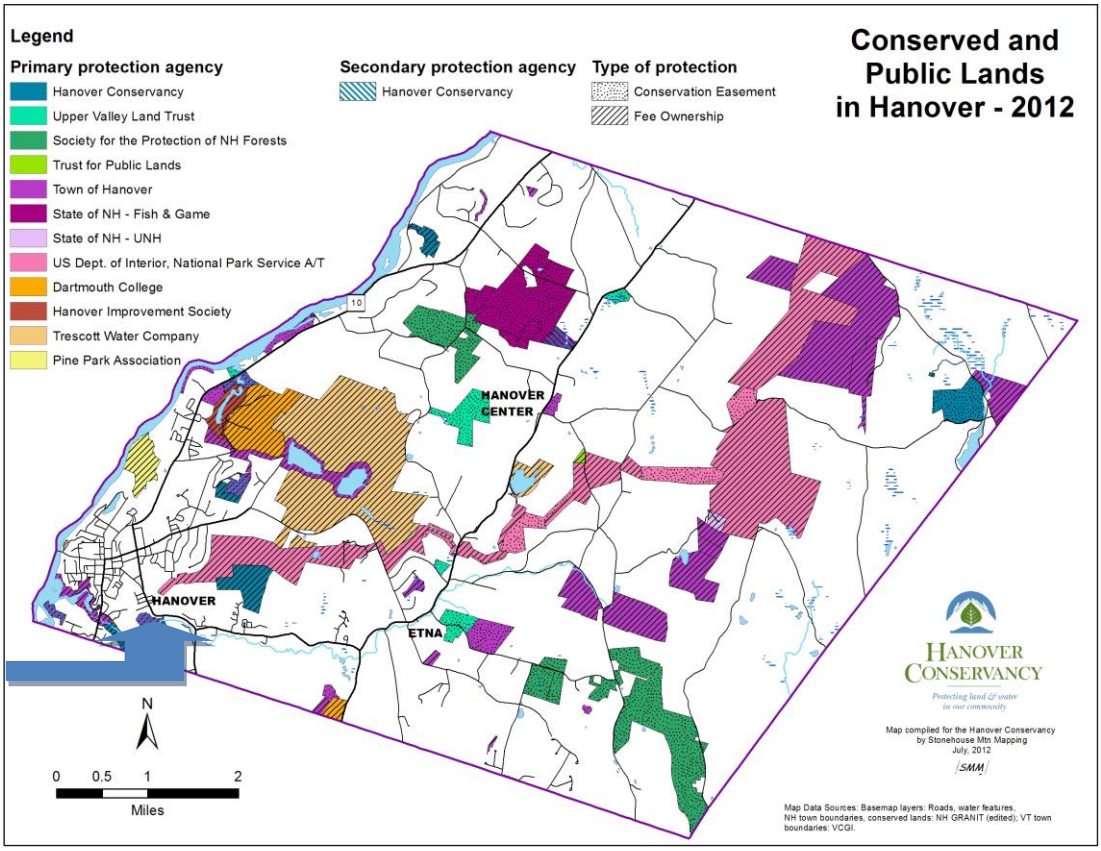
Mink Brook Nature Preserve




# I. Introduction

## A. The Mink Brook Nature Preserve

The Mink Brook Nature Preserve is located within easy walking distance of downtown Hanover, New Hampshire. The property's network of trails, leading through second-growth forests, follows the lower reach of Mink Brook, Hanover's largest stream, and a small tributary, Trout Brook. As overgrown former pasture surrounded by residential development and traversed by both a power line and a sewer line, the preserve cannot be considered a truly wild area, especially along the north side of the brook, but it is also not a cultivated, manicured park. The Preserve is a powerful example of grassroots conservation efforts and continues to inspire conservation in Hanover. Once slated to become a 30+ lot residential subdivision, the property was purchased in 1999 by the Upper Valley Land Trust (UVLT) in collaboration with the then Hanover Conservation Council. Major gifts from Dartmouth College and the Quinn Family, with 450 other donations, funded the purchase. UVLT subsequently deeded the property to the Council with conservation restrictions.

## B. The Mink Brook Stewardship Committee

The Nature Preserve is supervised by the Mink Brook Stewardship Committee ("Mink Brook Committee") under the direction of the Hanover Conservancy's Stewardship Committee. The Mink Brook Committee is an advisory group composed of volunteers, neighbors, and representatives of the Hanover Conservancy.

**1. Meetings and Minutes -** The Mink Brook Committee shall meet at least three times each year, with agendas prepared by the chair, who is appointed by the Conservancy's Stewardship Committee. Minutes are distributed to all members and filed at the Conservancy office. Subcommittees can be formed to accomplish a specific task; they should be chaired by a member of the Mink Brook Committee and can include interested community members and others with specific expertise.

**2. Committee Responsibilities**

- Monitor and record all management activities
- Evaluate conditions of trails; schedule improvements
- Assist with public events at the preserve, such as work parties and educational events
- Monitor use of the property
- Monitor wildlife habitat and health of vegetation
- Communicate or respond to those who have expressed interest in the Preserve
- Provide an annual stewardship report on activities and problems to the Conservancy
- Prepare an annual work plan in consultation with Conservancy staff
- Assist Conservancy staff in updating the plan at five-year intervals as required by the deed.

## C. Mink Brook Stewardship Fund

A far-sighted donor provided a substantial gift to initiate the Mink Brook Stewardship Fund when the property was protected in 1999. The maintenance costs at this property, especially invasive species control, can be significant. As of January 1, 2016, the Mink Brook Fund balance stood at $38,435. The Conservancy should continue to encourage donations to the Mink Brook Fund to care for the property into the future.

## D. Permitted Uses

The following activities are permitted by the deed:

1. Right to use the property for public pedestrian recreation and natural open space purposes consistent with the conservation deed restrictions.
2. Right to designate, maintain, alter, and relocate trails for walking, skiing, and other non-motorized recreational activities.
3. Right to construct, place, or introduce the minimal structures or improvements necessary for public trails such as water bars or timber steps, simple stream crossings (with temporary abutments)
4. Right to place small, low-impact temporary instruments for educational study or scientific purposes.
5. Right to post signs or plaques identifying the Preserve, marking trails, memorializing donors or events, identifying natural or historic features and/or outlining the proper use and care of the Preserve.

## E. Prohibited Uses

The following activities are prohibited by the deed:

1. No residential, commercial, or industrial activities.
2. No building or structure except as specifically permitted.

3. No impervious surface, permanent lighting, underground tanks.
4. No mining, quarrying, excavation, or removal of rocks, gravel, sand, topsoil; no bulldozing, excavating, drilling, or any other change of the natural topography of the land, except to manage a trail or reduce trail erosion.
5. No manipulation of natural watercourses or other water bodies, or activities detrimental to water purity or that could alter natural water level or flow.
6. No rights of way, driveways, roads, or utility lines except those previously of record, so long as they are in effect.
7. No harvesting, cutting, removing, or otherwise destroying trees or other vegetation (including application of herbicides) except pursuant to a management plan, conducting only the minimum cutting needed to maintain wildlife habitat, create a trail, maintain public safety on trails, or eradicate invasive species or disease posing a significant threat to the ecological integrity of the Preserve.
8. No dumping, injection, spraying, or burial of trash, debris, waste, or materials known to be environmentally hazardous.
9. No commercial advertising structures.
10. No motorized vehicles except to maintain the sewer line and power line or for maintenance-related use pursuant to this management plan.

In addition, the use of bicycles is not permitted in the Preserve as a condition of the major gifts that provided for the purchase and protection of the property.

## F. Current Management Concerns

This property's history and setting within a densely settled area present a number of potential conflicts. Management should seek to:

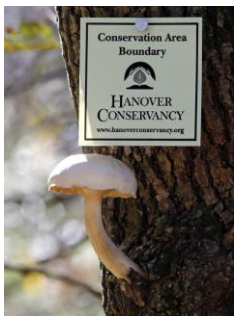
1. Restore native vegetation in an area that is subject to invasion by exotic plants from upstream and from surrounding neighborhoods.
2. Manage human-wildlife interactions that result from neighborhoods that surround bear and other large mammal habitat.
3. Manage streambanks to allow natural stream processes to unfold, while recognizing that a major sanitary sewer line passes across and along this part of Mink Brook.
4. Provide for controlled public pedestrian use in an area that is close to downtown Hanover and surrounded by residential neighborhoods, where there is strong pressure to create a commuter connection for bicycles. Manage conflicts between the many dog owners and other trail users.

## G. Conservation Monitoring

The Upper Valley Land Trust holds a conservation deed restriction on the Preserve and monitors it annually. A Conservancy representative (member of the Mink Brook Committee or Conservancy staff or board member) should accompany the UVLT monitor to answer questions. The Mink Brook Committee should review UVLT's monitoring report and respond to any reported issues.

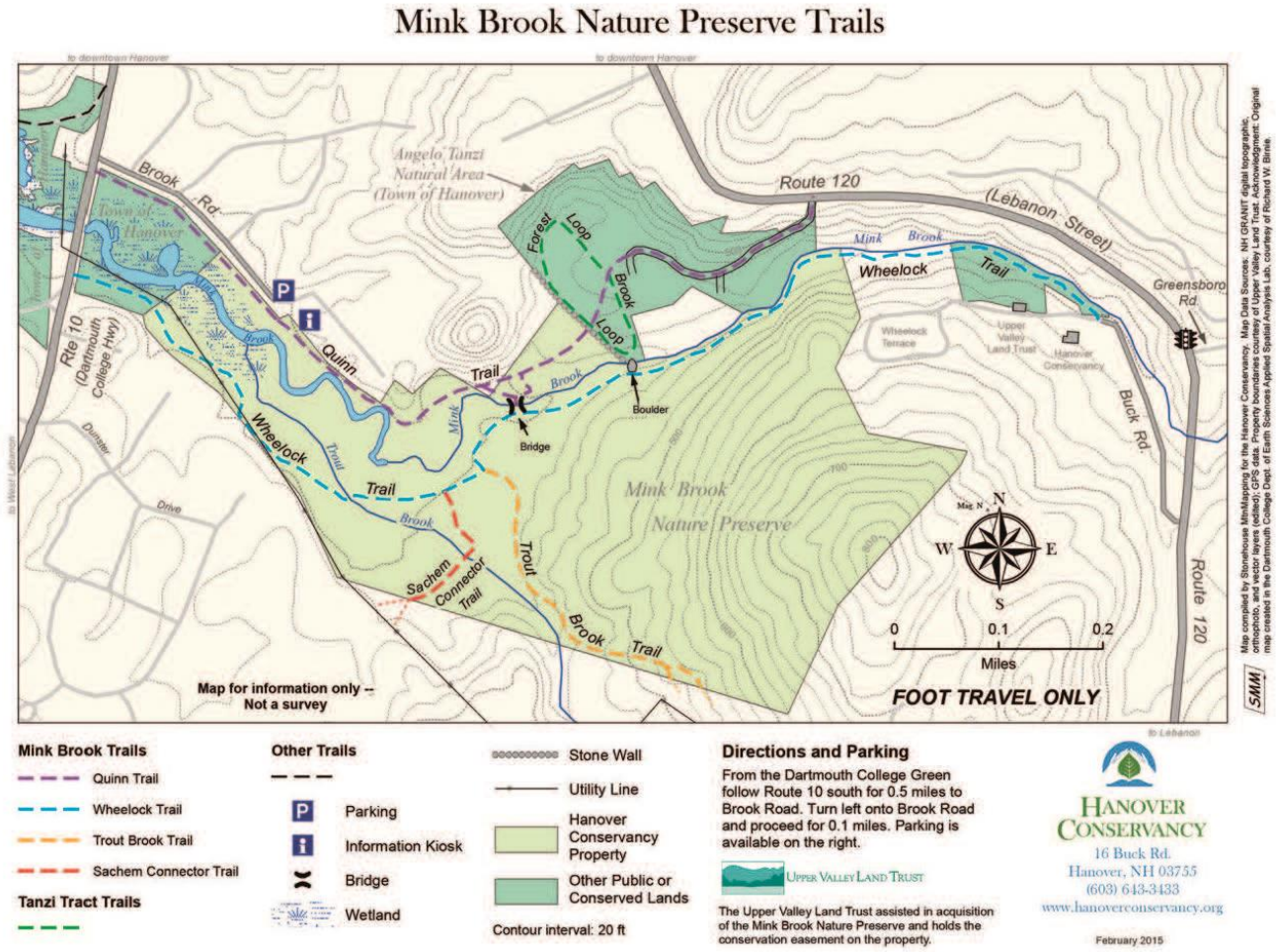
## H. Management Plan Revision

The deed requires that the Hanover Conservancy review the Management Plan every five years and submit updates or revisions to the Upper Valley Land Trust's designated representatives. Once revisions are approved by the Conservancy and Upper Valley Land Trust, copies of the revised Management Plan shall be available at the offices of each organization. The deed reserves to UVLT the right to approve or disapprove the Management Plan and to designate up to two representatives to participate in preparing the initial Management Plan and updates. UVLT will notify the Conservancy of changes to the designated representatives in writing; this representative is currently UVLT's Stewardship Coordinator. From 1999-2009, the Director of Real Estate for Dartmouth College was also a designated representative. Dartmouth officially withdrew its representative, citing satisfaction with the Hanover Conservation Council's (now the Conservancy) management of the preserve.




## I. Boundary Marking

The boundary is marked with small (4" square) tags (right). Boundary marking should be more frequent where existing boundary definitions, such as stone walls, are not evident. Boundary markings should be checked regularly, at least every five years. In some areas, the boundary runs along residential neighborhoods and requires monitoring for encroachment by compost piles, interference with vegetation, or unauthorized structures.



# II. Natural Resources & Management

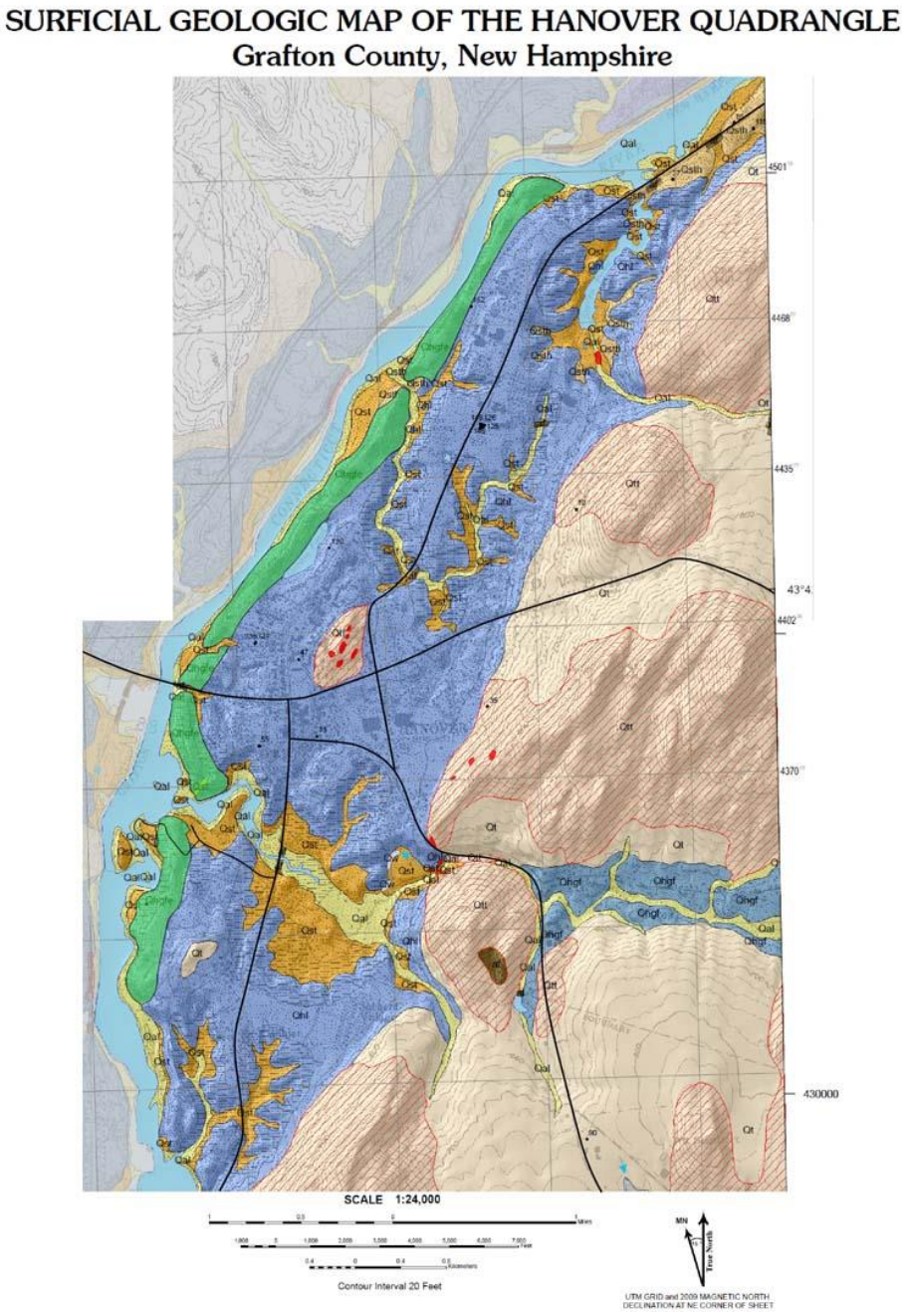
## A. Natural Resource Inventory

A habitat assessment and inventory of the Preserve was prepared by Ehrhard Frost, Alice Schori, Alcott Smith, and Linda Wilson upon acquisition of the property in 1999. The inventory includes observations and descriptions of soils, indigenous mammals, trees, shrubs, and herbaceous plants. The focus will be on the quality of the wildlife habitat on the Preserve and the abundance of non-native invasive species. The Conservancy will maintain records of flora and fauna observed at the Preserve. Updates to the inventory may be conducted by either paid or volunteer naturalists with adequate training and experience in habitat assessment.

## B. Geology & Soils

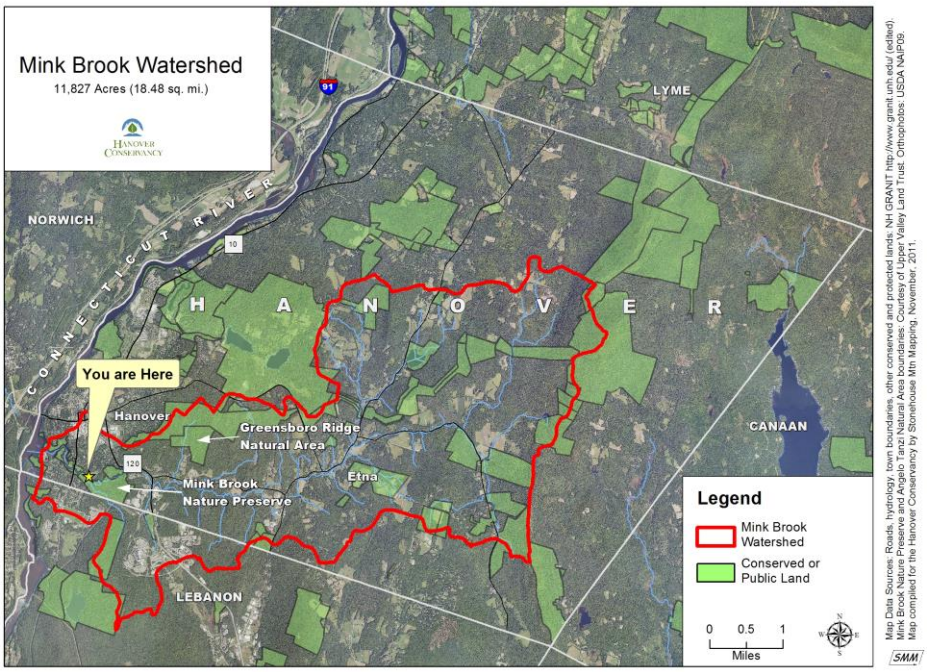
Much of the Preserve is underlain by the lacustrine sediments of glacial Lake Hitchcock, which inundated the entire area of the Preserve except for the hill top on the south side. The dramatic topography of the southern part of the preserve shows the erosive force of water cutting through these sediments as the lake drained. Clay deposits on the north side of the brook were once mined to create the College's tennis courts.

Stony Kearsarge and Cardigan soils and loose glacial till characterize hilltops and slopes, and in the valley and floodplain are found well-drained to poorly drained Suncook, Hadley, Occom, Pootatuck, Winooski, Rippowam, and Limerick soils.



# C. Water Resources

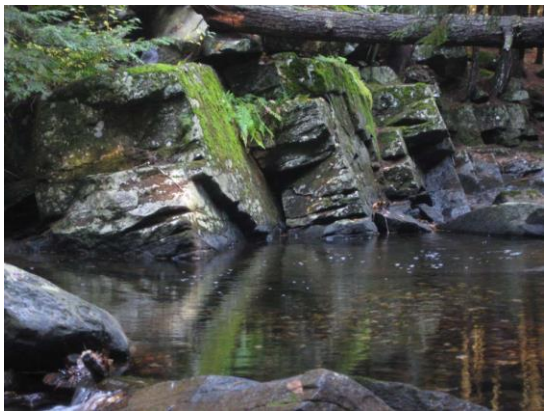
## 1. Watershed & Flow




Mink Brook is the only fourth order stream in Hanover and drains a watershed of 18 square miles. From 1962-1998, a gage upstream in Etna measured flow from 4.6 square miles of the upper watershed. This gage is no longer maintained.

The lower reach of Mink Brook is affected by operations at Wilder Dam downstream on the Connecticut River, with the lotic part of the brook meeting the water backed up behind the dam in an area below the log bridge, causing siltation and poor flushing. The effects of the dam's operations in altering aquatic habitat and introducing aquatic invasives are currently under study as part of the relicensing procedure for Wilder Dam.

A small, approximately two-foot-high concrete dam spans Mink Brook near the southeastern corner of Map 24 Lot 77, a residential property on the north side of the brook. This dam was built in the 1920s to create a swimming hole. Observers report that it does not impede the movement of white suckers or other fish.



## 2. Erosion

As it passes through the Preserve, Mink Brook leaves a relatively narrow channel, confined in some places by rocky ledges, and enters a broader floodplain. In two places, the channel is prevented from natural meandering in this floodplain where the Town installed riprap on the north bank to control erosion near the sewer line.

On August 28, 2011, Tropical Storm Irene dropped 3-5 inches of rain in the area. Immediate effects at the Preserve included undercutting of two trees that fell into the brook and struck the log bridge, knocking off one of the tension blocks. The trees were quickly cut and allowed to move downstream. A temporary block was crafted by a neighbor and then replaced with tension cables restrung in 2013.

By early 2012, it became apparent that the thalweg (main flow) of the brook had shifted to the north side of a small island just upstream of the log bridge, abandoning the channel on the south side. By late 2012, bank erosion accelerated and markers placed to monitor the erosion were either removed by trail users or by the brook itself. Photographs were taken in spring and fall to document changes. By 2013, the north bank just upstream of the log bridge had become deeply scoured, creating a sharp bend in the channel, and began to capture woody debris. New erosion began on the south bank opposite this bend. By Spring 2014, new erosion on the north bank just below the bridge, and close to the sewer line, was observed and reported to the Hanover Department of Public Works.

In May, 2014, the Conservancy installed a bioengineering project on approximately 100 feet of the north bank above the log bridge, consisting of live stakes of Streamco willow harvested from a nursery at Birch Meadow Farm in Fairlee, Vermont. It was hoped that this non-structural treatment might help establish new vegetative growth in the most actively eroding area, slow the pace of erosion and protect the bank, and help protect water quality. As of August, 2014, most willow stakes had sprouted, except for those installed in the area of the debris jam, where soil contact was difficult to achieve. They survived through 2015.

Dartmouth's Earth Sciences Department conducts fluvial geomorphology studies of Mink Brook in the Preserve. Results will be shared with the Conservancy and the public.

## 3. Wild Brook Trout Habitat

The New Hampshire Fish and Game Department, aided by Trout Unlimited and the Hanover Conservancy, conducted a study of wild brook trout habitat throughout the Mink Brook watershed in the summer of 2011. Two sampling sites fell within the Mink Brook Nature Preserve: #36936 in the mainstem, and #37149 in Trout Brook. (right).

The two locations within the watershed that did not contain brook trout were both downstream of Rt. 120. These locations included a smaller tributary draining the stormwater detention pond on Medical Center Drive and a section of the Mink Brook mainstem within the Nature Preserve. NH Fish & Game biologists concluded that water temperature was likely a factor that precluded wild brook trout presence here, and recorded a water temperature of 78.6 degrees in the drainage from Medical Center Drive on the day of electrofishing. Being a species dependent on cool water, wild brook trout are seldom found in streams with water temperatures that

routinely exceed 70ºF. By contrast, a healthy brook trout population was noted in Trout Brook, which yielded the largest number of trout of any site sampled in the watershed.

Fish Species Sampled by Electrofishing at the Nature Preserve, 2011 (source: NH Fish & Game Dept.)

| | Atlantic Salmon (stocked as fry) | Blacknose Dace | Brook Trout | Longnose Dace | Longnose Sucker | Slimy Sculpin |
|---|---|---|---|---|---|---|
| Mink Brook Mainstem (#36936) | 17 | 75 | | 13 | 1 | |
| Trout Brook (#37149) | | | 41 | | | 1 |

Brook trout are sensitive to habitat disturbance, and while trout habitat in Trout Brook appears to be healthy, that of Mink Brook likely reflects temperature impacts and sediment deposition from upstream.

An intact riparian zone provides both shade and prey in the form terrestrial invertebrates. Removal of streamside vegetation may cause a stream to become too warm to support brook trout. Impervious surfaces and undersized culverts increase peak flows and cause erosion and sediment deposition, which may fill pool habitat and bury spawning gravel. Fragmentation is an important limiting factor when it comes to maintaining healthy brook trout populations because impassable stream crossings prevent brook trout from accessing critical habitat, like a cold stream in the summer or spawning habitat in the fall.

Trout Brook was the only location in the watershed where slimy sculpin were found. Like the brook trout, this fish species is particularly sensitive to adjacent land use that alters natural flows and increases sedimentation and substrate embeddedness.

## 4. Water Quality

Volunteers sampled Mink Brook water quality on a monthly basis from June through September, 2002-2006 at three locations:

- Etna village
- Buck Road just above the abandoned bridge
- Brook Road at a small inlet next to a culvert

Samples were analyzed by a licensed professional water testing laboratory for turbidity, electrical conductivity, total phosphorus, and *E. coli* bacteria. Sampling activities were discontinued after no surprising results were found and the cost of processing samples became unsustainable. All results were consistent with what would be expected for a brook of this nature. No consistent seasonal variations were observed, nor was there any consistent variation among the three sites along the course of the brook.

**Summary of Results:**

- *Conductivity*: Values ranged between 100 and 700. Etna values tended to be lower than samples taken at Buck or Brook Roads. There did not appear to be any consistent temporal trends during the summer or during the multi-year sampling period.

- *pH*: The pH at all sites was almost always between 7 and 8. There were no consistent differences among the sites, no trends during the summer, and no trends over the multi-year sampling period.
- *Phosphorus*: With the exception of one isolated extremely high reading in Etna, all values were in the good-to-average range of 5 to 25 micrograms/L. The single high reading did not correlate with abnormalities in any other parameters on that date. The Brook Road samples may have been higher than the others, possibly because the brook tends to be shallower and much slower here. No trends during the summer season or over the multi-year sampling period were apparent.
- *Turbidity*: All values were below 10, and usually well below 5. The Brook Road site tended to become stagnant during periods of low flow, probably accounting for relatively higher readings. Otherwise there were no consistent trends among the sites during the summer season, or during the sampling period.

In 2012, the NH Department of Environmental Services established a trend water quality monitoring station on Mink Brook at the Buck Road bridge just upstream of the Preserve. DES monitors three times during the summer for temperature, macroinvertebrates, and other aspects, and each year they also monitor during a different season.

## 5. Sediment Quality

In 2000, the Environmental Protection Agency, in cooperation with the Connecticut River Joint Commissions, sampled sediments at 100 locations along the river and inside the mouths of major tributaries, including Mink Brook. Found in the brook's sediments at this site: (#SD081L) - phenanthrene, fluoranthene, pyrene, benzo(a)anthracene,benzo(a)pyrene, chrysene, indeno(1,2,3-cd)pyrene, and nickel. All of these are typical automotive contaminants commonly found where roads like Route 120, Greensboro, and Etna Roads travel close to waterways.

Concerns have been expressed by a neighbor that the storage and use of recycled asphalt near Mink Brook could be affecting water quality in the brook. While the Town's management of this material has been deemed appropriate by NH DES and upheld by the court, the concern remains. Traces of this material are more likely to be found in the sediments than the water column.

# Water Resource Management

1. Support a proposal by Dartmouth's Earth Sciences Department to install a new flow gage just upstream from the Preserve, since such a permanent structure, useful to understanding flow in the brook, is not permitted under the terms of the deed.

2. Participate in the relicensing process for Wilder Dam. Encourage restoration of more lotic habitat and changes in dam operations that could reduce siltation and introduction of invasive aquatics.

3. Monitor erosion near the footbridge. If the Department of Public Works elects to pursue stream bank stabilization to protect the sewer line, the Conservancy should work with DPW to select a treatment that includes significant re-vegetation of the stream bank.

4. Encourage Dartmouth researchers to share findings of fluvial geomorphological studies with the Conservancy and the public.

5. Protect riparian vegetation to keep water temperatures cool and help control erosion and sedimentation.

6. Track water quality monitoring data gathered by NH DES.

7. Investigate the feasibility of monitoring sediment quality, bracketing recycled asphalt storage sites, in the context of costs and available funding.

8. Activities on the Preserve should not contribute to deterioration in water quality in Mink or Trout Brooks. If the quality of water entering either stream is found to have undesirable characteristics, the Conservancy will consider efforts to identify the polluting sources and work with others to implement remedial steps.

# D. Vegetation

## 1. Native Vegetation

The forest on the Preserve varies in character from floodplain forest of silver maple, box elder, ash, and slippery elm to upland forests of pine, hemlock, maple, and oak. Woody vegetation has returned to former pastures and croplands. The 1999 Habitat Assessment and Inventory provides more detail on this aspect. The Preserve displays a variety of mushrooms and other fungi, especially in fall. Several rare and threatened plant species have been observed on the property:

| **Species** | **Last observed** | **Status** |
|---|---|---|
| Barren strawberry (*Geum fragarioides*) | 1999 | State threatened list |
| Golden-fruited sedge (*Carex aurea*) | 2000, not found 2009 | State threatened list |
| Granular sedge (*Carex granularis*) | 2001 | State endangered list |
| Northern waterleaf (*Hydrophyllum virginianum*) | 2009 | State threatened list |
| Stickseed (*Hackelia virginiana*) | 2014 | State endangered list |

The stickseed population appears healthy and is located in an area that receives little if any foot traffic or other disturbance.

The brook's lower floodplain, recovering from removal of buckthorn and other invasive woody plants, is currently sparsely occupied by a variety of tree and shrub species. This area, along with the brook's lower floodplain on town-owned land near its confluence with the Connecticut River, represents a prime opportunity for restoration of the native silver maple floodplain forest. Indeed, there is no other Hanover tributary to the Connecticut that offers such an opportunity, due to topography and encroaching development.

## 2. Invasive Vegetation

At the time of the Preserve's acquisition, the stream corridor of the property, once used for pasturage, had become heavily infested with glossy buckthorn *Rhamnus frangula*), Japanese knotweed (*Fallopia japonica)*, honeysuckle (*Lonicera* spp), barberry (*Berberis* spp), oriental bittersweet (*Celastrus orbiculatus*), and Amur maple (*Acer amurensis*). The Conservancy began to work on this problem in 2005 and entered into a series of cost-share agreements with USDA-NRCS to address this infestation. Treatment areas were flagged and a cut stump treatment applied to terrestrial areas in 2009, 2010, and 2011.

Following several years of treatment with herbicides applied by licensed contractors and guided by forester Ehrhard Frost, 2000 whips of native trees and shrubs were planted in the treated areas in 2012 (right). A planting list appears in Appendix B. Many volunteers, including from the Hanover Lions Club, participated in the planting. Plastic mesh guards were used on tree plantings to discourage browsing by deer and beaver. In 2015, the mesh guards were removed from plantings on the north side and a survival rate of approximately 40% was observed.

Seedlings of glossy buckthorn in particular are returning, but respond well to hand-pulling. The remains of many dead large woody plants have filled much of the floodplain space since 2009, but were not disturbed out of concern that they might sprout. In 2014, a group of these was cut at the soil surface and removed where the Quinn Trail comes close to the brook below the house at 2 Thompson Terrace. The dead material was chipped and removed. Within a month, herbaceous growth occupied the space.

In 2011, 2013, and 2015, a licensed professional herbicide applicator sprayed the knotweed from the center of the brook (left) with coordination on water

levels from operators of Wilder Dam. Several large knotweed colonies upstream of the Preserve have the potential to start new knotweed colonies here.

In 2012, colonies of garlic mustard had appeared by the Brook Road gate, on the south side of the brook near the neighborhood, and on the slope near Wheelock Terrace. Annual "pulling parties" seem to have had an effect. Invasive plants also colonize the National Grid powerline that runs along the south boundary of the Preserve. National Grid visits the power line every few years to control brush under the line and is required to notify the Conservancy in advance. Subject to review, the practice of mechanical cutting and minimal topical application of the commercial version of glyphosate to the stumps appears to be agreeable to both parties.

# Vegetation Management

1. Monitor survival of native plantings and remove remaining mesh sleeves to avoid constricting growth. Consider additional plantings of native trees and shrubs, especially silver maples within the floodplain, and of larger specimens. Encourage silver maple floodplain forest restoration on adjoining Town-owned land.

2. Trees of good wildlife value for seeds should be permitted to reach maturity, especially basswood (Linden, *Tilia americana*) and bitternut hickory *(Carya cordiformis)*.

3. All native plant material (leaves, stems, branches, bark) will be allowed to decompose on site or in brush piles. Remove dead invasive plant material when possible to allow faster regeneration of native plants.

4. Fallen trees and snags should be allowed to remain to provide wildlife habitat except where they pose a danger to trail users. Trees falling into the brook from the buffer should generally be allowed to remain in place to provide aquatic habitat complexity.

5. Trees or branches may be cut for these purposes:
    a. to eliminate a danger to trail users, clear fallen trees or branches blocking trails, clear seedlings and saplings established on the trails, or for new approved trails
    b. for materials for signage or trail improvements within the Nature Preserve.
    c. to increase the pace of natural succession toward more mature forest by limited and selective cutting of early successional vegetation. For example, in dense, single-species, uniform-aged stands of white pine that are undergoing natural "self-thinning," the thinning process may be accelerated by cutting of some smaller, suppressed stems.
    d. any other tree cutting must be approved by the Hanover Conservancy and Upper Valley Land Trust.

6. Continue to control invasive plants, especially buckthorn and knotweed, currently the most problematic. Methods will be chosen after consulting experts and considering the chances of success and resources available. Manual removal, such as cutting and/or pulling is preferred, but limited use of rapidly-degrading herbicides (local and tightly controlled) is an option for species that are exceptionally difficult to control manually.

a. Monitor re-sprouting of treated invasives
b. Remove invasive seedlings
c. Reduce dead invasive material by cutting and laying on the ground to speed decomposition and allow native vegetation to return.
d. Work with forester to set up and fund a follow-up treatment, if necessary
e. Continue to re-plant with native plants as the opportunity arises, to discourage new invasive infestations.
f. Continue to encourage National Grid to minimize the use of herbicides during its brush clearing operations under the power line.
g. Educate neighboring landowners about invasive plants to discourage infestation from abutting properties.

7. Review flagging left from earlier treatments and remove flagging that is no longer necessary.

8. Rare, threatened, or endangered plant species shall be protected. Species of concern will be reported to the New Hampshire Natural Heritage Program.

9. No native wildflowers, mushrooms, or other native plant material may be harvested from the Preserve.

## E. Wildlife

The Mink Brook Nature Preserve is home to black bears, mink, red fox, coyote, deer, and other mammals, described in the 1999 Habitat Assessment and Inventory. Moose are occasional visitors. The Preserve provides important stopover habitat for waterfowl and other birds during migration, offering a resting and feeding area that connects the Connecticut River migratory route with the uplands.

Since 1999, hunting and trapping have not been permitted on the Mink Brook Nature Preserve, except for the control of diseased or dangerous animals. Fishing is allowed only for sporting purposes. Black bear sows have sometimes used a tree near the Brook Road kiosk as a babysitting tree for cubs (right), and regularly patrol the Preserve's human neighborhood.

The deer population in Hanover appears to be on the rise, and a discernable browse line is apparent in parts of the Preserve. In 2013, concerned about possible over-population of deer, the Hanover Conservancy and Mink Brook Committee conducted a survey of neighbors. Results of this limited survey (20 respondents) indicated that all had seen deer browsing in their home landscape, 80% viewed deer as a nuisance, and 80% called for some form of deer culling.

## Wildlife Management

1. Continue and enhance efforts to avoid human/bear conflicts by educating the Preserve's human neighbors about controlling bear food attractants such as birdfeeders and household trash.

2. Consider allowing deer hunting by archery south of Mink Brook, since the Preserve abuts a much larger area to the south that is open to hunting. There shall be no hunting or trapping on the portion of the Preserve that is north of Mink Brook, due to proximity to densely settled neighborhoods. The decision regarding hunting will be made by the Conservancy's Stewardship Committee in consultation with the Mink Brook Committee, and shall consider the wishes and concerns of the Preserve's neighbors.

3. Encourage dog owners to leash their pets when walking in the Preserve after bears and cubs have emerged from their den.

4. Encourage bird trips at the Preserve to help maintain a current bird list.

## F. Adjacent Lands

The Mink Brook Nature Preserve is the centerpiece of an array of related land and water protection projects that date from the Conservancy's earliest years. The first parcel purchased by the Council was the abutting Tanzi Tract in the 1960s, followed in the 1970s by Mink Brook West and the South Esker. These lands were given to the Town. The Preserve is also adjacent to other undeveloped parcels in Lebanon including the college and hospital lands and Indian Ridge. To help sustain this larger ecological unit, the Conservancy will promote habitat and wildlife protection where possible on neighboring lands, encourage protection of open space when adjacent properties are developed, and manage the Preserve in the context of this larger area. The Conservancy will continue to seek opportunities to protect critical related properties.

Most trails on the Preserve cross protected land, except for a short section of the Quinn Trail, which crosses privately owned land associated with 12 Storrs Lane. The Conservancy should seek a trail license to secure permanent public access across this section of trail. The underlying sewer easement does not convey that right.

# III. Land Use History and Cultural Features

A primary objective of protecting the Mink Brook Nature Preserve was to honor the continuing significance of this place to Native people. Mink Brook (Mosbasak Sibosis) has an ancient history as the home of Abenaki people, including a village at the confluence of the Connecticut River in an area now largely inundated by Wilder Dam. A number of Native families also lived here to support their children as they attended Dartmouth College or Moor's Charity School.

## A. Recent History

The recent history of the Preserve has been researched by Frank J. Barrett, Jr., whose family once owned the land (see appendices).

In 1761, Royal Governor Benning Wentworth reserved this land for himself when he chartered the Town of Hanover. In 1770 the Proprietors of the new town offered this land to Rev. Dr. Eleazar Wheelock, the founder of Dartmouth College, as part of a larger contiguous block of land, in a successful attempt to persuade him to choose Hanover as Dartmouth's home. Wheelock soon built a mill on the brook whose foundations can still be seen at the Tanzi Tract just upstream. The Preserve property was held by Dartmouth College and Eleazar Wheelock – mostly land from the original 300 acre Wheelock holding. Dr. Wheelock died in 1779, leaving 200 acres including the Preserve and Brook Road area to his son, Ralph, who died in the 1820's, when the Mink Brook lands passed out of Wheelock Family.

By 1840, the Benton Family had established a farm here, building the brick cape on South Main Street followed by a large barn in 1851. The family had 140 Merino sheep and farmed 150 acres in Hanover, including the Preserve lands, and 174 acres in Lebanon. The College purchased the

farm from the Benton estate in 1898 for $4500 and sold it to Charles Stone in 1903, who established a dairy farm here (left). Millet was raised on terraces on what is now the south side of the Preserve.

In 1948, in preparation for construction of Wilder Dam, the family sold flowage rights to the Bellows Falls Hydroelectric Company along Mink Brook to the 385-foot elevation. The next

year, Stone sold the farm and 169 acres, excluding the land around his home, to Frank Barrett, Alfred Granger, and Joseph Ransmeier for $15,000. The farm buildings were razed or given away, a large free standing hill near the south of the main barn was bulldozed, and the residential subdivision that included Brook Road, Granger Circle, Mitchell Lane, Dayton Drive, Barrett Road, and Thompson Terrace was laid out.

In the late 1990s, when Barrett and Ransmeier proposed a 34-lot subdivision on the remaining land, the community came together and, with the help of Dartmouth College and a generous donor, purchased the property for conservation. The transaction was managed by the Upper Valley Land Trust, which conveyed the property to what is now the Hanover Conservancy.

## B. Historic Features

Several historic features remain but most are difficult to see. Features significant to the Abenaki are present on the Preserve but are not identified in this plan. A very early mill site has been eroded away by the fluctuating waters of Mink Brook but the earthen dam that was once part of the mill site is still visible in the meadows south of the brook, near Trout Brook. The remains of another mill, located upstream between the Tanzi Tract and land now owned by UVLT, is easier to view.

Near the top of the hill, just below the northwesterly facing ledges, unused slabs of granite quarried from those ledges, probably intended for use in the big barn's foundations, are still lying in the woods.

A stone wall that begins near the intersection of the easterly property line with the Gile Tract and the Hanover-Lebanon town line marks the ancient property line between the 300 acre Wheelock parcel and the 1000 acre Dartmouth College parcel of land. That easterly property line makes a series of erratic westerly jogs as it runs north over the top of the hill and descends the northerly side. This reflects the fact that in 1771, after Wheelock had established his first saw mill on Mink Brook, it was found to be located not on Dartmouth College property as the College Trustees had intended, but rather on Wheelock's private property. Therefore, to appease the Trustees, the original property line was adjusted westerly, giving additional land to the College.

# Management of Cultural & Historic Features

1. The historical and cultural significance of Native American activities on the Preserve will be respected. The Conservancy will support ongoing use of the Preserve by members of the Native American community for cultural and spiritual purposes which are compatible with the Deed and the Management Plan.

2. Advice from representatives of the Native American community, and in particular from the Abenaki and the Dartmouth Native American Studies program, will be respected regarding proposed uses and policies (e.g., trail placement) which have the potential to lead to disturbance of sites within the Preserve that have particular cultural, historical,

or religious significance to Native Americans, or would tend to unduly disrupt cultural uses of the Preserve that have historically taken place.

3. The Conservancy will work with prior owners, the Hanover Historical Society, and others as opportunities arise to preserve and expand historical records to show how these factors have shaped the Preserve's natural environment and the history of Hanover.

4. Stone walls and other historic features will not be disturbed. The unusual history of the property will be shared with the community and students at the college.

# IV. Public Use and Management

## A. Permitted and Prohibited Uses

The Hanover Conservancy manages the Nature Preserve to provide access to its natural, ecological, scenic, and cultural resources and to encourage respectful interactions by visitors with the natural environment. Access to portions of the Preserve may be closed to the public to fulfill other priorities of the Deed Restrictions. Reasons for partial closures may include, but are not limited to, a significant wind event or major flooding, an area being occupied by wildlife (e.g. a denning bear), or the presence of a rare species which may need special protection.

1. **Permitted Public Uses**: foot travel, scientific research, education. Wheelchairs and other power-driven mobility devices may be used on much of the Quinn Trail, where gates and paths along this part of the sewer easement are generally wide and flat enough to accommodate them.

2. **Prohibited Public Uses**: No bikes, tracked or wheeled vehicles, fires, hunting, camping, combat games (including paintball), hoofed domestic animals (including horses), or removal of vegetation are allowed on the Mink Brook Nature Preserve. The prohibition on bicycle use reflects conditions placed upon the two major grants that led to the acquisition and protection of the Preserve. The donors' intent was to honor the significance of the Preserve to Native Americans. No structures, temporary or permanent, are allowed (except those permitted by the Deed Restrictions and built and maintained by the Hanover Conservancy). No dumping of any kind, including yard and household wastes.

## B. Education & Interpretation

The Mink Brook Nature Preserve offers a valuable outdoor laboratory of forest and wildlife ecology and a display of historical land use features. The Hanover Conservancy uses the property for educational field trips. The Conservancy website provides trail and safety guidance for the public, a map, and information about the property and its history, user etiquette, role of UVLT, and permitted uses. The website also offers an opportunity to share information about other Mink Brook issues, such as invasive plants and deer impacts.

1. **Signage: -** Signs are posted at the primary entrances identifying the Preserve and giving the appropriate uses. A rustic kiosk on the Quinn Trail near the Brook Road gate (right) displays trail maps, safety notices, permitted and prohibited uses, and interpretation of the Preserve's history and significance. The kiosk is also useful for posting trail updates and other notices to the public. Signage at the Mink

Brook Preserve should be compatible with the natural setting: minimal, but adequate to convey needed information and keep trail users from becoming lost. A major effort to reduce and consolidate excessive and deteriorated signage took place in 2012. Wooden routed signs with a natural finish have been used to mark trails, in addition to blazes.

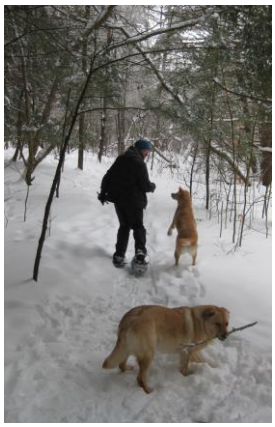
2. **Public Information–**The Conservancy has published a map of the property and made it available for free download from the Hanover Conservancy website. A printed map and guide of the property was updated in 2014 and reprinted in 2016. In 2014 an occasional electronic newsletter service was established to alert Mink Brook neighbors and friends about conditions at the Preserve. Conservancy staff also monitor an informal listserv among Mink Brook neighbors.

## C. Visitor Etiquette

Visitors should leave no trace of their visit, avoid disturbing plants and wildlife, and keep pets under control. Visitors are expected to carry out what they carry in, and remove their own trash, toys, and other possessions. No structures, temporary or otherwise, including stick forts or camping structures, are permitted on the Preserve without the permission of the Conservancy.

## D. Dogs

The Preserve has become a very popular destination for dog walking. Dog owners must pick up after their pets and restrain them from disturbing others and from harassing wildlife. Dogs should be leashed in this well-used neighborhood preserve. Under New Hampshire law, dogs chasing deer may be shot by officials and the owner fined.



Many dog owners using the Preserve do not pick up their dogs' waste or may bag and leave it on the trail for others to find. Where droppings are left close to the water, they represent a threat to water quality. The Conservancy does not have the staff or budget to maintain a dog waste bag dispenser or a garbage can, and must rely on pet owners to carry out their pets' waste.

## E. Camping and Fires

No fires are permitted at the Preserve, due to the proximity of neighborhoods, except those conducted by the Mink Brook Committee with a fire permit issued by the Hanover Fire Department. There is no camping permitted at the Preserve.

## F. Organized Events

Groups of 10 or more wanting to use the Preserve for an organized activity should notify the Conservancy staff of their intentions in advance and acknowledge their understanding of the Preserve's permitted and prohibited uses. Groups wishing to arrange for special events, such as a wedding, should contact the Conservancy well in advance. Written permission from the

Conservancy is required and a donation to the Mink Brook Stewardship Fund will be welcome. The property will not be closed to the general public during the event.

Prohibited activities at organized events include: no disturbance of soil, plants, or wildlife; no vehicles without special permission; no firearms; no fires or fireworks; no distribution of materials that could be considered litter (such as balloon release, release of non-native species, confetti). The site will be cleaned up promptly following the event.

## G. Scientific Research

The Nature Preserve offers an easily accessible research site for many areas of inquiry. Research that does not substantially disturb the property or obstruct walking trails is encouraged, and requires advance written permission of the Hanover Conservancy. Researchers are required to share their findings and may be asked to provide a demonstration for the public. Several Dartmouth earth science, biological science, and environmental science classes conduct research on the Preserve and/or on Mink Brook. Temporary signage may be installed to interpret research projects for the public.

## H. Memorials

A brass plaque (right) honoring the Quinn Family was placed on a boulder at the entrance to the Quinn Trail from the Tanzi Tract in 1999. A second plaque is mounted on the Brook Road kiosk. The Mink Brook Committee should recommend low-maintenance ways to recognize gifts made to benefit the Preserve, such as planting of a native, site-appropriate species of tree.


## H. Recreational Trails

The Preserve offers a network of four trails that link to nearby conservation areas and neighborhoods. The primary trailhead is at the Brook Road gate, on the north side of Mink Brook at the sharp turn in Brook Road. The Quinn Trail runs along the north side of the brook, connecting Brook Road and Route 120, and largely follows the buried sewer line. The Wheelock Trail runs along the south side of the brook and connects Route 10 with Buck Road. The Trout Brook Trail and Sachem Connector Trail leave the Wheelock Trail on the south side of the property and continue beyond it. In 2011 the Conservancy worked with the Hanover Conservation Commission's Trail Committee to build a new path connecting the Quinn Trail at the Brook Road gate with town-owned land along the brook on both sides of Route 10.

1. **Parking** - Space for four cars exists near the Brook Road gate. A bicycle rack is located nearby. Automobile parking should not become an intrusive element in the neighborhood. Additional parking, which provides access to trails on the southern portion of the property, is available about one quarter mile west in a Town-owned parking lot just across Route 10 from the beginning of Brook Road. There are approximately six spaces in this area next to the electrical transformers. Parking at the

Hanover Conservancy offices on Buck Road is available for those entering the east end of the Wheelock Trail. There is no parking at the east end of the Quinn Trail or west end of the Wheelock Trail.

2. **Gates** –A gate stands at the sewer utility easement entrance at Brook Road to admit maintenance vehicles and prevent unauthorized entry of other vehicles. The gate can be locked; keys are held by the authorized utility offices, the Conservancy, and emergency services. If further gates become necessary, they should be constructed primarily of natural materials (e.g. wood or stone) and should not be higher than four feet.

3. **Trails** – The number of trails at the Preserve is intentionally limited to ensure that some areas (such as deer yards) remain "remote" from visitors and available to wildlife, and to avoid potential impact on sensitive cultural features. The Quinn Trail over the sewer easement does not require blazing and can accommodate wheelchairs between the Brook Road Gate and the short steep hill. The Wheelock Trail is indicated with blue blazes; the Indian Ridge Trail with orange blazes, and the Sachem Connector Trail with red blazes. Both of these trails continue on to abutting properties and coordination with these property owners is necessary to keep them well marked. The Town of Hanover currently mows the sewer easement area. The open west end of the Wheelock Trail is cleared with a brush cutter or weed whacker at least once a year in late June. Decisions on new trail building are made in consultation with the Conservancy's Stewardship Committee and the Upper Valley Land Trust.

4. **Water crossings** – A large and handsome log bridge was placed over Mink Brook in 2009, linking trail networks on the north and south sides of the brook. Constructed of a single pine log with tension cables, this bridge was damaged during Tropical Storm Irene in 2012. Tension blocks and the log abutments were then replaced and the tension adjusted. A specific weight limit for the bridge has not been calculated, but it is wise to limit use of the bridge to no more than two people at a time. In 2010, the Conservancy asked the Hanover High School athletic program not to allow its athlete training groups to run over the bridge.


Until 2015, the bridge had never been treated with preservative. In 2014, the bridge was scrubbed with a weak vinegar solution to remove algae and prepare it for application of a preservative that is recommended by the U.S. Forest Service as safe to use over water. This treatment should be repeated every two years. This well-traveled bridge collects ice and snow in winter. A shovel is provided to keep the bridge clear.

Currently, two small log crossings and a stepping stone crossing convey trails over Trout Brook and a smaller drainage. These replace unauthorized structures.

# Management of Public Use

1. **Monitoring Public Use–** Members of the Mink Brook Stewardship Committee should monitor the property regularly. Continue to remind people to pick up after their pets and carry out their trash. Trails should be monitored for erosion and over-use, and where a good alternative route exists to an erosion-prone path, it should be considered. Trail monitors should also notify the Committee chair or Conservancy staff of minor problems, such as trash (remove small amounts; report a major mess), evidence of recent fire (no longer burning), downed or threatening large branches or trees on or near trails, illegal cutting, illegal structures, unsafe conditions (loose step in trail), or evidence of unauthorized disturbance or removal of vegetation. For major problems (fire, party, noise, vehicle trespass, unauthorized hunters), contact the police immediately at 643-2222 and then contact the Conservancy office at 643-3433.

2. **Public Notices–** The information kiosk should be periodically reviewed for obsolete messages and signs of vandalism. In season, post signs to invite volunteer participation at specific work days and alert trail users to times when herbicides will be used to control invasive plants. Educational materials that refer to Native Americans should omit details which might compromise the preservation, privacy, and sanctity of specific sites or activities.

3. **Educational Programs -** Outdoor trip programs should continue to provide education for the public with an emphasis on natural history, interpretation of forest and landscape features, and principles and priorities for conservation. Other organizations proposing trips to the Preserve should notify the Hanover Conservancy as a courtesy. The Conservancy will reach out to Hanover's schools to make teachers aware of the Preserve and encourage use of the property for field studies led by educators.

4. **Trails –** Continue to limit the number of trails at the Preserve to ensure that some areas remain remote and to avoid potential impact to sensitive cultural features.
    a. **Maintenance** - Trail maintenance should minimize the impact on wetlands and areas of important vegetation or wildlife habitat. Fallen branches that block trails and vegetation that interferes with trail use should be cleared. The open west end of the Wheelock Trail should be cleared with a weed whacker at least once a year in late June. Trees that have fallen across a trail may be addressed by cutting out a section of the trunk to clear the path. Hazard trees and limbs that pose a clear danger to trail users should be cut when necessary. For threats associated with large "grandfather" trees, consider rerouting the trail around the threat. The heavily used west end of the Quinn Trail benefits from an application of wood chips every few years to keep the compacted surface with its high clay content from becoming slippery when wet.

b. **Blazing and signage** - Check condition of trail blazing every five years. Blazes should be painted 2" wide by 6" long and spaced so only one blaze can be seen at once in either direction. Avoid painting blazes on rocks.

c. **Accessibility –** The Quinn Trail over the sewer easement and other trails at the Preserve should be formally evaluated against ADA standards and their ability to accommodate mobility-impaired visitors should be determined and results shared with the public.

d. **New or Re-routed Trails** - Trails should be designed for quiet reflection, aesthetic enjoyment, and nature study, accommodating constraints of the land. Decisions on new trail building will be made in consultation with the Conservancy's Stewardship Committee and the Upper Valley Land Trust. Trail design should be managed by experienced builders. If a member of the Stewardship Committee, Board, or staff is not able to fill this role, outside expertise, such as the Upper Valley Trails Alliance, should be considered. Trail layout should occur after a year's observation of wildlife use and drainage, including at least one significant rainstorm. A width of 4' should be sufficient; narrow and curving trails are preferred. Whenever possible, trailside trees should be left in place, especially on an inside curve. Trails should avoid steep and wet areas to minimize erosion. If wet areas or wetlands cannot be avoided, water bars, raised platforms, rustic bog bridges, or stepping stones should be used.

5. **Water crossings** – The log bridge over Mink Brook was treated with water-safe preservative in 2015 and should be treated again every 2-3 years. Trail crossings should be monitored after heavy rainstorms. Crossings should have minimal visual impact and should not significantly interfere with water flow, using natural stepping stones when available. Where stepping stones are not adequate, natural materials may be used to create a simple log crossing without permanent abutments, but should be chained at one end in case of very high water. A permit from the Hanover Zoning Administrator is required.

**6. Vehicles –** The Town uses the westernmost portion of the Quinn Trail for sewer line maintenance. Otherwise, vehicles are not permitted in the Preserve other than on a temporary basis associated with Conservancy events or for maintenance of abutting properties in cases where the property cannot be practically accessed in any other way. Conservancy permission for this use must be sought and received in advance.

# Management Summary

## I. Administration

1. The Mink Brook Committee shall meet at least three times each year.
2. The Conservancy should continue to encourage donations to the Mink Brook Fund.
3. A Conservancy representative should accompany the UVLT monitor annually.
4. The management plan must be updated every five years and approved by UVLT.
5. Boundary markings should be checked at least every five years.

## II. Natural Resources Management

1. Participate in relicensing process for Wilder Dam to follow potential effects upon the Preserve.
2. Support proposal by Dartmouth's Earth Sciences Dept. to install a new flow gage just upstream from the Preserve
3. Monitor erosion near the footbridge. If the Department of Public Works elects to pursue stream bank stabilization to protect the sewer line, work with DPW to select a treatment that includes significant re-vegetation of the stream bank.
4. Encourage Dartmouth researchers to share findings of stream studies.
5. Protect riparian vegetation to keep water temperatures cool and control erosion
6. Track water quality monitoring data gathered by NH DES.
7. Investigate the feasibility of monitoring sediment quality.
8. Monitor survival of native plantings and remove remaining mesh sleeves.
9. Consider additional plantings of native trees, especially silver maple.
10. Monitor re-sprouting of treated invasives; remove invasive seedlings
11. Work with forester to set up and fund a follow-up treatment, if necessary
12. Allow all native plant material to decompose on site or in brush piles. Remove dead invasive plant material when possible to allow faster regeneration of native plants.
13. Allow fallen trees and snags to remain except where they pose a danger.
14. Continue to control invasive plants, especially buckthorn and knotweed.
15. Remove flagging that is no longer necessary.
16. Continue and enhance efforts to avoid human/bear conflicts through education.
17. Consider allowing deer hunting by archery south of Mink Brook.
18. Encourage dog owners to leash their pets after bears and cubs have emerged.
19. Encourage bird trips at the Preserve.
20. Continue to seek opportunities to protect critical related properties.
21. Seek a trail license for public access across the privately owned section of the Quinn Trail.

### III. Historical & Cultural Features

1. Respect the historical and cultural significance of Native American activities on the Preserve. Seek advice from members of the Native American community regarding proposed uses and policies.
2. Expand historical records. Share Preserve's history with college and community.
3. Leave stone walls and other historic features undisturbed.

## IV. Public Use Management

1. **Permitted uses -** foot travel, scientific research, education. Wheelchairs and other power-driven mobility devices may be used on much of the Quinn Trail.
2. **Prohibited uses -** no bikes, tracked or wheeled vehicles, fires, hunting, camping, combat games (including paintball), hoofed domestic animals (including horses), or removal of vegetation. No structures, temporary or permanent. No dumping, including yard and household wastes. No camping or fires. The prohibition on bicycle use reflects conditions placed upon the two major grants that led to the acquisition and protection of the Preserve. The donors' intent was to honor the significance of the Preserve to Native Americans.
3. Members of the Mink Brook Stewardship Committee should monitor the property regularly for trail conditions, trash, and evidence of problems.
4. Dog owners must pick up after their pets. The Conservancy does not have staff or budget to maintain a dog waste bag dispenser or a garbage can.
5. Monitor kiosk for outdated signs and replenish maps; post signs to invite volunteer to work days and alert trail users to use of herbicides.
6. Hold public trips and programs; encourage use of the property by teachers
7. Encourage scientific research and share results with the public
8. Identify appropriate memorials.
9. Organized events require a special permit from the Conservancy. The property will not be closed to the public during the event. No release of non-native objects.
10. Continue to limit the number of trails to ensure that some areas remain "remote" and to avoid disturbing sensitive cultural features.
11. Clear west end of the Wheelock Trail at least once a year in late June.
12. Evaluate trails against ADA standards and their ability to accommodate mobility-impaired visitors.
13. Protect the large log bridge from concentrated heavy use. Apply a water-safe preservative every four years to prolong the life of the bridge (first done in 2015)
14. Monitor smaller crossings after heavy rainstorms.