pressley

McLean Open Space Land

Comprehensive Trails System Plan

Prepared for the
Land Management Committee
Belmont, Massachusetts
FINAL - March 2008

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Landscape Architects
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By
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Introduction

The land currently known as the McLean Open Space (MOS) was formerly private property owned by McLean Hospital until under the enactment of the Memorandum of Agreement (a rezoning and development agreement) between the Town of Belmont and McLean Hospital the land was deeded over to the Belmont in 2005. The Town land consists of an Open Space parcel, an affordable housing parcel, and a Town Cemetery (Highland Meadow Cemetery). The Open Space property and the inactive portion of the Cemetery are included in this trails plan and collectively referred to as the MOS. They are held under the conservation restrictions included in the agreement (Documents B1 and B2). The conservation restrictions list prohibited and permitted acts and uses for the MOS including passive recreational use of the site by the public including hiking, cross-country skiing, and bird-walking. A provision of the conservation restrictions permits non-motorized biking as permitted only per an approved plan for the trails.

The MOS is overseen by the McLean Land Management Committee (LMC) as designated in the property transfer agreement. The LMC is composed of nine members. Four members are appointed by the Town, four members are appointed by McLean Hospital, and the ninth member is an appointee of the Trustees of the Reservations, the holder of the Conservation Restrictions. The LMC meets on a regular basis to make decisions about maintenance issues and strategic planning for the future of the property.

The existing trail system of the MOS is a mix of trails that were established at different times in the property's history. Some trails, such as the Old Coal Road, were originally service roads for McLean Hospital operations. This trail, as well as other former "roads," continues to be generally wide reflecting the use by vehicles in the past and now serve as fire roads for emergency access. Other trails are narrower providing connections throughout the property. A portion of the trails have been designated as part of the Western Greenway, a trail system that links together green spaces in Belmont, Waltham, and Lexington.

The development of this Comprehensive Trail System Plan was a process between the consultant team, Pressley Associates, Landscape Architects and LEC Environmental Consultants, and the LMC. The consultant team inventoried and analyzed the existing trails, conducted meetings with the LMC and public, and formulated draft general and specific recommendations for trail system enhancement and sustainability. After review, the LMC revised the overall recommendations and adopted the final trails plan contained herein, but this trails plan is only a starting point for the trails system. The LMC is conducting a meeting in March 2008 to further evaluate the specific environmental impact of the trails plan on the ecology of the Open Space as a whole. In meetings to follow, the LMC will determine the prioritization and methodology to implement the trails plan or revise the trails plan as appropriate.

This trails plan presents a blueprint for the future improvement of the trail network and serves as a complement to the newly developed Highland Meadow Cemetery as well as the recent restoration of the meadow ecosystems (Great Meadow and the Heart-Shaped Field). This plan seeks to meet a number of goals, including improving trail access for passive recreational use, improving trail sustainability, allowing public safety, and continuing emergency vehicle access, all within a conservation framework. Along with the separate restoration of the meadow habitats, this plan seeks to enhance preservation of natural habitats. In many ways, attaining these goals requires common solutions and recommendations, including trail closures and re-routing, new trails, trail signage, trail design standards, a program for implementing the trail recommendations, a trail maintenance program, and funding sources.

This report first provides the inventory and analysis of the existing trail network on a trail by trail basis. This is followed by recommendations addressing the criteria of sustainable trail design, multi-use trails, emergency access, potential parking areas, signage, and trail accessibility. It is not intended for these recommendations to be "set in stone" but rather be a starting point toward creating an improved trail system for users of this public property. Recommendations should be flexible based on resources available to the LMC and the Town of Belmont and the changing needs and desires of the LMC and general public. It should also allow for change as

site conditions are monitored.

For the purposes of this report, the consultant team has prioritized the recommendations within an implementation strategy based upon safety, ecological concerns, user needs, private property issues, and other factors. After the LMC sets their priorities for trail system improvement, funds to implement the trails plans must be secured. Thus the Plan directs the LMC towards potential trail-specific funding and grant opportunities along with a cost estimate for the full construction of recommended trail system by professional contractors. It should be noted that some of the work may be performed by volunteers but for the purpose of full understanding, the total construction values are included.

Once the changes to the trail system become reality, trails maintenance will be an ongoing issue to ensure safety of the trail users, continue emergency access, and sustain the desired trail conditions. The final part of the plan contains a listing of typical maintenance tasks as well as general guidelines for the establishment of a trail maintenance program. Lastly, it is recommended that the LMC explore ways to energize and utilize volunteer labor on an ongoing basis.

Chapter 1
Trail System Analysis

Property Description

As part of the 2005 rezoning and development agreement, the Town of Belmont became the owner of approximately 120 acres of land, now known as the McLean Open Space (MOS), a mix of upland hardwood forest, pine forest, forested wetlands, and open meadow. This land has been permanently dedicated as open space by conservation restrictions and, combined with other protected land from the McLean Hospital campus, comprises approximately 140 acres. As part of the 120 acres, the land transfer included 13.9 acres to be used as a new municipal cemetery, officially named the Highland Meadow Cemetery, with four acres currently developed for cemetery use. The remaining 9.9 acres of the cemetery land will continue to function as part of the public open space until it is developed in the future. 4.6 acres of the open space is located on the west side of Mill Street contiguous with the town-owned Rock Meadow Conservation Area. This part of the open space is not included in this trail system plan.

Other parcels of the McLean Hospital property were rezoned for residential, senior living, private open space, and research and development use (see Figure 1). The residential zones 1A and 1B have been mostly developed and partially occupied by new residents at the time of this writing. A 100-foot buffer separating part of the MOS from the hospital campus was established in the rezoning plan. The core hospital campus (Zone 5) continues to function for patient services and research.

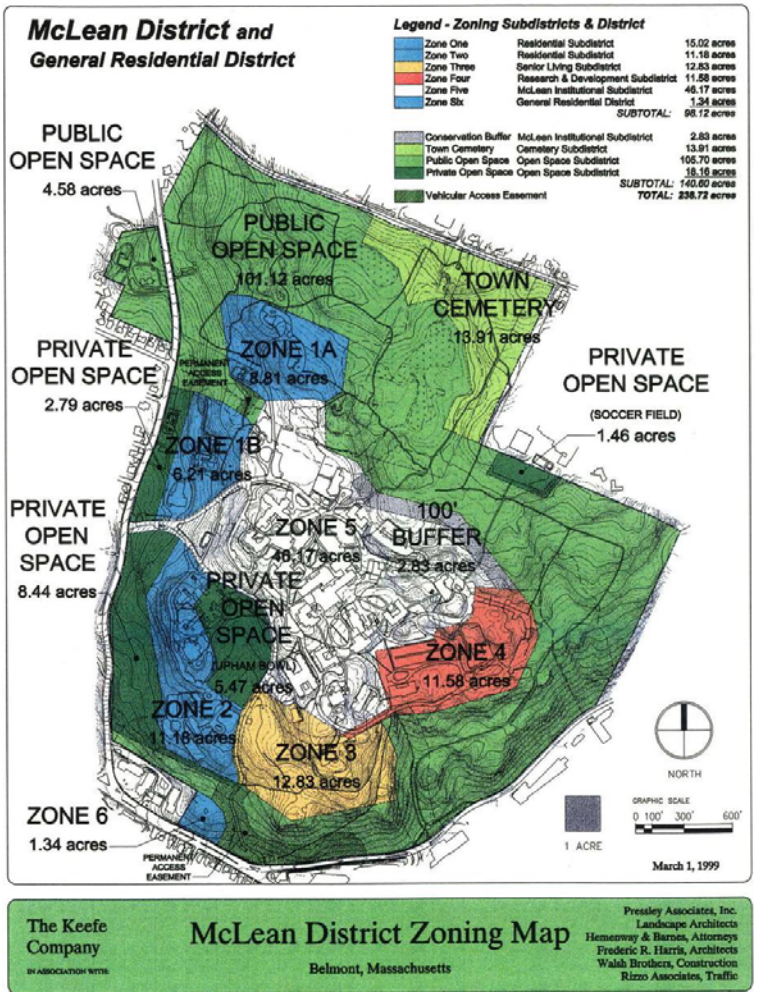


Figure 1: McLean District Zoning Map

The MOS is located on the western side of the Town of Belmont, near the borders of the adjacent towns of Lexington and Waltham. The property surrounds the northern, southern, and eastern sides of the McLean Hospital and the other development zones. A number of other open space properties are adjacent or near to the MOS and when combined, they make up a large network of recreational and natural land unique to this inner part of metropolitan Boston. These properties include the Massachusetts Department of Recreation and Conservation's Beaver Brook Reservation, the Belmont Rock Meadow Conservation Area, and the Massachusetts Audubon Society "Habitat" wildlife sanctuary, each with their own trails system (see Figures 2 and 3).

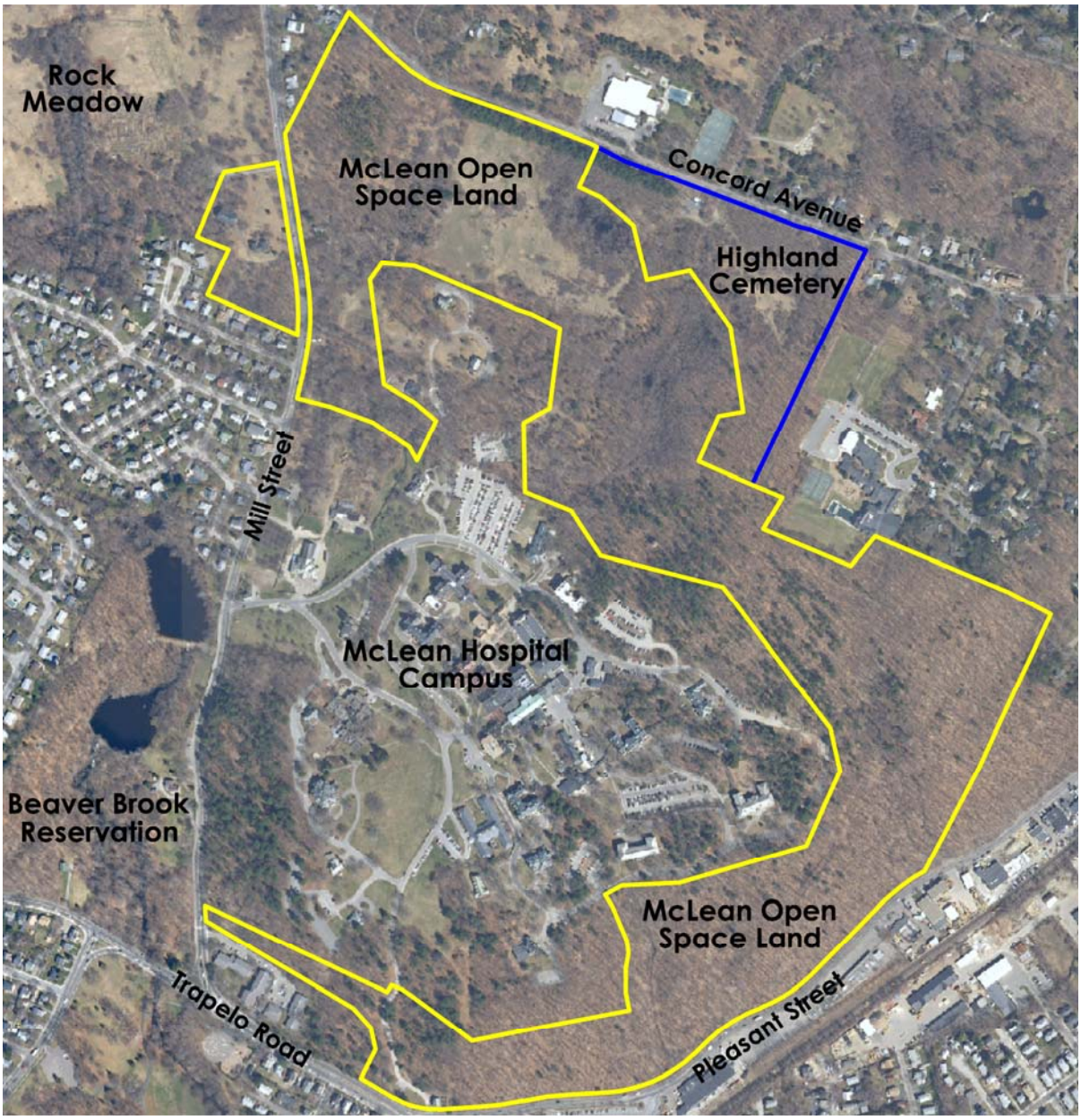


Figure 2: McLean Open Space Land and Highland Cemetery
(note: rezoning parcels not shown in this figure)

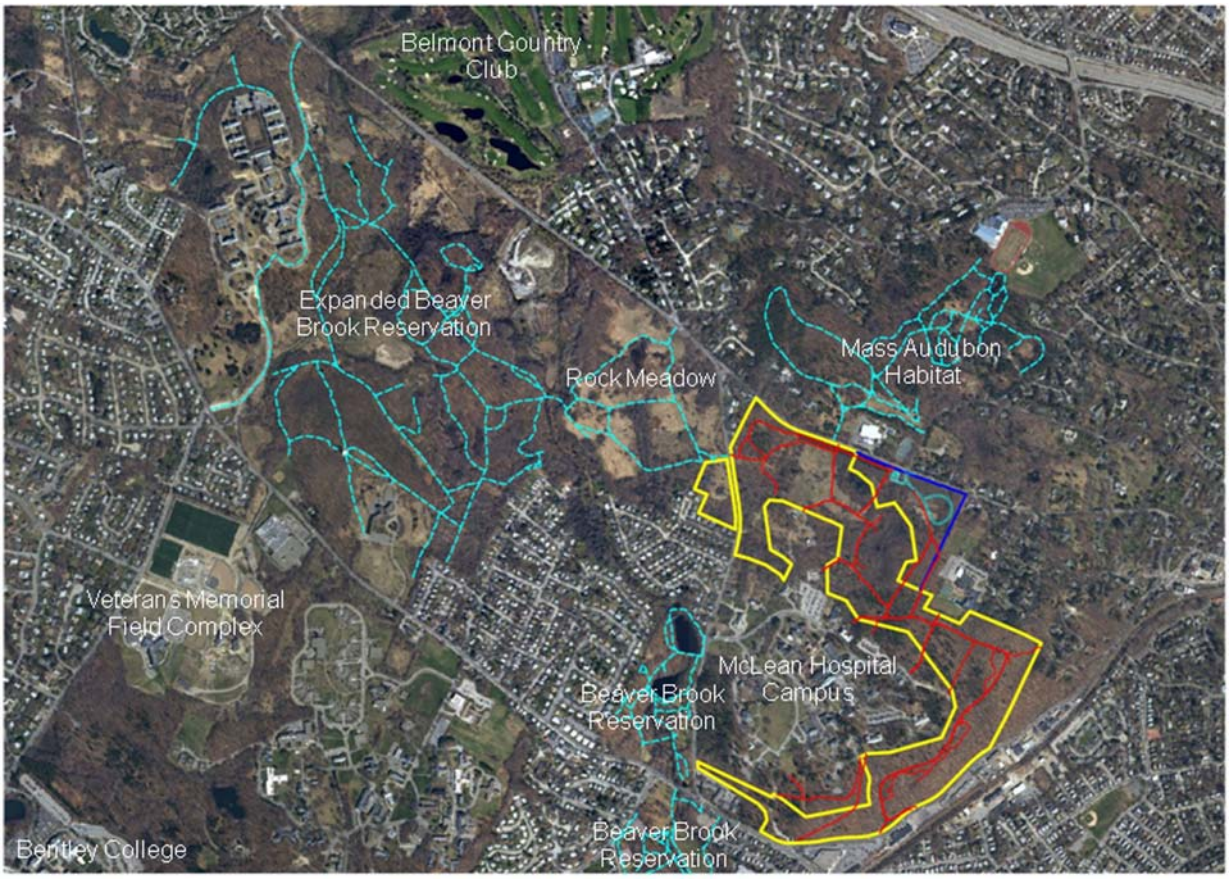


Figure 3: Adjacent Open Spaces and Trail Systems

Site Ecology

The MOS is comprised of a variety of habitat types, including upland and wetland forest, upland and wetland meadow, streams, and vernal pools. The wooded portions of the MOS are primarily comprised of oak (*Quercus* sp.) and pine (*Pinus* sp.) dominated upland forest, and red maple (*Acer rubrum*) dominated wetland forest. Generally, the canopy provides moderately dense cover, resulting in a sparser understory; although pockets of dense shrub and groundcover growth occur throughout the site, particularly below openings in the canopy. The meadow areas, the Great Meadow and the Heart-Shaped Field, contain wildflowers, including goldenrods (*Solidago* sp.), wild carrot (*Daucus carota*), and cow vetch (*Vicia cracca*), along with grasses and other herbaceous plants, and appear to be mowed often enough to limit significant woody growth and habitat succession. While the majority of the MOS is forested, the meadow areas provide habitat heterogeneity and ecosystem interfaces, or 'ecotones', that add to the site's overall habitat value. The trails that traverse the property provide access to and across these habitat areas.

The MOS contains several ephemeral streams that appear to direct surface water and stormwater between wetland areas (particularly within the northern portion of the Open Space) and off-site (particularly within the southeastern portion of the site). The wetland areas contain two Certified Vernal Pools and at least one Potential Vernal Pool according to the Habitat Atlas published by the Natural Heritage and Endangered Species Program (NHESP) and Mass GIS. Additional Vernal Pool habitat may occur as small, inundated pockets located within the interior (and topographically depressed) portions of the forested wetland habitats.

The Belmont Conservation Commission has jurisdiction of all Wetland Resource Areas and Buffer Zones on the property, as outlined and defined under the Wetlands Protection Act and its implementing Regulations (WPA/R). Under the WPA/R, the Buffer Zone extends 100 linear feet from the boundary of Bordering

Vegetated Wetlands and/or Bank associated with streams and ponds ("Resource Area"). Work proposed within the Commission's jurisdiction will require permitting with the Commission. Further, the Commission maintains a 25-foot No Disturb Policy, the inner-most area of the 100-foot buffer zone, per the approved Belmont Wetland Setback Policy. Proposed construction or alteration within the 25-foot area will only be allowed if the applicant can prove to the Commission one or more of the following:

1. that such activity would not have a significant and adverse impact on the resource area;
2. that such activity will provide public benefits that will outweigh any such impact; or
3. that the activity is a minor activity as defined by the Wetland Protection Act Regulations at 310 CMR 10.02(2)(b)(1).

Permissible alterations to the twenty-five (25) foot buffer zone area include, but are not limited to, planting of native and indigenous vegetation; pruning and routine maintenance of existing vegetation; maintenance and replacement of existing landscaped beds; removal of invasive plant species; maintenance of existing paths; maintenance of existing utilities and stormwater management systems; and improvements to the wildlife habitat values of the property.

Designated Areas within the McLean Open Space Land

For the purposes of this trail plan, the site was divided into six physiographic areas identified by the Land Management Committee (see Figure 4).

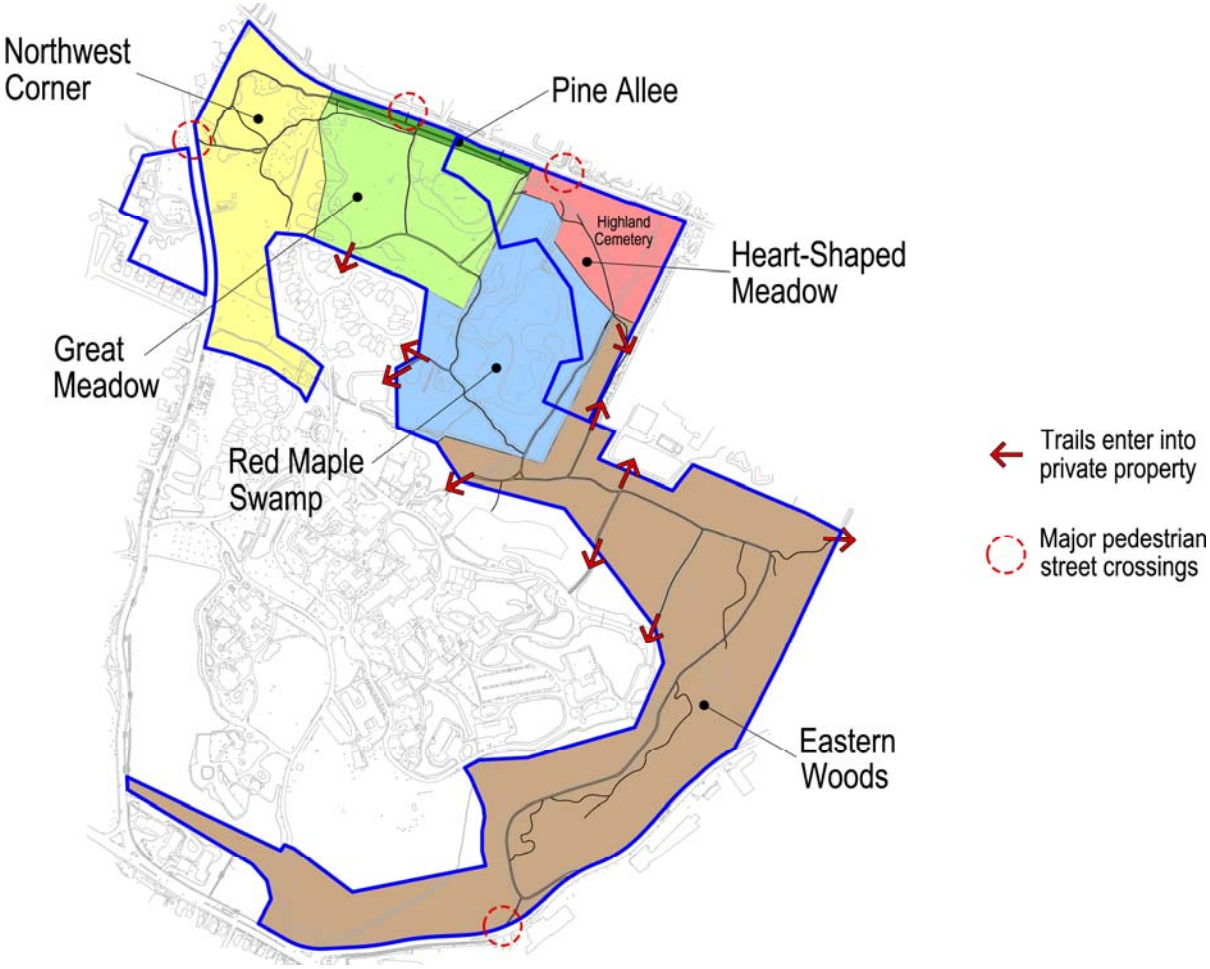


Figure 4: Six Physiographic Areas of the MOS

Eastern Woods: The mostly wooded area along the eastern side of the MOS; partially bounded to the east by Pleasant Street; largest of the six areas.

Heart Shape Meadow: Open meadow area along the northern boundary of property along Concord Avenue; includes the Highland Meadow Cemetery; meadow currently under a New England meadow habitat restoration plan as implemented by the LMC.

Red Maple Swamp: The wetland area south of the Heart-Shaped Meadow and its surrounding forested immediate upland areas.

Great Meadow: The large meadow centrally located on the property; includes Lone Tree Hill, the highest point in the MOS allowing views to surrounding areas; the Great Meadow is in the process of being restored to a New England meadow habitat.

Pine Allee: Narrow band of pine trees along the northern border of the property parallel to Concord Avenue; The Great Meadow lies to the south.

Northwest Corner: The northwest portion of the MOS bounded by Concord Avenue to the north, Mill Street to the west, and the Great Meadow and the Pine Allee on the east.

Trail Analysis Process

Several sources of information were used in the analysis of the existing trail system including the review of previously prepared site studies, property regulations, topographic surveys, site walks by Pressley Associates and LEC staff, and conversations with members of the Land Management Committee, the Belmont Fire Department (Chief David Frizzell), and the McLean Hospital Facilities Department (Mr. Andy Healey). The trails studied in this plan include the trails within the main open space of 101.12 acres and the town cemetery land of 13.91 acres. The 4.58 acres of land on the west side of Mill Street is not included in this study. A total of four site visits were conducted by Pressley Associates staff during the spring and summer of 2007: May 29; June 1; June 18; and August 24.

Previous site studies and regulations reviewed included:

- *Ecological Assessment of the Undeveloped Areas on the McLean Hospital Property* prepared by Woodlot Alternatives, Inc., August 1997.
- *Highland Meadow Master Plan* prepared by The Halvorson Company, April 21, 2000.
- *McLean Hospital Reuse Master Plan*, Belmont, Massachusetts prepared by Design Consultants Inc, May 15, 2000.
- *McLean Hospital Open Space Ecological Management Plan* prepared by BCS.
- *McLean Trail Assessment* prepared by the New England Mountain Bike Association, October 17, 2001.
- Conservation Restrictions B-1 and B-2, McLean Hospital Property, Open Space Property and Cemetery Portion, May 19, 2005.
- *Recommendations for Field Management at the McLean Open Space* prepared by Mass Audubon Ecological Extension Service, May 15, 2006.
- *Highland Meadow Phase 1 Schematic Design* prepared by The Halvorson Company.

The property base mapping used in this report was created using the May 15, 2000 survey prepared by Design Consultants Inc. for the McLean Hospital reuse and rezoning process. This base mapping was enhanced using select data layers available from the Massachusetts Geographic Information System. Existing topographic lines on the survey are at two-foot intervals.

The trail system was reviewed both as a complete system and on a trail-by-trail basis mindful the role that the surrounding natural, physical, and cultural environment have on the trails. As the trails have no formal names, it was necessary to develop a system for identification of the individual trails. Trails were codified using a lettering and numbering system. Primary trails, the longer and typically wider and more used trails, were given a numerical code (Trail 1, Trail 2, etc.) with a total of sixteen primary trails. Secondary trails, the shorter, narrower, and less used trails, were given an alphabetical code (Trail A, Trail B, etc.) with a total of six secondary trails. In addition, trailheads identified in the field were given a Roman numerical code. In Figure 4, the primary trails are indicated in red, the secondary trails in blue, and the trailheads with an orange circle.

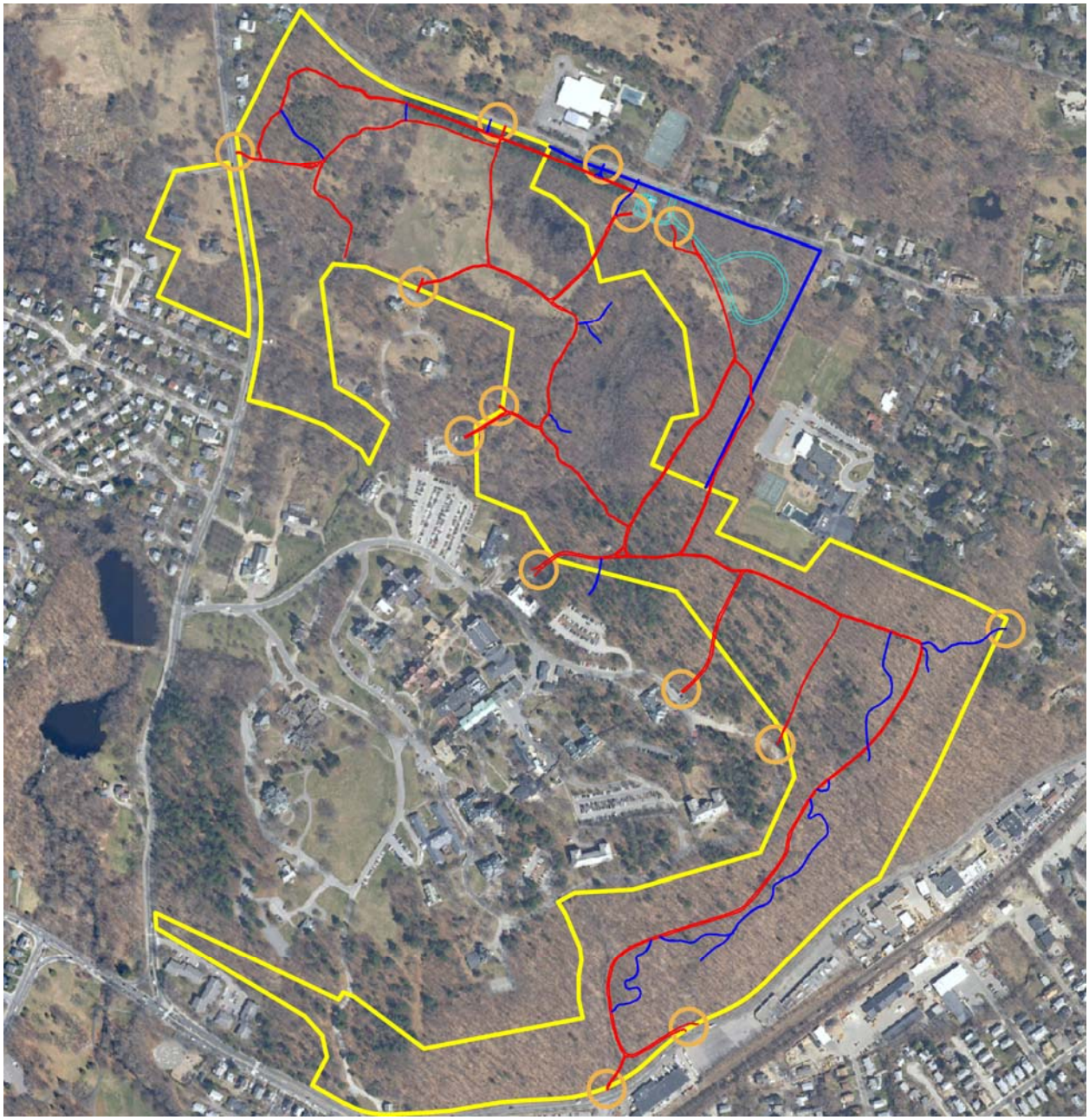


Figure 5: Primary Trails, Secondary Trails, and Trailheads

Trail by trail descriptions and analyses for each trail are at the end of this chapter. In addition, Appendix A contains photographs of the individual trails taken during the four site visits and Appendix B is composed of graphical Analysis Plans.

Summary of Existing Trail System Conditions

Historically, McLean Hospital allowed passive pedestrian and bicycle use of the trails on the land and this use continues much as it did before the 2005 land transfer. Trail users include walkers, joggers, nature-watchers, cross-country skiers, and mountain bikers. The trails were developed informally without regard to environmental and physical issues, user types, proximity to neighbors, and other concerns typical of more formally planned and designed trail systems. There are a number of highly eroded sections of trail throughout the property. Trails seem to provide easy access to the different areas of the site but were not properly planned out with good, sustainable trail design and construction practices. Trails connect to adjacent public and private properties with little to no signage indicating property boundaries. Per the conservation restrictions, all motorized vehicles are prohibited with the exception of maintenance and emergency vehicles but there is some visible evidence of possible illegal vehicle access. In addition, some trails have been created within the past few years without the permission of McLean Hospital or the Land Management Committee.

When the property was under the ownership of McLean Hospital, emergency access routes were typically maintained on a regular basis by hospital maintenance staff in coordination with Belmont Fire Department. Since the property was transferred, there has been no regular maintenance of the trails resulting in fallen trees and invasive plant growth encroaching onto some the trails.

The trail system runs throughout most of the property. The total length of all trails is approximately 19,160 linear feet (3.6 miles) with the Primary Trails accounting for around 15,800 linear feet and Secondary Trails totaling around 3,360 linear feet. Based on casual observations and information from the LMC, most pedestrian and mountain bike use appears to be local (Belmont, Lexington, and Waltham) with some mountain bike use coming from other neighboring towns in this part of the Boston metro area. It can be anticipated that trail use may increase in the future due as new residential areas are developed and occupied in the surrounding area. Increased pedestrian use may likely also come from the Research and Development and Senior Living subdistricts.

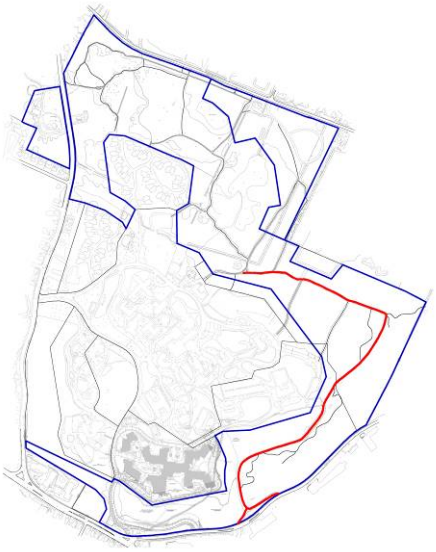
Conditions of the trails vary but all trails generally need some degree of redesign and/or maintenance. The trails vary significantly from linear, well-traveled trails measuring over 10 feet wide to narrow, meandering trails around one-foot wide. The trails are largely comprised of mostly compacted soil. Exposed roots and native stones and rock are common on sloped and compacted sections of the trail surface. In some areas where trails are steeper, gravel has been installed to control the erosive effects of water. Where steep trails are not graveled, the surfaces tend to erode and gully. Some trail sections have already been stripped to soil and expose the native rock, creating areas difficult to traverse. These eroded areas will only worsen unless corrective measures are taken. Pieces of decomposing asphalt are present in some areas of the Old Coal Road, the longest single trail on the property. Grass growth occurs on some of the trails; particularly in meadow areas and in the woods where sunlight breaches the forest canopy. Overgrown vegetation and low tree branches in some spots block trail use and reduce trail sightlines creating unsafe conditions for trail users.

There are some seasonally wet and muddy sections of trail. Trails tend to widen or braid at these areas but they typically dry out during the summer months. In some spots, vehicular tracks are evident, particularly where the trail surface is wet. These tracks most likely indicate that there has been some illegal vehicular use on the trails. Trail marking and signage are limited only to a few small trail markers for the Western Greenway.

Access points are found along Concord Avenue, Mill Street, and Pleasant Street as well as from Zone 1A (the Woodlands at Belmont Hill development), the McLean Hospital campus, and Zone 4 (the future Research and Development subdistrict). Most of these trailheads tend to be poorly defined and none are signed. At most of the roadway intersections, impaired sightlines and overgrown vegetation present very dangerous conditions to pedestrians attempting to cross the road. There is no dedicated open space parking. No site maps or information areas exist to assist uninformed trail users.

Individual Trail Description and Analysis

Trail 1



Description and Location: Commonly known as the "Old Coal Road," Trail 1 connects Pleasant Street at the base of the hillside of the Eastern Woods to the water tower area in the central part of the Open Space. Along the way to the water tower, Trail 1 intersects with Trail 2, 3, 5, A, B, C, and D. Near the water tower, Trail 1 connects to Trails 4 and 6. At the base of the Eastern Woodlands hill, the trail splits to the north and south with both split trails terminating at Pleasant Street The southern split terminates across street from the Shaws grocery store driveway and the trail meets Pleasant Street at a steep grade. The northern split is longer in length and has a gentler grade, terminating at a large paved area. There is a metal gate at the end of the split trail. The paved area at the end is currently used as a staging area for the Pleasant Street construction. Advancing up the hill, Trail 1 runs parallel to Junction Brook. Halfway up the hill, Trail 1 goes between two old stone walls and then passes by the old Codman House parking area (half the parking area in within McLean Hospital property; half within the MOS property). This parking area is currently in a state of disrepair and the McLean Hospital portion is used as construction staging for work on the hospital campus. Further up the hill, a small stream passes under the trail via a small culvert pipe. Past the parking lot, the trails tread narrows. Near the top of the hill, the trail veers to the northwest at the intersection with Trail D. Past this turn the grade of the starts to flatten and then the trail tread becomes wider past the intersection with Trail 5. The trail runs through an open forest area and the trail corridor is plenty wide enough for vehicular access.

Trail Surface: At the base of hill near Pleasant Street, the trail is composed of a mix of gravel, larger stones, broken asphalt concrete, and loose dirt and sand. Further up the trail past the stone walls, the trail becomes composed mostly of compacted soil with some exposed native rock and tree roots. At the top of the hillside where the grade begins to flatten, the trail surface is composed of a good amount of compacted soil and organic duff. In sunny areas, there is some grass and herbaceous vegetation growth within the trail surface.

Trail Length: 3,850 feet (0.73 mile)

Trail Width: **Tread**: Varies - 7 to 10 feet wide at and below stone walls; 2 to 5 feet between stone walls and top of hillside; 8 to 10 feet in the flatter area between Trail 5 and the water tower
Corridor: Typically 10 to 14 feet wide

Grades: Mostly between 2% and 5% with some areas between 5% and 10%; At base of hillside, trail steepens to over 12%.

Issues:

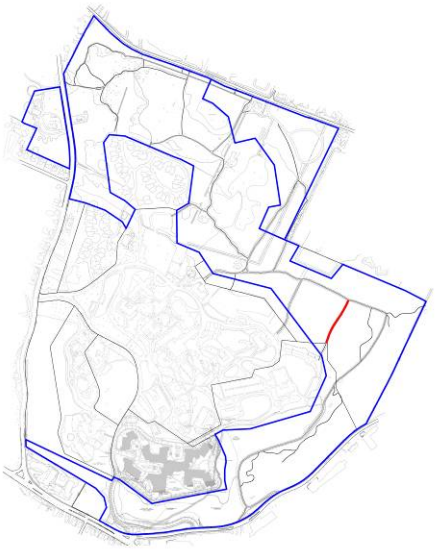
- Trailhead across street from Shaws (southern trail split) is dangerous due to limited sightlines along Pleasant Street, overgrown vegetation, and steep trail grades
- Area of tree fall across trail at the southern trail split
- During spring and following rain, there is significant ground water seepage across the trail surface in the area of trail immediately above the trail split. It is assumed ground water is coming from Junction Brook. The seepage water then flows back into Junction Brook at the top of the southern trail split. This water flow is fairly rapid at times and is causing trail erosion, gullying, and general muddy conditions.

- Significant trail erosion and gullying is occurring in the area of trail between the stone walls as a result of focused water flow originating from the Codman House parking lot. The stone walls trap the water, making the problem worse as the water flows down the trail.
- Halfway up the hill, a large tree has fallen across trail thus blocking any emergency access; a short well-established trail goes around tree to the east and connects back up to Trail 1 on the other side of the tree.
- Significant amount of Japanese knotweed (an invasive plant) growth is occurring around area of above tree fall.
- The small pipe culvert at the stream crossing has filled in with dirt and debris causing the stream water to flow over trail surface.
- Below the area where the trail turns to the northwest, there is an area of erosion and gullying along this steeper area of the trail.
- There are several seasonally wet and muddy areas between Trail 2 intersection and the water tower area (also note that truck tracks where visible in these muddy area during two of the analysis site visits).
- The Belmont Fire Department desires to have this trail maintained for emergency access.

Analysis:
Trail 1 is one of the major trails in the Open Space and also serves as a primary emergency access route, but poor trail conditions and erosion has seriously degraded the overall quality and usability of this trail, particularly along the hillside portion. The quality of the trail does increase as the grade decreases along the top of the hill. Secondary Trails A, B, and C provide an alternate route to Trail 1 for access to top of the Eastern Woods hillside. Without a major trail reroute, Trail 1 will not be able to meet trail accessibility standards.

The fallen trees require removal for safety and site access. The Codman House parking lot runoff issue as well as the ground water seepage at the base of the trail requires addressing to prevent further trail erosion. The pipe culvert requires removal of debris blocking the stream water flow.

Trail 2



Description and Location: In the Eastern Woods, Trail 2 connects Trail 1 to an old parking area/roadway on the McLean Hospital property. The area of the McLean campus where the trail terminates is currently unused (near old Codman House area) but will be part of the future Research and Development subdistrict (Zone 4). The trail corridor is mostly covered over with herbaceous plants such as grasses, garlic mustard, and poison ivy along with some seedling woody plants. A former vehicle access route, this trail appears to be mostly unused now. The trail runs through an open forest area.

Trail Surface: Mostly compacted soil with some visible gravel and exposed native stone with significant grass and herbaceous vegetation growth.

Trail Length: **Total**: 600' (0.11 mile)
Within Open Space property: 525' (0.10 mile)

Trail Width: **Tread**: 1 foot wide maximum
Corridor: 12 to 14 feet wide

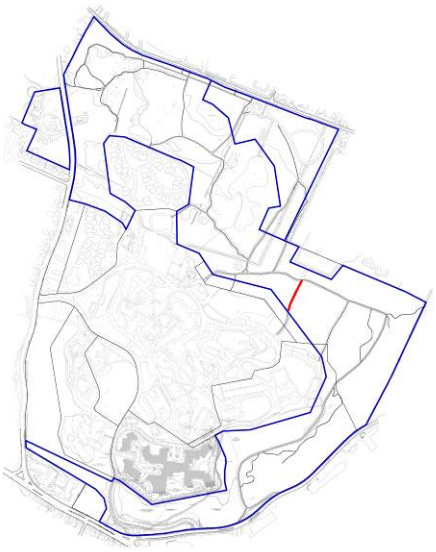
Grades: Trail is steeper in the middle and lower sections (5 to 10%) with some areas exceeding 12%; trail is more level (0 to 5%) near intersection with Trail 1.

Issues:

- Trail is almost obsolete due to nonuse and is significantly overgrown with vegetation.
- McLean Hospital sees no current use for this trail.
- Trail should no longer be required for emergency access.

Analysis:
Future use of this trail will depend on final design and construction of the Research and Development subdistrict.

Trail 3



Description and Location: In the Eastern Woods, Trail 3 is a moderately-used trail that connects Trail 1 to McLean Hospital campus by passing through the established 100' Buffer area. The trail terminates in drive/parking area across from the Wyman House. The trail runs through an open forest area and the trail corridor is wide enough for vehicular access. The trail currently provides one of the three used connections from the McLean Hospital Campus into the MOS.

Trail Surface: Compacted soil with some exposed native rock, installed gravel, and some roots. Some grass growth within tread area; Along the steeper area within the 100' Buffer area, installed gravel and rock covers most of the trail surface (presumably for stabilizing the steep trail).

Trail Length: **Total**: 550' (0.10 mile)
Within Open Space property: 310' (0.06 mile)

Trail Width: **Tread**: 5 to 7 feet wide
Corridor: 10 to 12 feet wide

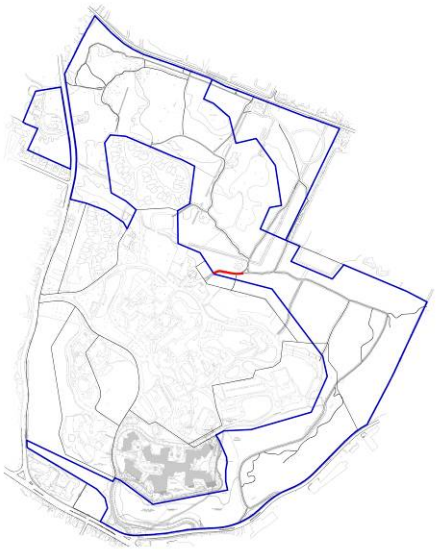
Grades: Quite steep (12 to 20%) within the 100' Buffer area and McLean campus property; much more level (2 to 6%) in the Open Space and near intersection with Trail 1.

Issues:

- The steep area has erosion potential although it is currently stabilized by the gravel.
- Trail is too steep to meet trail accessibility standards unless significantly rerouted.
- The metal gate at the end of the trail in McLean is currently destroyed and open. Only a chain with a sign at the small Wyman House parking area serves to restrict vehicular access although there is plenty of room for an illegal vehicle to go around the chain and enter into the Open Space property.
- The Belmont Fire Department desires to have this trail maintained for emergency access.
- McLean Hospital (per Andy Healey) desires to maintain this trail as one of the entry trails from McLean into the Open Space.

Analysis: Trail 3 receives enough use as a pedestrian access trail into the MOS to justify maintenance.

Trail 4



Description and Location: A moderate to well used short trail in the Eastern Woods connecting the water tower area to the McLean Hospital campus by passing through the 100' Buffer area. Trail terminates into a lawn area behind the Bowditch and Oaks buildings with a signed chain gate. Trail 4 connects to Trails 1 and 6 at the water tower area. The trail runs through an open forest area and the trail corridor is wide enough for vehicular access. The trail currently provides one of the three used connections from the McLean Hospital Campus into the Open Space Land.

Trail Surface: Mostly compacted soil and duff near the water tower changing over to a compacted soil and installed gravel mix at steeper section of trail within the 100' Buffer area. Some areas of the trail exhibit seasonally wetness.

Trail Length: **Total**: 450' (0.09 mile)
Within Open Space property: 350' (0.07 mile)

Trail Width: **Tread**: 6 to 8 feet wide
Corridor: 12 to 14 feet wide

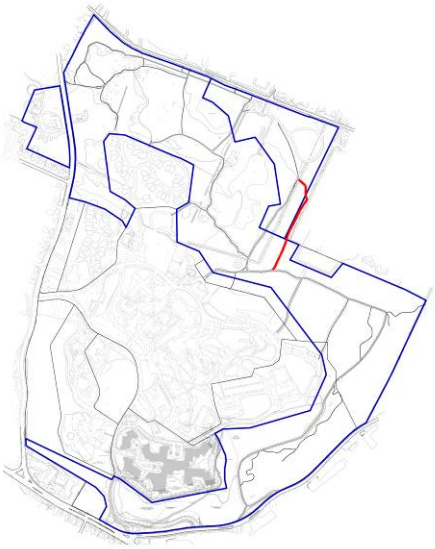
Grades: Moderately steep (10 to 12%) within and north of the 100' Buffer area; much more level (2 to 5%) in the Open Space by the water tower and at intersection with Trail 1.

Issues:

- Some minor erosion issues along the steeper parts of trail, mostly near & within the 100' Buffer area.
- Truck tracks visible in the muddy parts of trail during the spring/early summer site visits,
- McLean Hospital (per Andy Healey) desires to discontinue use of this trail as one of the entry trails from McLean into the Open Space due to patient safety and privacy issues.

Analysis: This relatively short trail only serves as an access route for McLean Hospital. McLean Hospital would like to close trail to prevent trail users accessing this part of the hospital campus.

Trail 5



Description and Location: A well-used trail connecting Trail 1 to the intersection of Trails 6 & 7 in the Highland Meadow Cemetery. About half of the length of this trail runs outside of the MOS property line and through private property. The southern segment of the trail within the Open Space has a corridor wide enough for vehicular access, while the trail is much narrower in the Cemetery. At the intersection of Trail 6, Trail 5 passes through an opening in an old stone wall. The trail runs through an open forest area.

Trail Surface: Smooth, compacted soil; exposed rocks and roots are present along the steeper parts of the trail south of the property line due to minor erosion. No major erosion issues visible.

Trail Length: **Within the Open Space Land**: 300' (0.06 mile)
Within cemetery land: 150' (0.03 mile)
Total trail length (including private property): 875' (0.17 mile)

Trail Width: **Tread**: 5 to 6 feet wide within Open Space; approximately 2 feet wide within Cemetery
Corridor: 8 to 12 feet wide within Open Space Land; 3 to 5 feet wide within Cemetery

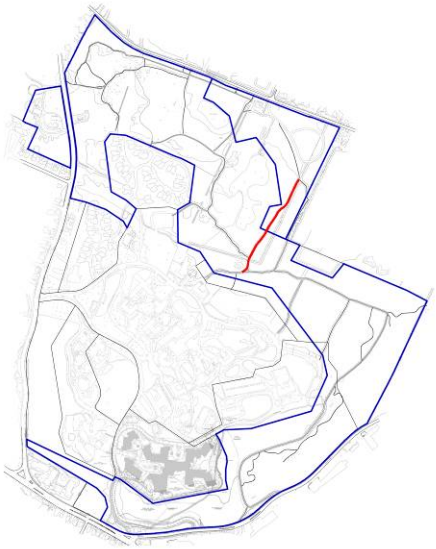
Grades: Relatively level (1 to 5%) with a moderately steep area (6 to 12%) south of the property line.

Issues:

- Portion of trail passes through private property
- Steep area south of the property line goes straight down fall line although there are no major erosion problems.

Analysis: Trail is in relatively good condition and provides a nice trail experience through the woods. The fact that half of this trail passes through private property restricts its inclusion as an official Open Space trail. Trail 6, which is about 160 feet to the west, runs parallel to Trail 5 and both connect to the same general areas of the Open Space and Cemetery. Measures could be taken to direct trail users away from Trail 5 and onto Trail 6.

Trail 6



Description and Location: Within the Eastern Woods, Trail 6 is a well-used trail connecting the water tower area and Trails 1, 4, & 8 to Trails 7 and 5 within Highland Meadow Cemetery. This trail runs roughly parallel to one of the old stone walls to the east and alongside the Red Maple Swamp to the west. This trail runs through an open forest area and has a corridor wide enough for vehicular access.

Trail Surface: Compacted soil with some exposed native rock and roots. No major erosion visible.

Trail Length: **Total**: 960' (0.18 mile)
Within Open Space: 375' (0.07 mile)

Trail Width: **Tread**: 5 to 8 feet wide
Corridor: 12 feet wide

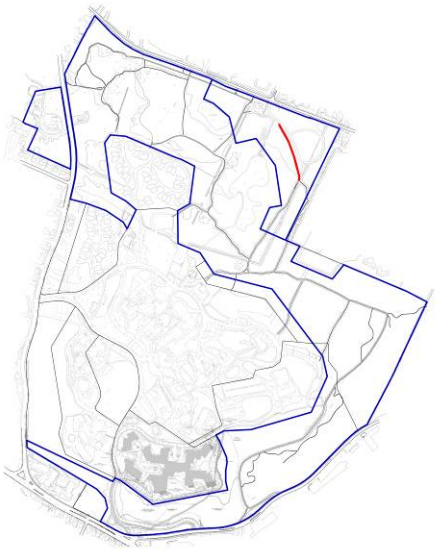
Grades: Very level (0 to 5%) along most of the length of the trail with an 80 foot long stretch near the Trail 5 intersection where the grade maxes out at approximately 10%.

Issues:

- No major erosion issues
- Some large roots and rocks in trail tread.
- Portions of trail within 100' wetlands buffer
- Within the future phase area of the Highland Cemetery

Analysis: Trail is in relatively good condition and provides a good, open trail experience through the woods. If accessibility is desired, some of the larger exposed rocks may need to be removed or allow for proper clearance. Trail 5, which is about 160 feet to the east, runs parallel to Trail 6 and both connect to the same general areas of the Open Space and Cemetery. The Cemetery is not expected to expand into this area for many years. Until then, this trail could be maintained on an as-needed basis for continued emergency access and allowed to continue its use as one of the connections between the main MOS, the Concord Avenue neighborhoods, and the Cemetery.

Trail 7



Description and Location: A moderately-used, narrow trail located in the Heart-Shaped Meadow. When the meadow grass is high, it is difficult to make out the location of most of this trail. Trail 7 parallels the new Highland Cemetery driveway for most of its length and a short trail at the intersection of Trails 5 and 6 lead directly to the driveway. Some trail users may opt for the using the driveway instead of Trail 7, particularly when the meadow grass is high. The upper portion of trail goes through opening in the old stone wall that runs along the west side of the meadow. This trail terminates near the Concord Avenue Cemetery entrance. A short walk down the cell tower driveway provides pedestrian entry to Trail 10 and 16.

Trail Surface: Smooth compacted soil; no visible erosion issues.

Trail Length: 525' (0.10 mile)

Trail Width: **Tread**: 1 to 1 ½ feet wide
Corridor: Open (through meadow); narrows at opening in stone wall

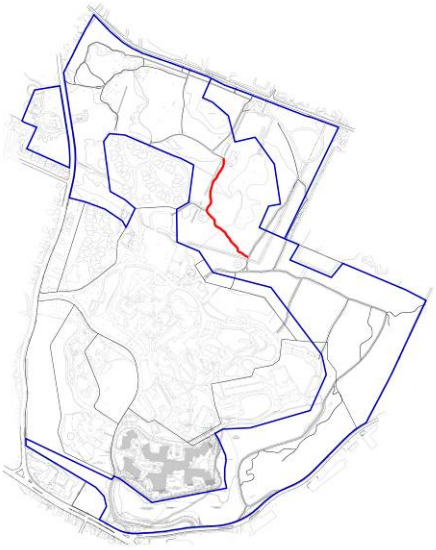
Grades: Most of the trail is relatively level (3 to 5%) with a very steep area (10 to 20%) for about 80 feet east of the stone wall

Issues:

- Trail is very closely located to Cemetery driveway.
- Some invasive plants and poison ivy are located along trail edge.
- No major erosion issues.
- Trail not accessible due to steep grades based on current trail accessibility standards.

Analysis: Trail 7 provides a nice trail experience through the small Heart-Shaped Meadow. However, it may be desirable to move a portion of this trail away from the Cemetery and possibly closer to the edge of the woods to provide more of a meadow experience. Invasive plant issues are currently being addressed as part of the meadow management plan. Connections to the second, southern opening in the old stone wall on the west side of the meadow could be explored resulting in the possible installation a trail through the Red Maple Swamp. A more formal trail connection through the northern opening the stone wall will better connect the meadow to the cemetery roadway.

Trail 8



Description and Location: This well-used trail skirts the southern and western edge of the wetlands of the Red Maple Swamp. Its function is to provide an essential connection between the eastern and western sides of the MOS by connecting Trails 1 and 6 to Trails 10 & 11 (Great Meadow). This trail also connects to the shorter Trail 9 (which, in turn, connects to the McLean Hospital campus). A small, rubber-covered, wooden bridge crosses the main stream outlet for the Red Maple Swamp. A portion of this trail runs above the recently installed water main between Concord Avenue and the McLean campus. Several short trails into the wetland areas (Trails E) start from this trail. The trail is relatively narrow on the east side of the bridge but widens on the west side, near the intersection with Trail 9, with enough clearance to allow for vehicular access. The wider trail continues up to the Great Meadow. At the point where the trail passes by the wetland areas on both side of the trail, the tread is raised above the surrounding wetlands but still becomes seasonally wet and muddy. As the trail enters into the Great Meadow, it passes through a wide opening in the old stone wall that defines the eastern edge of the meadow. This trail runs through both upland and wetland forest areas.

Trail Surface: Compacted soil with exposed rocks and roots throughout length of trail; some installed gravel at Trail 9 intersection. Along the steep area immediately east of the bridge, there is some significant trail erosion. There is also minor to moderate erosion at the stone wall. The seasonally wet area at point where trail is closest to wetland presents muddy conditions.

Trail Length: 1100’ (0.21 mile)

Trail Width: **Tread**: 2 to 6 feet wide (varies)
Corridor: 8 to 12 feet wide on west side of bridge; 5 to 6 feet wide on east side of bridge

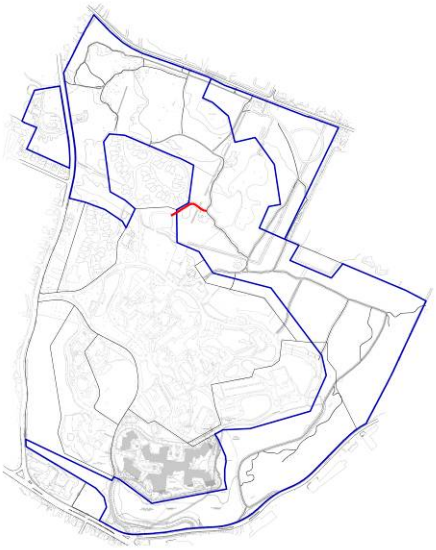
Grades: Most of trail is moderately level (2 to 6%) with a moderately steep to very steep area (10 to 20%) east of the bridge.

Issues:

- Seasonally muddy area
- The bridge may be located too low, thus damming up the flow of the outlet stream. Debris typically collects on the upstream side of bridge.
- Bridge possibly too narrow; otherwise the bridge is in relatively good condition and appears to be stable.
- Most of trail is within the 25-foot and 100-foot wetlands buffers.
- Erosion problems due to steep trail east of bridge.
- The Belmont Fire Department desires to have this trail maintained for emergency access.

Analysis: This trail is a link between the wooded hillside of the Eastern Woodlands and Great Meadow while also being an enjoyable walk through the denser woods surrounding the Red Maple Swamp. If this trail is removed, the only other route to connect the east and west side of the property will be a combination of Trails 7 and 10. Options for replacement of the bridge should be considered to prevent debris buildup pending conservation requirements. A potential reroute along the steep area of the trail should be considered; otherwise the trail should be regraded to improve drainage of water off of the trail. Options should be evaluated to deal with seasonally muddy area adjacent to the wetland areas; area can possibly be fixed by raising the grade of the trail.

Trail 9



Description and Location: Within the Red Maple Swamp area, Trail 9 is a moderately-used trail connecting Trail 8 to both the residential subdistrict (Zone 1A) and the McLean campus Trail terminates at a metal pipe gate at the end of a McLean parking lot. The trail runs through an open, grassy area with wooded areas to the north and east. The last 55 feet of the trail is actually on the McLean property. A narrow and barely distinguishable trail connects Trail 9 to one of the residential roads in Zone 1A via a mulched landscape bed. A portion of Trail 9 is immediately behind several of the newly constructed residential units. Invasive Japanese knotweed grows in the area between the trail and residential units.

Trail Surface: Compacted soil with a good amount of grass growth within the trail tread (trail receives a good amount of sunlight). There are exposed rock and placed gravel on upper portion of trail near the Trail 8 intersection.

Trail Length: 290' (0.05 mile)

Trail Width: **Tread**: Varies within corridor (mostly grass covered).
Corridor: 8-12'

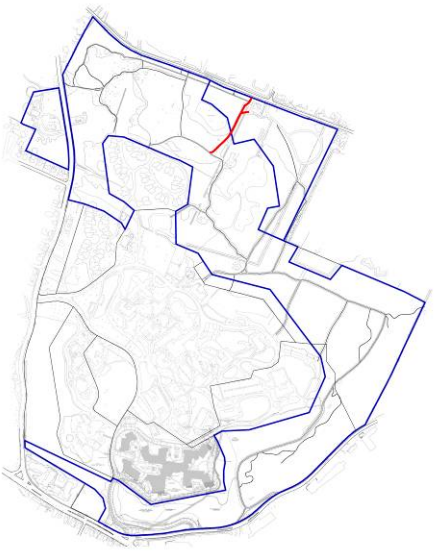
Grades: Moderately steep (8 to 12%) throughout the length of the trail with some area around 16%. The trail flattens slightly at the parking lot.

Issues:

- Some minor erosion along steeper portion of trail.
- Dense stands of invasive knotweed (also known as false bamboo) growing along trail.
- The Belmont Fire Department desires to have this trail maintained for emergency access.
- McLean Hospital (per Andy Healey) desires to maintain this trail as one of the entry trails from McLean into the Open Space.

Analysis: In order to prevent further spread of the knotweed, control measures are needed. This trail and Trail 3 could serve as the only trails into the Open Space from the McLean campus. Maintenance and repair of the gate would serve to restrict illegal vehicle access.

Trail 10



Description and Location: A well-used and wide trail that connects to Trail 11 on the eastern side of the Great Meadow and to the cell tower area. A short and narrow extension of this trail connects to the eastern end of the Pine Allee (Trail 16). Trail 10 runs along the upland area between the northern end of the Red Maple Swamp and the vernal pool area to the west. This trail runs parallel to and approximately 30 feet apart from the old stone wall that defines the eastern end of the Great Meadow. Trail 10 connects directly to the end of the cell tower driveway. The trail is located mostly within the open mowed area of Great Meadow with woodland edges along both sides of the trail.

Trail Surface: Compacted soil; compacted tire treads are visible with grass growth in between.

Trail Length: 600' (0.11 mile)

Trail Width: **Tread**: Typically two 2 feet wide tire treads; approximately 8' total width
Corridor: 20 feet plus; trail mostly located within the mowed meadow area.

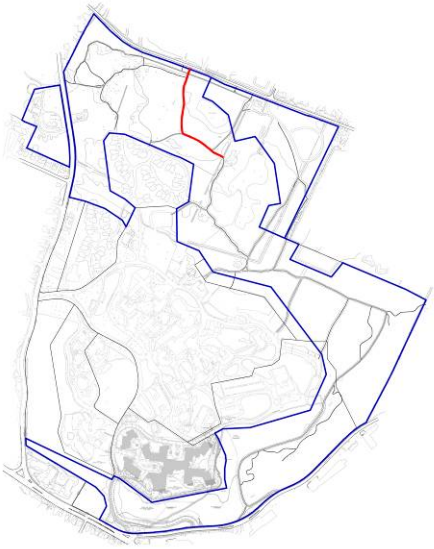
Grades: Trail is mostly level (0 to 5%) and steepening slightly to 7 to 8% near the trail termination with the cell tower driveway.

Issues:

- Some minor seasonally wet areas with visible truck tire ruts.
- Some poison ivy immediately adjacent to trail
- There is potential for future erosion problems caused by the newly-constructed emergency tower paved access drive. The existing grading on drive funnels storm water flow directly onto trail.
- Portions of trail within the 100 foot wetland buffer area.
- The Belmont Fire Department desires to have this trail maintained for emergency access.

Analysis: This trail provides a direct connection between the Cemetery and the Great Meadow. A trail connection could be explored between this trail and Trail 7. Some water diversion measures may need to be taken to prevent any erosion issues resulting from the cell tower driveway.

Trail 11



Description and Location: This is the main trail through the Great Meadow and runs alongside the highest point on the Open Space (Lone Tree Hill). The trail connects to Trails 8 and 10 at the eastern side of the meadow. It also connects directly to Trails 12, 13, and 16 (the Pine Allee) and terminates at a gated trailhead on Concord Avenue. Atop Lone Tree Hill, this trail also provides indirect access to the Judy Record Memorial.

Trail Surface: The trail is typically composed of compacted soil with some installed gravel at Concord Avenue trailhead. There is a seasonally wet area at about the halfway point between the top of the hill and Concord Avenue. It appears that this wet area is created by ground water movement from the vernal pool area to the east. The trail tends to widen and braid in this area as walkers and bikers attempt to avoid the muddiest areas. This area typically dries in summer then trail returns to a single route. During site visits, there was evidence of attempted trail mitigation by the installation of tree branches and wood boards within the muddy trail section.

Trail Length: 975' (0.18 mile)

Trail Width: **Tread**: 1 to 2 feet wide; trail splits into two tire treads on uphill portions of path. At the muddy area, trail braids. Trail widens to 6 to 8 feet at Concord Avenue gate.
Corridor: Open (within grass meadow)

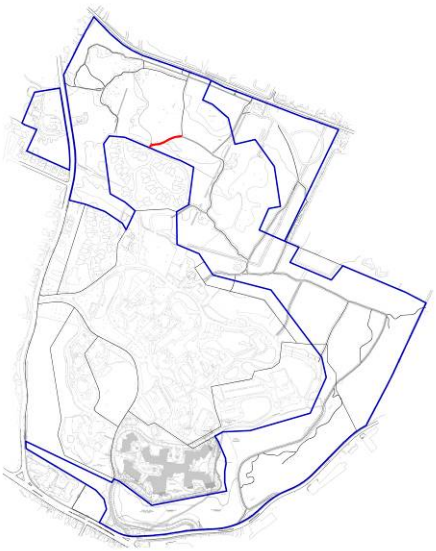
Grades: Along the top of the hill, the trail is very level. Heading north towards Concord Avenue the trail drops at an average 6% grade with a slight low point at the seasonally wet area.

Issues:

- Seasonally wet area allows for the creation of trail braiding in the springtime and presents muddy conditions.
- Some poison ivy immediately adjacent to trail.
- Portion of trail is within a delineated wetland buffer
- No areas of erosion problems visible.
- The Belmont Fire Department desires to have this trail maintained for emergency access.

Analysis: This trail can arguably be considered the most scenic of the trails in the Open Space. Further evaluation of the muddy area may call for possible trail rerouting or more permanent mitigation measure(s).

Trail 12



Description and Location: Within the southern part of the Great Meadow, this moderately used path provides a connection down the Lone True Hill from Trail 11 to the recently developed Residential subdistrict 1A. Although mostly within the mown grass of the Great Meadow, Trail 12 passes through an area of invasive plants and staghorn sumac. There is a moderate amount of erosion along the steeper part of the trail (trail goes directly down the fall line). The trail terminates at a newly gated trailhead located at an opening in the old stone wall defining the southern edge of the Great Meadow.

Trail Surface: Mostly compacted soil with a good amount of grass growth in the trail tread. Some exposed stones due to erosion along steeper portions of trail.

Trail Length: 325' (0.06 mile)

Trail Width: **Tread**: 1-2'
Corridor: Open (within grass meadow)

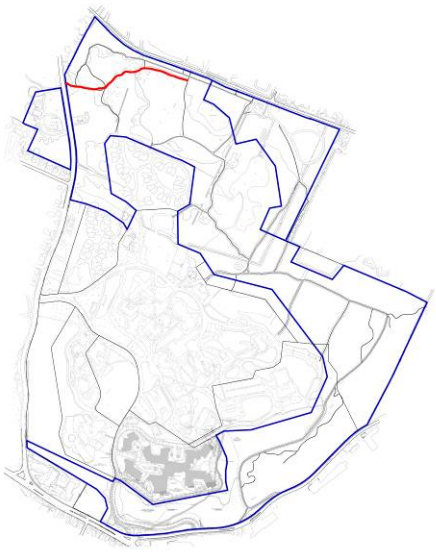
Grades: About half of the trail can be considered very steep with a 15 to 18% slope. Trails levels out to relatively flat at both ends.

Issues:

- Some poison ivy and invasive plant growth adjacent to trail
- Trail runs directly down the fall line of hillside creating erosion and gullying of the trail surface.
- Possible increased use of trail with the full development of residential areas.

Analysis: This trail will probably receive a good amount of pedestrian traffic as is serves as the main access to the Open Space from the residential area. There is a good potential to reroute this trail to more closely follow the contours of the hillside, to create a more interesting journey through the meadow, and prevent erosion problems while still providing the essential connection to Trail 11. Control of invasive plants is being handled under the separate meadow restoration project

Trail 13



Description and Location: Within both the northern part of the Great Meadow and the Northwest Corner, this well-used trail provides a connection between Trail 11 and the Concord Avenue trailhead to the Mill Street trailhead and the trails and parking area of Rock Meadow (Belmont conservation land) on the other side of Mill Street. This trail directly connects to Trails 14, 15, and F and indirectly to Trail 16 (the Pine Allee) via a short connecting path. The upper eastern portion of this trail skirts the northern edge of the Great Meadow. Here the grass can grow tall and encroaches on both sides of trail. The western portion proceeds rapidly down the hill through the successional shrub and pine forest area down to Mill Street. Going down the hill, the trail winds through several areas where the adjacent woody vegetation is very tight to the trail and greatly restricts sightlines. At the top of one of the steeper areas of the trail halfway down the hill, the trail splits on either side of a medium-sized oak tree. The trail terminates abruptly at Mill Street. There is a Western Greenway marker tag attached to an adjacent utility pole.

Trail Surface: The trail tread is relatively smooth compacted soil through the Great Meadow portion of trail. Within the Northwest Corner, the trail surface is a mix of looser, eroded soil with numerous exposed native stones and some larger rocks. Erosion is quite common as the trail typically follows the fall line of the hillside. Severe gullying and u-shaped channeling of the trail is also occurring in some sections. .

Trail Length: 1190’ (0.23 mile)

Trail Width: **Tread**: Varies from 1 foot wide through the meadow to 1 ½ to 3 feet wide on the hillside
Corridor: Open through meadow area; 2 to 8 feet wide on hillside (corridor extremely narrow in some areas due to encroaching woody vegetation).

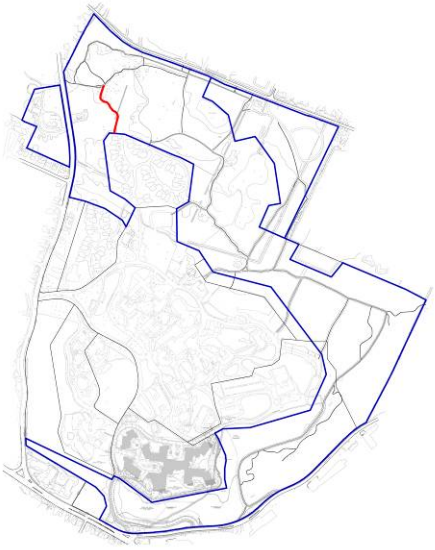
Grades: The trail is flat on the upper part of the trail through the meadow; trail grades vary on the hillside with several very steep areas (14 to 18%) separated by more moderately sloped to flat areas.

Issues:

- No regular mowing of the trail corridor through the Great Meadow means that tall grass covers the trail during spring and summer.
- Low hanging tree branches at western edge of the meadow.
- Tight woody and invasive vegetation along some sections of trail restricts sightlines.
- Highly eroded and gullied trail surfaces
- Loose soils
- Large rocks and steep trails restrict accessibility.
- Sections of trail follow fall line.
- Some poison ivy adjacently to trail.
- The trailhead at Mill Street presents a safety issue as the sightlines up and down Mill Street are restricted by vegetation and the overall alignment of the road. Automobiles travel at high rates of the speed on this road and the traffic levels are usually quite high, especially at rush hours, making crossing Mill Street very difficult.

Analysis: Of all the trails in the Open Space, this trail arguably has the most problems with erosion and could be a prime candidate for at least partial rerouting. At a minimum, the overgrown vegetation currently restricting sightlines along the trail should be cut back or removed. Options for the Mill Street trailhead need exploration for safer access to and from Rock Meadow.

Trail 14



Description and Location: Located within the Northwest Corner, this trail spurs off of Trail 13 and goes through a small open grassy area before descending into a wooded area. In the woods, the lower portion of the trail passes through an opening in an old stone wall before terminating in an overgrown, seasonally wet area. Based upon previous studies, this trail seems to have been well-used in the past as it once connected into the McLean Hospital campus. With the construction of the Residential subdistrict (Zone 1A), this trail now basically dead-ends at the residential property line.

Trail Surface: Compacted soil with some rocks and roots before terminating in an area overgrown with dense grass and herbaceous vegetation. Some minor erosion is present at the single steep section of trail.

Trail Length: 500' (0.09 mile)

Trail Width: **Tread**: 1 to 2 feet wide; trail becomes mostly indistinguishable past the stone wall
Corridor: 5 to 6 feet wide; upper portion of trail runs through a small open grass area

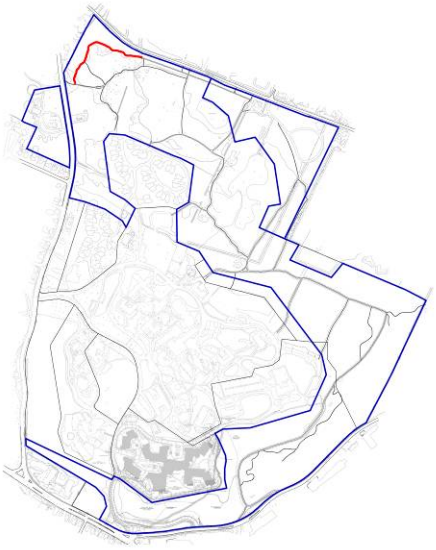
Grades: Trail is relatively flat (1 to 5%) with a single, moderately steep area (approximately 10%)

Issues:

- Dead-end trail due to existing grades and location of new house and roadway in residential development; not feasible to provide a connection into residential area.
- Wet, muddy soil at end of trail
- Some minor erosion at steep portion of trail

Analysis: This trail is a good candidate for elimination, but the upper segment of trail can be used in potential reroute of Trail 13.

Trail 15



Description and Location: This trail runs within the Northwest corner of the Open Space and acts as a connection between Trail 16 (Pine Allee) and Mill Street (via Trail 13). Trail 15 also intersects with Trail F. Trail 15 can be considered an alternate route for Trail 13. Through its entire length, Trail 15 descends the hillside and in many areas goes quite steeply down the fall line. While many areas of the trail are in relatively good condition, the steeper sections do have some moderate erosion problems. According to previous studies, these steep sections used to be more severely eroded, but gravel and some very minor drainage grade dips were installed in the past few years to deal with this issue. This trail mostly runs through the red pine forest and passes several small, open grassy areas within the pines.

Trail Surface: Compacted soil with some rocks and minor roots. In the steeper sections, larger native rocks are exposed and gravel has been installed. Gravel tends to be quite loose when walked upon.

Trail Length: 875' (0.17 mile)

Trail Width: **Tread**: 1 to 4 feet wide; wider at the steeper areas
Corridor: 4 to 10 feet wide; corridor narrows at the bottom of the hill

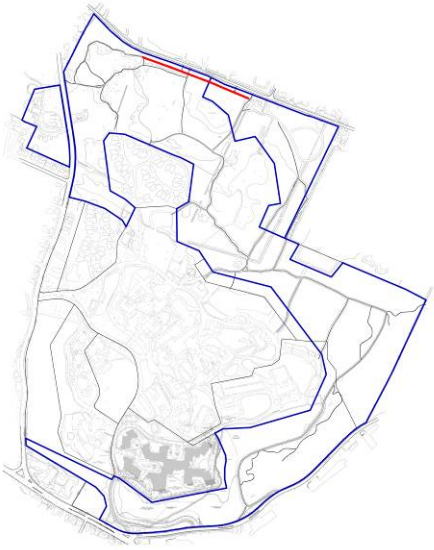
Grades: The majority of the trail tends to exceed 5% with two sections at 20%; trail flattens at bottom of hill (Trail 13 intersection) to around 2%.

Issues:

- Moderate erosion at steep portions of trail; trail often follows fall line
- Loose gravel presents some unsafe conditions

Analysis: Despite its erosion problems, this trail is arguably one of the best woodland trail experiences in the MOS even though there is the ever present traffic noise from busy Concord Avenue and Mill Street. The trail provides direct access to the Pine Allee and several pleasant small meadow areas. Options for eliminating the problems at the two steep areas of the trail should be explored.

Trail 16



Description and Location: Trail 16 is located within the Pine Allee, a unique landscape feature in the MOS. This straight-running trail, parallel to Concord Avenue, is lined with a two single rows of white pine trees, many of which approach 24 to 30 inches in diameter. Other smaller pines, oaks, and pine seedlings are in the understory. Pine leaves and duff cover the trail surface. Trail 16 connects directly to Trail 15 at its western end, Trail 11 at its halfway point, and to Trail 10 via a small connector trail at its eastern end. About 60 feet to the west of the Trail 11 Concord Avenue trailhead, there is a narrow trail that passes through the old stone wall and connects across Concord Avenue to the Audubon Habitat trail system. This area is also considered part of the Western Greenway and there is a Western Greenway marker tag attached to any adjacent tree. There are a number of other small trails that lead off of Trail 16 to Concord Avenue via openings in the stone wall. The wooded area of Trail 16 provides a forested wildlife corridor between the eastern and western wooded areas of the Open Space.

Trail Surface: Compacted soil with a layer of pine leaf and bark duff which acts to soften the surface of the trail. Some small roots break the trail surface.

Trail Length: 1000’ (0.19 mile)

Trail Width: **Tread**: 5 to 6 feet wide
Corridor: 6 to 8 feet wide; corridor defined by pine tree trunks

Grades: The majority of the trail is fairly level (0 to 5%) with the western end of the trail steepest at around 7% (near the Trail 15 connection).

Issues:

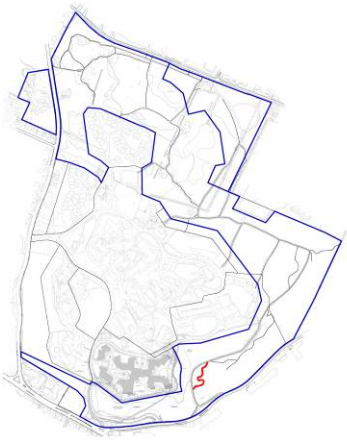
- Several pine trees are missing.
- Broken branches from the pine trees fall on trail.
- Compacted trail may affect health of trees.

Analysis: This trail, as defined by the rows of pine trees, provides a unique experience. But some landscape maintenance will be required in order to retain the aesthetic and landscape quality. Vehicle traffic along this trail must be avoided to prevent damage to the trees by compacting and rutting the trail tread.

Secondary Trails A, B, C, D, E, F

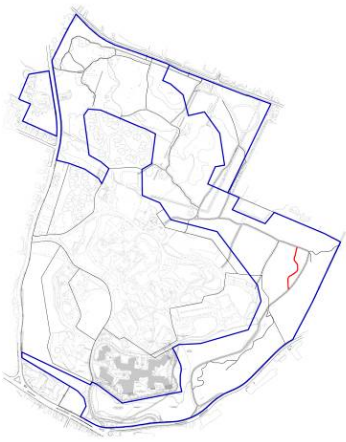
Descriptions and Locations: Based on site observations and previous studies, the Secondary Trails are a group of trails that have been created more recently than the Primary Trails, either through repeated use or deliberate trail cutting and clearing.

- **Trails A, B, and C** are narrow (single-track) trails through the Eastern Woods and provide an alternate route to Trail 1. Some portions of these trails are very steep and in these areas there is potential for future erosion problems. There is a wet and muddy area along a section of Trail B.



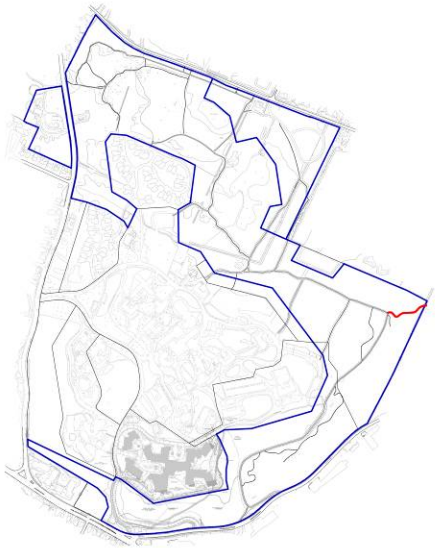
Trail A

Trail B



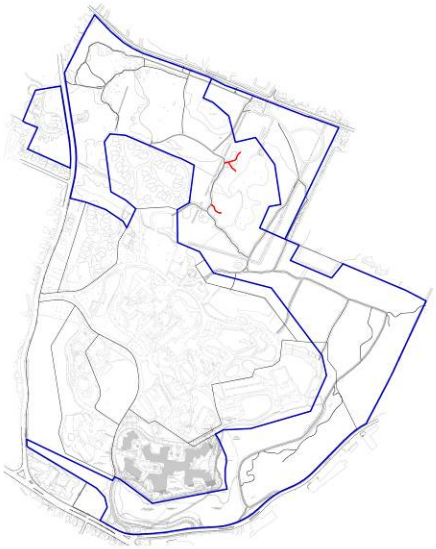
Trail C

- **Trail D** is a moderately well-used trail in the Eastern Woods that connects into the MOS from the dead-end of Snake Hill Road. It terminates at Trail 1. There are some areas of moderate erosion where the trail steepens.



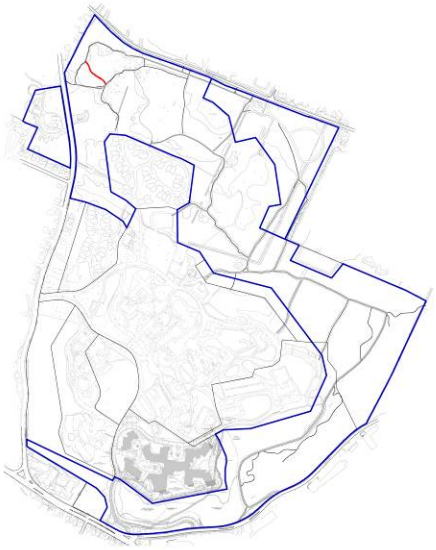
Trail D

- **Trails E** are a series of three trails emanating from Trail 8 and into the area surrounding Red Maple Swamp. All three trails seem to dead end at the edge of wetland.



Trail E

- **Trail F** cuts across the side the hill in the Northwest Corner and connects Trails 13 and 15. It goes through the heart of the red pine forest.



Trail F

Trail Surfaces: Generally all of the Secondary Trails surfaces are composed of compacted, loamy soil with some exposed native stones and roots. Wherever grades tend to exceed 10% to 12%, there is some level of trail erosion, exposing more rock and loose soil. As these trails are newer and not used at the same level as the Primary Trails, the Secondary Trails surfaces are generally not as compacted nor as wide. The exception is Trail D which is fairly well compacted throughout, perhaps due to abundance of use from Snake Hill Road. Trail F has a layer of pine leaf and bark duff making for a softer surface.

Trail Lengths: All lengths approximate.

A: 525 feet
B: 1,225 feet
C: 540 feet
D: 390 feet
E: 400 feet (all three trails combined)
F: 290 feet

Trail Width: **Treads**: Generally 1 to 2 feet wide; Portions of Trail D approximately 3' wide
Corridor: Generally 2 to 5 feet wide

Grades: The Secondary Trails were not surveyed as part of the original topographic survey and the trail alignments shown on the plan are approximate only. Therefore the grades for the Secondary Trails have not been measured but it is estimated that some sections of trail exceed 15% or more with some areas following the fall line. Trails C and E are generally flat with Trail C having a single moderately steep area at the southern intersection with Trail 1. Trail F is probably around 7% to 8% and tends to hug the contours of the hillside.

Issues:

Trails A, B, and C: There are several areas where these trails are too steep to be sustainable. A part of Trail B goes through a wet area that appears to be wet and muddy year around (as opposed to the seasonally wet areas along other trails in the MOS). On one site visit, there was active water flow in this area.

Trail D: Trail users unfamiliar with the MOS trail system do not know that this trail connects to a private road outside of the MOS presenting a private property issue.

Trails E: These trails tend to be seasonally wet and muddy.

Trail F: There are no significant issues with this trail aside from a few exposed roots.

Analysis:

Trails A, B, and C: Although the general alignment of these three trails work, there are some areas that are probably too steep to be sustained over time. With minor reroutes at the steep and wet areas along with good surface water control techniques, these trails can continue to provide alternative routes to Trail 1. The wet area in Trail B calls for an alternate trail tread solution. Although used frequently by mountain bikes, these trails also serve as nice, short, and narrow hiking trails through the woods and provide some unique experiences within the MOS.

Trail D: This trail may need some rerouting or regrading in the problematic spots. It serves as a necessary entry into the MOS for the residents of private Snake Hill Road. Methods, such as signing and/or maps, could be explored to better direct trail users and inform them of this essentially dead-end trail.

Trails E: These trails serve as educational trails providing access to the wetlands and vernal pools of the Red Maple Swamp. There may be opportunity to extend one of these trails further into the swamp and connect to other areas of the MOS although there may be some wetland regulatory issues involved with such an extension. Extending these trails may lead to degradation due to increased use.

Trail F: Remain in its current alignment, Trail F can possibly provide, via a linkage with Trail 15, an alternate and less steep route around the steeper section of Trail 13.

Trail System Recommendations

The recommendations contained in this chapter are based on the analysis of the existing trail conditions presented in Chapter 1 as well as information gathered from LMC meetings and correspondence, the property's conservation restrictions, interviews with the Belmont Fire Chief and the Facilities Department at McLean Hospital, and research into sustainable trail design and construction practices applicable to the MOS.

From the trails analysis, it was determined that all of the existing trails within the open space have issues that must be addressed in order to make a better trail system for all users, to prevent negative environmental impacts, and to minimize future maintenance. Therefore the trail system should be designed for sustainability.

The National Park Service has defined trail sustainability as follows:

> Sustainability is the ability of the travel surface to support current and anticipated appropriate uses with a minimal impact to the adjoining natural systems and cultural resources. Sustainable trails have negligible soil loss or movement and allow the naturally occurring plant systems to inhabit the area, while allowing for the occasional pruning or removal of plants necessary to build and maintain the trail. If well built, a sustainable trail minimizes seasonal muddiness and erosion. It should not normally affect fauna adversely nor require rerouting and major maintenance over long periods of time.
>
> - US Department of the Interior, National Park Service, *Natural Resource Management Guidelines*, 1997

The Roanoke Valley, Blue Ridge Parkway Trail Plan, prepared by the National Park Service (currently in draft form and open for public comment), presents the following concise information on trail erosion and sustainable trail design:

> Proper design, siting, and construction of trails are needed to reduce erosion. Trail erosion is a result by a combination of steep grades, water, soil type, and trail users. Water damages the trail surface by removing soil when it flows across its surface and the steeper the grade, the more velocity and power the water has to move material downhill. Trail users increase this erosion potential by loosening the surface of the tread, making it easier for water to scour it away. In order to prevent erosion, it is critical to site the trail in a manner that encourages sheet flow (a dispersed flow of water across the trail) rather than channeling the water down the trail, leading to a down-cutting of the trail tread. Most trail designers have recognized that the easiest and most effective way in which to reduce erosion and protect the trail tread is through contour trail design. Contour trails, also referred to as sideslope trails, follow grades on the side slope of the hill, and outslope slightly toward the low side. These features encourage sheet flow of water across the trail, and thus minimize erosion by redirecting water off the trail. Grade reversals or "dips" are also used to reduce erosion by redirecting water off the trail.

There are many sources of information on sustainable trail design. A number of these resources have been listed in Appendix F. Some information is freely available from websites and several books on the subject have also been published in the past few years. It is recommended the LMC start and maintain a library of these resources as they begin implementation of the trail plan.

In the MOS, some of the existing trails are unused as a result of the development and rezoning plans for the McLean Hospital campus and these trails should be considered for elimination then restored to natural conditions. Other trails have very steep alignments resulting in runoff and erosion which will only get worse if allowed to stay in their present state. In these instances there are opportunities to reroute the trail to follow a less steep route, running as a contour trail across the slope rather than straight down the fall line. For some trails, it is impractical to realign or relocate them but there can be measures put in place to minimize their

negative issues. New trails will create opportunities to improve site circulation and trail user experience. Certain trails will need to be maintained with proper clearance to allow for emergency and maintenance vehicle access. Other trails should be narrowed to improve trail user experience and to maximize the amount of "wild" land along the trail available for plants and wildlife.

Some trails only serve as a connector trail from the MOS into private properties. There are recommendations for the rerouting, and in some cases elimination, of these trails. Of these trails to remain, there needs to be a clear indication to trail users where the trail enters into private property. In turn, such trails should not be officially recognized as official MOS trails in trail maps to discourage use by those users not associated with the private property. Safe roadway intersections and connections to other adjacent open space properties are needed.

One of the major issues confronted during the process of the trails system analysis and implementation plan was the issue of multiple uses of the trails. Currently all trails in the system are available for use by both walkers and mountain bikers. Since the time the MOS was granted over to Belmont, there has been no official policy established on the use of mountain bikes but their use has been permitted. In the opinion of the consulting team, the use of mountain bikes is not the main cause for the poor condition of many parts of the trail network. Rather most trail damage is due to the erosion effects of water as well as overly steep.

In meetings with the LMC and the public as part of this trails plan, many citizens expressed concerns about user conflicts and the environmental impacts of bicycles. With proper trail design and construction, all trails in the MOS can accommodate the multi-use of both walkers and bikers. The LMC agreed to recognize that some areas have certain environmental and cultural sensitivities that calls for the restriction of some trails to pedestrian use only with other trails established as multi-use.

The key to a successful multi-use trail system is educating users on proper trail etiquette and awareness where pedestrians and mountain bikers share the same trail. The International Mountain Bike Associates has developed a well recognized "Rules of the Trail:"

1. Ride On Open Trails Only
2. Leave No Trace
3. Control Your Bicycle
4. Always Yield Trail
5. Never Scare Animals
6. Plan Ahead

Per Rule #4, yielding means that when the bicyclist encounters another user, the biker should slow down, establish communication with the other person, be prepared to stop safely, and pass only when safe to do so. Signs listing these trail rules can be posted at most major trailheads. Mountain bikers should also be informed to respect the trail system by riding only on multi-use trails, not building illegal trails, not skidding or brake sliding, and avoiding seasonally-muddy conditions. Figure 8, presented later in this chapter, shows the recommended multi-use trail system.

Recommendations Summary

- Address trail user safety.
- Keep some existing trails in existing location and alignment. Some areas of these trails require repair and management of existing conditions issues.
- Reroute some existing steep trail sections to control existing erosion problems and prevent future erosion.
- Reroute some existing trail sections to improve the trail-user experience.

- Abandon some existing trails either due to non-use or as a specific request from McLean Hospital due to private property concerns.
- Install new trails to improve trail connections and user experience.
- Set up conditions for trails that are accessible to all trail users through proper trail design and rerouting.
- Implement measures to address private property concerns.
- Improve trail information to users.
- Improve connections to adjacent public open spaces.
- Implement a system of multi-use trails and pedestrian-only trails
- Establish emergency vehicle access routes and entrances
- Designate possible locations for trail-user parking
- From a habitat protection/enhancement perspective, implement basic ecological principals to the trail plan, including limiting habitat fragmentation, increasing areas of undisturbed habitat interior, balancing pedestrian use of the MOS with its function as wildlife habitat, focusing application of these principals to the most sensitive habitat areas within the property, and implementing these principals to the extent they could be integrated with the overall trail plan goals.

Figure 6 is a plan of the recommended overall trail system. Please refer to the Recommendations Plans in Appendix C for more detailed plans.

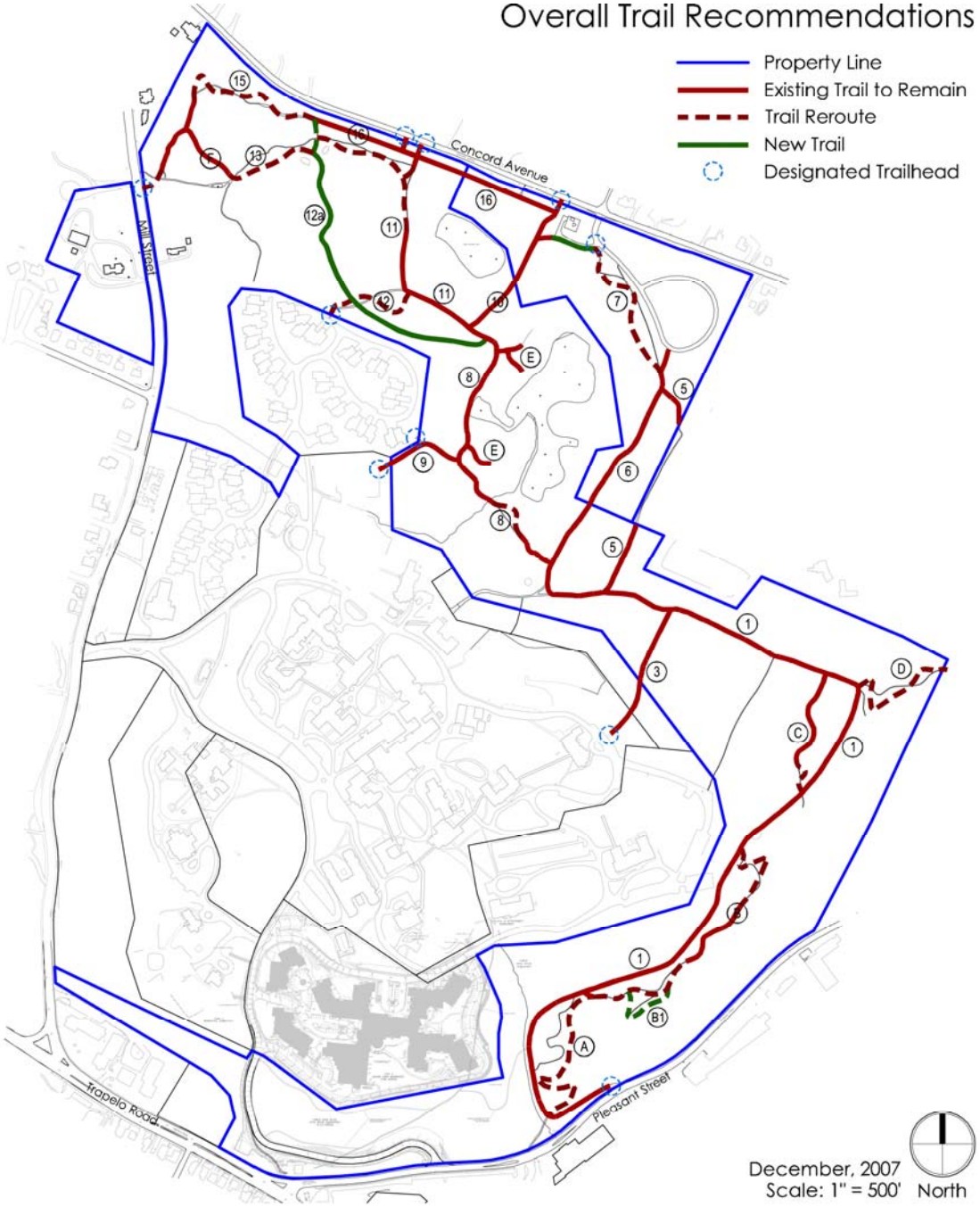


Figure 6: Graphic of the Overall Trail Recommendations

Trail Design Standards

Trail Alignment
Trails should follow the natural topography of the land as much as possible. This is referred to as contour trail design where trails flow with the land rather than against it. In wooded areas, trails should gently curve to add interest and variety; in meadow areas, more linear trails are desired to avoid users from easily creating shortcut paths.

Trail Grade
Per the generally recognized "half-rule", the running slope of any given section of trail should not exceed one-half of the hillside grade. An example of this is if the average slope of a hillside along its fall line is 18%, the trail winding its way up the hill should only have a running slope of 9% or less. In aligning a trail this way, water will have a tendency to sheet flow down the hillside and over the trail rather than concentrating the water flow down the trail (and causing erosion). No matter the slope of the hillside, sustainable natural trail design calls for trails to not exceed an average running slope of 10% to 12% unless trail armoring, steps, or other measures are put in place to prevent erosion. Short stretches of up to 20% can be allowed but should be minimized and used with appropriate trail drainage features.

Turning Radius
Curves in the trail should be wide and gently curving with no sharp turns. Clear and unobstructed sight distances should be a minimum 50 to 60 feet in either direction along the trail for user safety and awareness. Well designed and constructed curves are aesthetically pleasing, tend to be easier to maintain, and reduce user conflict. Turns and bends in the trail also generally help to reduce travel speeds of mountain bikes.

Trail Width
The trail corridor is the area of clearance between immovable objects alongside the trail, typically trees and large rocks. The trail tread is the actual surface that is actively walked or traveled on. Along emergency access routes, the grades along the width of the trail corridor should coincide with the tread grade; cross-sloping only enough to allow for proper trail drainage. For clearing new and existing trails, use arboriculturally correct and aesthetic pruning techniques for removal of tree limbs and shrubs. All identified invasive plants adjacent to trails should be removed.

	Emergency Access Trails	Non-Emergency Access Trails
Corridor Width	12' minimum	7-8' maximum*
Clearing Height	14' minimum	8-10' minimum
Tread Width	5' minimum	2-3' minimum

*Secondary trails can have a corridor width of 6'.

Tread Surface
In order to maintain the natural look of the MOS, trail surfaces should be composed of well compacted, native mineral soil. Good trail design calls for the removal of all organic soil (topsoil) from the trail tread area, exposing the mineral soil beneath. Asphalt, concrete, stonedust, or other paved-surface paths should not be constructed within the MOS. On trails designed for accessibility, rocks and roots should not protrude beyond 2 inches from the trail surface. Compacted gravel used to fill holes and low areas in the trails should always be covered with a two to three inch minimum layer of compacted mineral soil.

Trail Surface Drainage
The surface of trail should be cross sloped (perpendicular to the travel direction) towards the downhill side with between a 2% to 5% cross-slope. This cross-slope allows for sheet drainage of water from trail. In wider sections of trail, the surface can be crowned from the center, similar to roadways, so that water drains off both sides. In addition, grade dips (also called rolling grade dips) should be installed along steeper areas of trail to divert water flow off of the trail. Grade dips are short areas of trails graded opposite of the prevailing trail grade

that stops the flow of water going down the trail. The grade dips are graded to move water off the side of the path at a spill point, typically at areas coinciding with natural drainage ways for best performance. It will be necessary to locate grade dips at regular intervals along the trail. The cross-slope at the spill point (the lowest part of the grade dip) can be sloped up to 10% to facilitate water shedding. Well constructed grade dips are maintenance free and are a better alternative to water bars which require replacement or repair over time. Water bars can also present a trip hazard to users and are usually visually unattractive trail features.

Water Crossings

Where a bridge is required to cross over a stream, the bridge should be five-foot wide. This is wide enough to allow for two people to pass but not wide enough for vehicles. Planks of wooden bridges should be oriented at a 90-degree angle to the direction of travel. If the bridge has over a 30 inch drop, railings on both sides of bridge will be required. Otherwise there should be structural three-inch edge protection put in place. Wood is the recommended material for bridge construction. Recycled plastic made to look like wood is commonly used for decks, bench slats, and other outdoor construction, but, despite the best intentions of using recycled materials, lack the character, natural shape, and texture of real wood. In addition, plastic and other synthetic lumber is considerable more expensive to use and special hardware must be used to attach pieces.

Any proposed new bridge will also need follow the design standards included in the Massachusetts River and Stream Crossing Standards as developed by the River and Stream Continuity Partnership.

Wet Area Crossings

In low-lying areas, water tends to saturate the trail surface, resulting in seasonally wet and muddy areas. Depending on the severity of the problem, there are several solutions available:

1. Relocate the trail around the wet area along a higher grade.
2. Installation of a wooden puncheon, which sits directly on the ground via mud sills or sleepers, or a wooden boardwalk, which typically are supported by in-ground piers.
3. Elevate the trail surface by three to six inches. Use gravel or native stones to fill and elevate trail surface and cover with two to three inches of compacted mineral soil. The permeable sub-grade fill allows for the movement of subsurface water under the trail so that hydrologic functions are unobstructed. This is typically called a causeway or turnpike, depending on the construction method. Turnpikes design typically involves the construction of side ditches whereas causeways do not. These elevated areas of trail can also be lined with rocks on either side to help support the trail tread and define the edge of the trail. Geotextiles (synthetic, permeable fabrics) and/or geocells (raised synthetic grid structures that confine and prevents movement of the fill material) completely covered with mineral soil can also be used in the construction of causeway or turnpike. Use of these additional materials adds to the overall stability and sustainability of the structure and if installed properly, will not be visible.

Abandoned Trails

Sections of trail or entire trails abandoned should be restored to natural conditions. The goal of trail abandonment is to make the old trail look like it was never there. In order to do this, the tread must be conditioned to allow for the growth of new vegetation. It is important that the old tread is decompacted and scarified. This tread conditioning can be done with manual tools such as a pick-mattock or Pulaski or with mechanical tools such as rototillers and core aerators. In sloped and eroded areas, check dams may need to be installed to slow or block the flow of water over the old trail. Check dams can take many forms based on the need. Tree logs, rocks, straw bales, straw wattles, and erosion control blankets are example of various check dams. Disguise the old trail by dragging logs and branches across the trail, raking in leaves and other organic matter, and transplanting in small native plants from other parts of the site. Remove any nearby identified invasive plant species so they do not attempt to take over the disturbed area. In meadow areas, abandoned trail section will need to be seeded with a native meadow grass and wildflower mix. Selection of the seed mixture

will need to be appropriate for the area where it is to be planted (wet or dry soil, sunny or shady, etc.).

At the ends of abandoned sections, planting of carefully selected nursery-grown native vegetation should be considered to conceal the entrances to the abandoned path and will help to discourage continued use of the old trail and will jump start the restoration project. It may be necessary to take the extra step of installing temporary "Trail Closed" signs. If use of the old trail continues, temporary fencing may be required.

When a section of a trail is rerouted, make the transition to the new section smooth, natural, and seamless; this further discourages the use of the old trail by directing users along the path of least resistance.

Work within Wetland Buffers

There are a number of wetland areas within the MOS. Any of the recommended trail work planned within a wetland resources area will require the appropriate legal notice and approvals of the Belmont Conservation Commission in advance of any work. New wetland flagging may be required in the immediate area of the trail work.

Signage

A clear and consistent sign package should be developed to communicate important information to trail users. Signage for the MOS generally falls into four categories:

1. Road safety signage, which would clearly indicate where trails intersect with roadways
2. Directional signage, such as trail intersection signposts and blazes
3. Visitor information and regulatory signage that lists the rules of MOS
4. Private property signs indicating where a trail enters into private property

Care must be taken to limit the amount of signage necessary to properly convey the intended information without "over-signing" the property to the detriment of site aesthetics.

The most important location for informational and regulatory signs is at major trailheads. Trailhead signs can be as a simple as a single pane sign indicating the name of the property and general operational rules or can be a more formal kiosk allowing for the distribution of trail maps. A bulletin board format facilitates the posting of seasonal events and activities such as trail maintenance days. Trailhead information signs and/or kiosks are recommended at Trailheads II, VIII, IX, and XII.

If the LMC takes the step of officially naming or numbering the individual trails, uniform trail identifiers should be placed at major trail intersections that correspond to the official trail map. A recommended idea for trail intersection signposts can be a simple 6"x 6" treated lumber post about 48" inches high. Small painted aluminum signs (5 ½" x 5 ½") indicating the trail identifier along with additional signs indicating any trail restrictions are placed directly on the post. This method allows for the installation of trail signs in a visually unobtrusive way.

At the ends of pedestrian-only trails, it may be important to have a small sign indicating "no bikes allowed." A non-obtrusive sign for this used in many parks is a simple symbol of a bike with a cross through it. Rules regarding the use of multi-use paths, along with trail etiquette, can be posted at the trailhead kiosks.

Proposed locations for private property signs are shown on the Recommendations Plans in Appendix C.

Until abandoned trails have had a chance to be restored, temporary "Trail Closed" signs should be installed to prevent continued use of the old trail. Also temporary signs can be installed at any trail area under construction or rehabilitation.

Trail System Map
An official trail map should be approved by the LMC and published for use by the public,. This map can be displayed or distributed at the trailhead kiosks and posted on the LMC website. This map can also be part of a MOS brochure that also lists the property's rules and regulations. The map should coordinate with any trail identifier signage installed.

Specific Trail Recommendations

Eastern Woods
Due to poor sightlines, steep grades, and generally unsafe conditions the southern split-off of Trail 1 (Trailhead I) should be abandoned and the northern split-off of the trail that heads down to Trailhead II should be improved and serve as the sole Pleasant Street site entry point. The access gate at Trailhead II should be maintained and locked so as to continue to prohibit illegal vehicle access. A clear and safe route around the gate to allow for safe pedestrian and bicycle access needs to be constructed.

It is important to continue to allow the Trail 1 corridor width to be wide enough to allow for emergency and vehicle access; however the tread width can be reduced to a six to eight feet maximum width while maintaining the required clear corridor width (12' wide by 14' high). Improve the surface of Trail 1 by removing all the old asphalt pieces and large stones from the tread. Fill ruts, holes, and low spots with a compacted mixture of crushed stone, gravel, and mineral soil leaving a compacted soil tread surface. It is important to cross slope or crown the tread to allow for shedding of water off of the trail. The area of spring water seepage can only properly be addressed by contracting a hydrologic study by an engineer then constructing the recommended solution to block the flow of ground water onto the trail. A critical area of Trail 1 is between stone walls below the parking area. The best recommended solution is the construction of a swale (drainage ditch) in the area between the trail tread and the lower stone wall. The trail tread must be sloped towards the swale to allow for the water to shed off of the trail and into the swale. The ditch should be sufficiently designed and constructed to allow for drainage of water on past the area of the wall. The bottom of the ditch should be lined with embedded stones to prevent erosion. The embedded stone can be selected to match the stone wall. Rip rap or another material can be installed at the base of the ditch to slow the flow of water entering into the landscape, thus preventing erosions problems.

The problem created by the old Codman House parking lot can only be solved by a coordinated effort between the LMC and McLean Hospital. At the least, remove the portion of the parking lot within the MOS. Following removal of the asphalt and pavement subbase, the area should be filled with soil and graded in a way to prevent water runoff onto Trail 1. The area should also be planted with native vegetation to create a natural buffer between the properties.

Remove the dead tree over Trail and abandon the small trail going around the tree then restore to natural conditions. It is also recommended to implement a control program to eliminate the invasive knotweed growing in this area to prevent its further spread. Debris should be removed from within the culvert pipe followed by annual maintenance to ensure proper water flow and to reduce the amount of water flowing over the trail. As part of the engineering study, the sizing of the culvert pipe can also be analyzed to see if a larger pipe is recommended. The seasonally wet areas along the upper section of Trail 1 can be improved by raising the grade of the trail surface via a causeway to prevent muddy conditions and widening of the trail tread.

Abandon Trail 2 due to non-use and to restore habitat. In the future as Zone 4 is designed and developed, a new access trail from this area may need to be considered.

Trail 3 should be maintained as an access from the McLean Hospital Campus although, as this trail enters into private property, it should not be recognized as part of the official trail system. In turn, Trail 5, which enters into private property, should not be an official trail.

Due to the poor alignment and location of Trail A, reroute this trail to avoid steep grades and prevent trail erosion. Restore the abandoned section of Trail A to natural conditions. Reroute the steep sections of Trails B, C, and D to a less steep alignment. The wet area along Trail B is best handled by installing either a wooden

puncheon or boardwalk. Trail D it should not be recognized as part of the official trail system as this trail leads to a private property road. Since Trail D does have some steep and eroded areas, a reroute of this trail to a less steep alignment should be considered, but it is less of a priority than other trails is the system.

As Zone 3 is developed in the future, there should be a consideration for installing a connector trail to Trail 1. It will be necessary for this new connector trail to go over the stream, most likely with a pedestrian bridge. A suggested route is shown on Sheet R-2.

Trail 4 should be abandoned in order to close Trailhead VI per the request of McLean Hospital. It will be critical to plant the area where Trail 4 intersects with Trail 1 with native plants to discourage continued trail use.

Red Maple Swamp
Narrow the wide tread of Trail 6 to around four to five feet wide while maintaining the corridor width for emergency vehicle access. The few ruts, holes, and low spots should be filled with mineral soil and major protruding rocks removed. The slope should be cross-sloped to drain surface water off the trail.

Retain the existing relatively narrow tread of Trail 8 between Trails 9 and 6. It is recommended that the steeper area of trail to the east of the bridge be rerouted to a less steep alignment. Consider a new, longer bridge at the stream crossing. The proposed bridge should be higher over the water surface and wider. Raising the existing bridge is not possible due to the short span of the existing bridge. Based upon the final height of the bridge, handrails may be required. Design and installation of a new bridge will require approval from the Belmont Conservation Commission as this area is clearly within the wetland buffer. Between Trails 9 and 11, maintain the twelve foot corridor of Trail 8 to allow for emergency vehicle access but reduce the actual trail surface tread to a maximum of four to six feet. The other part of Trail 8 should be off-limits to vehicle access due to the proximity to the wetlands. A solution for the low, seasonally wet area of Trail 8 is raising the surface grade of the trail via a turnpike or causeway. Gravel installed in the subsurface of this raised area will allow the flow of groundwater underneath the trail.

Maintain Trail 9 as a connector trail from McLean Hospital campus and the private residential Zone 1A, but this trail should not be considered a part of the official trail system. Fill ruts, holes, and low spots with a mix of crushed stone and mineral soil. The gate at Trailhead VII should always be closed and maintained in good condition to prevent illegal vehicle entry into the MOS.

Keep Trails E “as is” and with no trail maintenance. These trails should also not be considered part of the official trail system. During the process of meeting with the LMC and public as part of this trails plan, options were considered for expanding the trail system into the northern part of the Red Maple Swamp and connecting to trails in the Heart Shaped Meadow. However due to concerns over the wetlands, plans for this extension was not considered feasible or appropriate.

Heart-Shaped Meadow
There is an opportunity to create a more interesting and sustainable trail through the reroute of Trail 7. The rerouted trail can be more separated from the Highland Meadow Cemetery driveway and located closer to the woodland edge. Going up the small hill at the northwest corner of the meadow, the rerouted trail should more closely hug the contours rather than going straight up the hill. Abandoned sections of trail should be allowed to return to natural meadow conditions.

From Trailhead VIII, there is the opportunity to create a new trail alongside the tower driveway to connect to Trail 10. This new trail should relatively narrow (with three to four foot maximum tread) and should be separated from the driveway by a minimum of six feet. At the end of the tower driveway, the area will need to be regraded to direct water flow away from the trail, reducing the amount of erosion onto Trail 10. Another option is installing a small area of rip-rap at the base of the driveway to slow the rate of water flow.

Great Meadow
Maintain Trail 11 in its current condition and alignment. The exception is the seasonally wet area between the

top of the hill and Trailhead IX. In order to prevent undesirable trail widening and braiding in the future, install either a puncheon or raise the trail tread with a causeway. In order to create a better flowing overall trail system, abandon the upper part of Trail 13 through the Great Meadow and smoothly extend Trail 11 to connect over the edge of the northwest part of the meadow and into the Northwest Corner. Locate this Trail 11 extension to be slightly more south of the existing Trail 13.

Trail 12, with its existing steep alignment and eroded surface, is not a sustainable trail. Reroute to a less steep alignment and connect to the residential Zone 1A at the existing Trailhead XI. The gate at Trailhead XI should always remain closed and maintained in good condition to prevent illegal vehicle access. Restore abandoned areas of Trail 12 to meadow conditions by decompacting the soil, filling in eroded areas, and seeding with a native meadow grass mix.

New Trail 12a provides an alternate route through the Great Meadow, wrapping around the southern and western sides of the field. Design and construct Trail 12a using the Trail Design Standards in this report. This new trail will serve as the multi-use trail through the Great Meadow allowing other trails to be pedestrian-only.

Reroute Trail 10 to directly connect to the new Trail 12a. Where Trail 10 links up with Trail 16 in the Pine Allee, selectively prune the existing vegetation between these two trails with a minimum trail corridor clearance of four feet. In order to protect the important natural resources of the wetland area in the northeastern part of the Great Meadow, no new or rerouted trails are recommended near this area.

Pine Allee

Trail 16 is an important feature in the MOS and ever effort should be made to maintain this trail in its current condition. No maintenance vehicles should ever be allowed on the trail to prevent soil compaction and ensure the survival of the remaining pine trees. Any new pines planted to replace missing pine trees should either be small one or two-year old nursery grown trees or small pine seedlings carefully transplanted from elsewhere on the property. Smaller trees can more easily adapt to the shade conditions present here.

The gate at Trailhead IX Trailhead should always remain closed. Repair the gate and maintained in good condition to prevent illegal vehicle access. Trailhead IX should be considered as the main emergency and maintenance vehicle access point into the site due to ease vehicular entry from Concord Avenue.

At Trailhead X, several measures need to be taken to ensure safe pedestrian crossing over Concord Avenue. First cut back existing vegetation to open sightlines on both north and south sides of the road. Then the LMC will need to work with the Town of Belmont for the installation of a painted and signed crosswalk to warn motorists. For additional safety, a blinking warning sign can be installed

Northwest Corner

Due to the number of safety and erosion problems with Trail 13, it is necessary to reroute this entire length of trail. Reroute the middle section of the existing Trail 13 to avoid existing dense vegetation and the steep and eroded topography. This reroute is recommended to go through a more open and less steep area just south of this existing section of trail. The lower part of Trail 13 requires new a new alignment carefully designed to avoid the steep grades as the trail descends down to Mill Street. Two options for the lower part of Trail 13 are recommended:

1. Directly connect to Trail F then to the lower part of Trail 15. The existing alignment and grade of Trail F is a fairly sustainable trail design.
2. Install a new trail that gently winds down the hillside to south of the existing Trail 13. This option in shown on sheets R-7 and R-8 as Trail 13a.

Attention should be paid to the abandoned sections of Trail 13, more so than any other section of trail on the property. The severe erosion and gullied areas should be filled with a clean fill dirt and covered with new topsoil. Check dams are probably necessary to stabilize the soil and prevent more erosion. New woody plantings will be important to discourage trail users from following the old trail alignment. Also temporary signs explaining the route change may also be necessary.

Safety concerns at Mill Street warrant the relocation of Trailhead XII. The proposed new location is to about 75 feet to the south of the current location. Based on field observations, this new location has good sightlines and works better with the curvature of Mill Street. The proposed location has less existing vegetation, which is easier to prune back. The location also better aligns to the Rock Meadow driveway. Like the crossing on Concord Avenue, the LMC should work with the Town of Belmont for the installation of a new painted crosswalk and warning signs. Based on a traffic analysis, an on-demand crosswalk light may also be warranted to increase pedestrian safety.

The upper half of Trail 15 presents an opportunity for trail rerouting to avoid the problematic steep grades. Within this densely wooded area, it will be necessary to carefully select a route to go around the existing trees while facilitating trail drainage. The lower part of Trail 15 will need to be relocated to meet up with the new location of Trailhead XII.

Completely abandon Trail 14 and allowed it to restore to natural conditions. The upper part of Trail 14 could serve as part of the proposed Trail 13a if this trail is ever constructed.

Official Trail System Map

Based on the recommendations, Figure 7 shows the trails proposed as official MOS trails. Trails that only serve as connector trails into private property are not considered official trails. Figure 7 also recognizes four trailheads most appropriate for locating information kiosks and entry signage.

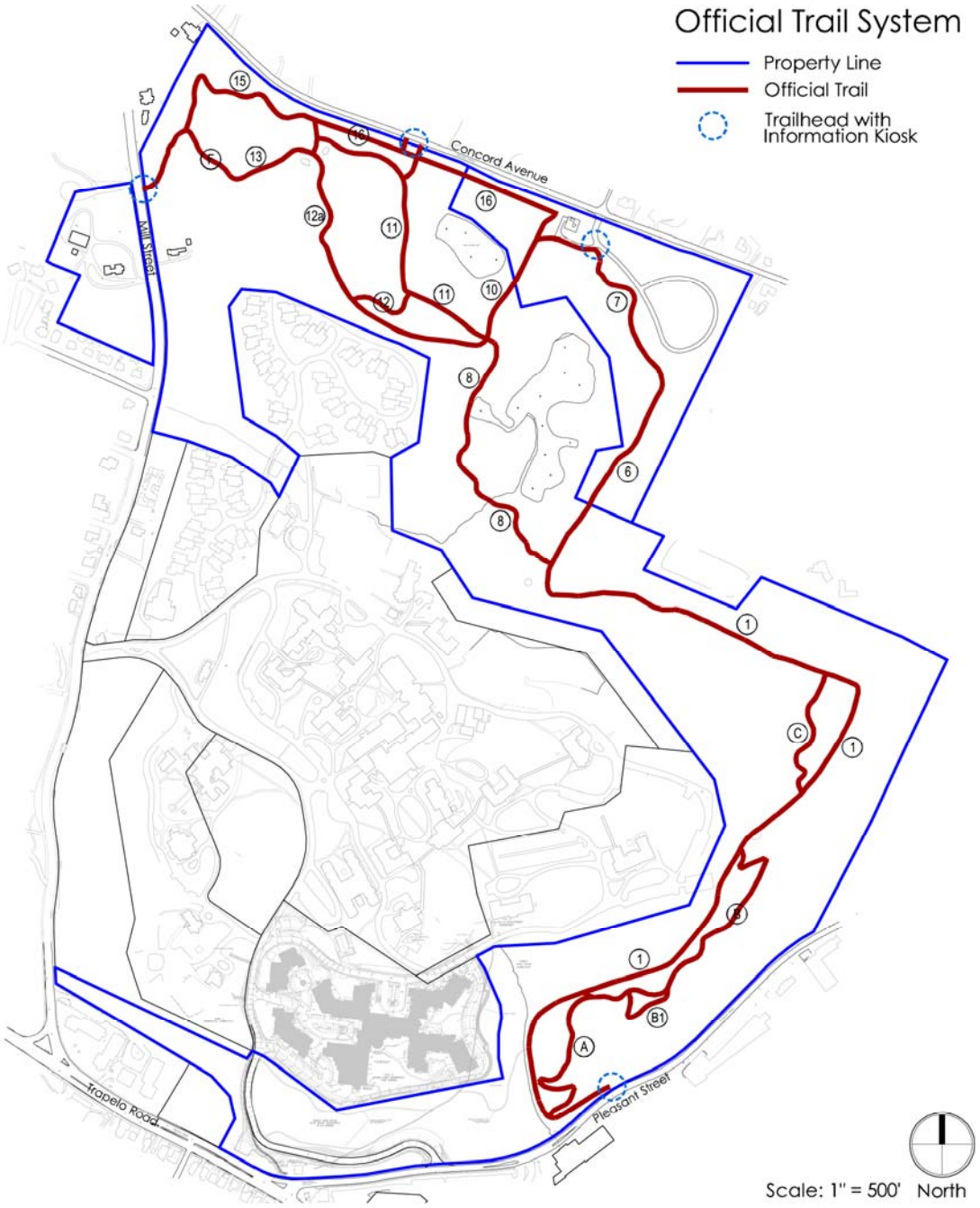


Figure 7: Graphic of Official MOS Trails

Multi-Use Trails

Multi-use trails are those trails allowed to have both pedestrian and mountain bike use. As shown in Figure 8, they are based on the alignments shown on the Recommendations Plans. The decision on the trail designation was based on a LMC meeting held in September 2007. The main criteria for the multi-use trail system are to connect between Pleasant Street, Concord Avenue, and Mill Street and over to the Rock Meadow Conservation Area. Pedestrian-only trails are centered in the main part of the Great Meadow, the Pine Allee, and the northern part of the Northwest Corner. Trail C is also pedestrian-only. Trail 12a was created as a multi-use route across the Great Meadow.

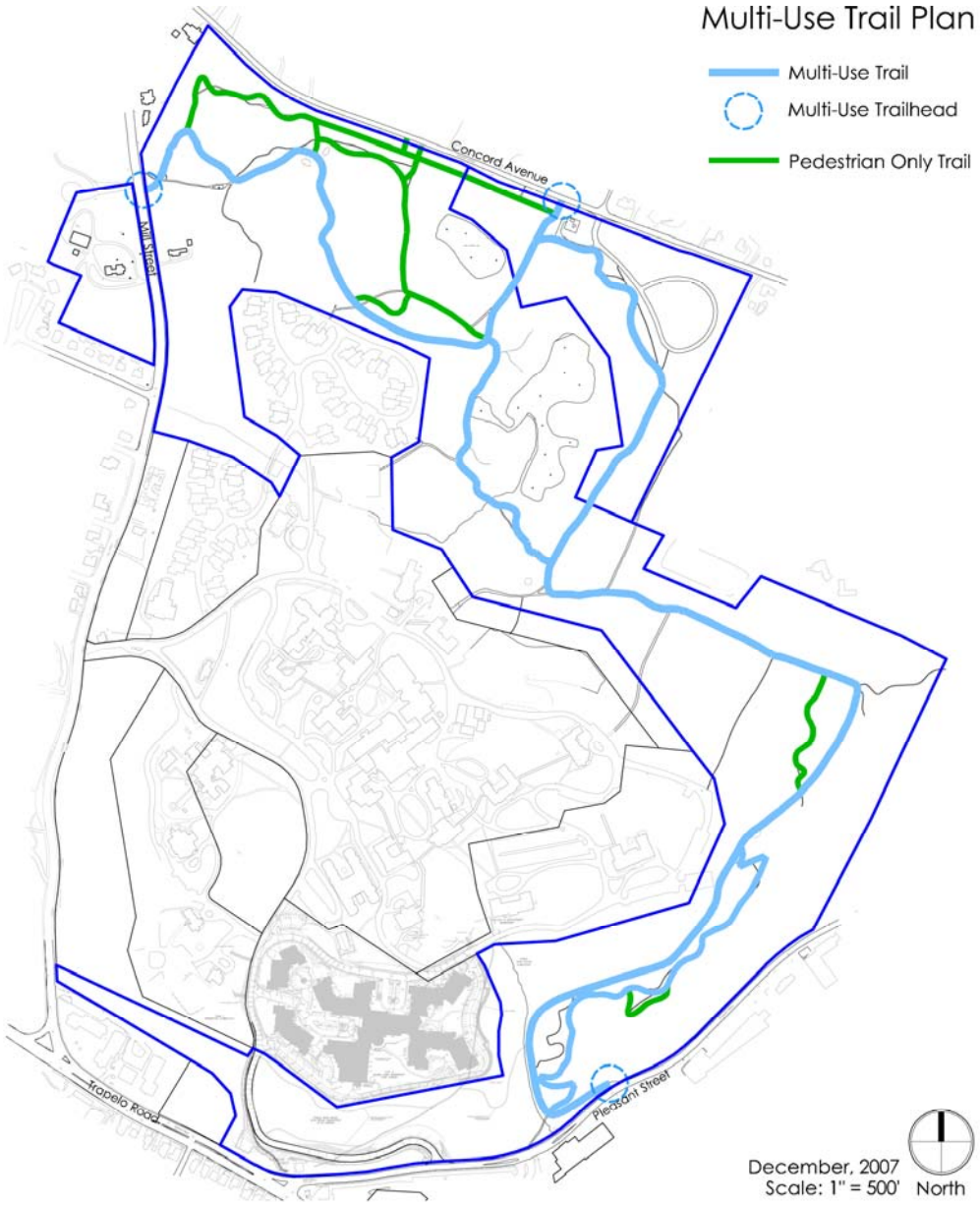


Figure 8: Graphic of Recommended Multi-Use and Pedestrian Only Trails

Emergency Access Routes

It has been requested by the Belmont Fire Department that certain trails meet the corridor height and width requirements (12' wide by 14' high) to allow for safe and clear emergency vehicle access. Figure 9 shows the trails and entrances recommended in this plan for maintenance for emergency access. These same routes should also serve as the sole route for all vehicles legally allowed entry into the property by the LMC, including maintenance vehicles. This restriction should be in place to avoid trail damage and compaction to other, less narrow trails. For the most part, trails shown as emergency access routes already mostly meet the corridor clearance requirements. The fallen tree across Trail 1 will need to be removed. Yearly maintenance of these trails will be required to ensure ongoing clearance.

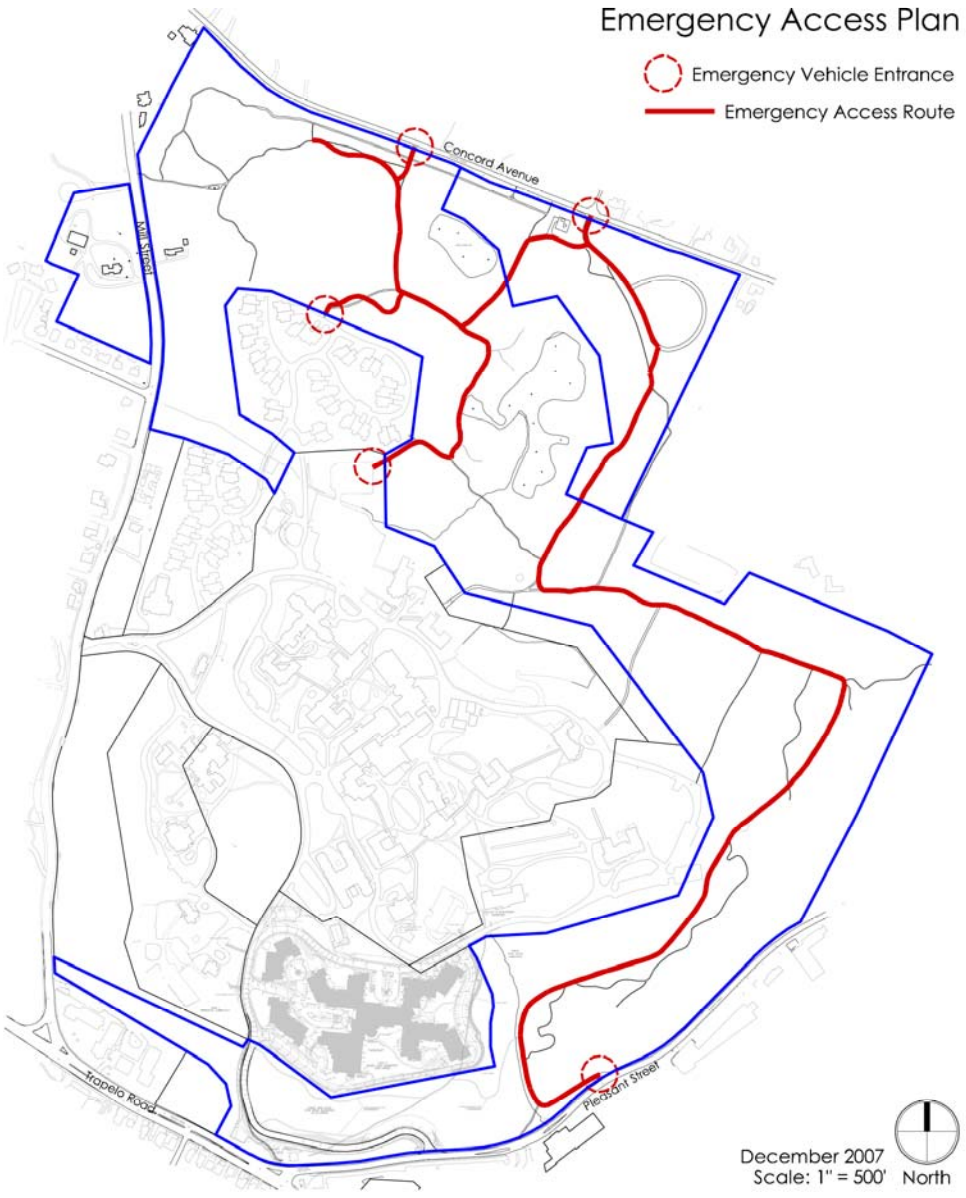


Figure 9: Graphic of Recommended Emergency Access Routes

Parking Areas

As there are not currently any official parking areas for users of the MOS, Figure 10 shows some possible locations for parking. Somerset Street and the Rock Meadow parking lot are existing parking areas; however both of these areas need some degree of designed site improvement. In addition, both existing parking areas require the crossing of busy roads to get to the trail system. The Concord Avenue, the Mill Street cottage site, Highland Cemetery (near the cell tower), and Pleasant Street parking sites will all require design and construction of new parking areas. The Pleasant Street and Concord Avenue parking sites, located immediately off of their respective roads, will need review by the Town of Belmont due to traffic concerns at these locations. Construction of the Pleasant Street lot at Trailhead II will require site grading into the hillside and possible disturbance to the existing stone retaining wall.

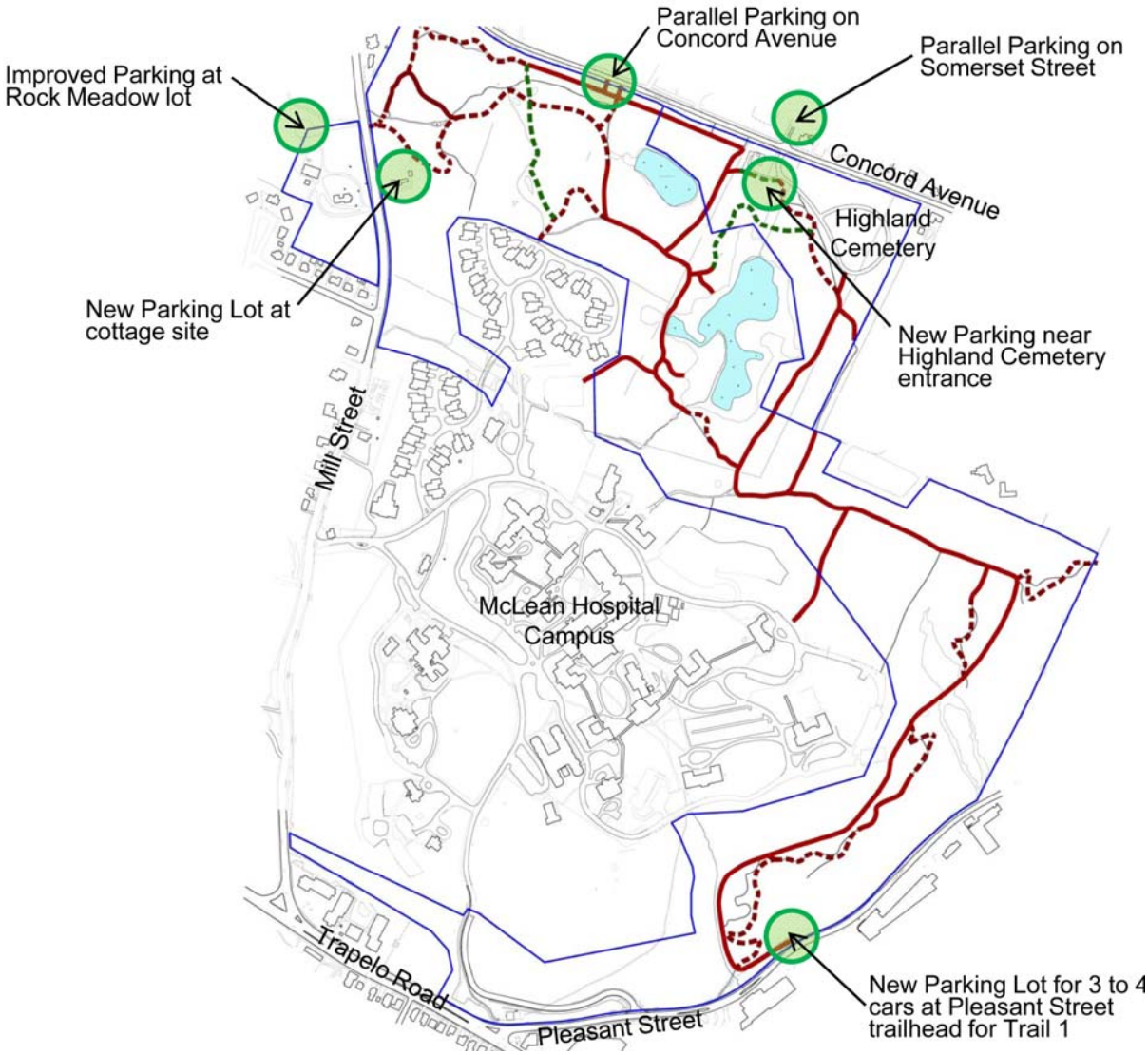


Figure 10: Graphic of Recommended Parking Locations

Accessible Trails

Based upon a careful examination of the final recommended trails plan over the topographic survey, it is feasible to have some of the trails considered an accessible trail based upon the proposed alignment shown on the Recommendations Plan. Figure 11 shows trails (indicated by the color green) that could possibly considered accessible if all trail accessibility criteria are meet. For new and reconstructed trails, precise trail construction will be necessary. Only when all of the accessible trail standards meet can any given trail be considered accessible.

See Appendix G for current trail accessibility standards in comparison to existing ADA access routes and outdoor access route standards. The U.S. Access Board has developed these trail accessibility standards as guidance only. They are currently not legally binding like other ADA regulations. These guidelines are similar to the accessibility guidelines used by the U.S. Forest Service and the Massachusetts Department of Conservation and Recreation.

Figure 11: Graphic of Recommended Accessible Routes

Trail Recommendations and Site Ecology

Habitat fragmentation occurs when larger tracts of undisturbed habitats are divided into smaller habitat areas. This division can occur both physically and/or functionally. While habitat fragmentation is often associated with roads and development that dramatically divide habitat areas, fragmentation can also occur to a lesser degree, such as with the trails (and utilization of those trails) at the MOS. The trail system is an existing condition; therefore the habitats are already somewhat fragmented. However, the recommended trail plan functions to reduce this condition, or limit its effects through trail closure and trail re-routing. The trail closures will function to increase contiguous habitat areas, and further limit anthropogenic disturbance within said habitat areas. Examples of this include the closure of Trails 2, 4, 7, and 14, which will result in increased areas of habitat interior - the preferred habitat of more reclusive wildlife species. The greatest example of this increase in interior space results from the closure of Trail 2, which will significantly increase the habitat interior located between Trails 1 and 3. The closure of Trails 4, 7, and 14 will also increase contiguous areas of habitat, but the resulting habitat interior function is reduced given the proximity of existing developed areas. Habitat fragmentation within the sensitive wetland areas within the MOS is very limited by the trail system, with relatively minor trail encroachments.

Generally, the trails to be re-routed occur along similar pathways adjacent to the existing trail, and are being re-routed along less steep topography thus decreasing erosion potential. This re-routing will have a minimal effect on habitat fragmentation throughout the site. The exception is the replacement of the western portion of Trail 13 with Trail 13a, which encroaches into a currently unfragmented area of the property. From a habitat fragmentation and alteration perspective, Trail F is the preferred option for the Trail 13 reroute, as it is significantly shorter than the 13a option and results in greater contiguous habitat south of the existing Trail 13.

Balancing the function of the MOS as wildlife habitat with its function as a recreational space requires focusing each function to appropriate areas within the property. As habitat fragmentation is limited and habitat interior is expanded with the trail closures and re-routing, focusing recreation to the trail system will limit anthropogenic disturbance to wildlife habitat elsewhere on the site. This can be accomplished by providing informational signage along the trails and at information kiosks at the trailheads to inform users to stay on the path system and that unauthorized creation of new paths and alterations of existing path is not allowed. Further, limiting some trails to pedestrian use only may further reduce potential anthropogenic effects on wildlife. As proposed, 'pedestrian only' trails occur mostly within the northern portion of the MOS. Multi-use trails begin at each of the proposed trailheads and generally coincide with the Emergency Access Routes but provide additional trail connectivity.

As proposed, the recommended trail plan balances the goals of habitat preservation and enhancement with other project goals, including improved function, safety, emergency vehicle access, and maintenance. The recommended trail system will provide a rich experience for recreational visitors, while preserving, or in some cases, improving the wildlife habitat function. The trail closures and re-routing have been designed to limit habitat fragmentation, and in some cases, increase areas of habitat interior. Clearly defined trails with signage and information kiosks at trailheads will focus recreational use of the Open Space to appropriate areas. This effort will both limit anthropogenic disturbance of wildlife habitat and enrich the experience of the recreational user.

Chapter 3
Trail System Plan Implementation and Funding

The recommendations outlined in Chapter 2 present the improvements needed to meet several of trail system needs ranging from trail user safety issues to enhancing visitor use and trail sustainability. Implementing all of the recommendations for the trail system may be impractical to do all at one time. This section of the Comprehensive Trails System Plan provides a strategy for implementing these improvements by defining priorities. This implementation strategy is based on the analysis of existing trail conditions, public comment, and the needs of the Land Management Committee. Following the priorities section is a listing of possible trail funding sources necessary for securing funds to implement the trail recommendations.

Trail Priorities

See the Recommendations Plans in Appendix C for the priority established for each recommendation based on the following criteria:

High Priority: These items are immediate priorities and are typically related to issues of public safety, severe trail erosion issues, private property, and emergency vehicle access. If left uncorrected, high priority issues would lead to a permanent loss of important natural and/or recreational resources or would impact the safety of the public. These high priority items should be addressed first, and funds should be found to accomplish this work. Some trail re-routes are listed as high priories due to major erosion problems.

Of the **high priority** items, these particular issues need to be addressed immediately due to safety concerns:

- Removal of the fallen tree across Trail 1.
- Closure of the southern spur of Trail 1 at Pleasant Street (Trailhead I).
- Clearing of vegetation blocking sightlines at Trailheads X (Concord Avenue) and XII (Mill Street).
- Investigate safe pedestrian street crossings across Concord Avenue and Mill Street.
- Pruning of woody vegetation blocking trail access along Trail 13.
- Closure of the steepest and most eroded part of Trail 13 with a re-route utilizing Trail F and Trail 15.
- Repair all vehicle access gates along Pleasant Street, Concord Avenue, and within the McLean Hospital property.

Medium Priority: These items are classified as needing immediate attention, but which could be delayed for two to five years. Medium priority improvement may also relate any one of the following situations:

- Lack of attention to a particular item would accelerate damage and lead to far more extensive costs;
- Lack of attention would detract significantly from the trail's appearance and/or function; or
- Improvements to the trail system such as many of the new trails, trail re-routes, and new trail features

Low Priority: These items require future attention, which means that they can be delayed for at least five years. When addressed in the future, they are repairs or other improvements whose delay will not affect site resources or appearance. Site parking along with improvements and repairs to less used and unofficial trails are typically considered low priority.

Low priority and some **medium priority** items will be subject to revision and reconsideration by the LMC based on future trail use and management policies.

Trail Funding Sources

Funds for the construction and maintenance of the MOS trail system can come from a number of sources. In addition to the Judith K. Record Memorial Conservation Fund, the following list contains possible trail funding sources from state, federal, and private agencies. The LMC is encouraged to pursue these funding resources and continue to look for other potential means of funding.

It is advised that the LMC designate an interested and able individual or subcommittee to be in charge of grant application and fundraising. Among the many skills for fundraising are an ability to write clearly and persuasively, an aptitude for public speaking, clear organizational skills, and a strong understanding of the trails construction and maintenance needs. A good deal of patience is also required. Since some grant programs require volunteers to assist in trail work, the person or persons in charge of fundraising should have an up-to-date record of any volunteer names and hours.

Funding can also be possibly secured from fundraising events and activities. National Trails Day occurs on the first Saturday of June each year and presents a great opportunity for fundraising and volunteer trail construction and maintenance programs. National Trail Day is nationally sponsored by the American Hiking Society (*www.americanhiking.org*). Trail events can be registered through their official program as part of the National Trails Day in order to garner additional attention.

Grant Programs

Massachusetts Department of Conservation and Recreation Recreational Trails Grant Program.
As a program administered by the Massachusetts DCR, this grant program is specifically for projects located within Massachusetts. In the past, the program has funded a number of projects for areas similar to the McLean Open Space Land. As described on the programs website, "The Recreational Trails Program provides funding on a reimbursement basis for a variety of trail protection, construction, and stewardship projects throughout Massachusetts. It is part of the national Recreational Trails Program, which is funded through the Federal Highway Administration (FHWA). Funds are disbursed to each state to develop and maintain recreational trails and trail-related facilities for both non-motorized and motorized recreational trail uses. In Massachusetts, funds are administered by the Department of Conservation and Recreation (DCR), in partnership with the Massachusetts Recreational Trails Advisory Board, and the Executive Office of Transportation (EOT)." Grants typically range from $2,000 to $50,000 and require a 20% project cost cash match and/or an "in-kind match" of materials, labor, and services. The total amount available for each year varies. For 2008 grants, applications were due on October 1, 2007.

Contact information:
Paul Jahnige
Director of Greenways and Trails
136 Damon Road
Northampton, MA 01060
(413) 586-8706 ext. 20

e-mail: paul.jahnige@state.ma.us

For additional information and application materials, go to *http://www.mass.gov/dcr/stewardship/greenway/regionalGrants.htm*

Fields Pond Foundation, Inc.
The Fields Pond Foundation is officially established as a private foundation and, among other conservation projects, issues grants for trailmaking and other enhancements for public access to public lands. As described by the organization, "The primary mission of Fields Pond Foundation is to provide financial assistance to nature and land conservation organizations that are community-based and that serve to increase environmental awareness by involving local residents in conservation issues." Grants can range from $500 to $25,000. Application materials can be submitted at any time throughout the year.

Contact information: Fields Pond Foundation Inc.
Five Turner Street, Box 540667
Waltham, MA 02454-0667
Phone 781.899.9990 Fax 781.899.2819
Email: info@fieldspond.org

For additional information and application materials, go to *http://fieldspond.org/welcome.html.*

American Hiking Society National Trails Fund

The American Hiking Society's mission is to serve as the national voice for America's hikers and "promote and protect foot trails and the hiking experience." The organization provides information on such trail issues as volunteerism, outreach, and education, policy and advocacy, and technical assistance. The National Trails Fund was created in 1998 and serves as the only privately supported national grants program for the establishment, protection, and maintenance of foot trails. Grants range from $500 to $5,000 with high preference for projects that foster volunteer trail work. Applications are due November 1st for grants issued the following year.

Contact information: American Hiking Society
1422 Fenwick Lane
Silver Spring, MD 20910
301-565-6704
301-565-6714 (fax)
info@AmericanHiking.org

Ivan Levin, Trails Program Manager ext. 208

For additional information and application materials, go to *http://www.americanhiking.org.*

REI Grants Program

REI, one of the most recognized names for retail outdoor gear, sponsors grant programs for both land conservation and outdoor recreation. This program is unique in that REI does not accept unsolicited grant requests. Rather a REI employee must nominate a organization to receive a REI grant. In 2007, REI funded a total of $3.5 million in grants. REI also participates in National Trails Day events.

For additional information and application materials, go to *http://www.rei.com/aboutrei/grants02.html.*

Other Sources of Assistance

National Park Service Rivers, Trails, and Conservation Assistance Program (RTCA)

The RTCA "is the community assistance arm of the National Park Service. RTCA staff provides technical assistance to community groups and local, State, and federal government agencies so they can conserve rivers, preserve open space, and develop trails and greenways. The RTCA program implements the natural resource conservation and outdoor recreation mission of the National Park Service in communities across America." The program has conservation professionals available locally in the Boston area. Organizations can apply for staff assistance with applications due by August 1st for assistance beginning the following fiscal year.

The NPS RTCA national chief is Charlie Stockman and he can be contacted at 202-354-6900.

Local contact information: Rivers, Trails & Conservation Assistance
National Park Service
15 State Street
Boston, MA 02109
Fax (617) 223-5164

Doug Evans
douglas_evans@ nps.gov
(617) 223-5124

For additional information and application materials, go to *http://www.nps.gov/ncrc/programs/rtca/*

American Trails

Per the American Trails website: "American Trails is the only national, nonprofit organization working on behalf of *all* trail interests, including hiking, bicycling, mountain biking, horseback riding, water trails, snowshoeing, cross-country skiing, trail motorcycling, ATVs, snowmobiling, and four-wheeling. American Trails members want to create and protect America's network of interconnected trails. We support local, regional, and long-distance trails and greenways, whether they be in backcountry, rural or urban areas. Our goal is to support America's trails by finding common ground and promoting cooperation among all trail interests. We're involved in everything from training trails advocates to increasing accessible trail opportunities for persons with disabilities." American Trails has a page on their website dedicated to trail funding ideas, grant writing, and volunteer programs: *http://www.americantrails.org/resources/funding/index.html*. American Trails also serves as a resource for trails training, courses, and conferences.

Contact information: American Trails
P.O. Box 491797
Redding, CA 96049-1797

Telephone: (530) 547-2060
Fax: (530) 547-2035
E-mail: trailhead@americantrails.org

Chapter 4
Trail System Maintenance

Yearly maintenance will be necessary to ensure that the trails remain in good condition as well as to remove tree blowdowns, prune back encroaching vegetation, and repair built structures. Trail maintenance is an essential component of a sustainable and fully functional trail system. The LMC should strive to implement a sustainable trail system. This will require a lot of initial effort at the beginning but will pay off with minimal future trail maintenance requirements. With sustainable trail design and construction, the trail system will be more stable with time and maintenance.

A large part of trail maintenance can be accomplished with the help of volunteers; particularly during well publicized "Trail Days" held once or twice a year in the spring and/or early fall. Other intense activities such as maintenance clearing and pruning for emergency access routes may require private contractors or town public maintenance crews. Any maintenance crew, whether volunteer, public works, or private contractor, will need to be headed up by a trained and experienced crew leader familiar with trail construction and maintenance techniques, trail tools, the site, and the trail system in general. Volunteer work crews should typically be limited to no more than 5 or 6 people per crew leader in order to ensure safety and quality of work. Each member of the crew should have a defined responsibility to make work as efficient and effective as possible.

Typical Maintenance Tasks

This list presents the most common maintenance needs anticipated for the MOS.

- Clear fallen and dangerous trees from the trail corridor
- Remove loose rocks, leaves, and other debris from the trail tread; selectively remove roots exposed due to compaction.
- Remove new woody plant growth within the trail corridor, especially remove plant growth restricting sightlines or blocking emergency and maintenance vehicle access and per the recommended trail corridor width indicated in the trail recommendations. All branches should be removed using the proper tools and pruning techniques. Particular attention should be paid to remove any hazardous or dead trees or branches that could potentially fall onto the trail.
- Remove, trim, and/or mow herbaceous and grass plant growth in the trail tread (a problem typically of meadow trails and sunny areas within the woods).
- Remove any invasive plants near the trail corridor.
- Restore the trail cross-slope; remove any berms forming on the edge of tread; use compacted mineral soil and/or crushed stone to fill holes or low spots; maintain tread at desired width.
- Inspect for excess trail erosion and conduct an appropriate repair; determine and correct the underlying cause for the erosion; consider re-design or re-route of trail if a persistent problem
- Look for any new wet or boggy areas and work out a plan for dealing with the issue with a trail reroute, drainage features or structures (grade dips), or elevated trail tread (causeways, etc.).
- Remove any newly created trails or "cowpaths" including braided and widened areas of trail by installing obstacles such as rocks, underbrush, or other vegetation and by using trail restoration techniques.
- Revisit any abandoned sections of trail to check for progress of restoration efforts; remove any invasive plants; inspect and repair check dams.
- Check health of any newly planted vegetation; replace any dead or declining plants.
- Clear any drainage structures of debris or organic matter (drainage dips, culverts, drainage swales).

- Repair and/or replace any built trail and drainage features and structures.
- Inspect wooden structures for rotten or worn components; remove all organic matter, leaves, and soil from wooden structures; inspect nails and drive them flush as needed.
- As needed, reshape the trail approaches to wood structures and causeways by crowning tread and smoothing transition.
- Inspect rock retaining walls (i.e. along Trail 1) for any damage, loose stones, or undermined foundations; determine need and feasibility of repair.
- Pick up litter.
- Repair and/or replace signs and trail markers. Some painted signs may fade over time and will require replacement or repainting.
- Resupply trail brochures or other information distributed at trailheads; these items may need to be resupplied several times during the active trail season.
- Update any information displayed at trailhead kiosks or bulletin boards (i.e. LMC meeting dates, trail maintenance days, special events or activities, etc.).

Trail Maintenance Program

As conditions and maintenance needs will change on a yearly basis, it is not feasible to propose a formalized maintenance schedule in this Trail System Plan. Once trail maintenance has been performed for a few years, the recommendations implemented, and the maintenance needs of the trails are better understood by the LMC and others maintaining the property, an official maintenance plan can be created.

For each year before any maintenance work in performed, a pre-season trail condition and maintenance survey should be performed to evaluate the need and amount of maintenance work required and a work plan drawn up. Ideally trail maintenance should be performed at least twice a year and the work plan should reflect this schedule. Priorities should be a component of the work plan. It should be anticipated, given limited time and resources that not all items on the work plan can be accomplished in a single season and some lower priority items may have to be handled in later years. The most heavily used trails should be given precedence over lesser used trails. The priority of maintenance tasks should be:

1) Fix or remove any unsafe trail conditions and hazards
2) Prune or remove any vegetation encroaching into the trail corridor
3) Repair environmental damage such as erosion
4) Restore trail to the desired conditions
5) Repair/replace signs and trail markers

A site walk should be done a few days before any scheduled maintenance activity or work day to see if any conditions have changed. This will ensure that there will be no surprises during the maintenance work and any additional equipment or materials can be procured. As each work task is completed, a detailed and dated log of all work performed should be kept by the trail crew leader and submitted to the LMC as an on-going maintenance record. Such a record is particularly important to evaluate the actual amount of time it takes to perform the different maintenance tasks and how to organize funds and other resources for future maintenance activities. A record of work is also beneficial if volunteers are used. Many grant funding sources require that a certain amount of volunteer time be used.

In order to keep informed of all of the maintenance needs of the trail system, the LMC should provide a one-point source for citizens to post any trail problems or concerns throughout the year. This can be in the form of comment box at the proposed trailhead kiosks and/or an e-mail address or telephone number. Another option is to provide a posting place on the LMC website.