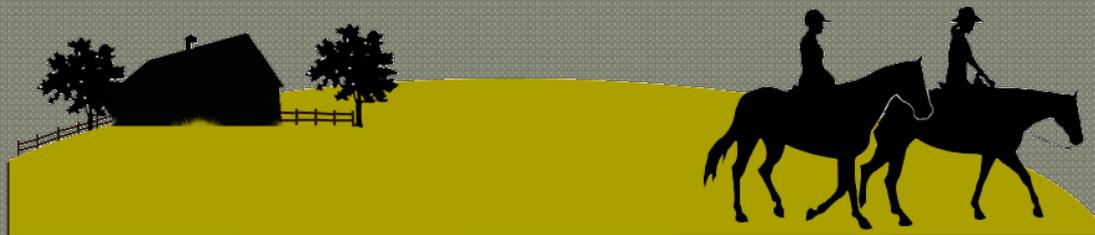


Multi-Use Trail Surface Study



CONNECTICUT EQUINE ADVISORY COUNCIL

Multi-Use Trail Surface Study

This study was conducted by the [Connecticut Equine Advisory Council](#). Research was completed in 2013 and this document was completed in 2014.

The Council was established on May 22, 2007 by Public Act 07-42 to assist the Department of Energy and Environmental Protection (DEEP) with issues related to the preservation of equine trails in the state.

Membership: The council consists of the president of the Connecticut Horse Council and five representatives from organizations that serve the horse industry within each congressional district statewide in addition to one member of the Connecticut Forest & Park Association, appointed by the minority leader of the Senate.

The Council's Goals are as follows:

Promote equestrian use on public lands.

Preserve, maintain and restore existing trails.

Promote the development of new "Multi-Use" trails.

Document and create maps for trails used by equestrians.



Purpose of the Study

The Equine Advisory Council conducted research and interviews statewide to determine the best answers for the following four questions:

- Project cost and general installation requirements for various surface materials
- Maintenance requirements for various surfaces
- Environmental impacts observed
- Suitability for multiple user groups



Contents

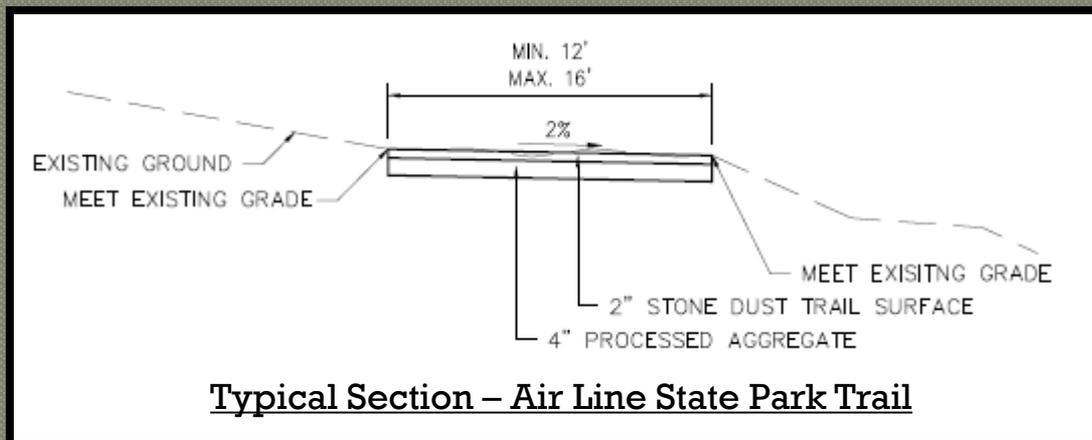
On the following pages you will find:

- Executive Summary
- Case Studies documenting all trails researched
- Information on 3 volunteer groups that can assist you
- Conclusions
- Trail building resources



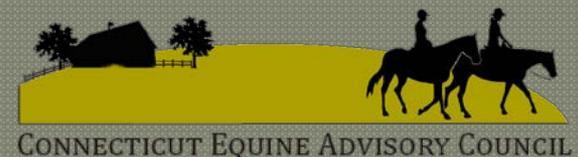
Executive Summary

- Most multi-use trail surfaces are either crushed stone (sometimes with a geotextile base) or the naturally occurring soil and rock
- Cost per mile averaged \$1 – \$1.5 million per mile (paved); crushed stone costs varied widely with availability of materials and degree of sub-surface prep required, but significantly less than pavement. Natural surface by far is the least expensive to install and maintain.
- The Connecticut DOT has weighted unit prices per cubic yard of fill, gravel base, to help with estimating costs of a new trail installation.

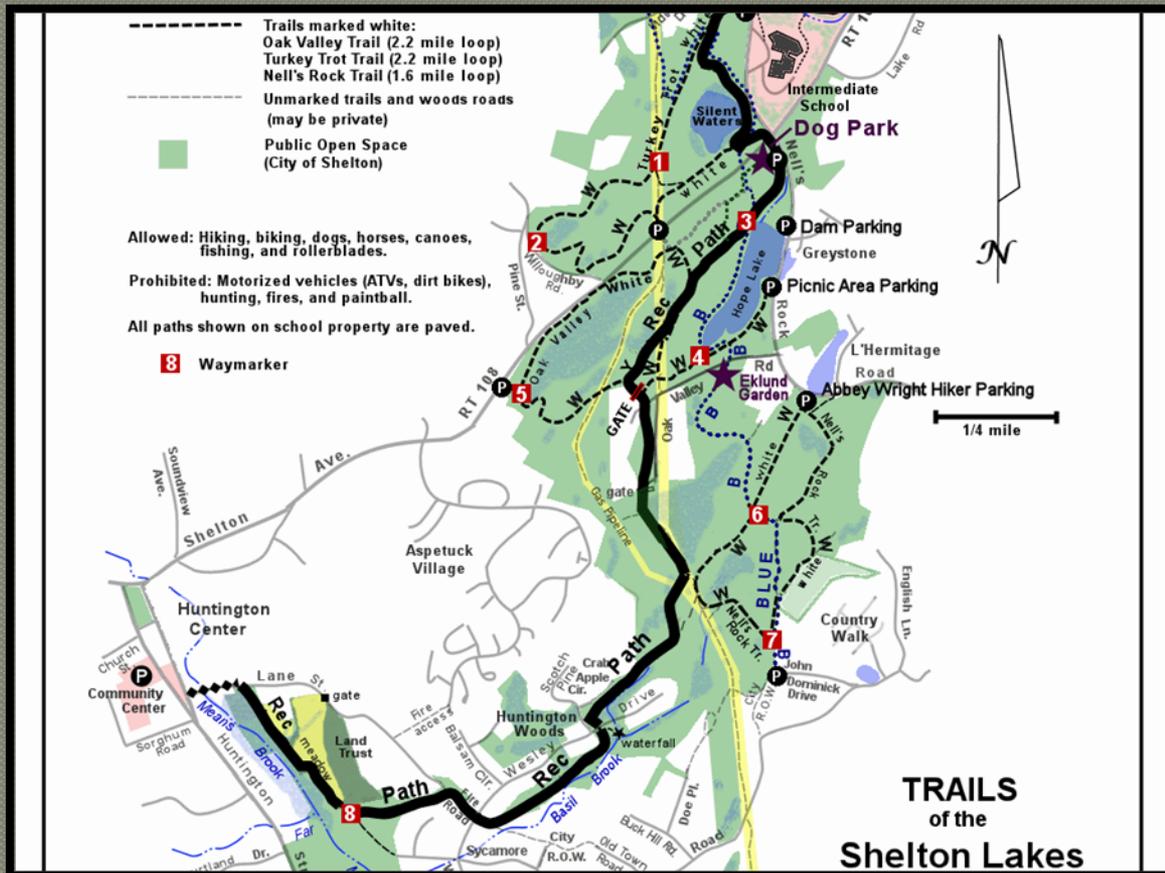


Executive Summary

- Maintenance is critical and a continuing cost on all trails. While some public works crews are used for this purpose, more trails researched use volunteer labor both for installation (soil and stone surfaces and for base courses of paved trails) and maintenance; consequently, dollar figures are hard to come by. Re-paving was estimated to cost roughly \$190,000.00/2.9 miles of trail in Cheshire.
- The greatest environmental impact on all trails is erosion, both from trail use and from flowing water. Natural soil and crushed stone are affected more than pavement however, good design and annual maintenance prevents deterioration.
- All of the trails researched support multiple uses. Pavement is least suitable for horses. Natural soil and stone dust is least suitable for roller blades and road bikes. It is important for trail managers to understand their user community before trail design begins.

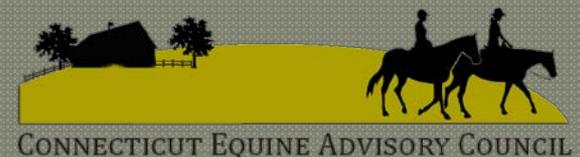


Case Study #1 - Shelton



Shelton Lakes Recreation Path

Interview with Teresa Gallagher, Conservation Agent; Terence Gallagher, engineer and volunteer for Shelton Trails Committee



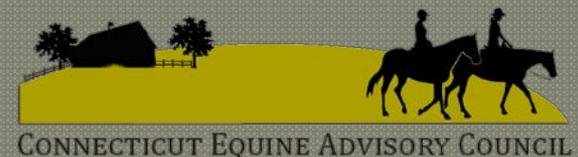
Case Study #1 - Shelton

- The oldest part of the Shelton Lakes Recreation Path was opened in 1994 around Hope Lake. It is approximately 4 miles long, most of the surface is crushed stone with 1/3 mile of pavement behind the high school. Crushed stone was selected because people prefer it to pavement to protect their knees and feet. The trail is graded for handicapped access.
- The cost of the paved sections is approx. \$1 million per mile for a 12' wide path, including plans, permits, site prep, labor, materials, benches, fencing, etc. The typical cross section is a 6" base, then 2-3" bituminous asphalt. Tree roots can crack the pavement so roots are cut, which may kill the tree.



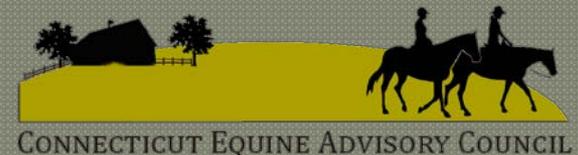
Case Study #1 - Shelton

- The crushed stone sections contain several inches of sub-base, then filter fabric and on top a few inches of crushed stone. The sub-base is road millings or gravel.
- The crushed stone was provided by vendors who sold it at cost to the town and installed by volunteers. A 2" layer of $\frac{3}{4}$ " aggregate was installed. The estimated cost was \$1 - \$2 per square yard for sub-grade prep, which is typical for non-railroad beds.
- The sub-base was 4-8" of processed aggregate stone $\frac{1}{4}$ to $1\frac{1}{4}$ " or road millings that were free; just had costs for hauling to the site at \$2 - \$3 per cubic yard unless a contractor was required to provide transportation in its contract with the Town. Some of the millings had been stockpiled from past jobs.



Case Study #1 - Shelton

- The filter fabric costs about \$600 for an 8' wide roll that is 300 – 600' long. Works out to \$1 - \$2 per linear foot on the trail. The rolls are heavy but can be cut with an Exacto knife.
- One 2 mile section of the unpaved portion of the trail required a professional contractor for brush clearing, wood chip spreading, contract administration, crushed stone, etc. for an 8' wide path, costing the town \$260,000. \$20,000 in volunteer hours were also used convert this to hours.
- Maintenance - Crushed stone may let in weeds, so mowers and weed whackers are used. May and June are the key months to cut back weeds, which is done annually. Very effective. Small paved portion has had no maintenance yet.



Case Study #1 - Shelton

- Environmental impact has been minimal on the unpaved path. There is some erosion just starting on unimproved natural earth trails that people walk and bike on. The crushed stone sections include drainage pipes in problematic areas. Hills need good drainage and erosion measures for all types of footing.
- Mountain bikers cause a lot of erosion on the natural soil trails as they tend to ride in muddy areas. Few horses use the trails so there are no noticeable impacts. Hikers have no real environmental impact. Since the trail is graded for handicapped use, it is not very hilly which helps prevent erosion.
- Trails are suitable for hikers, mountain bikers, horses, wheelchairs, baby strollers and dog walkers. Users have reported that the crushed stone as "scenic, rustic and comfortable". They do not want it paved.



Case Study #2 - Bethany

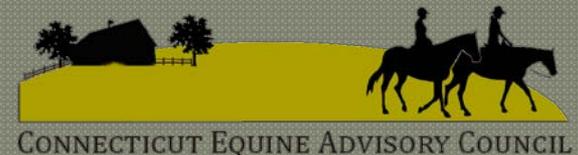
Interview with Linda Francois,
President of Bethany Land Trust and
corporate Secretary, Bethany
Horsemen, Inc.

- Bethany trail users include hikers, dog walkers, mountain bikers, runners, birdwatchers and, where suitable, horseback riders.
- All trails are natural soil, put in with volunteer labor and tools (chain saws, clippers, shovels, axes, etc.), so no cost to trail managers. A few trails have culverts and water crossings that were installed by the private landowner before the land or easement was donated for trail use.



Case Study #2 - Bethany

- Maintenance consists of paint for blazes as needed; occasional application of stone dust in small areas that tend to erode; and replacement of signs as necessary. Averages about \$200 per year in total costs, paid by Bethany Horsemen. A gate was installed by the Land Trust at the head of one trail (cost \$2400) to permit non-motorized access while keeping out ATV's. Both organizations use 100% volunteer labor. The Land Trust is just starting to keep track of man hours. Bethany Horsemen does not keep track.
- Water bars are made from chopped down cedar trees on the trail and were installed on sloped areas to prevent erosion. A little erosion occurs where areas tend to stay wet.
- Some trails abut South Central Connecticut Regional Water Authority property on which horses and hikers are allowed. The Water Authority tested the reservoir for 15 years and found no pollution at all from horses/hikers so testing was discontinued.



Case Study #3 - Cheshire

Interviews with Suzanne Simone, Environmental Planner; Robert Ceccolini, Parks & Recreation Director



Brooke Preserve

- Most trails on Town owned property in Cheshire existed at the time the property was purchased by the Town and have a natural soil surface.
- Users of the unpaved trails on the Dime Savings property include hikers, ATV riders (allowed on this property on unpaved trails), horseback riders, mountain bikers and hunters.
- One property (Dime Savings parcel) has no trails. The town received an estimate of \$60,000.00 for surveys and monuments to mark the boundaries (important to monitor encroachment). Volunteer labor will be used to install these trails.

Case Study #3 - Cheshire

- The DiDominicus property has wide wood-chipped trails; the Dept. of Public Works has also done some work and provided some material.
- Volunteers perform most of the maintenance. Volunteers clean up the trails and mark them. No labor or materials (minimal) are tracked. For extreme or complicated conditions, like trees down or installing bridges, the town employees (Dept. of Public Works and/or Parks & Rec) respond. The Town has no specific trail maintenance budget. Erosion is the biggest environmental impact on, especially from ATV's. Some areas are overused or prone to flooding, which also causes erosion.
- The Farmington Canal Heritage Trail (FCHT) is the only paved, Town managed trail. Users include walkers, runners, bike riders, roller bladers, dog walkers and strollers. Horses are not allowed on the Cheshire portion of the trail. No motorized vehicles permitted on Farmington Canal.



Case Study #3 - Cheshire



Farmington Canal Heritage Trail



CONNECTICUT EQUINE ADVISORY COUNCIL

Case Study #3 - Cheshire

- Development costs for the FCHT were about \$1 million per mile for a 10' wide paved, plus a 2 foot wide soft cinder shoulder (one side only) for a 3 mile section. The rail bed needed little site prep other than clearing brush, since it was already fairly level and contained a hard-packed gravel sub-base. Six inches of $\frac{3}{4}$ " process gravel was used, then paved. On the cinder side, no filter fabric was used, it was installed on the existing gravel base.
- Maintenance of the FCHT includes: the edge on one side is mowed every 2-3 weeks about 4-10' wide and cracks in the pavement are patched. Repaving will be needed soon (after about 20 years of use) at an estimated cost of \$190,000.00 for 2.9 miles of trail. The cinder shoulder has been re-done every 4-5 years at a cost of \$3,000 -\$4,000.



Case Study #3 - Cheshire

- The FCHT requires a lot of labor by the town and volunteers are asked to pitch in for spreading and packing the cinder. Annually a flail mower is used to get overgrowth and brush on both sides so it doesn't overgrow the trail. Another town laborer sweeps and chips the brush left. It takes a few days to complete.
- Future sections of the trail are estimated to cost about \$1.5 million per mile because of wetlands and other issues. The cost includes utilization of design engineers.
- No environmental impact noticed on the paved Farmington Canal Heritage Trail.



Case Study #4 - Middlebury

Interviews with Sylvia Preston, VP of Middlebury Bridle Land Association; Deborah Carlson, Treasurer MBLA

- All trails in town have a natural soil surface. User groups are horseback riders, a few mountain bikers, a few hikers and many illegal dirt bike riders.
- Installing trails has cost virtually no money. Most trails in town existed on Middlebury Land Trust and private property, and utility company easements and were historically used by the Middlebury Bridle Land Association (MBLA). Many new small trails have been cut to connect older trails but work has all been done by volunteers. MBLA does not track volunteer hours and they generally use their own tools.



Middlebury Land Trust Property



Case Study #4 - Middlebury

- Maintenance is also done by volunteer labor and equipment with few exceptions. One year MBLA repaired a trail using gravel. Walking the trails about 2 hours per week with clippers and pruners keeps it under control for the most part. Most big repair jobs are to remove fallen trees and repair jumps damaged by dirt bike riders.
- MBLA owns a small tractor which requires some maintenance and needs to be replaced. Figures for tractor and trail maintenance from 2007 – 2011 range from \$318.07 to \$846.79, averaging \$558.45. Environmental impact is almost all from dirt bike riders who make deep tracks that water runs through, resulting in deep ruts. Horse hooves do not make much impact although much of the area is sloping. Trails are extensive so equestrian use is spread out, enhancing sustainability and trails are well maintained.
- Environmental impact is almost all from dirt bike riders who make deep tracks that water runs through, resulting in deep ruts.



Case Study #5 – Cockaponset State Forest

Interview with Mark Leas, Bridle Path Conservancy
www.bpconservancy.org

- User groups include horseback riders, mountain bikers, boy scouts, Eagle Scouts, hikers, dog walkers, hunters, runners, sled dogs, cart drivers and horse drivers. Installation of trails mostly pre-existed Bridle Path Conservancy (BPC) as old logging roads or fire roads.
- Mainly done in the 1930's by the Civilian Conservation Corps. BPC has cut short access trails (with DEEP permission) between trails. BPC is all volunteer labor but owns a pole saw, hand tools and a power muck truck. Tractors used are owned by volunteers. With DEEP permission, BPC has installed stream bed armoring for conservation using geotextile fabric in 8' x 200' sheets (about \$400 per sheet) in level areas.
- In hilly or very muddy areas, they install a fabric, then place Geogrid material (4" height works best) on top of that and place 3" minus stone in the honeycombs.



Quinimay Trail



Case Study #5 – Cockaponset State Forest

- On top of that they place $\frac{3}{4}$ " minus gravel and compact it. The stone was supplied by the State and cost about \$400 for 100 feet. The Geogrid material cuts with a sawzall; current prices can be found at the Geo Products, LLC website, www.geoproducts.org.
- One hundred feet of trail takes 10 people about 8 hours to complete, plus set up and breakdown. They have also installed some pedestrian bridges. Costs have mostly been paid by grants from the State for trails work.
- Maintenance has mostly been clearing brush and fallen trees. The Geogrid areas were installed in 2004-05 and are just starting to show wear. Repair will be one or two buckets of stone per area. Damage caused mostly by sanctioned dirt bike races. The Geogrid areas hold up well, including to horses, and illegal motorized use by ATVs and the occasional 4WD vehicle. Tractors are just used for maintenance.
- Environmental impact is limited to erosion and runoff, which the maintenance is designed to prevent.



Case Study #6 –

Air Line and Hop River State Park Trails

Correspondence with Michael Reid,
District Operations for CT Dept. of Energy
& Environmental Protection

- Originally the trails were either old railroad beds that were fairly level or natural soil trails.
- All non-motorized users are welcome. Only roller bladers and skate boarders have expressed concerns; all others loved the surface.
- The rail beds were resurfaced with stone dust, averaging \$24 per ton (using current prices), using a small grader or bulldozer to establish a near final grade. Drainage issues were addressed earlier. Asphalt spreaders were used to put down the stone dust. At 4" depth, a mile of trail 10' wide requires about 650 tons of stone dust. The DEEP did the work with its own employees and did not keep track separately of their time for these projects.



Hop River State Park Trail



Case Study #6 – Air Line and Hop River State Park Trails

- Maintenance for the stone dust areas has been minimal surface maintenance. On occasion an area is eroded by illegal motor vehicle traffic but the repairs are usually simple and small cost.
- Environmental impact has not been noted by Mr. Reid but there could be a small amount of sediment entering a waterway during a major storm.



Air Line State Park Trail



Case Study #7 – Air Line Trail East Hampton

Correspondence with Keith Hayden, P.E., Director of Public Works for East Hampton

- Users include hikers, horseback riders and bicycle riders.
- Installation for a 4" thick, 10' wide stone dust surface is about \$20,000 per mile (stone dust only). Under this processed gravel to level the rail bed but no figures were given. Amount varies based on condition of the trail and amount of disturbance from vehicles, erosion or previous construction activities. Labor and equipment to install the stone dust run about \$10,000 - \$15,000 per mile. Stone dust was put down using a self-propelled paver and compacted using a static roller.



Case Study #7 – Air Line Trail East Hampton

Correspondence with Keith Hayden, P.E., Director of Public Works for East Hampton

- Maintenance varies from little or none on some sections more extensive erosion and ditch clearing. On average, it costs about \$5,000 per mile for material, labor and equipment per year. Resurfacing has not been necessary except to repair erosion caused by water flowing over the trail surface from clogged drainage ditches. The repair is done with stone dust.
- Environmental impact – erosion (see above)



Case Study #8 – Scantic River Greenway

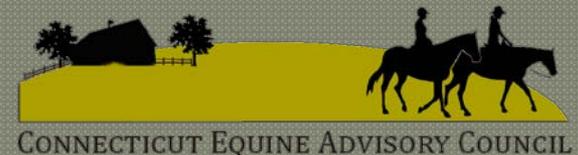
Correspondence with Jan Collins, Scantic River Watershed Association (SRWA)



- User groups include hikers, bikers, horseback riders, and snow-shoers. All non-motorized uses welcome.
- Trails pre-existed SRWA by many years. Greenway consists of State, town (Somers, Enfield and East Windsor) and private land; Association is all volunteers who clear and mark trails. Trails are all natural soil and rocks.

Case Study #8 – Scantic River Greenway

- Maintenance is by volunteers. Equipment has been purchased using DEEP's Recreational Trails Program grant money including a DR mower, chain saws, weed whackers and a trailer to store everything.
- Two grants of \$5,000.00 each were received. Trail clearing and marking are main maintenance activities.
- Erosion on the trails has mostly been from flooding due to rain and beaver activity rather than from the trail users themselves.



Ready to Help Your Project –

Connecticut Horse Council(CHC)

Volunteer Horse Patrol Program



Correspondence with - Diane Ciano, CHC Director and Volunteer Horse Patrol Coordinator

- The Connecticut Horse Council Volunteer Horse Patrol (CHC-VHP) provides a public service with local volunteers for trail monitoring, trail maintenance, trail building, marking trails, building multiple use bridges and organized clean-up days.
- The patrol is not involved in enforcement or policing. The primary responsibility is to serve as auxiliary “eyes and ears” for the protection of the resource and its visitors -- on the lookout for what is going on out on the trails.



CONNECTICUT EQUINE ADVISORY COUNCIL

Ready to Help Your Project –

Connecticut Horse Council Volunteer Horse Patrol Program

- Members assist with non-enforcement services for the public including, but not limited to, information on rules and regulations, facilities and special features and educate numerous user groups to ‘Share The Trail’ etiquette as well as give directions to lost persons.
- The Patrol members are CPR & First Aid certified and have provided First Aid to many people encountered on the trail, from bruised knees or cuts from a fall to the coordination of emergency medical services when necessary.
- The volunteers ride, bike or hike the trails and report suspicious or unusual situations, vandalism (and vandals) to appropriate authorities and otherwise let their presence be known to the other user groups on the trails as to their purpose to promote safety and education.
- No state or federal dollars support this program; funds and services are donated.



Ready to Help Your Project –

Connecticut Horse Council Volunteer Horse Patrol Program



- The CHC-VHP Patrol operates under the auspices of the Connecticut Horse Council in cooperation with DEEP and other governing land administrations. Since its beginning, the Patrol expanded to include, land trusts, open spaces, town lands, city parks and private lands.
- The CHC-VHP stats reveal the different usages of our parks and forests on various days of the week and reveal the time and activities that were observed.

Ready to Help Your Project –

Connecticut Horse Council Volunteer Horse Patrol Program



- In the 10 years since 2003, the CT Horse Council's Volunteer Horse Patrol Program has saved the State of Connecticut's tax payers \$539,487. This was accomplished through 27,666 hours of patrol and trail maintenance in 83 areas throughout the state.
- For more information contact CHC-VHP Supervisors, Diane Ciano, Vice President or Meg Sautter from the CHC website:
www.cthorsecouncil.org.

Ready to Help Your Project –

Connecticut Forest & Park Association



- CFPA is the state's oldest non-profit conservation organization.
- Maintains over 800 miles of Blue-Blazed Hiking Trails on state, municipal, and private property.
- All trail work is done by volunteers; in 2013, over 20,000 hours were put in on the trail system.
- Ridge-Runners patrol most popular sections.



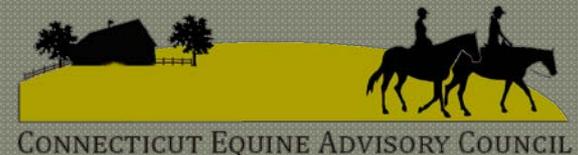
Ready to Help Your Project –

Connecticut Forest & Park Association



- CFPA trail volunteers build, maintain, and improve natural surface trails.
- Trail crews install kiosks/signage, geotextile, bridges, steps, remove large obstructions, cut back brush/limbs, and address erosion as needed.

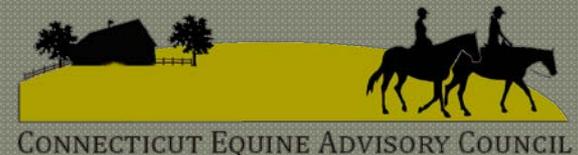
For more information contact Clare Cain, Trail Stewardship Director, or visit the CFPA website: www.ctwoodlands.org.



Ready to Help Your Project – New England Mountain Biking Association



- NEMBA trail volunteers design, build, maintain, and improve natural surface trails. They are also trained to provide education on safe riding and sustainable trail building.
- NEMBA has an excellent publication on how to build sustainable trails.
- The organization has found that most frequently they are called in to: Remove fallen trees and sometimes reposition rocks to re-bench a trail.
- Leaves enhance the water barrier qualities so they are left in place.
- Work parties are typically 3 hours long. Tools are carried in to a site
- NEMBA maintains a blog which is updated by riders frequently and has information on locations statewide. The information is shared with property managers when appropriate.
- Environmental impacts encountered include: mud, fallen trees and erosion.



Ready to Help Your Project – New England Mountain Biking Association

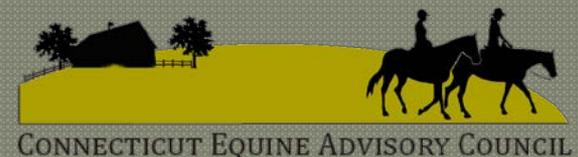
- Design is used to prevent motorized users. For example, the trail will go between tight trees, be laid out with swerves and curves, and will have obstacles (like choke point rocks).
- Trail building tasks include: Tear off duff. Duff is humus, dead leaves, bugs, etc. found in the first ½ - 1” of soil. This is spongy and does not compact; it becomes mud when horses and bikes travel over it. Dig to clay subsoil and pack it down. This creates a water barrier so the water runs downhill.
- Each trail is 18-24” wide. Trails are pitched so the water runs off.
- Armoring and flat rocks are placed for stream crossings. Goal is to install sustainable trails so they will last. Grades usually no more than 10%. Greater grades lead to erosion and users (hikers and horses) dig in for traction, creating gullies. Clinometers are used to measure grades. Pickmatics (part pick and part ax) are used to tear off duff and to make trenches.



Ready to Help Your Project – New England Mountain Biking Association

- Workers also use rock bars to pry out rocks, shovels, clippers and large pruners for vegetation, McClouds (flat metal at one end and tines at the other end), rogue hoes (one end a hoe and other sharp to cut roots, etc., and used for tamping), bow saws, grading rakes and steel leaf rakes.
- A set of tools is called a “tool crib,” consisting of 4 McClouds, 4 rogue hoes, 2 shovels, 1 bow saw, 1 – 4 pickmatics, 2 rakes and 1 pry bar. CT NEMBA has 5 or 6 tool cribs; each set of tools is about \$600. Other tools are provided by workers. Labor is all volunteer.
- A recent stretch of ½ mile trail at Huntington State Park (South Pond Trail) took 1300 – 1400 man hours, but it was a difficult section of trail because of the steep side slope, rocks, and recent hurricane.
- Horses are kept in mind when doing trails, and one project was jointly done with Newtown Bridle Lands Association. Not all trails are suitable for horses, for example the Rock n’ Roll Trail in Huntington S.P., which is too steep and rocky.

Interview with- Mark Lurie, President
Connecticut chapter



Conclusions

- All towns and trail groups are heavily dependent on volunteer labor and tools for installing and/or maintaining trails. Although recruitment and organizing people is required, the effort often leads to "buy in" from local people.
- Natural surface trails have the lowest cost to install and maintain. Volunteer labor and equipment is used almost 100%. Few groups or towns have figures on volunteer labor hours.
- Stone dust is popular with most non-motorized users. If minimal site preparation is needed, a 4" stone dust surface with processed gravel base 10' wide can be installed for approximately \$16,000 - \$20,000 (stone dust) plus \$10,000 - \$15,000 (labor/equipment) per mile. Maintenance is about \$5,000 per mile for material, labor and equipment annually for mowing, weed whacking, etc.



Conclusions

- Paving has the greatest initial cost of about \$1 million per mile (including engineering, site prep, labor, materials, etc.) but has less maintenance than other surfaces. The Farmington Canal Trail in Cheshire (a very well used trail) will need repaving soon after 20 years of use, at approximately \$190,000 for a 2.9 mile trail.
- Any surface other than natural trails has generally been funded using grant money.
- Most trails of all types pre-existed in some form before their transfer to the State, towns or organizations. Few completely new trails are being installed in Connecticut other than short connectors between trails.



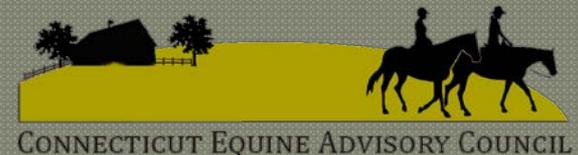
Conclusions

- The most consistent environmental impact of unpaved trails is erosion. Water bars are installed and grading the trails is performed to minimize it. Most erosion complaints are from illegal use by motorized dirt bikes and ATV's on unpaved trails. Paved trails may impact the environment while being installed, but no towns reported impact once paving was completed.
- User groups for unpaved trails vary according to terrain -- which may be flat or sloped, narrow or wide -- but include walkers (including those with strollers and wheelchairs), runners, dog walkers, horseback riders, carriage drivers, mountain bikers, snow-shoers, occasionally hunters, and ATV and motorized dirt bike riders (last two are usually illegal). Users of the paved areas are the same except that horses are generally not allowed, hunters do not use, and roller bladers and skate boarders only use paved surfaces.



Trail Building Resources

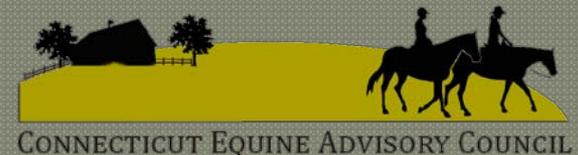
- AMC Field Guide to Trail Building and Maintenance (Appalachian Mountain Club)
- Trail Construction and Maintenance Notebook (U. S. Department of Agriculture/Forest Service Division)
- Managing Mountain Biking (International Mountain Biking Association)
- Designing Shared-Use Trails to Include Equestrians
(www.americantrails.org)



Acknowledgements

The Equine Advisory Council would like to thank all those interviewed for their time and contributions. In addition:

- Ruth Beardsley – Interviewer, research and writer
- Leslie Lewis – Interviewer, research and editor
- Laurie Giannotti - editor





Good construction means
a great experience for all trail users

For more information on the CT Equine Advisory Council, go to
www.ct.gov/deep/eac

