Boyce Mayview Park Interior Trails Plan

Township of Upper St. Clair, Pennsylvania

Natureshape

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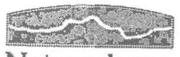
Contents



PREPARED BY

Troy Scott Parker
Natureshape LLC
8285 Kincross Drive
Boulder, Colorado 80301

Tel 303-530-1785
Fax 303-530-2270
tsparker@natureshape.com
www.natureshape.com

1

Planning Considerations

The Township of Upper St. Clair

The present-day Township of Upper St. Clair was intentionally designed as a community in a pastoral setting. Zoning and tight controls on growth were instituted from the beginning and continue to this day. At the edge of the Pittsburgh metropolitan areas, residents choose to live in this small upscale township largely for the pastoral atmosphere and for the Township management, ordinances, and regulations that keep it that way.

Dedicated facilities for pedestrian access, however, are often limited. Many residential streets and arterial roads lack sidewalks. And, like most communities in this part of the nation, few trails were built into neighborhood or community infrastructure. As a result, not only do many residents lack opportunities to enjoy the community without a car, but many don't even know what they're missing.

Now, communities nationwide, and even private developers, invest in trails for several reasons. Trails promote health and healthier lifestyles with increased exercise, increased mental health, and overall increased sense of well-being—all of which help shape a healthier community. People value trails—especially trails close to home—and study after study has shown increased real estate value because of nearby trails and open space. New subdivisions and private developments, especially in the western United States, routinely finance, plan, and build public trails into community infrastructure, knowing that trails sell homes faster and at higher prices. Parks, open space, and trails are prime marketing tools and are often featured in community and real estate promotions (including Upper St. Clair). Governments finance and build trails as community amenities and, in communities seeking to attract tourists and increase tourist business, as economic engines.

Hence—given its roots, goals, and management—it is *logical* for Upper St. Clair to have more trails close to home. Trails, especially highly naturalistic trails, would enable residents to see and experience more of why they choose to live here. The more that those trails have a "wilderness" feel, the more that they'll help provide the close link to nature which many people innately seek. It is also possible, perhaps even likely, that low to modest investment in trails by the Township can more than pay for itself from increased future property tax revenues as real estate value increases with the perceived value of increased local park and trail access.

Resources of Boyce Mayview Park

Boyce Mayview Park is the pastoral epitome of southwest Pennsylvania. From near-level meadows to steep slopes to deep ravines to floodplains, from brushy young forest to climax maple groves to conifer stands, from small springs and drainages to Chartiers Creek, and from wetlands to rock outcrops, land character and sense of place changes quickly and strongly from place to place. Former land uses of farming, logging, coal mining, and Mayview Hospital increased the variation, resulting in occasionally sudden and surprising changes that make the site even more interesting.

Plants and Wildlife

For flora and fauna, five aspects stand out:

1. The PennDOT wetlands provide critical habitat for a wide range of flora and fauna. Even though USC does not control the wetlands, the only land access to them is through the park, giving USC de facto responsibility for providing sustainable, enjoyable access.

2. Meadows host many breeding and migrating bird species that are important to southwest Pennsylvania. Part of their appeal to birds is their proximity to wetlands along Chartiers Creek and other active drainages as well as the quality of surrounding woodlands. Few people outside the birdwatching community, however, are aware of the importance of meadows and their associated woodlands as they disappear under development. As a unique situation that cannot be duplicated—largely because of their proximity to regionally important wetlands—meadow habitats should be preserved and even enhanced.

3. Varied topography, wetlands, ravines, varying slopes, meadows, and previous land uses of farming and logging created a mosaic of ecological zones in all phases of forest succession. The different zones are each habitat to different species, giving the park a wide variety of flora and fauna in a small area. The patchwork nature of these areas also create many ecological edges that in themselves are choice habitat for various species.

4. Two floodplains on Chartiers Creek (see "Floodplains" below) provide lush grass and support water-loving plants and trees. Both floodplains are considered sensitive areas, both for their ecology and for the difficulty of sustaining trails there.

5. Steep slopes above Chartiers Creek and in ravines host relatively undisturbed forest ecology classed "sensitive" in the Allegheny County Natural Heritage Inventory and the Parkwide Pre-Schematic Study. These slopes can, however, be enjoyed from appropriately designed trails with little impact, and the park is fortunate to include a number of these woodland pockets.

Except for the wetlands, meadows, and floodplains, much of the park is not considered highly "sensitive" for flora and fauna. Most areas have been disturbed by humans at some point, even including the steep-sided ravines since human actions have accelerated their erosion. There are no known threatened or endangered species, and most plant and animal habitats are fairly common in quality. However, these areas aren't "insensitive" and they require management of human use to protect them from excess change.

Points of interest/anchors

While the park offers continual variety of experience, it lacks major drama or distinct points of interest. A few overlooks offer limited views—very limited in summer when trees are in leaf. The highest point in the park has a flat top covered with dense brushy forest, eliminating views unless several acres are clearcut (which is not proposed). The second highest point hosts cellular communication towers. Chartiers Creek is difficult to reach because its shoreline alternates between extremely steep slopes and moist floodplains that we seek to protect. While the PennDOT wetlands are one of the park's most distinct features, they are artificial and not managed by USC, giving the Township little or no control over them and the trails at their edge.

Cultural resources

The area along Chartiers Creek was a major transportation route in prehistoric times. Artifacts have been found dating from 6000 BC to the 1600s. Archaeological sites, however, are buried or are not sufficiently visible to be noticed except by the trained eye.

With the exception of the brick and wood barns in Mayview Commons, old structures in the main part of the park are now little more than mossy foundations. These are interesting and unique as some of the oldest structures in a relatively modern community yet not major attractions in themselves.

A number of old farm roads still exist and many are currently being used as trails.

Trash and dump sites, mostly in the north end but also found elsewhere in the park, are currently more of a blight and safety hazard than a cultural resource.

Soils

Soil is to natural surface ("dirt") trails as paint is to artists: it's the medium in which the trail exists and it largely determines how the trail behaves when dry and wet.

Park soils are primarily clay loam which, when dry, works extremely well for natural surface ("dirt") trails but is slick and muddy when wet. Some areas also have gravel which reduces muddiness and improves soils for trail use.

Soil compaction is key for sustainable trails in clay-rich soils. After several cycles of wetting and drying—with compaction applied through trail use or mechanical means when trails are not excessively wet—these soils become very firm and quite resistant to displacement and erosion (highly beneficial characteristics for natural surface trails). The more compaction there is, the better the trail works as air spaces collapse and the soil becomes harder and holds less water. To maximize compaction through trail use, it's best to have trails be as narrow as possible in order to concentrate use on the same small area.

Having at least a thin surface layer of organic soil or gravel helps reduce muddiness when wet. Fallen autumn leaves on trails naturally help provide this organic layer, as does any non-clay topsoil, woodchips, mulch, or added compost. Note, however, that this organic layer can be very thin once the trail is firmly compacted.

Site drainage, runoff, and gullies

Heavy clay soils produce rapid runoff, especially during heavy rain. Trails must be designed to be sustainable against excess erosion. While it is virtually impossible to completely prevent trail erosion on a natural surface trail without employing artificial materials, appropriate trail design and shaping can prevent most erosion even in extreme conditions. Planning trails to limit erosion is a large part of sustainable trail design and this trail plan. Carefully designed new trails proposed in this plan can withstand rains similar to those brought by Tropical Storm Ivan with little or no erosion damage.

Steep-sided gullies form quickly with concentrated flows on steep slopes. Human activities that concentrate drainage have created new gullies within the park, including gullies at the outlets of drain tiles installed under Deer Meadow. These new gullies are usually very unstable and should be stabilized before they become deeper and wider. The flood of Sept. 17, 2004 accelerated these new gullies.

Trails should also avoid contributing to gully formation and avoid capturing and diverting drainage from existing gullies. Trails, however, can cross nearly all normally dry gullies with simple stone-reinforced crossings instead of culverts or bridges. Note that stone will have to be brought in to some crossings.

Slopes

The park has a full range of slopes from nearly level to nearly vertical. The steeper slopes are usually the least disturbed and the most dramatic. Near-level areas were usually farmed and tend to be difficult to drain.

Contrary to popular belief, it's much easier to form a long-term *sustainable* natural surface trail traversing a moderate slope than on a level or near-level area. Why? Because on a slope, it's relatively easy to drain water off the trail and send it down the slope. On a near-level area, however, soil compaction and displacement caused by trail use lower the trail surface, making the trail the lowest place around. Then the trail collects water, becomes muddy, and has little possibility for drainage. For this reason, most new proposed trails traverse significant slopes.

Floodplains

The park has two sizeable floodplains along Chartiers Creek. Sycamore Floodplain is south of the REEC and Chartiers Floodplain is the former police training area below the Morton Athletic Fields. Both floodplains were under an estimated 10' of water in the Sept. 17, 2004 flood.

Because Chartiers Creek is considered a navigable waterway, any activity within its channel and floodplains is strictly regulated by the US Army Corp of Engineers. Any constructed modification requires a permit from the Corps, and any structural modifications that change the dynamics of stream flow or floodwaters, including contributing sediment to the stream in normal or flood conditions, are discouraged.

Between the ecological sensitivity of the floodplains and the difficulty of forming and maintaining sustainable trails in these silty, poorly drained, flood-prone areas, this trail plan recommends avoiding trails on floodplains as much as possible.

Summary

For recreation and ecology, the main importance of the park is in its many quiet, enjoyable, dispersed, small-scale experiences of nature in many stages and aspects; its wide variety of plant species; its wetland access; and its exceptional bird and wildlife habitat zones. It is a microcosm of most of the ecological range of southwest Pennsylvania.

Cultural resources add some historical interest. Soils support natural surface trails fairly well, and this trail plan uses appropriate trail design to limit trail erosion even in extreme rainfall events. To maximize the hardening of trails by compaction, new trails will be narrow. Gullies require careful trail planning and significant extra trail work but can generally be crossed using native limestone to harden the surface. Some "new" gullies need additional stabilization.

To maximize trail sustainability and form positive drainage, many of the proposed new trails are on moderate to steep slopes. On the other hand, floodplains (with virtually no slope) will be almost entirely avoided in the designated trail system.

Regional Environmental Education Center (REEC)

The REEC creates an imperative to protect and enhance the natural environment in the north end of the park. This includes protecting plant and wildlife resources, cleaning the trash dumps in the ravines, and attempting to return parts of the adjacent area to its more natural state (such as the attempt to return the main drainage east of the center to its original meandering channel).

The center also creates a need for a nearby system of short, interconnected trails that enable visitors to experience as many environmental aspects as possible in a short time and short distance. The trails should form a number of loops that can be explored by class groups and the public in various ways. These trails should not, however, excessively degrade the local environment by their existence and should therefore be designed for low amounts of use and high sustainability.

Non-Park Land Uses

Dump sites

The former hospital used ravines and steep slopes at the north end of the park, including the north bank of Chartiers Creek below the surviving brick barn, as a dumping ground for virtually everything from jars to cars. Smaller dump sites and old trash are found in other parts of the park as well.

One ravine below the REEC Laboratory building, however, is a success story for cleanup efforts. All trash was removed and the water channel was stabilized with small check dams to reduce erosion. It is now a pleasant ravine proudly featured along a primary entrance trail, demonstrating the potential and benefit of removing other dump sites throughout the park.

More recently, community gardeners have dumped debris and imported supplies in the trees surrounding the garden areas.

Staging areas

The staging areas for mulch, aggregates, construction materials, and leaf composting also detract from the park's identity as a natural area. Nonetheless, people seem to accept that there is no better alternate site and tolerate these activities.

Police training area

The Township has designated the police training area on Chartiers Floodplain (now prominently posted "No Trespassing") as subject to future management decisions, including potential removal.

Utility corridors

Two natural gas pipeline corridors and one electrical power line cross the southern part of the park. All three corridors are perpetually mowed to a width of about 30 feet, significant fragmenting the local habitat both physically and visually. Their fall-line alignments, however, make them unsustainable as natural surface trail routes, and they tend to collect water in their more level segments. In lieu of formal trails, some visitors follow these mowed corridors, and it is expected that some will continue to do so even when new trails are available.

Community gardens

Although community gardens are not inconsistent with parks in general, they are inconsistent with a nature preserve or open space area. Compared to their

peak use when broad areas were gardened, only a handful of plots are now used. Most plots have returned to native plants. The rear gardens, north of the cellular towers, make it necessary to maintain vehicular access to the gardens which is also incompatible with a nature preserve.

This plan, in agreement with the Master Plan and Pre-Schematic Study, recommends removing community gardens from their current locations.

Existing Trails and Trail Use

Existing trails

Current trails form an unmarked, unmapped network that offers only a disjointed experience of the park. Nevertheless, sustainable portions of most existing trails have been incorporated into the proposed trail plan.

Some existing trails are old farm roads with straight, utilitarian alignments of near-constant grade. These were compacted decades ago and most are still in good shape despite some drainage problems. Yet they offer a relatively low-grade trail experience because, being too wide, straight, and smooth, they lack differentiation and pedestrian scale. Newer interior roads, some surfaced with asphalt millings, also serve as trails but suffer the same lack of pedestrian scale.

Some narrower hiking trails were built by Scout troups in the mid-1990s. Those that traverse slopes—the majority—are in good condition. But those that climb slopes at or near the fall line (the line that water follows when flowing down the slope) cannot drain to the side and are considered unsustainable.

Other trails were formed by visitor use in the past decade. Most of these were formed by mountain bicyclists blazing their own new trails in open forests in the parts of the park where there were no official trails. These tend to be sustainable in most sections but have occasional sections that are unsustainably steep and/or difficult to drain.

Not coincidentally, the visitor-formed trails tend to follow landscape edges and to be naturalistically anchored. They go where people want to go, many of them are highly enjoyable, they have already been compacted and have sustainable alignments, and many of them have been incorporated into the proposed trail system—although often with reroutes to solve particular problems.

Current trail use

Having spent over 30 days on the ground in the park, this author saw very relatively little trail use. Most visitors were on foot and about half of them had one or more dogs, usually off-leash despite leash regulations (although most of them were quick to leash their dog(s) once they saw other visitors). In that time, this author encountered only two mountain bicyclists, one of whom resides in Upper St. Clair. Neither horses nor evidence of equestrian use was seen.

Impact of dogs on wildlife

With the advent of dogs in the park, birdwatchers in the Bird Meadows area report that many of the birds are no longer there to be seen. It is well established that dogs scare and flush wildlife that would tolerate humans, especially birds, and that the "flush distance" is many times greater for dogs than for humans. This author witnessed this personally: in the meadow by the cellular towers, a dog 30 feet from me flushed birds in tall grass only 10 feet from me that I had just passed unseen at an even closer distance.

Public Perception of the Park

Public perception of the park is formed from a complex field. The following subjective view is the author's perception of how the park seems to be perceived based on weeks spent in the park and in Upper St. Clair.

Lack of strong identity and management

The park lacks identity, lacks a sense of wholeness, and lacks public perception of strong, active management. The park has been on the maps for many years but often has a different name on each map. Trailheads are ill-defined. Parking is haphazard. The trail system is largely informal, unsigned, and unmapped. Existing trails provide only a disjointed experience of the park. Many of the existing trails were illegally cleared, defined, marked (blazed with paint on trees), and even "built" by visitors over the years. Non-park uses (trash dumps, staging areas, police training area) continue to exist.

The park's lack of clear identity probably keeps many potential visitors away, especially those seeking a more structured experience and more obvious management. While this reduces the number of visitors (especially those from outside Upper St. Clair), it also discourages some USC citizens from enjoying their largest community public land asset.

Increasing rule violations

While all parks have occasional transgressions, rule violations at Boyce Mayview seem to be increasing. Increasingly, visitors are driving into the park where private vehicles are not permitted. The rear (north) community gardens area in the saddle north of the cellular towers is becoming more popular as a parking/trailhead area even though the area is posted "Gardeners Only" for vehicle access. When confronted, the drivers seemed to think they have the right to park anywhere they can drive. This author observed people driving most of the way to the wetlands and witnessed teenagers driving an SUV across the Morton soccer fields, tracing their tire tracks all the way to the REEC. Many dog owners illegally let their dogs off-leash within the park. And as noted earlier, community gardeners are dumping garden debris, both organic and inorganic, in the trees near the gardens.

Respect and appreciation for naturalistic experience

Nevertheless, despite past neglect and perceived lack of strong park management, most people still largely respect the park and abide by its few rules. The relative absence of litter and lack of intentional damage demonstrate that those few who currently venture into the park want to preserve it as a natural area and have their own sense of personal respect, appreciation, and even stewardship.

While designing trails in the park, people often asked me what I was doing. In conversing with visitors, the most frequent unsolicited comment I heard was, "I hope they leave it just like it is."

Given the fact that Upper St. Clair residents literally "bought into" an upscale, highly managed community with many rules and restrictions, people will likely appreciate and respect the park even more when it is more overtly managed and integrated into the community.

Existing Management Plans

Since land management goals for grasslands (meadows and fields), forests, water resources, habitat restoration, and more have not been formally developed, trails—including those proposed in this trail plan—may have to adapt to different future management. Such adaptation could include rerouting or closing trails, changing modality, etc.

To accommodate future decision making, this trail plan seeks to form a trail system that:

1. is designed to have little impact on the site, i.e. trails do little to change the character or nature of the park; and
2. is based on trails that can be easily modified, moved, or removed with little or no trace.

Art and Science of Natural Surface Trail Design

Natural surface ("dirt") trails are easy to form—even deer and animals form them. But being easy to form doesn't imply ease of maintenance for erosion control and wear caused by human use. Nor does it imply that people will be satisfied to stay on the trail and not want to make their own shortcuts, or that the trail will go where we need it to go. In reality, natural surface trails ***that are both enjoyable and sustainable in the long term*** can exist only within limited combinations of interacting factors.

Core trail design concepts

Successful design of natural surface trails depends on optimizing trails within the human and physical site context—to shape trails within the limited combinations of factors that can be both sustainable and enjoyable. These factors and how they interact are predictable and have been used to design the park's trails.

The factors are described as core concepts in the book *Natural Surface Trails by Design: Physical and Human Design Essentials of Sustainable, Enjoyable Trails* by this author. (The Township has three copies.)

Briefly, **natural shape** is used as the basic conceptual shape for natural surface trails. Natural shape is the twisty, winding, quirky, unpredictable-in-the-details shape found everywhere in nature:

The more a trail incorporates these shapes in its basic alignment and in its details, the more naturalistic it will seem. All new trails are consciously designed around these natural shapes.

Core Concepts for Natural Surface Trails

- Natural shape
- Anchors (edges, gateways)
- Safety
- Efficiency
- Playfulness
- Harmony
- Compaction
- Displacement
- Erosion
- Tread Texture
- Tread Watersheds

Anchors are any vertical features in the site such as trees, rocks, and constructed features. A trail feels grounded and appropriate when it passes close by or touches an anchor. In the park, new trails use trees as anchors to make the trail feel like it belong where it is. **Edges**—such as the edge between forest and meadow, or water and land—are extended anchors. Being on the edge gives you the experience of both sides at once, hence people find edges attractive. A number of trails follow strong edges such as the tops of bluffs or edges of meadows. Trails also cross edges at all angles such that one feels continually feels busy with new sightlines and different experiences. Overlooks are strong edges. **Gateways** are places where the trail passes through or between strong anchors on two or three sides, such as passing between two close trees or under a major tree branch. Gateways are very strong anchors that create a sense of progress. Structures such as bridges and boardwalks are strong gateways as well as strong anchors and edges—hence their appeal.

Safety, efficiency, playfulness, and **harmony** concern our feelings about the trail and our trail experience. We want trails to be sufficiently safe for us, yet safety is relative to all conditions and our abilities and desires at the moment. Efficiency is the feeling of wanting to take the easiest route or to walk where it's easiest to walk. Shortcutting happens when we feel the trail isn't sufficiently efficient. Playfulness is our desire for quirky, unexpected shapes and feelings on trails, usually directly related to nature and how the trail interacts with nature. A narrow, naturally shaped trail is often playful, but a wide, straight road isn't. And harmony occurs when safety, efficiency, and playfulness are all appropriate, and when natural shapes and anchors give the trail and its context a harmonious feel.

Compaction, displacement, and **erosion** are physical forces acting on trail tread (the actual travel surface). Compaction is the downward force caused by our weight on the tread. As mentioned previously, compaction hardens the tread and is generally considered useful. But compaction also lowers the tread, making it more likely to catch and carry water. Displacement is the horizontal force caused by friction of our feet against the tread. Displaced particles such as dust are kicked to the sides, slowly lowering the tread surface over the years. Displacement is undesirable but inevitable, so we have to expect that both displacement and compaction tend to turn the trail into a rut in time. Erosion is the conveyance of soil by water or wind. Wherever the tread isn't level and water flows—often in the rut caused by compaction and displacement—some erosion will occur, so we need to shape situations which limit the potential amount of erosion.

Tread texture is about the behavior of tread soil or surface material. Soils in the park are clay loam that is firm and hard when dry but slippery and sticky when wet. Crushed granite or crushed limestone may also be used to keep the tread from being muddy in wet spots, and these materials have their own behavior.

Finally, **tread watersheds** concerns

(1) predicting sources and behavior of water reaching the trail,
(2) predicting how well trail tread can accommodate trail use and water on the tread, and
(3) shaping the tread to sustainably accommodate compaction, displacement, and erosion while draining water to somewhere lower than itself.

Tread watershed planning is based on a dozen factors and is one of the most complex aspects of natural surface trail design. Ideally, however, much of trail drainage can be formed into the alignment of the trail itself rather than constructed, greatly increasing sustainability while reducing construction and maintenance costs.

For details, see *Natural Surface Trails by Design: Physical and Human Design Essentials of Sustainable, Enjoyable Trails.*

Trail design in Boyce Mayview Park

This trail plan explicitly designs enjoyable, sustainable trails based on all eleven interrelated core concepts. Doing so, however, requires *careful attention to detail*—every foot of every trail must consider all eleven concepts. Hence the trail plan needs to include the actual on-the-ground layout of trails since the exact alignment of a trail is the net result of applying all the concepts.

It so happens that factors in some parts of the park—especially trails on moderate slopes—can be combined to shape trails that are very easy to make, highly sustainable, and quite enjoyable. In other parts of the park, particularly the more level areas, more construction and maintenance will be required to avoid future drainage problems.

2

General Recommendations

The planning considerations in Section 1 lead to general recommendations

> *NOTE*
>
> ***As this is an Interior Trails Plan, only those issues directly affected by trails—or which trails directly affect—are discussed or proposed.***

Unlike federal and state land management which must accommodate the needs of many, township management is primarily responsible and accountable to its own citizens. This gives a township the ability to optimize land management for the best benefit of its own citizens—citizens who may have different or more specific needs and desires than a wider population.

Primary Trail and Park Management Concepts

The character of the Township of Upper St. Clair and the park's variety, size, important habitat zones, widely distributed natural interest, lack of dramatic "point" features, and current use suggest managing Boyce Mayview Park as a quiet, low-key, community nature preserve or "open space" area rather than a more active, developed park. This is consistent with the 1999 Boyce Mayview Park Master Plan and the 2003 "Parkwide Pre-Schematic Study" that recommended that the majority of the park be managed as open space and habitat conservation area for both "passive" recreation and natural values.

Toward this end, recommended primary trail and park management concepts should be to:

1. **Establish the interior of Boyce Mayview Park as an actively managed, unique nature preserve or open space area intended to simultaneously:**
   - **(a) protect and enhance natural habitats and cultural resources;**
   - **(b) provide opportunities for naturalistic, low-impact visitor recreation; and**
   - **(c) help engender a personal sense of appreciation, respect, and stewardship for natural and cultural resources.**
2. **Support open space and habitat conservation values by designing trails and management to encourage only low amounts of human use; to encourage a naturalistic "wilderness" feel; and to encourage slow and contemplative travel.**
3. **Design and shape low-impact natural surface trails to be both enjoyable and sustainable over decades, if not indefinitely.**

Implementing Trail and Related Park Management Concepts

The three primary concepts suggest, and are implemented through, more detailed concepts. These are introduced here and discussed later in this document.

1. **Give the park a clear identity in order to enhance appreciation, respect, and stewardship.** Establish definite trailheads with delineated parking; install major park signs at parking areas and major trailheads; install trail signs at intersections; provide maps; clearly post rules and restrictions; enforce rules.

2. **Consider renaming the interior of Boyce Mayview Park to quickly and firmly change public perception of the park and its management.** The portion to rename would include everything within current park boundaries except the developed portion of the proposed Mayview Commons area. The new name should imply management as a nature preserve or open space rather than the more developed features often associated with a park. A suggested name is "Upper St. Clair Natural Heritage Preserve," implying that both natural and cultural resources are protected and that only low-impact recreation is intended. A name such as "Upper St. Clair Open Space" implies somewhat less management, less protection, and less restriction on recreation.

3. **To the extent possible, reduce or eliminate land uses not consistent with undeveloped open space or natural preserves.** Clean up the dump sites. Limit the size and creeping spread of staging areas. Plant an evergreen screen around the cellular tower area.

4. **Connect the many parts of the park with a sustainable trail system.** Current trails are disjointed and leave the visitor with a disjointed view of the park. Form a single, coherent system of physically and ecologically sustainable trails so that visitors can travel from one point to any other major section of the park. Form a higher density of short trails around the REEC to facilitate field learning by attendees.

5. **Make the park seem as large as possible by forming a web of short, narrow, named trails that feel as different from roads as possible.** Make it necessary to use several trails to travel long distances inside the park. Provide loops and options from major trailheads.

6. **Limit trail use to pedestrians.** It is strongly recommended that mountain bicycles, horses, and motorized vehicles should be prohibited on most park trails for many reasons. Wheelchairs, including motorized chairs, may be usable and even encouraged on select trails. Restricting use to pedestrians:
   - suits the demographics of Upper St. Clair. Direct observation of trail use within the park suggests that nearly all visitors on designated trails are currently walking or hiking. This is especially true for Upper St. Clair with its above average percentage of older residents who typically prefer walking or hiking over mountain bicycling. And no evidence shows any public interest in horse use or motorized vehicles.
   - reduces total trail use by reducing the pool of possible users.
   - reduces visitor conflicts and improves safety by reducing differences in travel speed, clearance needs, etc.
   - prevents "trail use succession." On a trail shared by pedestrians and mountain bikes, many hikers feel intimidated by faster-moving mountain bikes and cease using the trail. Through hiker attrition, mountain bike usage can become the majority usage until the trail becomes a de facto mountain bike trail with a shape that gradually optimizes to the physics of bikes and on which hikers feel uncomfortable and unwelcome. This has happened on many other trails in many other places.
   - encourages slow travel. The park is not that large. Mountain bicyclists travel faster and could cover the entire trail system in half a day, whereas limiting travel to hiking, jogging, or running keeps visitors engaged longer and makes the site seem larger than it is.
   - helps keep trail use local. Mountain bicyclists and equestrians publish and purchase guidebooks on trail opportunities, belong to user groups and clubs that share trail information, and travel widely looking for new trails. If the park is open to mountain bicyclists and/or equestrians, it *will* become listed in regional or national publications which will bring people from many places to try out the trails for a day. This increases use but *brings no benefit to Upper St. Clair.* Hikers, however, are far less likely to travel long distances for the types of trail experience offered by the park. Note that visitation attracted by the REEC is still local or from the nearby region and that this plan does not attempt to discourage that educational use.
   - allows trail surfaces, alignments, sightlines, clearance, and trail structures to be optimized for the ergonomics, speed, and flexibility of pedestrian travel.

Mountain bikes and horses impart physical forces on trails that tend to shape trail tread to fit wheels and hooves more than human feet. For instance, mountain bikes tend to cause banked curves and a swaled tread. Horses tend to create a narrow rut with high displacement and can cause severe damage when the trail is wet.

- helps keep trails narrow by reducing overall trail use and reducing the need for visitors moving at different speeds to pass.

7. **Explore the many and varied landforms and ecosystems with low-impact, naturalistic trails.** It should be possible to sample and enjoy most of the park's ecological niches and major areas while staying on marked trails.

8. **Form narrow, winding, richly detailed natural surface trails that react intimately to large and small scale site features.** This shapes trails that encourage slow, contemplative travel; have many and varied sightlines; focuses attention on the visitor's immediate surroundings; make trails seem longer than they are; and gives each trail—and each part of a trail—its own strong, unique sense of place. Encourage—through trail shaping—visitors' intimate experience of nature along all trails throughout the park rather than focus travel and attention on a few geographic points.

9. **Use trail design—trail location, tread design, and trail structures such as bridges and signs—to incorporate, echo, and respect natural elements.** When park management clearly and consistently shows its own respect and appreciation for nature, that engenders the same in visitors as well.

10. **Be sparing about providing trail structures or surfacing that detract from the natural experience either by their existence or by their appearance.** Ideally, trail structures and any imported surfacing materials should be clearly needed and be rustic in shape, appearance, and materials (consistent with wilderness expectations). Similarly, be sparing about providing trails that are so smooth, wide, and/or straight that they begin to feel like small roads.

11. **Manage wetland access trails and trails in and near the REEC and major meadows to minimize disturbance of wildlife and maximize bird habitat.** Prohibit dogs on- and off-trail on trails leading to the wetlands, in and near Bird Meadows, and near the REEC. Consult with ornithologists on how to preserve and improve bird habitat in meadow areas including selective tree and vegetative plantings, vegetative management, and possibly forming a small new wetland in areas that are currently almost wetlands. To minimize impact and maximize educational and birdwatching opportunities, the proposed trail plan proposes bird blinds in lieu of new trails in Bird Meadows and adds a blind to Deer Meadow.

    Also consider regrading the large, flat, steep-sided, rectangular pile of soil excavated from the wetlands into more of its original, gently rolling topography. Because of poor drainage, the flat top of the pile is nearly unsustainable for natural surface trails without importing aggregates or digging extensive ditches. While regrading the pile would disrupt the area for several years until vegetation regrows, it would greatly improve site drainage and aesthetics. Note that soil can simply be moved around on site rather than hauled away.

12. **Remove and restore unnecessary non-park land uses, interior roads, and unsustainable trails.** Remove dump sites throughout the park and the police training area structures. Limit the slowly creeping spread of staging areas. Remove, reshape, and restore the rear community gardens and the roads leading to them. Close and restore trails and trail segments marked for closure in the proposed trail plan.

13. **Use appropriate design and planning to keep implementation and maintenance costs relatively low.** The proposed trail plan uses appropriate trail design and shaping to produce high-quality, enjoyable, sustainable natural surface trails with very low construction and maintenance costs. Details follow.

14. **Establish dog management.** Establish dog access policy, support, and enforcement. To reduce environmental impacts, the proposed trail plan suggests prohibiting dogs in some sections of the park. See "Dog Management" in Section 3.

Together, these aspects shape a low-key, naturalistic trail system primarily intended for local residents to quietly enjoy, appreciate, and respect the many aspects of nature in the park while keeping human impact low.

3

Proposed Trail Plan

Total mileage of all proposed and signed trails in the final system, including interior roads used as trails:
9.3 miles

Total mileage of dedicated trails (i.e., omitting Bird Meadows Drive and Ravine Drive):
8.2 miles

Overview

The proposed interior trail plan includes a mixture of new trails, existing trails, trail reroutes, and existing unpaved roads. The system creates a web of trails that make a wide variety of loops possible, including loops starting and ending at the three major trailheads with dedicated parking areas. A concentration of short trails near the REEC offer a variety of experiences in a relatively short distance.

The new trails and the system as a whole provide a more integrated way to experience the park than ever before. Trails visit all major ecosystems, all known viewpoints, and all points of significant interest. Trails also take good advantage of the park's many natural and formed edges, frequently following and crossing those edges to shape a lively trail experience with a surprising amount of variety.

To reduce overall impact, existing trails were used wherever they are sustainable (or could be made sustainable) and go to a logical destination. Existing roads are also used as trails, but the system has enough trails, links, and loops that one can often choose to avoid or favor roads according to one's desire.

Most new trails have a natural surface and are narrow to reduce site impact, construction impact, and maintenance needs. Many trails can be formed with little or no construction, and nearly all construction can be done with common hand or power tools and relatively little effort.

Trails were specifically designed to need very few trail structures such as constructed trail drainage, bridges, boardwalks, etc. Where structures are needed, they are carefully planned to integrate into the site and help create the desired trail experience.

Maps

This plan includes four maps:

- New, Existing and Closed Trails
- Final Proposed Trail System
- Sign and Bench Locations
- Dog Access

Please refer to these maps for trail and feature locations.

Major Trailheads

- Boyce Road near the cellular towers
- Boyce Road near Ardolino's Pizza
- Regional Environmental Education Center

Minor Trailheads

- Baker Park
- Morton Road at Rostron Drive
- Boyce School
- Friendship Village
- Railroad tracks near the wetlands (if and/or when a rail trail is developed)

Trails and Land-Based Decisions

The following discusses some of the larger issues of how land use, land features, and trails interact; how they were considered; and how this trail plan proposes to handle them.

New trail system provides surprising new experiences

By design, the new trails explore the park in very different ways than existing trails. One of the biggest differences is the way new trails traverse—rather than avoid—slopes, including steep slopes, and how they climb between different vertical levels of the park.

Also by design, trails integrate with the site by using natural shapes, anchors, edges, and gateways in all scales. Trees are often anchors very close to the tread. Trails follow and cross landscape edges in a wide variety of ways (see Chapter 3 in *Natural Surface Trails by Design*). Trees occasionally form gateways. All of the bridges are strong gateways.

Accessible trails

This plan includes wheelchair access on all or part of three trails: Beech Valley Trail near the REEC Lab, Wetlands Trail, and Overlook Trail. All three can be accessible with a compacted native soil (clay loam) surface or perhaps hardened with some stone pressed into the clay. Loose surfaces such as woodchips must be avoided.

With a native soil surface, these trails would not be suitable for use when soils are saturated or recently wet, but they would provide a highly naturalistic trail experience when moderately or completely dry. Given that much of the naturalistic charm of accessible trails is removed by trying to make them firm and stable in all conditions, this is an acceptable tradeoff.

Rather than claim full accessibility for these trails, the park should promote them as barrier-free trails usable in good conditions. Many wheelchair users relish the opportunity for such naturalistic trails and will greatly appreciate that they are NOT paved or made of crushed stone.

Sycamore Floodplain

Because it is a highly sensitive ecological area and because it's impossible to form a narrow, sustainable, natural surface trail in a level, silty plain without the trail turning to a muddy rut, no trails are proposed to this floodplain. This floodplain was under more than 10 feet of water in the September 17, 2004 flood.

Chartiers Floodplain

This floodplain is already bisected by gravel-surfaced Ravine Drive, and Chartiers Floodplain Trail is an wide, sustainable farm road down to the floodplain. Since these two access routes clearly exist and are virtually impossible to block, it was decided to join the two with a short segment of new trail across the upper edge of the floodplain. However, no new trails are proposed between Ravine Drive and Chartiers Creek, or north of the intersection of the two routes. Visitors exploring the floodplain will be encouraged to fan out and avoid making a trail in the near-level silt.

Bluff above Chartiers Creek between Mayview Road and Sycamore Floodplain

Trails are not proposed here because (1) the steep bluff is very wet and tends to slump in many places (physically unstable), (2) the bluff was a former dumping ground and has an amazing amount of difficult-to-remove junk from the former hospital and (3) once on the slope, it's impossible to avoid Sycamore Floodplain.

Mayview Commons active area buffer zone

The strip of land south of the REEC parking area, west of the ravine with Beech Valley Trail, west of the road to the REEC, and Chartiers Creek was established as a buffer area between quiet, passive interior trails and the activity area of the proposed Mayview Commons.

Topography created a second reason for leaving this area without trails. Because of topography and site context, any trail in this area would tend to invite visitors into the deep ravine and down onto Sycamore Floodplain (see above), a sensitive area which is being kept without dedicated trail access to help limit visitation.

Meadow north of the REEC

No trails are proposed for this meadow because of (1) lack of anchors or edges to create interest, (2) lack of vegetative screening for adjacent homes, and (3) physical trail sustainability problems (erosion) almost certain to be encountered from hard rain in a sloping grassland with rapid runoff and no tree canopy.

Farm ruins along Lost Farm Trail

The trail passes through the ruins of concrete, stone, and brick foundations and miscellaneous junk from this former farm, abandoned in the 1950s. While the trail does not touch or enter any of the ruins, the site should be checked and stabilized and/or signed for the safety of those who will undoubtedly want to explore them. If the Township is uncomfortable with going through the ruins,

this trail can simply be omitted. Note, however, that the ruins are also very close to the proposed Perimeter Trail and will be invite the curious from that trail as well.

Deer Meadow
This meadow is ringed and crossed by several trails developed to create ecological experience trails for the REEC. Were it not for the adjacent REEC, fewer trails would have been proposed for the meadows.

Old shelf road between the Between Two Worlds Trail and Chartiers Creek
Looking down from the east half of Between Two Worlds trail, an old shelf road is visible halfway down the steep bluff. This was once accessed by truck and holds a steel and concrete foundation for mining equipment. Although this shelf could be a through trail between Cathedral Point and the east end of Between Two Worlds, it was decided to leave the shelf trailless and without formal access—largely so that the view from the top would not be looking down on another trail that you can see but not directly access. Yet curious visitors will want to go down there and some will undoubtedly climb down the steep bluff to do so, causing site damage in the process. This is a "damned if you do, damned if you don't" situation—having a trail there creates curiosity, and so does *not* having a trail.

If it is decided to develop a trail on the shelf in the future, it's easy to do. Climb down to the shelf and follow it west as far as it goes, then keep going at the point of least sideslope. Climb gently and you'll come out at Cathedral Point, the logical endpoint for the trail. On the east end, follow the shelf along the old roadbed and cross the old 3-foot diameter concrete culvert. After the culvert, drop below the roadbed and continue to traverse upward at an approximately 15% grade until you reach Between Two Worlds Trail. Unfortunately, both ends are far way from where you are when you see the trail below you and want to go down there. Preventing that temptation is one of the main reasons for not developing a shelf road trail. The other reason is to avoid redundancy.

Shortcutting below Cathedral Point, Chartiers Point, and Split Earth Point
Anyplace where the trail is on high ground and something down below looks interesting, people will be tempted to simply go straight down the slope to get there—yet that alignment cannot be made sustainable without major, intrusive structural trail work (usually steps or switchbacks). All three of these points have this situation as well as existing shortcuts to destinations below. Once trail use increases, there could be more shortcutting.

All three points will be signed "Area Closed for Restoration—Please Stay on Trail." Physical barriers can also be used if signs prove insufficient (a barrier is proposed for Split Earth Point, see "Split Earth Point Retaining Wall" in Section 5), but for the others, the Township is advised to try the signs first and only resort to physical barriers if necessary. See descriptions of these points later in this section.

Morton Valley (along Morton Run between Rostron Drive and Boyce School)
To protect riparian areas, modern trail planning usually avoids continually disrupting them by closely paralleling streams with trails. However, it was determined that letting the new Morton Valley Trail follow the stream for a few hundred feet has educational and experiential value. This spring-fed run is the only natural stream in the park that has water most of the time. The segment with the trail is already impacted by being just below Morton Road and by having a social trail immediately along the water (shown by the dashed line on the map). Impacts of the new trail are reduced by keeping it well above the floodplain, by careful alignment that minimizes erosion and runoff, and by following the stream for only a few hundred feet before climbing higher up in the valley.

Because people intrinsically enjoy being close to water, though, it is expected that some visitors will continue to use the existing social trail at the edge of the stream. This plan proposes that the park allow the social trail to exist—since it would be nearly impossible to close it—but not perform maintenance or encourage its use.

To protect the upper part of the valley, no trails or access are proposed there except for the existing Boyce School Trail.

The uppermost part of the valley, near the intersection of Boyce Road and Morton Road, is a spring-fed wetland designated highly sensitive in the Pre-Schematic Study. This area, however, is already bisected by the existing Boyce School Trail, although the springs themselves are not accessed by any trail and one does not even think to look for them from the existing trail. Closing the Boyce School Trail was considered yet deemed unnecessary since it receives very low use. To help protect the headwaters from erosion and sedimentation, the west end of the trail was rerouted to have a gentler, more sustainable alignment that will channel much less sediment into the stream. The name "Boyce School

Trail" was also retained since it's less likely to encourage trail use from inside the park than a more naturalistic name.

To further help protect the upper valley, this plan closes and restores the existing trail between the intersection of Boyce Road and Morton Road and the saddle by the rear community gardens. This eroding trail has an unsustainable alignment that unnecessarily dumps sediment into the valley. This trail is replaced by the new Sky Meadow Trail.

Bird Meadows
To minimize impact on birds, no new trails are proposed for the heart of this area, especially the prime area between the USC materials staging areas on Bird Meadows Drive and the large soil pile created by excavating the wetlands. Bird blinds are proposed in lieu of trails. Bird experts selected the locations of the blinds. The blinds also serve as educational resources calling attention to the rich bird habitat here.

Bird experts also examined the locations of trails in the Bird Meadows area and determined that human use would not excessively impact birds.

Visitors are currently following the perimeter of the soil pile on both its top edge and a perimeter road at the base of the rectangular pile. Since these strong edges are relatively irresistible to some visitors, this plan proposes that they be allowed to exist as social trails yet not maintained or mapped as part of the formal trail system.

Old spring house along Many Habitats Trail next to Bird Meadows
Located within sight of Bird Meadows Drive, curious visitors have worn a clear trail to the small concrete structure that was once a spring house. Since it can't be hidden and is of some historical interest, it was decided to route Many Habitats Trail immediately in front of the entrance. While most visitors won't want to enter the wet, dark, dank, low structure full of spiders, it should be posted "Do Not Enter." The thin concrete roof should also be posted, "Keep Off."

Staging areas in Bird Meadows
Although the trail plan cannot directly address these, they are a major impediment to full recreational enjoyment of that part of the park and should be removed—or at least minimized in size—as much as possible. Perhaps one or more of the three staging areas can be moved adjacent to the leaf recycling-composting area and screened from public view with berms and/or evergreen plantings.

Community gardens in the saddle
This plan proposes that the rear gardens—and all of the roads leading to those gardens—be removed and restored. Restoration entails physically removing the roads, restoring the original slopes as much as feasible.

Boyce Road Trailhead parking and entrance drive redesign
Parking and the entrance drive were redesigned in order to form coherent entrances to the trail system as well as to establish a new sense of park management. Fill soil generated by this work can be used to help restore roads leading to the rear community gardens.

Sky Meadows Trail and its effect on birds
This new trail passes through a thin strip of brushy woodland rich in birds because of the meadows on both sides. Again, this alignment was checked with bird experts who determined that the area is habitat mostly to very common species, that any disruption would be highly localized, and that the common species would adapt.

Wetlands Trail passes low above homes
In order to be as accessible as feasible, the new Wetlands Trail is routed relatively low on the hillside above the homes on Maple Lane. If this were a hiking-only trail, it would have been located higher on the slope to stay farther away from the homes. If for some reason it is decided not to make this trail accessible, a higher alignment would be more comfortable for everyone.

Four upland areas reserved for wildlife
To preserve some relatively large areas of mixed forest and meadows on moderate slopes for wildlife, no trails are planned in the following four areas:

- The area north of Morton Fields, south of Baker School, west of Morton Road, and east of Old Farm Road Trail.
- The peak of the highest point in the park above the existing Upland Trail. This area is still bisected by a gas line directly over the top which some visitors will continue to follow (this use will not be encouraged or discouraged), but all other existing roads and trails in this area are proposed for closure and restoration.

- The area northeast of the above peak below Upland Trail and west and above Morton Ravine Trail.
- The area west of the cellular towers, specifically between the Many Habitats Trail and Old Oak Trail.

Brief Descriptions of Proposed Trails

Listed from north to south, with lengths of each trail in feet:

Lost Farm Trail 1,138'
Starting from the proposed Perimeter Trail (currently a former township road), this trail passes through the extensive foundation ruins of the old dairy farm. It then crosses the deep ravine below Baker Park on top of the new retention pond dam (eliminates need for a bridge) and drops down to the upper end of Deer Meadow.

Baker Slope Trail 1,372'
This replaces the steep, eroding current trail with a gentler trail winding through mixed forests with a surprising number of tree species. The lower end now goes directly to Deer Meadow.

Old Farm Road Trail 2,983'
This existing wide, smooth, former road connects the REEC to Morton Fields on a gentle grade with mostly straight segments. It feels like an old road but some visitors will prefer this open feel. It is treated as a spine trail for the north end of the park.

Beech Valley Trail 803'
Starting at the REEC lab building, the first 250 feet along the top of a pleasant ravine can be made accessible with minimal effort. After that, it follows an old farm road on a steep drop down this pleasant, newly cleaned ravine. The ravine crossing desperately needs a bridge (Beech Valley Trail Bridge, described in Section 5).

Meadow Edges Trail 1,223'
Partly existing and partly new, this trail explores the edge of Deer Meadow as well as the upper edge of the deep ravine immediately north of the meadow. The trail has major contrasts from one side to the other, and from one part of the trail to another, as it explores different ecosystems.

Butterfly Trail 376'
Milkweed Trail 431'
These short trails go directly into the heart of lower Deer Meadows. They make possible a number of shorter loops.

Between Two Worlds Trail, with Cathedral Point and Chartiers Point 1,670'
One of the most dramatic trails in the park, this largely existing tread follows the top edge of the steepest bluff above Chartiers Creek. The "two worlds" of its name are the Deer Meadow and Chartiers Creek, and the "between" of its name is from the narrow strip of forest between the two which hosts the trail. In winter, the view includes wetlands south of Chartiers Creek.

Cathedral Point has one of the most pleasant examples of forest canopy in the park.

Chartiers Point is a dramatic overlook over a sharp bend in Chartiers Creek.

Woodlands Trail 2,242'
Partly new and partly existing, this rolling trail crosses open, mature hardwood forest and five significant gullies. It features a timber bridge at its south end.

Chartiers Floodplain Trail 753'
This old farm road—still in good condition and sustainable—drops down the steep bluff to Chartiers Floodplain. Although the wide width of the natural surface road lacks the intimacy and drama that a narrow trail in the same location would have, it's still an enjoyable walk. To minimize site impact, this plan proposes using the existing road rather than developing a parallel but narrow new trail.

Ravine Drive 2,280'
The existing gravel-surfaced interior park road from Morton Road to Chartiers Floodplain.

Curved Bridge Trail 343'
This short trail across the park's central ravine—The Hinge—connects the two sides of the park with a sustainable creek crossing. The dramatic 94' bridge is built from three segments on a curved alignment. The curve enhances its aesthetic appeal, is far more interesting than a single straight bridge, and removes an otherwise 90° turn at one end of the bridge. See Section 5 for bridge details.

Trillium Trail 3,375'
Follows an old road along but well above Chartiers Creek. This is the main existing trail to the wetlands and has two wetland viewing areas with railings. The portion along the wetlands is managed by PennDOT, not USC.

Switchback Trail and Split Earth Point 915'
This steep, dramatic new trail cut into the steep slopes above Morton Ravine climbs between the lower and middle levels of the park.

Split Earth Point at the top of the trail is a "lands end" peninsula type of point featuring a split in the rock where the outside edge of the point is pulling away from the main mass.

Sylvan Ridge Trail 3,220'
This is the west half of the existing Upland Trail plus existing but previously unnamed social trails north to Split Earth Point. Much of it follows the ridge through widely mixed forests from the park's high point north to the central ravine.

Upland Trail 4,037'
This is the east side of the existing Upland Trail plus existing but previously unnamed social trails north to Split Earth Point. It, plus the Sylvan Trail, is currently a popular loop from the Boyce Road trailhead.

Morton Ravine Trail 1,823'
Follows an old road on a near-level grade between Split Earth Point and the point where Morton Valley ends and Morton Ravine begins. It has good views of the deep, steep ravine.

Queen Maple Trail 1,266'
This trail was developed to provide the experience of traversing the steep bluff and to access the Queen Maple, a knarled, picturesque maple tree that may be one of the oldest trees in the park. One of the most dramatic trails in the park, it includes rock outcrops (dubbed Vision Rocks) and follows an obvious split earth (mass wasting) fissure for about 100 feet.

Many Habitats Trail 3,014'
The longest entirely new trail crosses most of the ecosystems in the park in rapid succession. It feels very rich as it crosses many landscape edges. It also passes directly by an old concrete spring house. The upper end approaching the Queen Maple tree is optimized to provide advance views of the tree.

Bird Meadows Drive 3,647'
Existing interior road surfaced with asphalt and asphalt millings from Two Forks Trailhead (Ardolino's Pizza) to the wetlands.

Wetland Bluff Trail 2,176'
Partly existing and partly rerouted, it pleasantly follows the top edge of the steep bluff above the wetlands, passing through mature forest while glimpsing and occasionally entering Bird Meadows. **Valley View Point** along the trail is a minor overlook with a good view of the wetlands and the hospital grounds in winter (view is obscured by leaves in summer). The west end of the trail is a steep but sustainable drop down to the wetlands and the Trillium Trail.

Wetlands Trail
1,901' from Two Forks Trailhead to Wetland Bluff Trail, and
1,450' from Wetland Bluff Trail to wetlands
This entirely new trail is conceived as the shortest, most pleasant route to the wetlands. Starting from the Two Forks Trailhead near Ardolino's Pizza, it skirts the edge of the park above Maple Lane to access the wetlands with relatively little elevation change, making it relatively easy to form it as a wheelchair-accessible trail to the wetlands.

The trail can be developed in stages with the later stages as options. Stage One is to shape the tread as a hiking-only tread formed by use. It needs an 18-foot bridge for this use. The trail would end at the Wetlands Bluff Trail, and visitors can then follow that trail down to the wetland.

Stage Two is to make that route accessible. The current route is designed to be upgradable to accessibility by widening and mechanically compacting the tread to a 3-foot width with occasional 5-foot wide landings and passing zones. The largest accessible upgrade is the proposed 74-foot-long Two Forks Boardwalk spanning the small valley next to the trailhead. The boardwalk would raise the low bridge approximately 6 feet and incorporate it into a level, curving boardwalk between the parking lot and the opposite site of the small valley. See Section 5 for details of the Two Forks Boardwalk. However, at this stage, wheelchair users can still only get as far as the top of the bluff over the wetlands.

Stage Three is to continue the accessible trail all the way to the wetlands. This requires constructing a long ramp to get down the bluff. Because it is 65 vertical feet between the top of the bluff and the Trillium Trail at the wetland edge, the full ramp is about 1,450 feet long at 4.5% grade, with two switchbacks. While most of the ramp can be earthen, the upper 250 feet need a boardwalk to traverse the steepest part of the bluff without disturbing roots of the many mature hardwoods on that slope. This is the Wetland Bluff Boardwalk described in Section 5.

White Pine Trail 1,553'
This trail incorporates part of the trail originally built by Boy Scouts to access the wetlands from the Upland Trail, and part of a social trail. It parallels and provides an alternate route or a return loop for the newly designated Sylvan Ridge Trail.

Morton Falls Trail 299'
Provides neighborhood access to the park by connecting the intersection of Morton Ravine and Morton Valley Trails with the intersection of Morton Road and Rostron Drive. The trail includes a 50-foot bridge over Morton Run which has a pleasant view of the highest waterfalls on this natural stream.

Morton Valley Trail 1450'
This entirely new trail follows the gentle stream along Morton Road near Rostron Drive for about 775 feet, providing the only close access in the park to a natural stream. It then climbs away from the stream to join the existing Upland Trail.

Sky Meadow Trail 1,263'
Beginning at the Boyce Road Trailhead, this entirely new trail goes to the saddle by the rear community gardens with a relatively gentle, traversing, sustainable grade. It passes through meadows at both ends and a wildlife-rich strip of brushy woodland in between. It replaces the existing trail between the intersection of Boyce Road and Morton Road and the saddle.

Old Oak Trail 1,394'
Also beginning at the Boyce Road Trailhead, this new trail goes through mature and younger forests below the cellular towers. The trail passes by and through many mature trees along a gentle grade down to the saddle by the community gardens. It replaces the road to the saddle that currently goes by the cellular towers.

Hidden Pond Trail 1,003'
Passes along the dam of Hidden Pond, connecting to Bird Meadows Drive and Many Habitats Trail at its two ends. It's a gentle, quietly lovely trail.

Little Falls Trail 950'
This dramatic new trail follows a lovely ravine below Hidden Pond. Few people even know this pleasant ravine exists. At the top end of the ravine, the trail winds

through four tributaries and passes limestone ledge waterfalls that give the trail its name.

Boyce School Trail 845'
This existing trail from Boyce School into the park has a rerouted west end to meet the new Sky Meadows Trail. The two small existing bridges across the stream are retained. Since this trail crosses a designated ecologically sensitive area (natural riparian area), high amounts of trail use should be discouraged. Since the trail is only a spur to the school and has no parking or other access from Morton Road, trail use will likely remain low.

Overlook Loop 1,659'
This short loop out of the Boyce Road Trailhead has one of the best views in the park as one looks to pastures and private land to the northeast. This trail is designed to be wheelchair accessible as a natural surface trail although it can initially be developed as a hiking-only trail. Note that this trail can only be made accessible as a full loop once the road from the cellular towers to the rear community gardens has been closed and restored. The current crossing on the steepest part of this road cannot be made accessible without removing the road.

Friendship Trail 969'
Connects Many Habitats Trail to the edge of the Boyce Road right-of-way at the edge of the park across from Friendship Village. The trail does not include any construction within the right-of-way or on Boyce Road and hence does not require any state approval or permissions.

If Boyce Road is realigned in this area in the future, request the state to build a pedestrian underpass into the embankment of the realignment. The underpass may also serve as a drain or box culvert, enabling the underpass to serve two functions with one structure and increasing the chance for funding and construction.

Unnamed connector trails

- 300' between Old Farm Road Trail and Lost Farm/Baker Slope Trails
- 232' between Old Farm Road Trail and Between Two Worlds/Woodlands Trail
- 232' between Sylvan Ridge Trail and Upland Trail (north connection)
- 229' between Sylvan Ridge Trail and Upland Trail (south connection)
- 204' between Many Habitats Trail and White Pine Trail
- 85' between Old Oak Trail/Overlook Trail and Boyce Road Trailhead on west side
- 46' between Old Oak Trail/Overlook Trail and Boyce Road Trailhead on east side

Total trail mileage
Total mileage of all proposed and signed trails in the final system, including interior roads used as trails:

9.3 miles

Total mileage of dedicated trails (i.e., omitting interior roads Bird Meadows Drive and Ravine Drive):

8.2 miles

Trail Development Priorities

Trails can be developed in two phases. Phase One includes nearly all trails and results in a fully functional trail system for hiking use, but only limited opportunities for wheelchair users.

Phase Two consists of extensions and upgrades primarily serving relatively small populations, including increased accessibility and a prime connection between the park and Morton Road. While desirable, they are also relatively costly. The Township may wish to defer these projects for another year, or simply not implement them.

Highest priorities are listed first. Note that these can all be underway concurrently—it's not necessary to finish the first on the list before undertaking the next item:

Phase One Priorities

- **Bridge on Beech Valley Trail (below the REEC).** The lack of this critical bridge over a virtually uncrossable channel severely limits trail use options near the REEC.
- **Trails in and around Deer Meadow.** Relatively quick and easy to develop, these trails should be done to provide opportunities for REEC visitors. For maximum usefulness to the REEC, development order should roughly be:
  - Beech Valley Trail (existing and new)
  - Meadow Edges Trail (existing and new, needs drainage work and gully crossings)
  - Between Two World Trail (mostly existing)
  - Milkweed Trail (new, short meadow trail, needs drainage work)
  - Butterfly Trail (new, very short meadow trail, needs drainage work)
- **Two timber bridges on the Woodlands Trail and Queen Maple Trail,** in that order. The steep-walled channels crossed by these bridges are difficult and dangerous to cross now. Attempting to cross them without bridges will damage the channel banks. Building the bridges will enable those three trails—plus the trails that connect to them—to be formed by use.
- **Timber bridge on the Wetlands Trail.** If it is decided to form this trail by use initially and upgrade it to accessibility later, build the timber bridge near the trailhead now.
- **Switchback Trail and the Split Earth Point retaining wall.** Perched on steep slopes, the Switchback Trail below Split Earth Point must be constructed before it can be used. Soil and rock excavated from construction should be used to backfill the new retaining wall on Split Earth Point. The Switchback Trail also needs its own small stone retaining walls which can be built at the same time as the wall at Split Earth Point.
- **Reroutes on the Woodlands Trail.** A number of reroutes on this existing trail improve both sustainability and the trail experience. As part of the main connection between the northern and southern sections of the park, these reroutes should be formed before the old route becomes too established.
- **Lower (northern) portions of Morton Valley Trail.** Parts of this new trail paralleling the stream need to be cut into steep slopes before the remainder of the trail can be formed by use.
- **Tread formation for all trails except accessible trails, Curved Bridge Trail, and Morton Falls Trail.** Perform any tree and brush clearance that hasn't already been done and form trails by use. Install tread drainage/hardening and stabilize gullies as needed. Stage signposts and bench parts for the Upland Trail-Sylvan Ridge Trail area to the saddle by truck before roads to this area are removed.
- **Bridge and trail of Curved Bridge Trail.** This relatively major project connects the two sides of the park. It can wait until later in Stage One because crossing the current stream is not too difficult and causes no damage. Finish the bridge before signing or officially opening the trail.
- **Boyce Road Trailhead parking area/entrance drive reconstruction, and removal and restoration of old roads and old trails in the Sky Meadow/Saddle Meadow/high point area.** This is most efficiently done with small or medium-sized heavy equipment. Doing all of the earthmoving at once allows soil to be moved around the area as needed. Regrade the community gardens in the saddle to restore the original slope. Close and restore the existing trail from the Boyce Road-Morton Road intersection to the saddle.

- **Build Overlook Loop.** With the road north of the cell tower removed, the Overlook Loop can now be completed as an accessible trail across that road.
- **Install trail intersection and other signage for all trails.** This is left until last in order to give the new trails time to compact through initial public use on previously unofficial trails. Signing the trails makes them official and completes the trail system.

Phase Two Priorities

- **Wetlands Trail as an accessible trail.** Widen and mechanically compact the tread. Build the Two Forks Boardwalk as the last step (small trail construction equipment can cross the timber bridge across the stream but not the boardwalk). This is set at a lower priority simply because other projects serve a greater population.
- **Wetland Trail extension to Trillium Trail, including Wetland Bluff Boardwalk and earthen ramp.** If it is decided to extend the Wetland Trail all the way to the wetland itself as an accessible trail, this can be done in Stage Two. Logistically, it makes the most sense to build the Two Forks and Wetland Bluff boardwalks at the same time.
- **Morton Falls Trail and bridge.** This is a low priority because (1) visitors are currently crossing the shallow stream without damage and (2) this long bridge is likely to see relatively little use even when complete. Nonetheless, providing this bridge creates a prominent new neighborhood gateway, firmly ties the neighborhood to the park, and draws increased attention to the park.

  The following is a suggestion but must <u>not</u> be considered legal advice. It is not recommended to build the Morton Falls Trail unless the bridge is provided. Liability is based on the *expectation* of safety. While visitors may cross the stream now, as long as there is no official trail, they do so at their own risk and with a relatively low expectation of safe conditions, hence low liability for the Township. If the trail is built and made official without a bridge, though, the potentially slippery or hazardous crossing may become a liability because the public has a higher expectation of safety on signed and maintained trails than this unimproved crossing provides. Hence the bridge is necessary to fulfill the expectation of safety on an official trail so close to developed neighborhoods.

Trail Flagging Completed as Part of Trail Plan

New trails are already completely designed and staked on the ground

The only way to truly consider all eleven human and physical concepts of natural surface trails (see "Art and Science of Natural Surface Trail Design" in Section 1) is to design each piece of each trail on the ground. Only then can natural shapes, anchors, edges, and gateways be found, felt, and incorporated; safety, efficiency, playfulness, and harmony sought and optimized; compaction, displacement, and erosion potential predicted and evaluated; soils examined; and tread watersheds and tread construction appropriately planned.

Hence all new trails and trail reroutes were carefully designed, laid out, and staked in the field. This took most of over 35 days in the field and thousands of blue whisker-like stakes. As a result, the master plan and detailed plan were done hand-in-hand, and all trail lines on the map are already marked on the ground.

Most new trails require very little construction

As Section 4 explains in detail, it's possible to both maximize sustainability and minimize cost and effort by "walking trails in" rather than by formally constructing all portions. Forming tread by use has 11 advantages (see Section 4). Most of the new trail mileage is appropriate for forming tread by use and has been carefully designed to be sustainable when formed that way.

This process is much like how a deer trail or "social" trail is formed. Visitors simply follow the closely spaced blue stakes in the field to compact the tread into existence.

The downside is that trails can be difficult to hike until they've been "beaten down" to support our feet, especially where the trail traverses significant slopes. Also, without initial construction, trails also don't necessarily look like trails until they have been used for awhile.

Initial construction is still required where trails cross steeper slopes and in some of the more level areas where tread drainage needs to be constructed.

Construction Notes for Trail Work

Starting from the north end of the park:

Lost Farm Trail

- Form tread by use except when traversing the steeper portions of the sides of the ravine as flagged on the ground.
- On the riprapped overflow chute of the retention pond dam across the ravine, rearrange the jagged large stones and fill voids with smaller stones to form a smooth, stone and gravel crossing at the same grade as the original riprap.
- About 220' north of the south end of the trail, the tread crosses a grassy area. Create a causeway by importing soil excavated further north when traversing the steep ravine wall.

Baker Slope Trail

- Form drainage dips on both sides of the climbing turn. Trail alignment should create the lower dip, but a dip may need to be constructed above the turn.
- The trail crosses two forks of a gully. Build stone gully crossings across each.
- The gully here has abundant stone to fill needs for many gully crossings throughout the park.

Old Farm Road Trail

- Dig at least three drainage dips to drain the road at intervals between the REEC classrooms and the ravine between Hawk and Deer Meadows.
- Dig a drainage dip in the low spot in the road about 90' south of the beginning of the old trail to Baker Park.

Beech Valley Trail—accessible northern 250'

- Trail begins at the lower "terrace" of the REEC lab building.
- The first 250' by the lab is designed to be accessible.
- On both sides of the roof, dig shallow, grass-lined swales to channel lab roof runoff to the southeast. Currently, this water spreads all over the area below the lab, contributing to muddy trail conditions. Where the current trail comes around the west side of the terrace, install a gravel-lined drainage dip with coarser stone than the crusher fines of the trail.
- The trail runs through a low, wet area between the lab terrace and the forest. For ~38' through the bottom of the low point, excavate soil to 5" down for 3' wide, install geotextile, and install 3/4"-minus crushed stone 6" deep with a 1.5" crown. At the drainage crossing, reduce the crown to 0". See drawing on page 3-35 of *Trails Design and Management Handbook*. Consider extending crushed stone tread to the REEC lab.
- To make the trail easier in a wheelchair, remove the top 8" of the artificial crest at the edge between meadow and forest.
- In the accessible portion in the forest, allow the new tread to compact with traffic or mechanically compact it with a roller or tamper. Compacting a very thin layer of gravel into the soil will help harden the tread and reduce muddiness, but don't add so much that it looks like a gravel trail.
- Form a 5' wide level turnaround at the end of the accessible portion.
- Do not claim accessibility until the tread surface becomes sufficiently firm and stable that narrow wheelchair tires do not sink in.
- Seek advice from wheelchair users on the specifics.

Beech Valley Trail, remainder of trail

- Form tread with outside edge as staked. This pulls the trail back from the edge.
- Install drainage dips as staked.
- On the climbing turn south of the bridge, restore the original slope of the hillside by removing the outside edge of the road fill. Cut and fill tread grade as needed to create a smooth grade between the bridge and the large tree south of the bridge. See site plan for the bridge in Section 5 for more tread construction details near the bridge.
- Add woodchips throughout the new segments until they compact enough to not be so muddy.

Meadow Edges Trail

- Between the Beech Valley and Butterfly Trails, trail crosses five gullies in a row. Depending on depth, handle each one as a drainage crossing or a gully

crossing. The second lowest gully is 4' deep. Form a crossing by filling it in with irregular stones up to 18" below the top. See "Gully Crossings" in Section 4.

- Stabilize the gullies mentioned above to prevent them from undermining the trail.
- In the low areas around the intersection with Milkweed Trail and continuing north, create a soil causeway at least 4" high after compaction. At the many drainage dips and drainage crossings flagged in this area, dip the causeway down to grade level and harden it with gravel pressed into the clay. Widen tread to 30" but taper edges down to existing grade. Within the 200' closest to the Old Farm Road Trail, causeway can be 24" wide and 2.5-3" with frequent drainage dips to let meadow water drain toward the nearby stream. See "Causeway" in Section 4.
- For maintenance in the meadow sections, add soil over time as tread compacts and sinks into the formerly plowed meadow. Install frequent drainage dips to let meadow water drain toward the nearby drainage.
- Add woodchips throughout the new segments in the meadow until they compact enough to not be so muddy.

Butterfly and Milkweed Trails

- Ditch and crown the entire length of both trails. Dig ditches on both sides. Add layer of woodchips on top to reduce muddiness.
- For maintenance, add soil over time as tread compacts and sinks into the formerly plowed meadow. Try to keep the tread crowned so that water quickly flows into the side ditches.

Between Two Worlds Trail

- At Cathedral Point, restore the slope below the trail and install at least five "Area Closed" signs on rebar supports below the trail along likely ways down the slope. Bring a few dead trees and/or branches into the middle distance from the trail to visually disrupt potential pathways down. If shortcutting continues, build a two-rail split rail fence following the line staked on the ground, or a three-rail fence if shortcutting is rampant. Test the ground to make sure postholes can be dug before committing to the fence.
- In all efforts at Cathedral Point, strive to not draw attention away from the lovely, airy openness of the spot. Visitors should notice the trees and focus on nature instead of constructed trail facilities or barriers. At some point, the cure for shortcutting here can be worse than the disease.
- Along the bluff, the tread was pulled in from the edge for safety, particularly REEC school groups. To restore the old tread, transplant moss from the new tread to the old tread. In transplanting, dig down several inches and water the transplants by hand until they take hold. Moss transplants quite well.
- Remove old wire and fencing from next to the trail near the southwest corner of Deer Meadow.
- At Chartiers Point, restore the slope below the trail and install two or three "Area Closed" signs below the trail along likely ways down the slope. Bring a dead tree trunk into the middle distance along the shortcut to visually disrupt the potential path down. As with Cathedral Point, avoid going too far in attempts to prevent shortcutting since such efforts can ruin the experience for everyone.
- In the deep, abrupt gully crossing just east end of Chartiers Point, remove the crests and build up the bottom with stone to form an easier, visually anchored crossing. 20' past this, dig a ditch to drain the wet patch in the trail into the nearby gully and treat the wet patch as a drainage crossing. See "Drainage Crossings" in Section 4.
- In the two-headed gully closest to the east end, install stone gully crossings in both channels.

Connector between Old Farm Road Trail and the intersection of Between Two Worlds and Woodlands Trail

- Construct causeway up to 1' high at Old Farm Road and continuing downhill about 45' and a depth of 8" until it reaches higher tread above the drainage from the old sileage pit. Close and restore adjacent muddy trail in the drainage.

Woodlands Trail

- The tight-angled intersection between Woodlands and Between Two Worlds is prone to shortcutting but little can be done to stop it. A boardwalk on Woodlands Trail beginning at the intersection and spanning the gully was contemplated but rejected as unnecessary.

- The new reroute on the north end crosses several minor drainages as flagged. Make sure these drainages drain across the trail.
- Suggest using soil excavated from full bench tread on northern gully crossings to build the causeway on the connector trail to Old Farm Road Trail.
- In the major southern gully crossings, try to throw excavated soil from full bench treads out of the gully.

Chartiers Floodplain Trail

- Old road is in excellent shape and needs little work.
- Make an easy to use tread through the washed-out drainage crossing near the base of the old road.
- On Chartiers Floodplain, press a thin layer of 3/4"-minor gravel into the silt to help resist sinking from compaction and to help prevent mud. Over the years, keep adding gravel so that the tread level is always at or just above the surrounding grade.

Curved Bridge Trail

- Do not attempt to block access to the valley floor, especially on the south side where the old roadbed leads nicely down to the stream.
- The northern 29' of the tread, just below Ravine Drive, is built on fill. Bring fill up from full bench tread excavation below.
- The north end of the trail is cut from the roadbank of Ravine Drive. If the bank collapses into the trail, it may be necessary to built the tread on imported fill or to construct a stone retaining wall to hold back the roadbank.
- Flagged positions for the northern pier and the north abutment don't necessarily correspond to the drawings in this plan. Use the fiberglass bridge position staked on the ground as a constant and calculate new positions for the northern pier and abutment accordingly.
- During bridge construction, try to minimize site damage to the valley floor.
- Erect the fiberglass bridge on rented scaffolding all across the stream.
- Do not drop fiberglass pieces. If a piece becomes damaged or split, even on its face, water will seep in and begin to damage the piece through frost action.

Trillium Trail

- Drain sunken tread toward Chartiers Creek at intervals.

Switchback Trail

- Tools for construction: pick mattox, digging/rock bar, 5-gallon plastic buckets to haul fill soil and smaller stones, shovels for scooping, adze hoe.
- Ramp up from Trillium Trail is built on fill. Get fill soil from full bench cuts higher on the trail.
- Flagging is for full bench trail through all of the steeper parts. Critical: form tread dips at all flagged dip locations.
- Do NOT do clearance first. Start from the bottom and stay on the new tread as much as possible, using the excavated tread as a stable work platform to move ahead.
- Construction sequence:
  1) Working your way uphill from the tread you've already formed, clear leaves and fluffy organic soil from 12" of treadway uphill of the blue stakes
  2) Form tread by compacting (stomping) loose soil as much as possible. Only dig when soil is too stiff or the sideslope is too steep to form a useable tread with your feet.
  3) Do clearance after the initial tread is formed. This helps reduce excess off-tread damage to the slope.
  4) Use your feet and tools to form 14-22" of tread (22" where slope is steepest, near the switchback). If you remove any stones, temporarily stockpile them above the backslope. Cut the backslope vertical for now.
  5) Use excavated firm soil to as fill in filled tread sections below the switchback. Stockpile material until enough tread exists to haul it to where fill is needed.
  6) Use stones set aside during earlier stages for stone retaining walls or backfill for walls. Scatter unused stones or use elsewhere in the park for gully stabilization and drainage crossings.
  7) Once the tread for the entire trail is formed, cut the backslope to lean back into the hill enough that soil and debris won't slump onto the tread. Ideally, the backslope is not much steeper than the hillside.

8) Restore off-tread impacts. Replace organic soil on the backslope. Coat the new tread with 2" or so of organic soil stockpiled in earlier steps.

- Build 30' of the lower leg of the switchback on fill.
- Trail has two "tree saver" stone retaining walls that help avoid the need to cut large tree routes near their trunks. Both are flagged on the ground:
  a) 15'-long wall above the switchback, maximum 15" high, form tread dip in center below large tree.
  b) 14'-long wall approx. 100' east of Split Rock Point on new trail. Max height approx. 16" tapering to 0" at both ends.
- Retaining wall on Split Earth Point can be drylaid or mortared from behind, i.e. no mortar is visible from the front. Soil is so rocky here that the wall will probably not settle much. Top of wall is on varying grade—never level.
- On Split Earth Point, remove the dead stump by the center tree (the stump with the beer bottle in it).
- See Split Earth Point site plan in Section 5 for more details.

Sylvan Ridge Trail

- On the steeper sections, dig drainage dips wherever the trail grade is relatively more level and the cross slope is steep. These are the most sustainable locations for dips.
- Form a raised drainage crossing at the muddy, low spot south of the intersection with Queen Maple Trail. Use gravel and smaller stones to line the bottom of the crossing.
- Form a drainage dip south of the intersection with Morton Valley Trail to avoid draining tread runoff into the intersection.

Upland Trail

- On the steeper sections, dig drainage dips wherever the trail grade is relatively more level and the cross slope is steep. These are the most sustainable locations for dips.
- Drain the muddy section just south of the northern gas line by digging a ditch through the berm on the trail (this part of the trail is an old road). Continue the ditch alongside the lower parts of the trail to drain the tread.
- Reroute the trail across the saddle as flagged. The new route has better drainage and can be formed as a narrow tread rather than the wide woodchip tread that is there now.

Morton Ravine Trail

- Trail is basically OK as is.

Queen Maple Trail

- Critical: dig drainage dips at all flagged locations. Trail grade is too steep to drain through rolling grade by entirely by alignment.
- Bury the large, raised tree route where noted.
- The trail intentionally avoids being on the Vision Rocks or other flat limestone slabs since these slabs tend to be slippery when wet.
- Near the bottom of the trail, where it crosses the social trail created by bicyclists, the trail crosses a slight drainage. Make sure that the trail crosses this drainage at a low point to avoid intercepting the drainage.
- See the Queen Maple Trail bridge plan in Section 5 for details on the west end of the trail and bridge.

Many Habitats Trail

- Build causeway across the low spots by the spring house and immediately south of the northern gas line. Leave drainage crossings to let site water across.
- Tread in the meadow should be fairly sustainable without extra effort. But if it starts to show signs of widening or muddiness, add a ditch on the uphill side (and perhaps also on the down hill side) and crown the tread.

Bird Meadows Drive

- Unclog the culvert north of the sewer contractor's staging area.
- Repair drainage problem at the top of the grade down to the wetland. The problem diverts water down the road instead of the roadside ditch, causing heavy erosion in the surface of asphalt millings.

Wetland Bluff Trail

- Starting from Bird Meadows Drive, access to the trail starts from the perimeter road below the wetland excavation soil pile. Dig ditches to drain the two-track ruts of this road.
- The east half of the trail has been rerouted and now includes several more drainage crossings. The most difficult section is toward the middle where the trail dramatically traverses the steep walls of a deep gully.
- At the east end at the top of the bluff, a small gully is just about to undermine the trail. Stabilize the gully before it can consume the trail.

Wetlands Trail

- As a hiking trail, the beginning of the trail north of the Two Forks stream crossing collects water and has a fall line alignment. If the trail is not upgraded to wheelchair accessibility, add stone steps and a thick layer of woodchips above the bridge to reduce erosion.
- Tread in the north end of the trail, though grassy woodlands with very little slope, is likely to sink too deep in time and be difficult to drain. If this happens, it can be ditched and crowned.

White Pine Trail

- Reroute both ends to improve drainage and sustainability.
- Restore the rerouted trail segments at each end by scarifying (loosening) compacted tread and bringing in dead leaves, branches, etc. to make it look as if the trail had never been there.
- Install drainage dips at points of minimal tread grade.

Morton Falls Trail

- Do not build the trail until the bridge is actively under construction, and do not officially open the trail until the bridge is complete (see explanation under "Morton Falls Trail" in "Trail Development Priorities" earlier in this section).
- Although this plan identifies a 50-foot fiberglass bridge as the proposed bridge, an alternate site can be considered. A three-segment bridge, very similar to the Curved Bridge on the Curved Bridge Trail, could be built above the falls on an alignment close to where the original farm road crossed the stream. All three segments would be timber stringer spans of about 20 feet each. Stone piers like the Curved Bridge would rest on bedrock at the surface of both sides of the main stream channel, and the bridge itself would also have a curved alignment. This bridge would be less dramatic and more romantic than the fiberglass bridge, it would be in the shade and not highly visible from Morton Road, it would cost about 50-60% as much, and the bridge itself would not be as close to the prominent concrete sewer access. Overall, it would have a softer, gentler, more rustic feel more in keeping with the rest of the park. However, during floods, the piers would be in the flood channel and the bridge would be much lower, making it possible for the bridge to catch flood debris, and the bridge stringers will have to be replaced every twenty years or so whereas the fiberglass truss is much easier to maintain. Using steel stringers will increase construction cost but create a stronger bridge with less maintenance and inspection needs.

Morton Valley Trail

- Portions of the tread near the stream were designed with minimal grades to help minimize potential erosion and stream sedimentation. Attempt to maintain outslope on these segments to reduce sediment runoff to near zero even in heavy rains.
- In excavating full bench tread segments near the stream, widely disperse material uphill of the trail.
- Where the trail pulls away from the stream, it crosses a very steep bank through a tangle of debris. This is to help facilitate drainage—if the tread were on the grassy meadow below, it would require substantial and obtrusive drainage work to make it sustainable. The many dead trees on the slope above may indicate that this is a wet hillside and it may be necessary to compact gravel into the tread to reduce muddiness even on the steep slope.
- Below the intersection with the Upland Trail, the trail has a climbing turn almost directly up the fall line. Carefully establish drainage dips where flagged in order to prevent erosion.

Sky Meadow Trail

- Install 4-5" high causeway through the lower portions of the brushy woodland crossing from about 40' north of the intersection with Boyce School Trail as far as Saddle Meadow. Install causeway here initially, while soil can still be trucked

in to the saddle. Form drainage crossovers every 30 or so feet and at all low points in trail alignment.

- It may also be necessary to at least crown the tread through Saddle Meadow.
- Remove old trash dumps and remnants of community gardening visible from the trail.
- Form drainage dips where flagged through Sky Meadow. These may have to be dug somewhat.
- The flag line for the upper end of the trail assumes that the two roads it crosses will be removed and the original slope restored.

Old Oak Trail

- This new trail has already been constructed as a test project.
- Form a drainage dip in the gas line corridor above the intersection with the Upland Trail and Sylvan Ridge Trail in order to avoid draining tread runoff into the intersection. To avoid digging in the gas line corridor, pile soil into the tread below the drain location to form a crest that will divert runoff.

Hidden Pond Trail

- Form 4-5" high crowned causeway between Bird Meadows Drive and the outlet of the pond, about 350'. This entire area tends to be wet, and raising the tread will avoid mud and braided tread later. Causeway may be unnecessary in the slightly higher ground near the trees south of the gas line, but adding even 2" of compacted tread here would help keep the tread from becoming a rut later.
- Where the trail crosses the riprapped pond outlet, add smaller stones and rearrange existing stones to form a smoother, more stable crossing. Add a few inches more stone to the sides of the crossing than to the middle so that the crossing itself dips toward the middle. This will concentrate drainage into the middle, keeping most of the crossing tread dry. Avoid using flat stones since these become slippery—use smaller, angular stones and gravel instead. Curve the entire crossing instead of going straight across. No bridge is needed since water can never be very high.
- On the tread across the dam, add a crown to reduce muddy tread (there is no sideslope to drain a compacted, sunken tread) and/or maintain a thick layer of woodchips here.

Little Falls Trail

- Most construction on this trail was constructed as a test project. To complete it, compact the entire surface and the outside edge by stomping on it. Compact a bit of gravel into the soil surface to harden it slightly and improve traction. Install a thin layer of woodchips or compost to cover the clay and simulate the thin organic layer that naturally develops in undisturbed areas.
- Construct 8 stone steps/risers on the face of the dam below Hidden Pond. See "Stone Steps" in Section 4. Since the dam is seeping and the face of the dam seems constantly wet, install a full gravel tread 3-4" deep between the steps with no soil on the surface. Also install a gravel tread for at least 14" below the bottom step. Place geotextile under the gravel to keep it from mixing down into the soil below. Use gravel with fines that will become firm as the fines fill the void, and avoid using the same crushed stone as was used by the REEC (not enough large particles).

Boyce School Trail

- The two existing bridges across the braided stream can be retained, but the steep plastic lumber ramps at their ends are slippery when wet. Suggest modifying the bridge to have level steps instead of ramps, or building up soil ramps at the ends to bury at least the bottom half of each ramp.
- The original location has a poor, fall-line alignment that potentially erodes directly into the stream. To improve it, the west end is realigned with a gentle traversing grade with less erosion potential.
- Scarify (rip up) and restore the abandoned segment.
- Where the realigned segment crosses the existing trail between the saddle and the Boyce Road & Morton Road intersection, form a drainage dip in the Boyce School Trail to prevent water from the old trail from being diverted down the new one.
- Through and on the approaches to the low-lying poison hemlock section of the west end, form a 4-5" high causeway for approximately 75'.

Overlook Loop

- Initially, trail tread can be formed by use for a hiking-only trail. Except for shaping tread dips where flagged, a hiking-only trail needs almost no construction.
- Flagged design of the east end assumes the road it crosses twice will be removed and regraded to match the original slope.
- Clean up community garden debris in trees along the east side.
- Because the existing road north of the cell tower is very steep where the trail crosses it, the Overlook Trail cannot be made accessible all the way around the loop until the road is removed. Once this road is gone, form a drainage dip where the trail crosses the former road.
- For optimal accessibility as a natural surface trail, tread needs to be compacted as much as possible. Compaction removes voids that store water, making the tread much firmer and more stable even in wet conditions. Compacting a thin layer of gravel into the surface helps to reduce muddiness, but don't add so much gravel that it begins to look like a gravel trail.
- The easiest way to compact the tread is to build it with a small excavator. The excavator's own weight, plus impacts from its bucket, provides adequate compaction. A small, self-propelled roller can optionally provide even more compaction.
- Because of the compaction needs and because building the trail with small machines can do the job more efficiently than hand construction, this plan recommends contracting accessible construction to a trail contractor with the appropriate trail-scaled equipment. Check www.trailbuilders.org for potential contractors and build this trail at the same time as other accessible trails for greatest efficiency.

Friendship Trail

- Stabilize the unstable gully coming down from Boyce Road. Add riprap below the current crossing to try to maintain it. If the current crossing cannot be maintained, a bridge may be needed.
- Add low causeway (3-4" high) through low-lying, near-level segments northeast of the current gully crossing.

Suggested Bench Locations

The "Sign and Bench Location" map provides many possible bench locations. Yet benches tend to civilize the feel of the park more than many would like. This author believes that benches should only be placed sparingly, if at all. It's best to wait and see which locations really need benches.

This plan recommends only eleven bench locations, none of which would be installed until Phase Two. The locations are:

- Intersection of Beech Valley, Meadow Edges, and Between Two Worlds Trails, south of the REEC. This is in the middle of a steep climb. Once the ravine is cleaned up, it would be a shady, pleasant place to stop for a moment.
- Cathedral Point on the Between Two Worlds Trail, inside the curve and facing west-southwest.
- Chartiers Point on the Between Two Worlds Trail, next to the dog grave and facing Chartiers Creek.
- Intersection of Curved Bridge, Trillium, and Switchback Trails, on the Chartiers Creek side of the intersection and facing the creek.
- Switchback Trail, below the switchback. The bench should be above the trail, facing the ravine. This is a steep climb and this is primarily a resting bench.
- Valley View Point, on Wetland Bluff Trail.
- Midway along the Morton Valley Trail, near the southernmost point where the trail is still next to the stream. This spot, below the old barn on Morton Road, is one of the most pastoral locations in the park.
- Two Forks Trailhead, next to the beginning of the boardwalk in the parking area. This is a "waiting" bench for those waiting for others in their group to arrive.
- Two locations on the Overlook Trail, facing east and northeast. These are the best locations for a vista bench in the park.
- Next to the trail entrance on the east side of the Boyce Road trailhead parking area.

4

Natural Surface Trail Shaping

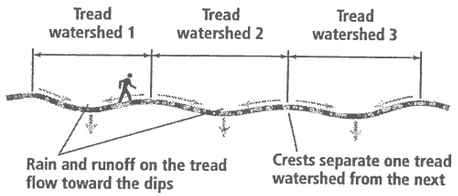
Descriptions of trail construction and maintenance techniques referenced in Section 3

Natural surface trails are dynamic, complex systems of human and physical forces and relationships. They also change predictably over time. Only by understanding, predicting, anticipating, and working with these human and physical dynamics can natural surface trails be sustainable.

Physical Sustainability and Rolling Grade

95-100% of the sustainability of many natural surface trails comes directly from their exact alignment.

Alignment not only determines much of ecological sustainability (by the presence or absence of a trail), but also the details of physical sustainability through trail drainage. Natural surface trails must drain water often enough to prevent accumulations that lead to erosion, puddles, and preventable mud. Using a technique called *rolling grade,* skilled trail designers align the trail like a mini roller coaster with frequent crests and dips that prevent water from running along the trail for too long:

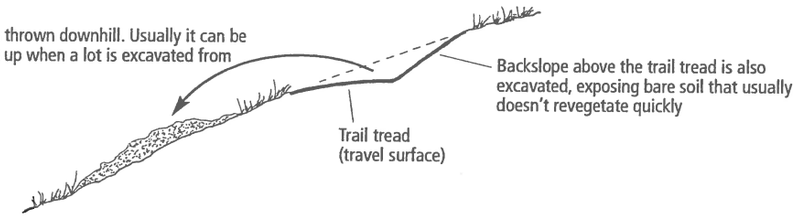


Ideally, rolling grade isn't constructed by building structures, nor by adding waterbars and drainage dips to a trail after it has started to erode. *Rolling grade should be designed and shaped into the alignment from the beginning.* When the trail is conceived, staked, and formed as a series of gentle dips and crests all along the way—even when the trail is climbing—then erosion is self-limiting. How far apart the crests and dips are depends on twelve factors explained in Chapter 7, "Tread Watersheds," of *Natural Surface Trails by Design: Physical and Human Design Essentials of Sustainable, Enjoyable Trails.*

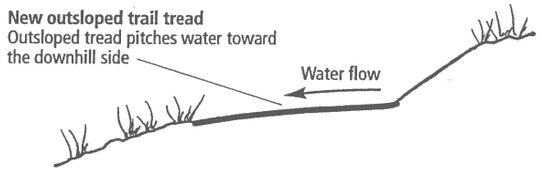
Forming Trail Tread By Use

Trail "tread" is the actual surface on which we actively hike or travel. On a natural surface trail, the tread itself is a dynamic system that changes with human use and inevitable erosion. The major change is that the center of the trail tends to deepen in time via compaction (weight of walking and wheels), displacement (sideways movement of kicking soil), and erosion.

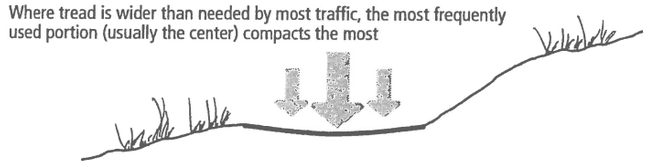
When a new trail is formally constructed on a slope, it's typically cut into the slope. The excavated material is thrown downhill. Hence the site is impacted on both sides of the tread:



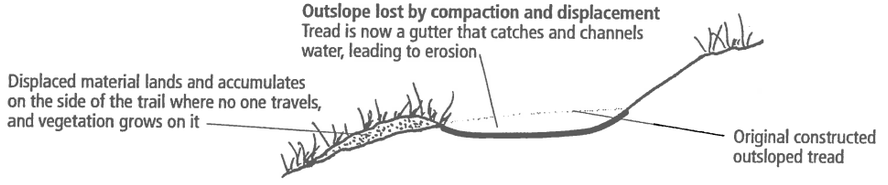
Ideally, the tread is cut to pitch water to the downhill side. This enables water to continually flow off the trail like water flows off the pitched surface of a city street:



Human use on a new trail, however, compacts and displaces the trail. Since people typically avoid the outside edge, they travel in the center and deepen it, through compaction and displacement, more than they deepen the outside edge:



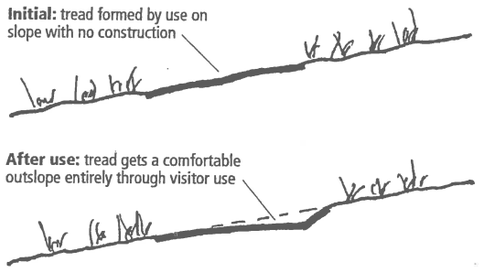
Within 1-3 years, the original outslope is often lost, displaced material piles up on the outside edge along with the grass that grows there, and the trail starts to catch and carry water like a gutter, leading to erosion:



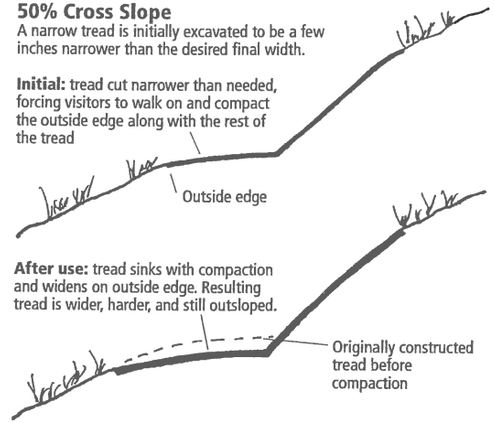
Hence building a new trail can make it pretty and smooth in the beginning but can lead to problems later. And since the trail is usually built wider than needed, it exposes more bare soil to erosion as well as impacts the site through excess excavation and "disposal" of excavated material.

However, there's a simpler, "greener" way that produces better results in the long run. Instead of completely constructing the trail, let visitors follow a carefully designed and staked trail alignment and form the trail tread completely or partly through compaction and displacement caused by their own use:

20% Cross Slope
Tread formed by use gets a compacted outslope through compaction and displacement—no construction at all.



50% Cross Slope
A narrow tread is initially excavated to be a few inches narrower than the desired final width.



Forming tread by use has **14** advantages over constructing a tread from scratch:

1. It reduces future compaction, displacement, and erosion, hence reducing future tread shape change and increasing sustainability.
2. It greatly reduces or virtually eliminates trail construction costs.
3. It tends to create a more sustainable, longer-lasting outslope.
4. It enables a majority of park trails to be usable immediately after initial clearance and construction of necessary structures such as bridges.
5. It forms a tread no wider than necessary, keeping the trail intimate as well as minimizing site disturbance and reducing the amount of bare soil subject to erosion.

6. It eliminates or reduces excavation, disposal of excavated material, and site disturbance outside the traveled area.

7. By reducing the disturbed area—often limiting it to the trail tread itself—it helps reduce introduction of exotic species and noxious weeds.

8. It forms a tread precisely where visitors want to put their feet (and/or wheels). Even if they don't follow the flag line exactly, the trail should still be okay.

9. The initial tread is rough and naturalistic, both of which tend to improve drainage and sustainability over smooth, roadlike treads.

10. The tread can be widened (by cutting into the slope on the uphill side) and/or smoothed at any time as needed.

11. Trails designed with rolling grade (as nearly all new Boyce Mayview trails are) have built-in backup drainage even if outslope fails in the future after years of displacement and use.

12. Deer trails and people-made "social" trails often don't get muddy because they form through the organic layer of fallen leaves and natural compost. Forming tread by use forms tread the same way as deer trails, whereas constructing tread typically removes the organic cover, exposing sticky, slippery clay that we have to manually re-cover with organics.

13. By allowing a rapid public opening, it reduces the amount of time in which "trail opponents" could remove the flag line.

14. Last but not least, it helps engender stewardship in visitors by enabling them to participate in the shaping of the trails. Those who visit early in the evolution of the trails will see the system evolve nicely, building awareness of the park's gentle, naturalistic approach.

The plastic flags—a special type that can be walked and ridden on without damage, breakage, or danger—can be removed when the trail is clearly formed. They are held in the ground with long rustproof screws. Both the flags and screws can be reused.

For the first few months and years, trail crews with simple hand tools should travel the system to inspect and modify the evolving treads as needed. In particular, rocks and roots may emerge as the treads form. Larger rocks, however, may be left in place as natural features at the crew's discretion. Crews can be volunteers.

In addition, please note the following:

- On slopes steeper than 35-40%, it's helpful to construct a tread at least 16" wide. Since one can predict how much tread compaction will occur, the amount of slope can be used to specify how wide the initial constructed tread should be so that it widens to the desired width with use. The tread can always be widened later if needed.
- On slopes steeper than 70%, of which the park has very few, the trail will have to be constructed in its entirety.
- On slopes less than 10-20%, including nearly all of the meadows, trail soil will likely compact and/or displace to below the level of the lower edge. This will cause water to collect in and run down the trail as in the compacted rut of the constructed trails above. This is anticipated and handled by (1) forming rolling grade in the alignment or construction of each trail, (2) constructing a raised (crowned, causeway) crushed stone or woodchip surface to shed water and continually limit erosion, or (3) using both methods together.
- Trails designed to be accessible to wheelchairs may be designed to be formed by use for hiking-only use but constructed for wheelchair use unless the situation is such that it can support wheelchairs directly.

Tread Flagging Conventions

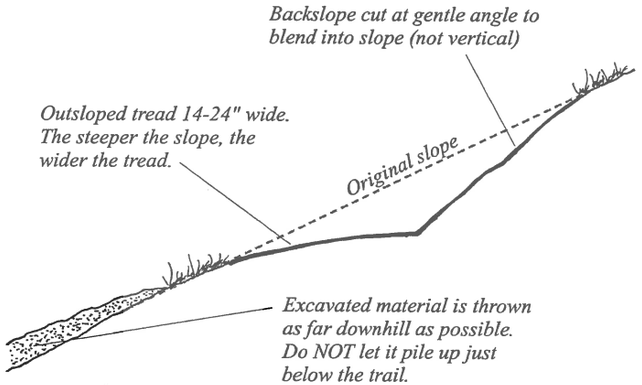
- All new trails and rerouted segments are flagged on the ground with flexible, blue, whisker-like flags.
- Trails on sideslopes of approximately 25% or less have centerline staking, i.e. stakes mark the center of the tread. Treads with centerline staking are often designed to be formed by use as the public follows the stakes.
- Trails on steeper sideslopes have outside edge staking, i.e. stakes delineate where the downhill side of the tread should eventually be. These treads are designed to be excavated as full bench tread (see "Full Bench Tread" later in this section).
- Where centerline staking changes to outside edge staking, two flags are placed side-by-side in the tread, one in the center and one on the downhill side for the outside edge.
- Drainage dips are marked by two flags inline about 6" apart in the direction of the tread. These mark locations where a tread dip or drainage dip should be but which either needs to be constructed or may not be obvious. Note that tread dips formed by tread alignment are usually not flagged as dips since the dip is formed entirely by alignment—no explicit construction is needed.

Full Bench Tread and Sidecast Tread Construction

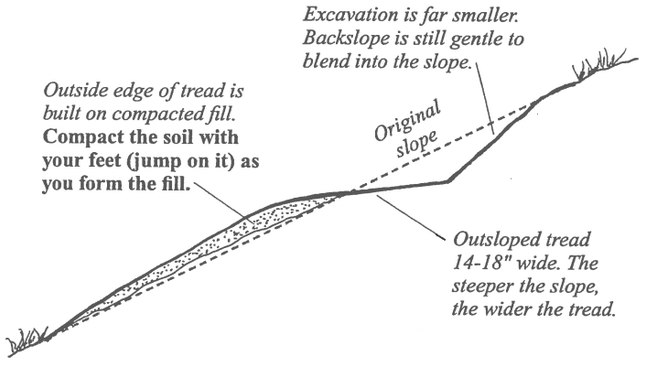
When traversing slopes, trail can be cut as a full bench (tread surface entirely on undisturbed soil) or by sidecast construction (downhill edge built on fill generated by excavating the uphill edge. Full bench creates a stable tread immediately. Sidecast construction reduces excavation effort and site impact, but the outside edge will be soft until it has been wetted, dried, and compacted for several months.

Sidecast can be used wherever full bench tread is not specified in staking.

Full Bench Tread
Tread surface is entirely excavated. Removed material is thrown and dispersed downhill instead of being left at the edge of the trail.



Sidecast Construction
Lower edge of tread is built on fill generated by cutting the uphill edge. This can work well in Boyce Mayview clay, but it can take months for the fill to compact and be stable.

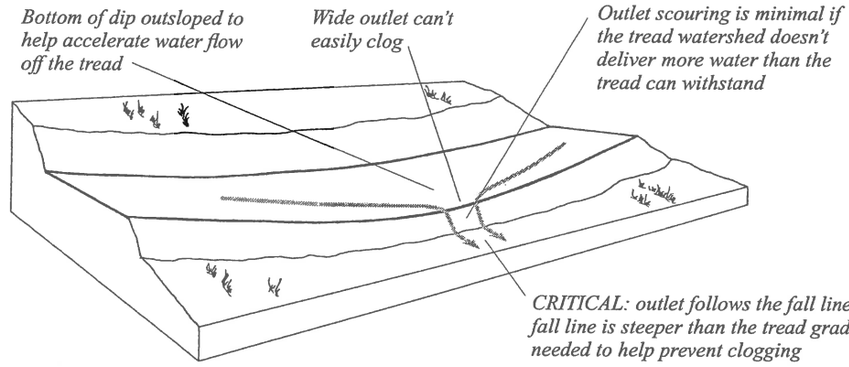


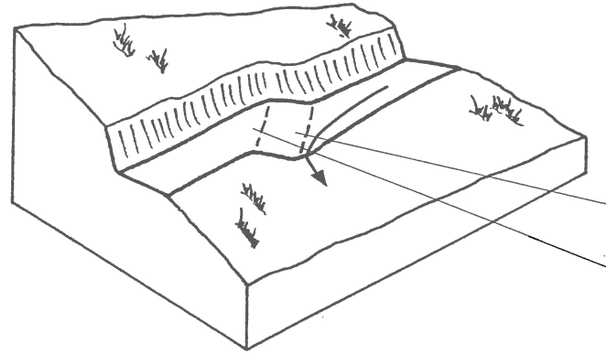
Drainage Dips

At frequent intervals throughout the trail system, dips in the tread cause water to fall off the side. Most dips are shaped by the alignment of the tread and don't need to be explicitly built. On steeper trails, especially where dips are staked on the ground, some dips need to be excavated a bit to ensure drainage.

Dip shaping is simple. Follow the six characteristics for sustainable dips in *Natural Surface Trails by Design,* pp. 60-61.

Maintenance: Cleaning out and maintaining the functional shape of dips is one of the most critical aspects of erosion control and trail maintenance. ***Always*** inspect and clean out dips. If a dip scours because it's handling too much water, add another dip on the trail above to divide water flow.





Climbing crest and dip
While climbing in a slope traversal, tread jogs quickly up and down the slope to form a relatively small dip and crest through alignment

Ditching, Crowning and Causeway

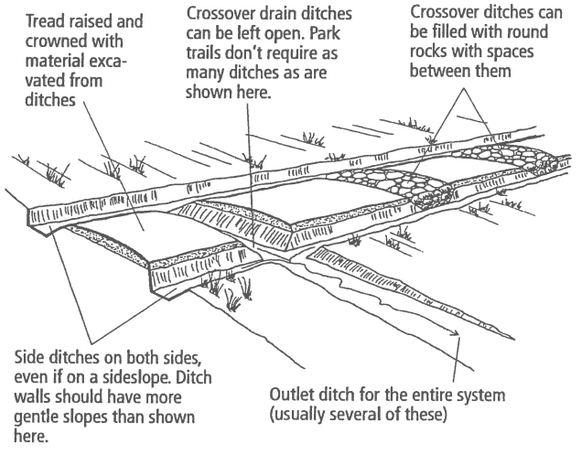
In wet areas, adding a ditch next to the trail on the uphill side (if traversing a slope) or on both sides (if sideslope is near level) creates a lower place for tread water to drain. Side ditches drain the system to somewhere lower. No culverts are used—crossover ditches cross the tread as drainage dips at intervals. Ditching lowers the local water table but no park trails are in wetlands. Ditch walls should be shallow instead of 45° or vertical.

Crowning raises the center of the tread to help drain it. Crowning is often used with ditches: material dug from the ditch is added to the crown. Additional soil or crushed stone can also be imported.

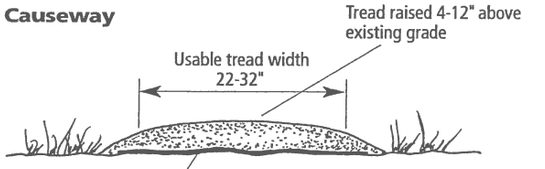
Causeway is an raised tread without side ditches. It's more naturalistic than ditching but requires more effort because all material is imported to the site. In the park, causeways are usually 4-12" high.

Maintenance: In time, more soil or crushed stone will need to be added to crowns and causeway as materials compact and displace. Ditches can (and should) have vegetation.

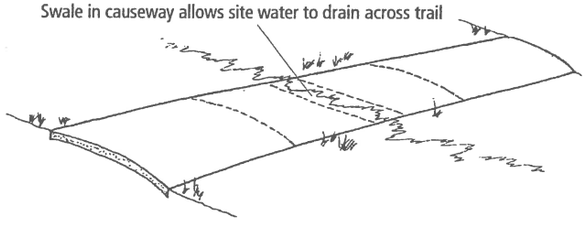
Ditching and Crowning



Causeway



Causeway can use ditches to drain site water across the tread (as shown at top) or gentle swales where causeway tapers down to ground level at intervals (below). **Swales are preferred.** Bottom of swales will likely need stone or crushed stone to prevent mud.

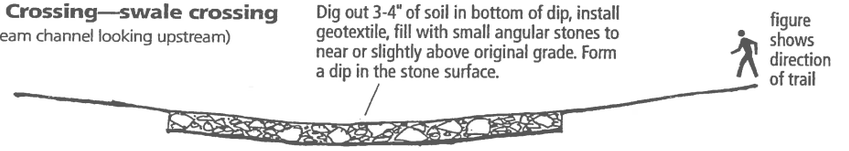


Drainage Crossings

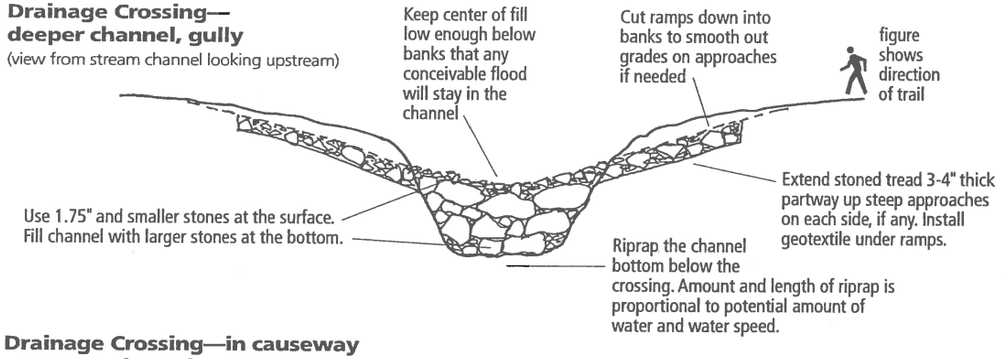
Wherever a trail crosses a site drainage—no matter how minor—the drainage channel must be a local low point in the trail so that water in the drainage stays in the drainage instead of being captured and diverted down the trail. In other words, each drainage crossing is a tread dip with the channel crossing the bottom.

Drainage crossings that tend to become muddy or that carry significant amounts of water often should have a stone surface to prevent muddiness. If the trail tread can enter and exit the bottom of the drainage without creating a steep grade, add a thin layer of small angular rocks to the crossing. For deeper crossings, add larger stones and a top layer of smaller angular stones to bring the bottom up to within 9-14" of the tread. For unstable or deepening gullies, add substantial riprap below the crossing to prevent undermining the crossing. Avoid using large, flat, smooth stones in the tread that can become slippery.

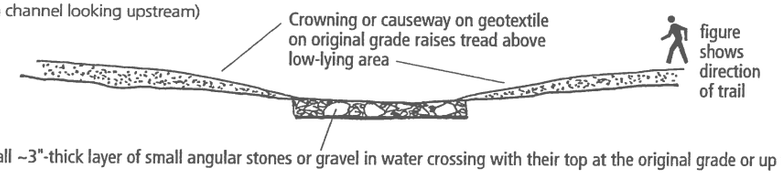
Drainage Crossing—swale crossing
(view from stream channel looking upstream)



Drainage Crossing—deeper channel, gully
(view from stream channel looking upstream)



Drainage Crossing—in causeway or crowned tread
(view from stream channel looking upstream)



On geotextile, install ~3"-thick layer of small angular stones or gravel in water crossing with their top at the original grade or up to 1" higher

Gravel and Crushed Stone

Both gravel and crushed stone make excellent all-weather trail tread. Both, however, will quickly erode with fast-moving streams of concentrated water. Hence these materials work best where water drains off the tread quickly enough that amounts don't become erosive.

Section 3 of *Trails Design and Management Handbook* is an excellent reference for gravel and crushed stone treads. Also use the materials test on page 50 of *Natural Surface Trails by Design* to evaluate behavior of proposed crushed stone products before purchase or installation.

Woodchips and Organic Soil

In nature, fallen leaves and organic debris form a thin organic layer on top of the park's clay soil. The organic layer reduces muddiness and keeps us from sticking to and sliding on wet clay, or from getting dusty with dry clay.

Where trail shaping exposes bare clay—especially uncompacted bare clay—it should be covered with a new layer of organics, including leaves, woodchips, and even compost. Only a thin layer is needed, but it needs to be kept in place. After the first year, fallen autumn leaves will probably be sufficient to replace the layer each autumn in wooded areas. Meadows may need spring and/or fall applications of mulch or compost.

As clay tread compacts, it will become harder, absorb less water, be less slippery, and won't stick to shoes as much. At this point, the organic layer becomes less necessary. Hence future years won't need nearly as much effort to spread organics as the first year or two.

Soil Stabilizers

An ever-growing number of products promise to harden native soil to prevent mud and dust. Most of them, however, require far more mechanical compaction than is possible on narrow trails and/or are based on chemicals that break down with time.

In time, with repeated wetting and drying and compaction through everyday use, native clay will become hard and stable. It can always be muddy and slippery when wet—because it's clay. But it will still be natural, and it won't be nearly as bad as it is when uncompacted. Hence this report recommends against commercial soil hardening products.

Culverts

Using culverts is not advised because they (1) look and feel artificial and utilitarian, (2) tend to clog with debris in storm runoff channels, (3) are difficult to clean out unless they are large enough to crawl through (24"), and (4) tend to accelerate water that can accelerate erosion at their culvert outlet.

In addition, the trail system attempts to openly show water—wherever it exists—as a respected, accommodated part of nature. By openly draining water on the surface, the trail itself constantly reminds visitors of the presence and power of water.

Steps

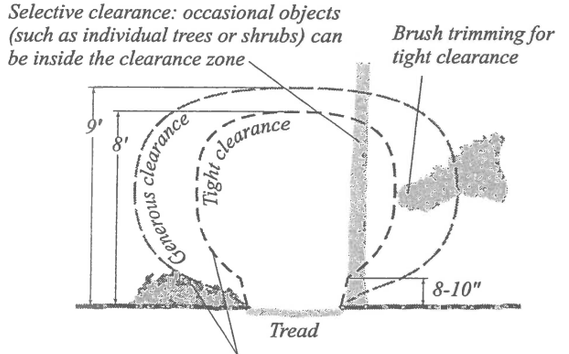
Stone steps are specified in two locations. At best, stone steps are beautiful anchors and attractive features in a trail. At worst, they are difficult to use and people bypass them, defeating their purpose as erosion control or enhancements to the trail experience.

Avoid the two most common mistakes people make in building stone steps: (1) using stones that are too small and (2) not spacing steps to people's pace. See "Steps" on pages 3-39 to 3-41 of *Trails Design and Management Handbook* for detailed information.

Clearance

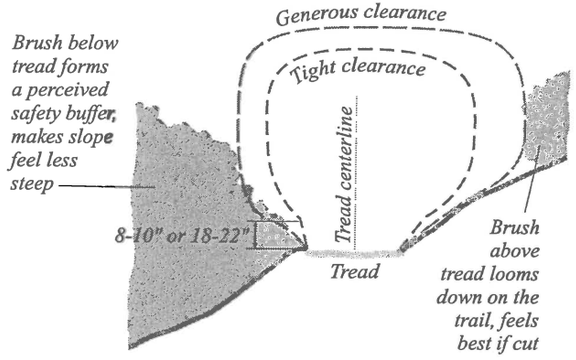
Humans need clearance shaped like a keyhole, with much more space around the head and torso than around the legs. Use tight and/or generous selective clearance to give each trail an appropriate feel given its location and context. In general, as long as clearance is comfortable and harmonious, it's okay.

Selective clearance



*Clearance zones are **average** clearance distances. Individual tree trunks, branches, etc. can optionally extend to the tread edge. Width varies by modality and desired trail experience.*

Differential clearance on sideslopes



Standard Trail Maintenance

Because sustainability is built into the trail system—especially in the native surface trail tread itself—trail tread will become *more* stable with time as equilibrium is reached. For this reason, maintenance needs are high in the beginning and decrease with time.

Highly Recommended: For the best trail maintenance training, staff and volunteers should hike during moderate or heavy rain. Hiking in the rain clearly shows how trails react to drainage.

Maintenance schedule

- **Year One:** Inspect entire trail system monthly. Take basic hand tools (saw, McLeod) to solve most common problems during inspection. Also inspect immediately after moderate or heavy rains and after windstorms.
- **Year Two:** Inspect entire trail system every 6 weeks and after heavy rains and windstorms.
- **Year Three:** Inspect entire trail system every 2 months and after exceptionally heavy rains and windstorms.
- **Year Four and beyond:** Inspect entire trail system every 3-4 months and after exceptionally heavy rains and windstorms.

Standard maintenance during each inspection

- Clean out, widen, and/or deepen drainage dip and tread dip outlets as needed
- Inspect for and drain any puddles caused by tread compaction from trail use
- Inspect for any excess trail erosion and add additional drainage dips upstream or conduct other repair. Look for the water sources and the context for erosion, then change the context to reduce future erosion potential. Do not simply fill in erosion ruts without changing the underlying causes of erosion.
- Selectively remove berms that block drainage off the outside edge of trail tread
- Add soil to fills and causeways where excess compaction or displacement occurred
- Inspect and adjust drainage of trail structures and drainage crossings
- Inspect and stabilize gullies, especially gullies caused or exacerbated by human actions
- Adjust tread to accommodate visitors' actual path (primarily during the first year)
- Selectively remove roots exposed by compaction, displacement, and erosion. Roots that are not a severe tripping hazard can be left in place.
- Add or increase layer of woodchips or organic soil on tread where clay is excessively muddy
- Check and adjust function of trail structures and bridges
- Inspect signs, replace any lost or excessively damaged signs
- Clear fallen trees and branches
- Check and adjust trail clearance, clear brush growth
- Clear or mow excess grass in tread, especially in meadows
- Spot-water transplanted plants and planted trees (primarily during the first year)
- Pick up litter

Major Maintenance and Replacement

- **Because of sustainable design and with frequent, light maintenance, natural surface treads should *never* need to be extensively reconstructed, heavily repaired, or closed for structural/physical reasons.**
- Wood structures will need eventual repair and replacement. Southern yellow pine (one of the best species for with preservatives and outdoor exposure) pressure-treated with ACQ has a rated life up to 40 years but will likely need to be replaced before then. Bridge and boardwalk decks will wear out from exposure and use long before the superstructure does.
- Fiberglass parts of fiberglass bridges need no maintenance.
- Signs with high amounts of sun exposure may fade somewhat after 20 years or need to be replaced due to loss or vandalism.

5

Trail Structure Specifications

Trail structures demonstrate how the land manager regards the trails and trail experience

Setting the Tone

Trail structures have a disproportionately large role in setting the tone of the trail system. Because structures are not acts of nature but instead are completely provided or constructed by the Township, they largely demonstrate how the Township apparently regards the trails and the visitor's experience. Structures that seem in harmony with the overall trail experience will reflect well on the Township, whereas structures out of harmony will reflect badly.

Spatial qualities of naturalistic trail structures

The core concepts of natural shape, anchors (including edges and gateways), safety, efficiency, playfulness, and harmony help us shape naturalistic trail structures in harmony with the desired trail experience.

Ultimately, a trail structure conveys or promotes feelings based on its physical shape and appearance (texture, color, rigid or relaxed geometry, etc.). By deliberately designing structural shape and appearance to *embody* natural shape, anchors, edges, gateways, safety, efficiency, playfulness, and harmony, we can shape structures that feel naturalistic—that complement their site and make us feel good about our trail experience.

More than anything, a structure needs to feel ***appropriate:*** not too smooth, not too rough, not too big, not too small, not too permanent, not too fragile, etc.

Based on the author's research, the following 20 spatial principles help shape structures that feel appropriate in natural settings:

- Site anchor or incorporated anchor
- Curved, articulated, or natural shaped structure
- Alignment on curve
- Flared or angled end
- Flared base
- Overlapping ends
- Varying width, height and/or thickness
- Stone on or below grade
- Multiple materials, textures and colors
- Thick lumber and timber
- Heavy-duty visible hardware

- Stone at ground level
- Differentiated large surfaces
- Natural shaped edges
- Shadow lines
- Thickened edges
- Extended ends beyond joints
- Non-square corners
- Repetition with metamorphosis
- Asymmetric spacing

This trail plan proposes structures based on many of these principles to make them comfortable, naturalistic, sustainable, and enjoyable.

Design principles for the desired tone

Structures embody the above principles to achieve a "pastoral" feel, i.e. simple, direct, solid, undecorated, and somewhat rustic in a utilitarian sense yet with inherent style from naturalistic materials and relaxed geometry. In particular:

- Structures are designed to look and feel:
  - sturdy
  - well-anchored
  - simple in concept
  - timeless
  - genuinely functional (rather than decorative or self-serving)
  - open and direct in that there are no concealed elements holding the structure together
  - in harmony with the site and human use
- Natural shapes, curves, and visual interest are built into the functional shapes of structures rather than applied as decoration.
- Timber is relatively thick and sometimes rough sawn. Most timbers are squared rather than round (Pennsylvania has not been a frontier for a long time).
- Foundations are anchored with stone wherever appropriate, and stone or concrete are generally used in ground contact instead of wood (except for wood posts).
- Because trails are narrow, structures are deliberately relatively small and/or narrow.
- Overtly decorative or dated forms (covered bridges, stone arch bridges, etc.) are avoided in favor of simpler, direct, open, timeless forms.
- Naturalistic materials that can gracefully weather are usually favored over synthetic materials that cannot weather gracefully.
- Structures are designed to be economical in material cost and construction effort, to minimize site impacts during construction, and to require relatively little maintenance. Note, however, that proposed designs and materials are often NOT the least expensive possible method since the cheapest method would usually feel inappropriate and/or require more maintenance.

Timber Stringer Bridges — General

Plans include three trails bridges of 14 to 18 feet in length and four or five feet wide. All three cross waterways that flow for extended periods after rainfall. One waterway is a small natural stream while the other two are deep, steep-walled ditches along unpaved park roads.

Bridges as anchors, gateways, and points of interest
Each bridge serves as an anchors in its site, as both an edge crossing and as an edge in itself, and as a gateway along the trail. This is why people find bridges so interesting.

By design, these simple timber bridges incorporate several principles for naturalistic structures. Most notably,

- Railings lean outward slightly, implementing the flared base and non-square corners principles. Outward leaning railings increase clearance at waist height where humans are wider. They also help keep narrow bridges from feeling like cattle chutes.
- Deck boards are 3×10s, one inch thicker and four inches wider than the 2×6s often used as decking. This thicker decking feels more substantial and lasts longer—the deck is the first part of a bridge to wear out, so having a thicker deck is an investment in lower maintenance and longer service life.
- Railings are braced with outriggers attached to extended deck boards. It's a simple, classic, rustic system but requires thicker, more rigid deck boards (hence the 3×10s). The outriggers and the diagonal braces they support create articulation in three dimensions, greatly adding to the romance and charm of the bridge.
- Railing posts are rough-sawn, full-dimension 4×4s which look and feel considerably more substantial than thinner, standard 4×4s.
- The ends of the bridge rails extend past the ends of the deck, implementing the overlapping ends principle.
- Stringers (beams) are rough-sawn timbers that are considerably stronger than necessary. This results in solid-feeling bridges and years of additional service life with little additional cost.
- The bridges have—and need—no decoration. Their shape is enough.

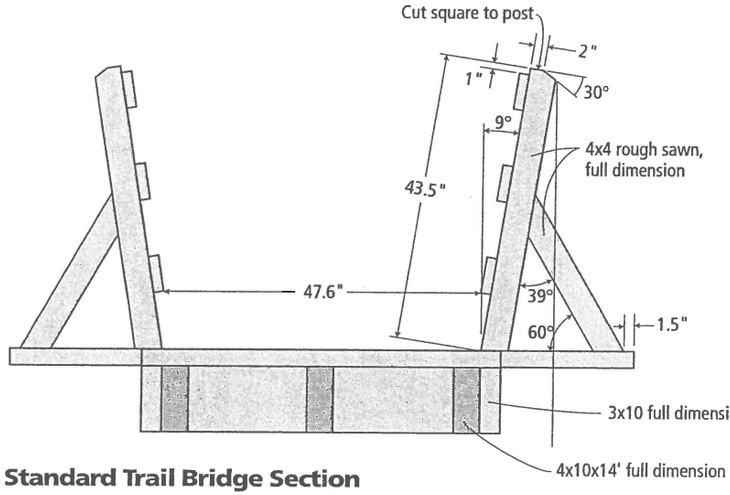
The resulting bridges are very unlike backyard decks. They're solid yet airy with pleasing proportions, their outward leaning railings and braces irresistible to visitors. These humble bridges will be attractive park features that encourage people to linger on the bridge, look down at the water and around at the scene, and be glad that they have a bridge and a park like this to enjoy.

Respectful yet not "green" design
It's certainly possible to build "green" bridges using plastic lumber and more durable stringers such as steel or fiberglass, but such bridges typically lack character, charm, or romantic qualities because they lack natural shape and texture. For instance, two plastic bridges on the Boyce School Trail aren't as inviting as they could be because they aren't harmonious in material, color, or design. Instead, the proposed wood bridges are designed to engage people, to have weathering textures and engaging shapes that respect, echo, and show appreciation for nature by *using* it rather than replacing it with lifeless material. The bridges use relatively little wood because they're small, and yet that small amount of wood can greatly increase human enjoyment over synthetic alternatives.* In addition, plastic lumber and more durable stringers are also many times more expensive than wood.

Railing design and maximum opening size
Traditionally, trail bridges don't have to meet residential or commercial building codes which specify a maximum four-inch opening in railings. This requirement is intended to prevent infants from squeezing through railings. If, however, the Township wants to use the four-inch maximum even though there's a very low probability that an unsupervised infant will be on a bridge, railings can be redesigned. Proposed railings are 42 inches high (AASHTO standard for pedestrian bridges) with maximum openings of less than 8¾ inches.

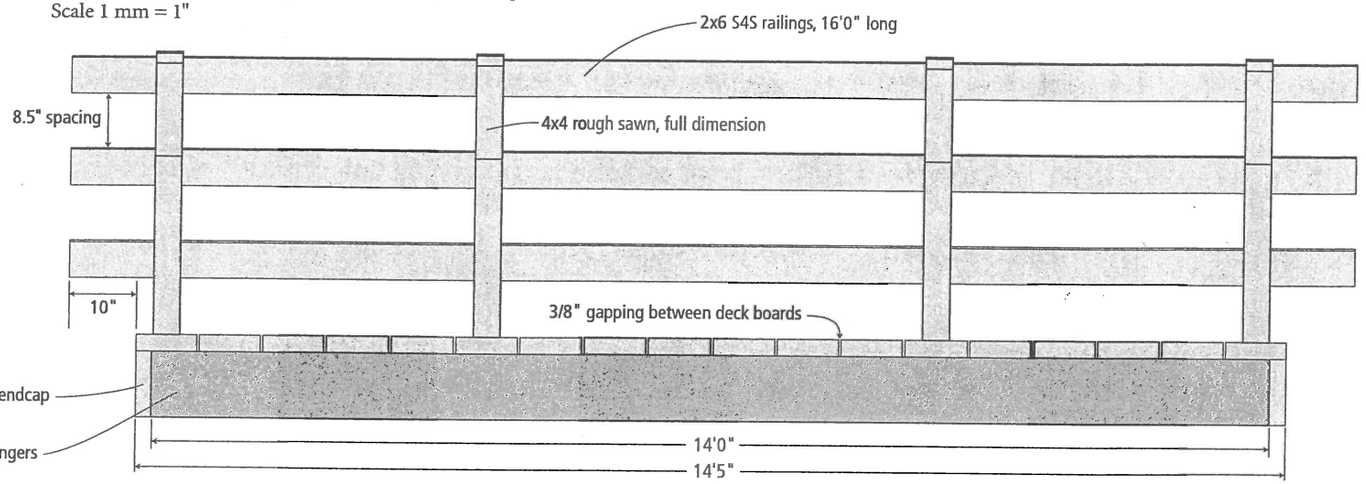
Bridge foundations
As small bridges with simple stringers, they can rest on mud sills (typically pressure-treated 6×6 or 8×8 timbers) that ride with the frost. This helps preserve the rustic charm and eliminates the need to try to hide a more engineered foundation. Optionally, they can be installed on 10" diameter concrete piers. Bridge timbers, however, will last longer if they do not directly contact concrete.

* This plan, however, recommends plastic lumber for boardwalk decks which (1) use much more lumber than these small bridges and (2) have enough natural shape to feel naturalistic through frequent angles and changes in direction and/or grade.



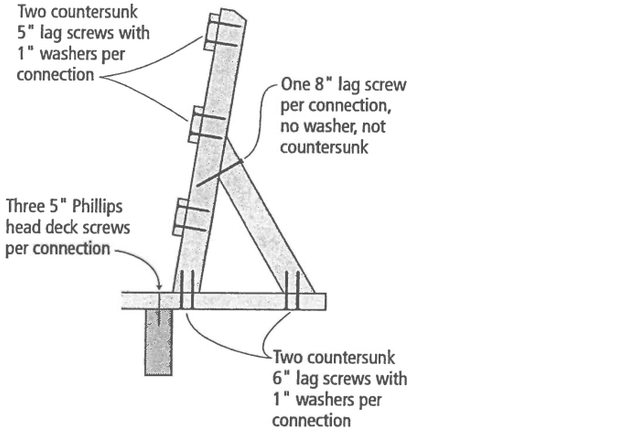
Standard Trail Bridge Section

Stringers are for 4' wide, 14' long span
Scale 1 mm = 1"



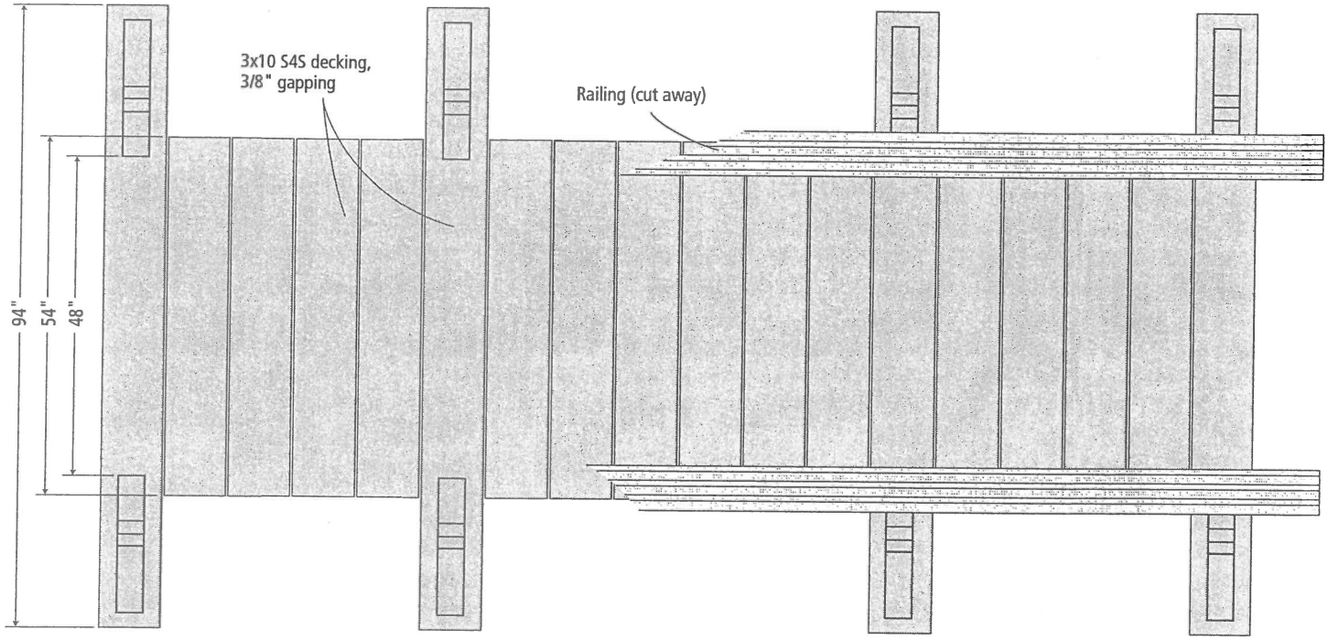
Standard Trail Bridge Elevation, 14' Span

Scale 1 mm = 1"



Section Hardware Details

Scale 1 mm = 1"

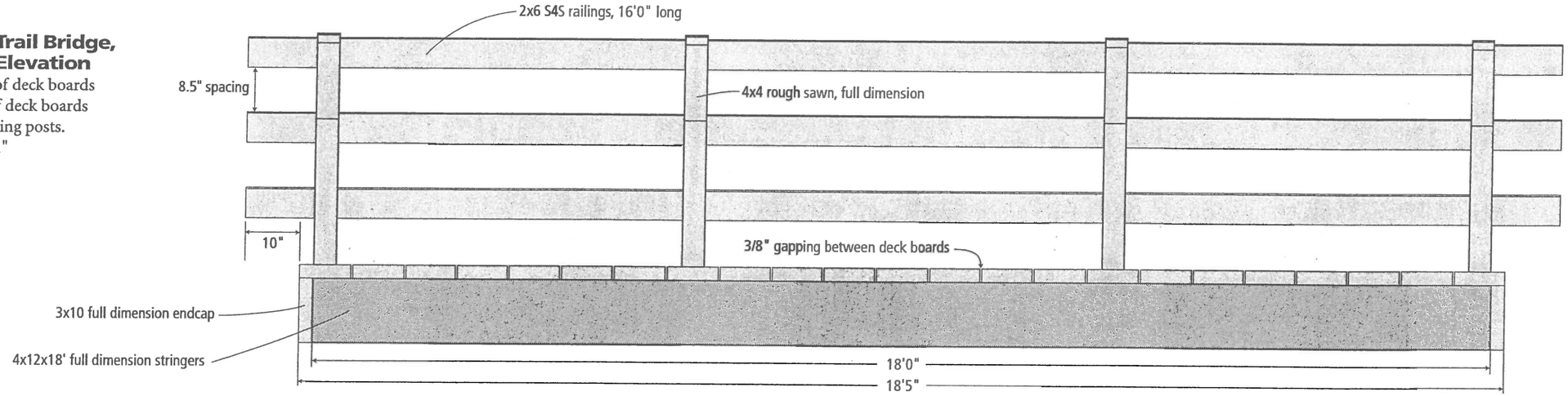


Standard Trail Bridge Plan View, 14' Span, 4' Wide

Scale 1 mm = 1"

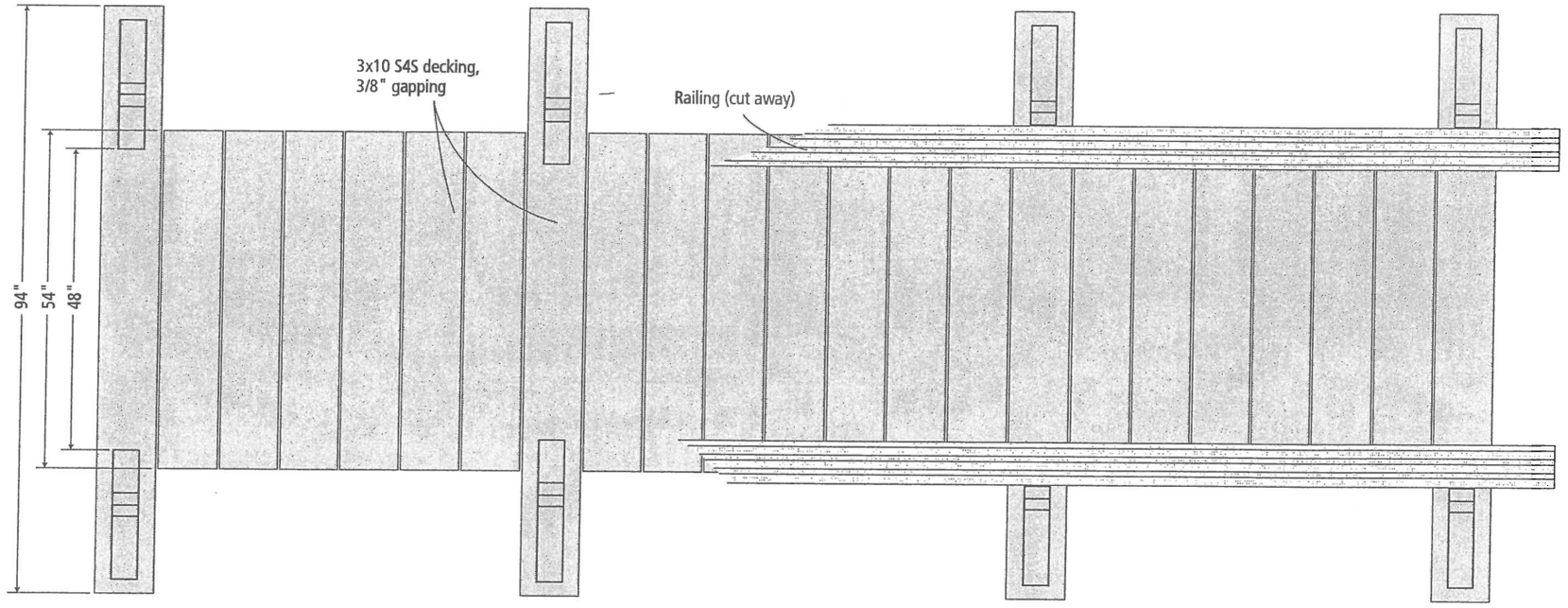
Standard Trail Bridge, 18' Span, Elevation

Note number of deck boards and location of deck boards supporting railing posts.
Scale 1 mm = 1"



Standard Trail Bridge, 18' Span, Plan View

Scale 1 mm = 1"



Queen Maple Trail Bridge at Bird Meadows Drive

[See page 40 for bridge design details]

This 14' long, 4' wide timber stringer bridge spans the deeply eroded drainage that drains some of Bird Meadows. After the road to the wetlands was constructed, this channelized drainage is all that remains of the original drainage channel that used to follow this natural ravine.

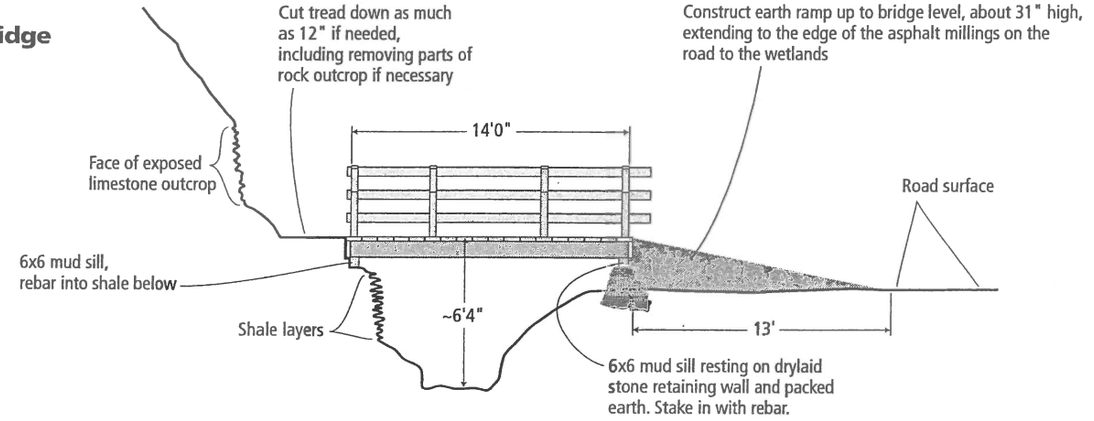
From the road (which serves as a trail), the bridge crosses onto a shelf on a limestone rock outcrop. To keep the bridge deck level, a ramp approximately 31" high and 13' long elevates the road end of the bridge up to the level of the shelf. The trail on the shelf is relatively dramatic and exciting—there's no other experience like this in the park. The small bridge nicely anchors the crossing and makes it into an event.

Although it is possible to use a culvert here instead of a bridge, the bridge clearly *acknowledges, respects, and celebrates the presence of flowing water.* A culvert cannot. This is the main reason for planning a bridge here.

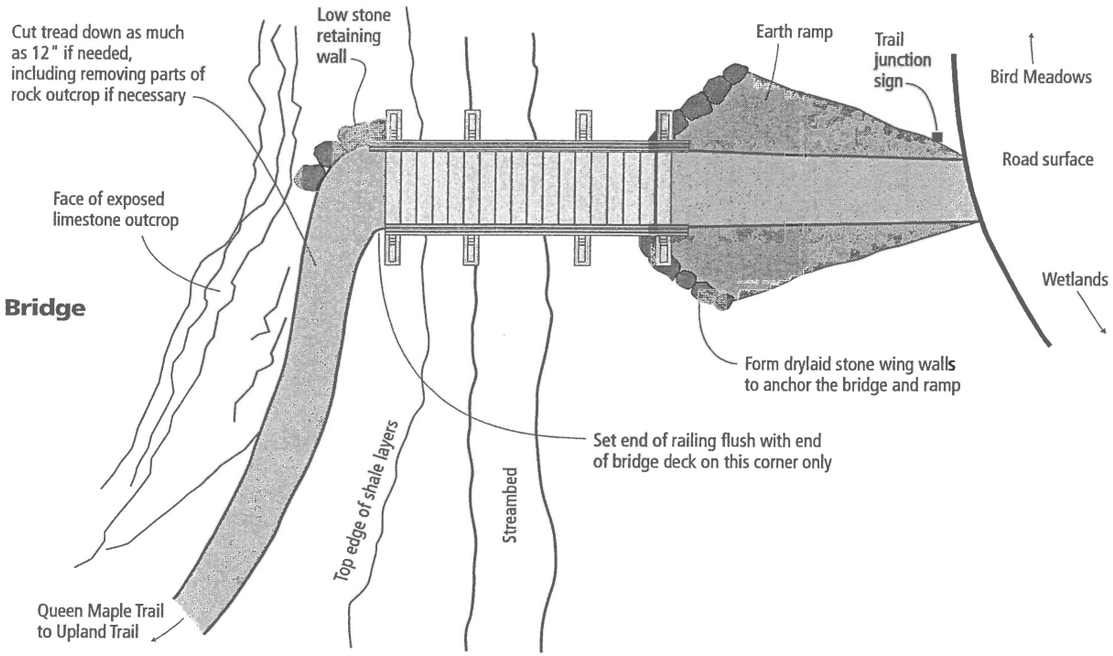
The bridge is also visible for hundreds of feet when approaching along Bird Meadows Drive from either direction, making the bridge a pleasant landmark even if one doesn't intend to cross it.

When coming down the Queen Maple Trail from above the bridge, the bridge is a pleasant surprise as you come upon it rather suddenly around a blind curve.

Queen Maple Trail Bridge Elevation
14' long by 4' wide bridge.
Looking upstream (east)
Scale 1 mm = 4 inches



Queen Maple Trail Bridge Site Plan
14' long by 4' wide bridge.
Scale 1 mm = 4 inches



Woodlands Trail Bridge at Ravine Drive

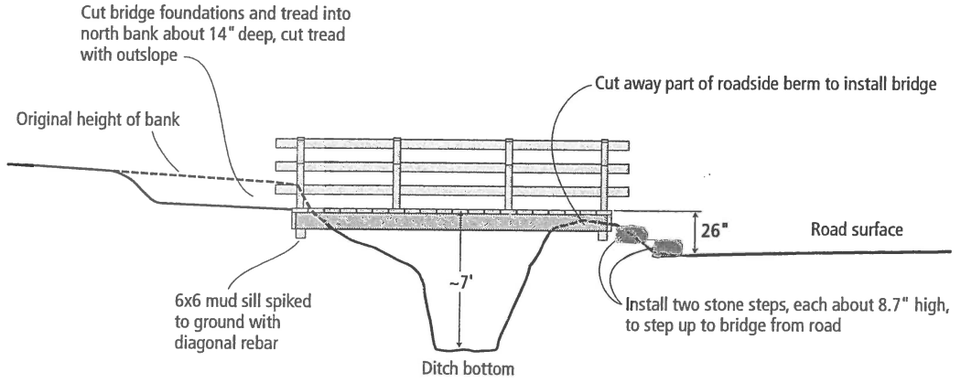
[See page 40 for bridge design details]

This 15'7" long by 4' wide bridge spans the roadside ditch along Ravine Drive through the Hinge. The September 17, 2004 flood made the ditch 2-3' deeper, washing out the old crossing. The ditch will continue to be unstable, so adding a culvert could add to the instability by accelerating water through the culvert or flood the road if the culvert should clog.

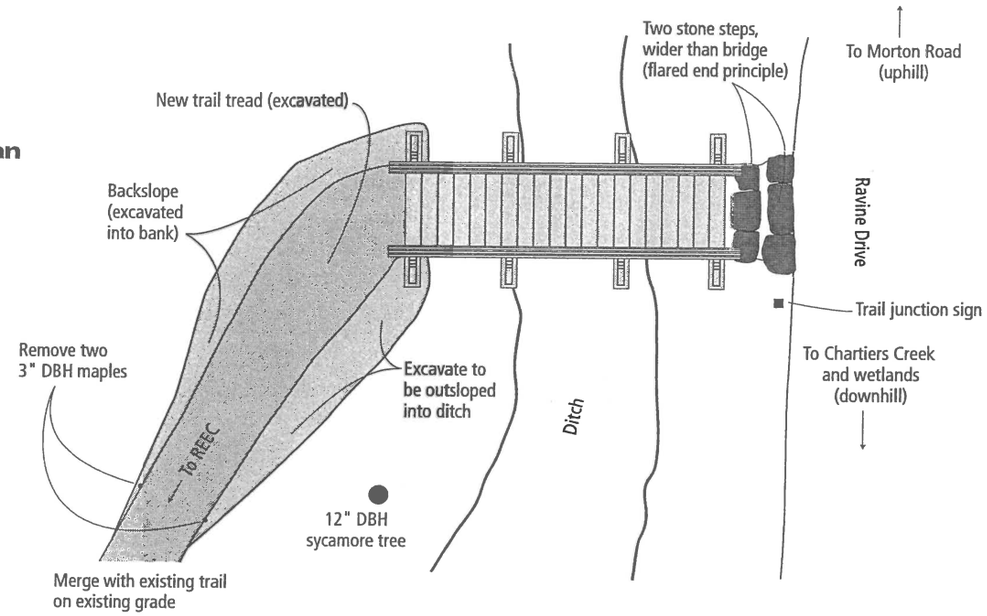
Using a bridge creates a strong visual anchor along Ravine Drive. Since visitors have to use the road for about 230' to get from the Curved Bridge Trail to the Woodlands Trail, the bridge makes a goal and landmark that clearly marks the trail junction.

Because the bank above the road is several feet higher than the road surface, the bridge has two stone steps to climb up from the road to the elevated bridge deck. On the bank side, the bank is cut down to reach the bridge deck and a new trail segment is cut into the upper corner of the bank. Like any new trail, this new tread should be outsloped into the ditch for drainage. In about 13', the new tread ramps up to join the existing tread.

Woodlands Trail Bridge Elevation
15'7" long by 4' wide bridge.
Looking upstream (east)
Scale 1 mm = 4 inches



Woodlands Trail Bridge Site Plan
15'7" long by 4' wide bridge.
Scale 1 mm = 4 inches



Wetlands Trail Bridge at Two Forks Trailhead

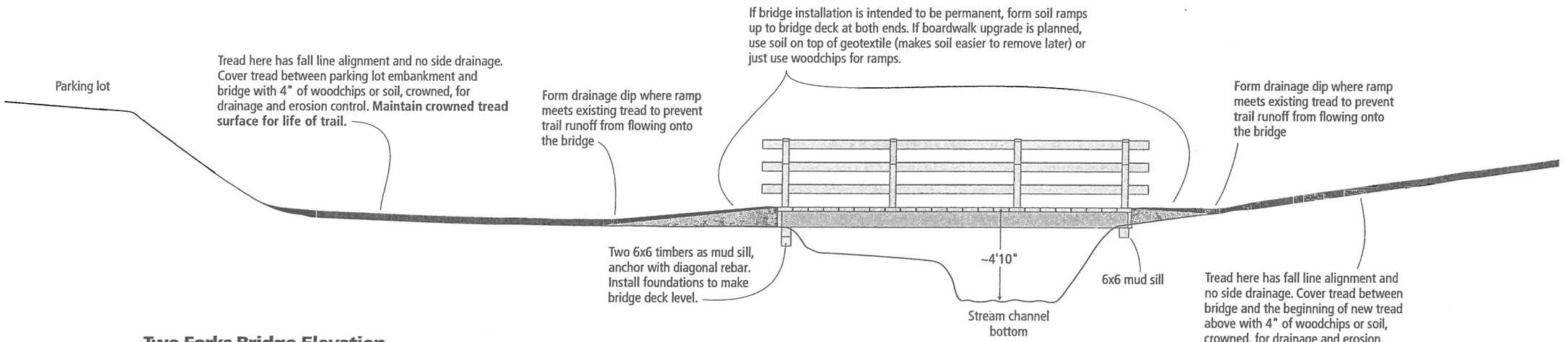
[See page 40 for bridge design details]
[See page 42 for plans for an 18' bridge but widen the deck by 1' for a 5' deck]

Standalone installation—temporary or permanent
On the Wetlands Trail next to the Two Forks Trailhead, this 18' long by 5' wide bridge can span the small stream from bank to bank by itself as shown here. This configuration is above the height of the September 11, 2004 flood. The trail and bridge can be built and maintained as either temporary or permanent.

Important: the tread approaching the bridge on both sides follows the fall line and is hence prone to erosion that would dump sediment directly into the stream. These tread sections require a surface of raised, crowned woodchips or soil to drain water off the trail and prevent tread erosion. The crowned tread must be maintained for the life of the trail.

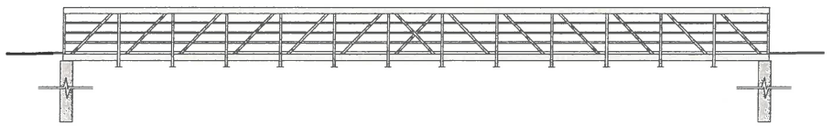
Installation as part of boardwalk
As part of the plan for the Wetlands Trail, the same bridge can be incorporated as the central crossing in a longer, higher accessible boardwalk [see page <None>]. In this case, the bridge can be built as shown here, then dismantled and reassembled within the boardwalk at a later date. Or the boardwalk and bridge can be built at the same time, which is less expensive in the long run but requires more commitment and planning up front. Note that the boardwalk completely avoids the potential tread erosion problems of a standalone bridge.

Need a bridge before the trail can open
Whether this stream is crossed by a standalone bridge or a boardwalk, the Wetland Trail should not be opened to the public until a raised crossing is provided. This is partly for safety and partly to prevent bank damage and stream sedimentation that will occur with an unbridged crossing.



Two Forks Bridge Elevation
Looking downstream (northwest). This option assumes that an accessible boardwalk may or may not replace this crossing at a future date.
Scale 4 mm = 1 foot

Fiberglass Truss Bridges — General

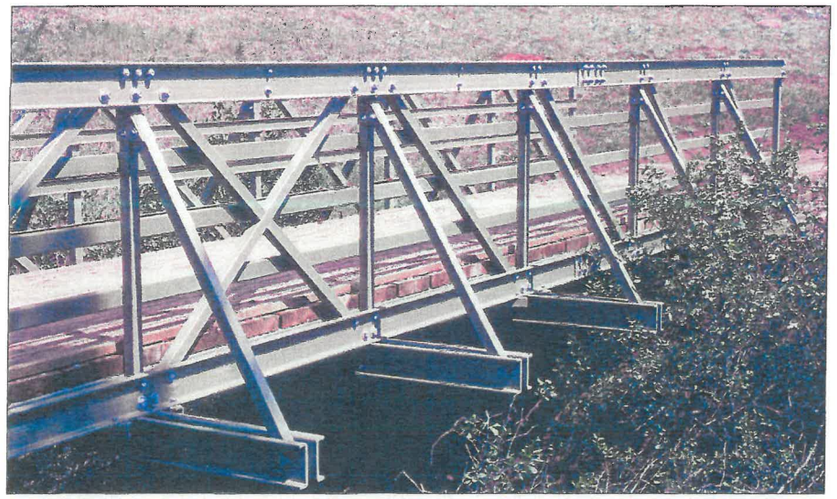


Three fiberglass trusses (actually fiberglass reinforced polymer, or FRP)—are proposed:

- 30' long by 6' wide on the Beech Valley Trail below the REEC. The bridge crosses a 6' deep, vertical-walled gully channel below the REEC that is virtually uncrossable by pedestrians. A bridge is sorely needed to connect the REEC to most of the nearby trails.
- 56' long by 6' wide crossing the active streambed on the Curved Bridge Trail in the central ravine ("The Hinge"). This span is part of a longer bridge that spans the stream and ravine that currently separate the north and south sections of the park.
- 50' long by 5' wide across Morton Run just northwest of the intersection of Morton Road and Rostron Drive. This bridge would improve park access from the neighborhood in the Rostron Drive area.

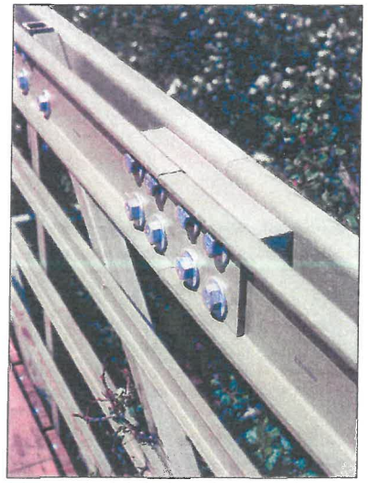
Reasons for selecting fiberglass trusses over other bridge types

1. **Ease of bridge construction on site.** The Beech Valley Trail and Curved Bridge Trail sites are inaccessible to cranes that could drop a prefabricated bridge into place, and overhead trees preclude helicopter delivery. The Morton Run site is only accessible via a long-boom crane that would could thousands of dollars to arrange and would block Morton Road. Fiberglass bridges, however, are delivered as separate lightweight components that can be assembled on site in a day or two with a few people with simple hand tools and without special training (volunteers often do it). *No piece is longer than 20 feet or weighs more than two people can easily lift.* Truss and deck pieces bolt together through pre-drilled holes much like a child's "Erector Set" toy building set. This is not possible with stick-built steel or timber bridges in which the main structural elements are too long and/or heavy to be easily handled.



Top and above: 47'x6' fiberglass bridge, Heil Ranch Preserve, Boulder County Parks & Open Space, Colorado. This bridge has the same manufacturer and identical truss design as the bridges proposed for USC.

2. **Ease of foundation construction.** Fiberglass trusses are so light in weight that two people can lift and carry the entire truss for one side of a 30' bridge. (A 50' or 56' bridge weighs less than twice as much.) The entire bridge can be supported on four simple, small concrete piers installed in augured holes rather than larger, excavated, backfilled, concrete footer-and-wall foundations needed for heavier steel or all-timber bridges. Using such simple foundations eliminates the need for heavy equipment access to build foundations, avoiding all the physical and visual site impacts and restoration needs heavy equipment would create.



Joints are simply bolted together. Photo shows a splice in the main truss chord.

Volunteers assemble a fiberglass truss. Photo by Roger Bell.

3. **Engineered structure.** All three spans are long enough to desire a engineered, stamped design. Each span is designed and stamped by a certified engineer. Hundreds of FRP bridges have been erected nationwide, many of them in Pennsylvania.

4. **Sustainable material.** Fiberglass reinforced polymer is extremely strong, hard and durable. It can be considered "green" design. It does not rust, rot, or weaken with age. The US Forest Service has deflection-tested it in similar trail bridge applications and shown it to have less deflection (sagging) than some steel bridges. It never needs paint or surface treatment. The dusty olive green color that runs entirely through the material will fade slightly toward a taupe-like color with time, especially on upward-facing surfaces exposed to long periods of direct sunlight, but this does not detract from the strength of the material. The Beech Valley and Curved Bridge Trail bridges are both primarily in the shade and should hold their original color better.

5. **Accordance with design principles and spatial qualities for naturalistic structures.** The bridge design is utterly simple, open, and direct. Diagonals in two dimensions and bolted connections create articulation and interest. Thin members and the general design are reminiscent of early 20th century steel trusses (a familiar sight in the Pittsburgh area) yet make no attempt to look decorative or "historic." The dusty olive green color blends nicely into all three proposed sites. Exposed bolted connections create an open, direct feel with pedestrian scale. The proposed design that supports the truss from the sides with outrigger braces has a lot of visual interest verging on playfulness. Thick (3x12) wood decking planks also help soften the lines and enhance pedestrian scale. The top of the truss is 42" above the deck, serving as a standard-height integral railing. Because the design and materials are so simple, it feels like the kind of bridge pioneers would have made if they had fiberglass and bolts.

6. **Removability and ease of maintenance.** Should a bridge have to be removed, it can simply be dismantled. In the unlikely event that any pieces are damaged enough to need replacement, they can be replaced. Even load-bearing truss components can be replaced without dismantling the entire bridge as long as the affected section of the bridge is supported by falsework during the process.

7. **Personal experience.** This author has had the pleasure of using and studying a fiberglass trail bridge near his home. Severe prejudice about the appropriateness of fiberglass in a trail setting was dispelled in an instant upon seeing and trying out the actual 47' bridge. It's now one of the author's favorite trail

bridges, and the bridges proposed here are the same design by the same manufacturer.

8. **Relatively low cost for an interesting, attractive bridge.** In the past, because of the high cost of FRP, fiberglass bridges were far more expensive than any other material. Although FRP prices have not dropped, recent dramatic increases in the cost of steel (caused by China reducing steel exports to fill its own infrastructure needs) make fiberglass trusses competitive with prefabricated steel trusses. And when the greatly reduced cost and impact of installing bridge foundations and the bridge itself are included, and when the cost of bridge design and engineering is handled in a routine manner by the manufacturer, fiberglass bridges are one of the most economical ways to span long distances in sites inaccessible to heavy equipment.

   It should be noted that steel roof-type truss rafters similar to those used in commercial buildings can be used as trail bridge stringers (like beams under the deck) at a lower cost than FRP bridges, but such bridges look and feel cheap and industrial compared to the more attractive, interesting and park-like fiberglass through trusses. While much lighter than a fully prefabricated bridge or a steel or timber beam, the small steel trusses are still quite heavy and would require considerable skill and effort to install in the proposed sites.

Bridge costs

Bids were obtained from the largest manufacturer of FRP trusses:

E.T. Techtonics
PO Box 40060
Philadelphia, PA 19106
(215) 592-7620
www.ettechtonics.com

The bridges below each include design, all bolts and hardware, foundation tie-down clips, olive green color impregnated throughout all fiberglass, 3 × 12 pressure-treated wood decking, three horizontal safety rails on the inside of each side of the truss, 42" railing height, and assembly instructions.

Beech Valley Trail Bridge (below REEC)	
30' × 6' FRP truss w/ 3 × 12 (2.5" × 11.25" actual) treated decking	$11,250
Shipping (unassembled)	600
Total	**$11,850**
Morton Falls Bridge (Morton Falls Trail)	
50' × 5' FRP truss w/ 3 × 12 (2.5" × 11.25" actual) treated decking	$18,750
Shipping (unassembled)	700
Total	**$19,450**
Curved Bridge Trail, fiberglass segment (across "The Hinge")	
56' × 6' FRP truss w/ 3 × 12 (2.5" × 11.25" actual) treated decking	$23,750
Shipping (unassembled)	750
Total	**$24,500**

Using 2 × 12 wood decking instead of 3 × 12 would significantly reduce costs but (1) reduces the usable lifespan of the deck, (2) removes some of the pleasantly "solid" feel of a 3 × 12 deck, and (3) increases the "hollow" sound of walking on the deck. It is also possible to use plastic lumber decking but it requires additional support joists under the deck, greatly increases cost, and removes highly desirable natural shape, texture, and variation. This author strongly recommends 3 × 12 wood decking.

Since E.T. Techtonics ships bridges from New Bedford, PA, the Township could conceivably reduce the $2,050 shipping cost by picking up the bridges with its own flatbed truck.

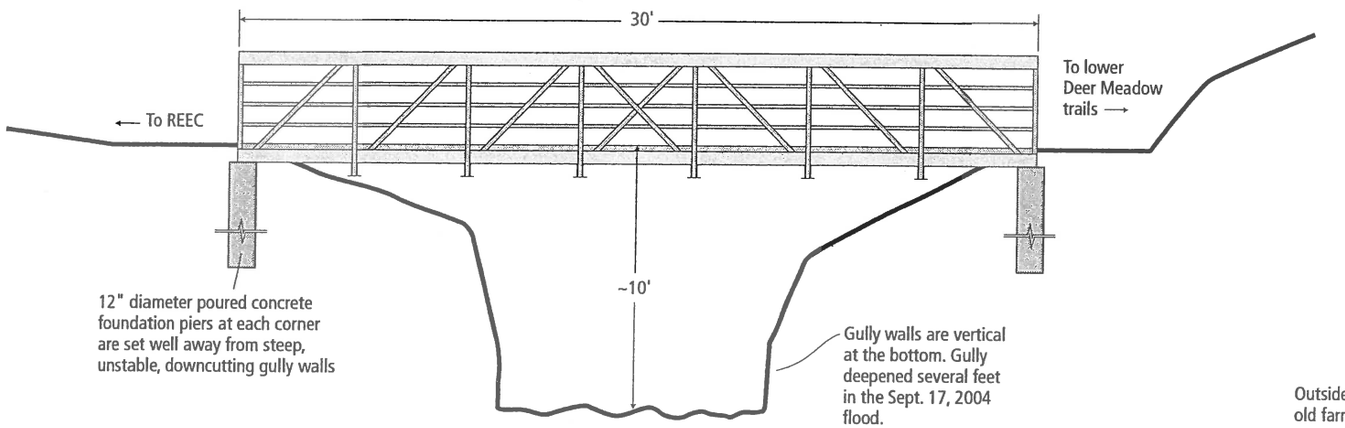
Beech Valley Trail Bridge — Beech Valley Trail

This 30' long by 6' wide bridge crosses 10' above a deep, steep gully which is currently all but impassible. It's a vital link connecting the REEC with many of the nearby trails.

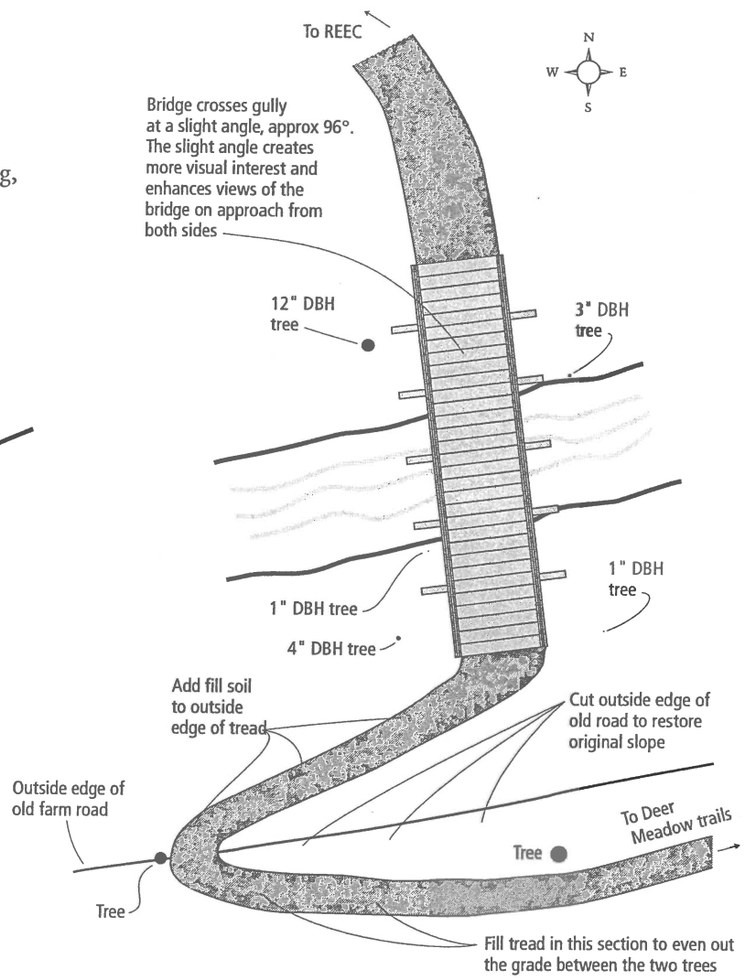
The 6' width enables visitors to linger on the bridge and enjoy being there without blocking traffic. The relatively wide width also makes it easier for groups to cross—much of the usage from the REEC will be in class-sized groups.

The crossing is intentionally at a slight angle (approx. 96°) to the gully. This slight angle feels more organic than a 90° crossing, helps flow with the curve of the approaches, and improves sightlines of the bridge when approaching it along the trail from a both sides.

Since the gully is unstable and keeps deepening and widening, the length and foundation accommodate significant future collapse of the near-vertical gully walls.



Old Beech Trail Fiberglass Bridge Elevation
Seen looking upstream (northeast)
Scale 4 mm = 1 foot



Old Beech Trail Fiberglass Bridge Site Plan
Seen looking upstream (northeast)
Scale 2 mm = 1 foot

Morton Run Bridge — Morton Falls Trail

This 50-foot long, 5-foot wide footbridge crosses Morton Run near the intersection of Morton Road and Rostron Drive. Visitors currently clamor down the steep road bank and cross the stream above the falls in the photo at right. Installing a bridge and sustainable trail to Morton Road would create an attractive, inviting, safe, and sustainable gateway into the park that would be usable at any time—a significant neighborhood asset. If the park Perimeter Trail is constructed, it would also connect to the new Morton Falls Trail and bridge.

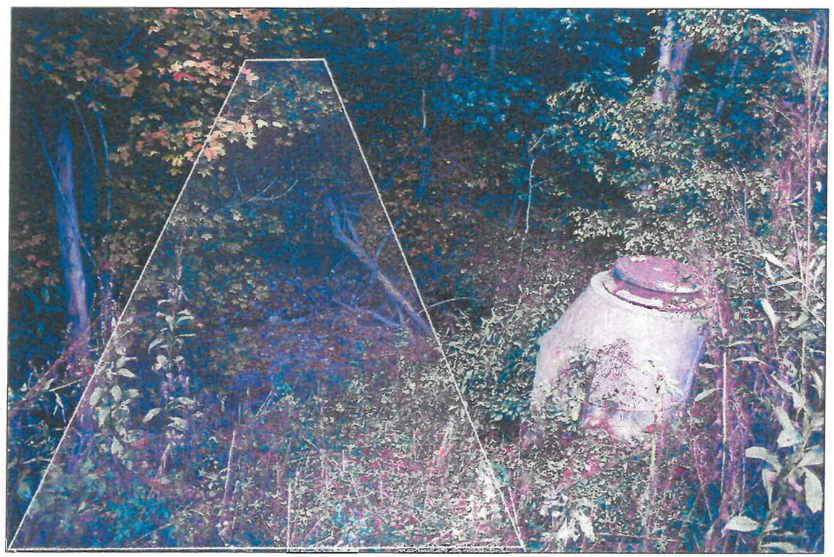
The lower two photos show the approximate position of the bridge within the site. The deck is 13' above the rocky streambed, making this the highest and most dramatic bridge in the park.

The site was selected for four reasons:

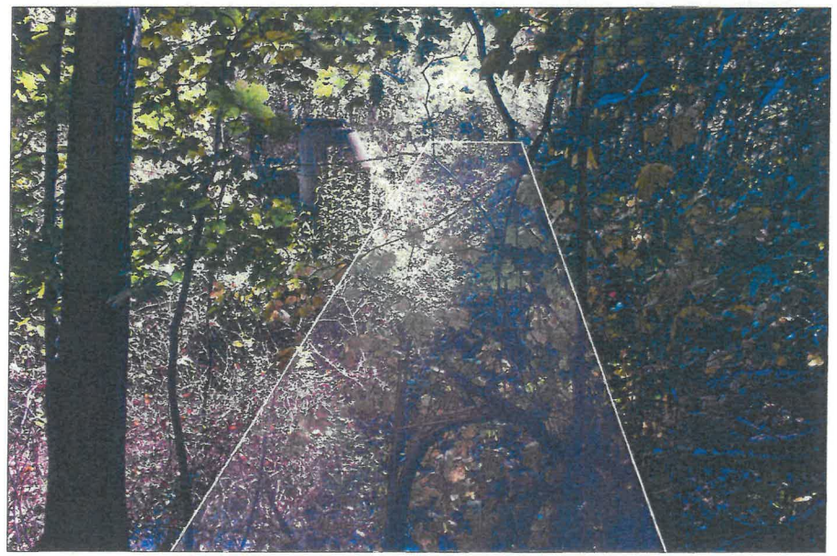
1. This is only place in the park where water flows much of the year over any substantial falls. The bridge would be just downstream of the falls, offering visitors the pleasant view in the photo at right.

continued on next page ►

View of falls from the bridge location. The view from the bridge itself, however, would be from 13' higher than this.



Approximate bridge location as seen from the Morton Road end looking west into the park. Note manhole at right.

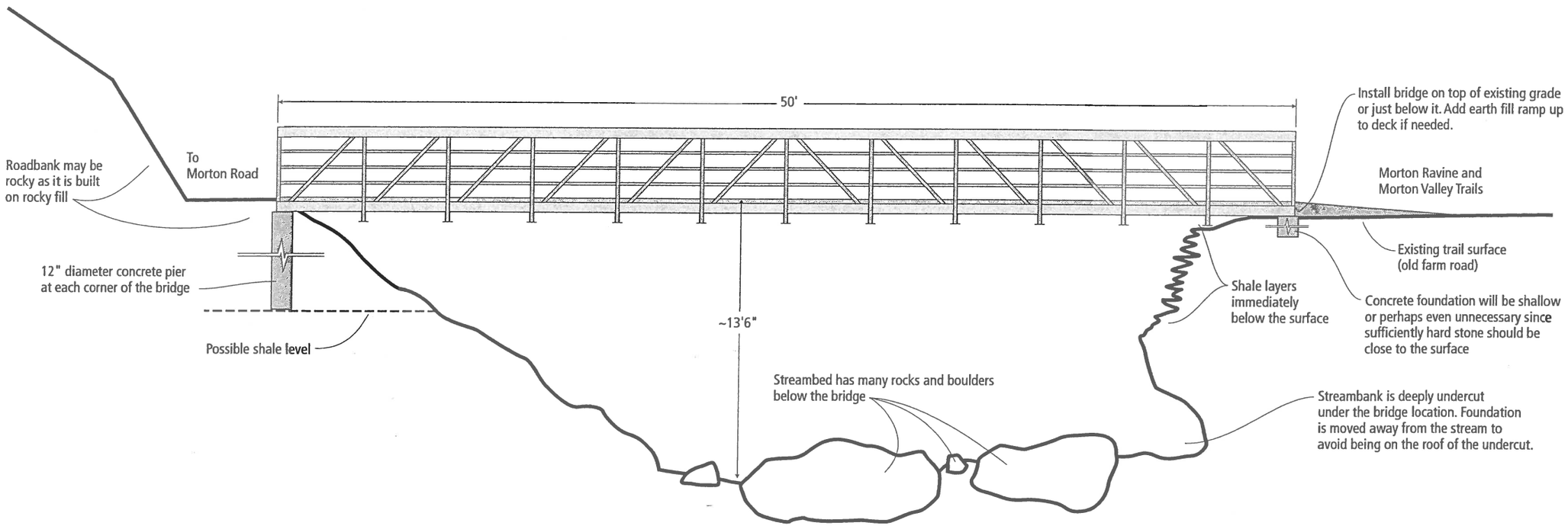


Approximate bridge location as seen from the park looking east toward Morton Road.

2. It's the easiest place to sustainably cross Morton Run. Upstream, the floodplain widens and the channel meanders in places, complicating bridge placement. Downstream, the channel falls into a deep, steep ravine. Here, though, the bridge is well above any possible flood yet the banks are still close together, and foundations are easy to form on both banks without impacting the stream.
3. Morton Road dips down and comes closest to the stream at this point, making it easier to get up to the road.
4. The Morton Road roadbank is less steep here than in most other places on the park edge, making it easier, more pleasant, and far less expensive to form a trail up the bank.

Unfortunately, the end of the bridge on the Morton Road side is next to a visually prominent, raised concrete storm sewer access. Site configuration makes it impossible to avoid the manhole. Painting the bare concrete or applying a stone facing would help to disguise the concrete. The bridge as planned does not obstruct, structurally modify, or change access to the manhole.

Although this bridge won't host much traffic, the 5' width helps make the bridge wider than it is deep, which is visually important for the bridge to look and feel stable. Wider width also enables visitors to linger on the bridge and enjoy the view without feeling like they have to move if someone else enters the bridge.



Morton Run Fiberglass Bridge Elevation (looking upstream)
Scale 4 mm = 1 foot

Curved Bridge — Curved Bridge Trail

As the name states, this bridge across the park's central ravine ("The Hinge") has a segmented curve. Over 94 feet long, the bridge has a 56' fiberglass truss as its main span over 10' above the active stream (right side in the above diagram, also see next page). Two timber stringer spans of approximately 20 feet each (left side) complete the structure. These shorter spans are stylistically similar to the other timber stringer bridges in the park.

The bridge spans the entire floodplain. The deck is about 6 feet above the apparent high water mark of the September 17, 2004 flood in which Chartiers Creek floodwaters backed up into the mouth of this ravine. The lowest parts of the bridge superstructure are about 5 feet above that observed flood level and only the bottom 1 foot or so of the proposed high pier would have been in the water. Since the bridged stream is not considered a navigable stream, this height is adequate.

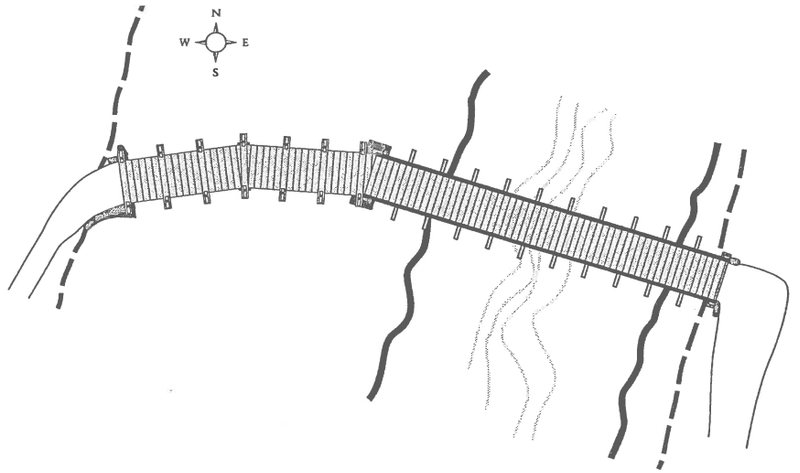
Why the curve?

The curve serves two functions. First, it greatly enhances the bridge experience. A curved bridge is much more interesting than a straight bridge because you can see the outside side of the bridge while you're on it, enhancing the feeling of the edge and giving you two views at once. Alignment on a curve—both in the bridge itself and in a curve of the trails approaching it on both sides—enables visitors to see and enjoy the complex shape from a variety of angles as they approach the bridge, pass over it, and look back from the other side. The curve also gives the main structure a natural shape, creates pedestrian scale through shorter spans, and anchors the bridge through the curves. Plus, the curve helps to form a number of desirable spatial factors for naturalistic structures: non-square corners; curved, articulated, or natural shaped structure; and flared or angled end; and alignment on curve.

Second, the curve eliminates a 90° turn on the north end, enabling visitors to smoothly transition from the trail to the bridge on that end. The 90° turn on the other end is on an old roadbed blasted out of bedrock and is both wide and very well anchored.

Prominent stone piers with simple abutments

The proposed design features two prominent, tapered stone piers that visually ground and anchor the bridge while adding rustic charm. The largest, at the left end of the fiberglass span, is about 6' high. Ideally, the piers will be mortared native, uncoursed, untrimmed limestone built hollow like a masonry chimney. After the mortar sets, the hollow center is filled with concrete for strength and durability. A concrete cap on top of each pier seals out moisture and creates a level platform for the bridge. The two inch per vertical foot batter (taper) on the piers implements the flared base and non-square corner factors that makes the piers seem more stable and interesting. Bedrock is likely to be just below the surface, reducing the cost of foundations for the heavy piers.



Abutments for the bridge can be simple concrete piles poured into augured holes which will likely hit bedrock. Bridge alignment in the site is such that the concrete in the abutments can be hidden with a small amount of native stone. The north end of the bridge has drylaid stone retaining walls to visually anchor that end and to minimize the footprint of the abutment on the floodplain.

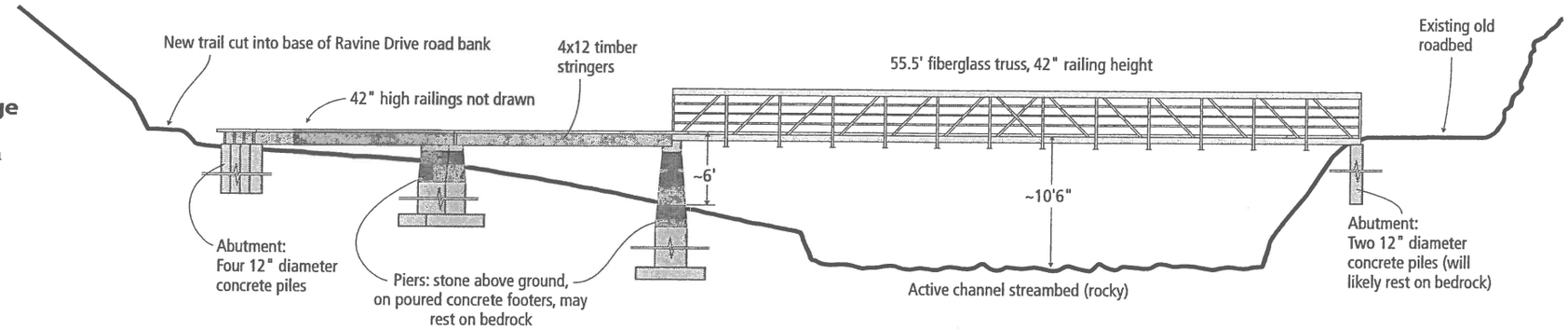
Because the site is next to Ravine Drive and an existing trail has a wide ramp from the road to the bridge site, it's easy to bring in small excavators and concrete mixers with minimal site impact.

Power of combinations

Combining a fiberglass truss with timber stringer bridges in one curved structure creates a rich mix of textures, shapes, colors, and materials. It's much more interesting than an all-timber structure or an all-fiberglass structure. Stone piers implement the stone-in-ground-contact factor and help anchor the bridge.

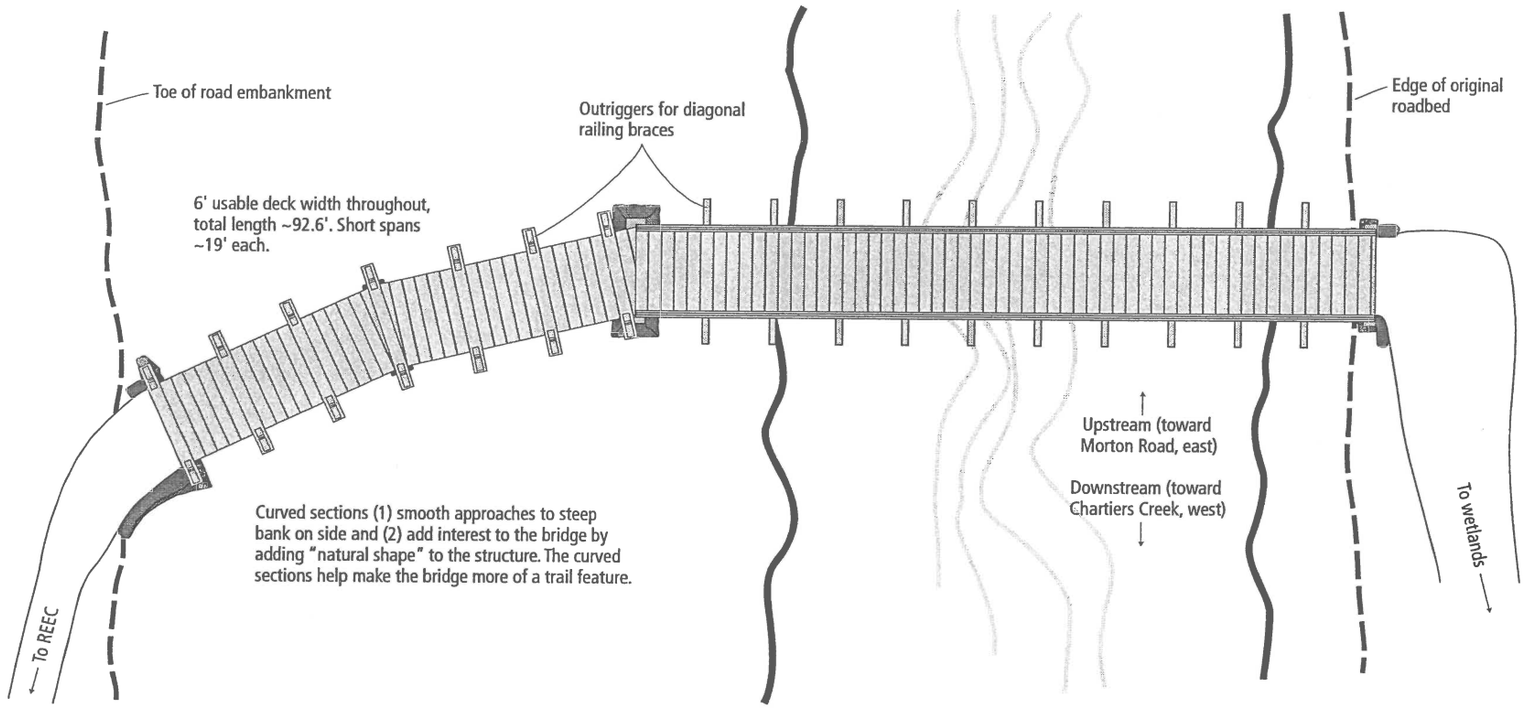
Curved Bridge Trail Bridge Elevation

Looking upstream (east). **Railing on short spans and backfill of north abutment not drawn.**
Scale 2 mm = 1 foot



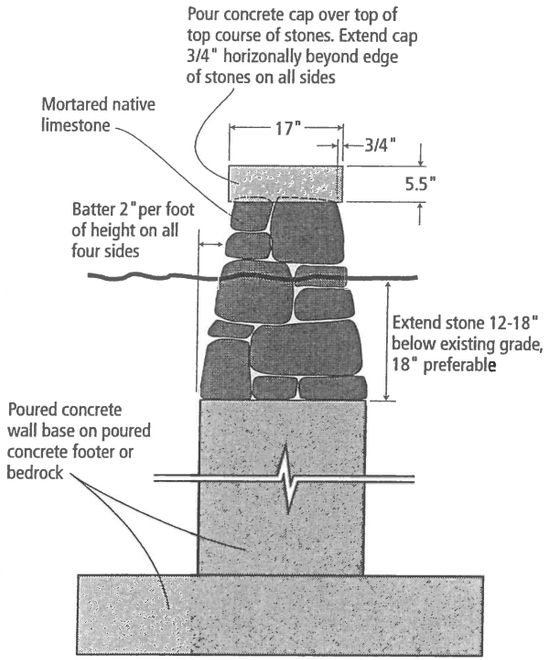
Curved Bridge Trail Bridge Plan View

Railing on short spans not drawn
Scale 2 mm = 1 foot

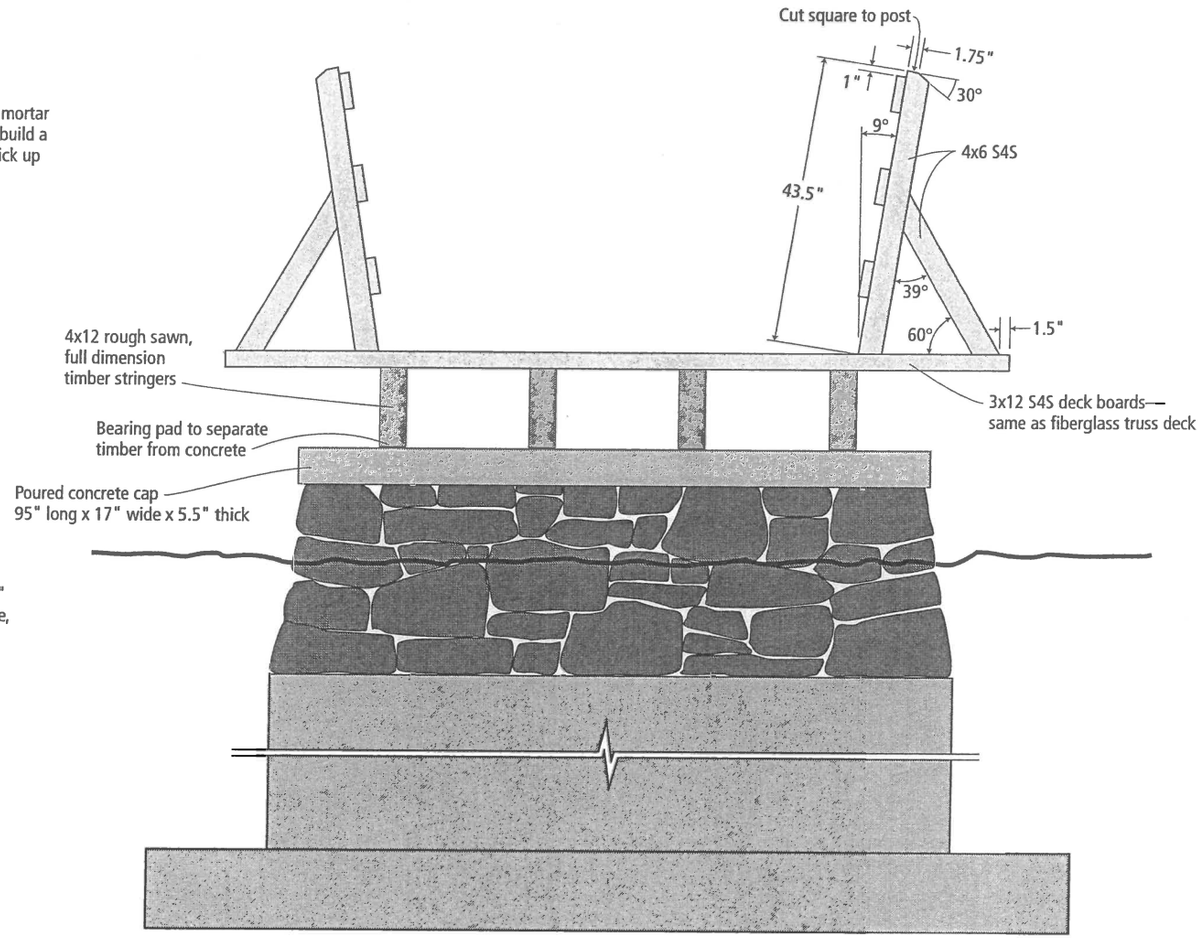


NOTE:
Stone piers should be built of untrimmed, uncoursed, mortared native limestone. Piers should be built hollow, like a masonry chimney. After the mortar sets, fill the hollow center with concrete for strength and durability. Then build a form on top and pour the top cap. Stones on the top of the pier should stick up into the cap.

Footers for piers may not be necessary if bedrock is reached.



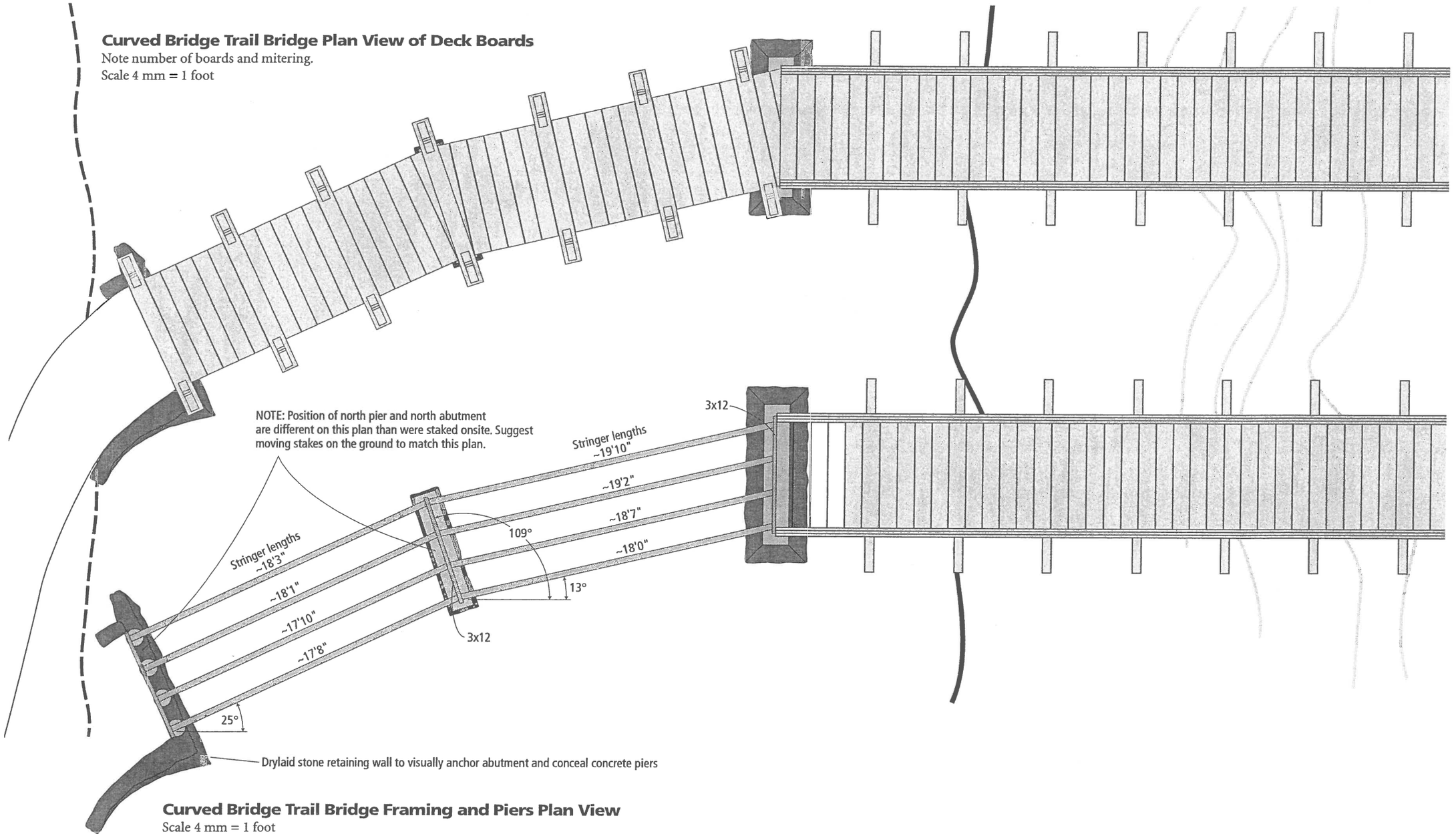
Curved Bridge, Stone Pier Between the Two Short Spans (Side Elevation)
Scale 1 mm = 1 inch



Curved Bridge, Section View of Short Spans Near Their Center Pier
Scale 1 mm = 1 inch

Curved Bridge Trail Bridge Plan View of Deck Boards

Note number of boards and mitering.
Scale 4 mm = 1 foot



Curved Bridge Trail Bridge Framing and Piers Plan View

Scale 4 mm = 1 foot

Two Forks Boardwalk — Wetlands Trail

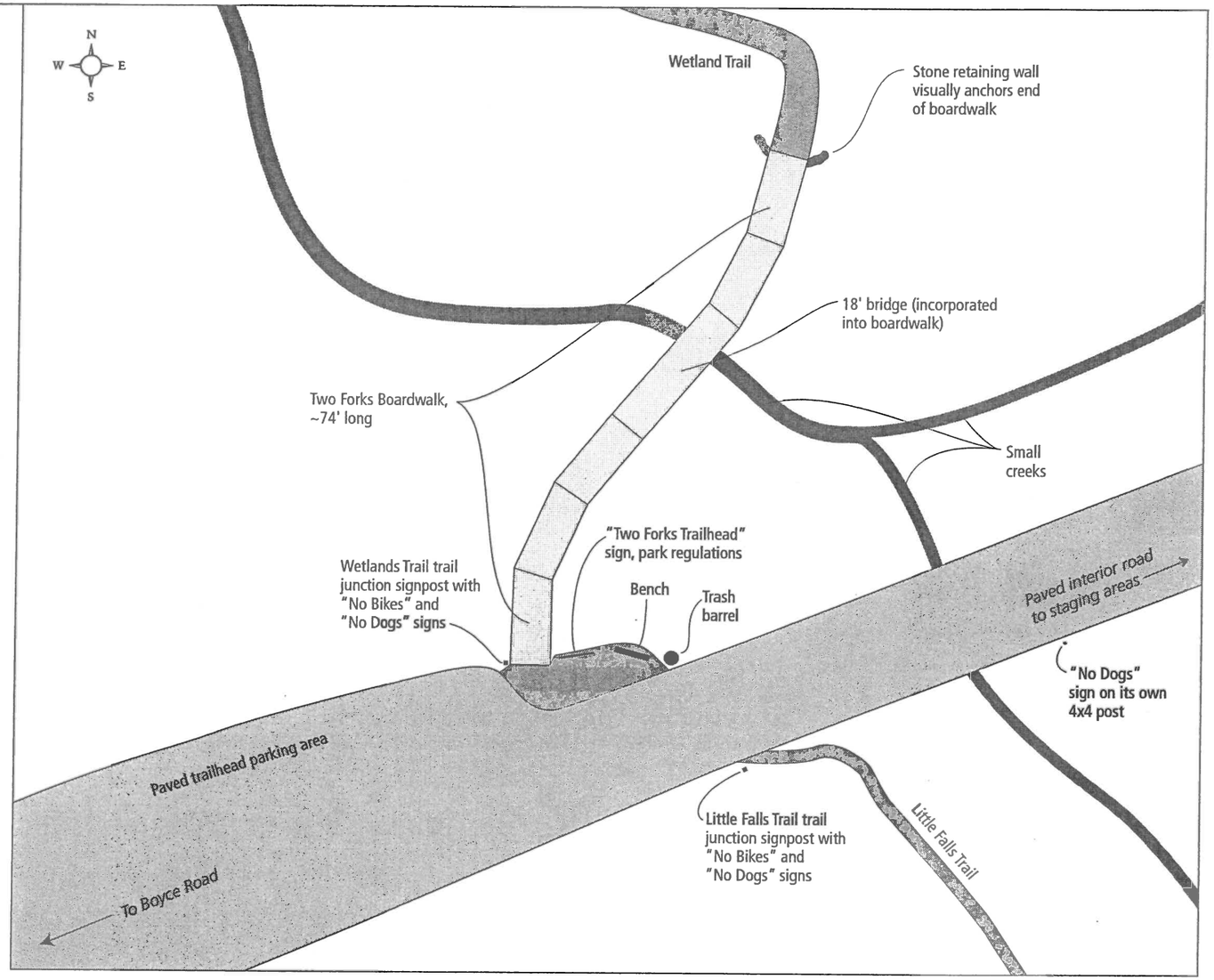
[For details on the incorporated 18' bridge, see page 45]

Optional boardwalk
This approximately 74-foot boardwalk would enable wheelchair access to the Wetlands Trail. Starting at the edge of the trailhead parking area, it would span the valley bottom with a gently curving, level crossing. It makes an irresistibly inviting beginning of the trail (a strong gateway) and uses natural shapes to curve around. Usable width would be 50 inches (4' 2").

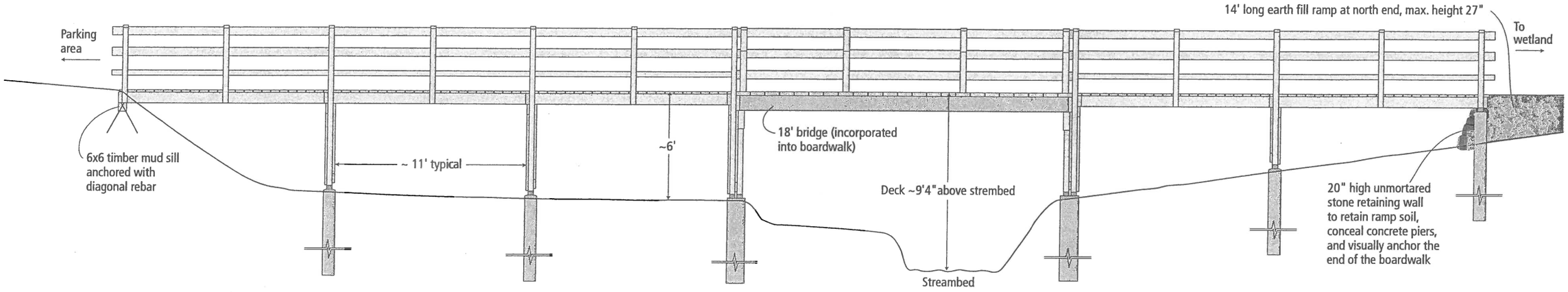
This boardwalk could be built initially, built at a later date, or never built. The trail, though, will not be accessible without this boardwalk.

Optional plastic lumber decking (from recycled plastic)
The boardwalk deck is an appropriate place to use plastic lumber. Although plastic lumber costs up to five times more than wood, it is far more durable and will easily outlast the wood superstructure. (For practical reasons, the superstructure **must** be wood.) Since the deck is the first part of a boardwalk to wear out (from sun exposure, exposure of flat sides, and traffic), plastic decking greatly reduces maintenance. Plastic lumber doesn't require any paint or surface sealants, has no knots, won't warp, split, crack, cup, or produce splinters, and doesn't sound as hollow as wood. Being uniform, it's also not visually distracting, tending to focus visitors' attention on the surroundings and the general shape of the boardwalk more than on the deck surface. Some brands have embossed woodgrain, and most brands fade somewhat in the sun—desirable because it reduces the plastic appearance.

Incorporated bridge
This boardwalk incorporates an 18-foot timber stringer bridge to cross the small stream from bank to bank in a single extra-long span [see page 45]. (Typical spans in this boardwalk are about 11 feet).



Two Forks Trailhead Site Plan
No scale



Two Forks Boardwalk Elevation (only upstream side drawn, boardwalk curve not represented)
Looking downstream (northwest).
Deck is level from end to end
Scale 4 mm = 1 foot

Integrating the boardwalk and the timber stringer bridge

The incorporated bridge adds variety and distinction to the boardwalk. The bridge has a 3×10 timber deck while the boardwalk has a 2×6 wood (1.5×5.5 actual) or 5/4×5.5 plastic deck. The bridge is 10 inches wider than the boardwalk, serving as a passing zone for wheelchairs. Bridge railings lean out slightly while boardwalk railings are vertical. The outward leaning bridge rail also makes the bridge seem wider still, inviting visitors to linger there. These differences differentiate and emphasize the bridge in the middle, making it seem more important and increasing its strength as a psychological gateway.

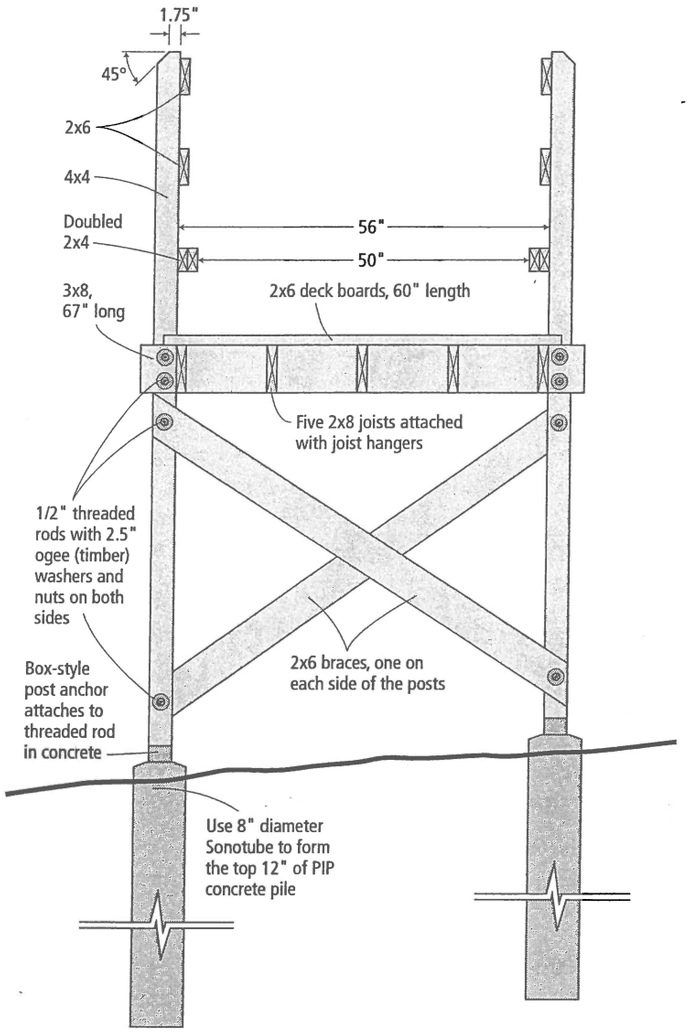
Level deck

The entire deck is level, eliminating the need for accessible handrails.

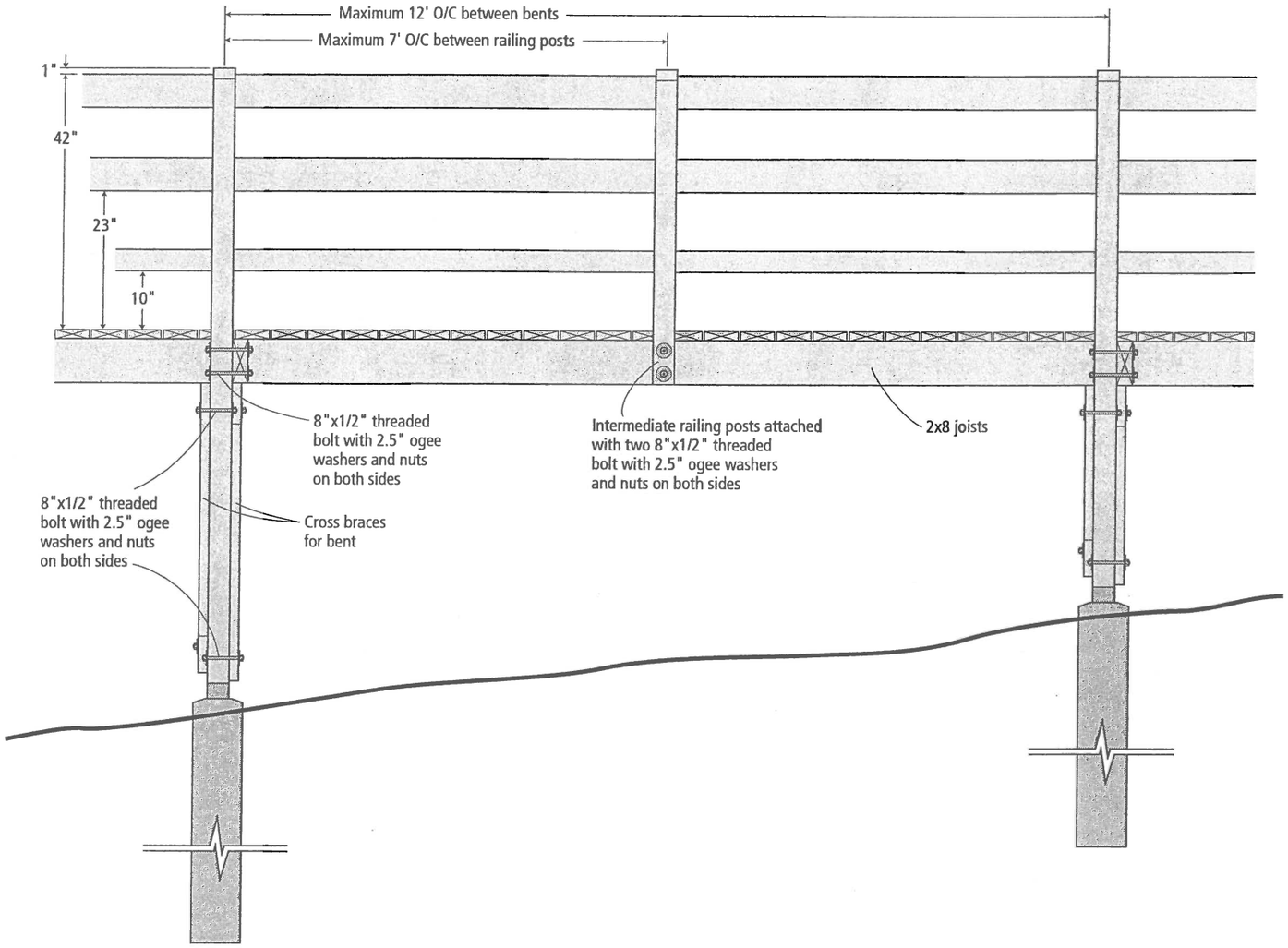
Overall effect

This boardwalk gives the Two Forks Trailhead a strong sense of identity. The winding boardwalk will be such a strong feature that it will generate interest in the Wetlands Trail and this part of the park. Visitors will perceive it as relatively playful and harmonious as well as safe and efficient.

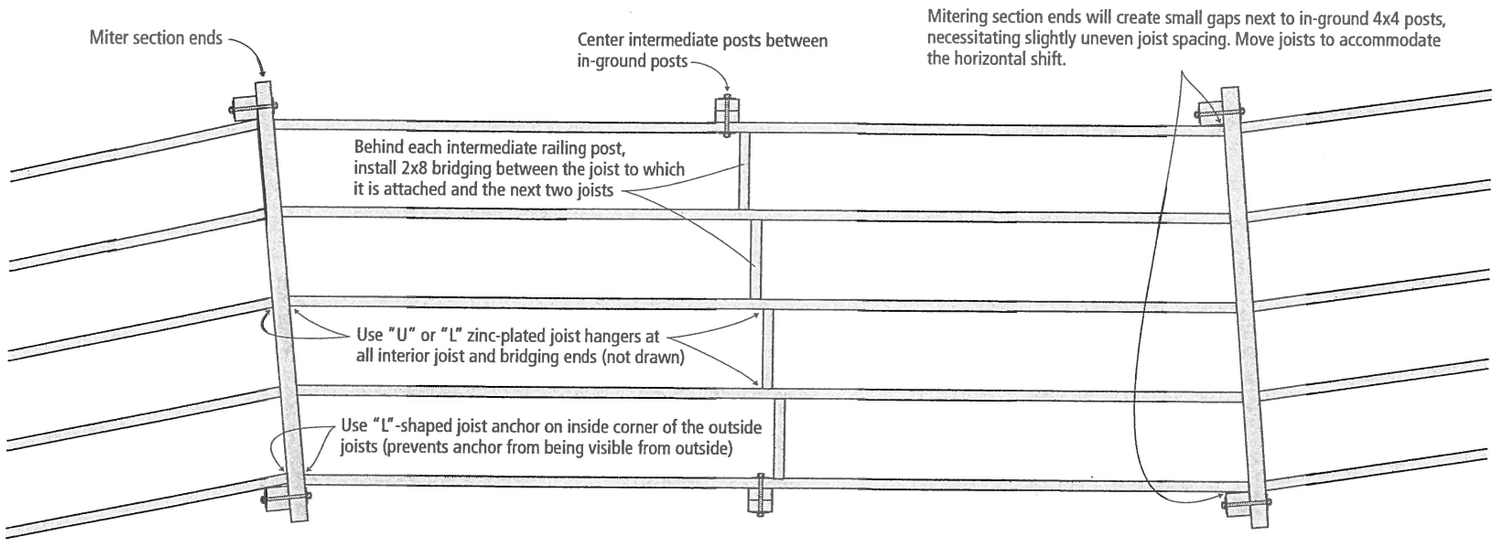
The boardwalk itself uses natural shapes through articulation, creates a very strong anchor and edge in the site, and it itself anchored through its own curves, its framing design and details, the relatively solid and sturdy timber bridge in the middle, a visible stone retaining wall at its north end, the parking area, and the trailhead information area.



Two Forks Boardwalk Section
Scale 1 mm = 1"



Two Forks Boardwalk Elevation Detail
Scale 1 mm = 1"



Two Forks Boardwalk Deck Framing Detail, Plan View

Joist hangers create most of the rigidity of the boardwalk in the direction of travel, eliminating the need for diagonal braces in the direction of travel. Install screws in all holes in each joist hanger to minimize movement of the joint. Use standard "U" hangers on interior joints and "L" brackets on the interior of the outside joists.
Scale 1 mm = 1"

Wetland Bluff Boardwalk — Wetlands Trail

This approximately 250-foot long, 50 inch wide boardwalk forms the top end of an accessible ramp to the wetlands. The boardwalk, along with over a thousand feet of earthen trail, enables wheelchair users—or any visitors—to reach the wetlands from the Wetlands Trail via a gentle (4% to 5%) grade.

Boardwalk minimizes disturbance, creates unique experience

The boardwalk is needed to traverse the steep (up to ~60%) slope at the top of the bluff above the wetlands. This is one of the "sensitive" slopes in the Allegheny County Natural Heritage Inventory for its near-original forest ecosystem. Indeed, the slope is pleasantly covered with hardwood trees of many ages and sizes, including very large trees. The boardwalk would wind and glide through the trunks without disturbing the ground, tree roots, or even tree branches—minimizing ground disturbance in the steepest parts of the slope. The only ground disturbance would be auguring 8-inch diameter holes for poured-in-place concrete piles to support the posts (bents).

The diagram at right shows the conceptual idea. The narrow boardwalk would attempt to **not** be straight. Instead, it would gently wind between, around, and very close to individual trees such that you can reach out and touch them. It's a pleasant experience unique in the park and relatively rare anywhere.

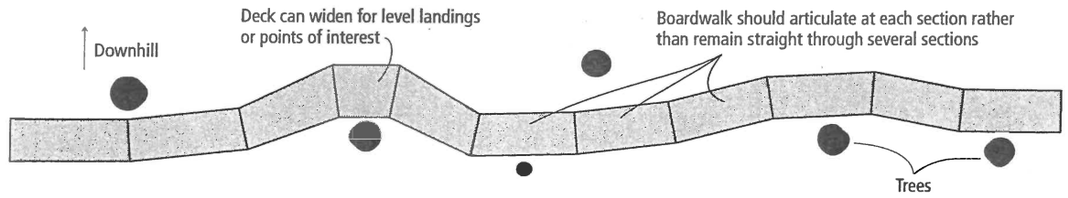
Simple boardwalk

Structurally, it's a relatively simple boardwalk. It uses the same basic design as the Two Forks Boardwalk—appropriate since it's on the same trail. The following pages show adaptations for location on steep slopes.

The outside (downhill) edge would have a railing along most or all of its length since it is generally more than 30 inches above ground. The inside (uphill) edge will have a railing only when it is horizontally far enough away from the ground to have a dropoff of more than 30 inches. Most of the time, the deck will be horizontally close to the slope and will need only a bullrail (bump rail) at toe level.

Gentle grade with a steeper trail option for the able-bodied

While it could be steeper and still be accessible, limiting grades to 4% to 5% most of the time makes it easily accessible. Two level landings at least 5 feet long and 5 feet wide will provide resting and passing zones in the narrow boardwalk. This spacing is well within accessibility guidelines.



Wetland Bluff Boardwalk Conceptual Plan—Relation to Trees

No scale

Boardwalk intended to hug the steep slope and go around trees rather than cut them. Go around trees on their downside side to eliminate need to cut into steep slopes to maintain grade.

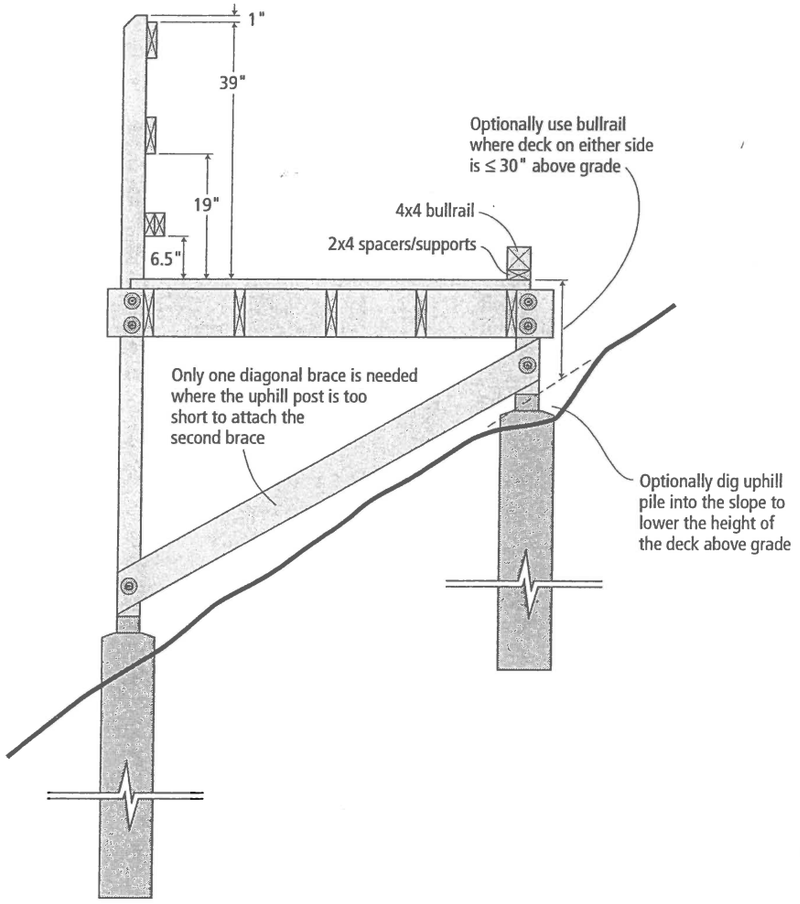
Because it is 65 vertical feet between the Trillium Trail at the wetland edge to the top of the bluff, the full ramp is about 1,450 feet long at 4.5%, with two switchbacks. The boardwalk is only for the top 250 feet where the slope is steepest.

Able-bodied visitors can use a steeper, nearby combination of old road and new trail to quickly climb up and down the bluff. Both the ramp and the steep route start near the same point at the top of the bluff.

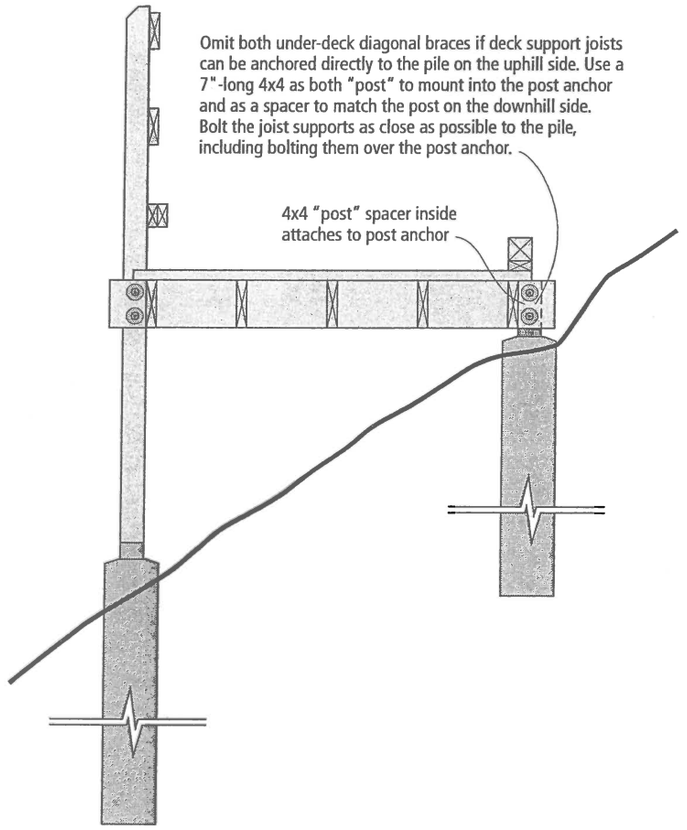
Boardwalk is optional

Even if this boardwalk is not built, or is built at a later date, able-bodied visitors can still reach the wetland via the steeper, inaccessible trail. Wheelchair users can follow the Wetlands Trail as far as the top of the bluff and stop at the overlook where the boardwalk would begin. The view from this overlook, however, is highly limited by tree leaves in summer and is not all that good even without leaves. The only way to really see and enjoy the wetlands is to get down there.

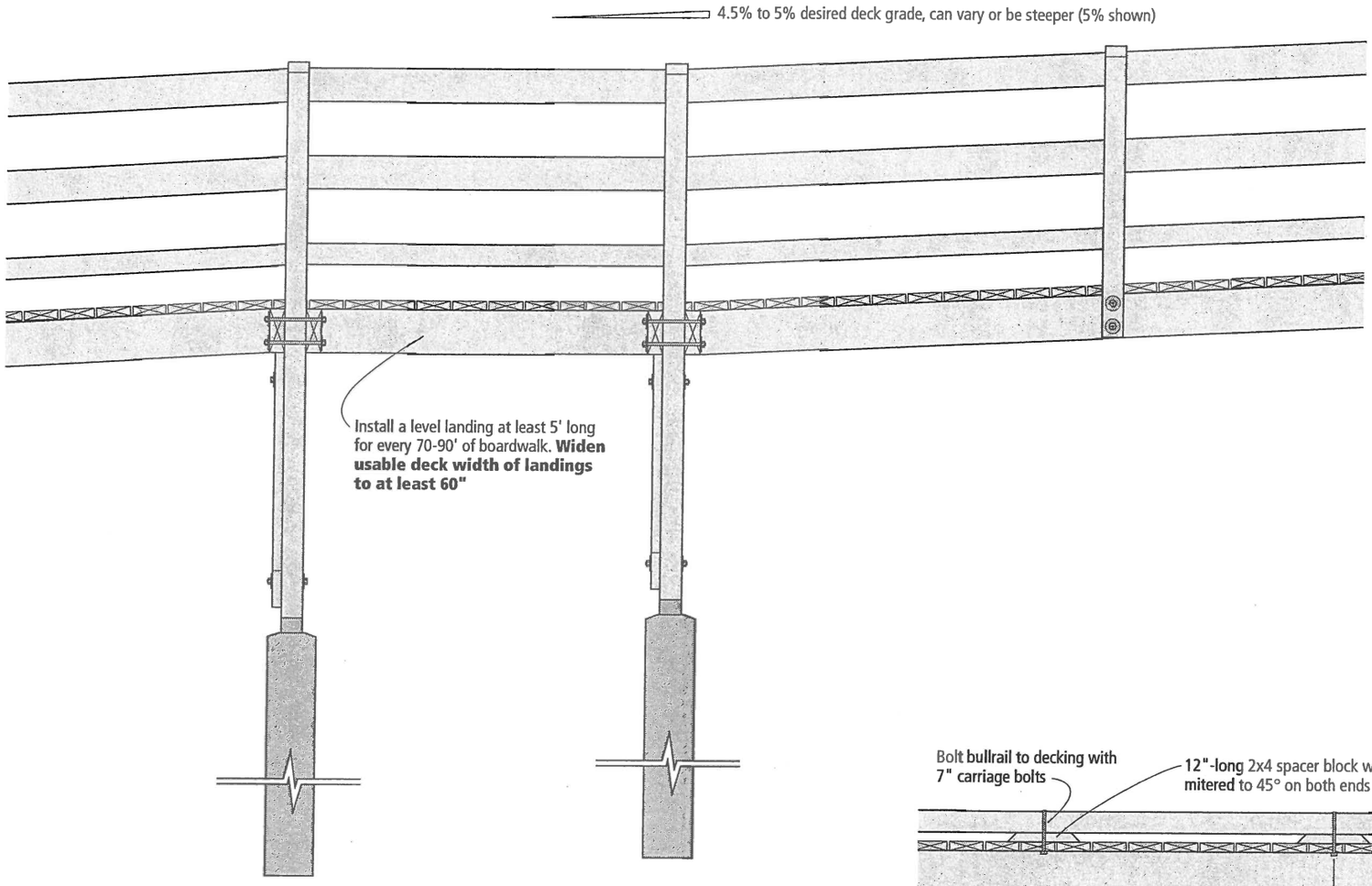
Measurements and notes indicate the differences between this boardwalk and the Two Forks boardwalk on which it is based. What is not noted is the same as for the Two Forks Boardwalk.



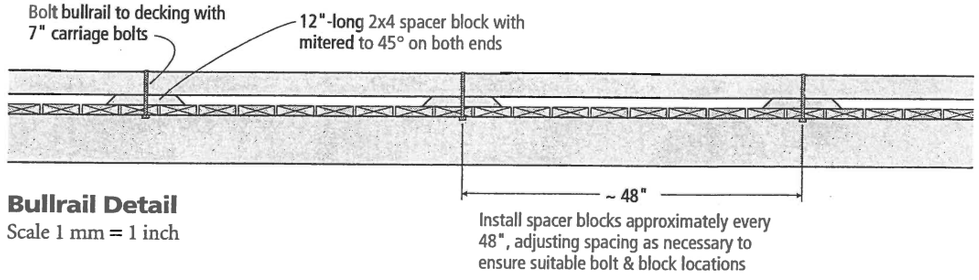
Wetland Bluff Boardwalk Section with One Diagonal Brace
Scale 1 mm = 1 inch



Wetland Bluff Boardwalk Section with No Diagonal Braces
Note above conditions for appropriate use.
Scale 1 mm = 1 inch



Wetland Bluff Boardwalk Elevation
Scale 1 mm = 1 inch
Level landing shown



Bullrail Detail
Scale 1 mm = 1 inch

Split Earth Point Retaining Wall

The problem with Split Earth Point

Since it's like a "Land's End" point, Split Earth Point has been the top of a steep route directly downhill toward Chartiers Creek. This route has been replaced by the new Switchback Trail. But there are two problems:

1. Because of the local configuration of rock outcrops, trees, grade changes, and rocky soil, you don't see where the new Switchback Trail begins unless you know where to look.
2. We need a physical barrier to make it clear that the old fall-line shortcut is no longer the route.

Solution: retaining wall

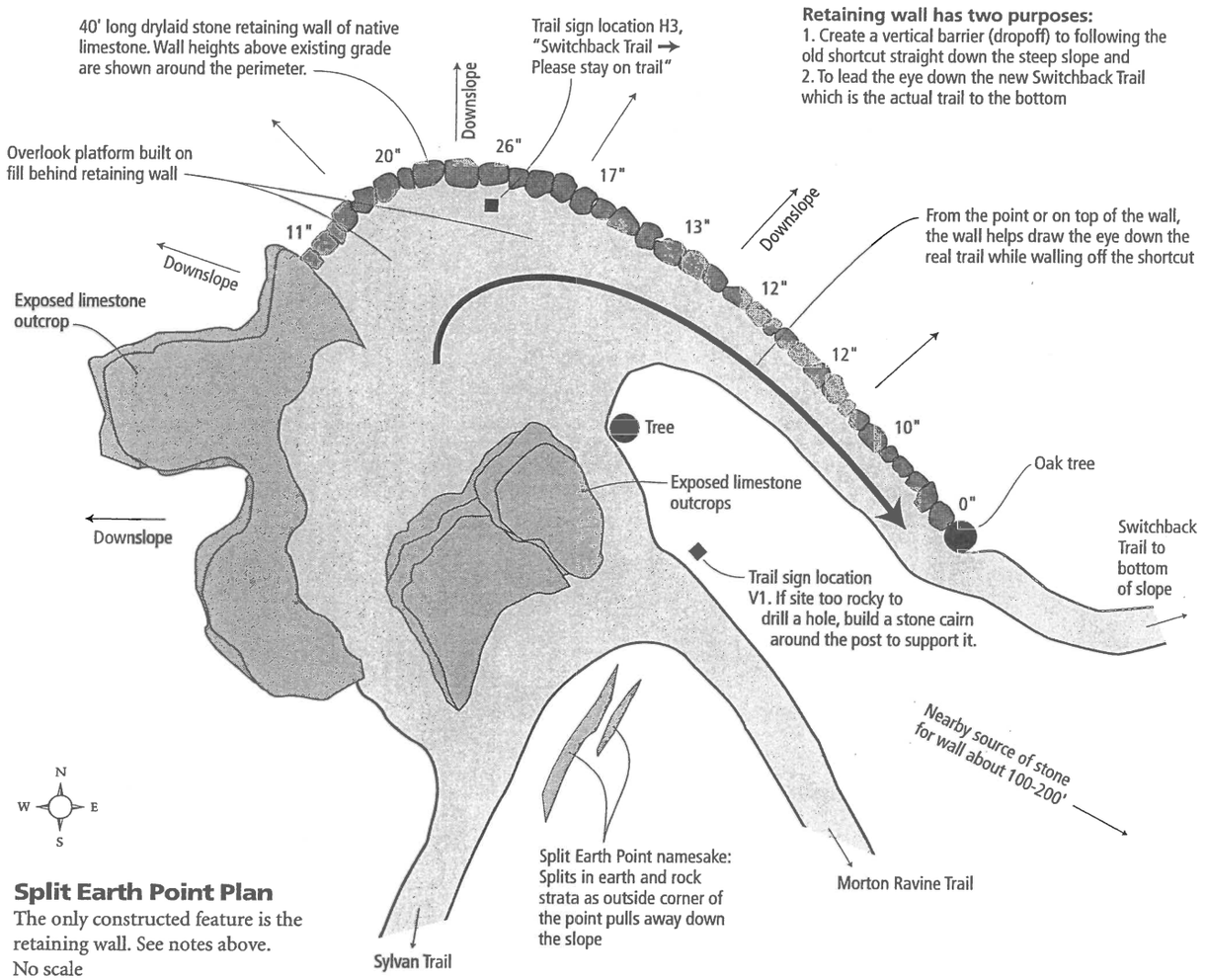
The proposed solution is to build a 40-foot long stone retaining wall connecting the rock outcrops at the point to the beginning of the Switchback Trail. The wall makes the point more of a "place" by defining its lower edge and forming a near-level overlook platform there. This platform is also the entrance of the Switchback Trail, and the same retaining wall continues down the first 15 feet of the trail. The wall not only creates a smooth, easy beginning to the trail, but also leads the eye down the trail as a non-verbal cue. The wall is highest (26 inches) where it's most tempting to shortcut down the slope.

The slope 100 to 200 feet to the southeast should have enough stone to build the low wall. Have a skilled stoneworker build a solid, attractive, and durable drylaid wall—an unskilled person will make a poor wall.

Preventing future shortcutting

To help deter those prone to climbing over or around the wall and shortcutting anyway, the plan includes one sign on the new platform, "Hillside Closed for Restoration — Please Use Trail," pointing down the Switchback Trail. We expect most people will choose to use the new trail.

If damaging amounts of shortcutting continue, install a three-rail buck-&-rail fence across the slope near the top. A buck-and-rail fence has the advantage of not requiring post holes which would be difficult to dig in the very rocky soil. The fence would have to be quite long since one can drop off the top in any direction and still reach the bottom through open forest. Post "Area Closed for Restoration—Please Use Trail" signs along the fence.



Split Earth Point Plan
The only constructed feature is the retaining wall. See notes above.
No scale

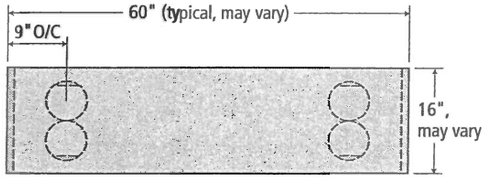
Benches

This custom design places native half-log seats on preservative-treated, round wood posts to form simple, rustic, sturdy benches. Ideally, the seat tops would be cut from windthrown trees in the Township or park, or harvested during routine tree removal operations. The seat logs would be sanded smooth on top but, for human health and naturalistic experience, would not be treated with preservatives or sealants. Designed for resting more than longer sitting—and to reduce their visual impact—the benches have no backs.

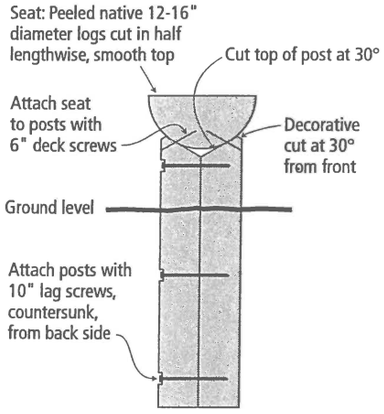
In this elegantly simple design, neither the seat logs nor the posts need to be custom-fitted to each other. If the seat log rots before the posts, it's easy to replace since it simply rests in a cradle formed by the posts.

The diameter of the log from which the seat is cut determines the thickness and height of the supporting posts. The larger the seat log, the thicker the posts. See "Log Bench Seat and Post Size Pairings," below, for parameters.

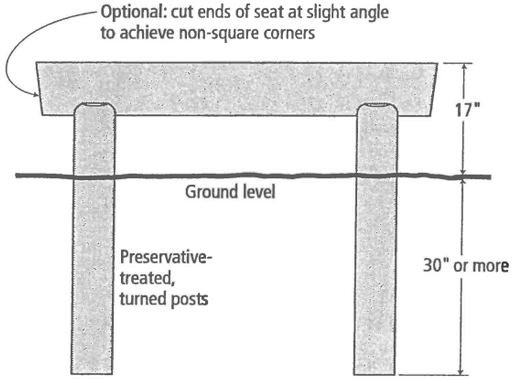
Posts and tops can be cut and worked in the shop, then carried into the park as separate components.



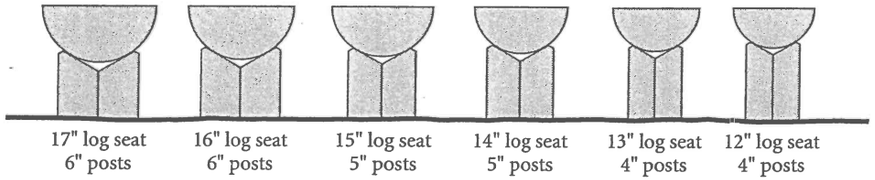
Log Bench Plan View
For 16" diameter log with 6" posts
Scale: 1 mm = 1 inch



Log Bench Side Section
For 16" diameter log with 6" posts
Scale: 1 mm = 1 inch



Log Bench Front Elevation
For 16" diameter log with 6" posts
Scale: 1 mm = 1 inch



Log Bench Seat and Post Size Pairings
16-17" diameter seat logs use 6" diameter posts
14-15" diameter seat logs use 5" diameter posts
12-13" diameter seat logs use 4" diameter posts
Adjust post depth so that seat height is 17"

Scale: 1 mm = 1 inch

6

Signs

Simple, low-key signs blend into the setting and help set the appropriate tone for open space-type experience

Importance of Sign Design

As representatives of management and like trail structures, the design of signs and signposts reflects on the Township's attitude and stewardship. This is not to say that "nothing is good enough," but rather that signs should be appropriate and harmonious in their context.

Signs proposed in this plan combine urban and pastoral aspects, letting the two complement each other.

Signs proposed in this plan

This plan provides details for common signs:

- Trail intersection signs
- "No Dogs" signs
- "No Bikes" signs
- "Area Closed" signs

Detailed design of major park entrance signs and trailhead rule- and notice-posting signs are not addressed here because (1) the name of the park interior needs to be set first (see item #2 on page 12) and (2) their design is highly site-specific. They should be handled as a separate design project after the park name is set and the majority of the master plan has been approved.

Trail Intersection Signposts

Trail intersection signpost and signs are simple, flexible, and limit "sign pollution."

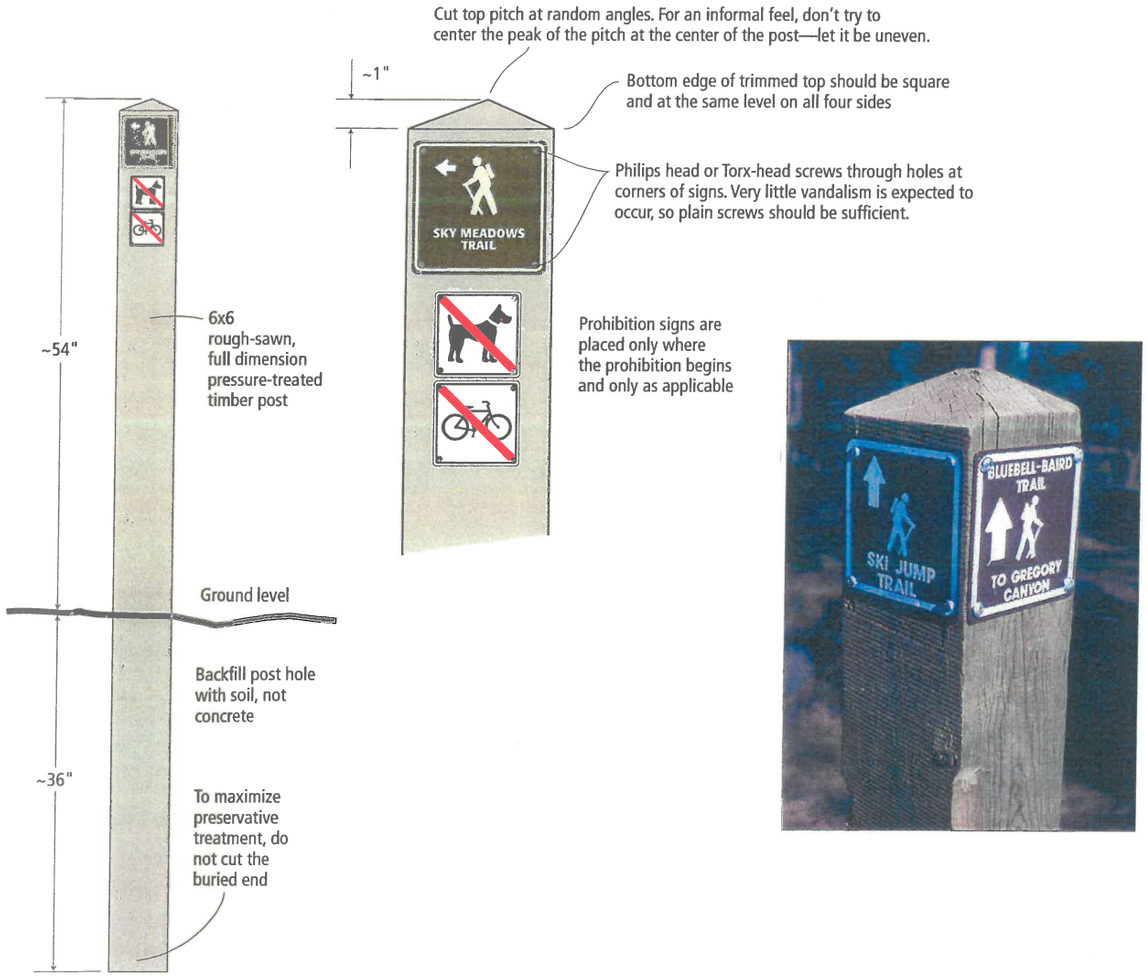
A single, square, rough-sawn, treated-timber 6×6 post at each intersection holds one or more signs on one or more sides. A chain saw is used to cut the top of the post to pitch water in three or four directions at shallow random angles, much like a hip roof on a house. Rough chain saw cuts and random angles create a rustic, informal feel matching the rough-sawn timber.

The signs themselves are flat, painted aluminum measuring 5½×5½ inches square (most common) or 5½ inches wide × 7½ inches high. Corners are slightly rounded and signs are simply screwed to the post with regular screws at all four corners. Since the signs are slightly narrower than the post, they do not extend past the post. Neat, formal sign graphics feature a hiker symbol and trail names in relatively small type. Arrows on each sign make it clear which trail is which and where you should head to follow a given trail.

Because trails can meet at any angle and intersections are usually between three trails, signs meant for you are generally mounted to face you as you approach.

However, because the signs are not double-sided and there is usually only one sign per trail per post, sometimes you may have to walk around the post to find the sign that applies to you. In these cases, signs are mounted to favor showing the way in to the park instead of the way out. Some critical intersections with this situation have two signs for one trail mounted on different sides.

Along with signs on multiple sides, signs can also be stacked vertically on any side. Special rules signs, such as "No Dogs" and "No Bikes" are attached vertically below the trail name signs. These slightly smaller aluminum signs are also face-mounted.



Trail Intersection Signs

Signs shown at actual size of 5½ × 5½ inches and 5½ × 7½ inches.

Background color:	PANTONE 448 C (brownish green)
Border and hiker symbol color:	PANTONE 4545 C (pale greenish gray)
Trail name and arrow color:	White
Substrate:	Aluminum, 0.063 gauge (1/16 inch)

"No Dogs" and "No Bikes" Signs

Shown at actual size of 3½ × 3½ inches.

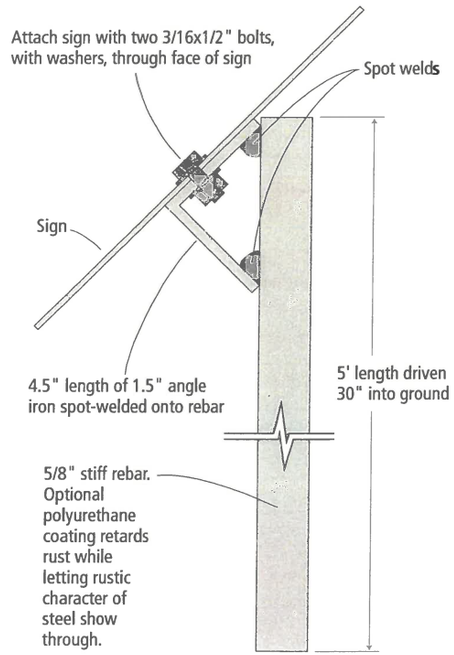
Background color:	White
Border and symbol color:	Black
Diagonal prohibition band:	Red
Substrate:	Aluminum, 0.063 gauge (1/16 inch)

"Area Closed for Restoration" Sign

Sign shown at actual size of 5½ × 5½ inches. This sign is designed to both stand out from and blend in to a natural background.

Background color:	PANTONE 448 C (brownish green)
Border, hiker, and text color:	White
Diagonal prohibition band:	Red
Font:	Formata Bold
Substrate:	Aluminum, 0.063 gauge (1/16 inch)

Temporary installations can use the rebar signpost below. Permanent installations can be on 4x4 posts.



Rebar Sign Support for Temporary Signs
Scale 1/2 inch = 1 inch

Interior Sign Quantities, Text, Locations

Sign locations shown here refer to the "Sign and Bench Locations" map. A "(2)" after a location code indicates that two copies of that sign are placed on two opposite sides of the same post.

5.5" square trail intersection signs—text on sign	Qty.	Sign locations (see map)
Beech Valley Trail	1	C1
Lost Farm Trail	3	B1(2) E1
Baker Slope Trail	2	E1 G1
To Lost Farm & Baker Slope Trails	1	F1
To Old Farm Road Trail	3	E1(2) N1
Old Farm Road Trail	4	A1 D1 F1 Q1
Meadow Edges Trail	3	I1 H1 D1
Butterfly Trail	2	I1 K1
Milkweed Trail	4	M1(2) H1 K1
Between Two Worlds Trail	4	J1(2) M1 N1
Woodlands Trail	2	N1(2)
To Woodlands & Between Two Worlds Trails	1	L1
Chartiers Floodplain Trail	1	P1
Ravine Drive Trail	2	P1 T1
Switchback Trail	3	U1(2) V1
Switchback Trail I Please Stay on Trail	1	H3
Trillium Trail	3	C2 D2 E2
Sylvan Ridge Trail	5	X1 Y1 H2 F2 R2
Upland Trail	7	Z1 T2 F2 R2 Q2 S2(2)
To Sylvan Ridge Trail	2	Z1 F2
To Upland Trail	1	X1
White Pine Trail	3	P2 R2(2)
To Morton Ravine & Morton Valley Trails	1	J2
To Overlook Trail & Sky Meadow Trail	1	E3
Morton Valley Trail	2	Q2(2)
Many Habitats Trail	2	A2 N2
Queen Maple Trail	4	Y1(2) A2 B2

5.5" square trail intersection signs—text on sign	Qty.	Sign locations (see map)
Bird Meadows Drive	3	C2 U2 K2
Wetland Bluff Trail	3	E2 G2 L2
To Wetland Bluff Trail	1	K2
Wetlands Trail	3	D2 G2 V2
To Many Habitats Trail	1	O2
Pine Forest Trail	2	H2 R2
Hidden Pond Trail	4	U2 X2 Z2 G3
Little Falls Trail	2	W2 X2
Friendship Trail	1	F3
Sky Meadow Trail	2	T2 Y2
To Overlook Trail & Old Oak Trail	1	C3
Total quantity of this sign size and type	**91**	

7.5" high x 5.5" wide trail intersection signs—text on sign	Qty.	Sign locations (see map)
Beech Valley Trail I Meadow Edges Trail	1	J1
Woodlands Trail I Chartiers Floodplain Trail	1	O1
Ravine Drive Trail I To Baker Park and Regional Environmental Center	2	R1(2)
Curved Bridge Trail I To Wetlands & Boyce Road	2	R1(2)
Ravine Drive Trail I To Wetlands & Boyce Road	2	S1(2)
Woodlands Trail I To Baker Park and Regional Environmental Center	2	S1(2)
Trillium Trail I Curved Bridge Trail	1	U1
Switchback Trail I Morton Ravine Trail	1	V1
Sylvan Ridge Trail I Switchback Trail	1	V1
Morton Ravine Trail I Sylvan Ridge Trail	1	V1
Upland Trail I Morton Ravine Trail	2	W1(2)
White Pine Trail I To Upland Trail	2	H2(2)
Many Habitats Trail I To White Pine Trail & Sylvan Ridge Trail	2	M2(2)
Morton Ravine Trail I Morton Valley Trail	1	I2
Sky Meadow Trail I Boyce School Trail	1	Y2
Overlook Trail I Sky Meadow Trail	1	D3
Overlook Trail I Old Oak Trail	1	B3
Many Habitats Trail I Friendship Trail	1	Z2
White Pine Trail I To Many Habitats Trail & Bird Meadows	1	P2
Old Oak Trail I Sylvan Ridge Trail	1	S2
Sky Meadow Trail I Boyce School Trail	1	Y2
Total quantity of this sign size and type	**28**	

Sign type	Qty.	Comments
"No Dogs"	32	Need 22, order 10 extra
"No Bikes"	32	Need 24, order 8 extra
Area Closed for Restoration—Please Stay on Trail	45	Used on closed trails, shortcuts, and sensitive areas throughout the park

7

Dog Management

No matter how domesticated an individual dog is, it descended from wolves and is perceived as a predator by wildlife. But while wolves hunted in packs and were only present for a short time in any one place in a wide territory, dogs can be found throughout the park every day.

The most obvious evidence of dogs is the recent scarcity of birds. Birdwatchers who used to spot many species in Bird Meadows report that they see far fewer birds, both variety and number, than they recorded a few years ago before dogs were allowed in the park.

Anecdotal evidence is backed up by scientific studies showing that one human with with one dog will flush wildlife (cause wildlife to flee) from much further away than one human alone. Exact distances depend on bird species and context, but the pattern is clear: dogs have much more impact on wildlife than humans.

Dog waste can also be a mounting problem. For instance, the US Forest Service reports that "Dogs are depositing an estimated 80 pounds of unscooped poop on trails every day" at two popular areas near Jackson, WY (population 4,800, dog population 5,200). [Betsy Johnson, "Heard Around the West," *High Country News,* 36 no. 24 (December 20, 2004), p. 24, also www.hcn.org.]

The City of Boulder, Colorado, Open Space and Mountain Parks Department reports "Dogs can be asymptomatic carriers of of internal parasites like Giardia and Cryptosporidium. Infected animals can pass up to 10 million Giardia cysts and/or 10 billion Crypotsporidum oocysts per gram of feces. Infection can occur with ingestion of one Crypotsporidium oocyst." These wastes are flushed into local waters when it rains. Boulder OSMP estimates 31 tons of dog poop are left behind each year despite poop pickup laws and spending $22,000 per year to supply dog waste bags at trailheads. [From http://www.ci.boulder.co.us/open-space/visitor/dogs.htm].

On leash and off, dogs can be unpredictable, attacking other dogs as well as humans. They can also attack, stress, or kill wildlife. To help prevent problems, the American Dog Owners Association (www.adoa.org) lists the following reasons to leash dogs:

- Leashes protect dogs from becoming lost and from regional hazards such as porcupines, mountain lions, bears, coyotes, snakes, other dogs and sick, injured, or rabid animals.
- Unleashed dogs intimidate other trail users and their dogs depriving them of the peace our parks and trails provide.

- Unleashed dogs harass, injure and sometimes kill wildlife.
- A leashed dog's keen senses can enhance your awareness of nearby wildlife or other wilderness visitors.
- Unleashed dogs increase the probability of dogs being banned from your favorite public lands and trails.
- Failure to leash your dog may result in a fine.

Recommendation

For environmental protection and public safety:

- Prohibit dogs in, and on trails leading to, select sections of the park richest in wildlife:
  - The wetlands
  - Bird Meadows
  - REEC and Deer Meadows
- Require dogs to be on leashes while in the park. While some parks and communities have "voice and sight control" policies, these would be considerably more difficult for the Township to enforce without dedicated law enforcement staff.
- Require that dog feces be removed. Beware of the practice of owners bagging feces only to leave the bags next to the trail for themselves or someone else to pick up later.

Suggested dog management facilities

Poop bag dispensers and trash cans: This plan recommends providing dispensers for poop bags and providing trash cans at trailheads. The annual cost of this can be substantial, but so is the ecological and trail experience cost of **not** providing them.

Loaner leashes: This idea removes excuses for having dogs off leash. At each major trailhead, install a 4x4 post with a peg that can hold several inexpensive 6-foot leashes. A sign at the top of the post reads, "Forgot Your Leash? Use One of Ours." Keep the post supplied with loaner leashes.

8

Cost Estimates

Estimated construction and maintenance effort and cost

Phase One construction estimate:	$117,363
Phase Two construction estimate:	$67,524
Estimated total construction cost:	$184,887

Interior Trails—Initial Construction Budget

Most labor is in-house. Work estimated at $25/hour is intended to be performed by Public Works. Work estimated at $50/hour—mostly hand work on narrow trail treads—is intended for Forestry. Volunteers can lower labor costs.

Item	Qty	Piece cost	Extended
■ PHASE ONE			
Trail Tread Construction for Hiking Use (all labor)			
Lost Farm Trail tread construction	16	$50	$800
Beech Valley Trail tread construction, improvements for accessibility	48	$50	$2,400
Baker Slope Trail, tread construction	12	$50	$600
Connector between Lost Farm/Baker Slope and Old Farm Road Trail, ditch uphill side, crown, woodchips	10	$50	$500
Meadow Edges Trail, gully xings, crowning, causeway	40	$50	$2,000
Butterfly Trail, ditching, crowning	18	$50	$900
Milkweed Trail, ditching, crowning	19	$50	$950
Between Two Worlds, tread cut, tread reroutes	24	$50	$1,200
Connector between Between Two Worlds and Old Farm Road Trail, causeway	16	$50	$800
Woodlands Trail reroutes, gully crossings, stone steps at bridge	34	$50	$1,700
Chartiers Floodplain Trail, compacting gravel into tread on floodplain	6	$50	$300
Curved Bridge Trail, see below			
Trillium Trail, no itemized work	0	$50	$0
Switchback Trail, tree removal (contracted)	1	$300	$300
Switchback Trail & Split Earth Point, coordination and supervision of volunteers	16	$50	$800
Split Earth Point and Switchback Trail, stone retaining walls	40	$60	$2,400
Sylvan Ridge Trail, drainage xing improvement, drain dips	10	$50	$500
Upland Trail, drain dips	6	$50	$300
Morton Ravine Trail, no itemized work	0	$50	$0
Queen Maple Trail, drain dips, tread cut	9	$50	$450

Item	Qty	Piece cost	Extended
Many Habitats Trail, clearance, ditching/crown near spring house and S of north gas line	14	$50	$700
Bird Meadows Drive, repair drainage and gullies at top end of grade to wetlands, regrade surface, unclog culvert on drainage north of contractor staging area	16	$50	$800
Wetland Bluff Trail, reroutes, restoring closed sections	30	$50	$1,500
Wetlands Trail, initially formed as hiking-only trail (bridge is separate)	10	$50	$500
White Pine Trail, reroutes, drain dips, restoration of closed sections	10	$50	$500
Morton Falls Trail, see below			
Morton Valley Trail, clearance, tread cut	20	$50	$1,000
Sky Meadow Trail, clearance, causeway	17	$50	$850
Old Oak Trail, clearance, tread work	10	$50	$500
Hidden Pond Trail, ditching, crowning, causeway	32	$50	$1,600
Little Falls Trail, tread cut, stone steps below pond	58	$50	$2,900
Boyce School Trail, reroute, restoration of closed sections, causeway, bridge ramps	21	$50	$1,050
Overlook Loop, see below			
Friendship Trail, clearance, gully crossing, causeway	30	$50	$1,500
Connector between Old Oak Trail/Overlook Trail and Boyce Road Trailhead on west side, crowning	5	$50	$250
Connector between Old Oak Trail/Overlook Trail and Boyce Road Trailhead on east side, crowning	4	$50	$200
Other unnamed short connector trails	4	$50	$200
Systemwide, general small widespread efforts	50	$50	$2,500
Subtotal, initial hiking trail tread construction			**$33,450**
Boyce Road Trailhead Parking Area Construction and Removal/Restoration of Roads North to the Northern Gas Line			
Supplies and materials (Public Works)	1	$700	$700
Labor (Public Works)	224	$25	$5,600
Subtotal			**$6,300**
Shipping for lumber			
Bridges and boardwalks use thicker timbers than most lumberyards handle. This estimate is from a lumber company in Houston, TX who specializes in bridge timbers and preservative-treated wood, and ships nationwide. All lumber quoted in this plan is #1 grade, ACQ-treated southern yellow pine, the most durable species for treated wood and considerably higher quality than wood from retail outlets like Home Depot which sells #2 and better. However, it takes two trucks @ $2,100 each from Houston to Pittsburgh to haul all the lumber. *This budget assumes that all lumber is purchased at the same time, which wouldn't happen in a two-phase project.*	2	$2,100	$4,200
Subtotal			**$4,200**
Three small timber bridges (Woodland Trail, Queen Maple Trail, Wetlands Trail)			
Lumber and materials	1	$2,952	$2,952
Labor (Public Works)	120	$25	$3,000
Tools, supplies	1	$300	$300
Subtotal			**$6,252**
Beech Valley Trail Bridge			
30'×6' fiberglass bridge	1	$11,250	$11,250
Shipping	1	$600	$600
Installation, time (Public Works)	48	$25	$1,200
Tools, supplies	1	$300	$300
Subtotal			**$13,350**
Curved Bridge Trail and Bridge			
56'×6' fiberglass bridge	1	$23,750	$23,750
Shipping for fiberglass bridge	1	$750	$750
Labor for fiberglass bridge assembly (Public Works)	60	$25	$1,500
Materials for timber segments	1	$2,392	$2,392
Materials for piers and abutments	1	$1,600	$1,600
Labor for piers and abutments (Public Works)	80	$65	$5,200

Item	Qty	Piece cost	Extended
Labor for timber bridge segments (Public Works)	64	$25	$1,600
Bridge tools, supplies	1	$1,000	$1,000
Trail tread construction	10	$25	$250
Subtotal			**$38,042**
Interior Trail Junction Signs and Area Closed Signs			
Design and layout of unique signs, sign production coordination	9	$60	$540
5.5 × 5.5" trail junction signs, all different	91	$18	$1,679
5.5 × 7.5" trail junction signs, all different	28	$22	$615
3.5 × 3.5" No Bikes signs	32	$8	$267
3.5 × 3.5" No Dogs signs	32	$8	$267
5.5 × 5.5" Area Closed signs	45	$7	$335
6x6 rough-sawn treated timber signposts (weight 96 lbs)	60	$26	$1,560
4x4 rough-sawn treated timber signposts	10	$10	$100
30 rebar sign supports	30	$4	$106
Tool rental (auger)	1	$300	$300
Installation time @ 4 man-hours per signpost for 100 posts (Public Works)	400	$25	$10,000
Subtotal			**$15,769**
Benches, per each			
Obtaining and crafting the split log seat, labor (Public Works)	9	$25	$225
Preparing bench legs, labor (Public Works)	2.5	$25	$63
Bench legs, hardware, purchased (assumes log for seat is free salvaged material)	1	$54	$54
Installation, labor (digging holes, transporting heavy components to remote locations)	10	$25	$250
Subtotal, cost per bench			**$592**
Estimated Total Cost of Phase One			**$117,363**

Item	Qty	Piece cost	Extended
■ PHASE TWO			
Morton Falls Trail and Bridge			
30' × 6' fiberglass bridge	1	$18,750	$18,750
Shipping for bridge	1	$700	$700
Bridge installation, time (Public Works)	72	$25	$1,800
Bridge installation, tools & materials	1	$300	$300
Trail construction, time (Public Works)	48	$25	$1,200
Subtotal			**$22,750**
Constructing Overlook Trail as an Accessible Trail			
Tread cut and mechanical compaction, compacting some gravel into soil (contracted)	1	$2,200	$2,200
Subtotal			**$2,200**
Upgrading Wetlands Trail to be Accessible as far as the Wetland Bluff Trail			
Widening and mechanically compacting trail tread, compacting gravel into soil (contracted)	1	$6,000	$6,000
Two Forks Boardwalk lumber, hardware, and concrete (not including materials for 18' bridge)	1	$2,012	$2,012
Boardwalk construction, time (Public Works)	168	$25	$4,200
Boardwalk construction, tools	1	$200	$200
Stone retaining wall for overlook platform on top of bluff, 34' long, avg. 42" high (119 sq. ft.), cost of stone and delivery to site			$1,000
Stone retaining wall construction	32	$65	$2,080
Cost and delivery of soil and gravel for crowning trail and backfilling retaining wall to top of bluff (Public Works)	7	$25	$175
Subtotal			**$15,667**

Item	Qty	Piece cost	Extended
Extending Wetland Trail to Wetlands as Accessible Trail			
Wetland Bluff Boardwalk lumber, hardware, and concrete	1	$6,700	$6,700
Boardwalk, construction time (Public Works)	372	$25	$9,300
Boardwalk, construction tools	1	$400	$400
Earth ramp, earthwork with mechanical compaction, compacting gravel into soil (contracted)	1	$4,000	$4,000
Subtotal			**$20,400**
Benches, installed			
Build and install 11 benches	11	$592	$6,507
Subtotal			**$6,507**
Estimated Total Cost of Phase Two			**$67,524**

Summary

Phase One cost, with no benches:	$117,363
Phase Two cost:	$67,524
Estimated total project cost:	$184,887

Notes:

- For boardwalk decking, using plastic lumber 5/4×6 decking instead of treated pine 2×6s adds $1,504 to cost of Two Forks Boardwalk and $6,286 to cost of Wetland Bluff Boardwalk. Plastic lumber cost is $3.16 per foot, treated wood is $0.70 per foot. Added costs do not include separate shipping of heavier material than wood.
- While this budget includes "No Dogs" signs posted at appropriate locations throughout the park, it does not include any other costs for dog management.

Sources of Estimates

Fiberglass bridges
E.T. Techtonics
PO Box 40060
Philadelphia, PA 19106
(215) 592-7620
www.ettechtonics.com
Contact: Roy Wilson,
ETTWilson@aol.com

Lumber and hardware
Bayou City Lumber
11106 Telephone Rd.
Houston, TX 77075
(713)-991-2377
www.bayoucitylumber.com
Contact: Ryan Guikema,
ryan@bayoucitylumber.com, quotation for Natureshape

Also (second estimate, probably better lumber)
Wheeler Lumber
9330 James Avenue South
Bloomington, MN 55431
(800) 328-3986
Fax: (952) 929-2909
www.wheeler-con.com
info@wheeler-con.com
Contact: Kevin Serres, Estimates & Sales, c.c. TT12626

Signs
Voss Signs
PO Box 553
Manlius, NY 13104-0553
(800) 473-0698
Fax (315) 682-7335
www.vosssigns.com
Contact: Mary Walser, quotation 978370

Plastic lumber
Schrader Co.
8216 23rd Place NE
Everett, WA 98205
(425) 377-1550
Fax (425) 377-0408
www.schraderco.com
Contact: Bob Lewis,
bob@schraderco.com

Maintenance Budget

As mentioned previously, because sustainability is built into the trail system—especially in the native surface trail tread itself—trail tread will become *more* stable with time as equilibrium is reached. For this reason, maintenance needs are high in the beginning and decrease with time.

Item	Hours	Piece cost	Extended
YEAR ONE			
Monthly inspection of the entire trail system: Inspecting for and draining any puddles caused by trail tread compaction with trail use, removing some berms at the outside edge of tread, clearing fallen trees and debris, picking up litter, checking and adjusting function of trail structures, checking and replacing any lost or excessively damaged signs	60	$50	$3,000
Adjusting tread for visitors' actual path, removing roots exposed by compaction, adjusting drainage of trail structures and drainage crossings, checking and adjusting trail clearance, adding soil to fills where excess settling occurred	45	$50	$2,250
Inspecting for any unexpected trail erosion and adding additional drainage dips or conducting other repairs; widening, deepening, or cleaning out drainage dip outlets; checking and stabilizing manmade gullies	40	$50	$2,000
Spot-watering transplanted plants and planted trees	20	$50	$1,000
Inspecting entire trail system as soon as possible after heavy rains and windstorms (Year One only)	50	$50	$2,500
Total	**215**		**$10,750**

Item	Hours	Piece cost	Extended
YEAR TWO			
Same activities as Year One, but inspections only every 6 weeks and after exceptional rain and/or windstorms	**140**	**$50**	**$7,000**
Total	**140**		**$7,000**
YEAR THREE			
Same activities as Year One, but inspections only every 2 months and after severe windstorms	**100**	**$50**	**$5,000**
Total	**100**		**$5,000**
YEAR FOUR AND BEYOND			
Same activities as Year One, but inspections only every 3 months and after severe windstorms	**72**	**$50**	**$3,600**
Total	**72**		**$3,600**

Major Maintenance and Replacement

- Because of sustainable design and with frequent, light maintenance, natural surface treads should *never* need to be extensively reconstructed, heavily repaired, or closed for structural/physical reasons
- Wood structures will need eventual repair and replacement. Southern yellow pine (one of the best species for with preservatives and outdoor exposure) pressure-treated with ACQ has a rated life up to 40 years but will likely need to be replaced before then. Bridge and boardwalk decks will wear out from exposure and use long before the superstructure does.
- Fiberglass bridges need no maintenance.
- Signs may fade somewhat after 20 years or need to be replaced due to loss or vandalism.

Natureshape

Prepared by Natureshape LLC
January 5, 2005

TOWNSHIP OF UPPER ST. CLAIR, PENNSYLVANIA
BOYCE MAYVIEW PARK INTERIOR TRAILS PLAN
New, Existing and Closed Trails

Forest
Meadow
Floodplain

New trails and trail segments
Existing trails and trail segments to use and maintain
Existing trails to allow but not sign or maintain
Existing roads used as trails
Existing trails to close and restore
Existing roads to close and restore
Trail bridges
Proposed Perimeter Trail
Natural gas pipeline corridors

1⅝" = ~1,000'
2.6/16" = ~100'
0' 1,000'

MAYVIEW MEADOW
REEC TRAILHEAD
REEC Classrooms
REEC Lab
(PROPOSED PERIMETER TRAIL)
LOST FARM TR.
OLD FARM ROAD TR.
HAWK MEADOW
BAKER PARK TRAILHEAD
BAKER PARK
BAKER SCHOOL
BAKER SLOPE TR.
BEECH VALLEY TR.
MEADOW EDGES TR.
Bird Blind #4
BUTTERFLY TR.
MILKWEED TR.
DEER MEADOW
Cathedral Point
Chartiers Point
BETWEEN TWO WORLDS TR.
SYCAMORE FLOODPLAIN
SUNSET RIDGE
WOODLANDS TR.
OLD FARM ROAD TR.
CHARTIERS FLOODPLAIN
CHARTIERS FLOODPLAIN TR.
SOCCER FIELD
U.S.C. VOLUNTEER FIRE COMPANY SUB-STATION
MORTON FIELDS TRAILHEAD
RAVINE DRIVE
SWITCHBACK TR.
Split Earth Point
CURVED BRIDGE TRAIL
TRILLIUM TR.
SYLVAN RIDGE TR.
MORTON RAVINE TR.
QUEEN MAPLE TR.
UPLAND TR.
APPROX. USC-PENNDOT BOUNDARY
Vision Rocks
MANY HABITATS TR.
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TRILLIUM TRAIL
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PENNDOT WETLANDS (FORMED AFTER BASE MAP WAS MADE)
Wetland Bluff Boardwalk
Valley View Point
SURPRISE MEADOW
WETLAND BLUFF TR.
SOIL PILE FROM WETLAND FORMATION
Bird Blind #2
Bird Blind #3
Bird Blind #1
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BIRD MEADOWS DR.
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CONTRACTOR STAGING AREA
MULCH STAGING AREA
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SKY MEADOW TR.
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BOYCE SCHOOL
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HIDDEN POND TR.
LITTLE FALLS TR.
FRIENDSHIP TR.
(possible bridge)
LEAF RECYCLING/ COMPOSTING AREA
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WINGFIELD PINES GOLF & SWIM CLUB
MAYVIEW ROAD
S.R. 3005
BOYCE ROAD S.R. 3006
SOUTHWOOD PSYCHIATRIC FACILITY
U.S.C. PARK
ST. CLAIR PLAZA
BOYCE PLAZA ROAD
MAPLE LANE (private)
MAGISTRATE
HIDDEN VALLEY DRIVE
J.C. PENNEY OFFICE BLDG.
FROSTY VALLEY GOLF COURSE
FRIENDSHIP VILLAGE
OLD BOYCE STATION ROAD
REDFERN DRIVE
HILLWOOD DRIVE
MORTON ROAD
STREAMS

Natureshape

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January 5, 2005

TOWNSHIP OF UPPER ST. CLAIR, PENNSYLVANIA
BOYCE MAYVIEW PARK INTERIOR TRAILS PLAN

Final Proposed Trail System

Forest
Meadow
Floodplain

Final singletrack trails, both new & existing
Existing roads used as trails
Existing trails to allow but not sign or maintain
Existing roads not used as trails
Trail bridges
Proposed Perimeter Trail
Natural gas pipeline corridors

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(possible bridge)
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BOYCE ROAD S.R. 3006
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Natureshape

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January 5, 2005

TOWNSHIP OF UPPER ST. CLAIR, PENNSYLVANIA
BOYCE MAYVIEW PARK INTERIOR TRAILS PLAN
Sign and Bench Locations

Forest
Meadow
Floodplain

S1 Trail junction signpost bearing one or more signs
NB "No Bikes" sign
ND "No Dogs" sign
▲ Potential bench locations

1⅝" = ~1,000'
2.6/16" = ~100'
0' 1,000'

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Natureshape

Prepared by Natureshape LLC
January 5, 2005

TOWNSHIP OF UPPER ST. CLAIR, PENNSYLVANIA
BOYCE MAYVIEW PARK INTERIOR TRAILS PLAN

Dog Access

Forest
Meadow
Floodplain

Trails on which dogs are permitted
Trails closed to dogs

1⅝" = ~1,000'
2.6/16" = ~100'
0' 1,000'

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REEC Lab
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BEECH VALLEY TR.
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BAKER SLOPE TR.
SUNSET RIDGE
SYCAMORE FLOODPLAIN
CHARTIERS FLOODPLAIN
CHARTIERS FLOODPLAIN TR.
WOODLANDS TR.
OLD FARM ROAD TR.
(PROPOSED PERIMETER TRAIL)
MORTON FIELDS TRAILHEAD
RAVINE DRIVE
CURVED BRIDGE TRAIL
Split Earth Point
SWITCHBACK TR.
TRILLIUM TR.
SYLVAN RIDGE TR.
MORTON RAVINE TR.
QUEEN MAPLE TR.
UPLAND TR.
Vision Rocks
APPROX. USC-PENNDOT BOUNDARY
PENNDOT WETLANDS (FORMED AFTER BASE MAP WAS MADE)
Wetland Bluff Boardwalk
MANY HABITATS TR.
MORTON FALLS TR.
TRILLIUM TRAIL
WETLANDS TRAIL
POTENTIAL RAIL TRAIL TRAILHEAD
WETLAND BLUFF TRAIL
Valley View Point
SURPRISE MEADOW
WETLAND BLUFF TR.
SOIL PILE FROM WETLAND FORMATION
Bird Blind #2
Bird Blind #3
Bird Blind #1
BIRD MEADOWS COMPLEX
WHITE PINE TR.
SADDLE MEADOW
MORTON VALLEY TR.
TWO FORKS TRAILHEAD
WETLANDS TR.
Two Forks Boardwalk
Spring house (historic)
BIRD MEADOWS DR.
CONTRACTOR STAGING AREA
MATERIALS STAGING AREA
MULCH STAGING AREA
HIDDEN POND TR.
LITTLE FALLS TR.
LEAF RECYCLING/ COMPOSTING AREA
FRIENDSHIP TR.
(possible bridge)
OLD OAK TR.
OVERLOOK LOOP
Cellular towers
SKY MEADOW
SKY MEADOW TR.
BOYCE SCHOOL TR.
BOYCE TRAILHEAD
(PROPOSED PERIMETER TRAIL)
SOCCER FIELD
U.S.C. VOLUNTEER FIRE COMPANY SUB-STATION
BAKER PARK
BAKER SCHOOL
BOYCE SCHOOL
STREAMS
WINGFIELD PINES GOLF & SWIM CLUB
MAYVIEW ROAD
S.R. 3005
BOYCE ROAD S.R. 3006
MORTON ROAD
U.S.C. PARK
SOUTHWOOD PSYCHIATRIC FACILITY
ST. CLAIR PLAZA
BOYCE PLAZA ROAD
MAGISTRATE
MAPLE LANE (private)
HIDDEN VALLEY DRIVE
J.C. PENNEY OFFICE BLDG.
FROSTY VALLEY GOLF COURSE
FRIENDSHIP VILLAGE
OLD BOYCE STATION ROAD
REDFERN DRIVE
MILLWOOD DRIVE