

203: TRAIL DESIGN AND LAYOUT

There is an art to trail design and layout. Through study and experience, a person locating the trail corridor and laying out the trail centerline will develop an eye for it, and the results will be sustainable trails that are easy to maintain and a delight to hike.

Trail design and layout requires consideration of many factors: geology, hydrology, botany, and aesthetics—just to name a few. Observe how use, weather conditions, water flow, and regrowth of vegetation affect a trail over time. Utilize professionals (FTA staff) and volunteers *with design and layout experience* as mentors. They've spent years acquiring relevant knowledge and experience. These skills can only be fully developed with experience. These skills are not complex but they are also not intuitive without exposure to training—both classroom and on-the-job. *Training is the first step and it starts with the individual accepting that there are things they can learn about trail design and layout.*

There are several very good books and manuals written on the subject of recreational trail design and layout. It would be a futile effort to summarize them in a few pages (see the end of this Chapter for reference material suggestions). Professionals and long-time volunteers spend years acquiring the relevant knowledge and experience. Below are some of the most relevant components.

Central to any design and layout discussion are Trail Fundamentals. These five concepts are the cornerstones of USDA-FS trail management:

- Trail Type (terra firma, water, etc...)
- Trail Class (1-5; see Chapter 201)
- Managed Use (hiker, bicycle or other)
- Designed Use (level of development for managed usages)
- Design Parameters (see Chapter 201)

Trail design and layout are much more than the application of FNST Design Parameters for a Trail Class. The trail class and parameters are specifications, while design and layout are techniques and skills. Design and layout merge sustainability, esthetics, flow, and how the trail fits into the setting. Trail design is an important factor in ensuring that the trail offers optimum scenic, geologic, historic, cultural and biological sites to provide a variety of diverse habitats for the trail user to experience. Trail design is the critical connection to make the trail sustainable, to reduce impacts to the natural environment, and to minimize future trail maintenance.

Sustainability.

In the trail development and construction community you hear the term “sustainable.” In trail jargon this is a trail that *accommodates its intended objectives while requiring minimal long-term maintenance.* A sustainable trail is often not the easiest to plan or construct. It frequently requires much more work to clear the trail corridor and establish a stable tread.

Trail design and layout is about fitting a sustainable trail to the land. Before starting the design and layout process there is an assumption that the selected trail corridor is in the best or optimal location

(see Chapter 210). Most of the Florida Trail is designed and managed for the pedestrian/hiker. The managed use for any Florida Trail segment is the decision of the landowner or manager.

Trail Corridor Reconnaissance.

Whether it is a new trail, a minor relocation or a major relocation, trail corridor reconnaissance is paramount. The reconnaissance process includes the identification and evaluation of alternative corridors, which will lead to the selection of the best possible location. Application of sound principles of trail location, corridor selection, and trail grade will minimize construction cost and future maintenance. Trail corridor reconnaissance and selection is a shared volunteer and FTA staff responsibility. The cost of construction as well as the long-term maintenance requirements are not decisive but are influencing factors in trail corridor selection.

The process starts with the examination of contour maps and aerial imagery to identify terrain features, drainage patterns, vegetation, and man-made structures. Inquire about current and future land use and management plans that might influence both the trail location and the user experience. Discussions with managers and volunteers familiar with the area are essential to identifying control points. Control points can be positive (things to route toward) or negative (areas to avoid).

There is no substitute for on-the-ground examination of potential trail corridors. Walk each feasible corridor and record the proposed centerline. Identify the alternative trail corridors on the ground with different temporary markers (flagging) that can be easily recognized and moved. Record all pertinent data on physical conditions and key features that are to be regarded as principal items for consideration in corridor selection. Examine control points closely.

Positive Control Points. Favor areas with the following features:

1. Natural stream crossings
2. Natural ridges
3. Natural openings
4. Open timber
5. Light stands of brush
6. Scenic vistas
7. Observation opportunities with special features
8. Access to water and areas protected from the weather
9. Natural drainages offered by sloped locations
10. Well-drained soils
11. Differing seasonal experiences and conditions
12. Natural contours in topography
13. Safe and quick crossing of roads and railroads
14. Reasonable access to other transportation modes
15. Good trailhead access
16. Available campsites
17. Location of potential blazing trees

Negative Control Points: Carefully consider the conditions of various trail corridors and avoid the following as much as possible:

1. Wet and flat areas with difficult drainage
2. Stream bottoms subject to periodic floods
3. Unstable, fragile soils
4. Steep slopes and abrupt elevation changes
5. Frequent stream crossings where fording is difficult or bridging impractical
6. Locations requiring bridges or culverts
7. Heavy vegetation requiring clearing and more-than-annual maintenance
8. Fragile vegetation areas
9. Cultural sites, except where featured as a trail objective
10. Lightning-prone areas
11. Road or railroad crossings with limited sight distances
12. Known habitats of threatened or endangered species of plants or animals—see [Notes on Florida's Endangered and Threatened Plants](http://freshfromflorida.s3.amazonaws.com/fl-endangered-plants.pdf) [http://fresh fromflorida.s3.amazonaws.com/fl-endangered-plants.pdf]
13. Private land requiring a right-of-way
14. Timbered areas prone to blowdown
15. Adverse effects on other resources such as wildlife
16. Fences, cables, and guy wires

Trail Layout.

Ideally, trail layout should follow the contours of the land and consist of a series of gently sweeping long curves. Long straight stretches and sharp angular turns should be avoided as much as possible. Layout should take advantage of natural drainage to minimize the need for drainage modifications.

Flat land.

Land is seldom truly flat--the elevation differences over long stretches south of Orlando can often be measured in inches. Trail builders generally prefer the highest ground possible for trails on flat terrain. The higher ground may be only inches above the surrounding terrain but is often recognizable by the type of vegetation. While it is always possible to elevate and harden the tread it is seldom cost effective for long trail segments. Sandy soils generally drain quicker than those primarily of organic matter. Discussions on elevating the tread are contained in a [Virginia Greenway](#) document and the [USDA FS Wetland Trail Design and Construction](#).

Trail Grade.

Florida has an overabundance of sandy soils that are highly erodable. The ideal grade is 3% or less in sandy soils. Grade is usually a controlling factor for a hillside trail location. Avoid closely spaced undulate grades and downhill grade/fall-lines where water will funnel. A slight downhill grade is necessary for crossing drainages and to provide grade undulations (grade reversals) for drainage purposes.

Hillside and Fall-lines.

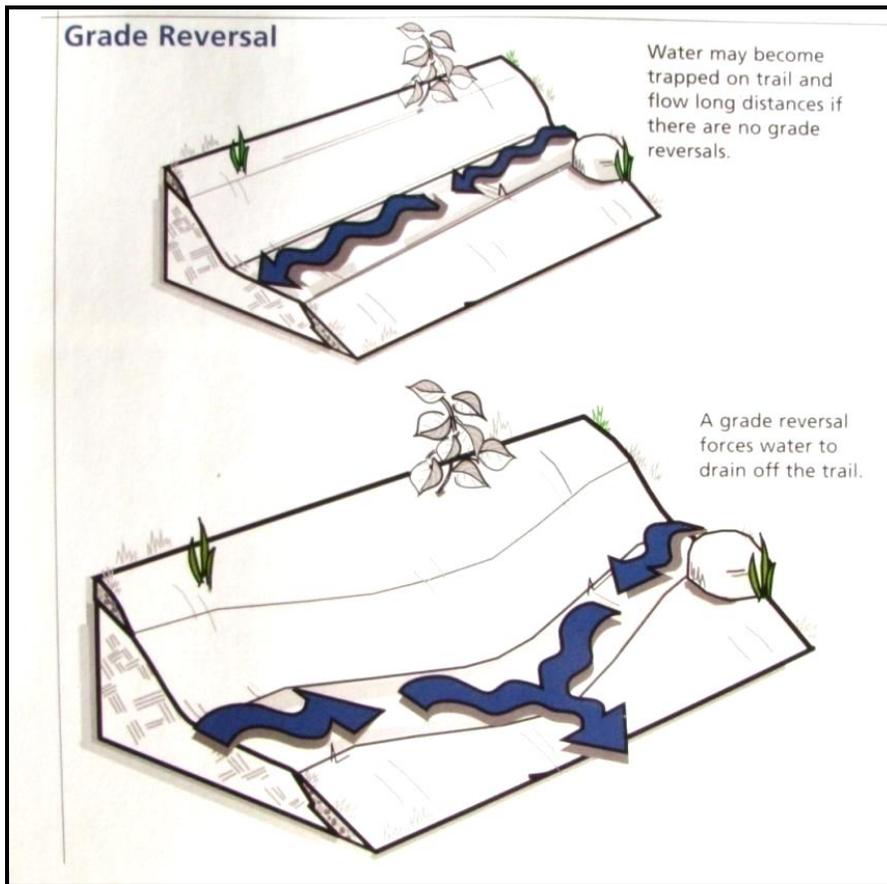
Locating the trail directly up/down a slope results in little opportunity to drain water off the tread. Florida is *not* all flat, and elevation changes of 50 feet or more are not uncommon. North Florida and the Panhandle have plenty of hills and erosion-prone grades. This is about *moving water* in, and crossing the trail tread. Even small elevation changes can create fall-line/erosion-prone trail segments in sandy soils.

With user impact a sand-based tread becomes compacted and a small trench forms. On a grade, water will run downhill until it encounters a way out. Ideally you want to vent the water off the trail every 20-30 feet. Water running in the tread for any distances will erode and destroy the tread.

Assume that *any* grade change is *erosion prone*. When grade changes are encountered the first solution is to find a more sustainable trail corridor to avoid or reduce the grade. If that isn't feasible, hillside trail construction techniques need to be applied. These can include use of natural terrain dips, grade reversals, tread out-sloping, and switchbacks. If design and layout do not fully address erosion, trail repair measures such as water bars and check dams may be necessary.

The Half Rule.

The half rule says that the trail grade should be no more than half the side slope grade. This rule really helps when putting trails on gentle side slopes. For example, if you're working on a hill with a 6 percent side slope, your trail grade should be no more than 3 percent. If the trail is any steeper, it will be a fall-line trail.



GRADE REVERSAL:
Reverse the grade for drainage, about every 20-30 ft.

Looks like a natural dip in trail.

Marking the Trail Corridor.

The trail corridor should be marked with flagging tape hung on bushes and tree branches. Once the final corridor is selected the corridor should be pin flagged. Pin flags mark the corridor for trail construction.

Flags can be placed on the uphill side, the right side, the left side, or on the least desirable option—the tread’s centerline. Centerline pinning is least desirable because the pins often will be in the way and interfere with clearing the corridor. *What is most important is that the trail crew clearing the trail corridor be fully aware of the pin flags orientation (left, right, or center) before work begins.* Pin flags are set at frequent intervals to clearly define the trail corridor and clearing limits. Flagging should be placed above the pin flags where they are obscured in grasses or other vegetation. The pin flags should remain in place until the trail is blazed.

The person marking the trail corridor is not always present during every aspect of trail development or construction. The pin flags serve to clearly show the exact trail corridor, tread and clearing limits for those evaluating the trail corridor and for the construction crews during the building process.

Structures such as bridges and puncheons should be clearly marked and identified on the ground and recorded in detail. Dangerous trees should be marked for removal. Roads and utility easements should be crossed at right angles.

Trail Design and Layout Resource Material.

AMC’s Complete Guide to Trail Building and Maintenance. 4th ed. Boston: Appalachian Mountain Club Books, 2008. ISBN: 1934028169. AMC, 5 Joy St., Boston, MA 02108. (603) 466-2721. www.outdoors.org/

Appalachian Trail Design, Construction, and Maintenance. 2nd ed. Harpers Ferry, WV: Appalachian Trail Conference, 2000. ISBN: 091795372X. Pub. #503. ATC, Box 807, Harpers Ferry, WV 25425. (304) 535-6331. www.atconf.org

Lightly on the Land: The SCA Trail Building and Maintenance Manual. 2nd ed. Seattle: Mountaineers, 2005. ISBN: 0898868483. The Mountaineers Books, 1001 SW Klickitat Way, Suite 201, Seattle, WA, 98134. (206) 223-6303. www.mountaineers.org

Trail Solutions: IMBA’s Guide to Building Sweet Singletrack. Boulder, CO: International Mountain Biking Association, 2004. ISBN: 0975502301. IMBA, P. O. Box 20280, Boulder, CO 80308. 1-888-442-4622. www.imba.com

[USDA FS Trail Construction and Maintenance Notebook](http://www.fs.fed.us/t-d/pubs/htmlpubs/htm07232806/toc.htm)

[<http://www.fs.fed.us/t-d/pubs/htmlpubs/htm07232806/toc.htm>]

[USDA FS Wetland Trail Design and Construction](http://www.fs.fed.us/t-d/pubs/htmlpubs/htm07232804/toc.htm)

[<http://www.fs.fed.us/t-d/pubs/htmlpubs/htm07232804/toc.htm>]