ENVIRONMENTALLY SOUND

NATURAL SURFACE TRAIL DESIGN & CONSTRUCTION

Wilderness Property Mgmt. / WPM *Trails* approach to creating sustainable, environmentally sound and recreationally valid trails for modern society.

Wilderness Property Management Inc.
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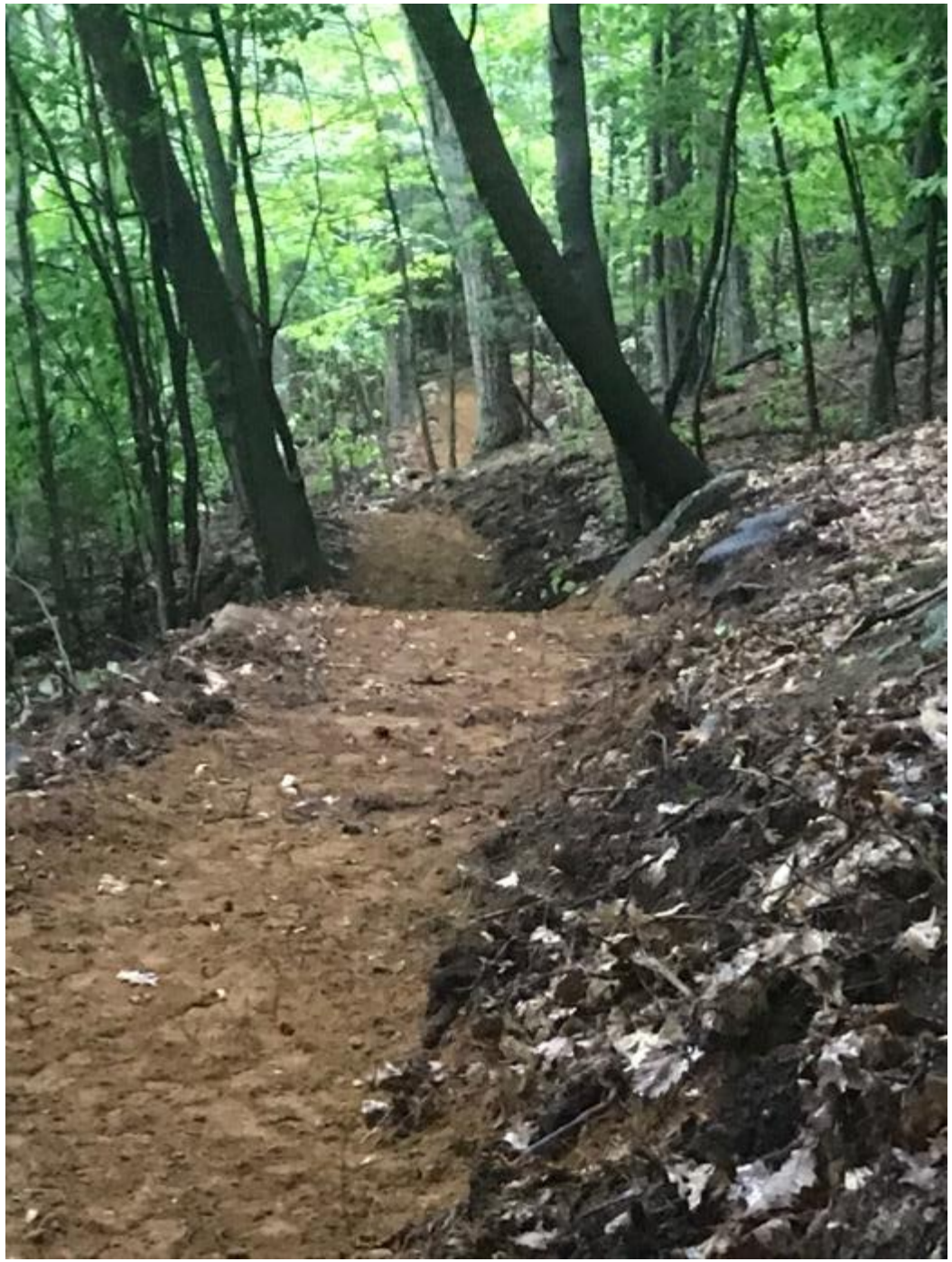


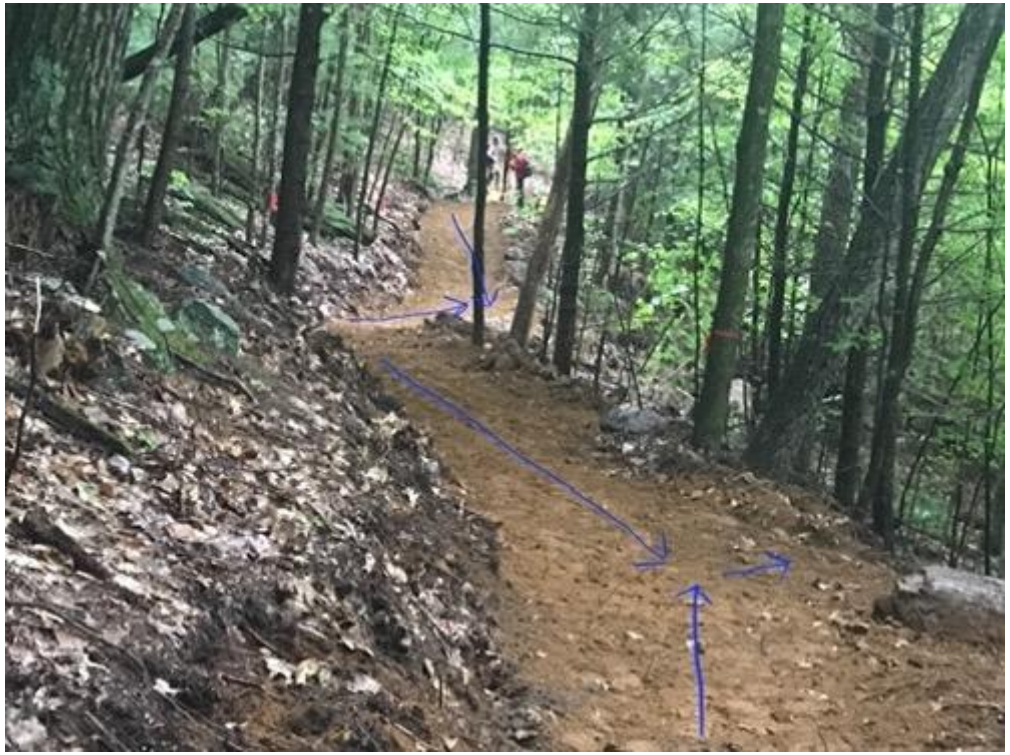
UNDERSTANDING TRAILS

- Trails go around large trees & rocks, not through them.
- Trails flow with the micro topography.
- Trails work with the flow of the land & water.
- Trails provide natural experiences along the way in addition to destinations.
- Pictures from the high use Pinnacle Trail in Town of Bolton. Entrance trail built in 2021. Middle trail built in 2020.

UNDERSTANDING NATURAL SURFACE TRAILS & STORMWATER RUNOFF

- Natural Surface Trails will cup from use and have down trail surface water runoff.
- Natural Surface Trails will have exposed soils that can migrate if proper steps aren't taken.
- Natural Surface Trails are frequently located in difficult and steep environments that can be susceptible to stormwater runoff issues.
- Natural Surface Trails are integral to society and require a deep understanding of the environment and construction techniques to be environmentally sound.
- Trails have both down trail and cross trail drainage needs.
- Out slope will only work in small specific areas and at 10% or greater amounts.
- Drainage needs to work with minimal maintenance.
- Trail Sustainability requires the trail to function without failure over time & use.

ROLLING CONTOUR TRAIL DESIGN



- The base design for sustainable & environmentally sound trails.
- The design technique can also be applied using micro topography. (small mounds, subsurface rock, etc.)
- This technique utilizes grade reversals for drainage.
- Frequency of drainage is determined by trail grade.
- Addresses down trail & cross trail drainage.

Design Impacts on Erosion & Runoff

- Grades of 1-7% withstand current rainfall & runoff with minimal impact.
- Grades from 8 to 15% need to be short to withstand current rainfall & runoff impacts. Position on slope and soil composition become critical.
- Grades greater than 15% need to be less than 15 feet in length and have stable soils.
- Grade Reversals should be less than 50 ft. apart on 3-7% grade trail. Generally, every 20-35 feet is best.
- The higher on the hill you are the less impact cross trail drainage has on design.
- Soil with a high rock content and/or water drainage withstands erosion forces on higher grade trails better.

1. Grade Impacts
2. Distance between Grade Reversals
3. Position on Slope
4. Soil Composition

DRAINAGE DESIGN

The Five Fingers of Drainage

1. Always- *Make drainage bigger (2-3 times) than you think you need.*

   The downhill rise should be <u>at least</u> 10 inches.

2. Always- *Put in drainage at every opportunity and more frequently than you think you need to.*

3. Always- *Align the drainage with the fall line and water flow.*

4. Always- *Out-slope the bottom of the drainage aggressively.*

   Makes the drainage self-cleaning by maintaining flow velocity.

5. Always- *Clear the drainage to open air or sump and leave room for new construction sediment.*

   Prevents pooling and puddles in the trail.
   All newly exposed soil will have some soil migration.

Grade Reversal Drainage Controlling Erosion & Runoff

Trail design alignment utilizing grade reversal to control erosion & runoff.

Original Trail alignment with constant grade shows erosion. (red line).

Picture of Goodnow Mtn. Trail on ESF lands in Newcomb.

Sustainable Grade Dip Design

- Aggressively out-sloped drainage bottom (10%+)
- Downslope berm greater than 10 inches
- Out drain aligned with fall line
- Cleared to open air

SUSTAINABLE LONG-TERM DRAINAGE

- Hardened/Armored downslope berms.
- Reinforced with large tree roots or rock. (upslope side of trees)
- Large downslope berms. (photo in prior slide)
- Large enough to still function when trail tread cups from high usage & natural forces.

LARGE, HARDENED & FREQUENT DRAINAGE IS THE ANSWER

INCREASING TRAIL TREAD DURABILITY REDUCES LONG TERM FAILURES FROM STORMWATER RUNOFF

- Research on the Appalachian Trail has shown that the rock content of the trail tread reduces wear and increases durability.
- Where Cross Trail Drainage is evident:

Increase the rock content in the trail tread and level large drainage pans to reduce erosion by creating sheet flow.

- Incorporate more mineral soil into the trail tread to reduce cupping from high use.

IDENTIFICATION OF INTERMITTENT CROSS TRAIL DRAINAGE

- Identify drainage areas with intermittent flows that can receive large stormwater runoff discharges.
- Areas that receive the largest runoffs are lowest on the slope and require large downslope berms and hardened trail treads.
- Size and harden the drainage according to the size of the watershed above that portion of trail.

Picture from mtb trail in Inlet, NY

WPM TRAILS CONSTRUCTION TECHNIQUES TO PREVENT SOIL MIGRATION

- Cover backslope and downslope immediately.
- Undermine backslope for mineral soil to build up trail tread durability.
- Chop backslope surface duff vertically to leave down slope roots and natural seed bed in place.
- Use excavated overburden to stabilize soils on downslope side of trail tread if necessary.

IMMEDIATE BACKSLOPE & DOWNSLOPE STABILIZATION PREVENTS STORMWATER IMPACTS

- Reducing exposed soil during trail construction is a critical step in preventing soil migration from stormwater.
- Not exposing soil on the steeper slopes associated with back slopes and downslopes reduces the soil available for migration.
- Immediately covering these areas during construction protects them from any rainfall events.

REVEGETATION OF BACKSLOPE & DOWNSLOPE UTILIZING OVERBURDEN

- Natural regrowth of onsite species.
- Roots and duff maintain site stability during and after construction.
- Maintains a natural & wild aesthetic.
- Reduces site impact to only the trail tread.

PREVENTING STORMWATER RUNOFF THROUGH TRAIL DESIGN & CONSTRUCTION

- Utilize Rolling Contour Trail Design.
- Utilize a 7% or less average grade.
- Frequent grade reversals or grade dips: increase frequency as the grade increases.
- Reinforce downslope berms with rock, roots or increased size.
- Identify areas with intermittent flows that need cross trail drainage.
- Incorporate as much rock and mineral soil into the trail tread as possible.
- Maintain duff and root mat on backslope.
- Cover downslope soil with overburden/duff from trail tread.

CAN YOU ANSWER THE FOLLOWING QUESTIONS ?

1. What type of trail design and alignment is most conducive to preventing environmental degradation?
2. What are the key elements that make this design successful ?
3. What drainage design elements are critical for long term sustainability & effectiveness ?
4. What construction technique dramatically reduces potential soil migration in a stormwater runoff event ?

OTHER TRAIL BASED ENVIRONMENTAL DISCUSSION TOPICS

Mountain Bike Trails (MTB)
- Cross Country Trail (XC)
- Flow Trail
- All Mountain Trail
- Freeride Trail

Very Difficult & Extreme Environments
- 100% + side slopes
- Rock & Bedrock
- Flat Terrain

Stream & Drainage Crossing Design

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