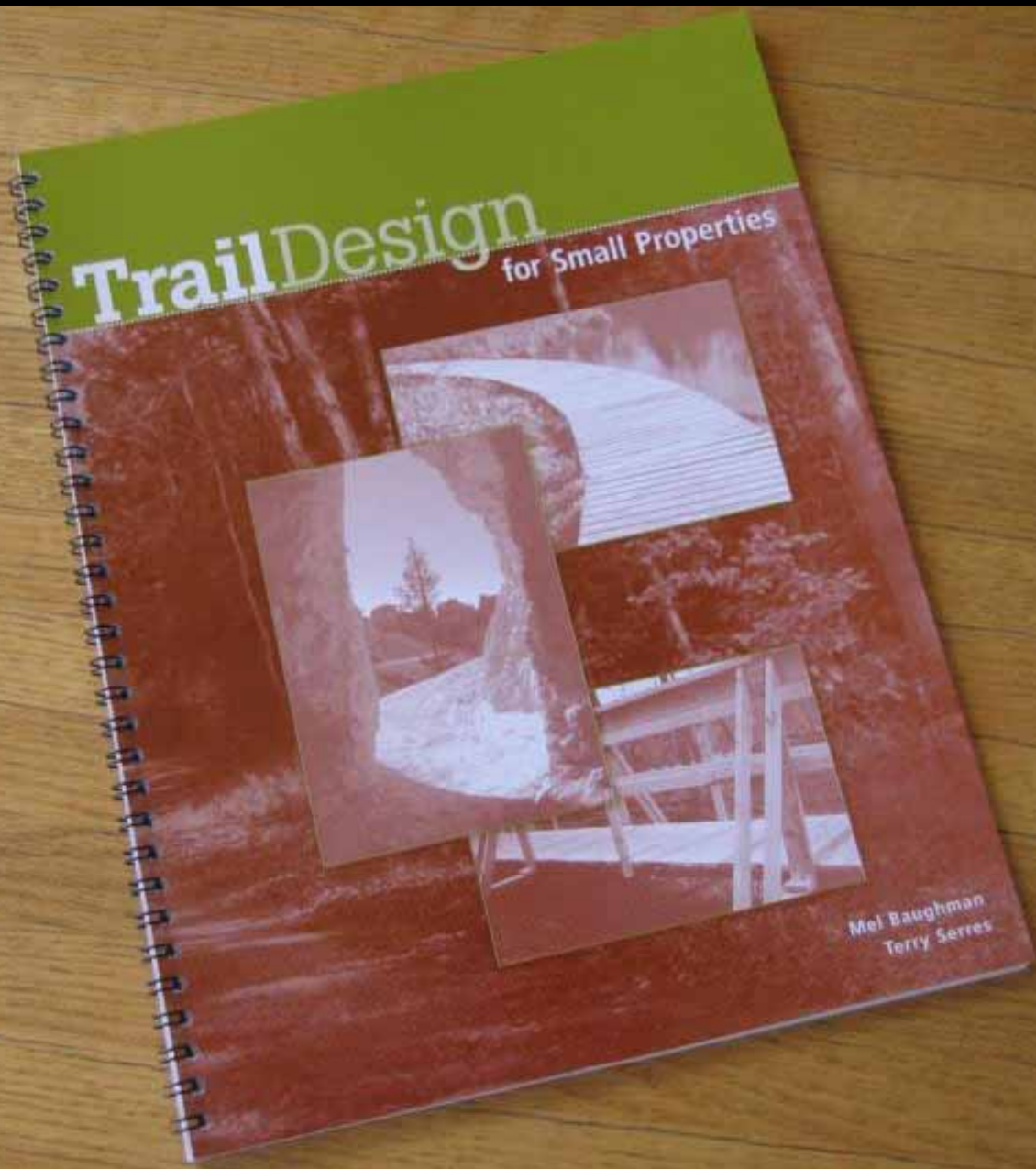


# Recreational Trail Design

A scenic photograph of a coastline. In the foreground, a large, dark, rocky outcrop (likely a sea stack or cliff) dominates the left side. The water is bright and shimmering, reflecting the sky. In the distance, a range of mountains is visible under a sky with scattered clouds. The overall scene is a mix of dark and light tones, creating a dramatic landscape.

Dr. Mel Baughman  
Professor Emeritus  
Department of Forest Resources  
University of Minnesota



# Trail Design

for Small Properties

Mel Baughman  
Terry Serres

# Steps to Follow

- Decide Trail Users
- Select the Corridor
- Establish Design Standards
- Mark Trail Location
- Clear the Trail
- Construct the Tread
- Install Structures
- Sign the Trail
- Install Facilities



# Step 1: Decide Trail Users



# Decide Trail Purpose



Trail Experience



Destination



Access for Management



# Consider Number of Users

At one time  
Over a season



# Type of User Experience

Difficult & Risky ↓



Easy & Safe ↓





# Step 2: Select a Corridor



“Swath of land within which a trail will be built”



# Aerial Views



# Topographic Map





# Scout in Dormant Season





# Scout in Season of Use



# Use Existing Travelways





# Points of Interest





# Different Habitats



# Attract Wildlife



Nesting boxes



Cover



Feeding Station



# Cultural Resources

## Highlight or Avoid?





# Anchor Points



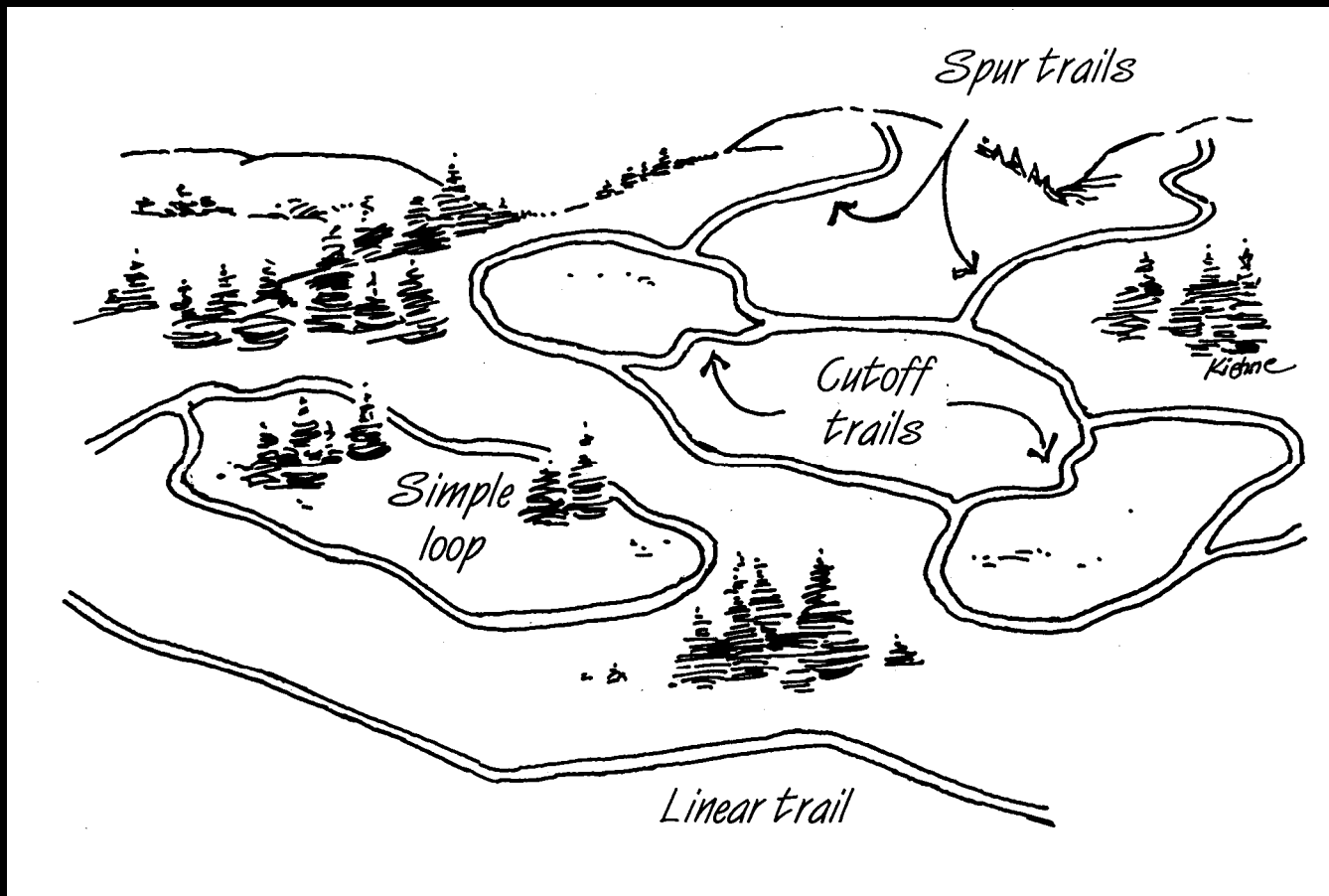
“Draw attention to natural objects”

# Step 3: Establish Design Standards

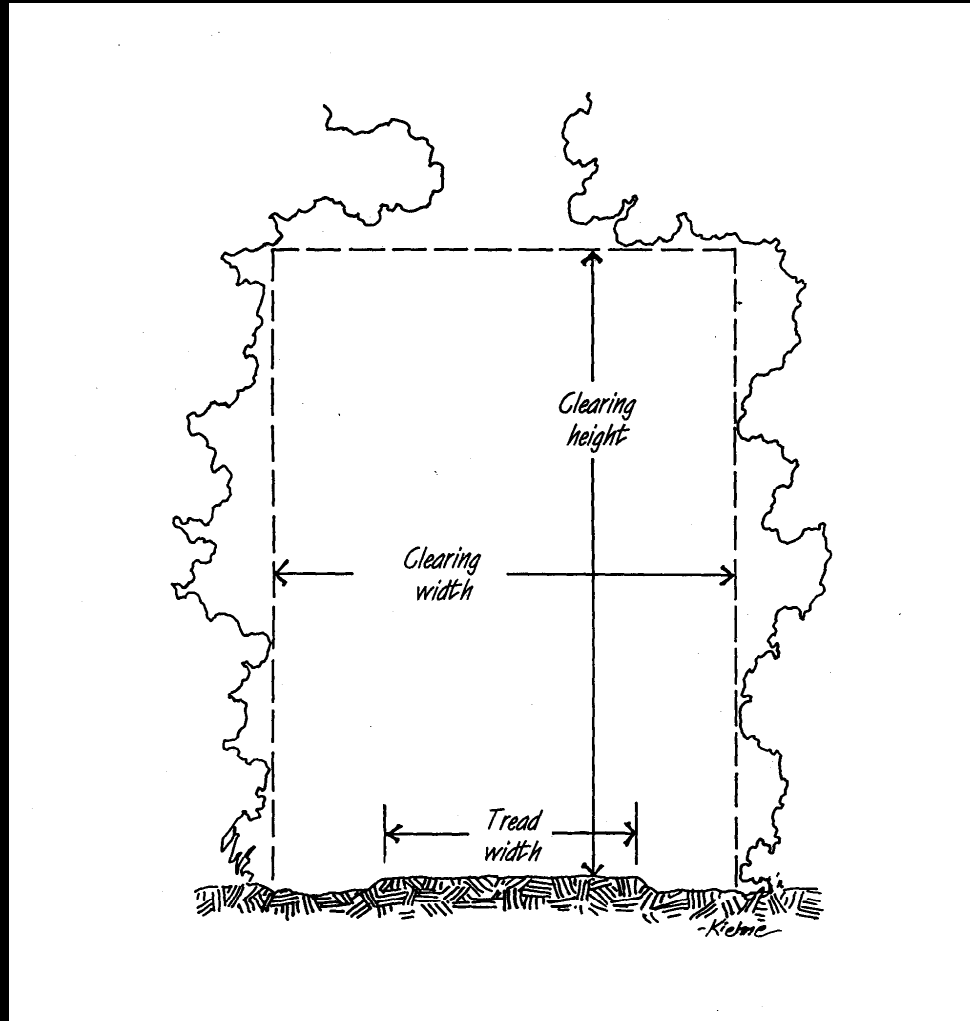
- Trail configuration
- Length
- Tread surface
- Tread width
- Clearing width
- Clearing height
- Grade
- Turning radius
- Sight distance
- Water crossings



# Configuration



# Clearing and Tread Width





# Clearing Width



Clearance beyond tread



No clearance beyond tread

# Clearing Height





# Setback from Waterway



“Too Close”



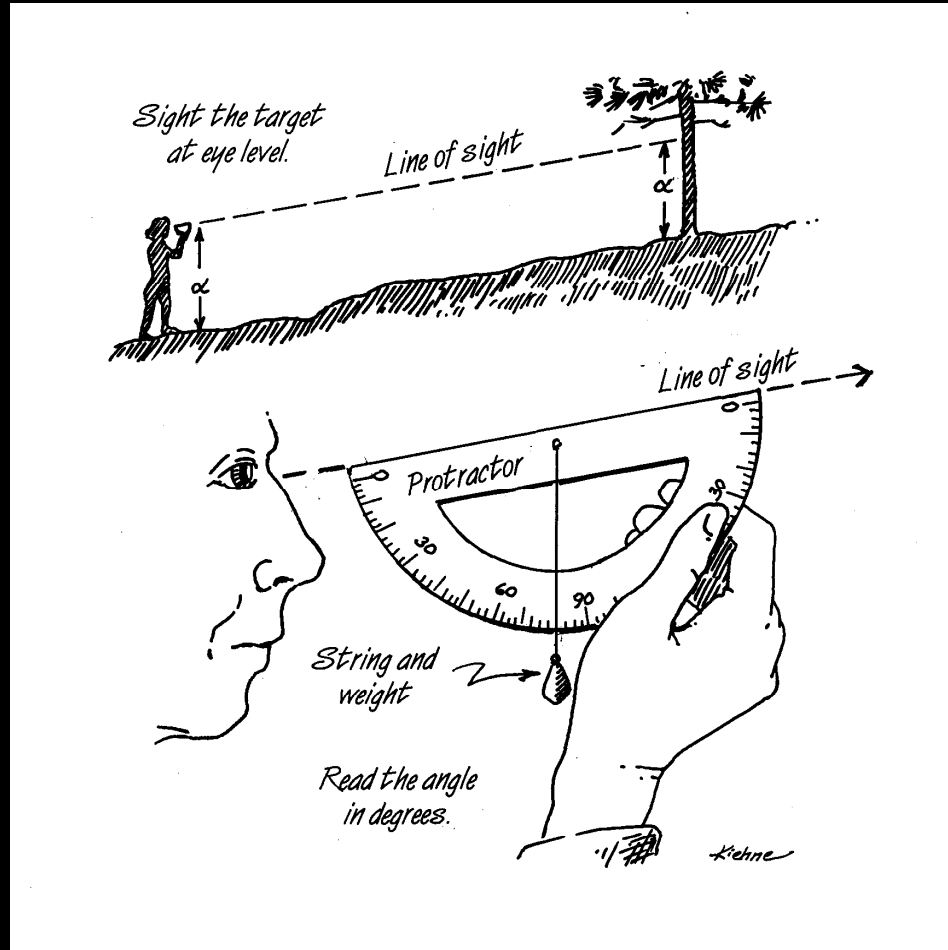
“Buffered Well”

# Sight Distance





# Slope



# Turning Radius

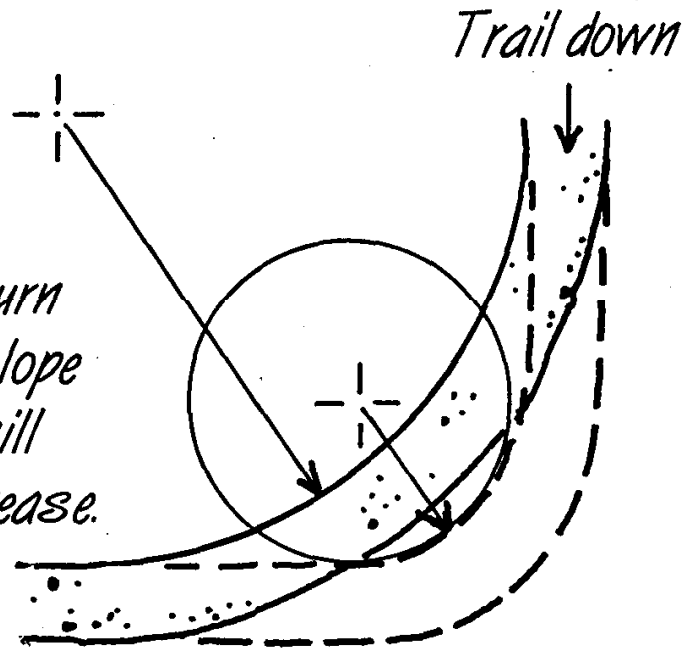


# Turning Radius

Increase  
turn radius.

Lengthen turn  
radius as slope  
and downhill  
distance increase.

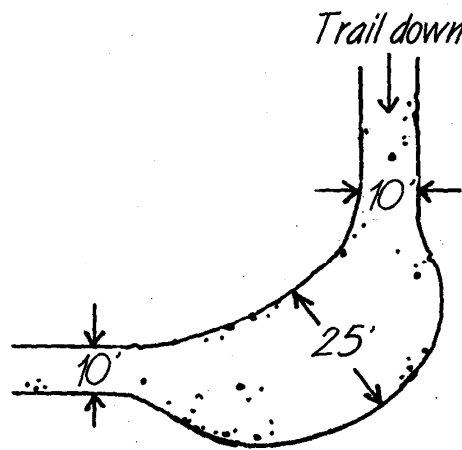
-Kierme





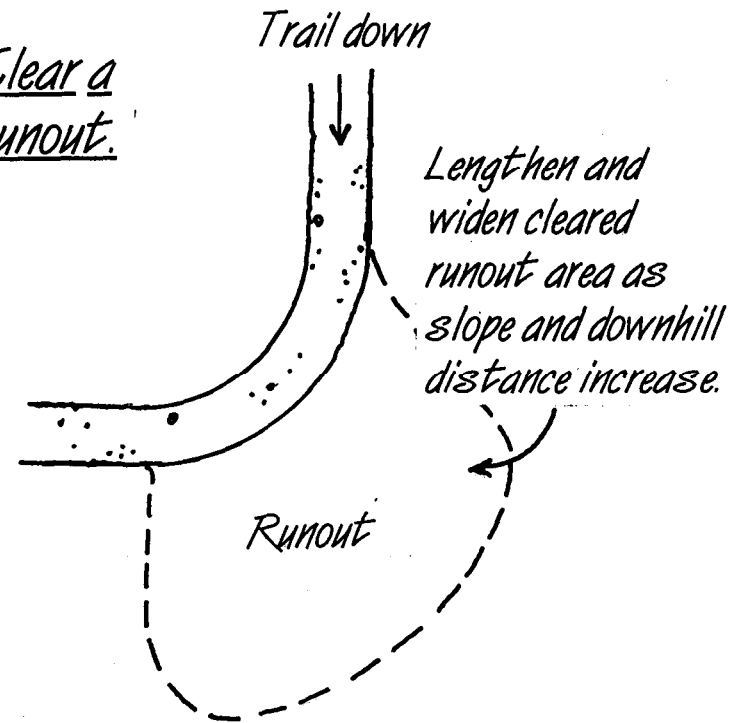
# Widen Tread/Clear Runout on Steep Slopes

Widen the trail.



Widen the trail more as slope and downhill distance increase.

Clear a runout.



# Step 4: Mark Trail Location



# Step 5: Clear the Trail



Trees



Soil



Rocks



# Fell Trees & Cut Logs



# Cut Limbs





# Cut Brush





# Remove Stumps & Rocks



# Digging Tools



Pick-Mattock



Pulaski





# Levers





# Winches



GripHoist



Come-A-Long

# Rock Carriers





# Break Rocks



Sledge Hammer & Chisels



Feather Wedge



# Rock Drill



# Haul Fill





# Move Dirt



Bulldozer



Mini-Excavator



Walk-Behind Loader



# Smooth Trail Bed



McLeod Tool

# Rock Rake





# Step 6: Construct the Tread

- Compaction
- Displacement
- Erosion





# Firm Natural Treads



Bedrock



Mixed Mineral Soil



Clay with Imbedded Rock

# Poorer Natural Treads



Sand



Rounded Gravel



# Wood Chips



“A temporary fix”





# Gravel



Round - Poor



Crushed/Angular - Better

# Rock



Rocks Imbedded in Clay





# Pavers



- Firm tread
- Vegetation grows
- Water drains through





# Vegetation

Protects Tread, Retains Snow



Grass



Leaves

# Tread Edging

Visually Defines Trail Boundaries





# Trail Edging

## Retains Fill



# Step 7: Install Structures to Cross Obstacles

- Flat Land
- Hills
- Boulder Fields
- Wetlands
- Streams
- Fences



# Crossing Flat Land



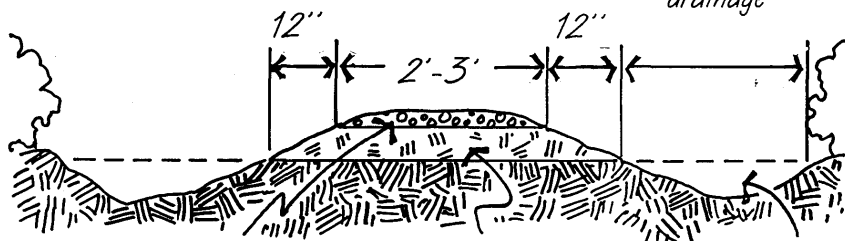


# Cross Drainage/Outslope



# Center Crowning w/ Ditches

*Center crowning*



*Gravel or  
woodchip cover*

*Fill from drainage  
cuts, minimum 3''*

*Minimum  
cut 3''*

*Width  
necessary for  
drainage*

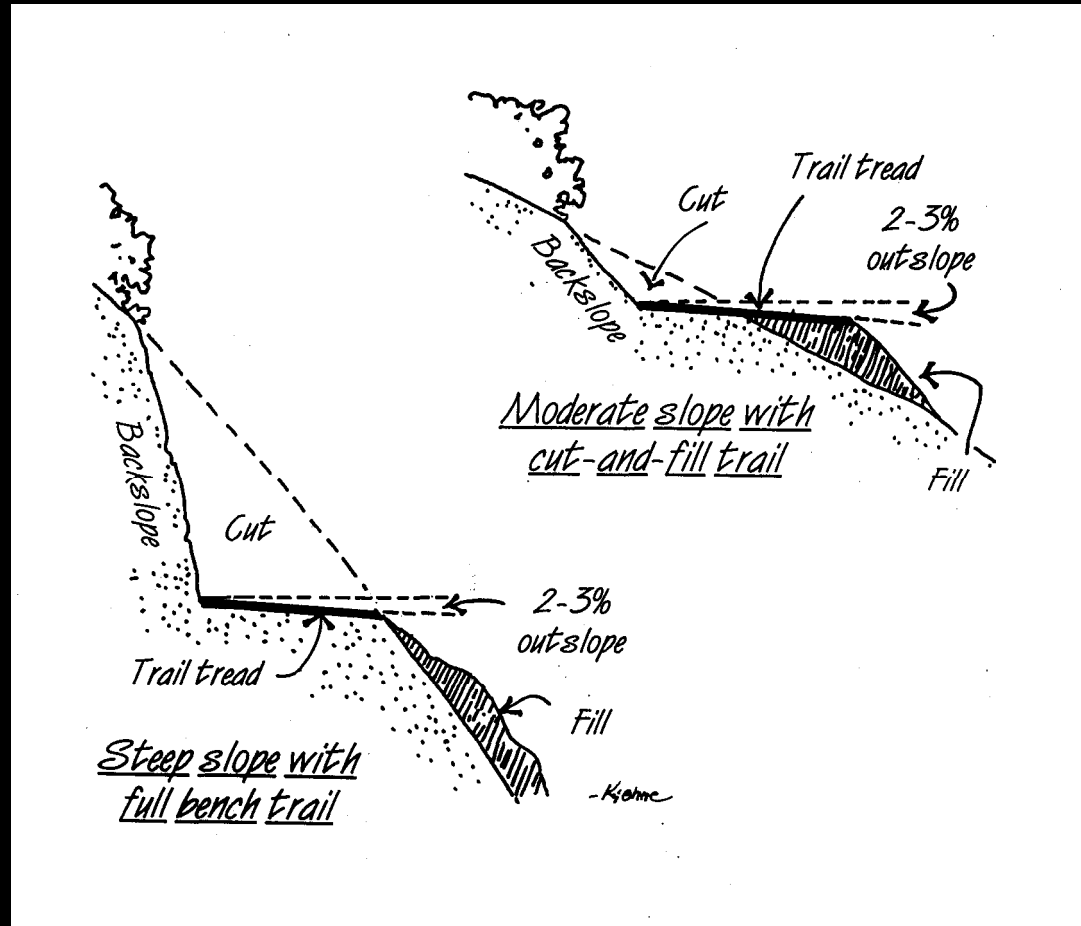




# Crossing Hillside



# Full Bench vs Cut-and-Fill







New trail with steep backslope



Old trail with eroding backslope

# Backslope Wall



Loose Rock



Fitted, Mortared Rock



Wire Gabion



Concrete Revetment



# Tread Walls



Fitted Rock



Mortared Rock

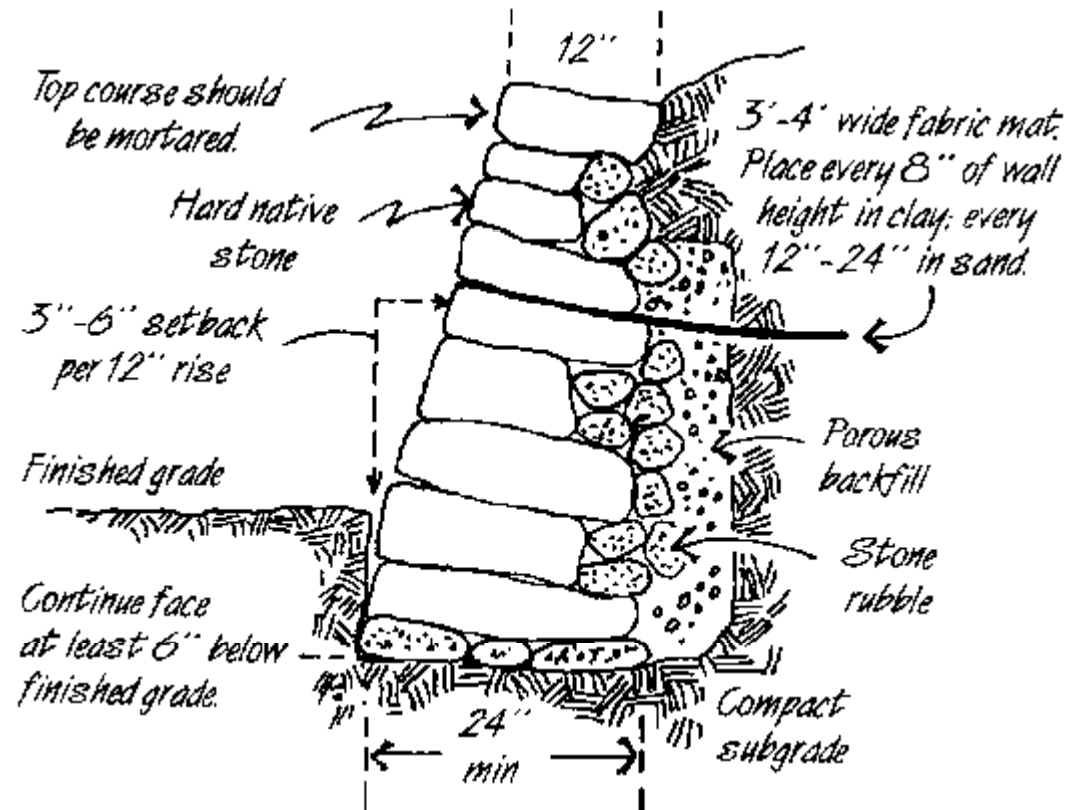


Logs



Plastic

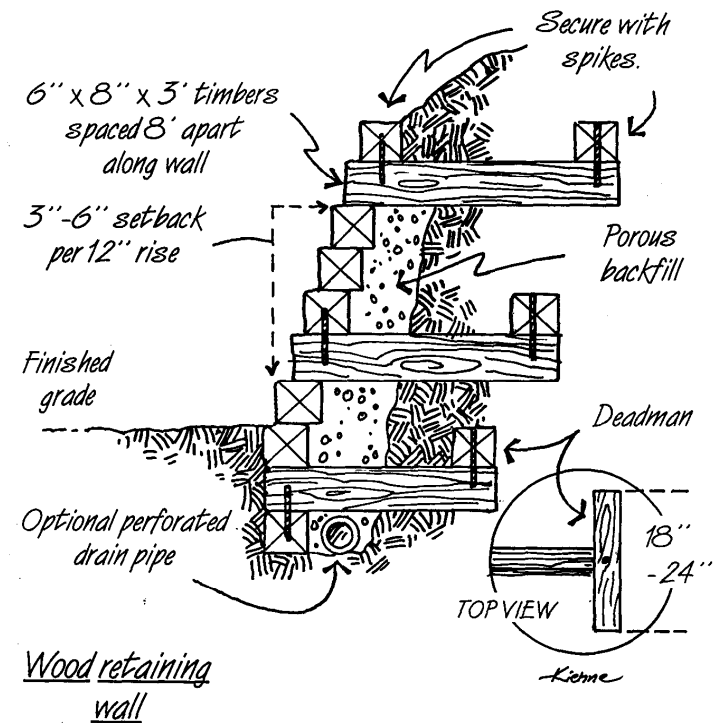
# Rock Wall Design



Stone retaining wall



# Wood Wall Design

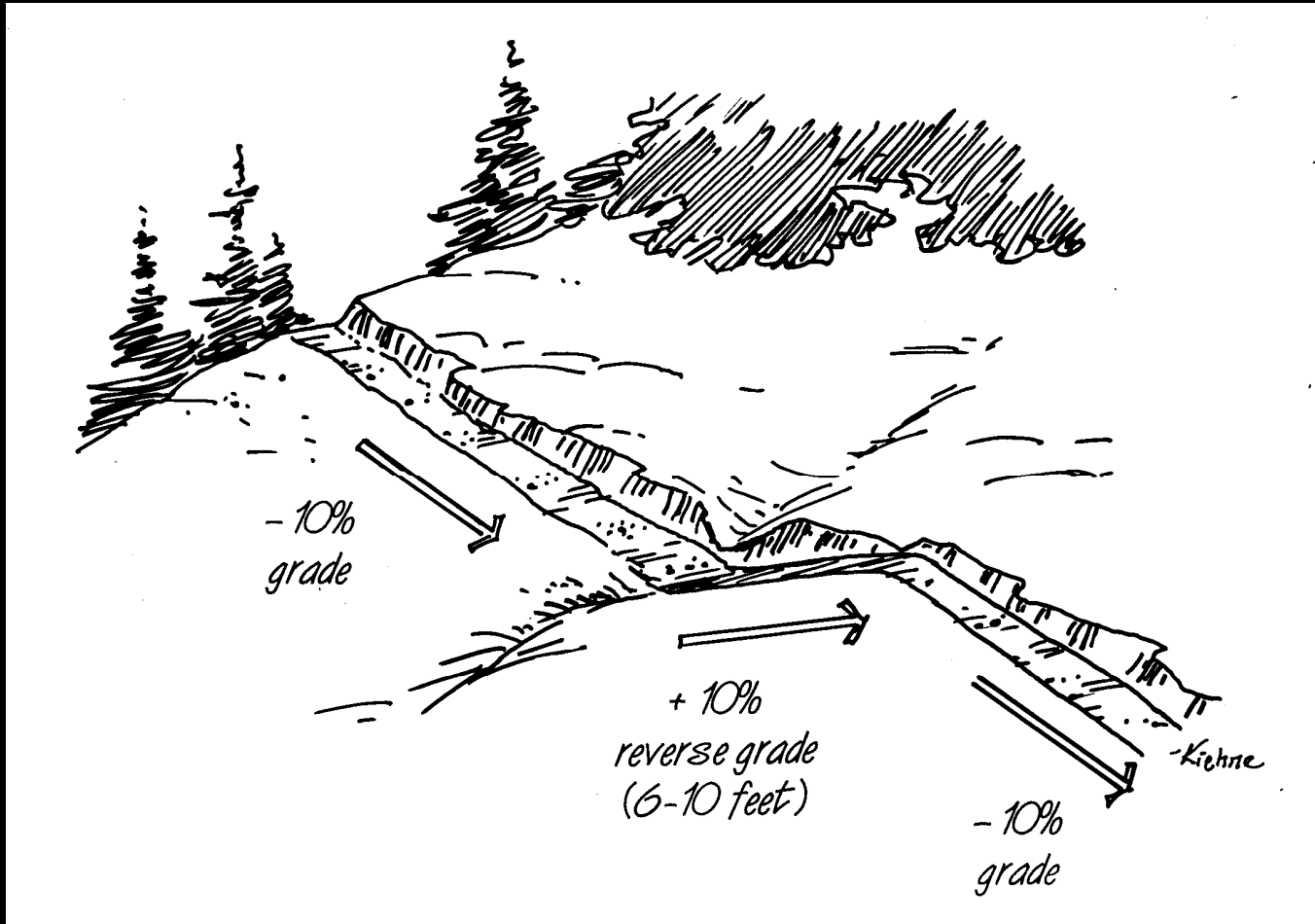


# Divert Water

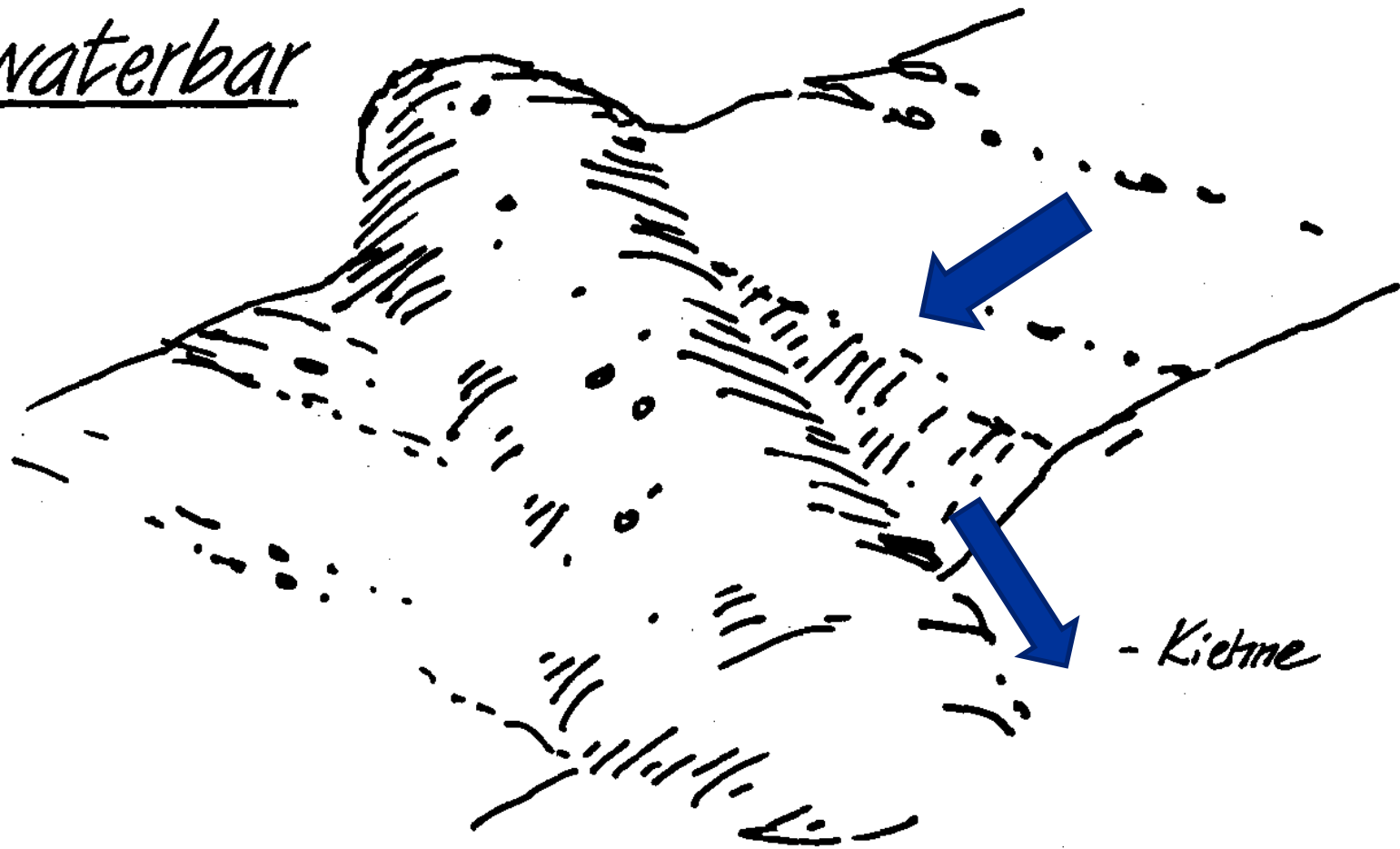




# Rolling Grade



Earthen  
waterbar





# Log Waterbar

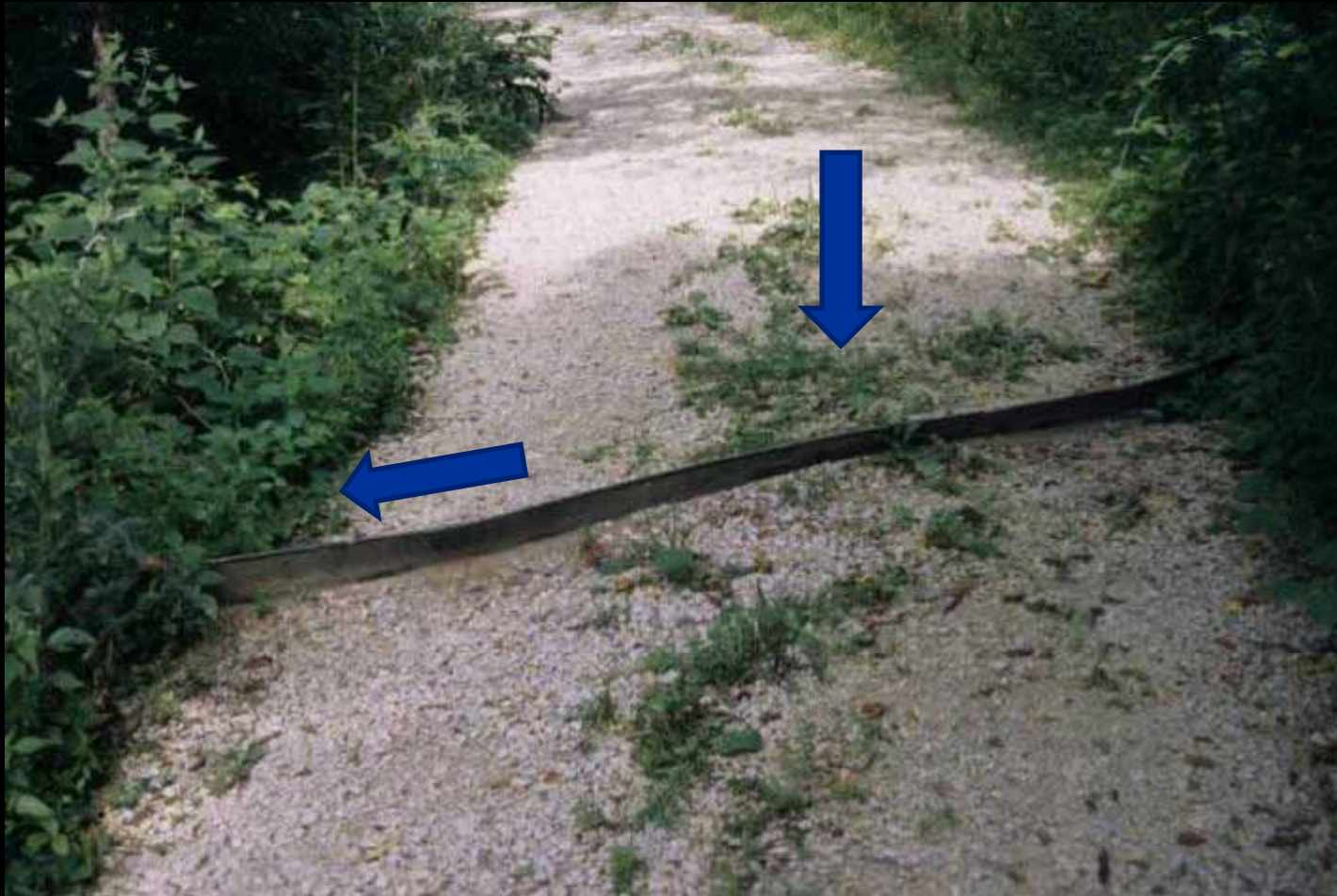


# Rock Waterbar



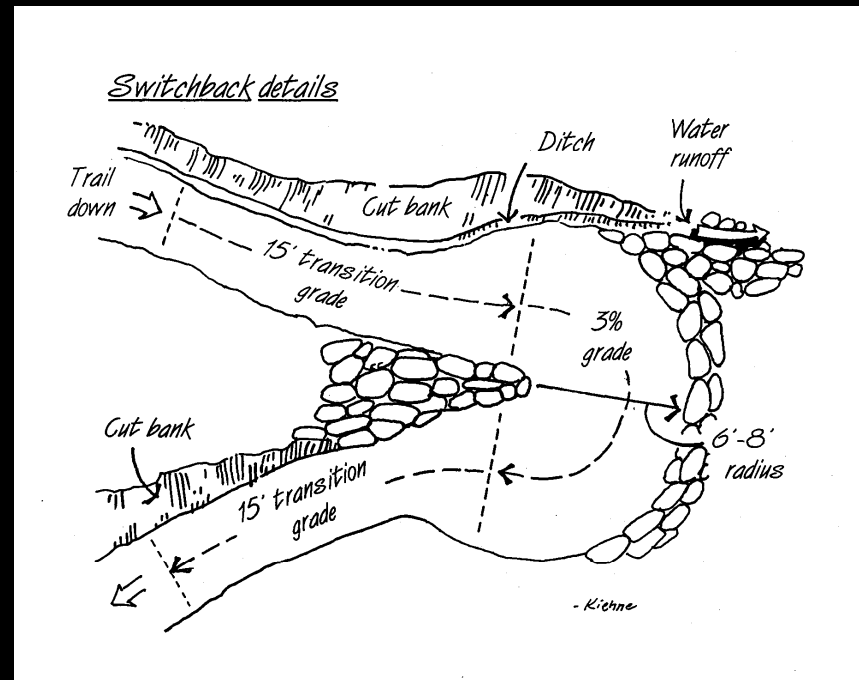


# Rubber Waterbar





# Switchbacks



# Switchback Platforms





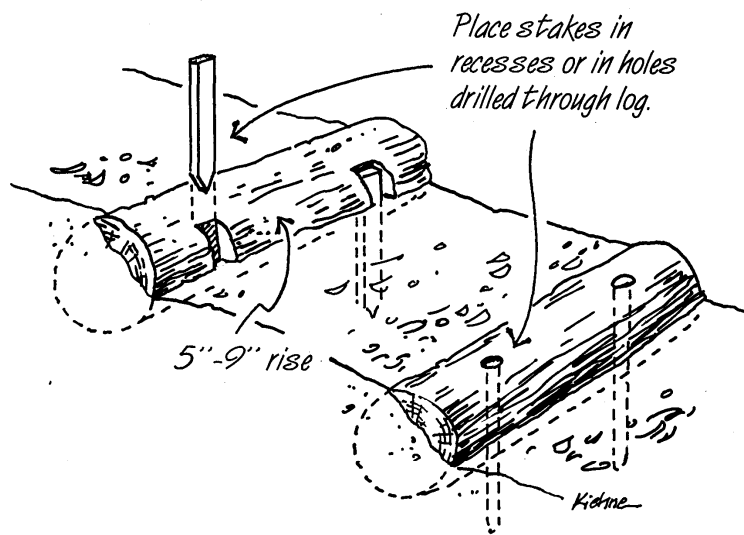
# Climbing Causeway





# Log Steps

Log steps



# Box Steps



# Wooden Ladder





# Steel Ladder



# Cross Boulder Field





# Cross Boulder Field



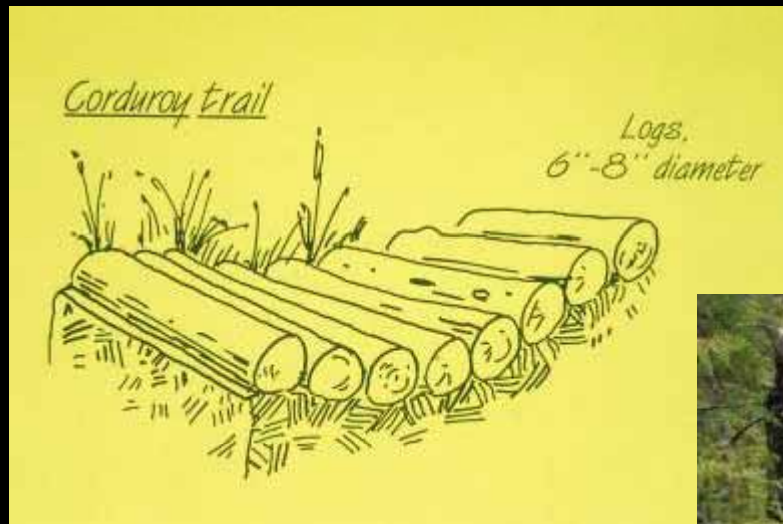
Rock Steps



Concrete Fill



# Cross Wet Soil



Corduroy



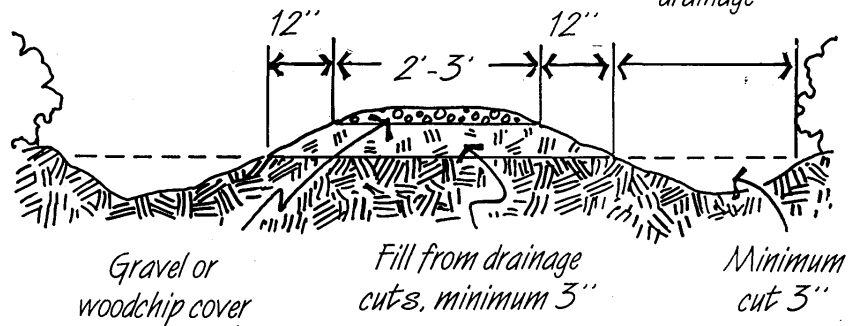
# Causeway





# Center Crowning

*Center crowning*

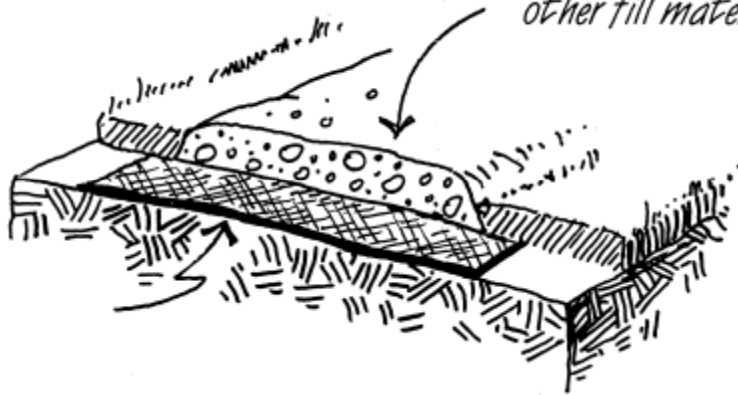




# Geotextile Fabric

Elevated tread with  
geotextile mat

3"-6" of gravel or  
other fill material



# Log Boardwalk



Half Logs



Steps



# Boardwalk

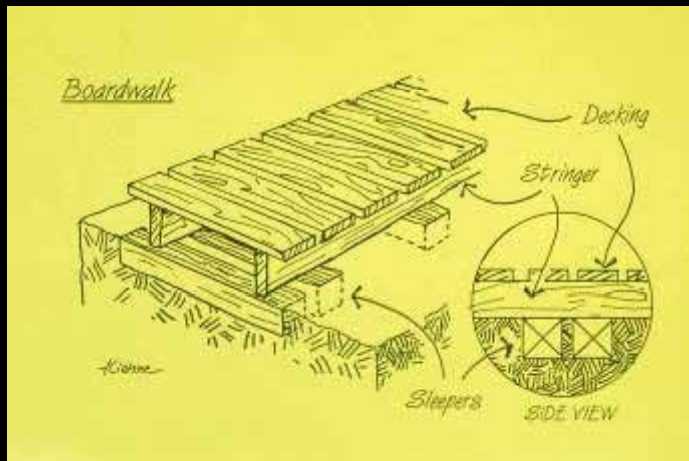


Cribbing Supports



6 x 6 Sleepers

# Low Boardwalk





# Elevated Boardwalk





# Floating Boardwalk



# Stepping Stones





# Ford & Stepping Stones





# Open-top Culvert



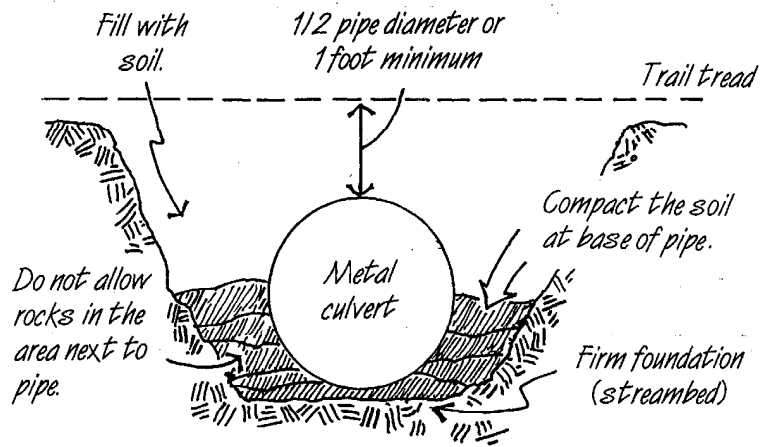
# Pipe Culvert



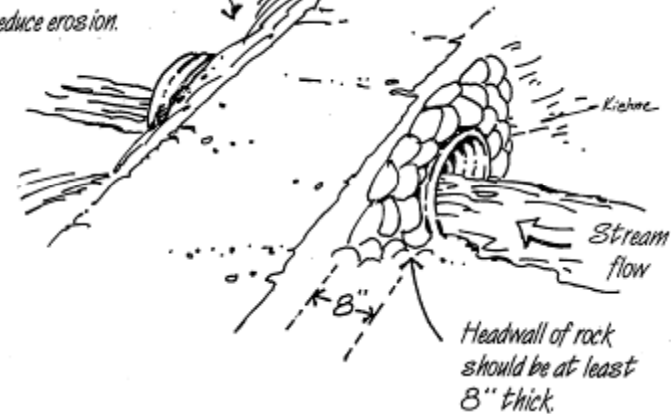


# Culvert Installation

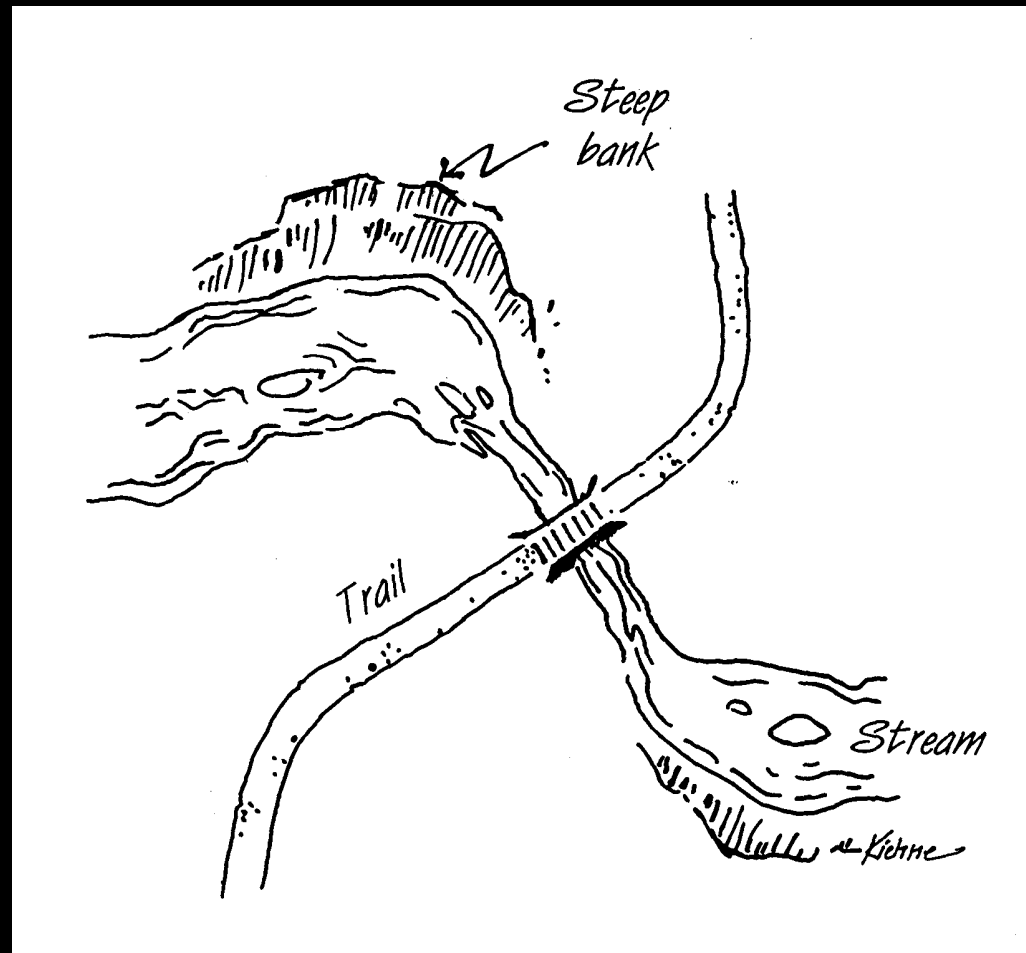
## Metal culvert



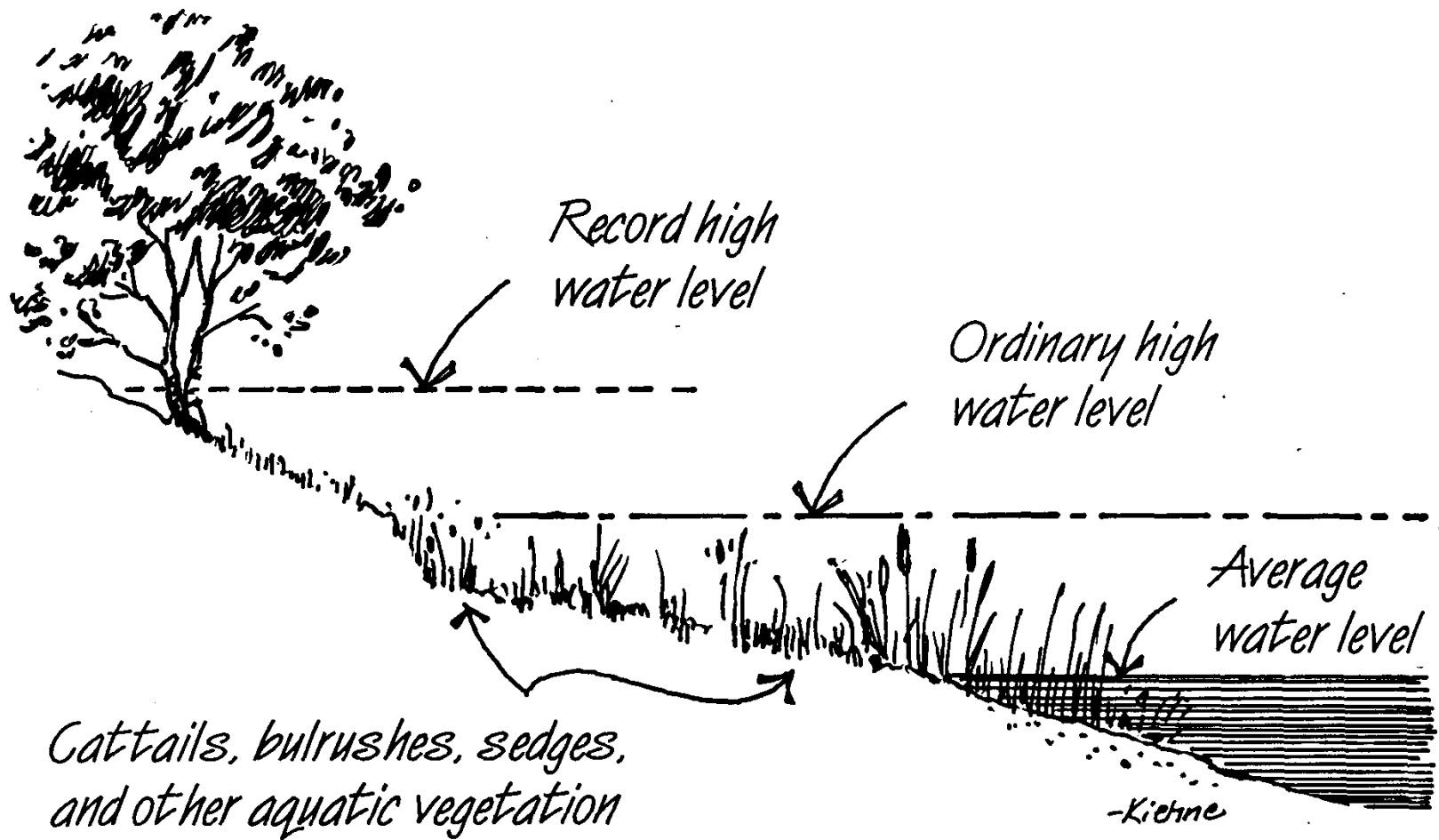
Use rocks or vegetation on the downstream side to reduce erosion.



# Bridge Location







*Cattails, bulrushes, sedges,  
and other aquatic vegetation*

*-Kierne*

# Bridge Girders

## Support Deck



Log



Solid Wood Beam



Laminated Wood Beam



Steel Truss

# End Abutments

## Hold up Girders



**Wood Mud Sill**



**Concrete**



**Rock**



**Wood Timbers**



# Mid-Span Abutments



Wood Poles



Wood Timbers



Rock-filled Wire Gabion

# Suspension Bridges





# Cable Car





# Bridge and Boardwalk Deck Materials



# Deck Board Orientation





# Deck Board Spacing



# Deck Traction





# Deck Traction



# Curb





# Hand Rail Supports



Buried in Ground



Outrigger



Attached to Girder

# Handrail Posts Flush or Protruding?





# Handrail Materials



Rope



Steel Cable w/ Plastic Coating

# Wooden Handrails



Sawn Wood



Round Wood



# Handrail Materials



Steel Pipe



Steel

# Fence Stiles





# Fence Gates



Fence Wire



Steel Cable



Steel Tubing



Steel Tube Frame & Wire Mesh

# Self-Closing Gate



Ball and Chain



Spring Hinges



# Cattle Guard



# Step 8: Sign the Trail

- Trailhead sign
- Confidence markers
- Directional signs
- Warning signs



# Trailhead Sign



# Confidence Markers

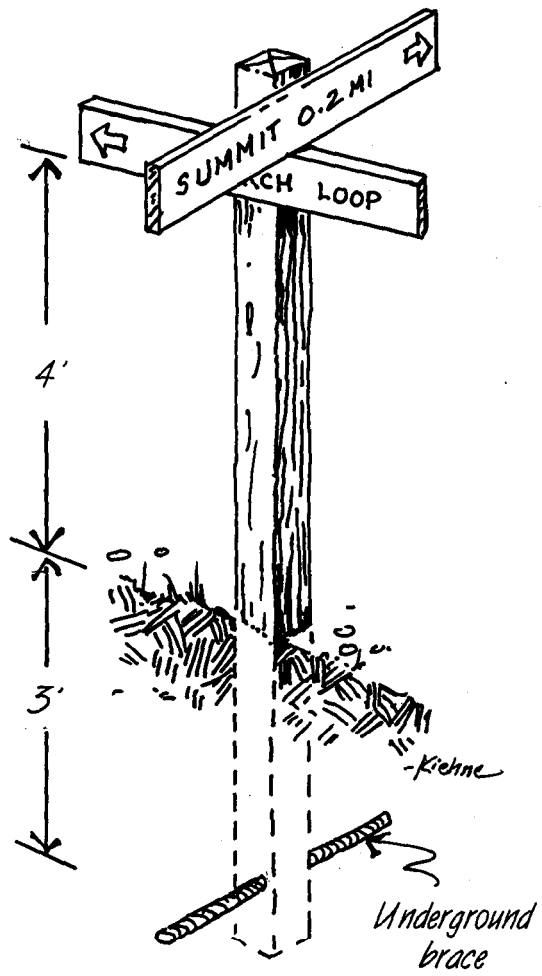




# Directional Signs



Directional  
post





# Warning Signs








WARNING  
ROCK CLIMBING IS  
DANGEROUS + + +





A black rectangular sign with rounded corners is mounted on a vertical metal post. The sign features white, sans-serif text. The background is a rocky, sandy terrain with scattered grey and brown stones.

SENSITIVE RARE PLANT  
HABITAT. STAY BEHIND CABLE

# Questions?

Mel Baughman  
baughman@umn.edu