

The GRAIP Road Inventory

**Tom Black and Charlie Luce
USDA Forest Service
Rocky Mountain Research Station**

For the next 90 minutes I will review the road inventory method and the data dictionary terms we use to describe the hydrology and geomorphology of forest roads



Goals of the GRAIP Inventory

To efficiently describe the attributes of the road and its area of influence in order to predict its geomorphic impact and risk to resources.



Planning an Inventory

- Identify the scope
- Obtain access to all roads
- Collect resources
- Data dictionary
- Train crew
- Data management





Inventory Equipment

- GPS receiver, one meter
- Laptop or data recorder with mount
- TerraSync
- Pathfinder Office
- 10 meter DEM
- Vehicle
- Stadia rod
- Stadia level (or range finder w/slope)
- Tape
- Field notebook



The Inventory Manual

United States
Department of Agriculture
Forest Service
Rocky Mountain Research Station
Boise Aquatic Sciences Lab

The Geomorphic Road Analysis and Inventory Package
(GRAIP) Data Collection Method
Tom Black and Charlie Luce



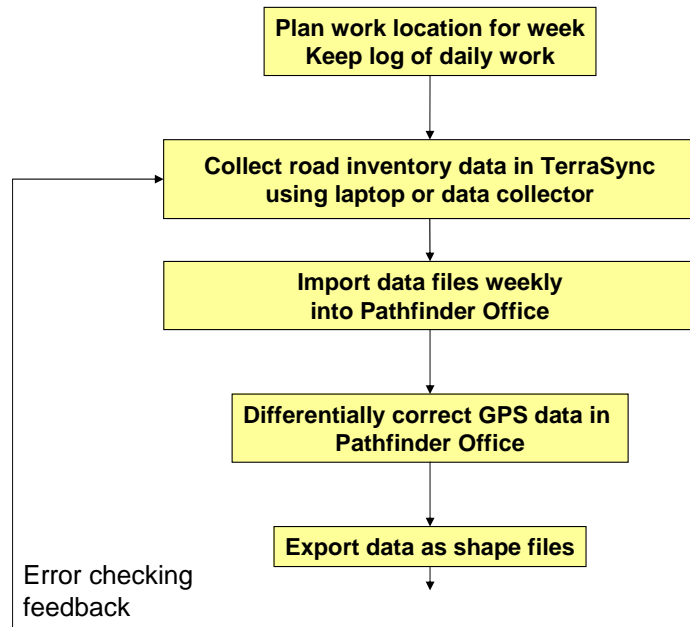


Which Roads to Inventory?

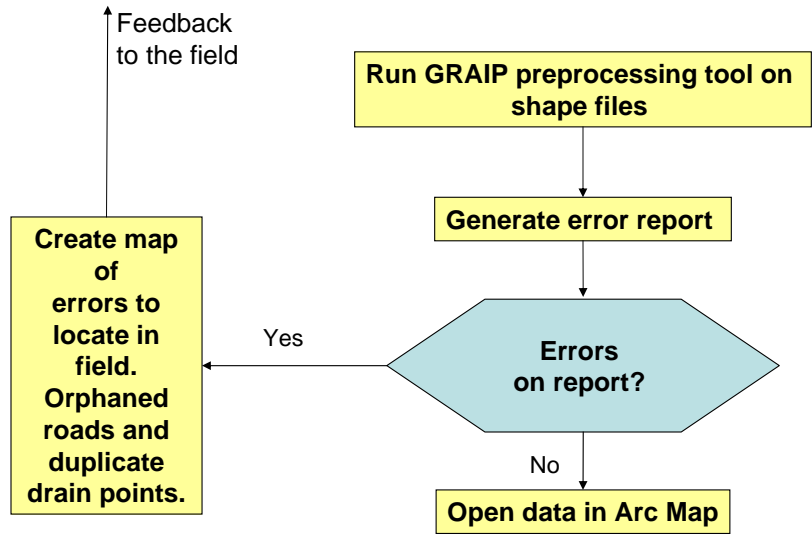
- High priority watersheds first
- Document all roads that produce runoff
- Closed roads still generate problems
- No runoff but stream crossings in place
- Use a backpack GPS on brushy roads
- Skid trails, ATV trails are significant
- Generally more roads than shown on maps



Inventory Workflow



Inventory Workflow





Drainpoints and Watersheds

- A drain point is where water leaves the road tread
- Each drain point defines a watershed
- Describe the attributes of the drain point
- Describe the attributes of the watershed in the road line
- Associate the points and lines using the time of collection CTime



Procedure at a Drain Point

- Locate the GPS at a drain point
- Select the drain point type from the drop down list
- Measure the required attributes of the feature
- Enter the data into the drop down menu
- Collect 60 GPS positions
- Record the drain point type and CTIME value in field notes
- Close the point

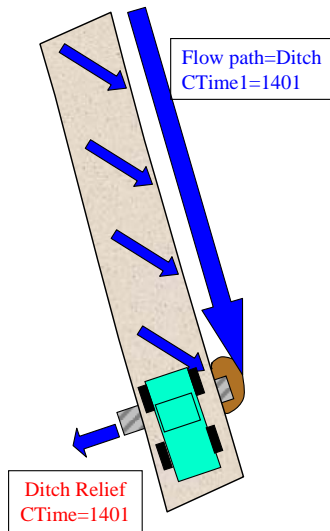


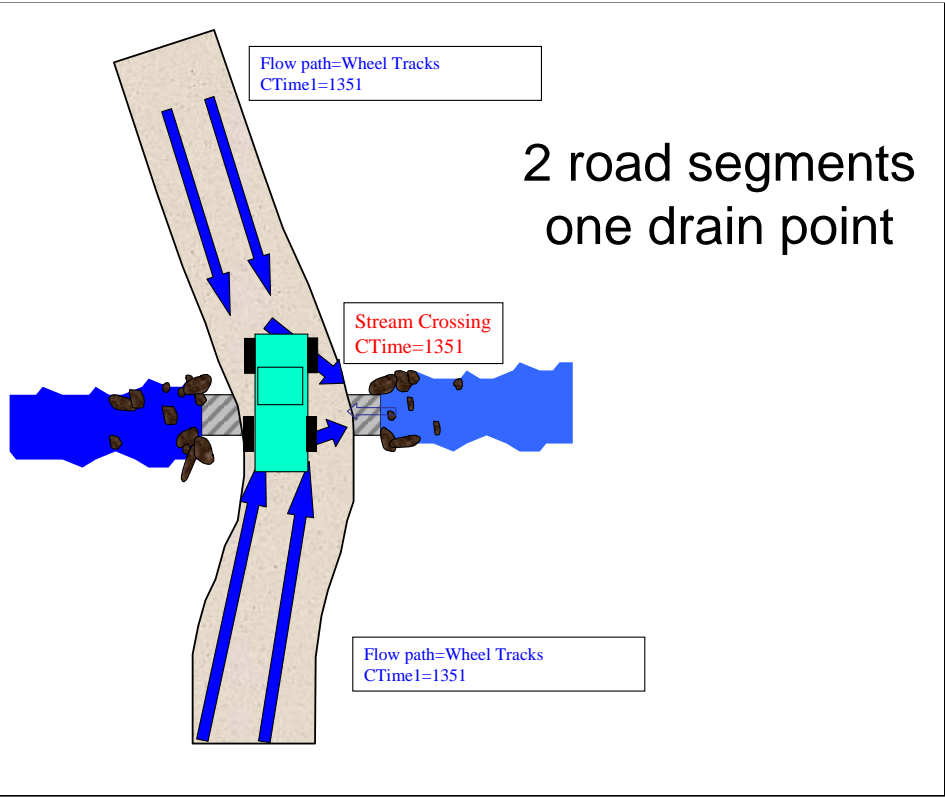
Procedure for a Line

- Begin a line at the lower end if possible
- Open a road line
- Enter the attributes of the road
- Enter the CTime value from the drainage point that receives water from the road
- End the road when:
 - New drain point
 - Top of hill
 - Road attribute changes classes

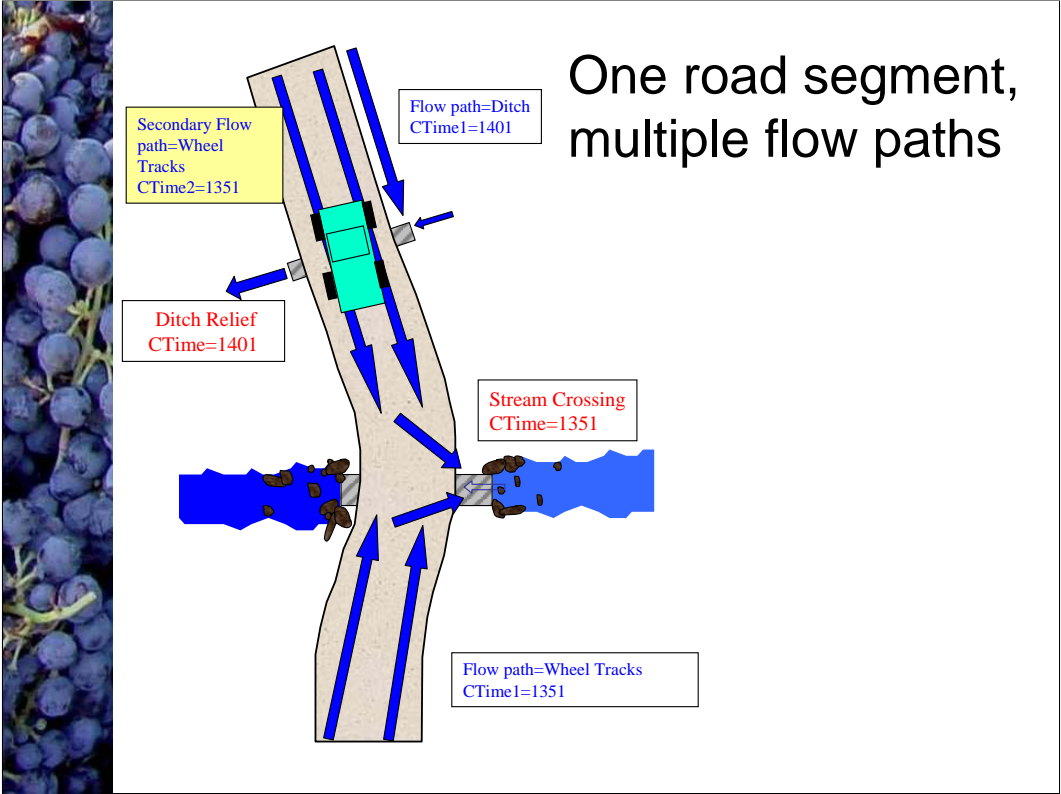


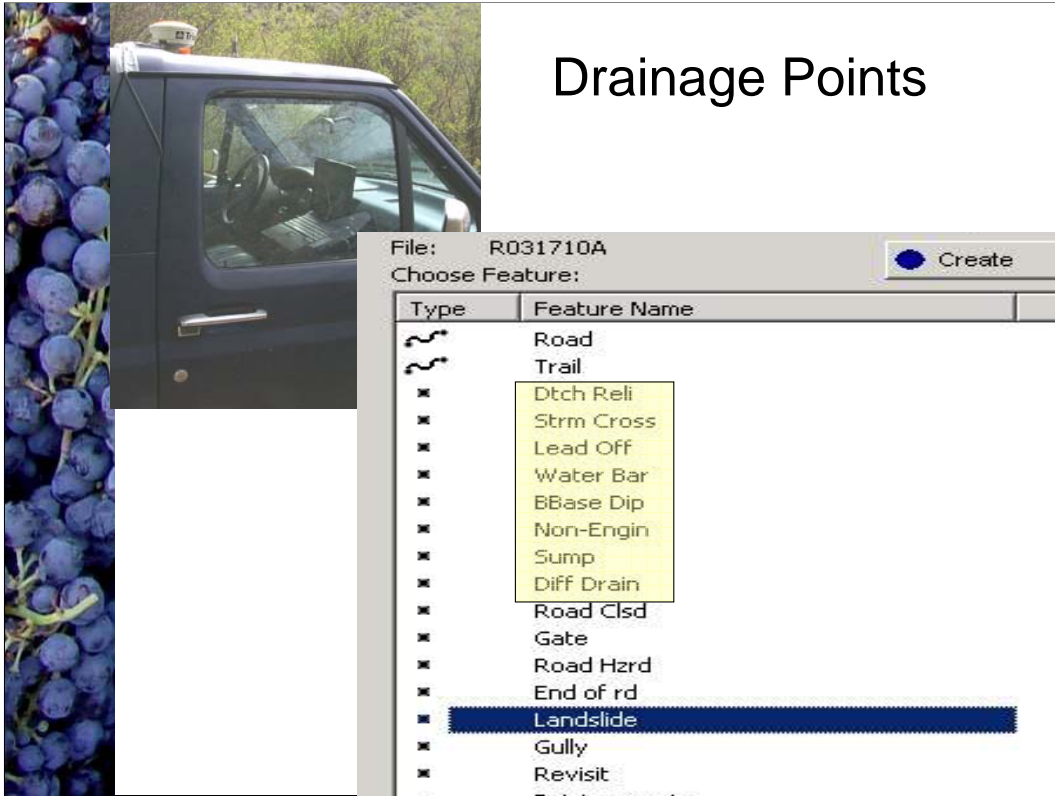
One road segment 1 flow path





One road segment, multiple flow paths





A road inventory is conducted using GPS to locate drain points and road segments
A data dictionary queries the crew on road attributes and
drain point conditions

The Road Line



The screenshot displays the TerraSync software interface. On the left, a dialog box titled "I2 ROAD" is open, showing various configuration options for a road line. The options include:

- SURF_TYPE: > 75 %
- SURF_COV: rutted
- ROAD_TYPE: system road
- RD_EDGE_1: 0 + 0'
- RD_EDGE_2: 0 no ditch
- EDGE_VEG_1: > 50 %
- EDGE_VEG_2: > 50 %
- EDG_CND_1: No problem
- EDG_CND_2: No problem
- FLOW_PATH1: Wheel Tracks
- FLOW_PATH2: No secondary
- FLWPTH_VG1: > 0 %
- FLWPTH_VG2: 110 %
- FLWPTHOND1: Rutted
- FLWPTHOND2: No Problem
- FILL_CHAR: 21-50
- *CDATE: 9/11/2007
- *VEICLE: 2
- COMMENT: (empty)
- *CTIME1: 1220
- CTIME2: 999

On the right, a map view shows a road line plotted on a grid. Below the map is a scale bar (0 to 250m) and a legend. The legend includes a circular diagram with a grid and a vertical scale bar. The vertical scale bar is labeled "Productivity" and "Precision". The legend also displays coordinates: 403011.44m N, 567285.47m E, 900.59m HAE, NAD 1983 (Conus), and PDOP: 2.74. The system tray at the bottom shows the Start button, TerraSync icon, and the time 12:27 PM.



Road Line

- Surface Type
- Surface Cover
- Surface Condition
- Road Type
- Road Edge 1
- Road Edge 2
- Edge Vegetation 1
- Edge Vegetation 2
- Edge Condition 1
- Edge Condition 2
- Flow Path1
- Flow Path 2
- Flow Path Vegetation 1
- Flow Path Vegetation 2
- Flow Path Condition 1
- Flow Path Condition 2
- Fill Channel
- CDate
- Vehicle
- Comment
- CTime1
- CTime2



Stream Crossing Attributes

- **Type** of stream crossing
- **Round Pipe Diameter** in inches
- **Oval Pipe diameter** in inches
- **Pipe Length** in feet
- **Channel Width** In feet
- **Pipe Number**
- **Fill Depth** Feet of fill above top of pipe
- **Condition**
- **Channel Angle**
- **Blockage Type**
- **Outlet Drop** Measured below pipe in feet and tenths





Stream Crossing Attributes

- **Pool Depth** Max. pool depth in feet and tenths
- **Pipe Grade** Measured in % slope
- **Substrate** Crossing material
- **Debris Flow** Evidence of past events
- **FILL EROSION** Erosion below pipe, 5 ft³
- **Diversion** directions if pipe is occluded
- **Comment** Is it on the TauDEM stream network?





Ditch Relief Culvert

- **SIZE** Diameter in inches
- **PIPE LENGTH** In feet
- **TYPE** Material
- **CONDITION** Sediment occlusion %, damage
- **SLOPE SHAPE** Receiving hillslope
- **DISCHARGE TO** Destination of water
- **STREAM CONNECTION** Hydrologic connection with channel
- **FILL EROSION** Erosion below pipe, 5 ft³
- **FLOW DIVERSION** Evidence of historic flow diversion to pipe
- **OBSTRUCTION** Debris in flow path of drain discharge
- **FLOW DIFFUSER**
- **CDATE, CTIME, VEHICLE,**
- **COMMENT**





Lead Off Ditch

- **Slope Shape**
- **Discharge to**
- **Stream Connection**
- **Condition**
- **Obstruction** Debris in flow path
- **CDate, Vehicle, CTime, Comment**



Water Bar

- **Slope Shape**
- **Discharge to**
- **Stream Connection**
- **Fill Erosion**
- **Type**
- **Condition**
- **Obstruction** Debris in flow path
- **CDate, Vehicle, CTime, Comment**





Broad Based Dip

- **Slope Shape**
- **Discharge to**
- **Stream Connection**
- **Fill Erosion**
- **Type** Grade Reversal, Flat Ditch, Constructed
- **Condition**
- **Material** from which constructed
- **Obstruction** Debris in flow path
- **CDate, Vehicle, CTime, Comment**





Non-Engineered

- Slope Shape
- Discharge to
- Stream Connection
- Fill Erosion
- **Condition**
 - Blocked Ditch
 - Diverted Wheel tracks
 - Broken Berm
 - Gully crosses road
 - Outsloped
- Obstruction CDate, Vehicle, CTime, Comment



Sump

- **Condition**
 - No problem
 - Fill saturation
 - Puddles on road





Diffuse Drainage

- **Slope Shape**
- **Discharge to**
- **Stream Connection**
- **Fill Erosion**
- **Condition**
- **Obstruction**
- **CDate, Vehicle,
CTime, Comment**



Landslide

- Road related
- Type
- Position
- Length
- Width
- Depth
- Age
- Confidence
- Photo



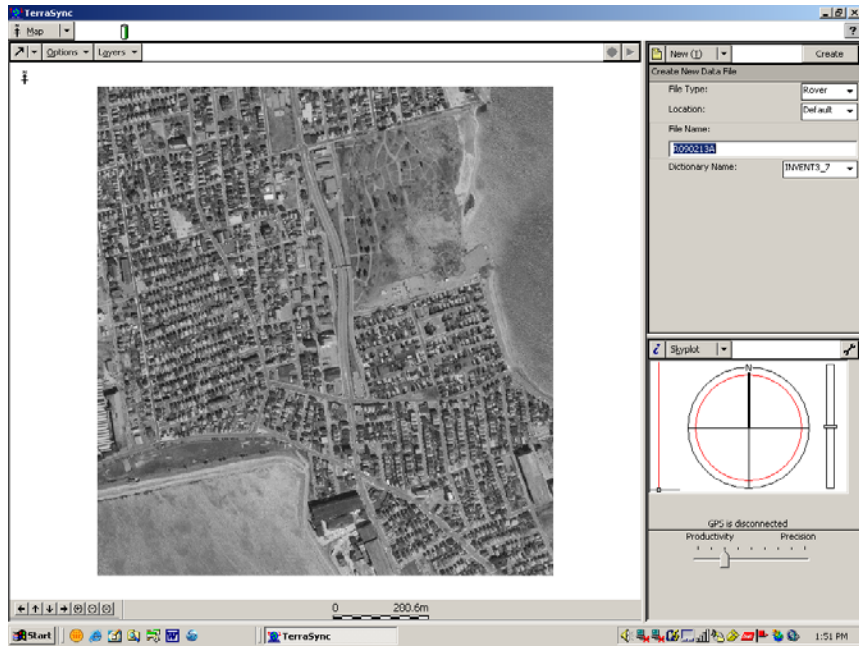


Gully

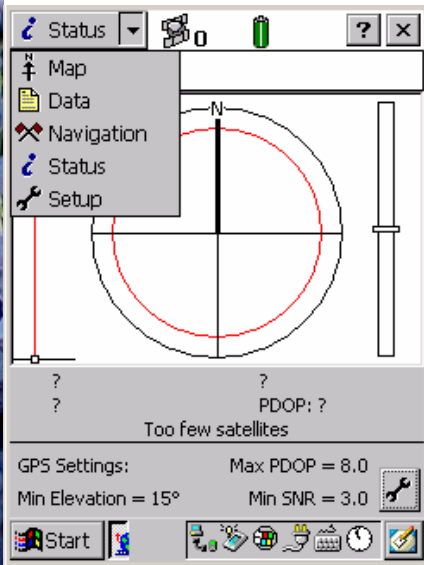
- Road associated
- Active
- Length
- Width
- Depth
- Minimum
 - 10 ft long
 - .5 ft deep



Starting TerraSync



TerraSync Layout



5 Sections

- Map
- Data
- Navigation
- Status
- Setup



Starting TerraSync

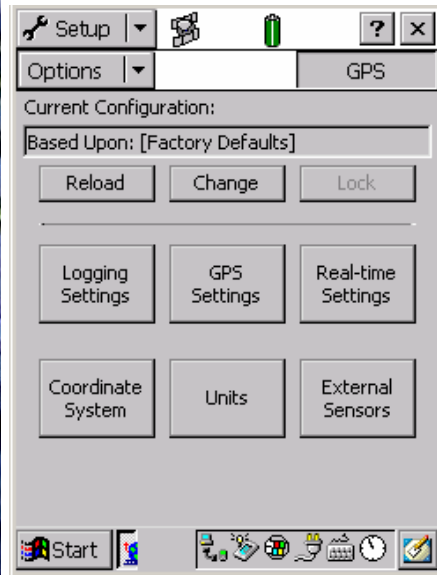
- Turn on the laptop
- Connect the GPS cable or enable Bluetooth
- Open TerraSync program
 - It will connect to GPS
- Setup Tab
 - Check the coordinate system is set to UTM zone 11N NAD83
- Data Tab/New
 - File type is Rover
- Select the generated file name (R091813A1)
 - Add a single digit vehicle number to the end
 - Note the file name in the field book



Starting TerraSync

- Choose data dictionary (Invent 4_0)
- If the GPS does not connect
go to setup/options connect to GPS (or use the GPS button)
if it still does not connect you are on the wrong com port so switch to another option and try to connect with that.

TerraSync Settings



- Coordinate System
 - Datum NAD 83 Conus
 - Projection UTM zone 11N
- GPS settings
 - PDOP
 - SNR



TerraSync Units

- Coordinate, Datums, and Units
 - The GPS receiver always records WGS-84 data even if you have the Display set to another Local coordinate system and datum

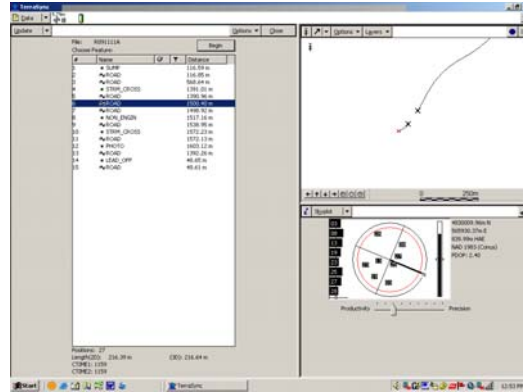


TerraSync 2.6+ FAQ

- Connect to GPS
 - Setup, GPS button
- Load New Data Dictionary
 - Data tab, File manager, Dictionaries (default)
- Change or add background
 - Data tab, File manager, Background
- Edit existing files
 - Data, Existing file and select file name

Updating a Feature

- Data tab
- Update
- Select road or drainpoint by order
- Update values
- Close feature
- Return to collecting new features

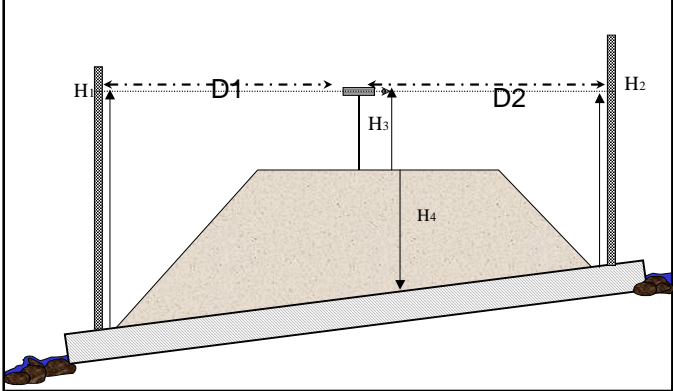




Switch to TerraSync for definitions

- Review drain point attributes
- Road line attributes
- Stream crossing attributes

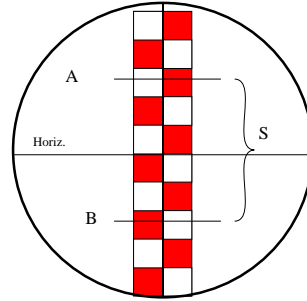
Fill Depth



$$H4 = ((H1 + H2) / 2) - H3$$

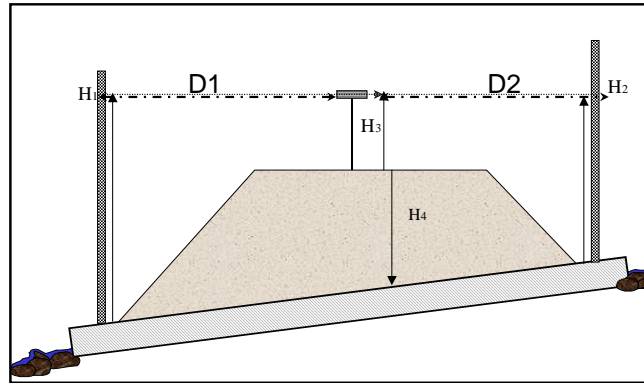


Stream Crossing Pipe Length



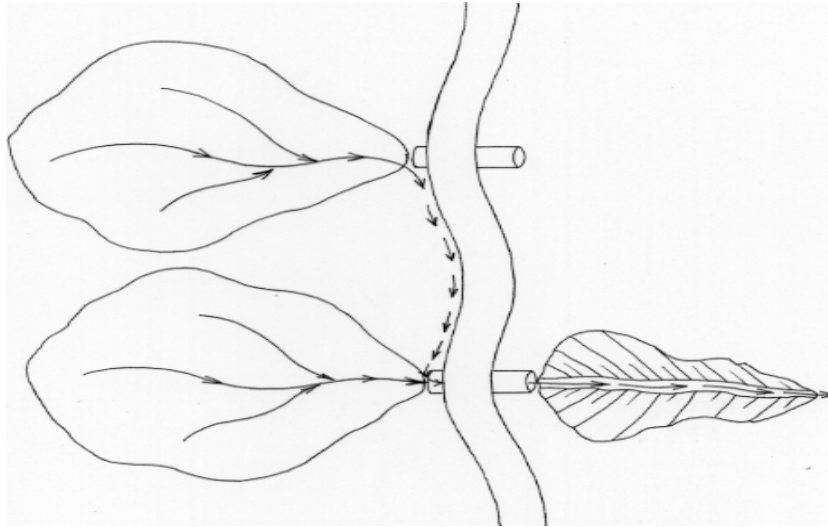
$$\text{Distance } D = (\text{Stadia interval factor}) \times S$$

Stream Crossing Slope



$$\text{Slope} = (H_2 - H_1) / (D_1 + D_2)$$

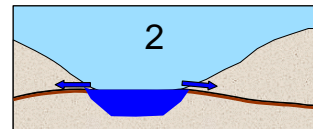
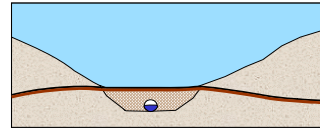
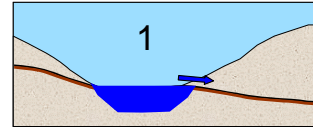
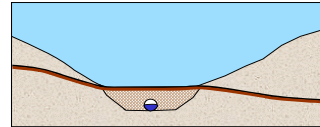
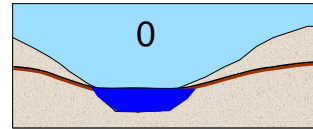
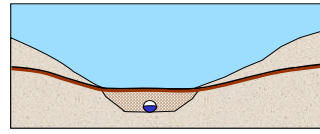
Diversion Potential



From Flanagan



Stream Crossing Diversion Potential





Field Issues

- PDOP <6 produces nice smooth roads
- Be aware of the satellite availability
- Plan day using Pathfinder Office QuickPlan and TS Plan to predict down time
- Minimum road segment of 50 feet
- Easiest to work uphill
- Start and end at drain points
 - Flag your last collected point



Safety

- Work as a team
- Use a CB near logging activity
- High-use roads
 - Pull to the right to collect points
 - Use a beacon
 - Stay alert
 - Stay on the outside of turns
- Plan around traffic cycles

Questions





Blacks Creek Road



South on Broadway
8.8 miles SE on HWY 84
Exit at Blacks Creek
Meet at the end of the pavement