

## Summary Slide

The following presentation was put together for the Virginia Parks and Recreation Society's 54<sup>th</sup> Annual conference on Greenways and Blueways in Virginia.

On behalf of Bland County and the US Forest Service we are very excited and grateful to have the opportunity to prepare this presentation of our means and methods for routing a "Trail Corridor". Using GIS and GPS software and technology we efficiently located viable route options for use in field work and trail design process.

This study is being used by the US Forest Service in preparing their environmental impact studies. We provided the USFS with a digital route file usable in common handheld GPS units for final trail corridor location (in lieu of trail ribbons and staking).

Overall this project connects Wolf Creek Indian Village a significant cultural heritage resource in Bland County with the Jefferson National Forest. Connecting the Indian Village to both Rich and Round Mountains.

In the future other connector trails are being planned that make their way from this project to the community of Bland and the Appalachian Trail to the south. This project is an ecologically sensitive design that brings to the community a taste of eco-tourism.

# GIS and GPS for Recreational Trail Planning and Design in Wild-land Settings

Mike Futrell – *GIS Administrator*

Michael LaRoche – *Landscape Architect*



**Draper Aden Associates**  
*Engineering • Surveying • Environmental Services*

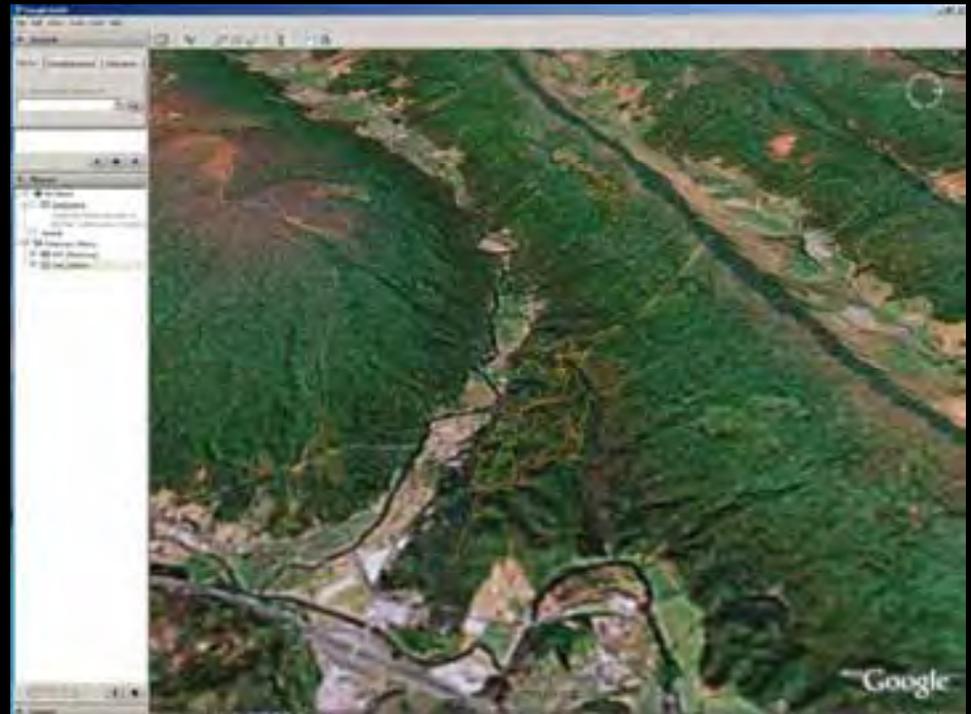
## What you will learn from this presentation:

1. Data gathering for GIS sources for basic trail planning
2. Explain the “merge and collaborate process” between GIS Data-Based Design and Field Adjusted Design
3. Walk through of a “Real World” design in USFS located in Bland County, Virginia.



# The Virtual World

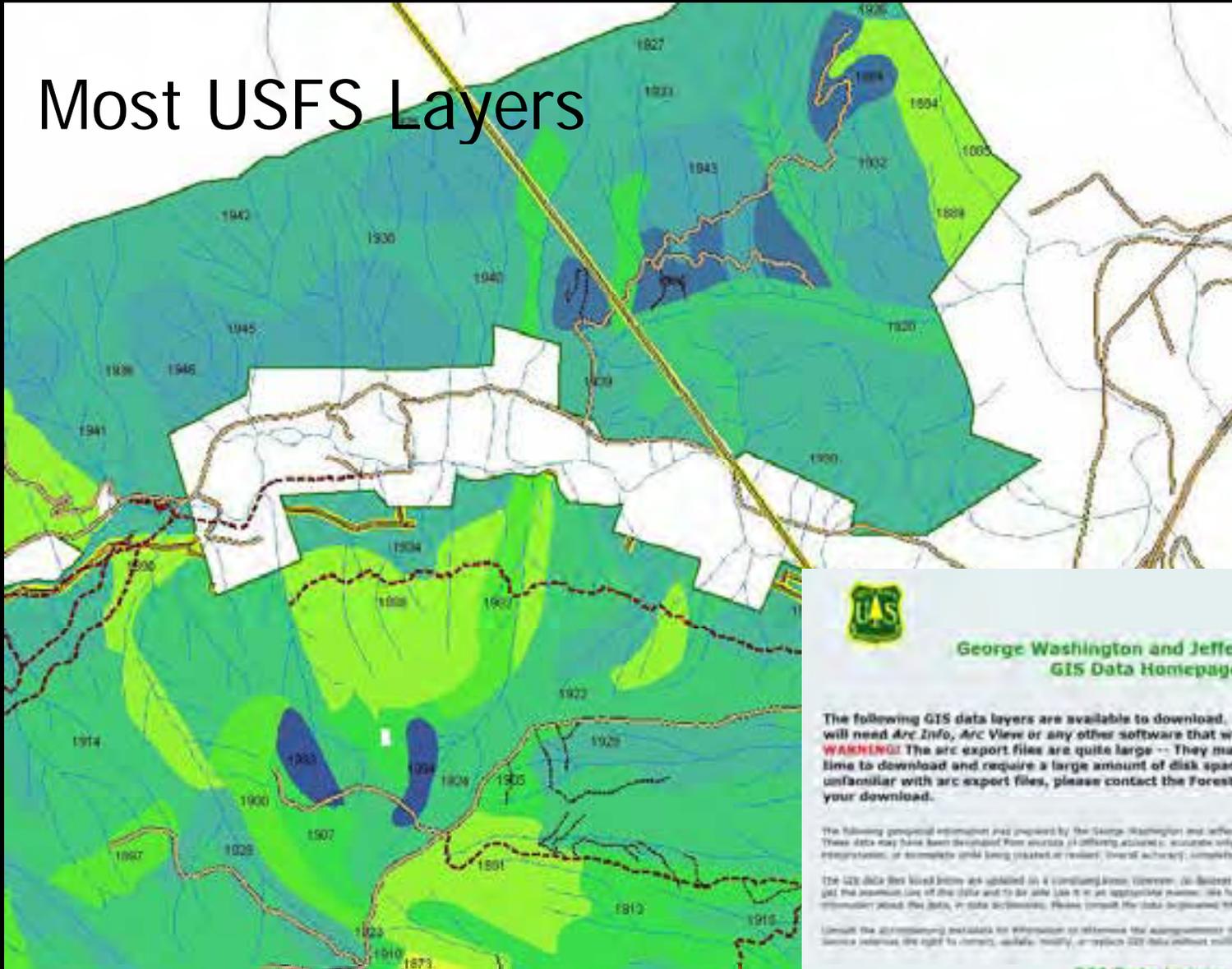
- GIS data and data derivatives used in guiding “DATA BASED DESIGN”
- Finding useful data can be a challenge



# Basic Data Collection for Trail Planning

- Types of Data used:
  - Aerials
  - Existing trails, logging roads of yesterdays
  - Interviews with people knowledgeable of the land
- Sources of GIS data layers:
  - USGS
  - USDA
  - USFS
  - Universities
  - State and Local GIS Departments

# Most USFS Layers



## George Washington and Jefferson NFs GIS Data Homepage

The following GIS data layers are available to download. To utilize these data layers you will need Arc Info, Arc View or any other software that will accept this type of format. **WARNING!** The arc export files are quite large -- They may take a considerable amount of time to download and require a large amount of disk space to operate. If you are unfamiliar with arc export files, please contact the Forest Service before you attempt your download.

The following geospatial information was prepared by the George Washington and Jefferson National Forests (2008 Forest Service). These data may have been developed from sources of differing accuracy, accuracy only at certain scales, based on existing interpretations, or incomplete until being created or revised; (overall accuracy), inconsistencies and omissions may exist.

The GIS Data Set listed below was updated in a continuing process. Coverage of the data is currently accurate as listed. We want you to get the maximum use of the data and to be able to use it in an appropriate manner. We have provided metadata, in general descriptions, information about the data, in data dictionaries. Please consult the data dictionaries for detailed information about the GIS layers.

Consult the accompanying metadata for information or determine the appropriateness of the GIS data for your intended use. The Forest Service reserves the right to correct, update, modify, or replace GIS data without notification.

### GIS Data Layers



[Link to FTP Site](#)



**Draper Aden Associates**  
Engineering • Surveying • Environmental Services

# Aerials, Soils, (many)



USDA

Geospatial

The one stop source of natural resources data

Data Gateway

SYSTEM STATUS

All products and services are running normally.

PLEASE NOTE: The Common Land code (CLC) product is not available to the public. See FAQ 39 for more information.

USDA.gov FOIA Non-Discrimination Statement Privacy Policy This Week Data Distribution Policy



# VGIN 2002 Aerials, Topos, (many)



## The GIS Spatial Data Server at Radford University

Virginia Spatial Data  
Digitized by Vince  
Speed School

Clickable Virginia Map  
(ArcGIS Spatial data  
server)

Digital Elevation  
Models (DEMs)

7.5 Minute USGS  
Topographic Maps  
(DTMs) of Virginia and  
Surrounding States

GIS Data Station

GIS Links

Map GIS Center at  
Other Spatial Data Links

Radford University Links

College of Arts and  
Sciences  
Radford University



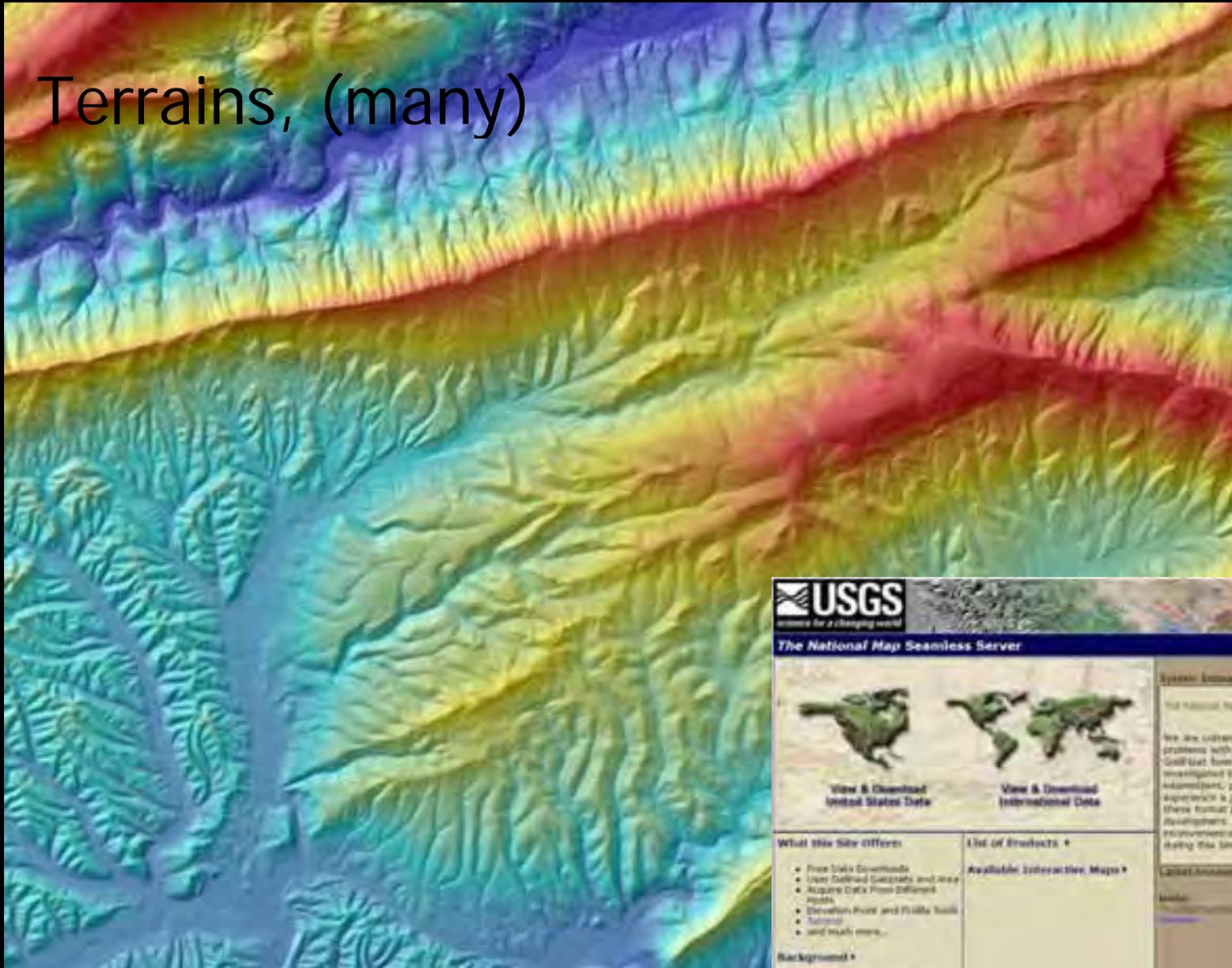
### Welcome!

Radford University's public online digital data for Virginia and the surrounding  
states of Missouri, North Carolina, West Virginia, District of Columbia, and  
Maryland. Some data are also available for South Carolina and Ohio. Data include  
state, federal, and local vector data (SHP/GIS), Virginia and digital  
elevation models (DEM) for each county and independent city in Virginia. GIS  
applications (2002) are available for all of Virginia as well as the states listed above.

This site is provided free of charge to the public. Radford University disclaims any responsibility for its accuracy or  
its use.

**New Available (November 8, 2007)** Download 2002 VGIN high resolution aerial  
photography for all of Virginia. The data is available now by using our ArcGIS server  
(2nd link on the left). Please let us know if you have problems downloading files.

# Terrains, (many)



**USGS**  
science for a changing world

USGS Home  
Contact USGS  
Search USGS

### The National Map Seamless Server

[View & Download United States Data](#)     [View & Download International Data](#)

**System Status**

The National Map Seamless Server is **Available**.

We are currently experiencing intermittent problems with downloads requested in US and Grid Cell formats. The problem is being investigated by our staff. Once the problem is resolved, please try your request again. If you experience a problem, it may be long-term fix for these format problems is currently in development. We apologize for any inconvenience. Thank you for your patience during this time.

**What this Site Offers**

- Free Data Downloads
- User Defined Geoprats and Area
- Acquire Data From Different Modes
- Elevation Point and Profile Tools
- Tutorial
- and much more...

**List of Products**

**Available Interactive Maps**

**Background**

**Frequently Asked Questions**

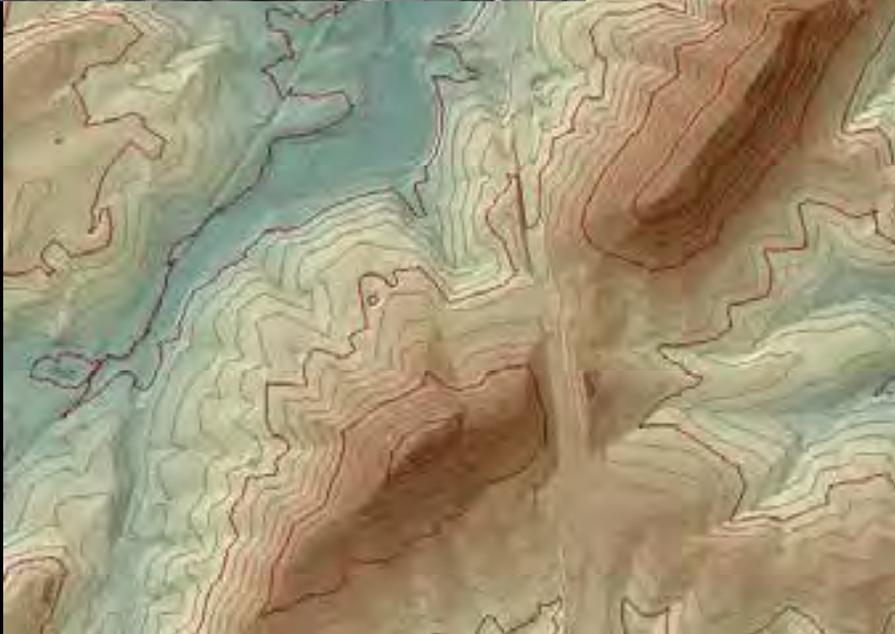
**Links**

Contact Us

# Design Tools - GIS Data Derivatives

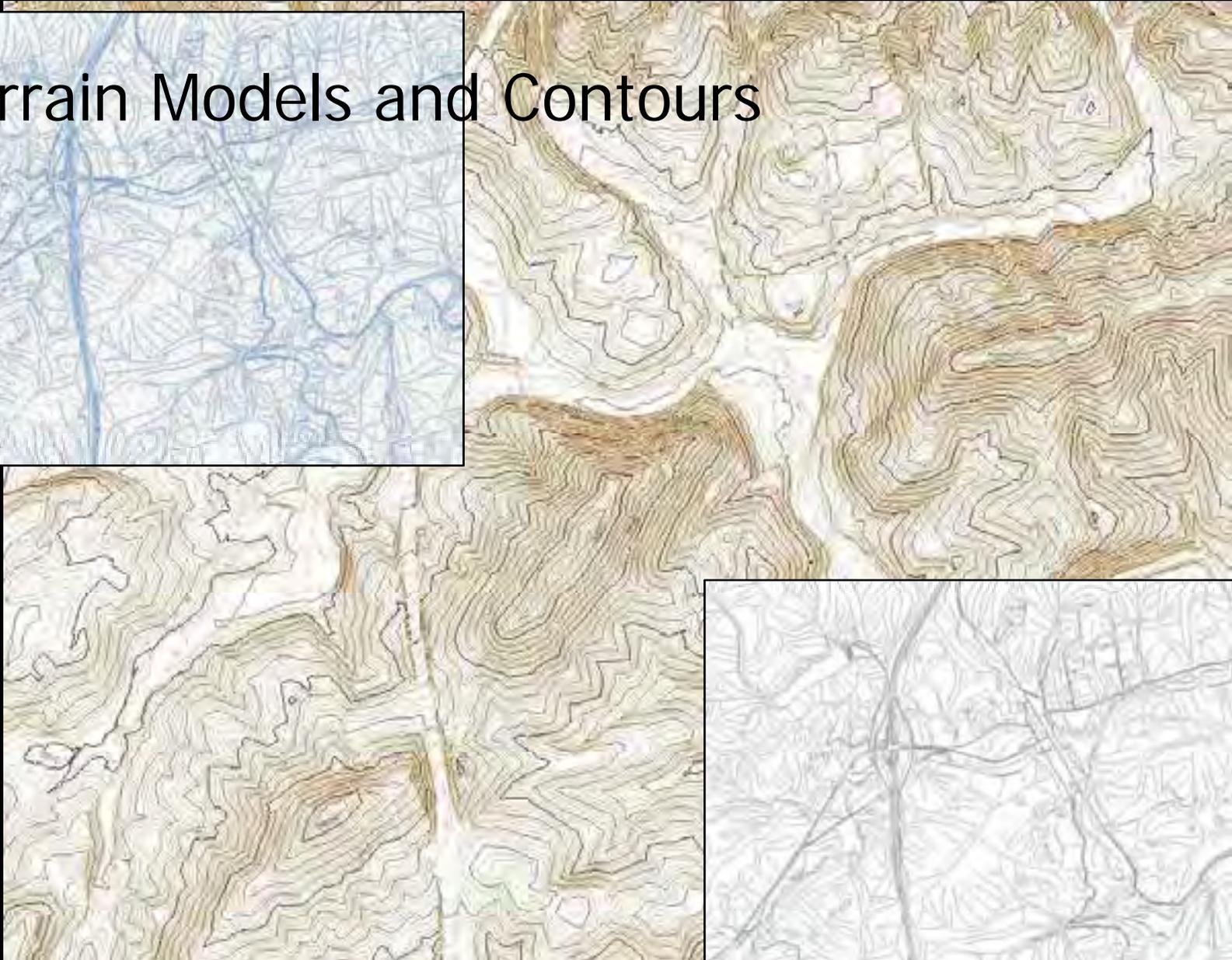
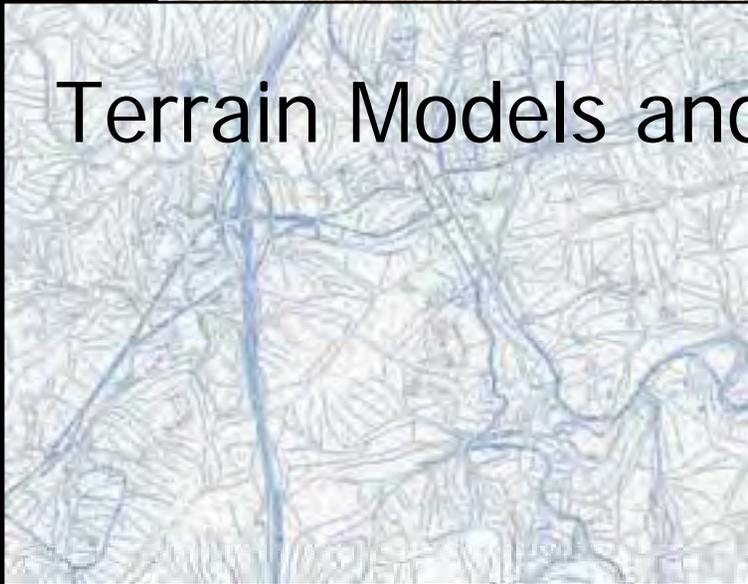
- Hillshade and Elevation Visualizations
- Terrain Models and Contours
- Slope and Aspect
- Digitize New Features

# Hillshade and Elevation Visualization

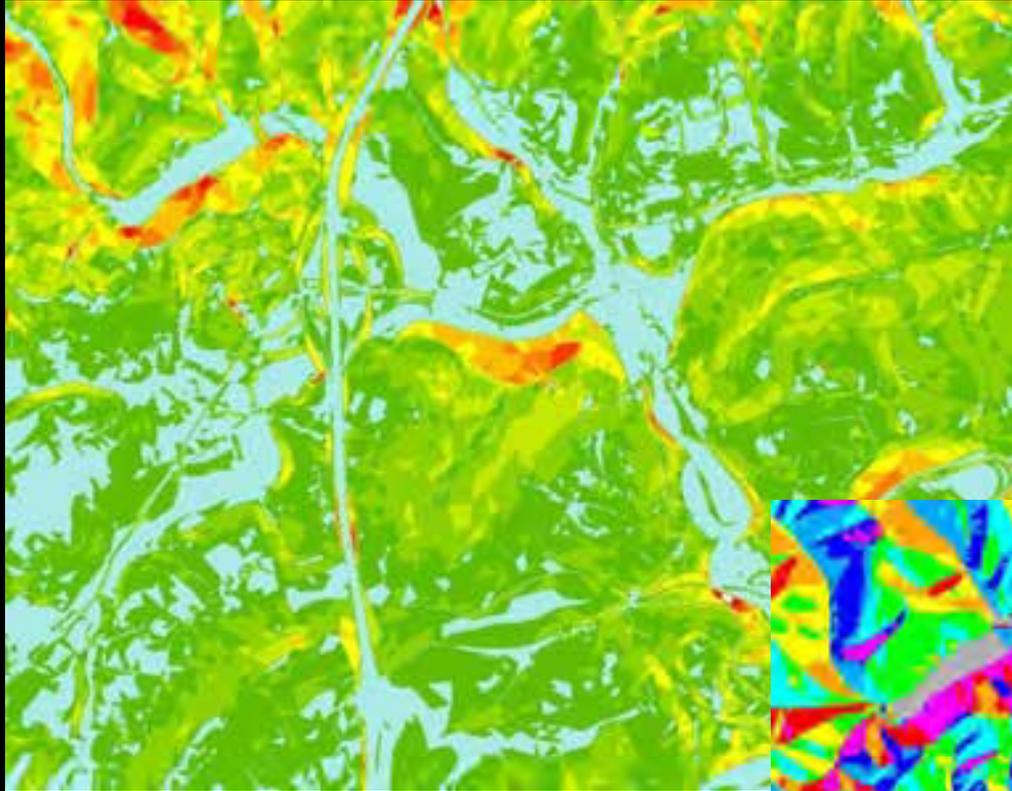


**Draper Aden Associates**  
Engineering • Surveying • Environmental Services

# Terrain Models and Contours



**Draper Aden Associates**  
Engineering • Surveying • Environmental Services



Slope Map

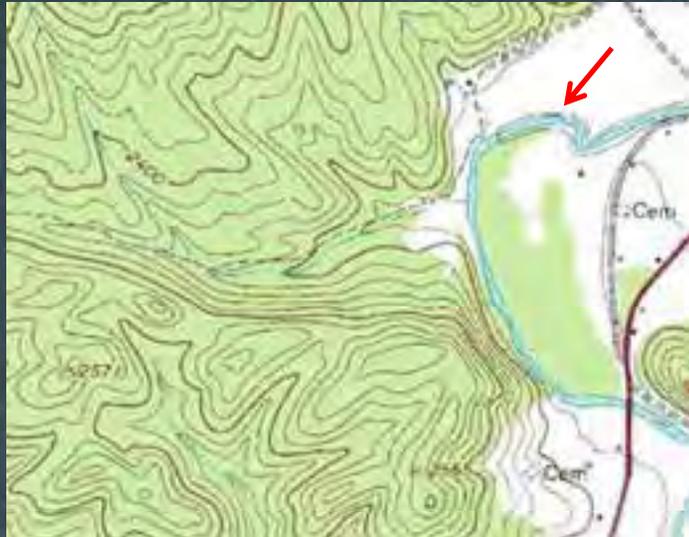
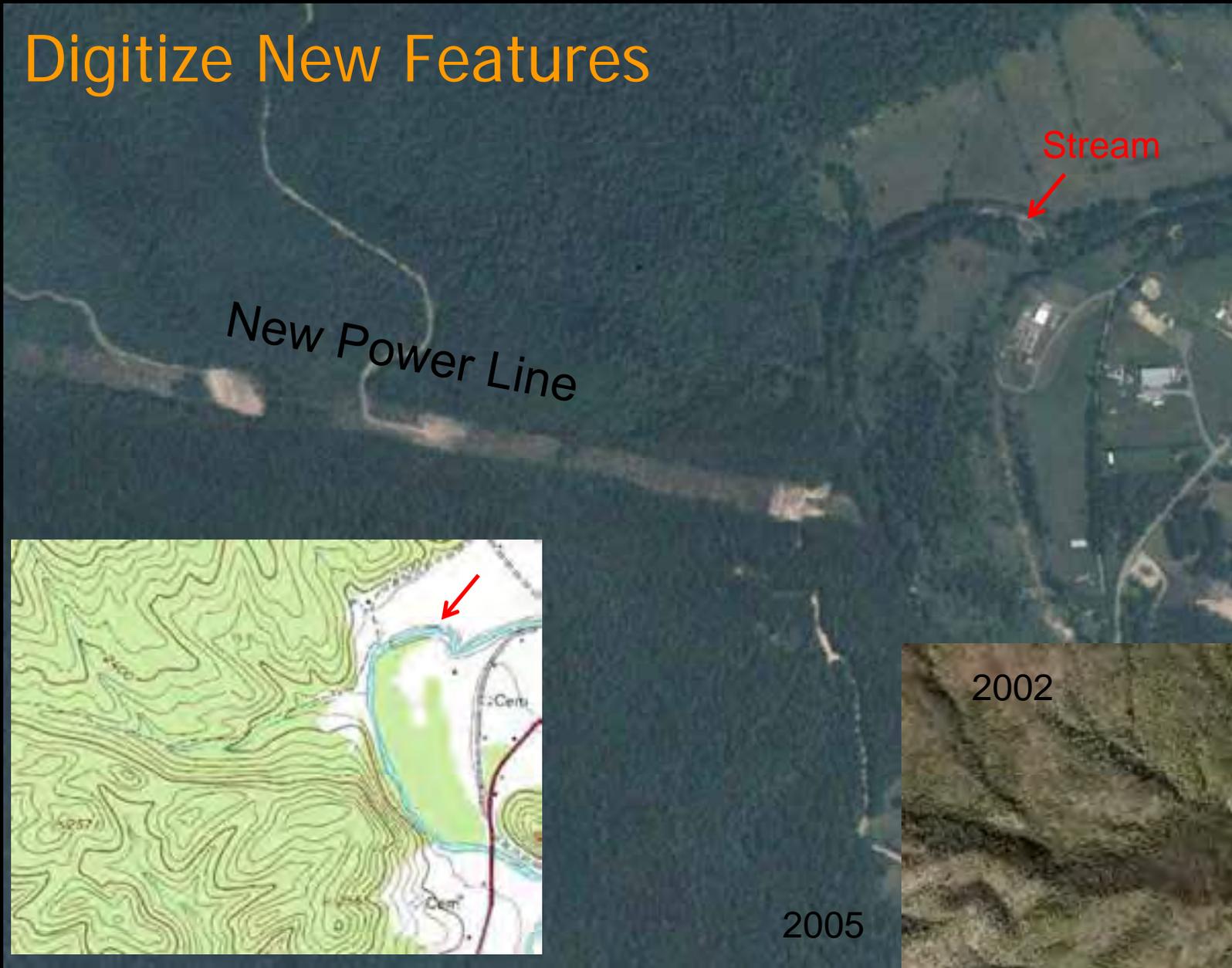


Aspect Map



**Draper Aden Associates**  
*Engineering • Surveying • Environmental Services*

# Digitize New Features

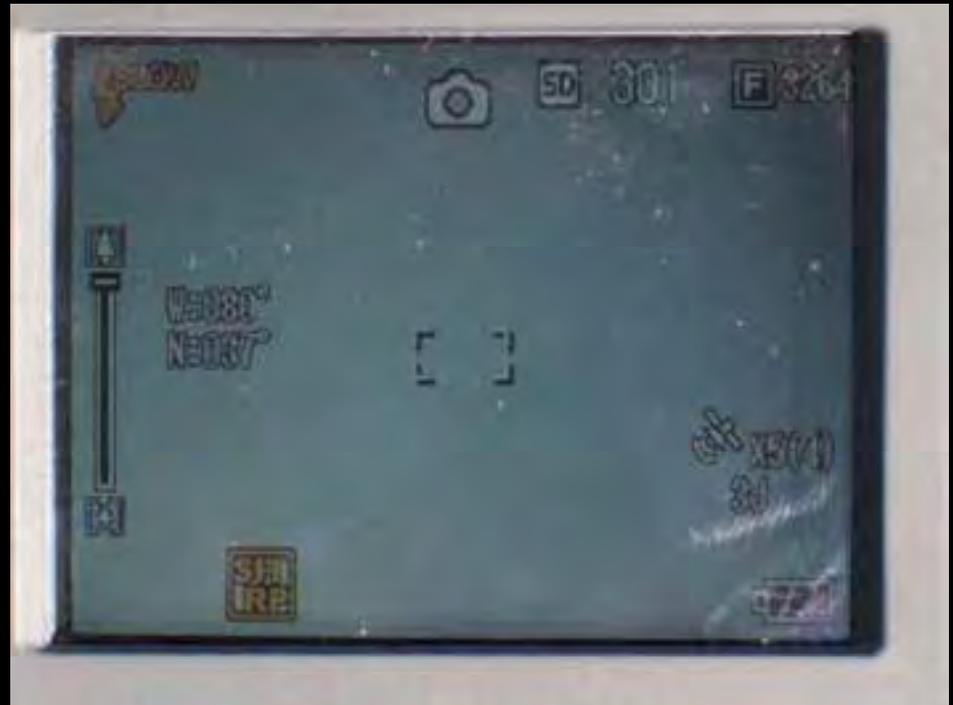


**Draper Aden Associates**  
Engineering • Surveying • Environmental Services

# Software and Equipment Used

- Ricoh GPS Camera
- Garmin Handheld GPS (60CSx)
- AutoCAD (Map and LDD)
- ArcGIS
- Minnesota DNR Garmin GPS Utility

# Ricoh GPS Camera



# GPS Camera = Georeferenced Photos



EXIF info

EXIF Tag	Value
FocalLength	5.80 mm
UseCount	
FlashFired	0/00
ColorSpace	sRGB
ExifImageWidth	1280
ExifImageHeight	960
Interpenetration	15773
ExposureMode	Auto
WhiteBalance	Auto
SceneCaptureType	Standard
ShutterSpeed	Normal

GPS Information

GPSVersionID	2.0.0.0
GPSLatitudeRef	N
GPSLatitude	37° 41' 52.00"
GPSLongitudeRef	W
GPSLongitude	79° 49' 11.00"
GPSTimeStamp	See level
Altitude	420 m
GPSTimeStamp	11:28:00

Mean Note (words):

Thumbnail	6 (JPEG)
Compression	72
XResolution	72
YResolution	72
ResolutionUnit	Inch
JpegIFOffset	10750
JpegIFByteCount	4804

13 NOV 2007 15:24

# GPS - A Better Compass

- Creating a new route using a GPS unit to guide the way...
- Tracklogs have replaced flagging tape and a compass.
- "Points of Interest" collection allows for virtual field data collection and observation notation.
- After using GIS data derivatives and design factors in trail planning, upload the trail route and you have a GPS unit guiding the way along a preliminary design path.



# Handheld GPS Unit



# GPS Interface Software

MN DNR - Garmin

File Edit GPS Waypoint Track Route Real Time Help

GPSMap60CSX Software Version 3.10 VERBMAP Americas Rec Basemap 4.00

Lat 37.1305648 Lon -80.40636390

Alt EPE

<<< Data Table >>>

Waypoint
  Track
  Route
  RTimeWpt

	type	ident	lat	long	y_proj	x_proj	comment	display	symbol	unuse
204	WAYPOINT	SV1	37.14212202	-80.54955999	37.14212202	-80.54955999		0		
205	WAYPOINT	SV2	37.14229267	-80.54982947	37.14229267	-80.54982947		0		
206	WAYPOINT	SV3	37.14234958	-80.55009283	37.14234958	-80.55009283		0		
207	WAYPOINT	SV4	37.14221941	-80.55003106	37.14221941	-80.55003106		0		
208	WAYPOINT	SV5	37.14210383	-80.55024262	37.14210383	-80.55024262		0		
209	WAYPOINT	SV6	37.14208656	-80.55004296	37.14208656	-80.55004296		0		
210	WAYPOINT	SV7	37.14230273	-80.55045728	37.14230273	-80.55045728		0		
211	WAYPOINT	Test1	37.20195472	-80.39994428	37.20195472	-80.39994428		0		
212	WAYPOINT	Tree 1	37.13006549	-80.54767549	37.13006549	-80.54767549		0		
213	WAYPOINT	Tree 2	37.13016347	-80.54778580	37.13016347	-80.54778580		0		
214	WAYPOINT	Tree 3	37.13011879	-80.54784824	37.13011879	-80.54784824		0		
215	WAYPOINT	Tree 4	37.13005082	-80.54789451	37.13005082	-80.54789451		0		
216	WAYPOINT	Tree 5	37.12996641	-80.54795377	37.12996641	-80.54795377		0		
217	WAYPOINT	Tree 6	37.12990330	-80.54801730	37.12990330	-80.54801730		0		
218	WAYPOINT	Tree 7	37.12982878	-80.54808746	37.12982878	-80.54808746		0		
219	WAYPOINT	Tree 8	37.12975418	-80.54797607	37.12975418	-80.54797607		0		
220	WAYPOINT	Tree 9	37.12940742	-80.54785327	37.12940742	-80.54785327		0		

Connected

Minnesota Department of Natural Resources

Home | About the DNR | Bureaus | Management Resources | Management Information Services | GIS | ArcView Resources

Recreation | Destinations | Nature | Education / safety | Licenses / permits / regs.

Home > About the DNR > Bureaus > Management Resources > Management Information Services > GIS > ArcView Resources

## DNR Garmin Application

### DNRGarmin GPS Application

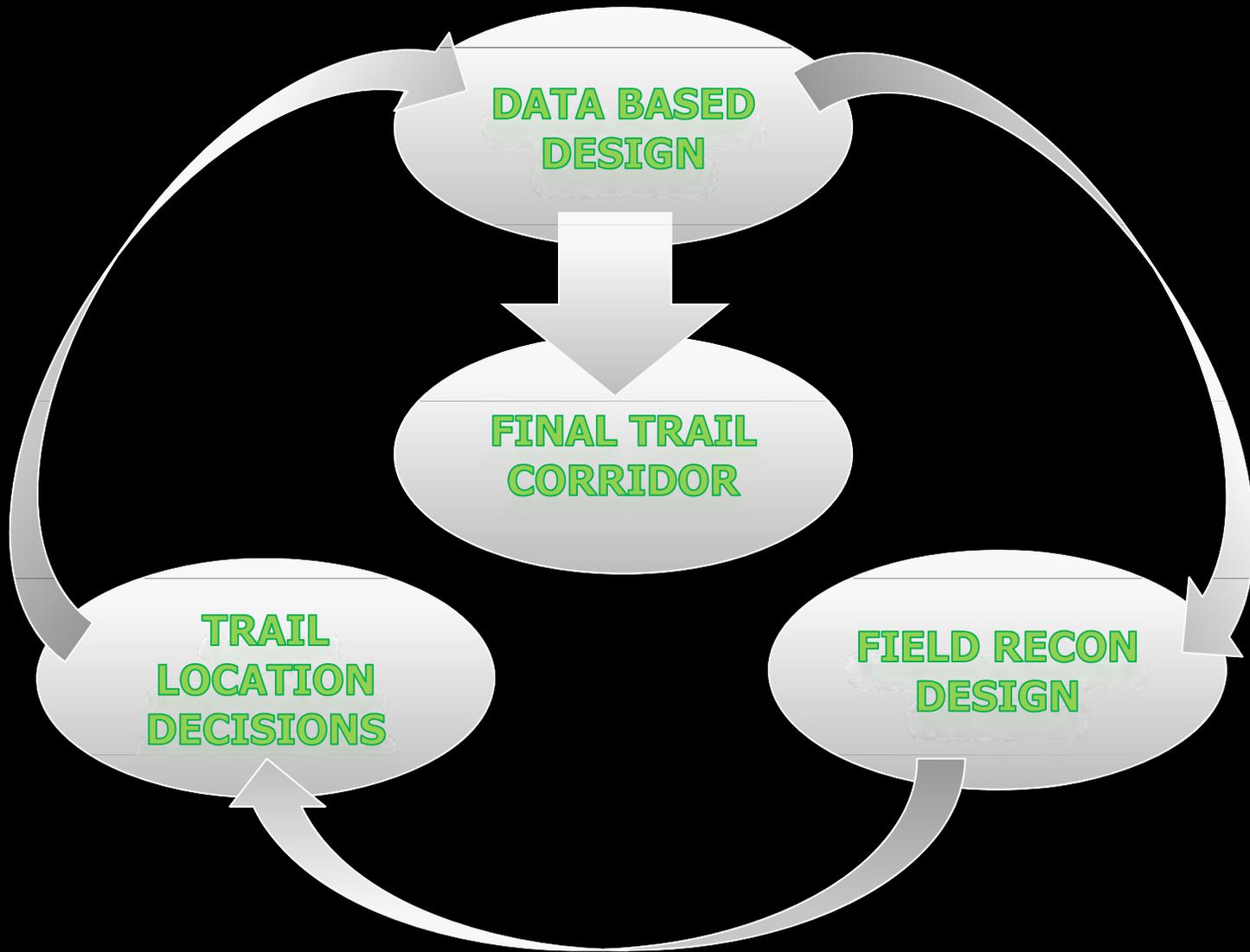
**Current Version:**  
 Arcview Extension: 5.4.0  
 VB Program: 5.4.1  
 ArcGIS Toolbar: 5.4.0  
 Build Date: 9/22/2008  
 Posted Date: 9/23/2008

**Works With:**  
 Arcview  
 Arcmap (9.x)  
 Google Earth  
 Landview  
 ArcExplorer 2.0 (non-java version)

# Data Based Design (Tools ~ Data Derivatives)

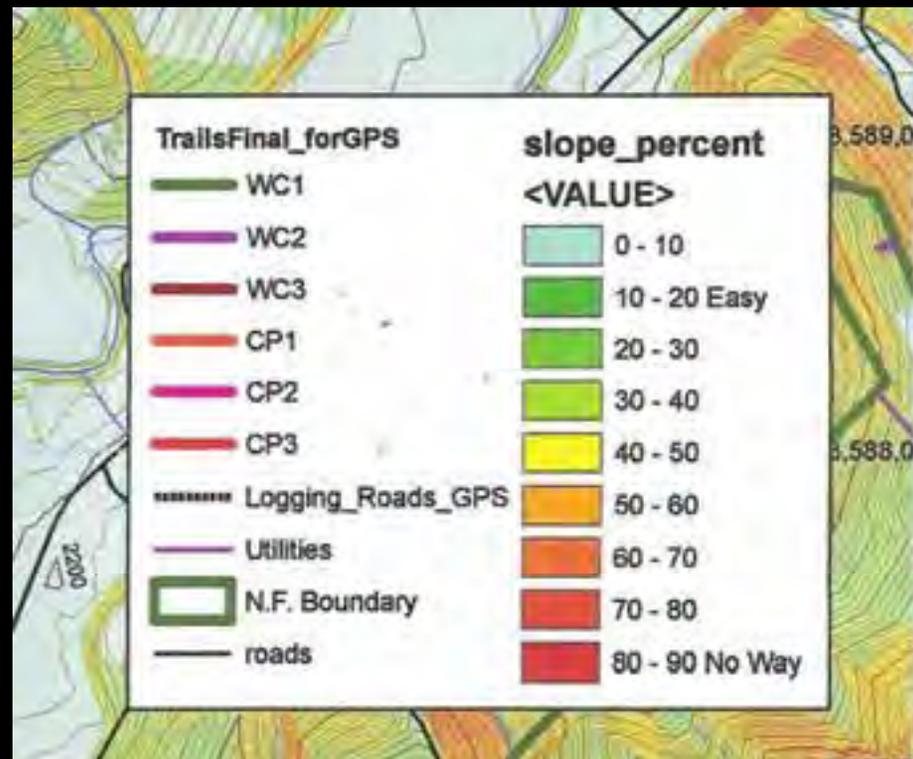
- Slope Analysis
- Aspect Analysis
- Vegetation Types in relation to Aspect Map (overlays)
- Identify viable routes based on a review of GIS data
- Identify routes and “pinch” points that require field investigation





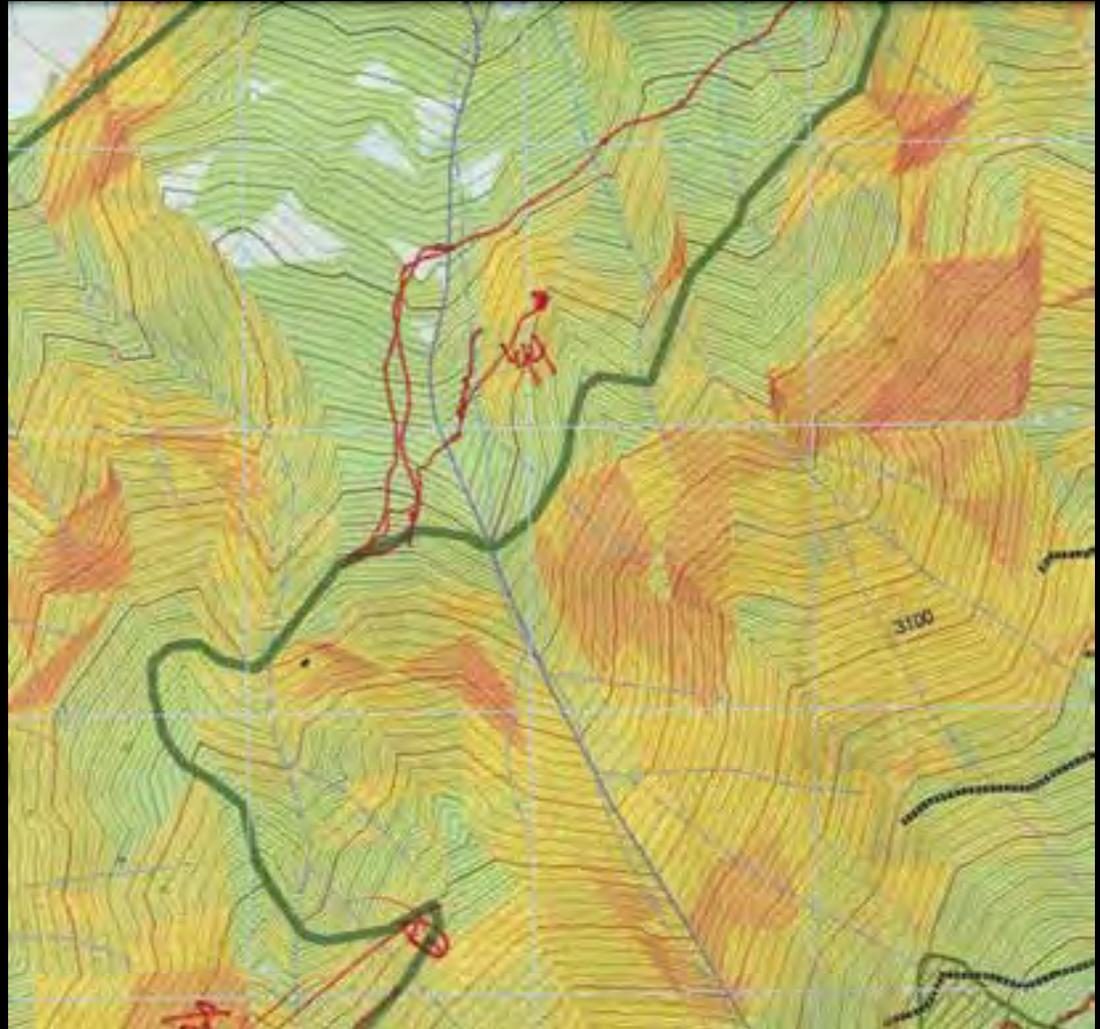
# Slope Analysis Mapping

- Legend, Slopes, existing logging trails, trail route design options



# Slope Analysis Mapping

- Weaving a trail through steep side slopes, avoiding the orange and red areas (steep)



# Slope Analysis Mapping

- Connecting Wolf Creek Recreation Area to the top of Round Mountain
- The challenge of ascending the north face of Round Mountain was a combination of avoiding steep rocky side slopes and dense thickets of Rhododendrons.
- Data-based trail design used the “follow the contour” method, while avoiding steep slope ranges used in the data based trail design.





Winter 2002



**Draper Aden Associates**  
Engineering • Surveying • Environmental Services

Vegetation Types in relation to Aspect

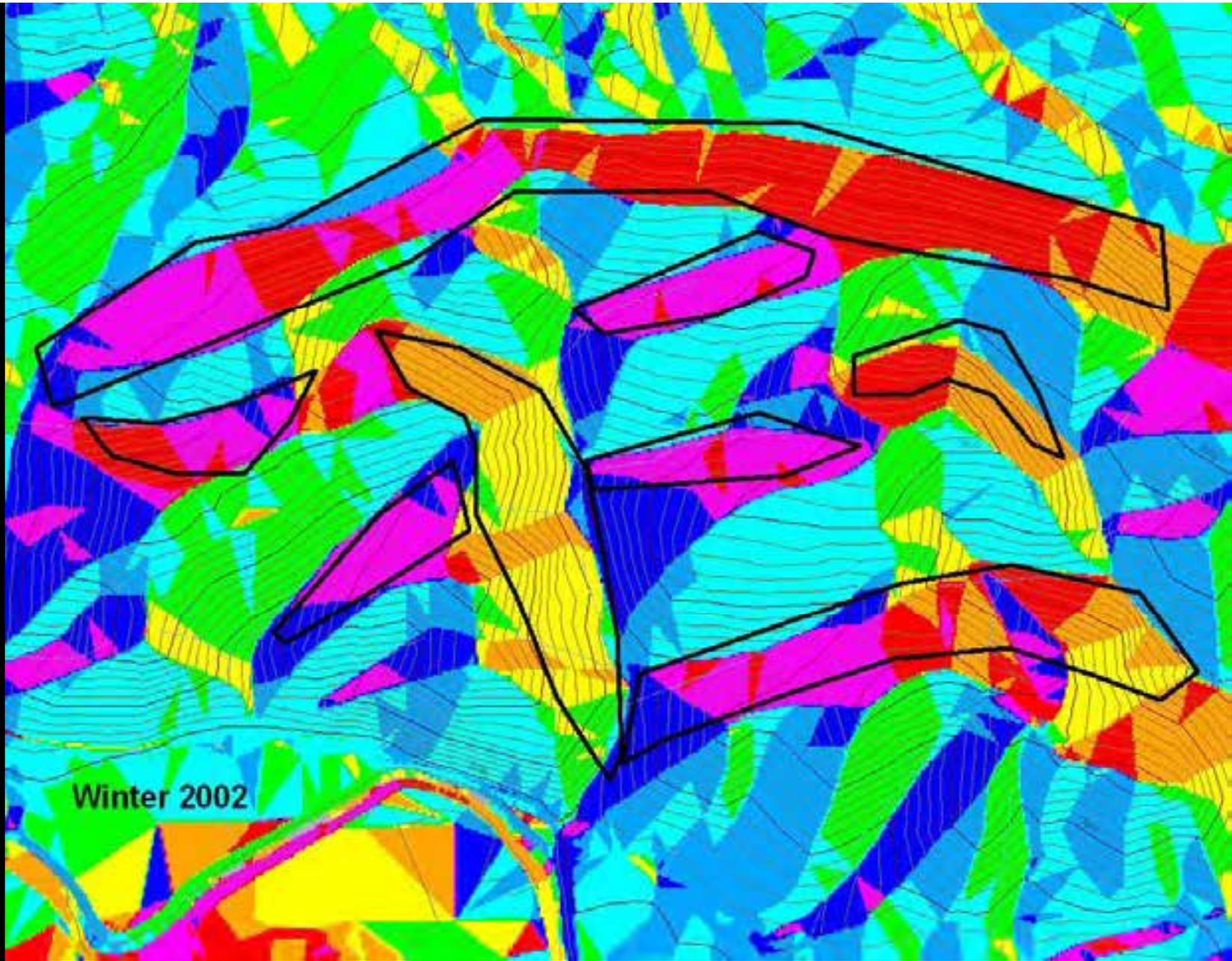


Winter 2002



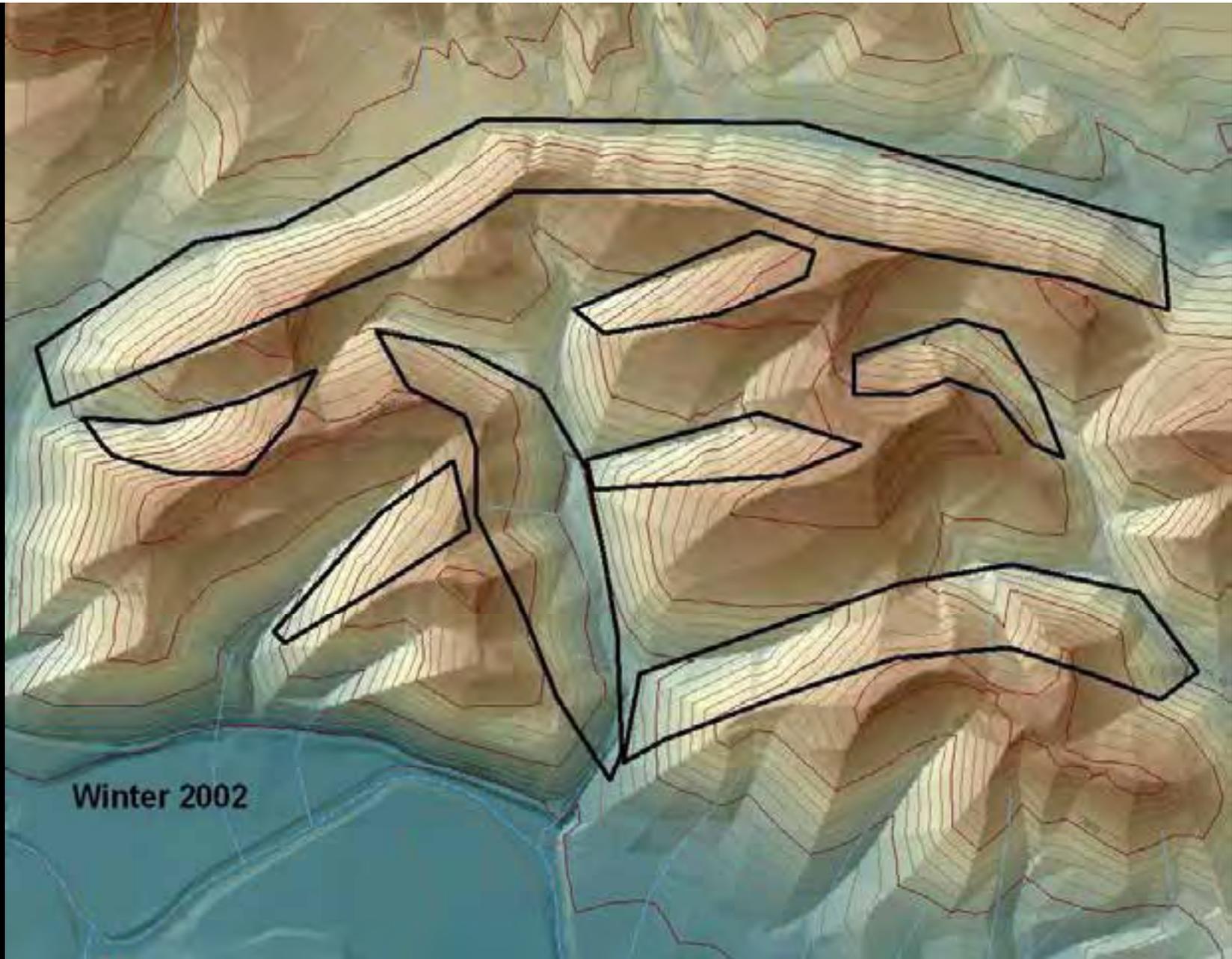
**Draper Aden Associates**  
*Engineering • Surveying • Environmental Services*

**Vegetation Types in relation to Aspect**



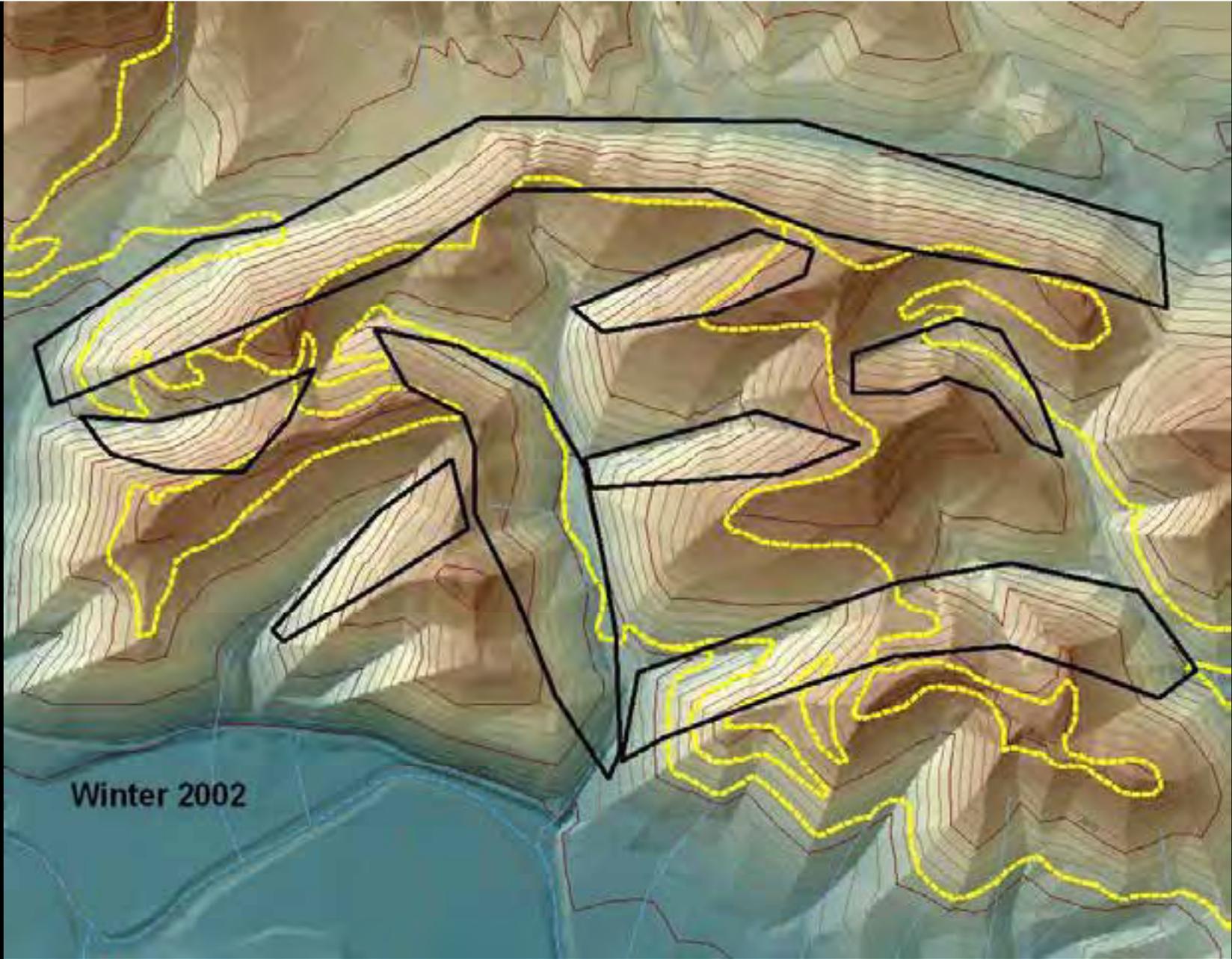
**Draper Aden Associates**  
*Engineering • Surveying • Environmental Services*

Vegetation Types in relation to Aspect



**Draper Aden Associates**  
*Engineering • Surveying • Environmental Services*

**Vegetation Types in relation to Aspect**



Winter 2002



**Draper Aden Associates**  
Engineering • Surveying • Environmental Services

Vegetation Types in relation to Aspect

# Design Considerations: Opportunities and Constraints

- Streams
- Steep erodible slopes
- Boulder fields
- Proximity to boundary and other properties
- Vegetation
- Points of interest and overlooks





Overlooks



Boulder Fields



**Draper Aden Associates**  
*Engineering • Surveying • Environmental Services*

# Vegetation Challenges



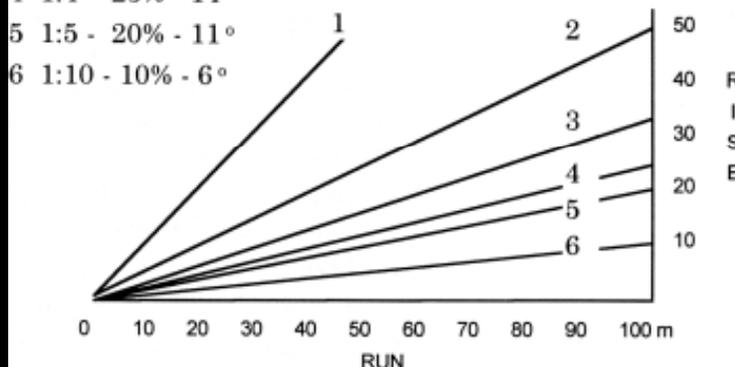
# Trail Classification

- Type of Users
- Trail Widths
- Slopes & Gradients

Figure 2

## Slope Gradients

- 1 1:1 - 100% - 45°
- 2 1:2 - 50% - 27°
- 3 1:3 - 33% - 18°
- 4 1:4 - 25% - 14°
- 5 1:5 - 20% - 11°
- 6 1:10 - 10% - 6°



## Trail Difficulty Rating System

	Easiest White Circle 	Easy Green Circle 	More Difficult Blue Square 	Very Difficult Black Diamond 	Extremely Difficult Dbl. Black Diamond 
Trail Width	72" or more	36" or more	24" or more	12" or more	6" or more
Tread Surface	Hardened or surfaced	Firm and stable	Mostly stable with some variability	Widely variable	Widely variable and unpredictable
Average Trail Grade	Less than 5%	5% or less	10% or less	15% or less	20% or more
Maximum Trail Grade	Max 10%	Max 15%	Max 15% or greater	Max 15% or greater	Max 15% or greater
Natural Obstacles and Technical Trail Features (TTF)	None	Unavoidable obstacles 2" tall or less  Avoidable obstacles may be present  Unavoidable bridges 36" or wider	Unavoidable obstacles 8" tall or less  Avoidable obstacles may be present  Unavoidable bridges 24" or wider  TTF's 2' high or less, width of deck is greater than 1/2 the height	Unavoidable obstacles 15" tall or less  Avoidable obstacles may be present  May include loose rocks  Unavoidable bridges 24" or wider  TTF's 4' high or less, width of deck is less than 1/2 the height  Short sections may exceed criteria	Unavoidable obstacles 15" tall or greater  Avoidable obstacles may be present  May include loose rocks  Unavoidable bridges 24" or narrower  TTF's 4' high or greater, width of deck is unpredictable  Many sections may exceed criteria

# Route Decisions for Trail User Groups

- User groups, Hiking, Back Country Horseback Trails
- Shared use with Mountain Biking

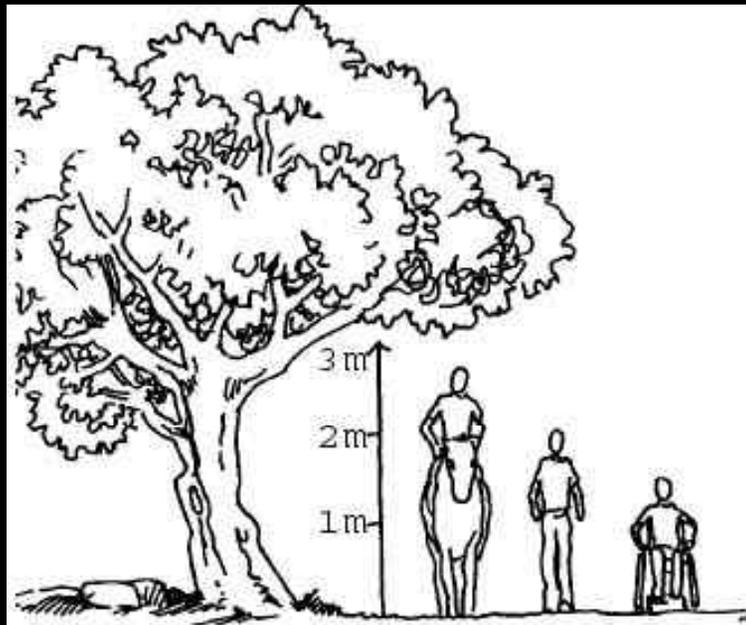


Image Courtesy of FHWA [www.fhwa.dot.gov](http://www.fhwa.dot.gov)

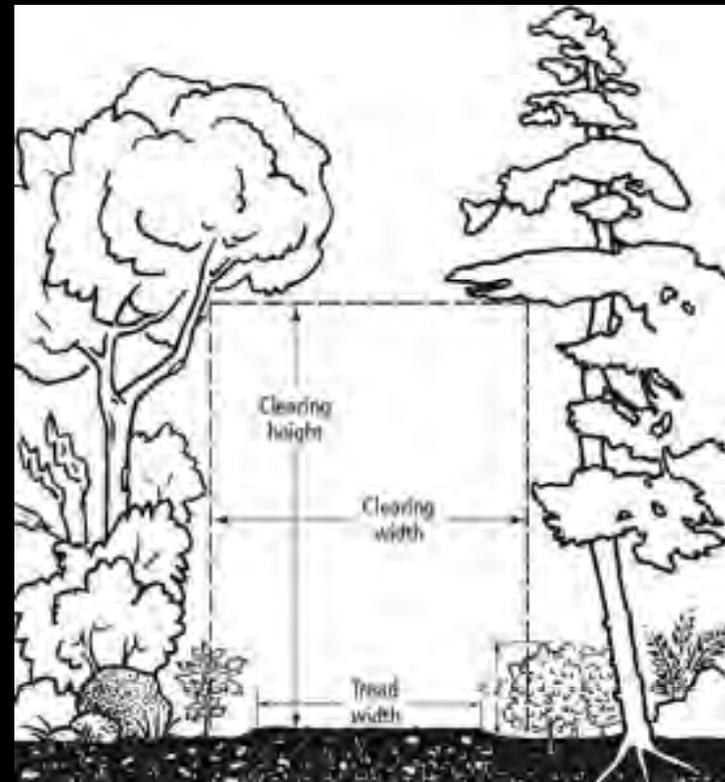
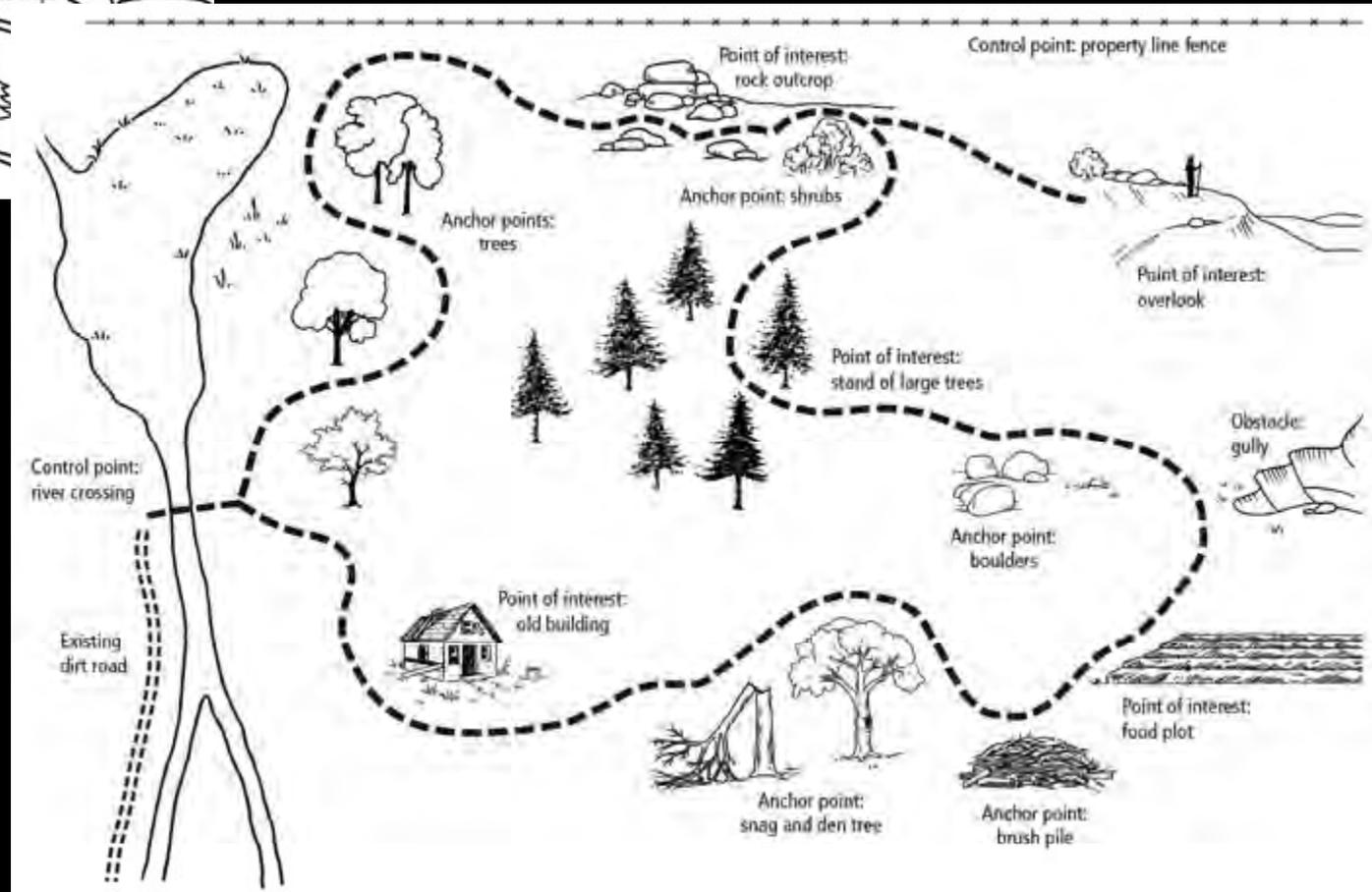
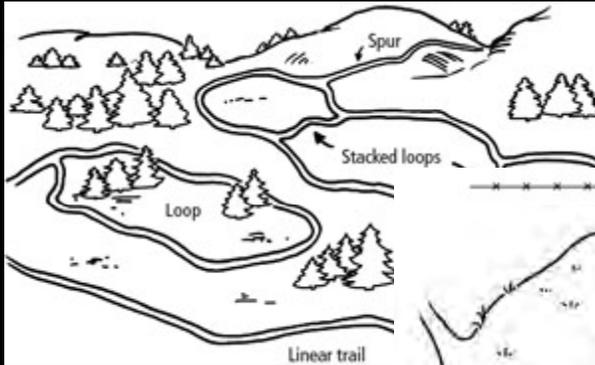


Image Courtesy of [www.extension.umn.edu](http://www.extension.umn.edu)

# Trail Design Features



Stretch – Pause – Break

Questions thus far?

# Wolf Creek Indian Village to Round Mountain USFS: Example of Concepts Implemented



# Design Process Illustrated

- USFS and Bland County collaborate on tourism and economic development with recreational trails connecting cultural and natural resources.

Bland County Economic  
Development Authority  
P.O. Box 125  
Bland, VA 24315  
www.bland.org  
ebl@business.bland.org@state.va.us  
County Administration  
(276) 688-4622 • 800-519-3468  
fax (276) 688-8758



## Bland County, Virginia

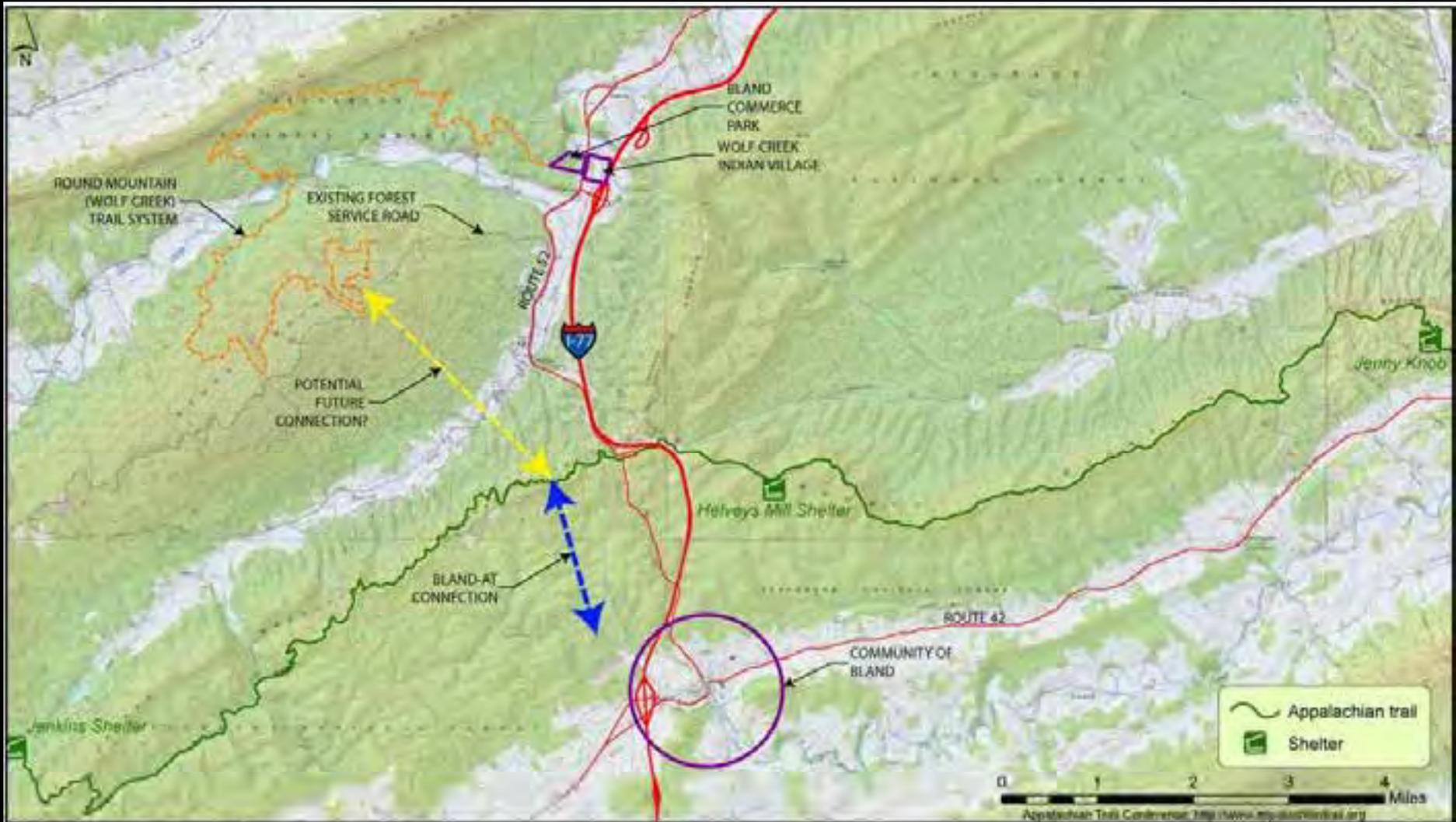
*...far from  
the ordinary*



Connecting USFS  
property to Wolf  
Creek Indian Village



**Draper Aden Associates**  
Engineering • Surveying • Environmental Services



Appalachian Trail Connector: <http://www.appalachiantrail.org>



**Draper Aden Associates**

Engineering • Surveying • Environmental Services

2706 South Main Street  
Blacksburg, VA 24060  
480-652-8448 Fax: 480-652-0281

Radford, VA  
Charlottesville, VA  
Hampden-Sydney, VA

DESIGNED  
DRAWN: AWW  
CHECKED: CBK  
DATE: 1-28-2008

VICINITY MAP  
**BLAND APPALACHIAN TRAIL CONNECTOR**

SCALE: 1" = 1 MILE

PLAN NO.

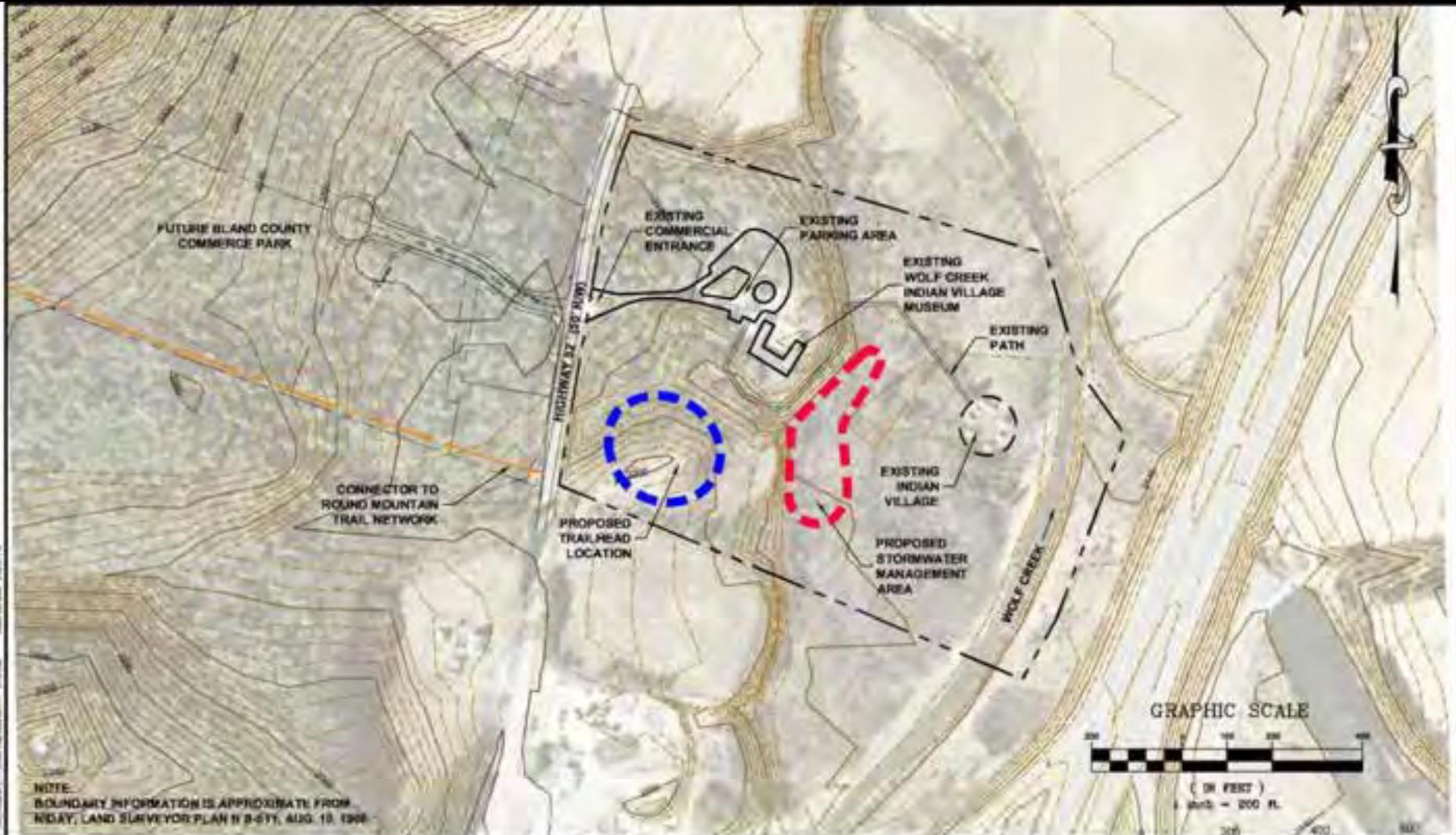
FIGURE

1



**Draper Aden Associates**

Engineering • Surveying • Environmental Services



NOTE:  
BOUNDARY INFORMATION IS APPROXIMATE FROM  
NIDAY, LAND SURVEYOR PLAN N 8-671, AUG. 19, 1908



**Draper Aden Associates**

*Engineering • Surveying • Environmental Services*  
2206 South Main Street  
Warrenton, VA 22080  
Tel: 502-544-7100 Fax: 541-553-0211

DESIGNED AVW  
DRAWN CBK  
CHECKED CBK  
DATE MARCH 24, 2008

LOCATION MAP  
ROUND MOUNTAIN TRAIL NETWORK TRAILHEAD CONCEPT  
BLAND COUNTY, VIRGINIA

SCALE: 1" = 200'

PROJECT: B05298-07P

FIGURE

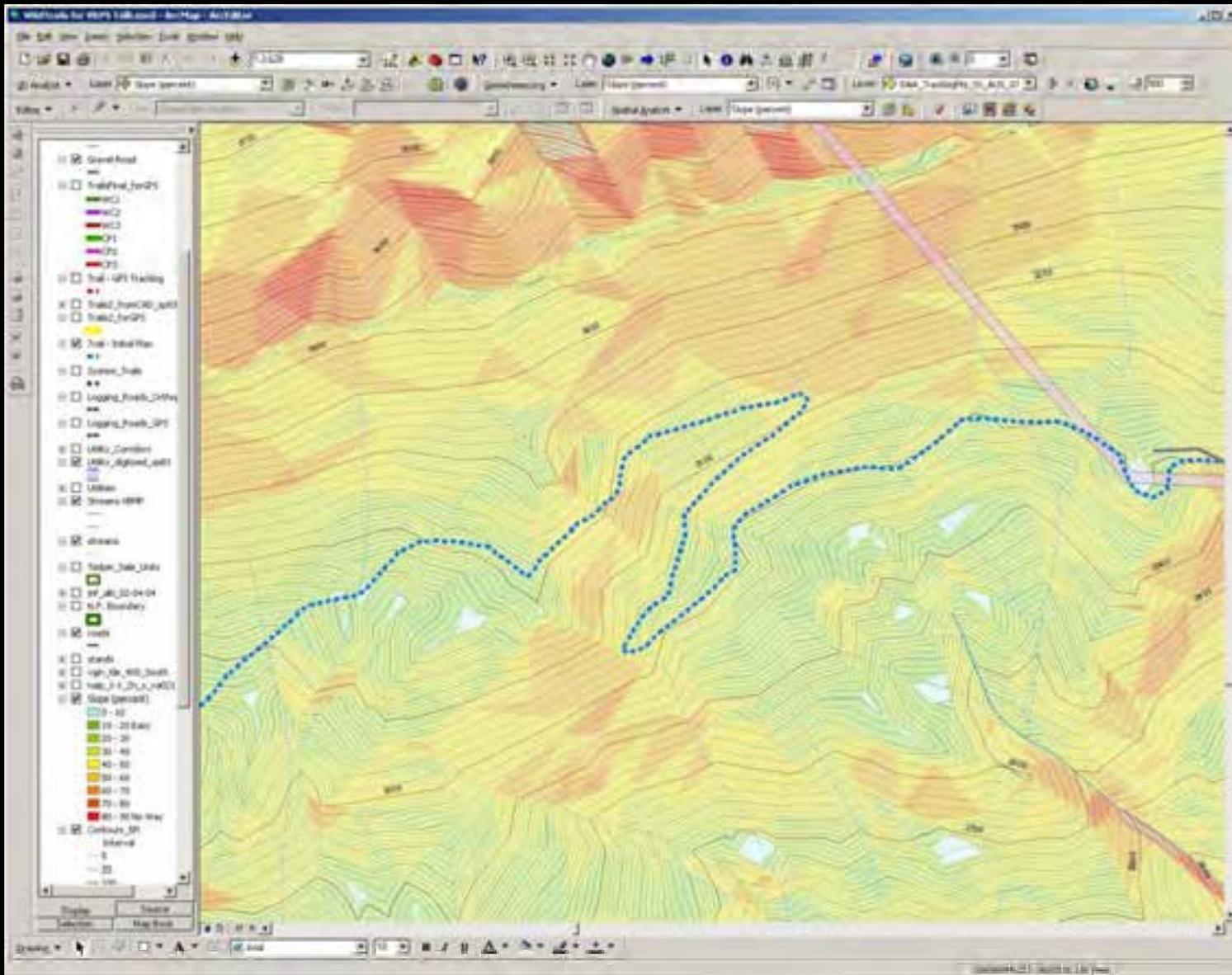
1



**Draper Aden Associates**  
*Engineering • Surveying • Environmental Services*

# Data Derivative Tools

- Next series of slides is a review of the design process.
  1. Data Based Design Route
  2. Field Recon and Route Adjustment
  3. Finalize of Corridor study area



**Draper Aden Associates**  
Engineering • Surveying • Environmental Services

**Data Based Design**

# Prepare for Field Work

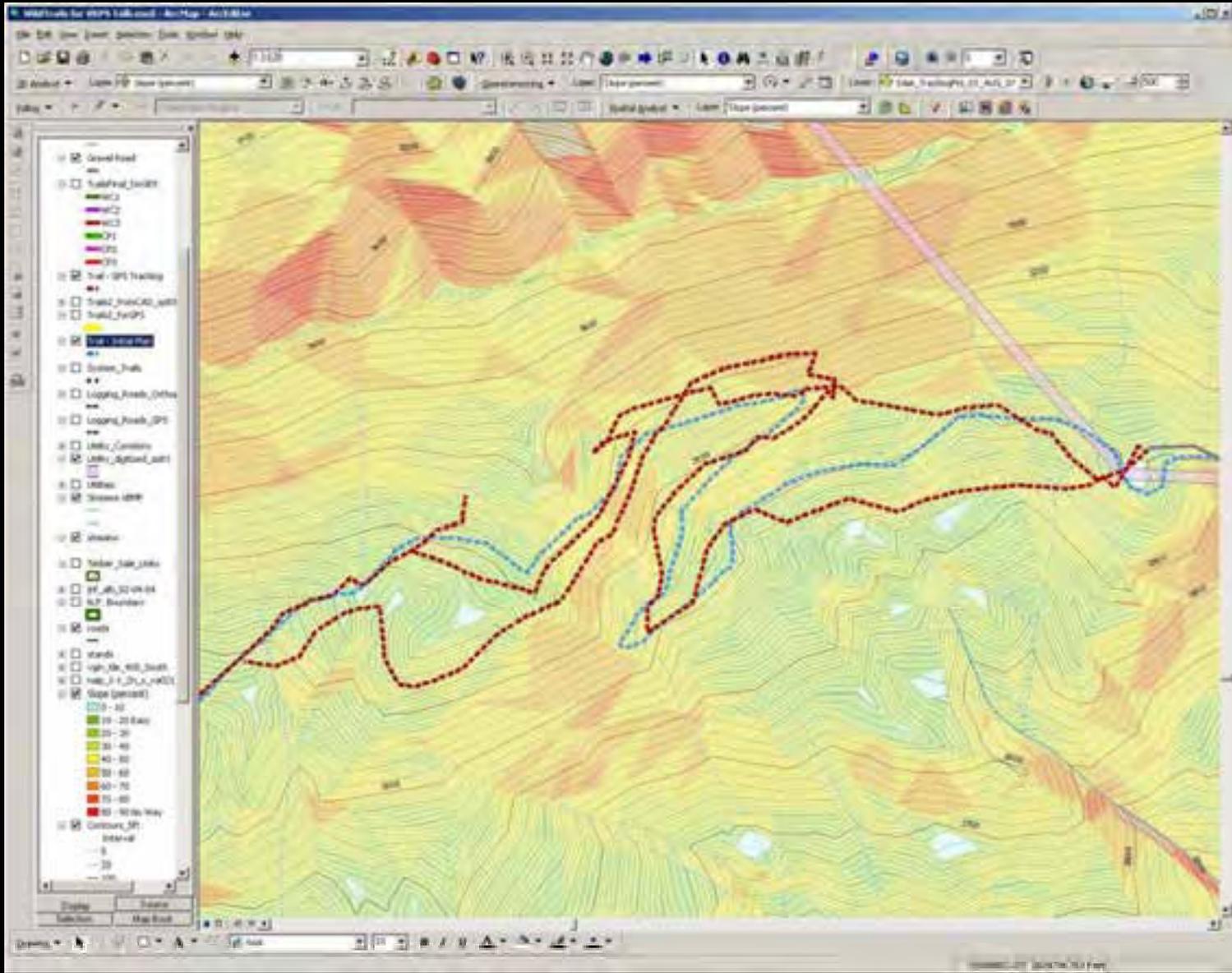
- Field Data Based Design
  - Upload GIS “DATA BASED DESIGN” to GPS unit
  - Gather slope maps GIS overlay maps to use in taking field notes
  - Define area of study and key study points “pinch points” or challenge areas
  - Head to the Wilderness!

# GPS Tracklogs, and Data Based Design



# Follow GIS Data-based Design Route

- Follow GIS data-based design
  - Retrieve “Actual/Field” adjusted trail route
  - Note reasons for trail relocation, remember this route is a corridor “study area” and requires further environmental impact analysis.
  - Note points of interest, views, significant landmarks,
  - Note factors that may affect trail construction level of difficulty and cost
  - Make notes on GPS and hard copies for use back in the office
  - Note routes not found in “data based design” to evaluate with GIS overlays



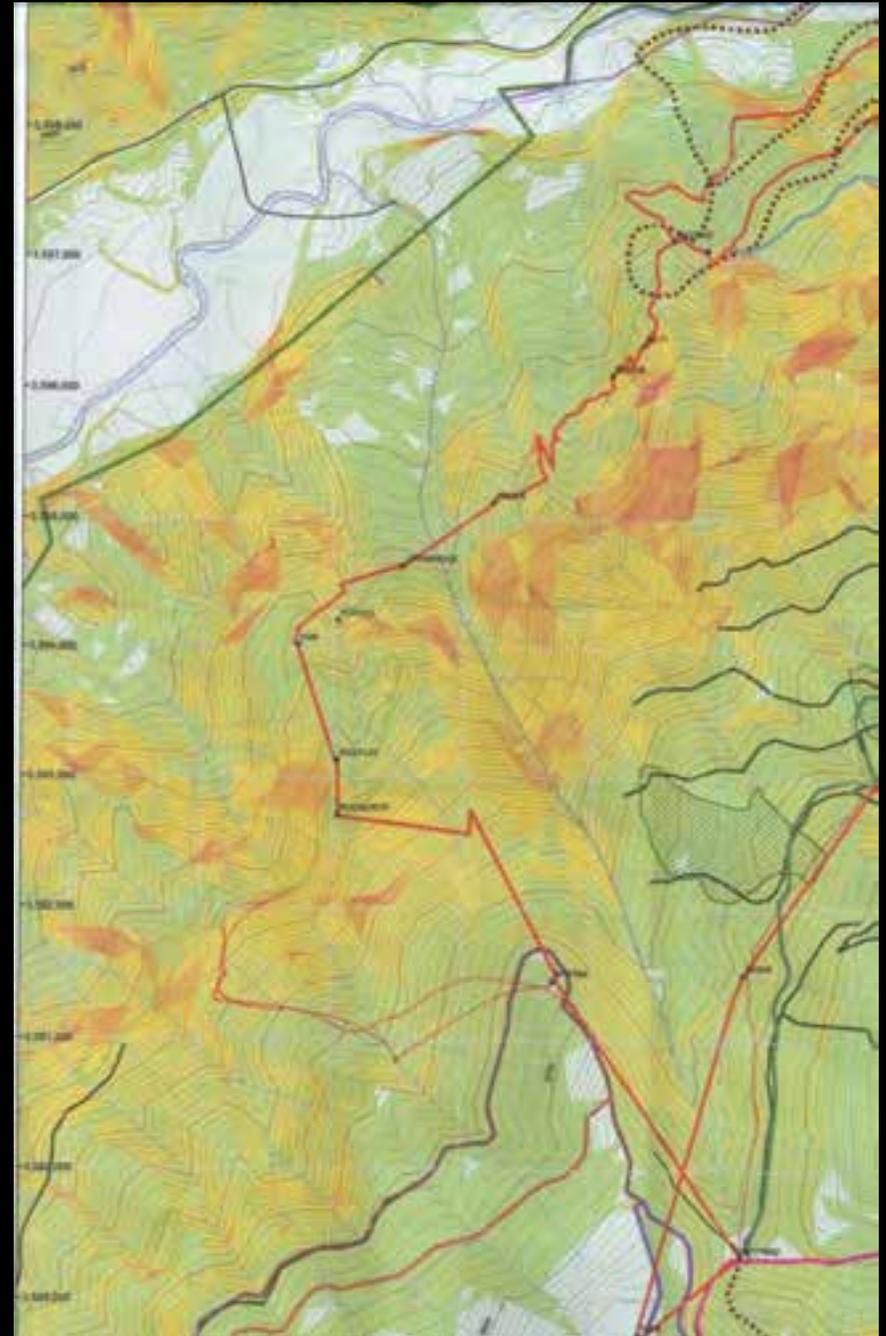
**Draper Aden Associates**  
Engineering • Surveying • Environmental Services

## Field Recon

# Deviations & features found along the way



# Slope Analysis Data & Field Adjustments

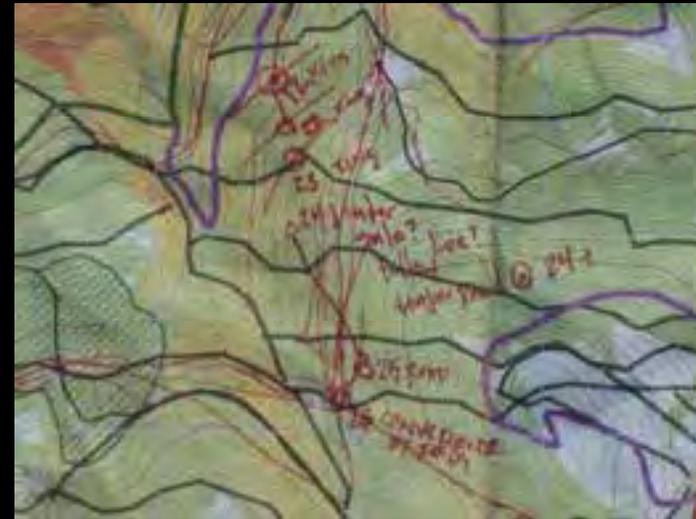


**Draper Aden Associates**  
Engineering • Surveying • Environmental Services

# Trail Constructability & Labor Effort



# Field Adjustments and Map Notes used in the field



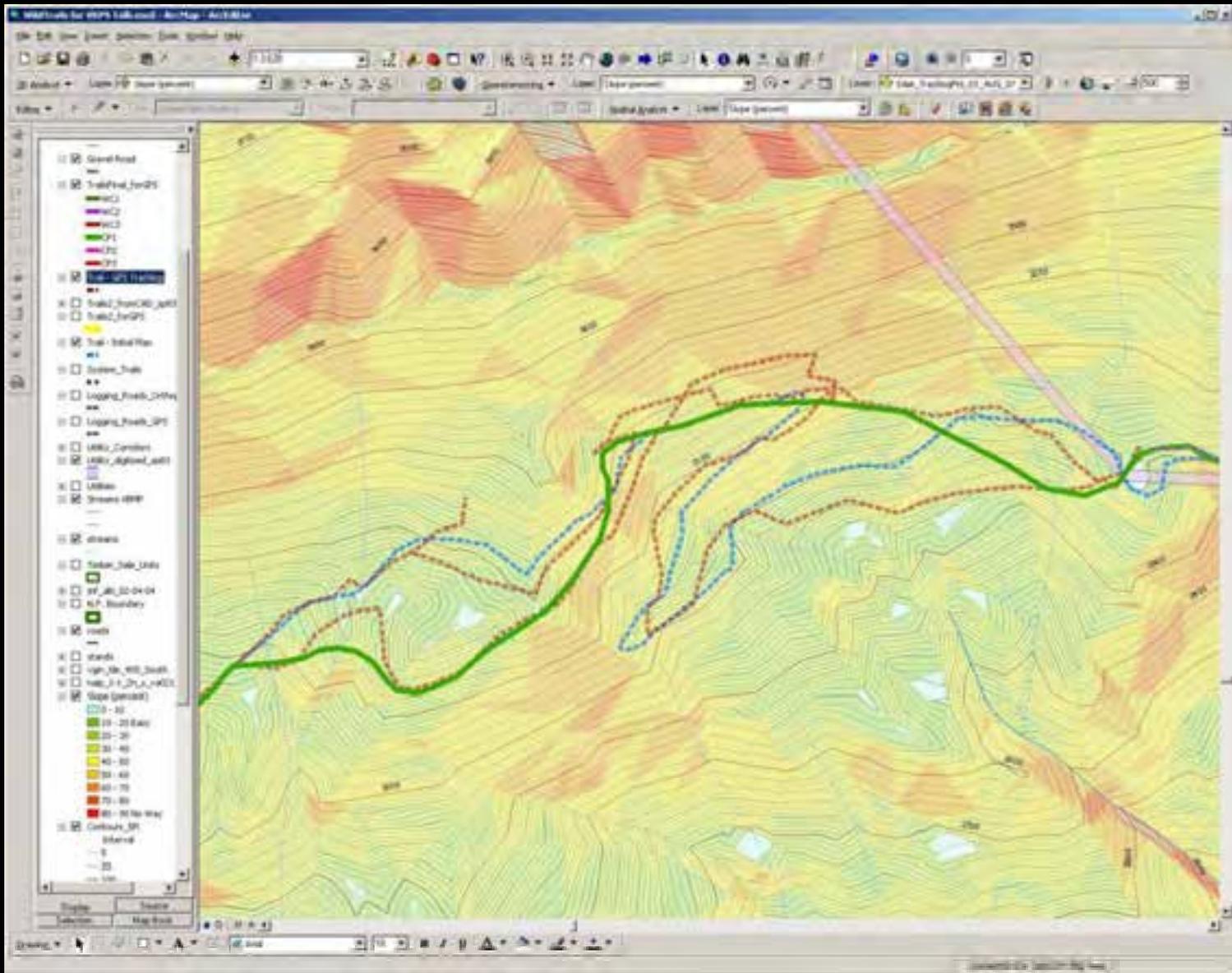
# Locating Switchbacks and Overlooks



**Draper Aden Associates**  
*Engineering • Surveying • Environmental Services*

# Decipher and compare Data based design with Field adjustments

- Take the points of interest and tracklogs from GPS into GIS utility program, to overlay design route with field route and other opportunities and constraints observed in the field.
  - Download data from GPS to GIS and CAD program
  - Plot field based design onto data derivatives (slope and aspect maps)
  - Determine routes abandoned OR approved for “final corridor study”



**Draper Aden Associates**  
Engineering • Surveying • Environmental Services

## Final Trail Corridor

# Round Mountain / Rich Mountain Trail Network

## Route Identification - Bland County, Virginia



Task: Identify locations for new trails to connect existing National Forest roads and trails.

A primary consideration in siting any trail in this area is the steepness of the mountain side. The 2002 Virginia Base Map (shown here) (public domain) provided a base for creating a terrain model that was used to create slope maps in addition to contours. This became the most important layer in guiding the design of potential paths for field reconnaissance.

To speed the collaborative process all the base layers were handled in ArcGIS. Potential trail routes were designed and uploaded to a DPC unit. Field reconnaissance became systematic as the team could already hike the proposed path. This efficient process allowed assessment and recording of site conditions with less worry of navigation.

# Process - Final Corridor Study Area

- Final Corridor Study Area
  - Adjust final corridor study routes based on GIS data derivative tools
  - Run sectional profiles of routes
  - Identify each route with a level of trail classification based on trail gradients and widths
  - Identify trail constructability and costs based on trail classification and site constraints.
  - Identify areas that require specific study (stream crossings, sensitive lands)

# Communicating the Final Design

- Sharing the final design in various formats.

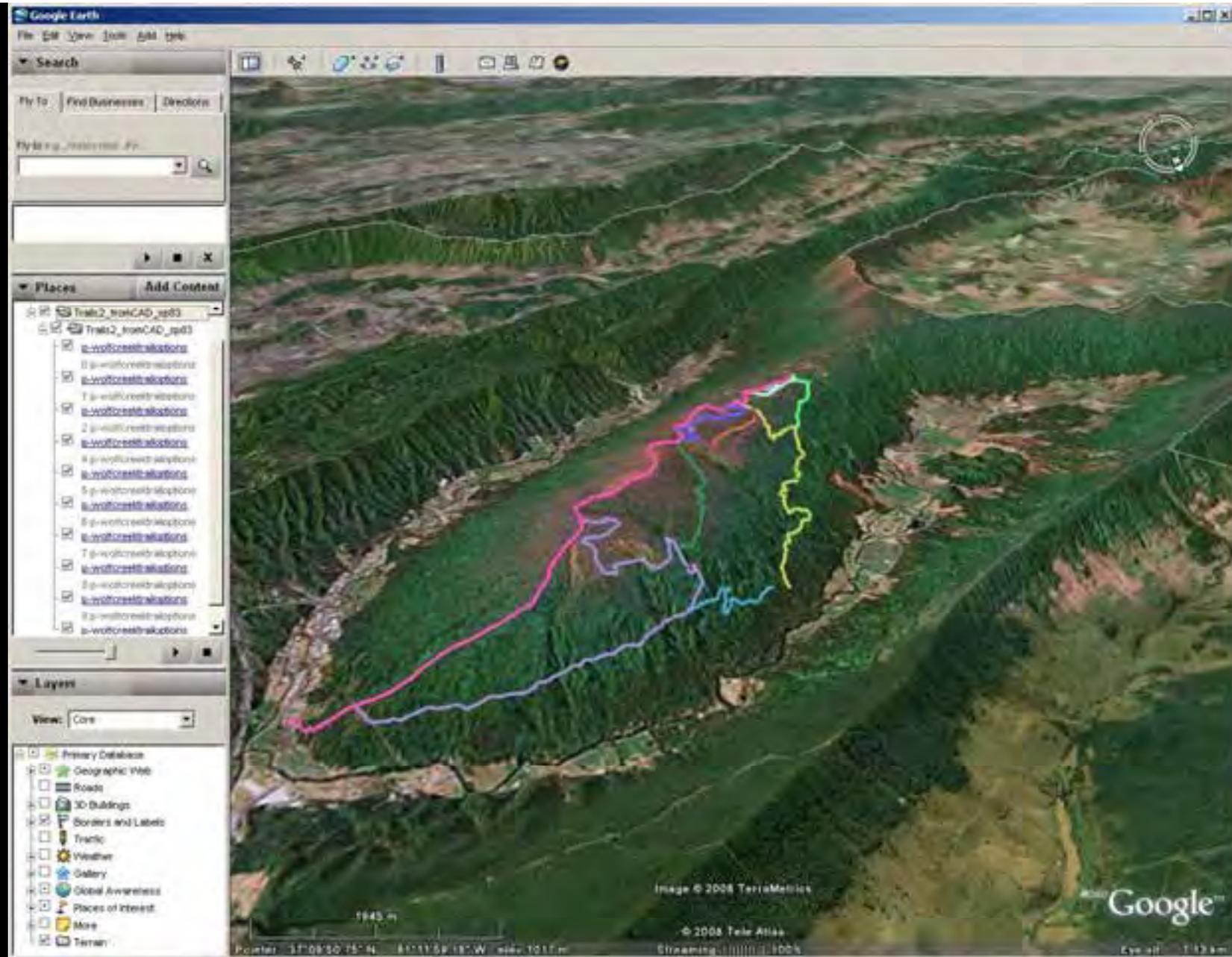
- Digital

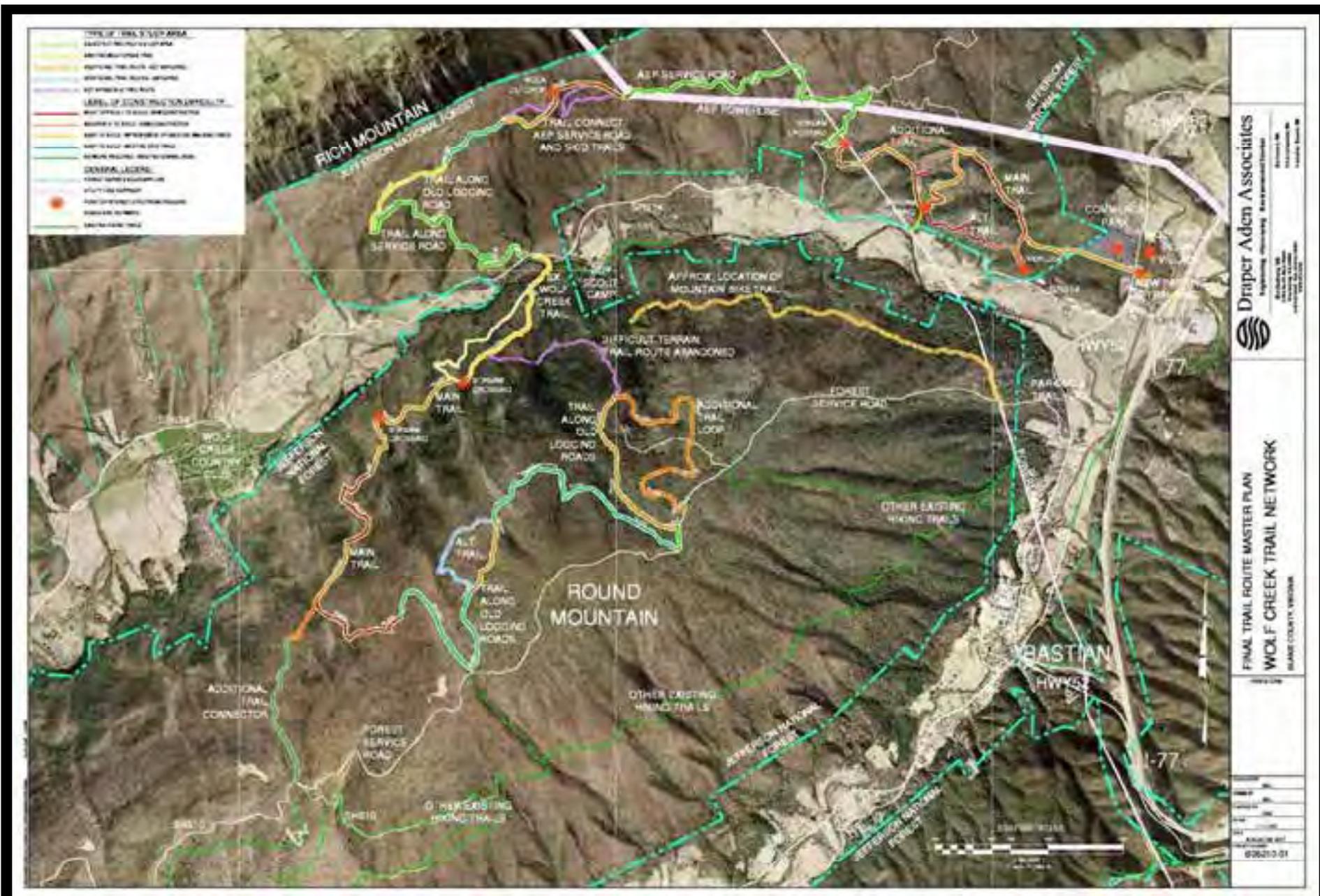
- Shape Files (SHP)
- Google Earth data files (KML)

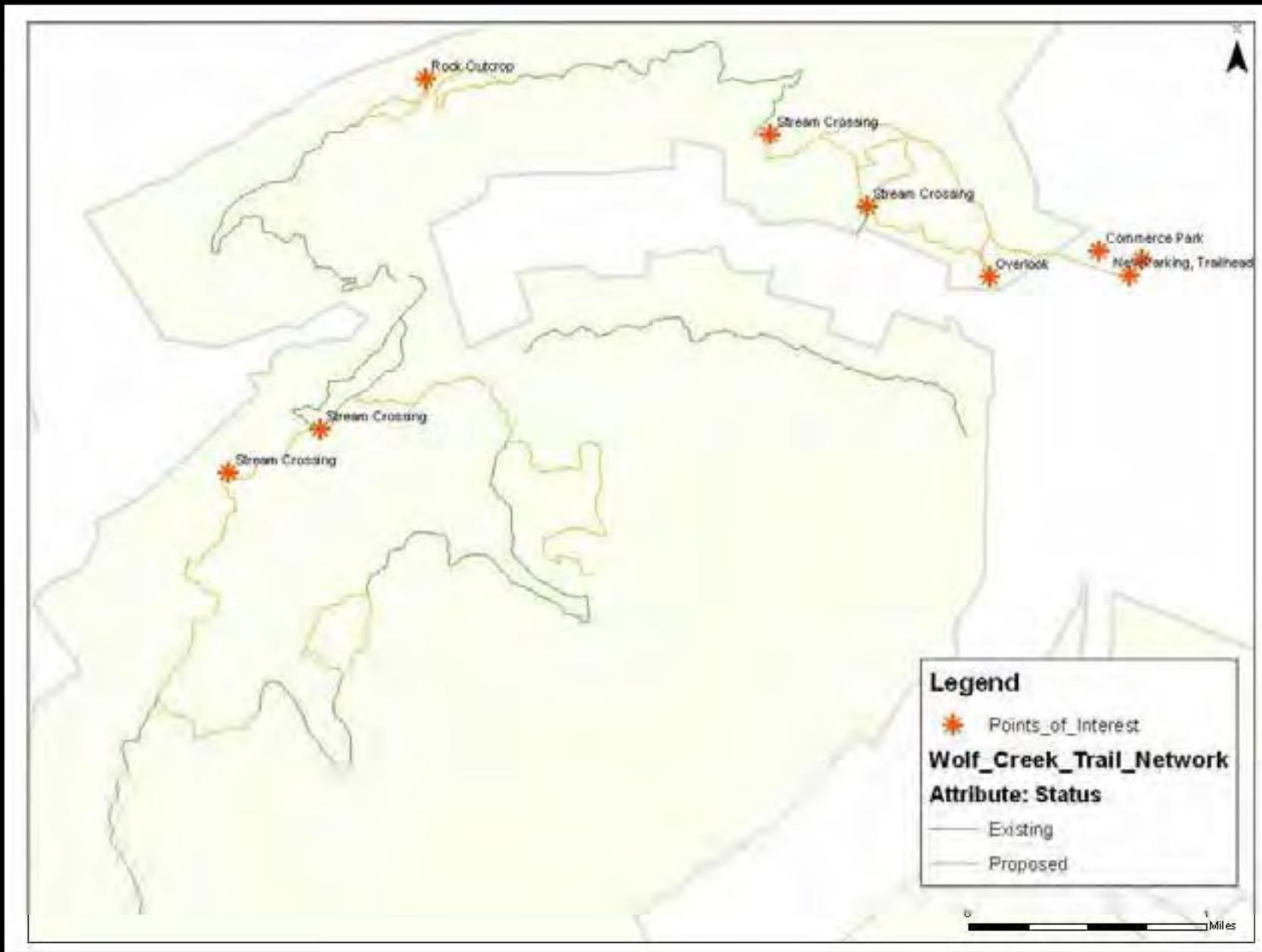
- Visual:

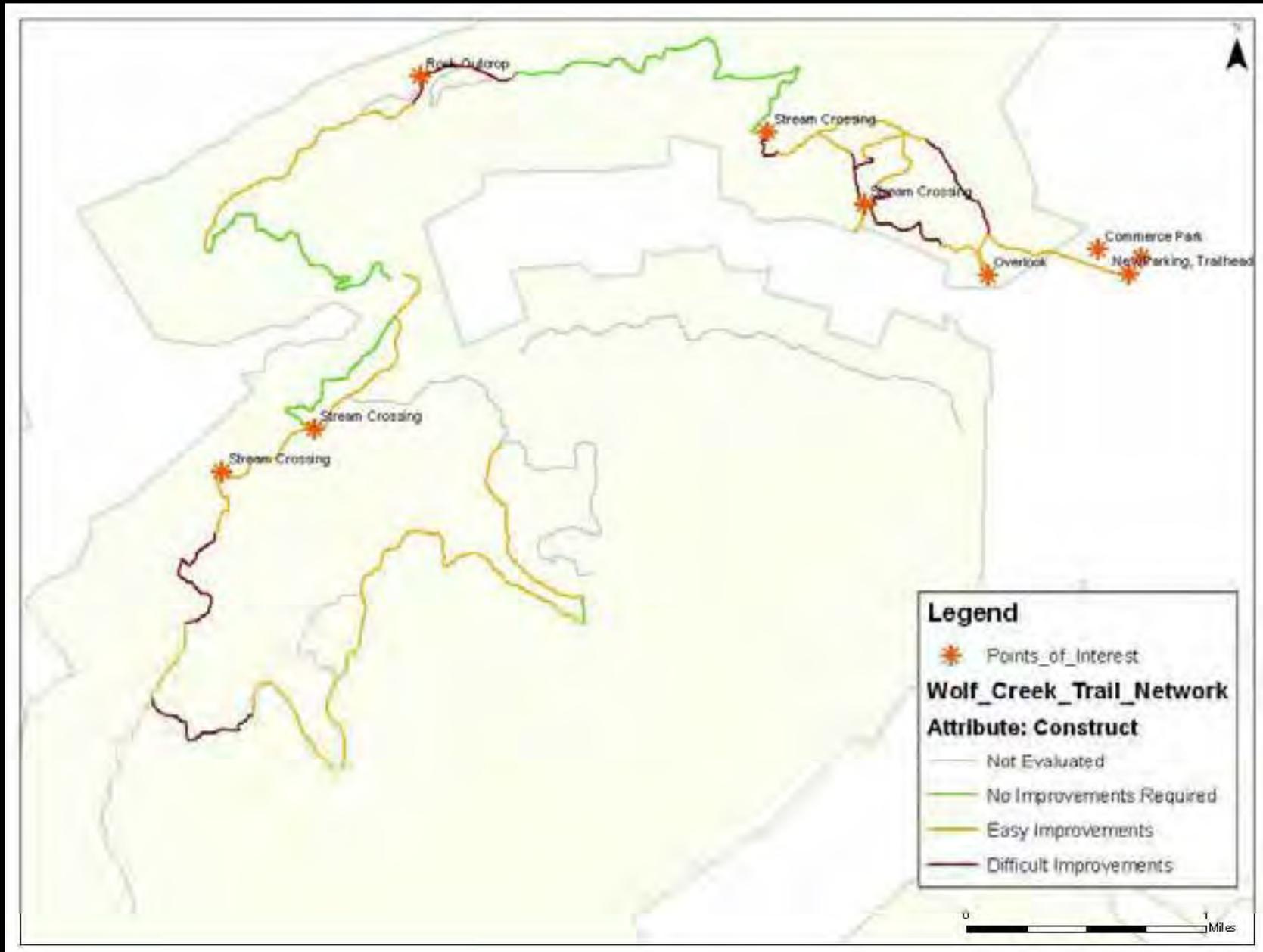
- Images (PDF)

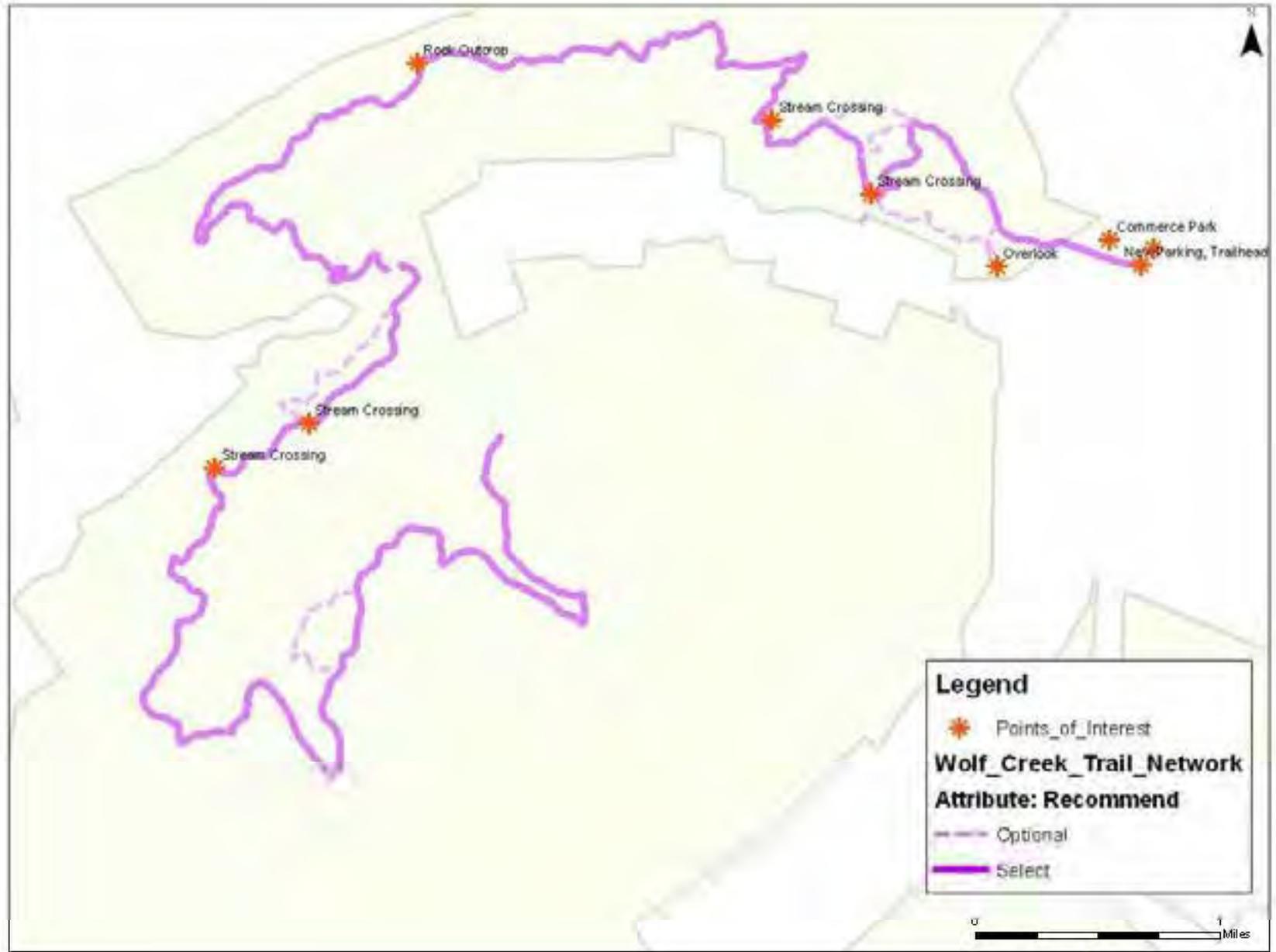




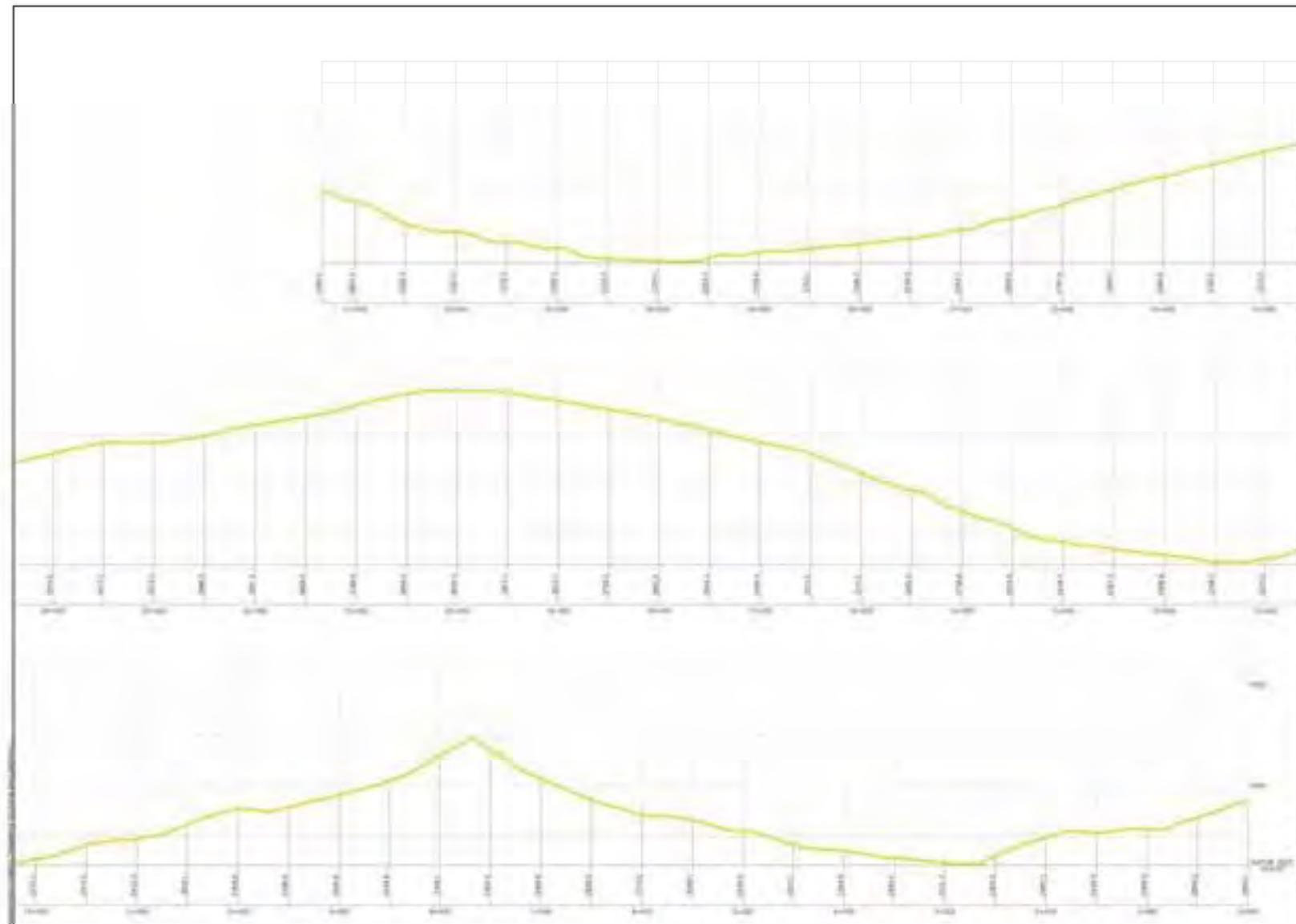








**Draper Aden Associates**  
 Engineering • Surveying • Environmental Services

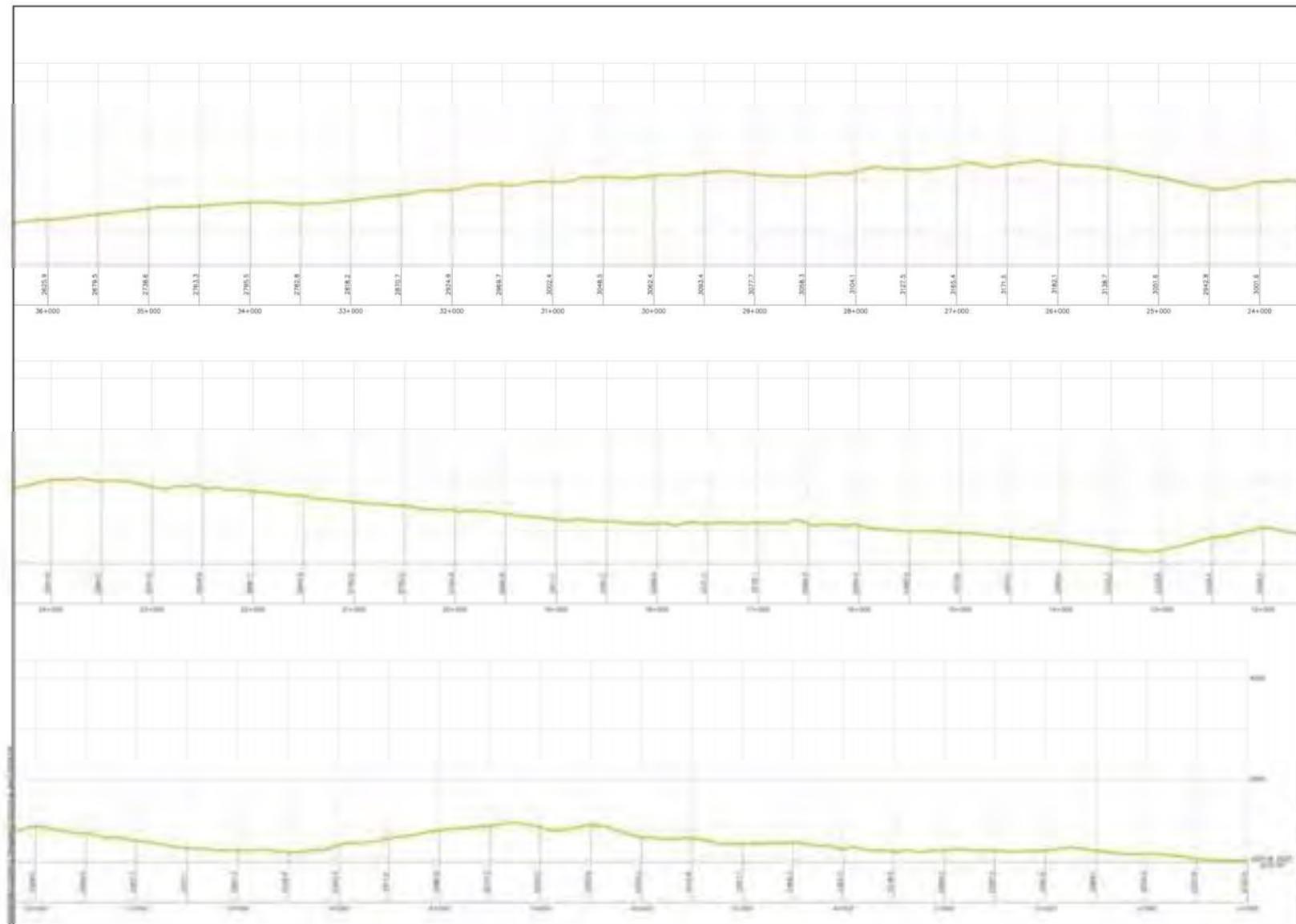


**SECTIONS THRU IRON AND ROUND MOUNTAINS  
WOLF CREEK TRAIL NETWORK**  
BLAND COUNTY, VIRGINIA

**Draper Aden Associates**  
Engineering • Surveying • Environmental Services

1000 N. Main Street  
 Suite 200  
 Blacksburg, VA 24060-1000  
 Phone: 540/526-1000  
 Fax: 540/526-1001  
 Email: info@draperaden.com

Project Name	Wolf Creek Trail Network
Project No.	000210-01
Date	10/10/10
Scale	As Shown
Author	JAD
Checked	JAD
Approved	JAD



**Draper Aden Associates**  
 Engineering • Surveying • Environmental Services  
 2000 N. 1st Street, Suite 100  
 Blacksburg, VA 24060  
 Phone: 540-538-1100  
 Fax: 540-538-1101  
 www.draperaden.com

**TRAIL PROFILES**  
**WOLF CREEK TRAIL NETWORK**  
 BLANE COUNTY, VIRGINIA

Project No.	606210-01
Scale	1" = 20'
Date	11/11/10
Drawn by	JLH
Checked by	JLH
Approved by	JLH

# Questions - Discussion

Michael LaRoche – *Landscape Architect*

Mike Futrell – *GIS Administrator*



**Draper Aden Associates**  
*Engineering • Surveying • Environmental Services*