

Precision Surveying of Historic Trails

Lewis and Clark in Idaho - 2004

Iowa State University GIS Day – Nov 15, 2006

1 Steve F. Russell – Interests and Goals

- Scholarly research on historic trails with original journals, original maps, and modern field work (camping out all summer)
- Work with state, federal, Tribal, and historic preservation agencies
- High-accuracy GIS results using ARCVIEW and precision GPS
- Natural history documentation: geology, plants, animals
- Archival results: publications and documentation in state historical society archives and journals

Ancient Nez Perce Trail followed by Lewis and Clark

4 Trimble Pathfinder Pro XRS

- Precision DGPS stand-alone unit
- Satellite, WAAS, and Coast Guard beacon DGPS
- 8-10 hours of battery life in the field
- Highly flexible data logging
- Designed to minimize data errors in the field
- High performance receiver with multipath compensation
- Designed to operate in heavy forest canopy

7 Screen Shot of Pathfinder Map and data

Initial Raw Survey Data with Topo Map

- Quad: Rocky Ridge
- Locality: Rocky Ridge Lookout
- DRG: o46114e6
- NAD 27 (conus) UTM
- ZONE: 11
- NORTH: 5161708
- EAST: 680670

10 USGS Topographic Map Errors

Errors in a topographic map can make it look like the GPS plot is in error

The map to the above right has the GPS data accurately plotted on a USGS 7.5 minute DRG. The map elevation contours are distorted and too far west and south of the actual location of this ridge

The GPS plot on the map to the below right has been distorted so that it appears to be in the correct location. This is fine for hiking and reading paper maps but any GPS readings taken from this map will be in error

Conclusion: The accuracy of USGS DRGs is not adequate for accurate portrayal of both the correct UTM location and the perceived topographic location

Last surviving plaque put along the trail by Jack Harlan, 1935

Note bullet holes!

2 Technology Summary

- US Geological Survey topographic maps
- USGS digital raster graphics maps
- ARCVIEW Geographic Information System precision mapping
- Trimble Pathfinder PRO/XRS precision survey quality GPS
- Pathfinder Pro mapping software
- Laptop with support software and CD archive
- Logistics: battery chargers, inverters

5 Let's Improve on the Expedition Maps

Lolo Creek and Hungry Creek in the Bitterroot Mountains of North-Central Idaho

8 Loss of Accuracy During Real-Time Tracking

- Methods of DGPS
 - Coast Guard beacon
 - Subscription satellite system
 - Wide Area Augmentation System (WAAS) satellite
 - Base-Rover differential GPS

In heavy forest canopy, only the low-frequency Coast Guard beacon is effective. DGPS satellite signals are too weak to be received.

Although the Pathfinder receiver reported 3D differential GPS, its tracking loop had lost lock and gave an error almost 40 times larger than was reported

So far, the only effective solution to this problem has been to manually post-process the data

6 Zig-Zag Searching for the Trail

It takes a large amount of searching all around to find the trail tread

A bear has been inspecting this old log in search of insects

9 Manual Post-Processing of Data - Final Results

Manual post-processing of data with ARCVIEW

- Smooth line drawn between known good points
- Interpolation is used
- Scallops and other loss-of-tracking artifacts are removed
- Field notes and memorized trail features are used to assist interpolation

Salmon River Canyon in Idaho

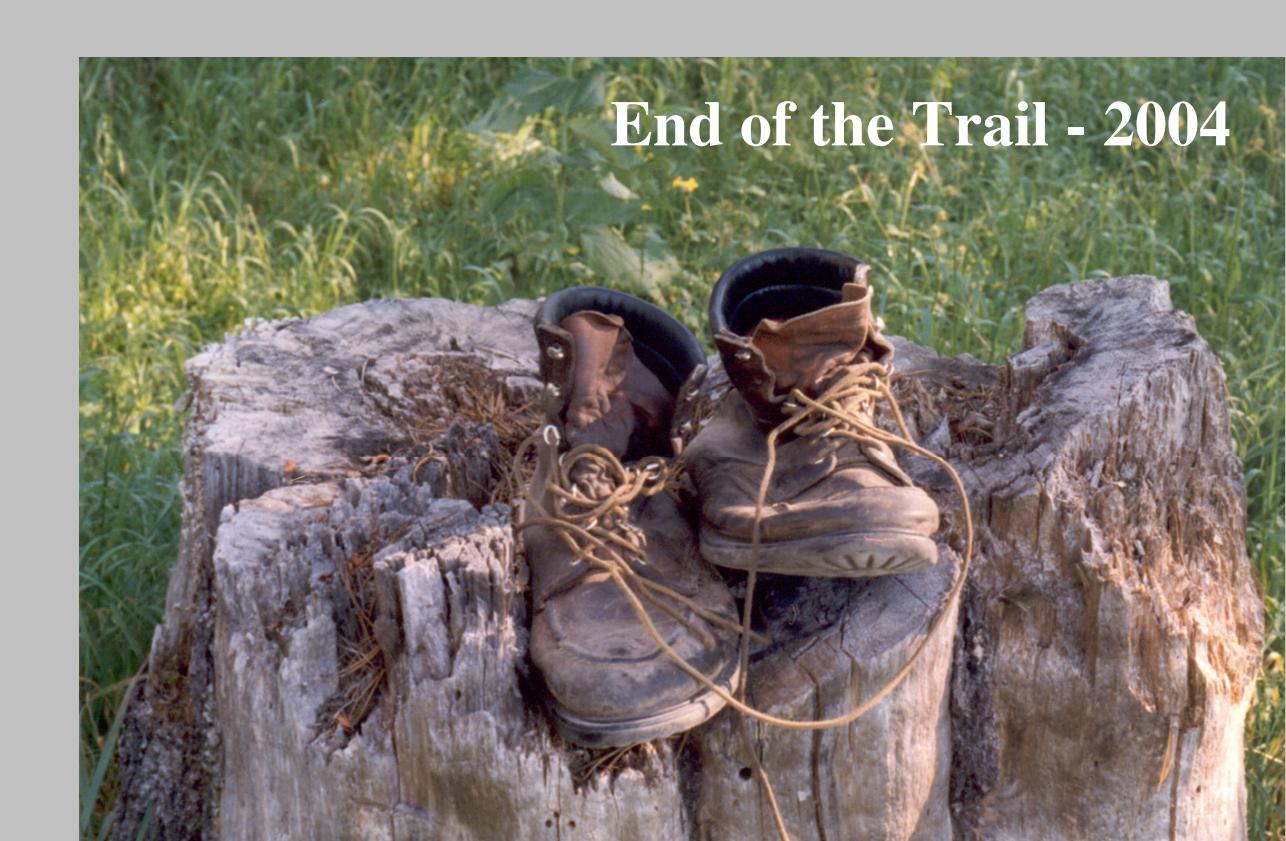
3 GPS Menagerie

Trimble 3-Mode Antenna
Laptop PC
Trimble Backpack Receiver
Trimble Ensign Handheld
Power Supplies and chargers for 12V and 120V
Trimble Scoutmaster Handheld
Garmin Etrex Vista Handheld
Garmin 12XL Handheld
Trimble Data-logger Computer
Garmin DGPS Mag Antenna
Garmin DGPS E-Field Antenna
Cables for connecting units

12 Lolo Summit

THE LEWIS AND CLARK PARTY CROSSED THIS PASS SEPT. 13, 1805, WESTBOUND FOR THE PACIFIC AFTER A LONG DETOUR TO THE SOUTH.

From the headwaters of the Missouri they had crossed the mountains to the Salmon. Finding that river impassable, they had to go north to the Clearwater, and came north to an Indian trail across it. Fortunately, first and ill-fated, the Indians were to have a half mile to go before they could cross the Clearwater, so the trail followed along the steep ridges which the trail followed for most of the rest of the course west to the Clearwater River.



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