

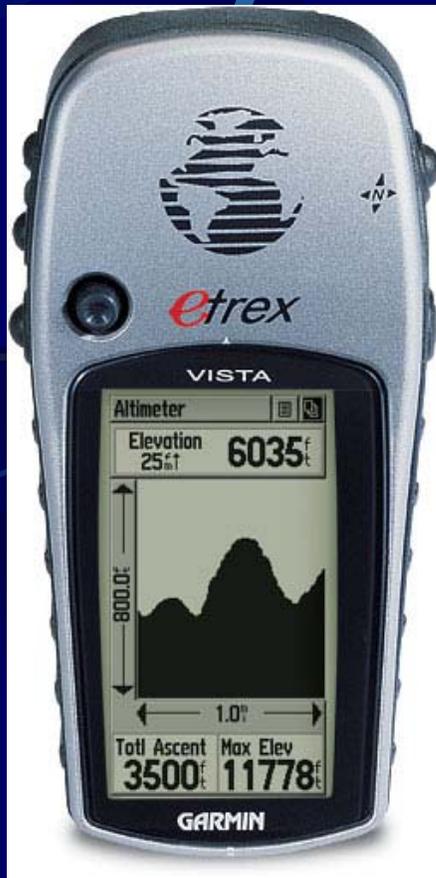
BLASTING APPLICATIONS FOR GPS

Ken Eltschlager
OSM, Appalachian Region

@ Advanced Integration of
Geospatial Technologies in Mining
and Reclamation Conference

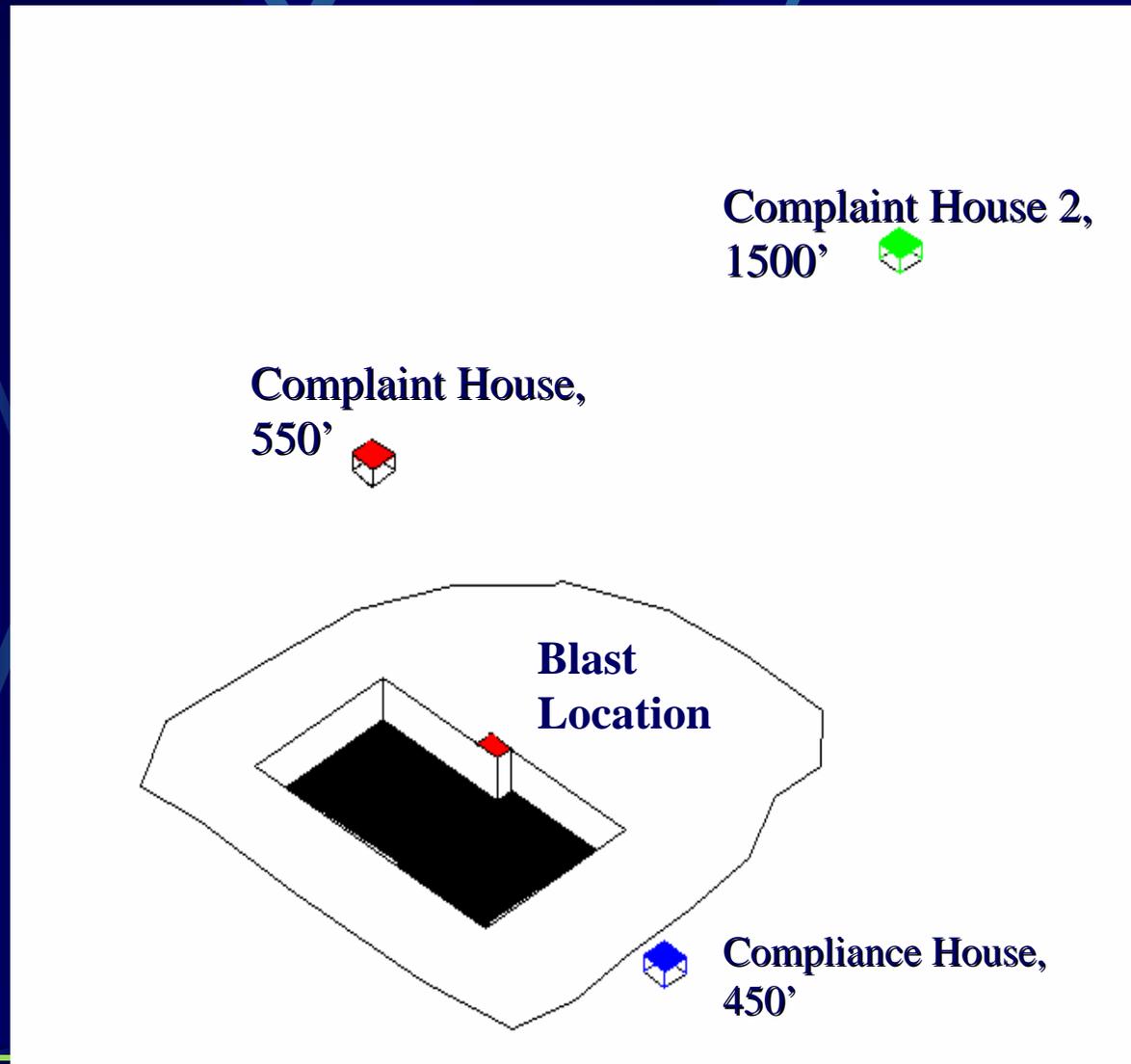
Atlanta, Georgia

December 7-9, 2004



PreBlast Survey and Blast Locations

- Required by rules
- Establish spatial relationships
- Establish distances
- Establish allowable charge weights
- Liability protection



35S5-WM1

13th April 2002

Magazines and Seismograph Locations

- Seismograph locations are important for liability protection and site characterization ■
- ATF requires schematics and aerial photograph documentation for:
 - Security
 - Emergency response

How Locations

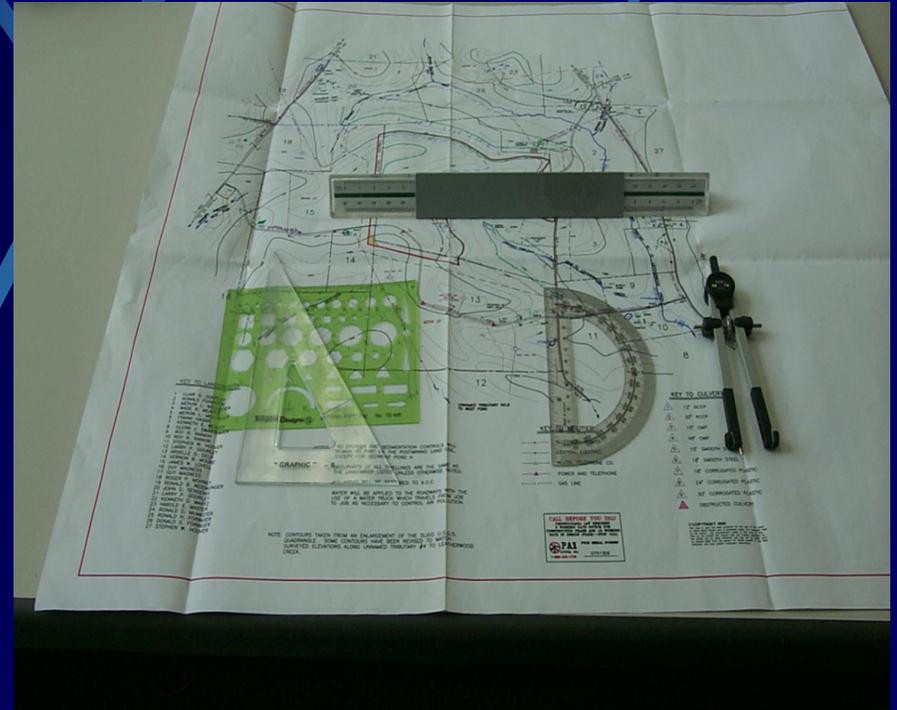
- Survey (costly)
- Aerial Photography (costly)
- Compass and range finder (line of sight)
- Topographic Grid map (eyeball)
- GPS



Accuracy of Blasting Data

- Two components

- Northing and Easting
- Latitude and Longitude
- Distance and Azimuth
- Grid map? ■



- Industry standard - Measurements to two significant digits

- $< 100'$ to the nearest foot
- $100' - 1,000'$ to the nearest 10 feet
- $1000' - 10,000'$...to the nearest 100 feet

GPS Accuracy

- GPS receivers use triangulation to calculate location
- Receiver must be locked on to at least three satellites to calculate a 2D position (latitude and longitude)
- Four or more satellites, can determine a 3D position (latitude, longitude and altitude), 40 feet accuracy on average

GPS Accuracy

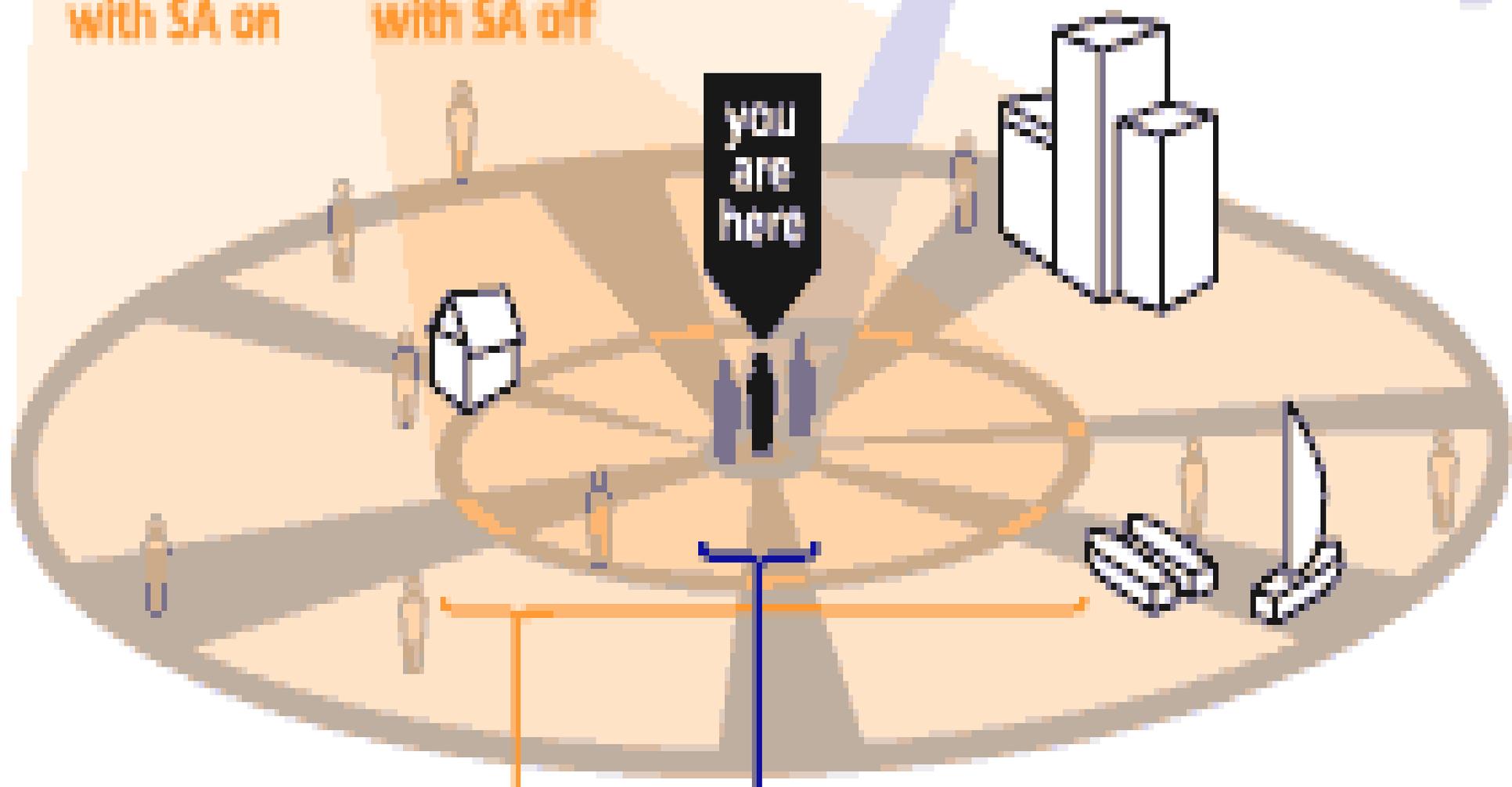
- WAAS (Wide Area Augmentation System) capability can improve accuracy to less than ten feet on average. ■
- Differential correction provides accuracy to within 3 feet, under ideal conditions less than 1- foot

GPS Accuracy

with SA on

with SA off

WAAS Accuracy



100 meters

15 meters

< 3 meters

GPS SELECTION

Low end

40 feet

\$100

Mid range

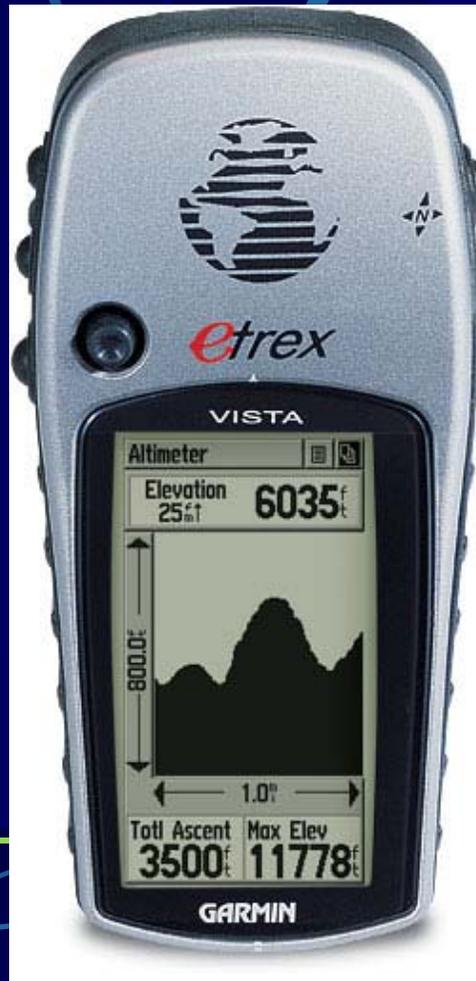
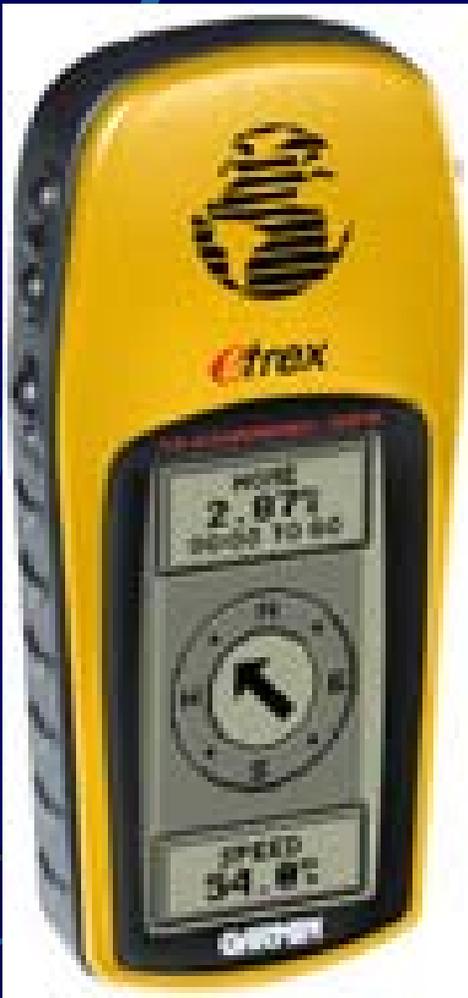
10 feet

\$450

High end

3 feet

\$4,000



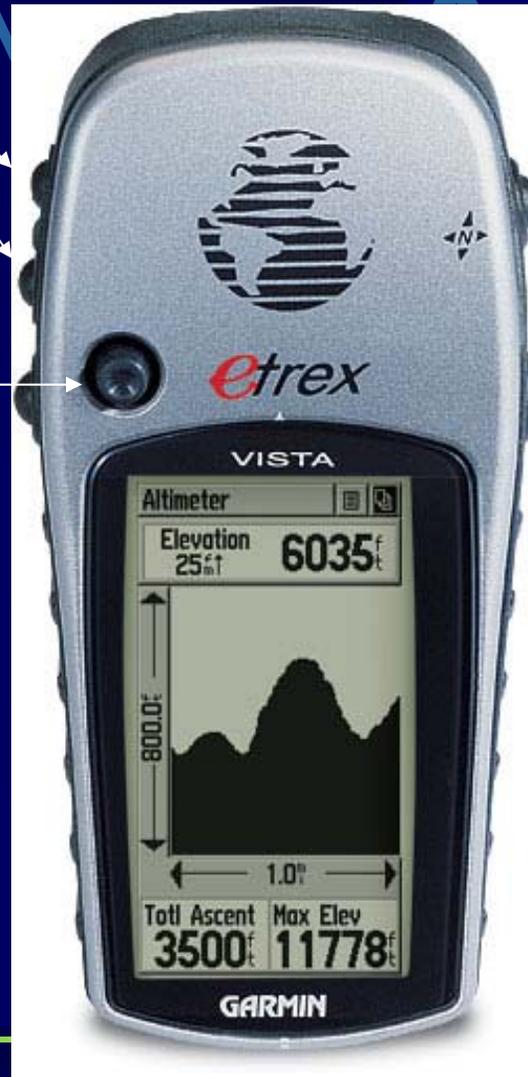
Track and Point Comparison Garmin vs Trimble



THE GPS UNIT'S BUTTONS

ZOOM
IN/OUT Button

CLICK STICK: Can
be pressed in, moved
up/down, or
left/right.

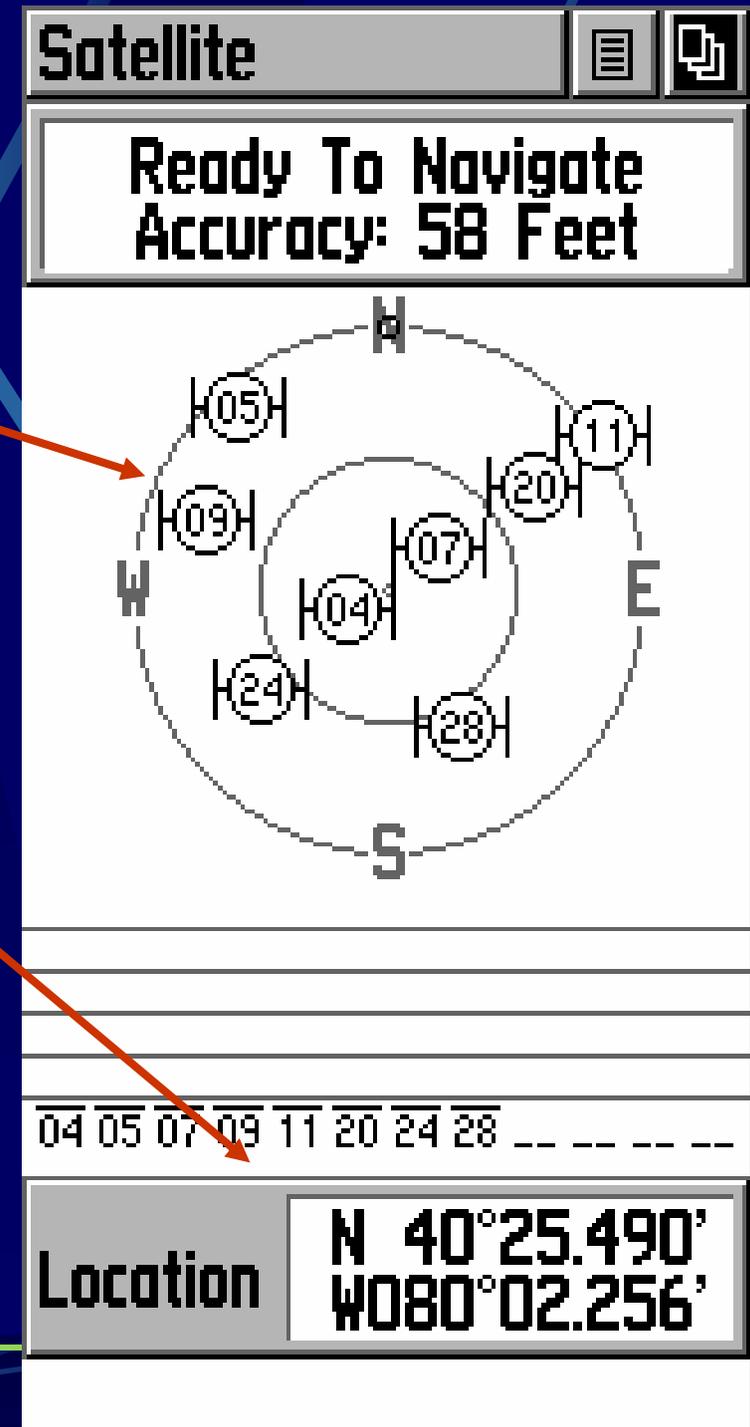


PAGE Button:
Used to cycle
through pages.

POWER Button

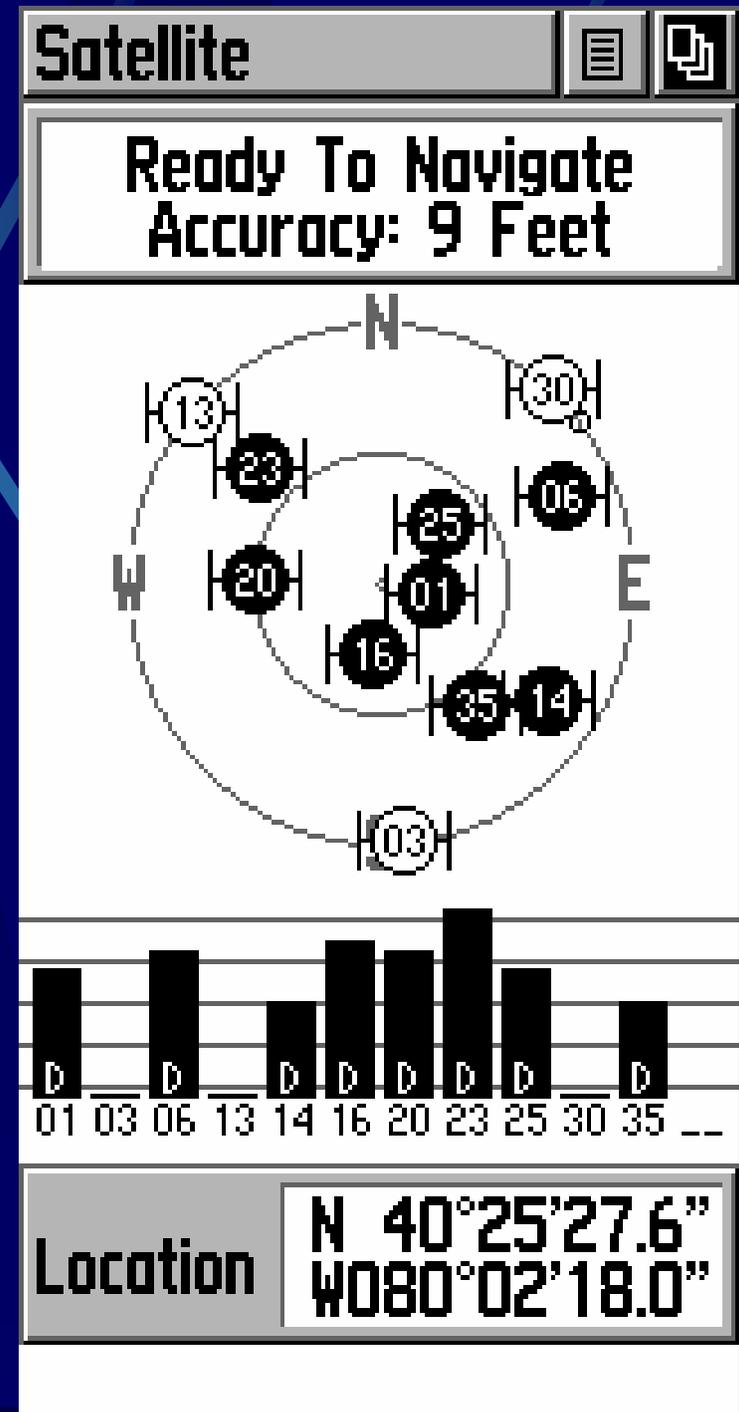
Satellite Page

- Once enough satellites have been located, you can begin using the GPS unit.
- The unit will display your current location coordinates at the bottom of the screen (dd mm.mmm or dd mm ss.s)
- Can be changed to UTM



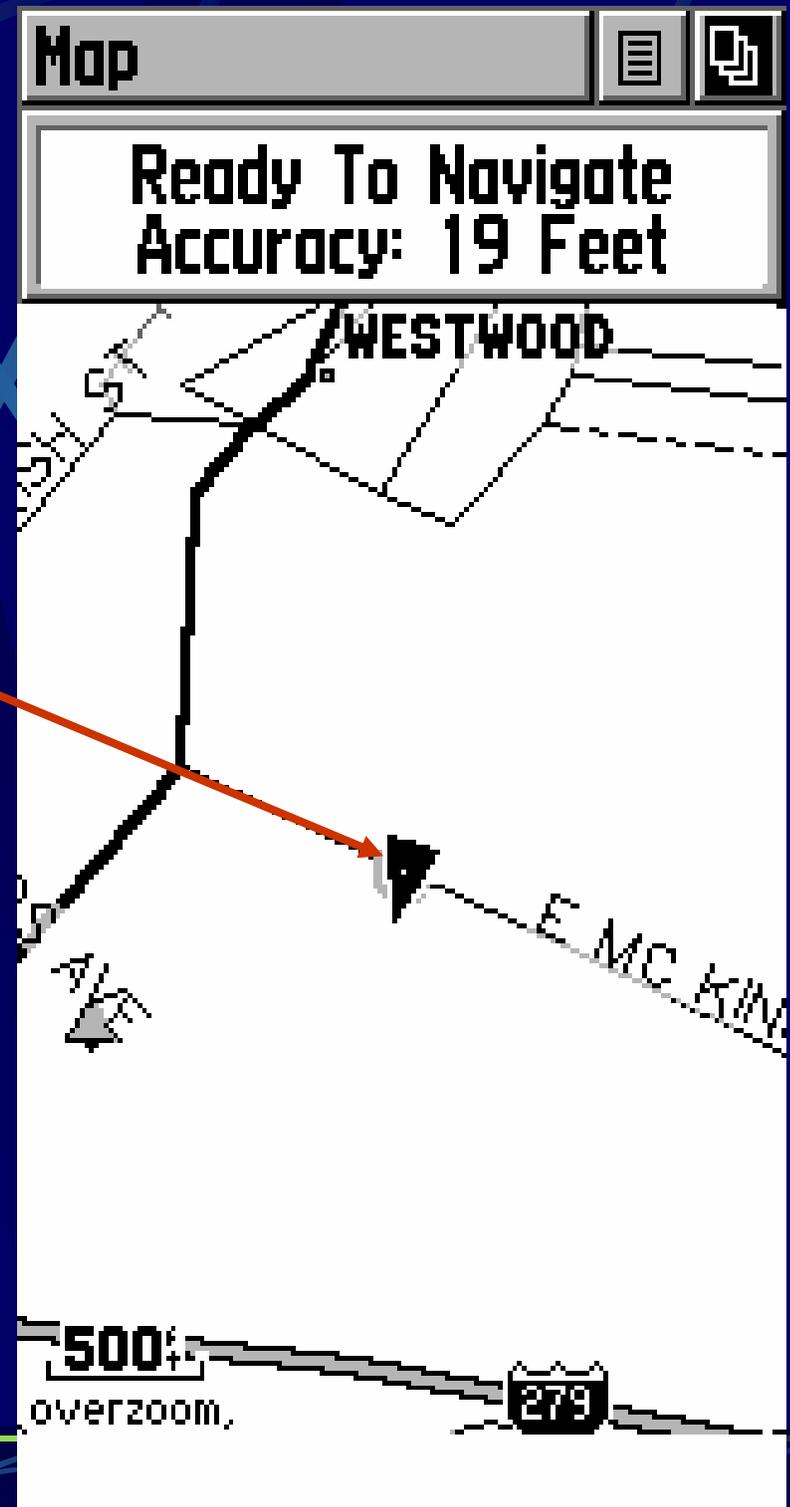
WAAS Enabled

- Acquired satellites darken
- Satellites # 33+
- “D” indicates differential correction
- Best with a clear view of sky (like most mines)



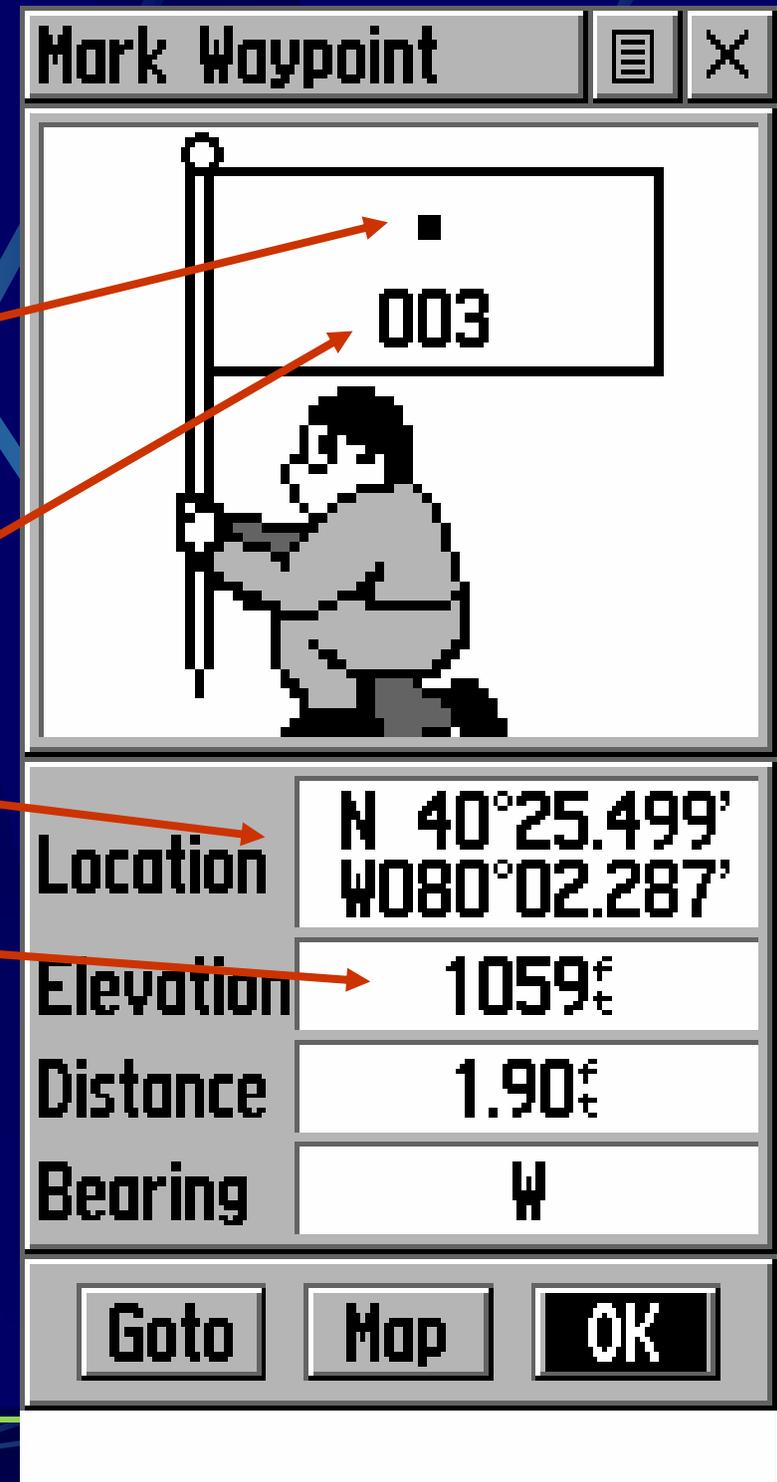
Map Page

- The black arrowhead represents you
-
- And the direction you are facing.
- The top of the GPS unit represents North.



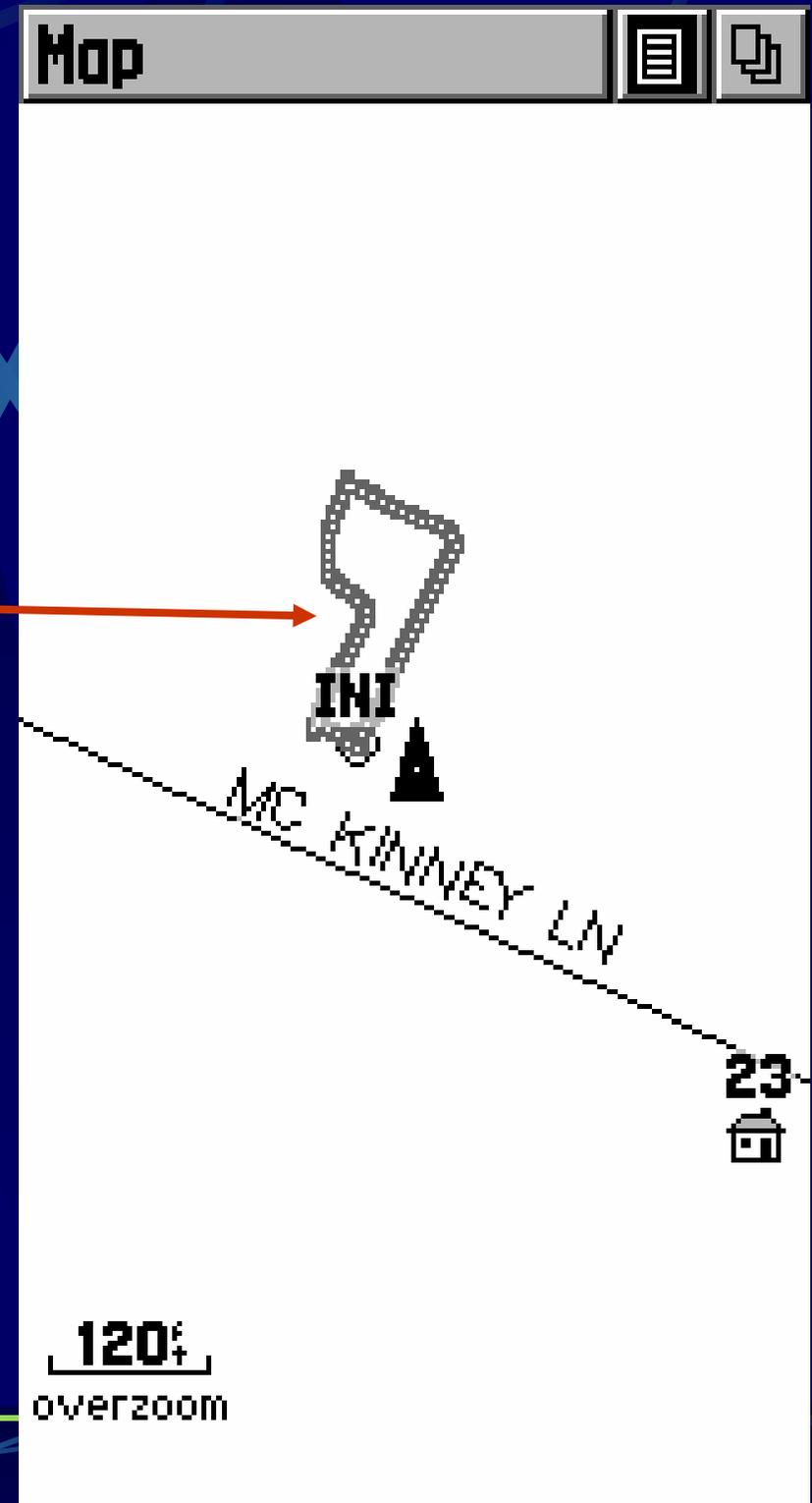
Waypoints

- Symbols
- Names (Shot121103)
- Coordinates
- Elevation
- 500 waypoint limit

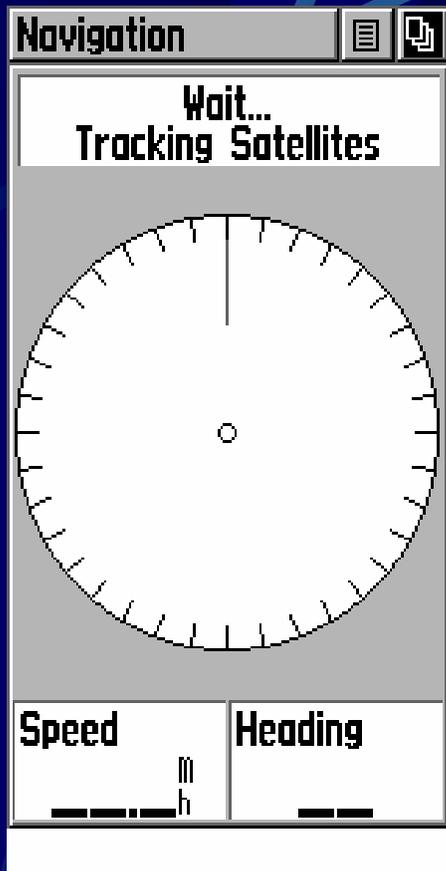


Tracks

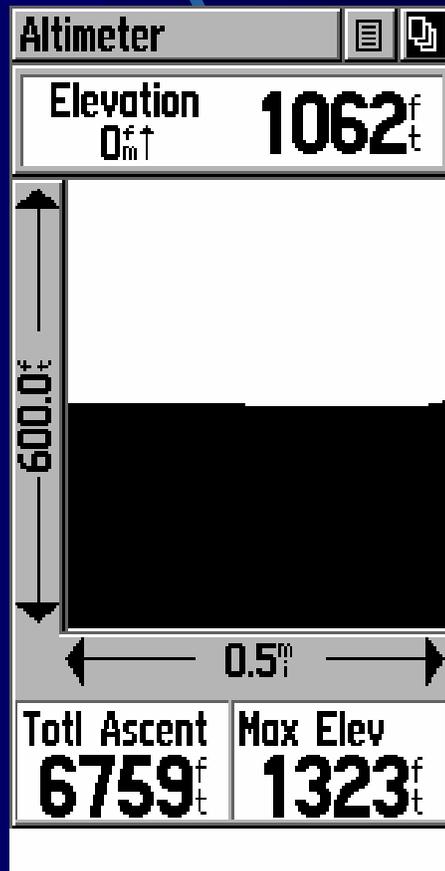
- Track is a cookie crumb trail
- Distance or time based
- 10,000 points



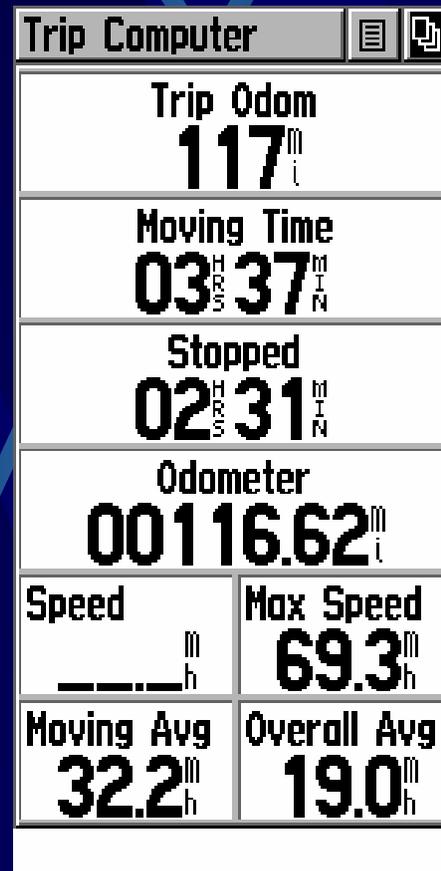
OTHER FEATURES



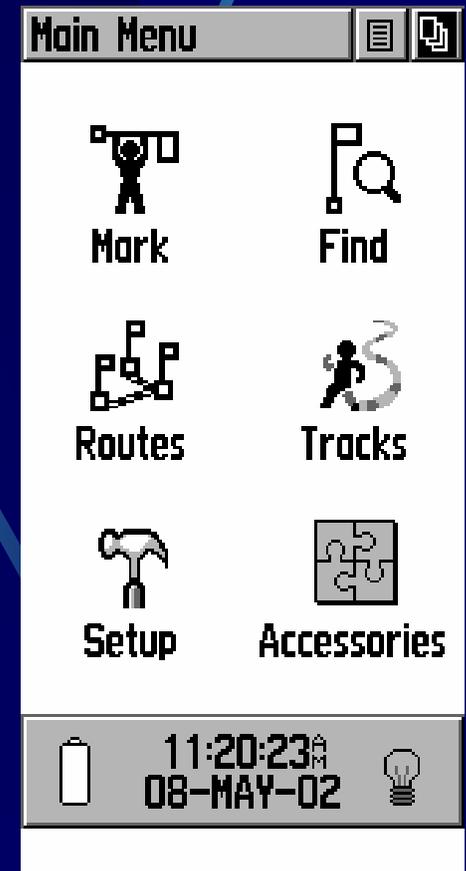
COMPAS
S



ALTIMETER



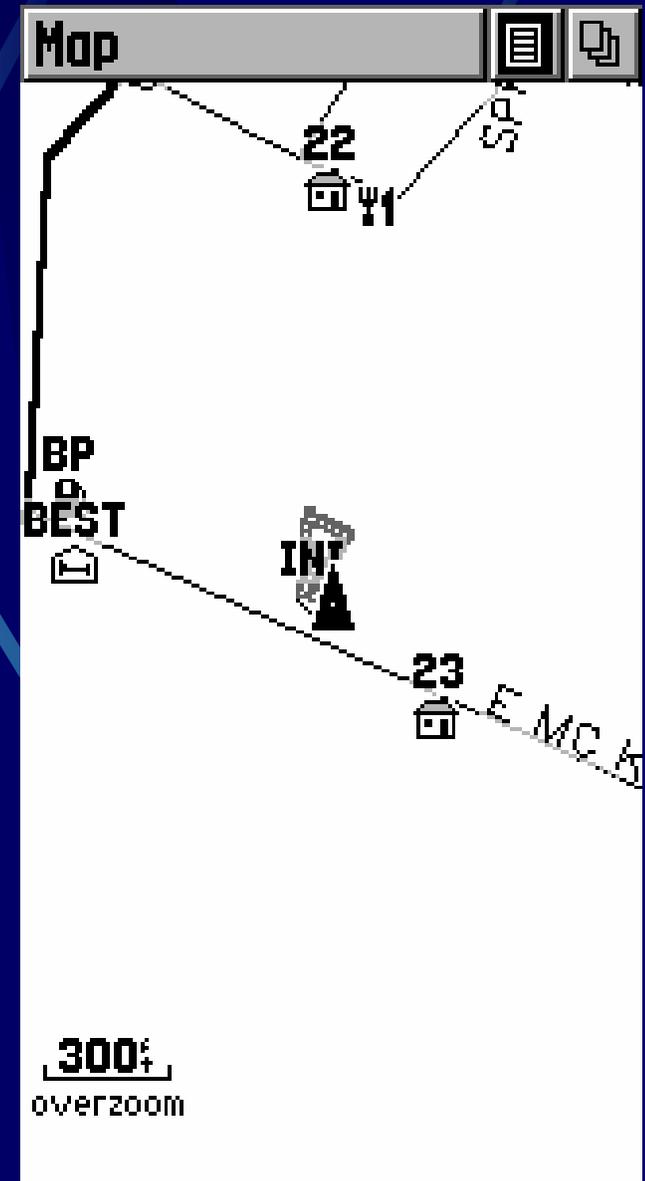
TRIP
INFO

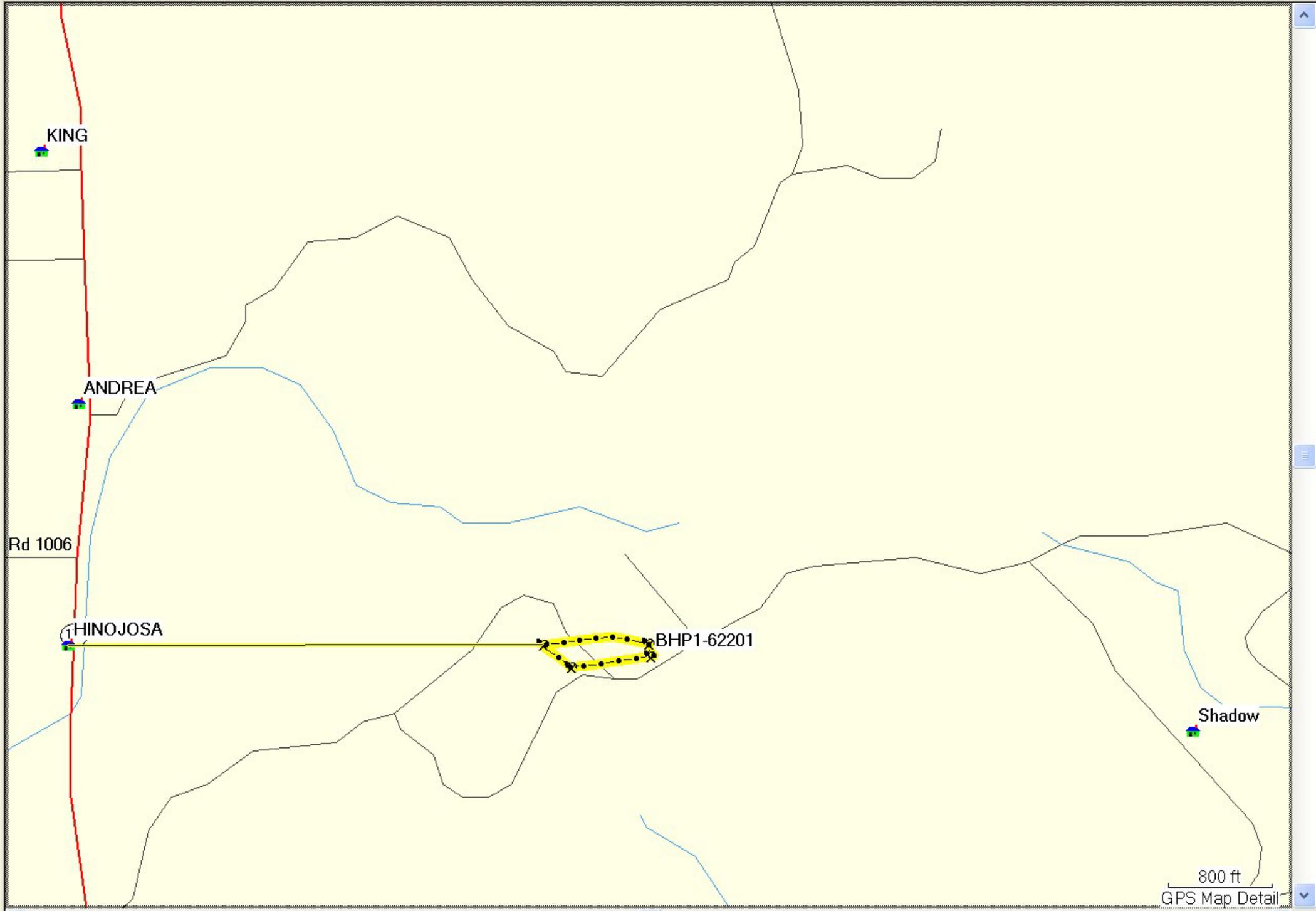


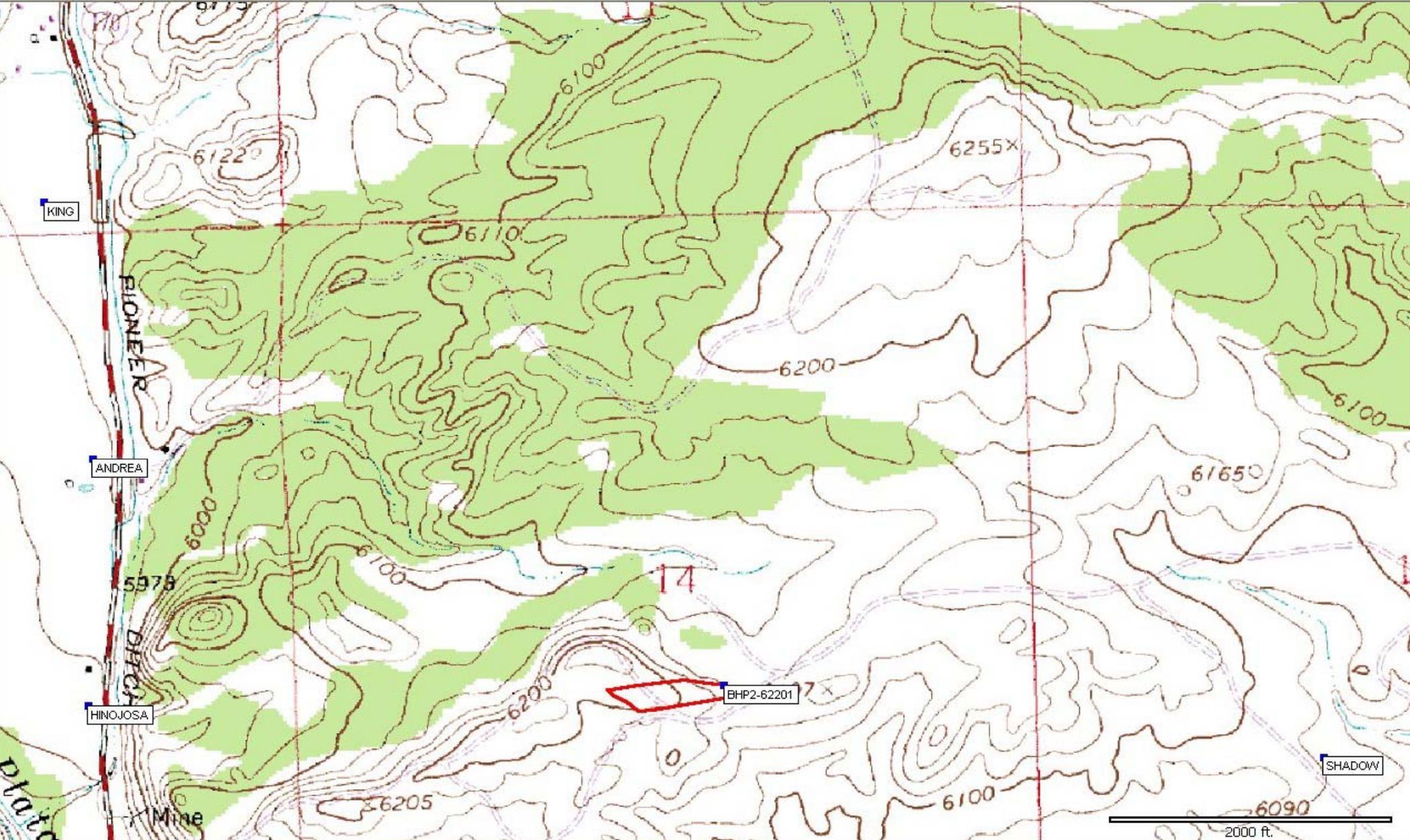
OTHER
FUNCTIONS

Software

- Download GPS to desktop
 - Map Source
 - ArcView
 - Ozi Explorer
 - TopoFusion
- Save data monthly
- Save data by site
- Query for locations and distances







Name	Length	Moving Time	Climbing Elev.	Avg. Speed	Color	Date	Max Speed	#Points	Total Time	Stopped Time
<input checked="" type="checkbox"/> Track	0.35 mi	No time data	71 ft	0.0 mph			0.0 mph	26	0:00:01	0:00:01
<input checked="" type="checkbox"/> Waypoints		No time data	No Data	0.0 mph			0.0 mph	0	No time d...	No time data



c:\

- C:\kene
- GPS
- topofusion
- LaPlatta

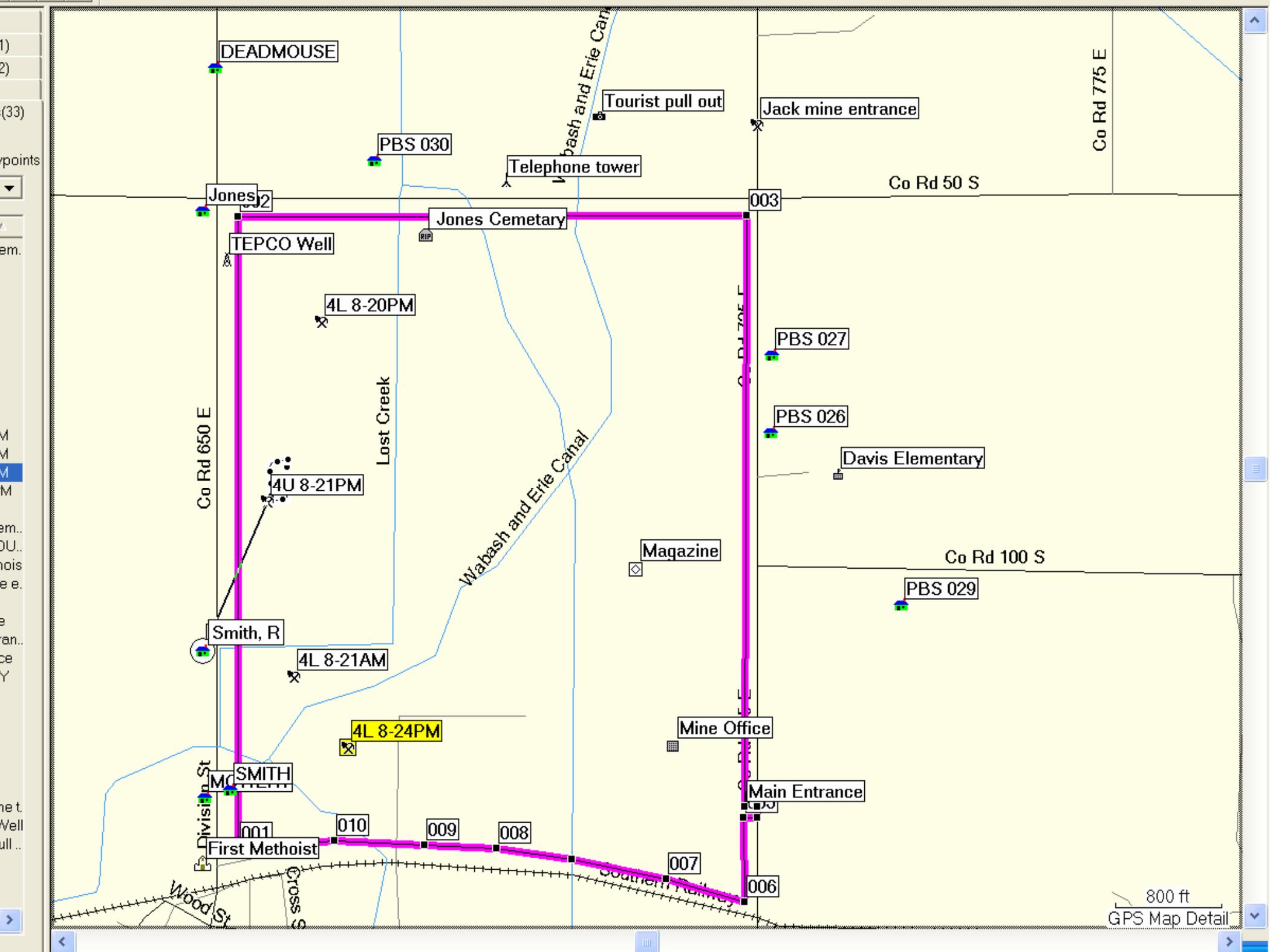
Track.gpx
Waypoints.gpx

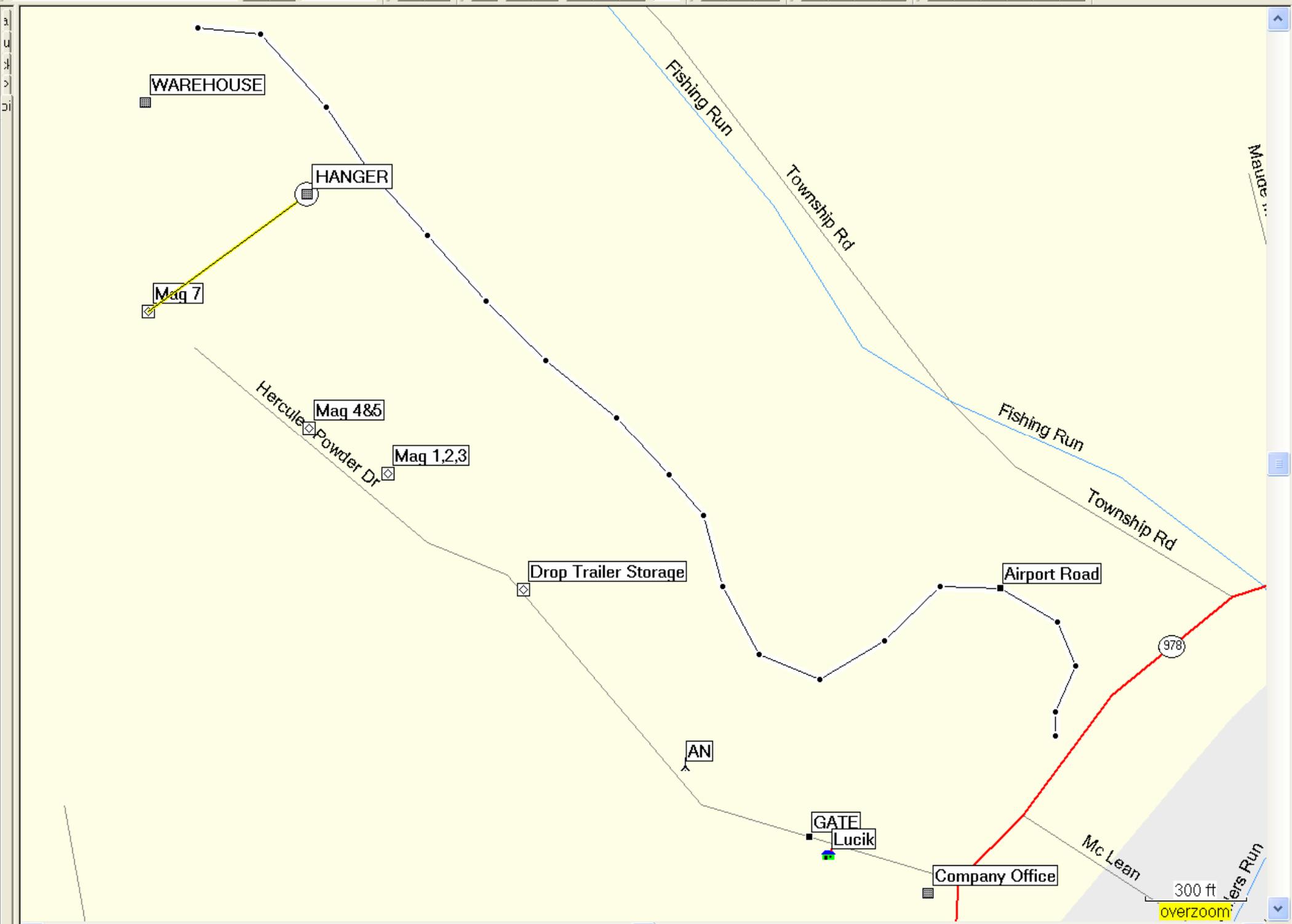
Add File >>

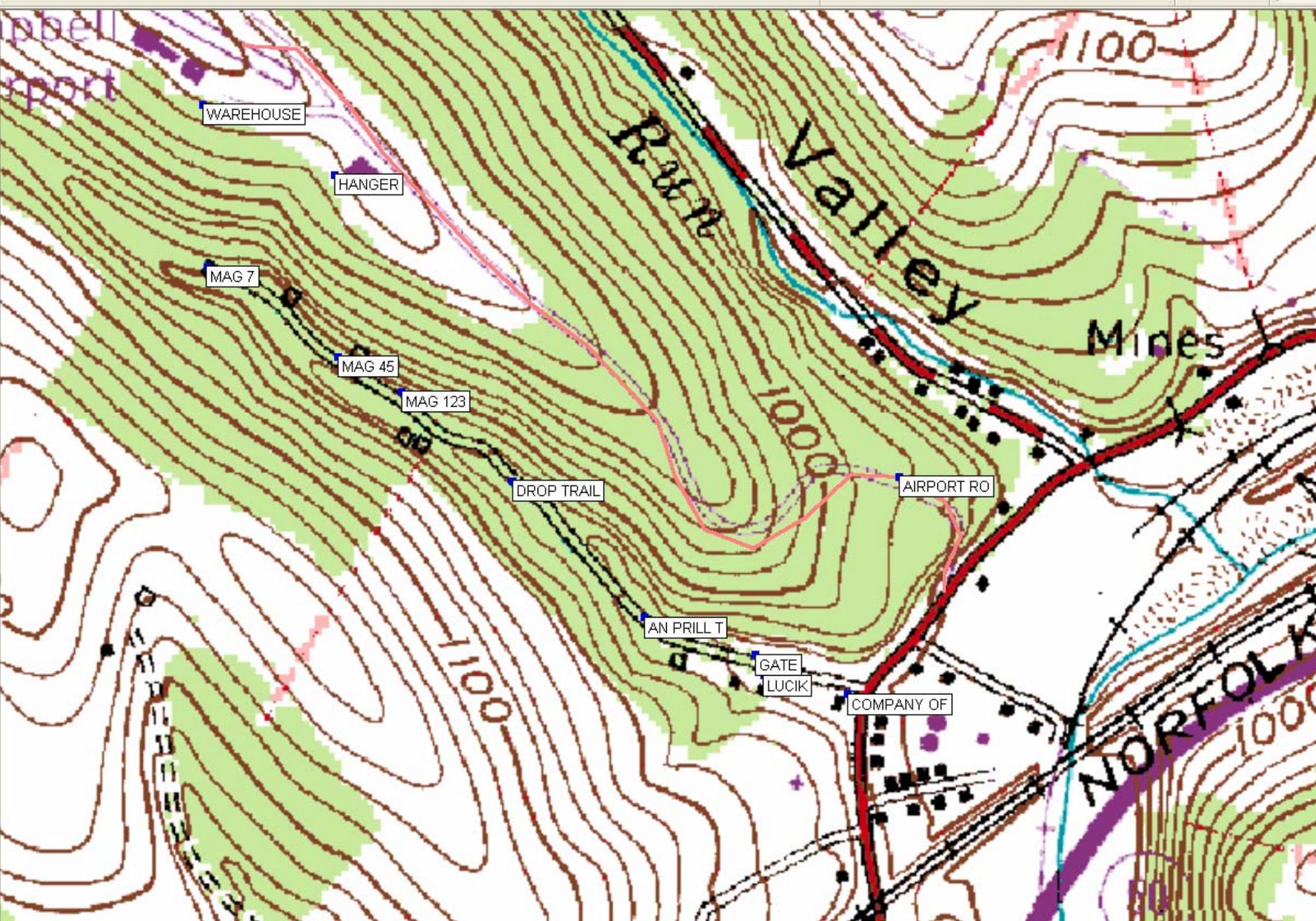
Add All >>

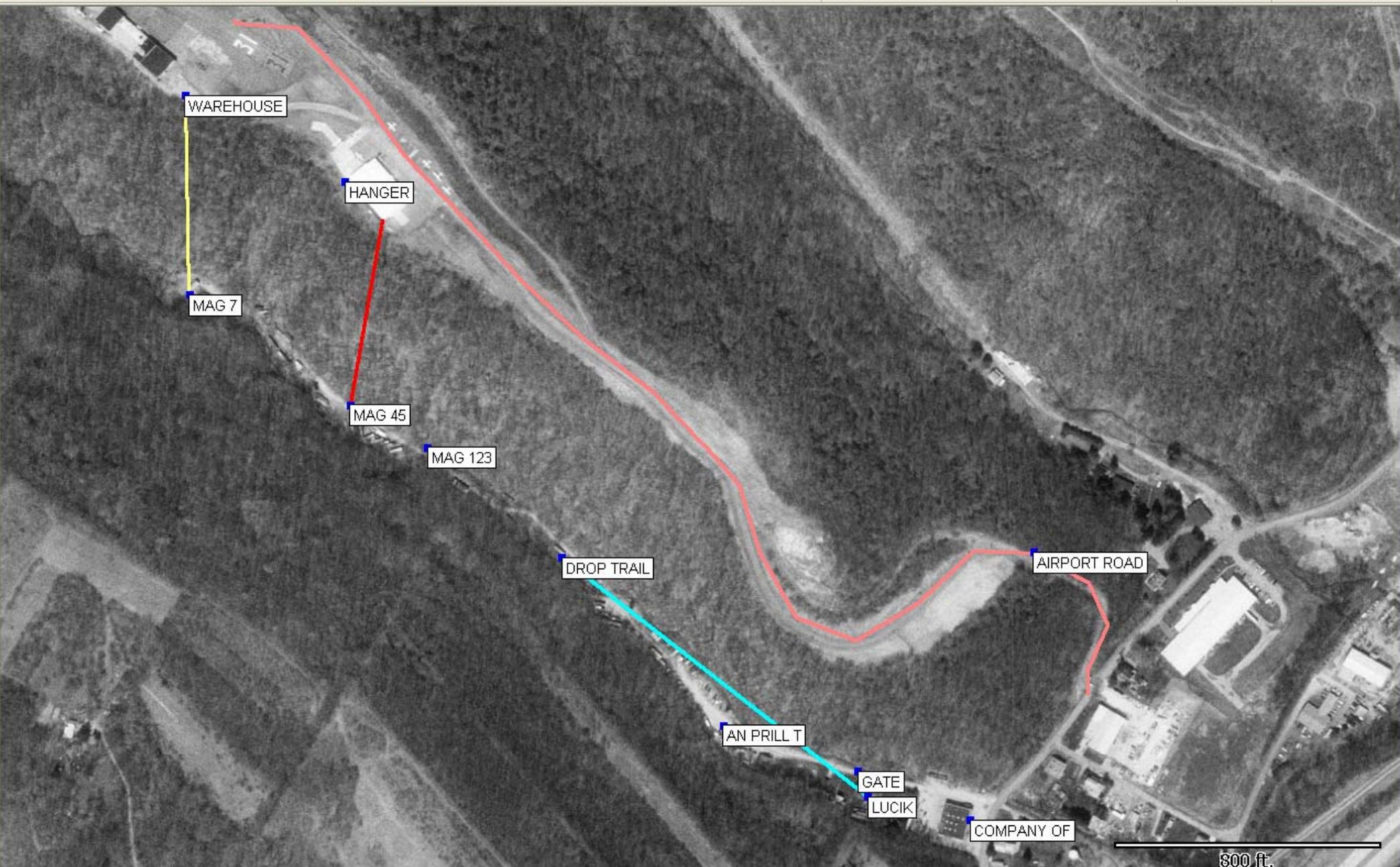
Remove

Name	Length	Moving Time	Climbing Elev.	Avg. Speed	Color	Date	Max Speed	#Points	Total Time	Stopped Time
<input checked="" type="checkbox"/> Track	0.35 mi	No time data	71 ft	0.0 mph	■■■■■		0.0 mph	26	0:00:01	0:00:01
<input checked="" type="checkbox"/> Waypoints		No time data	No Data	0.0 mph	■■■■■		0.0 mph	0	No time d...	No time data









c:\states.gpx

- C:\Program Files
- TopoFusion

states.gpx

Add File >>

Add All >>

Remove

Name	Length	Moving Time	Climbing El...	Avg. Speed	Color	Date	Ma
<input checked="" type="checkbox"/> Distance 45 to hang	559 ft	No time data	No Data	0.0 mph			0.0
<input checked="" type="checkbox"/> Distance 7 to Warehouse	594 ft	No time data	No Data	0.0 mph			0.0
<input checked="" type="checkbox"/> DTS to Lucik	0.22 mi	No time data	No Data	0.0 mph			0.0

GPS in Blasting

- Location and distance documentation
- Spatial relationships established
- WAAS enabled system - \$400
- PreBlast survey locations
- Permanent documentation of blast sites and seismograph locations for liability protection
- ATF documentation of magazines
- ** Area calculations for bonding**

QUESTIONS?

Global Positioning System

