INTRODUCTION TO GPS USING GARMIN E-TREX VISTA HCx

OSM TIPS Garmin Team

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Administratium
(Heaviest element known to man)

- Welcome
- Training Facilities
- Hotel
- Breaks
- Vouchers
- Notebook
- Class Agenda
- Sign-in
- Introductions
  - Who, Where, What do you do?
  - Experience with GPS?

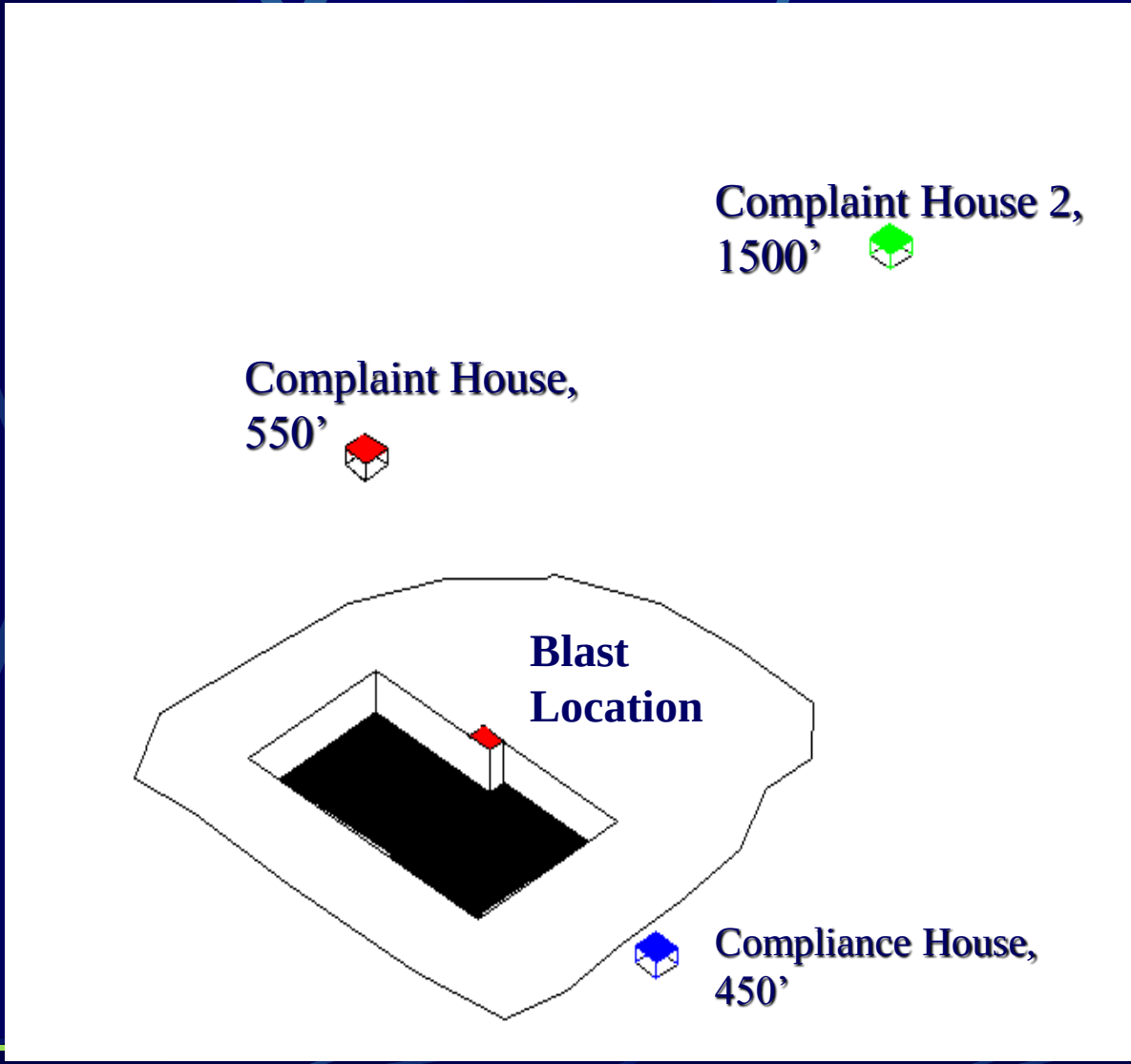
First a word from our sponsors ..... TIPS

Class Goals

- Gather site specific data in a global arena
- Get a unit in everyone's hands as a means of working our field personnel up the GPS technology ladder
- "No inspector left behind!"
- Maps are easy!

Locations - Regulatory

- Houses
- Wells
- Water monitoring Points
- Blast Locations
- Complaints
- Permit Signs
- Bore holes
- Preblast surveys
- Seismographs
- Seeps/springs
- Flyrock



Spatial Relationships are Important!

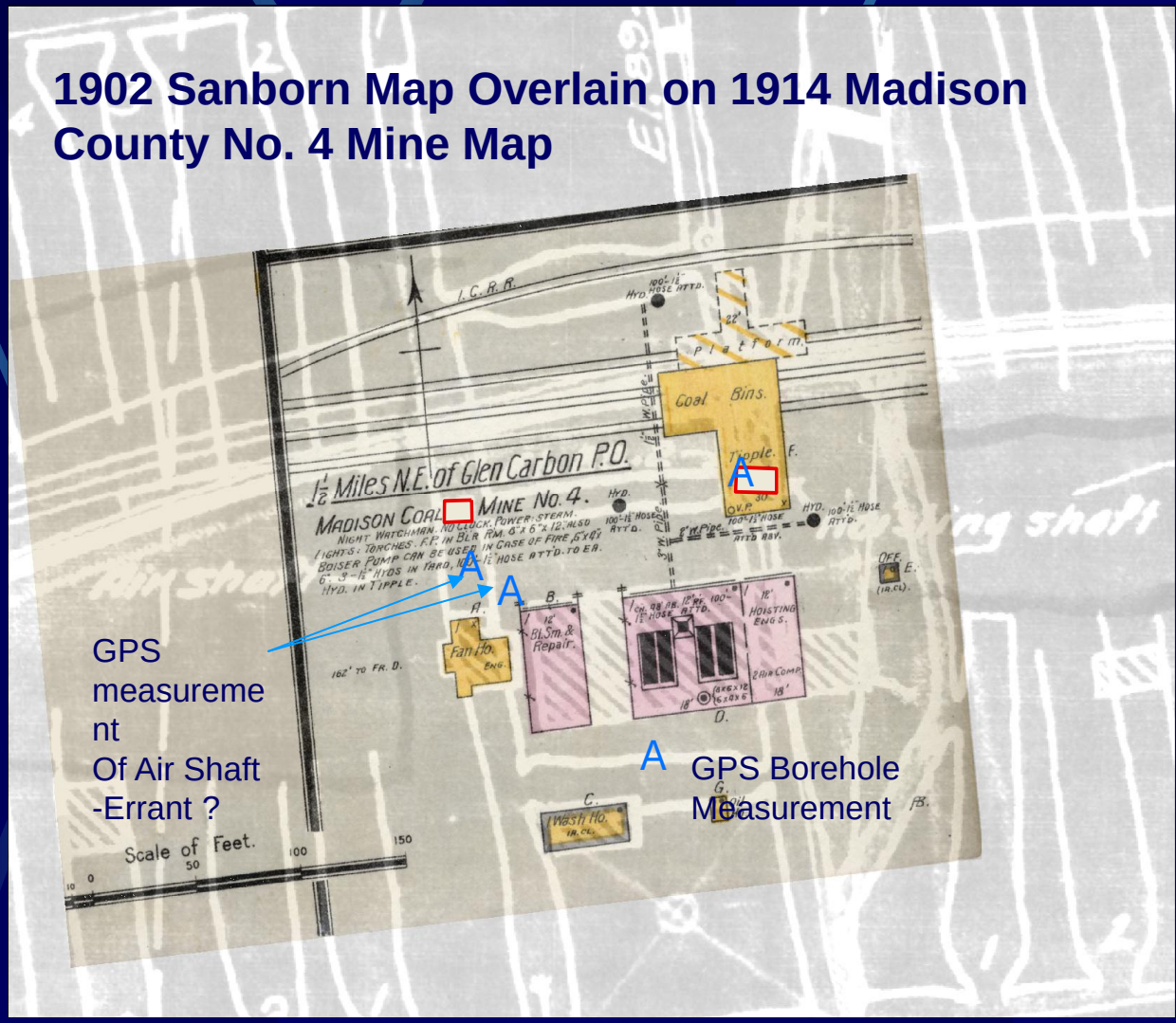
Example: Vibration Directional Effects

35S5-WM1

13th April 2002

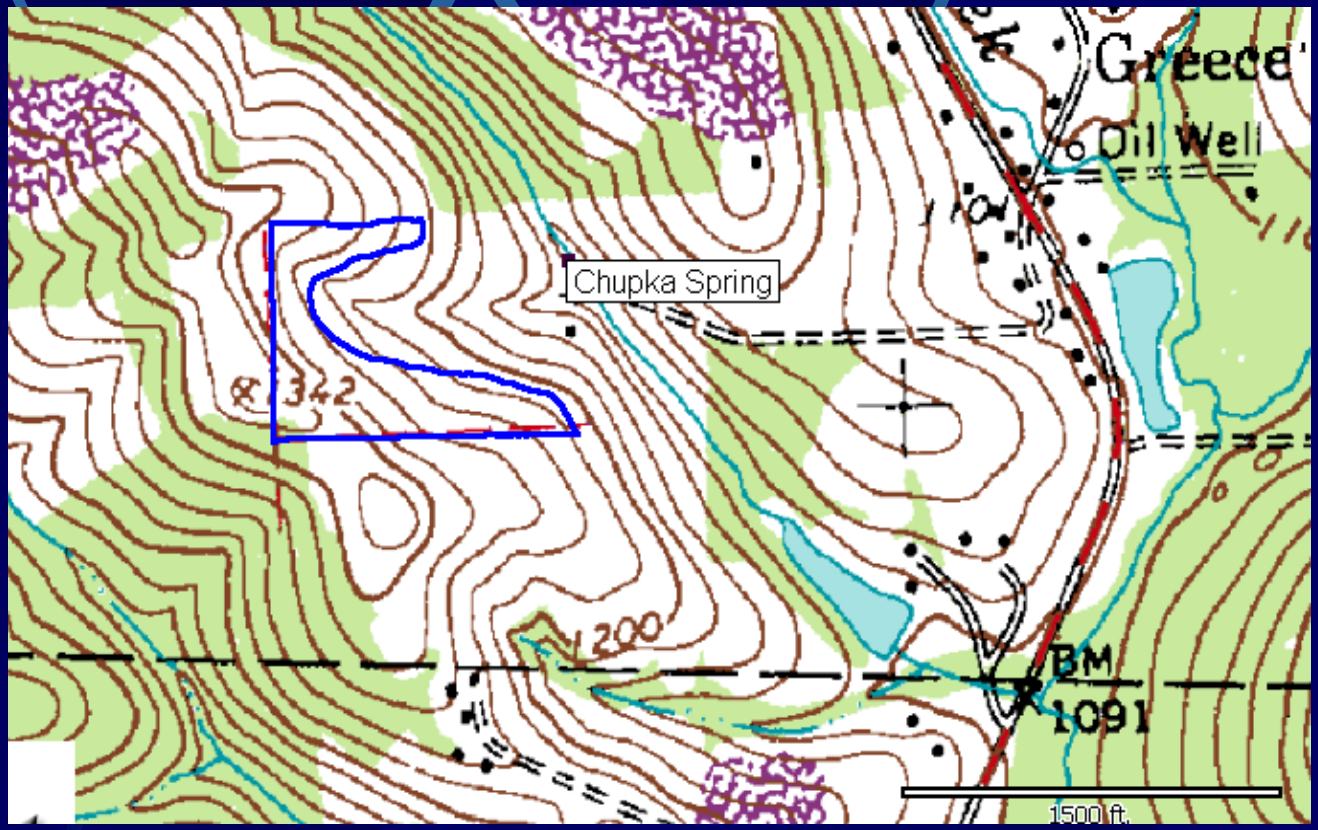
Locations - AML

- Potholes
- Shafts
- Drill holes
- Seeps
- Water sampling
- Inventory ID
- Houses
- Wells
- Entries/audits
- Endangered species
- Fire vents



Areas - Regulatory

- Permits
- Bonding
- Stockpiles
- Ponds
- Haul roads
- Landslides
- Blasting

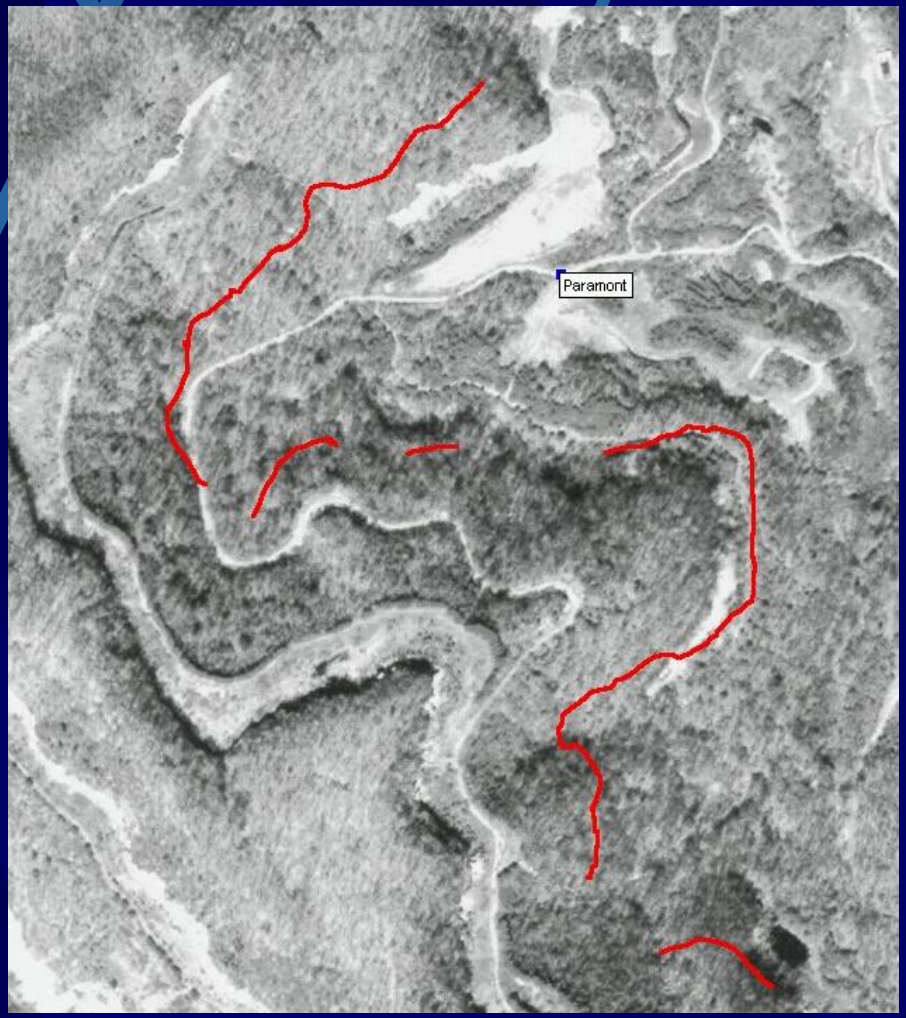


Areas - AML

- Landslides
- Mine fires
- Disturbed areas
- Site access routes
- Subsidence
- Linear features too

Linear Features

- Roads
- Diversions
- Property lines
- Highwalls
- Erosion gullies



Other Uses

- Navigation to mines
- Navigation to homes
- Cross sections
- Estimating travel times

How Locations and Areas?

- Survey (costly)
- Compass and range finder (line of sight)
- Compass and tape
- Grid map (eyeball)
- GPS
  - Best technology currently available!

WHAT IS GPS?

Global Positioning System (GPS) is a satellite-based Navigation system

- U.S. Department of Defense
- NAVSTAR, the official U.S. DoD name for GPS
- The first GPS satellite was launched in 1978
- A full constellation of 24 satellites was achieved in 1994

- GPS satellites:
  - Orbit the earth at about 12,000 miles
  - Constantly moving, two complete orbits in less than 24 hours
  - Travel at roughly 7,000 miles an hour
  - Satellites are powered by solar energy
- 1980’s - System available for civilian use but with Selective Availability (scrambled signal), accuracy 300 feet

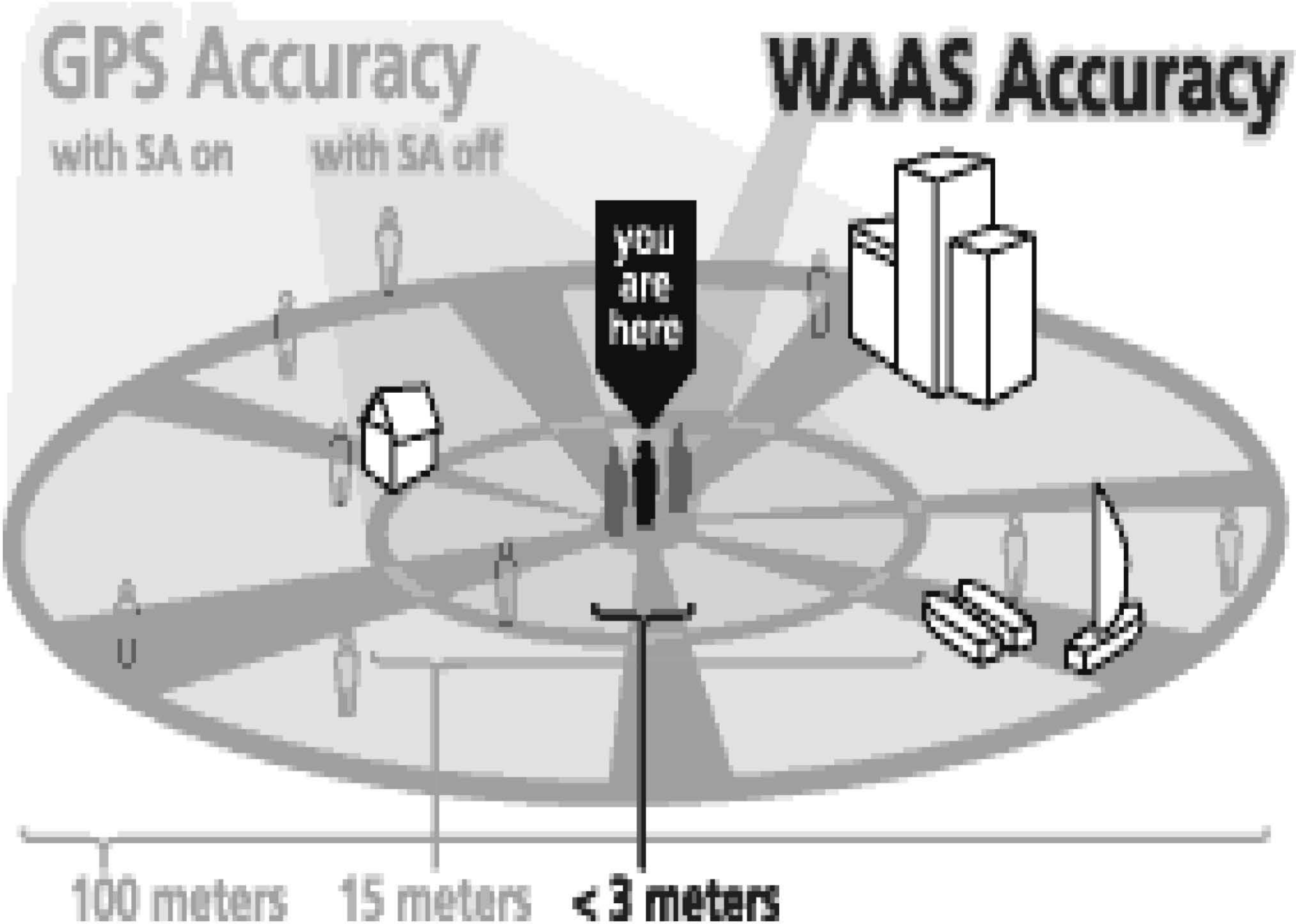
HOW GPS WORKS

- Selective Availability off in May 2001, now useable as a hand held unit

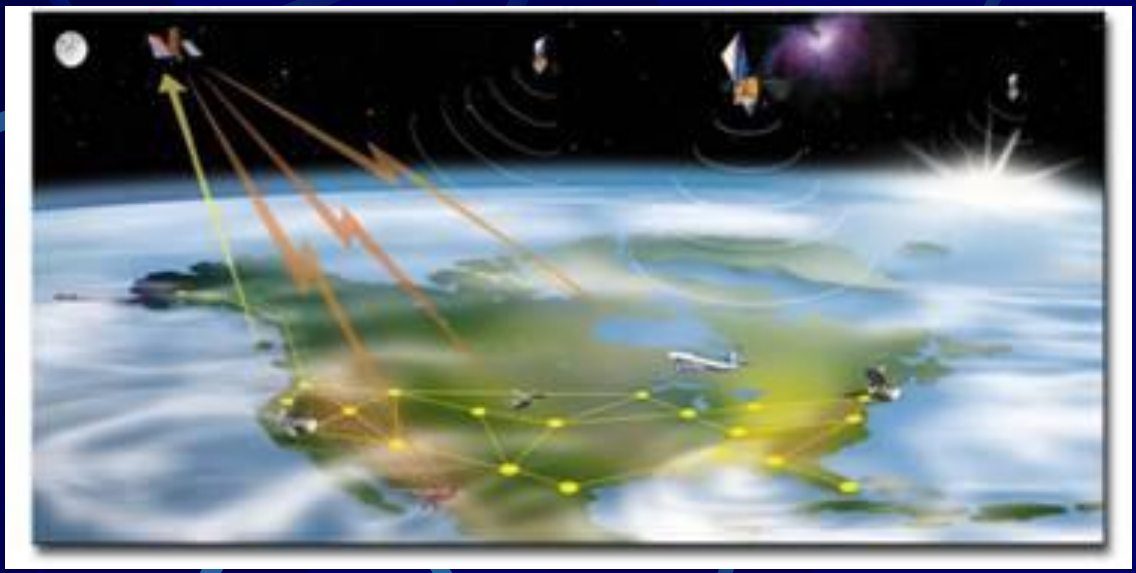
- Triangulation to calculate location
  - When locked on to at least three satellites, can calculate a 2D position (latitude and longitude)
  - Four or more satellites, can determine a 3D position (latitude, longitude and altitude)

HOW GPS WORKS

- Standard accuracy with original satellites, 40 feet
- WAAS (Wide Area Augmentation System) capability will improve accuracy to less than 10 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
you are here
100 meters
15 meters
< 3 meters

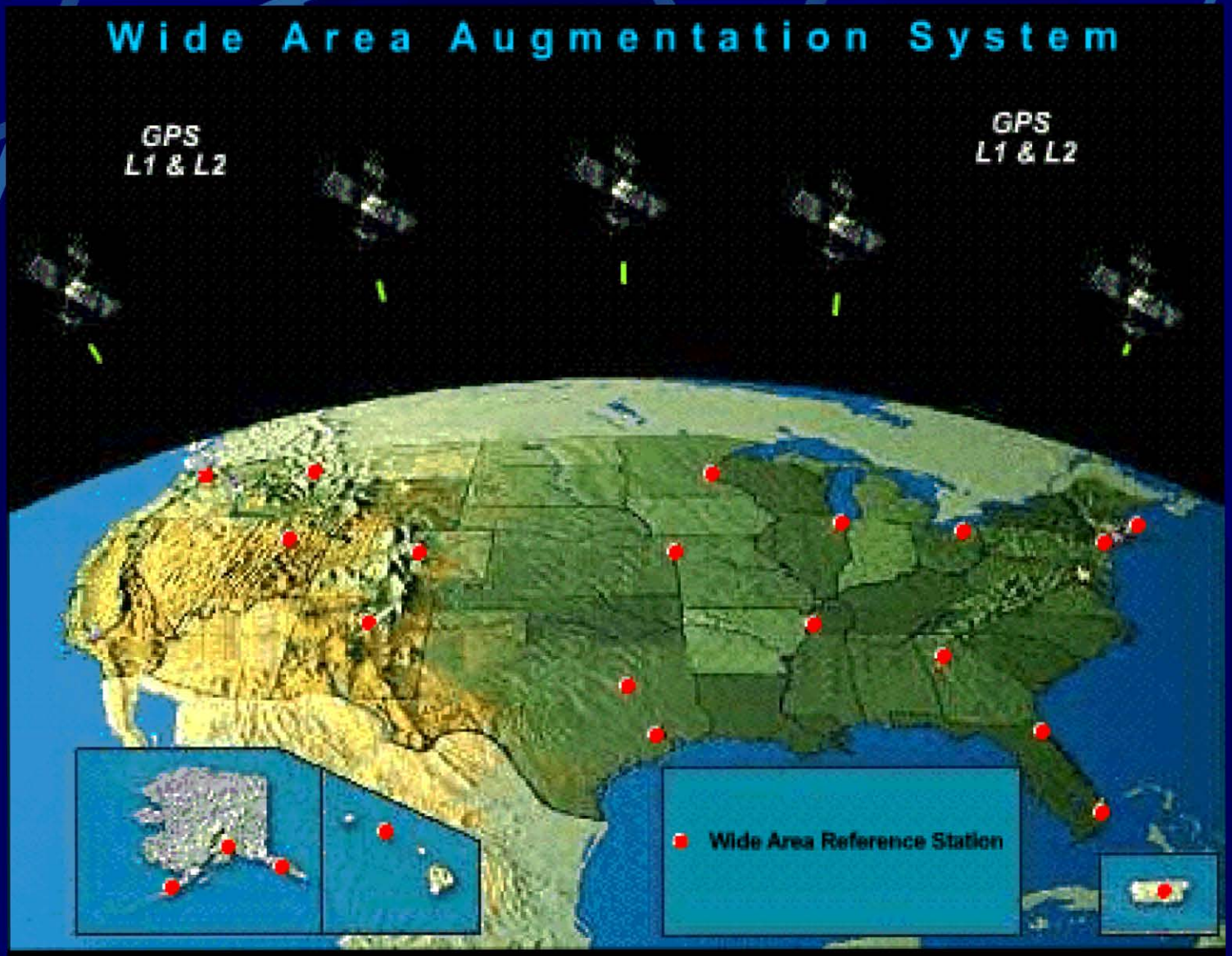
What is WAAS?



- Federal Aviation Administration Project - augments the GPS constellation to meet the necessary integrity, availability, accuracy, and continuity for use in all phases of flight (airplanes)
- WAAS consists of:
  - 25 reference stations
  - 2 master stations
  - 2 geosynchronous satellites
  - 3 uplink stations

WAAS Components

How Does It Work?



Wide Area Reference Stations Monitor the GPS Satellites

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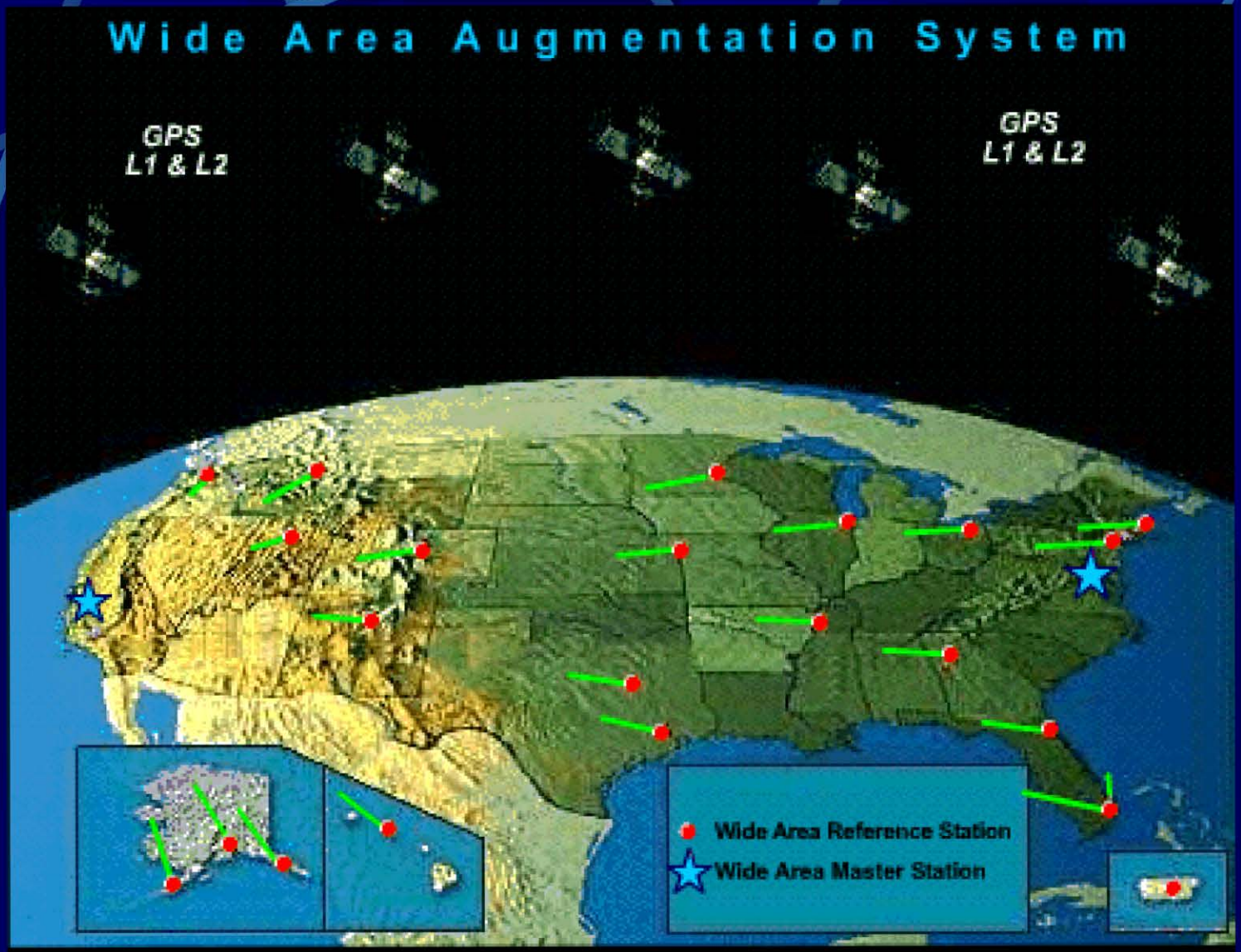
How Does It Work?



The Information Collected by the Wide Area Reference Stations is Sent to the Wide Area Master Stations Who Will Calculate the Correction Message

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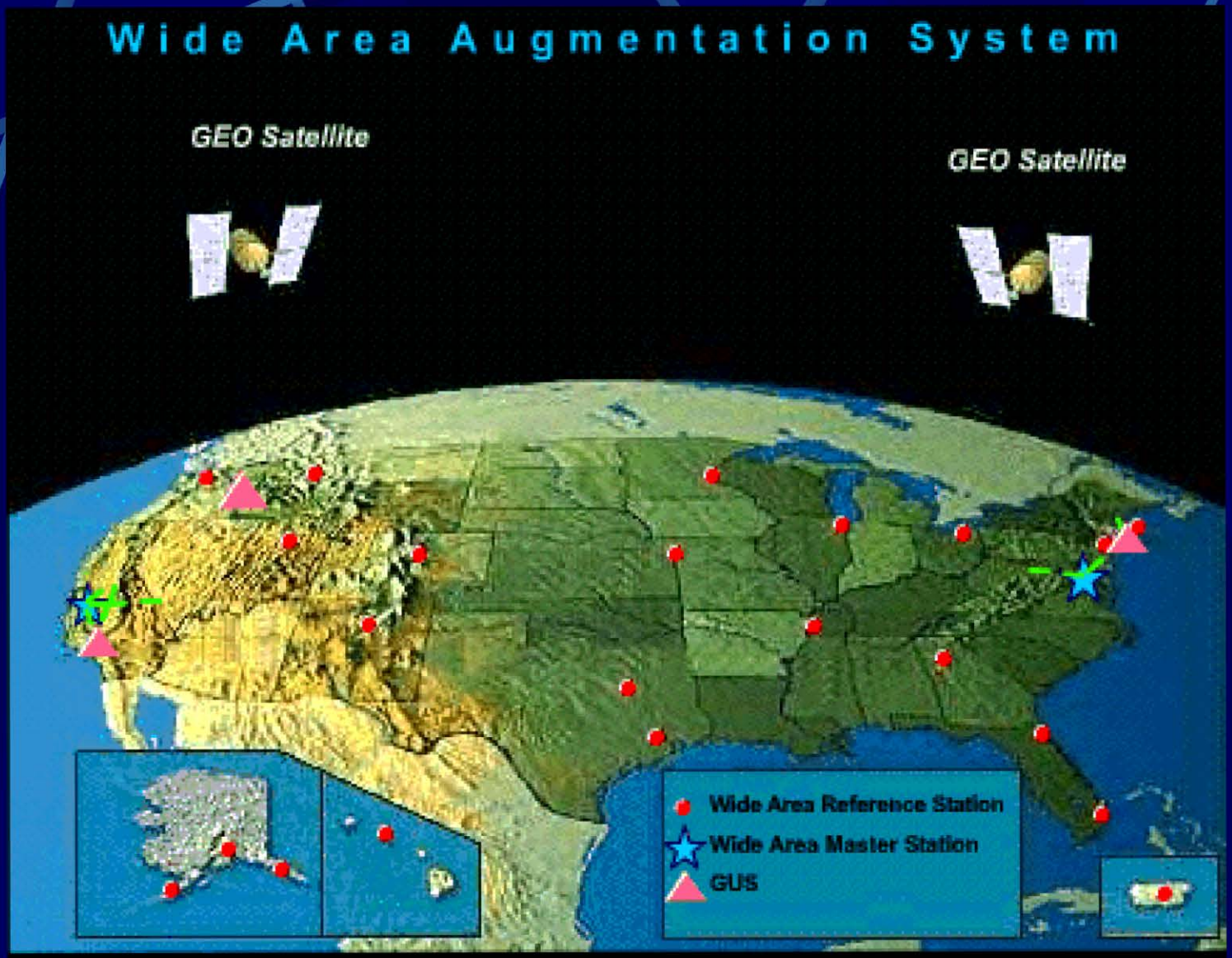
How Does It Work?



The Wide Area Master Station Uplinks the Correction Message to the WAAS GEO Satellites Via a Ground Uplink Station

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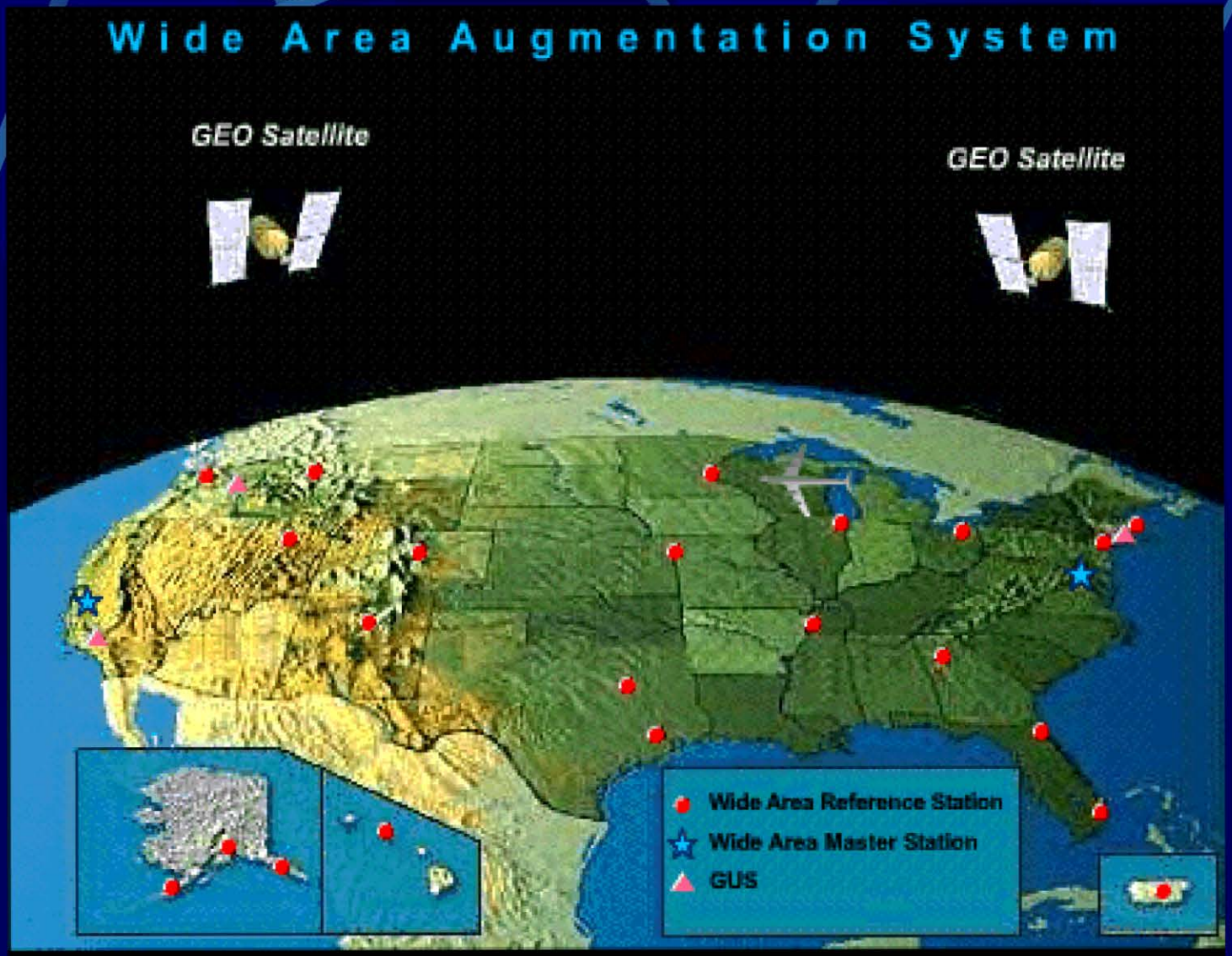
How Does It Work?



The WAAS GEO Satellites Broadcast the WAAS-Corrected Signal to Aircraft and Other Users in the Service Area

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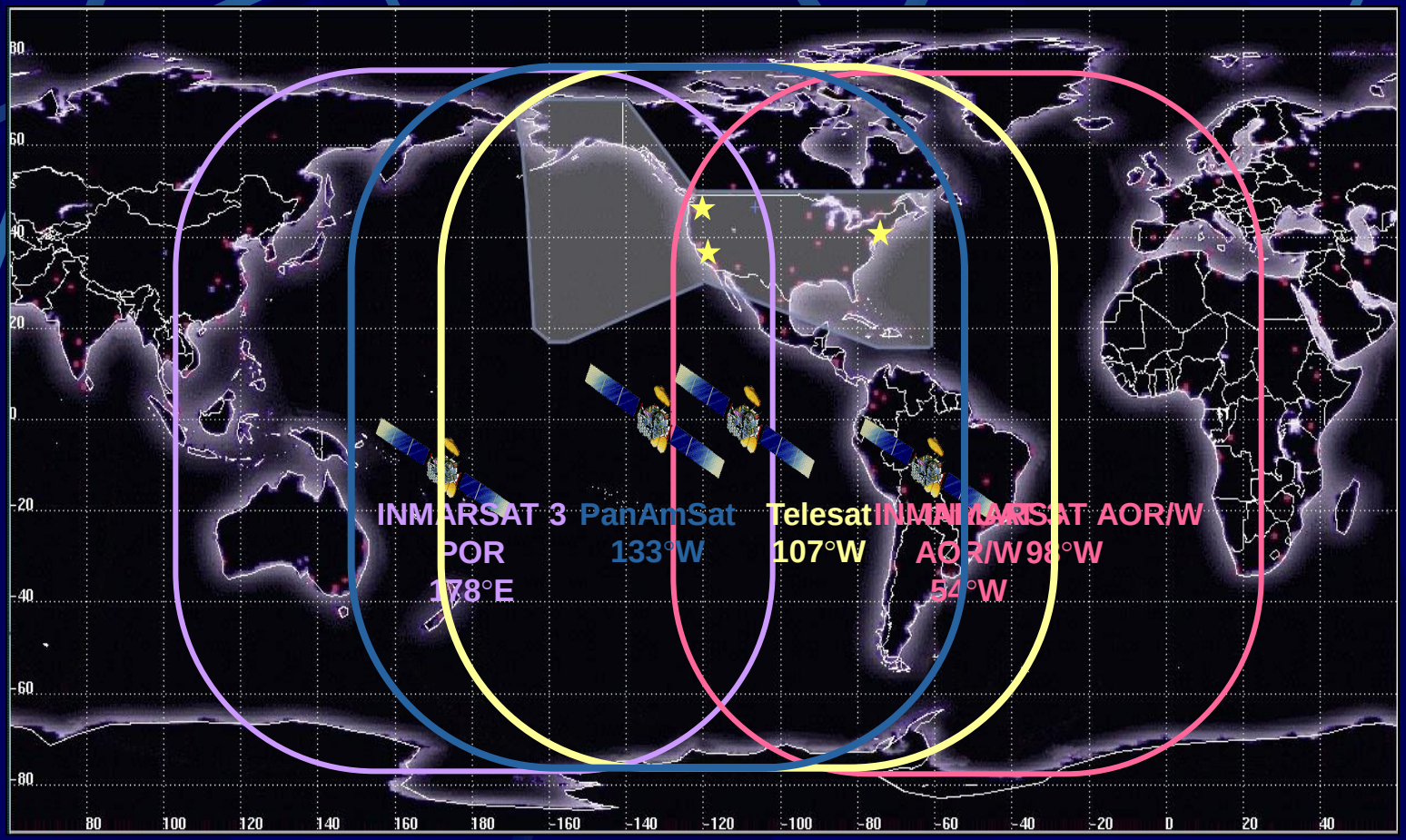
GEO Transition



- Provides Dual Coverage Over CONUS and Alaska with AOR/W as hot spare

WAAS Status

- WAAS has been available for recreational use and visual flight rules since August 2001
- WAAS was approved for aviation instrument operations on July 10, 2003
- Provides 100% coverage of Continental US & Alaska from 100,000ft. to surface

WAAS Status

- Began publication of WAAS specific approaches in September 2003
- Continuing to develop the system to expand vertical navigation to most of North America
- 2-3 meter accuracy
- More information-
  - http://gps.faa.gov/gpsbasics/index.htm
  - http://www.gpsinformation.org/dale/dgps.htm

Accuracy and Precision

- “Accuracy is the degree to which a measured value conforms to true or accepted values. Accuracy is a measure of correctness.”
- “Precision measures exactness. … It is a measure of the control over random error.”

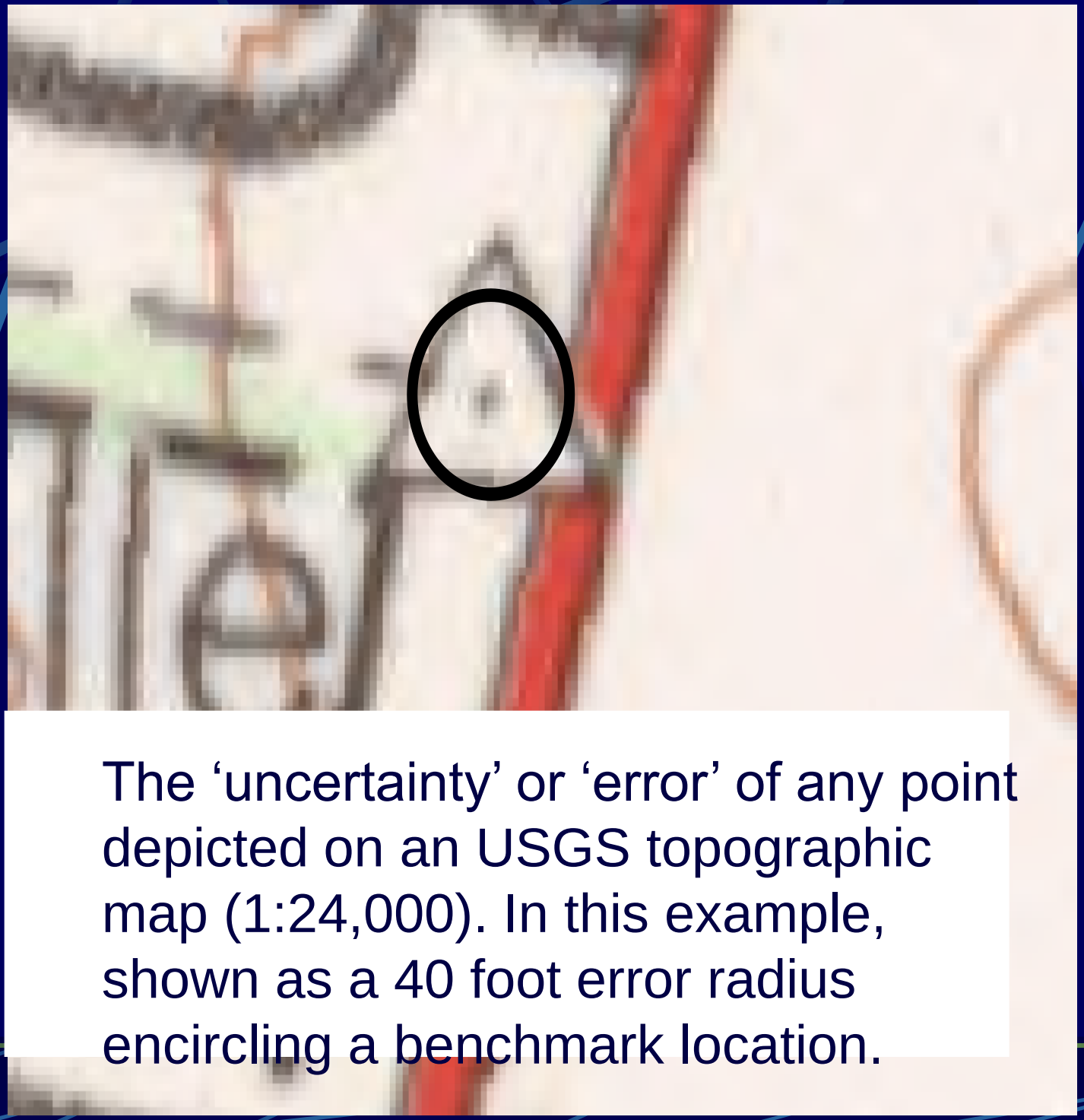
From: ESRI GIS Dictionary, 2005

USGS Accuracy and Precision Standards

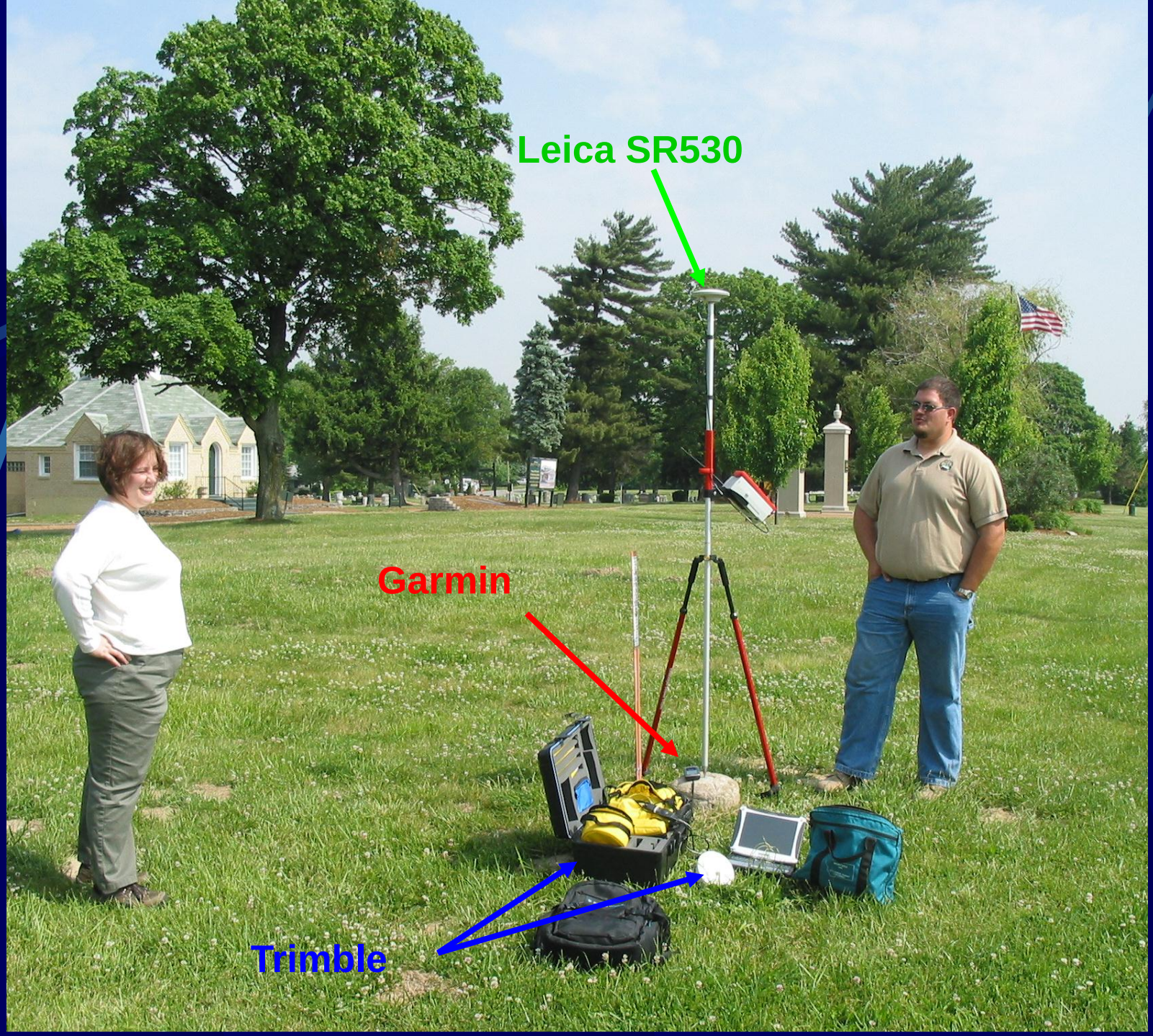
- 90% of “well-defined points” must be plotted to within 1/50th an inch accuracy on a 1:24,000 scale map which is the equivalent of **40 feet** on ground surface.

- “Well-defined points are easily visible or recoverable on the ground, such as the following: monuments or markers, property boundary monuments; intersection of roads and railroads; corners of large buildings or structures (or center points of small buildings).”

From: USGS Map Accuracy Standards Fact Sheet FS-171-99 (November 1999)



The ‘uncertainty’ or ‘error’ of any point depicted on an USGS topographic map (1:24,000). In this example, shown as a 40 foot error radius encircling a benchmark location.



Leica SR530 shown set up over USGS monument. Trimble with ArcPad setup in foreground. Garmin GPS Map 76 resting on USGS monument.

GPS Equipment Summary

Garmin eTrex Vista

- Easy to use and download.
- Sufficiently accurate in getting locations for mining.
- Projects in ArcView.
- Waypoint navigation can be used to locate field features.
- **Inexpensive to own and operate.**

GPS Equipment Summary
Trimble with Laptop and Arcpad

- Slight ‘learning curve’.
- Physically cumbersome.
- Accurate for measuring mining locations.
- ‘Real-time location’ on convenient base map(s) is very useful.
- **Fairly expensive to own and operate.**

GPS Equipment Summary
Leica SR530

- Significant ‘learning curve’.
- Physically cumbersome.
- Highly precise and accurate measurement.
- Not useful in ‘finding things’.
- Requires downloading data in office.
- **Expensive to own and operate.**

Track and Point Comparison
Garmin vs Trimble

GPS SELECTION

Low end	Mid range	High end
40 feet	10 feet	3 feet
$100	$350	$4,000

GARMIN

Owner's Manual

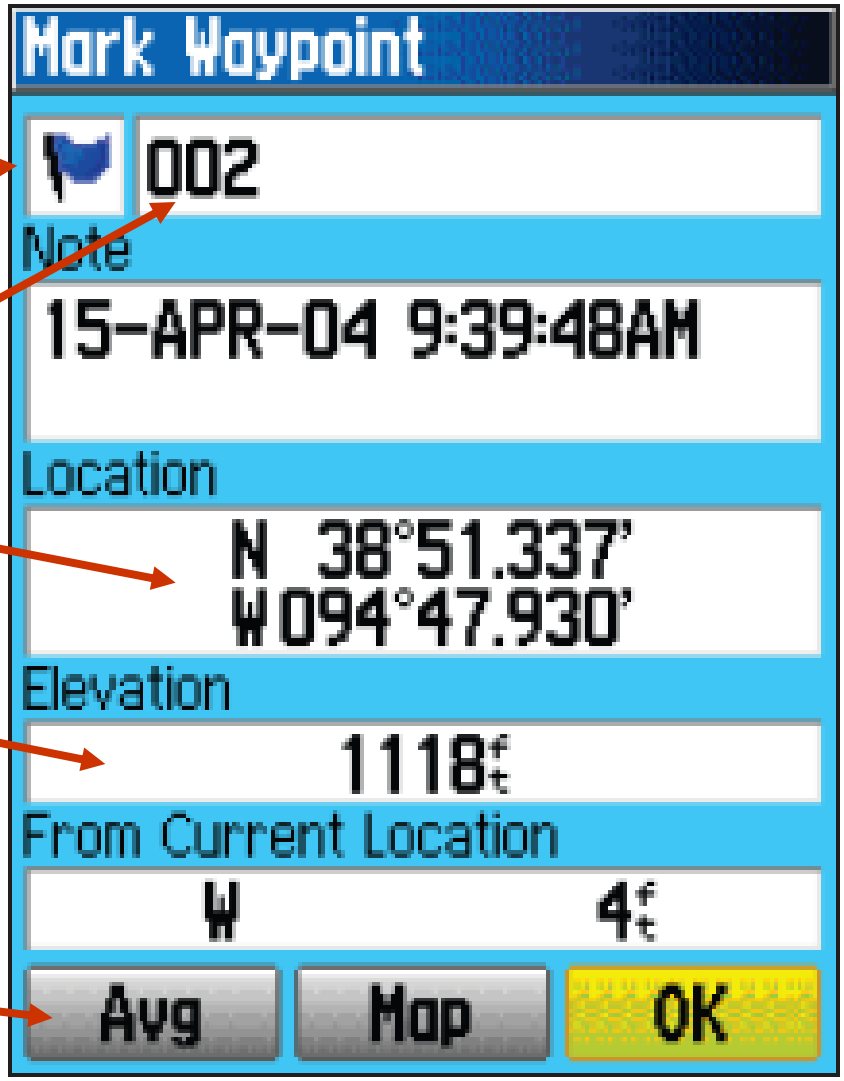
eTrex® HC series

personal navigator

(eTrex Vista HCx shown)

Waypoints

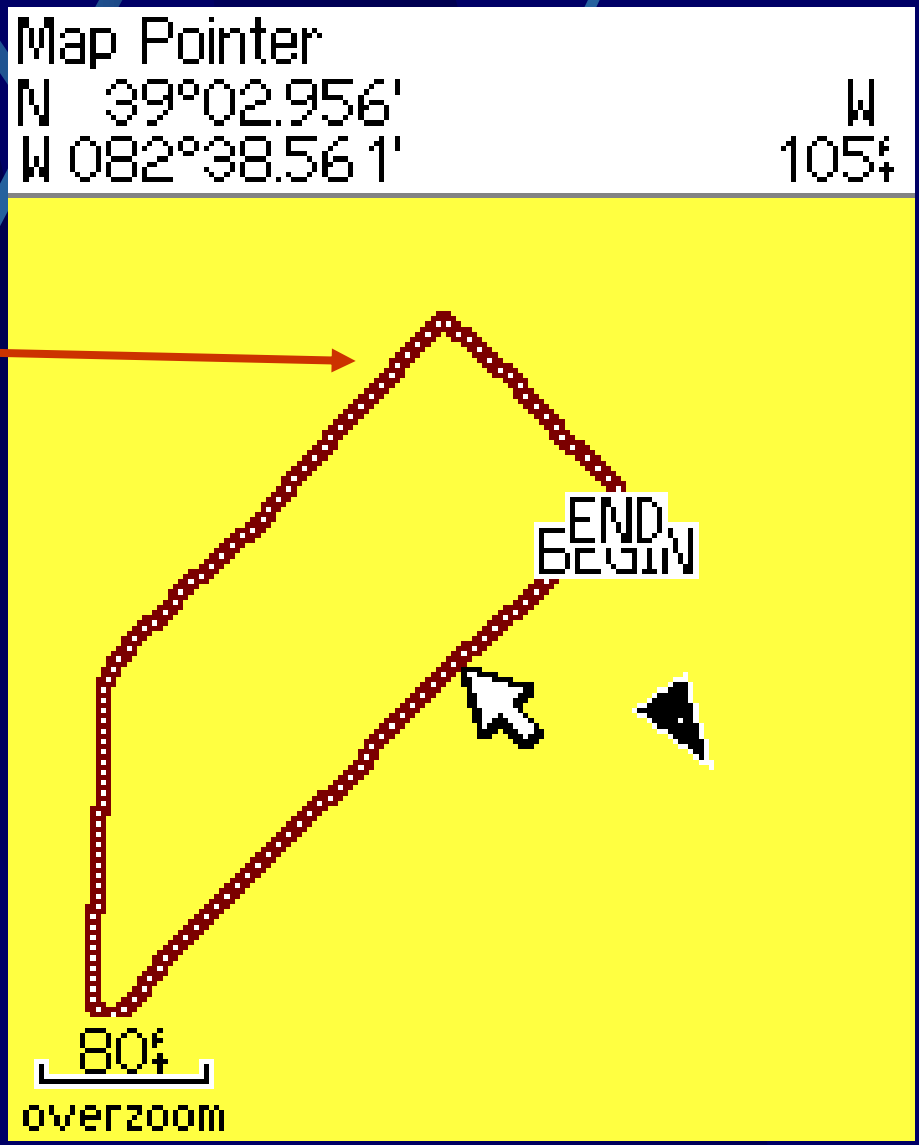
- Symbols
- Names (Shot121103)
- Coordinates
- Elevation
- 500 waypoint limit
- Averaging



Mark Waypoint Page

Tracks

- Track is a cookie crumb trail
- Distance or time based
- 10,000 points
- 20 saved tracks
- Linear Features
- AREAS!!!



Software

- Download GPS data to desktop
- Map Source – Manage the data
  - Edit data
  - Save data monthly or by site
  - AutoCadd conversion .dxf
- TopoFusion – Display the data
  - Topographic Maps
  - Aerial photographs
  - Conversion – shape files

LaPlatta.mps - MapSource

File Edit View Tools Help

US Road & Rec - Continental US | 800 ft

KING

ANDREA

Rd 1006

HINOJOSA

BHP1-62201

Shadow

800 ft

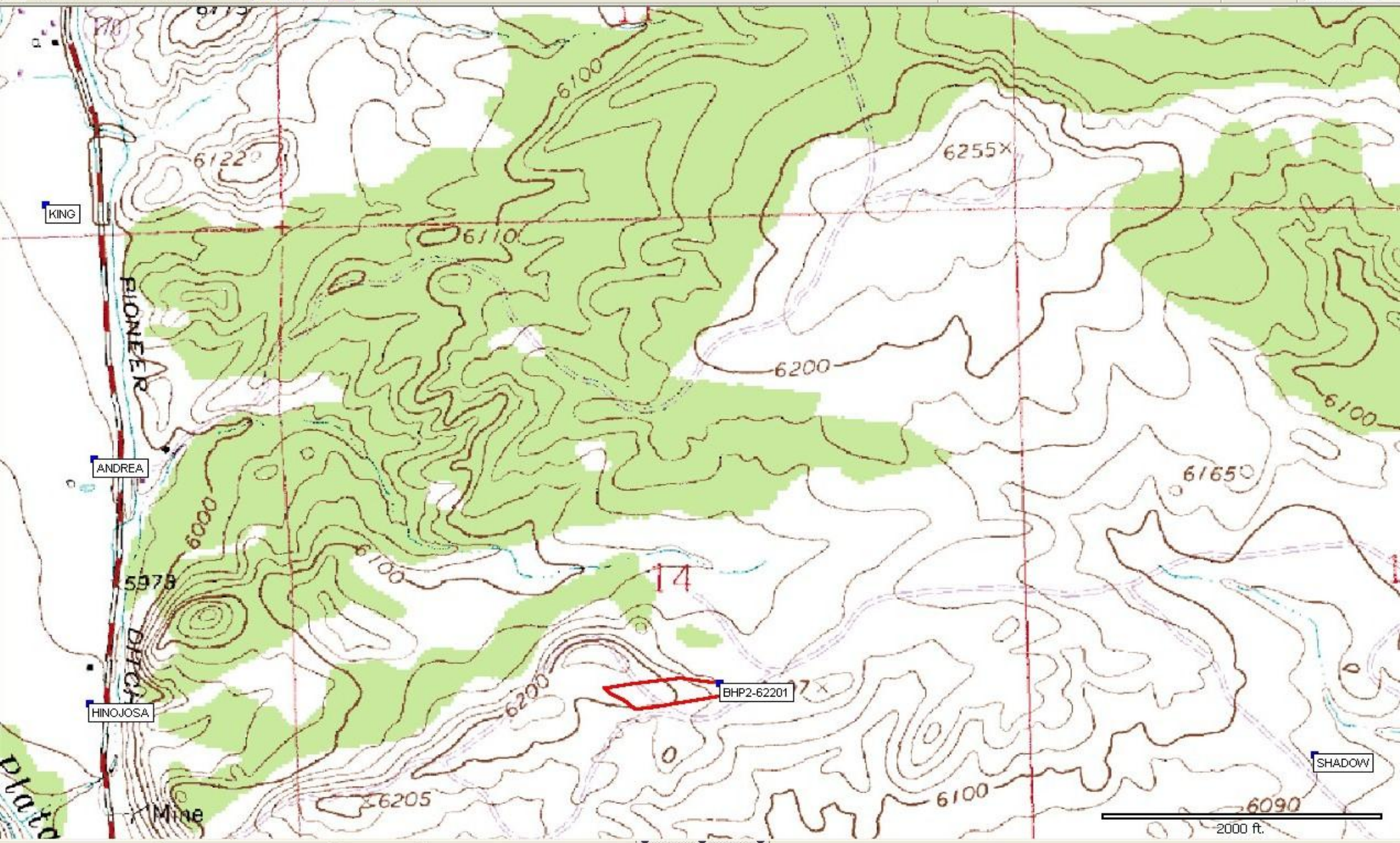
GPS Map Detail

1 Track(s) Selected | User Defined Grid(WGS 84) | Distance: 0.696 mi, Area: 0.000 ac, Bearing: 270° true, from BHP3-62201 to the Map Pointer

TopoFusion

File Edit Goto GPS Analysis Options Window Help

Z = 12 4097635 N 0751283 E 1:2.40 Topo 2M



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
Track	0.35 mi	No time data	71 ft	0.0 mph			0.0 mph	26	0:00:01	0:00:01
Waypoints		No time data	No Data	0.0 mph			0.0 mph	0	No time d...	No time data

TopoFusion

File Edit Goto GPS Analysis Options Window Help

Z = 12 4097318 N 0751638 E 1:2.40 Aerial 4M

KING

ANDREA

HINOJOSA

BHP2-62201

SHADOW

2000 ft.

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
Track	0.35 mi	No time data	71 ft	0.0 mph			0.0 mph	26	0:00:01	0:00:01
Waypoints		No time data	No Data	0.0 mph			0.0 mph	0	No time d...	No time data

BlackBeauty2 - MapSource

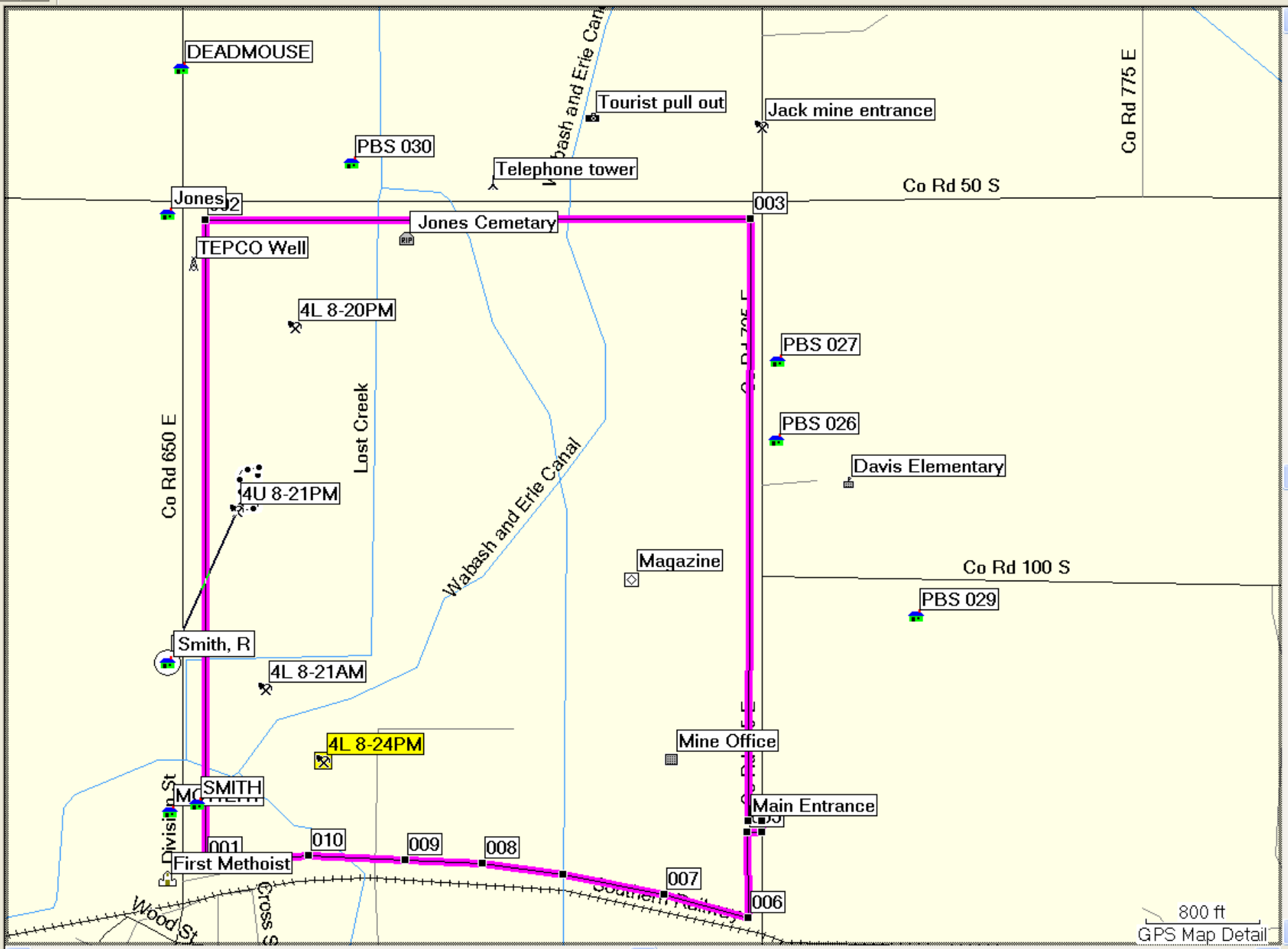
File Edit Find Transfer View Tools Utilities Help

US Road & Rec - Continental US | 800 ft

Maps
Routes(1)
Tracks(2)
GPS
Waypoints(33)

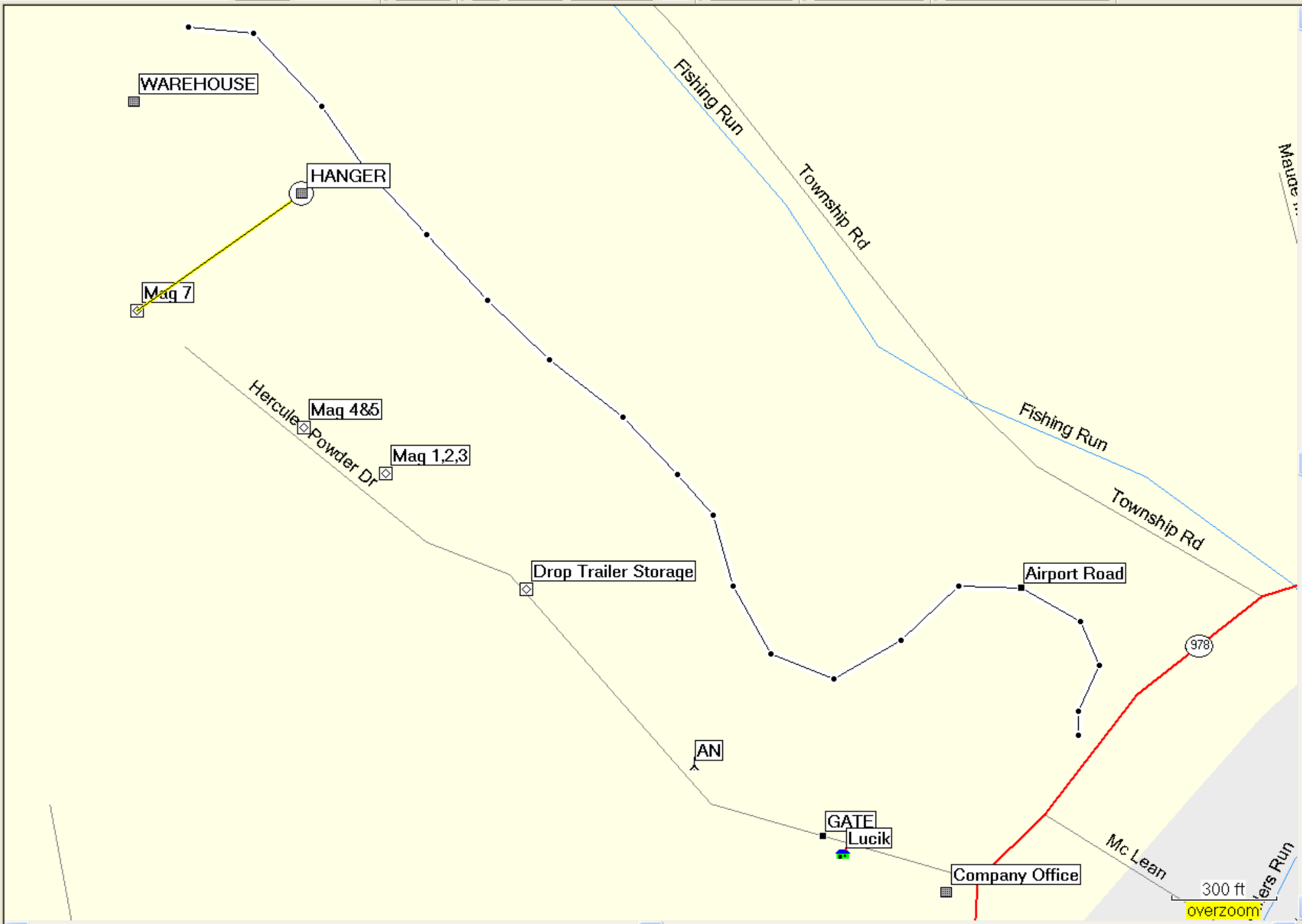
Show waypoints
All Catec

Name
Jones Cem.
001
002
003
005
006
007
008
009
010
4L 8-20PM
4L 8-21AM
4L 8-24PM
4U 8-21PM
5L 8-19
Davis Elem..
DEADMOU..
First Methois
Jack mine e.
Jones
Magazine
Main Entran..
Mine Office
MOWERY
PBS 026
PBS 027
PBS 029
PBS 030
SMITH
Smith, R
Telephone t.
TEPCO Well
Tourist pull ..



File Edit Find Transfer View Tools Utilities Help

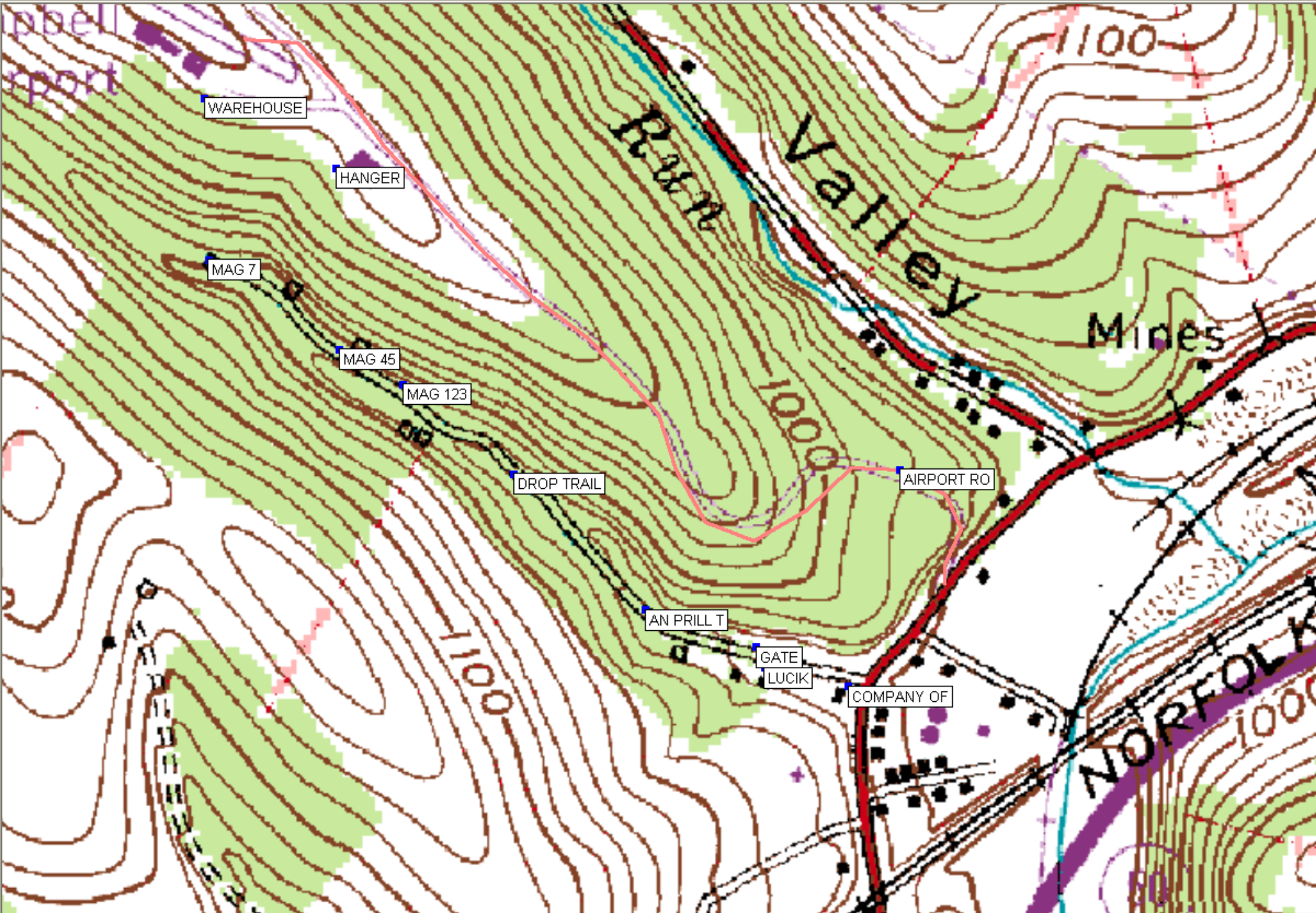
US Road & Rec - Continental US | 300 ft



TopoFusion

File Edit Goto GPS Analysis Options Window Help

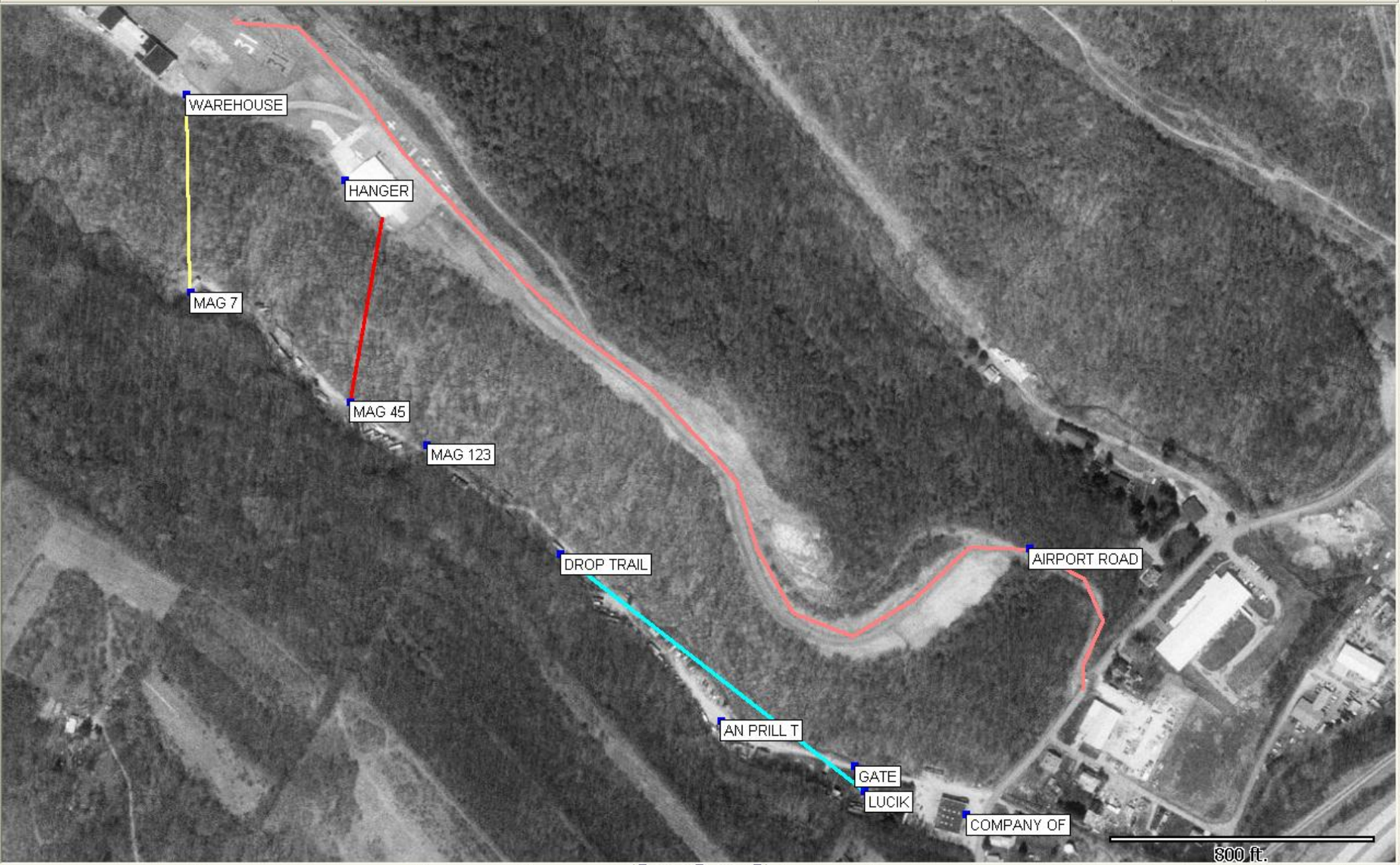
40.34967° N 80.17688° W 1:1.23 Topo



TopoFusion

File Edit Goto GPS Analysis Options Window Help

40.34873° N 80.18001° W 1:1.01 Aerial 1M



c:

C:\
Program Files
TopoFusion

states.gpx

Add File >>
Add All >>
Remove

Name	Length	Moving Time	Climbing El...	Avg. Speed	Color	Date	Ma
Distance 45 to hang	559 ft	No time data	No Data	0.0 mph			0.0
Distance 7 to Warehouse	594 ft	No time data	No Data	0.0 mph			0.0
DTS to Lucik	0.22 mi	No time data	No Data	0.0 mph			0.0

Garmin GPS in Mining

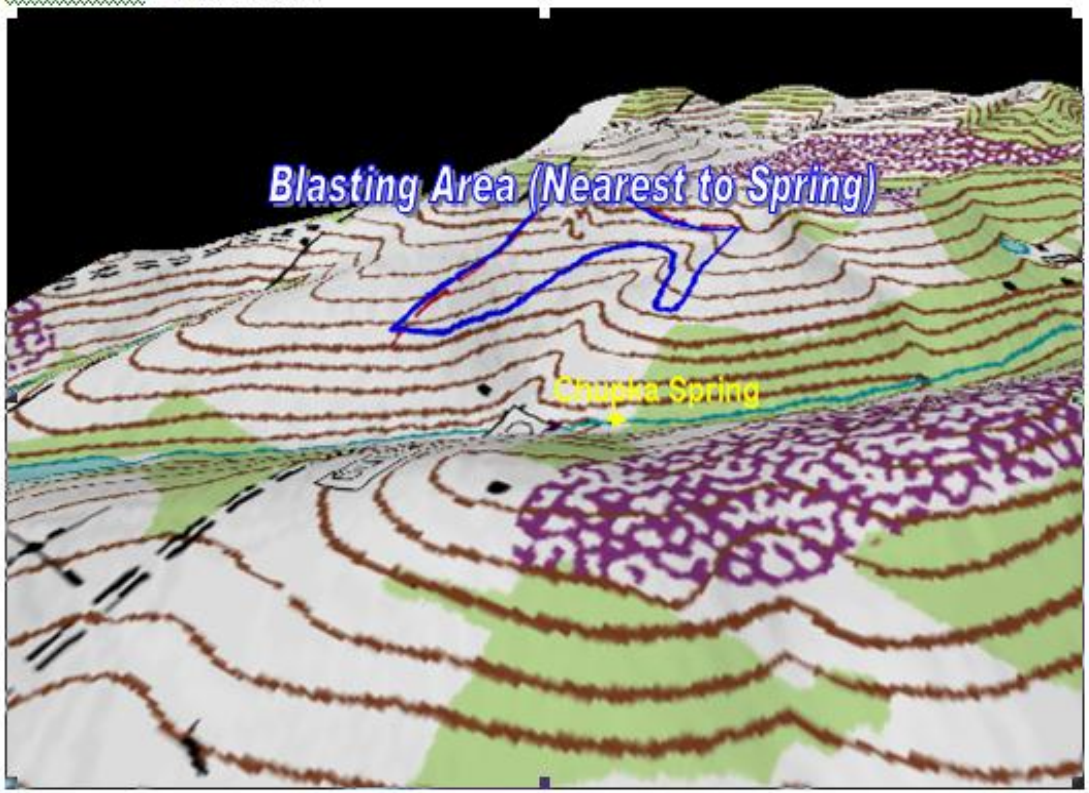
- Location and distance documentation
- Spatial relationships established
- WAAS enabled system - $400
- Permanent documentation of field data
- Develop site schematics
- Relate to topographic maps
- Relate to aerial photographs
- Include in reporting

Final Product

GROUND VIBRATION AND AIRBLAST

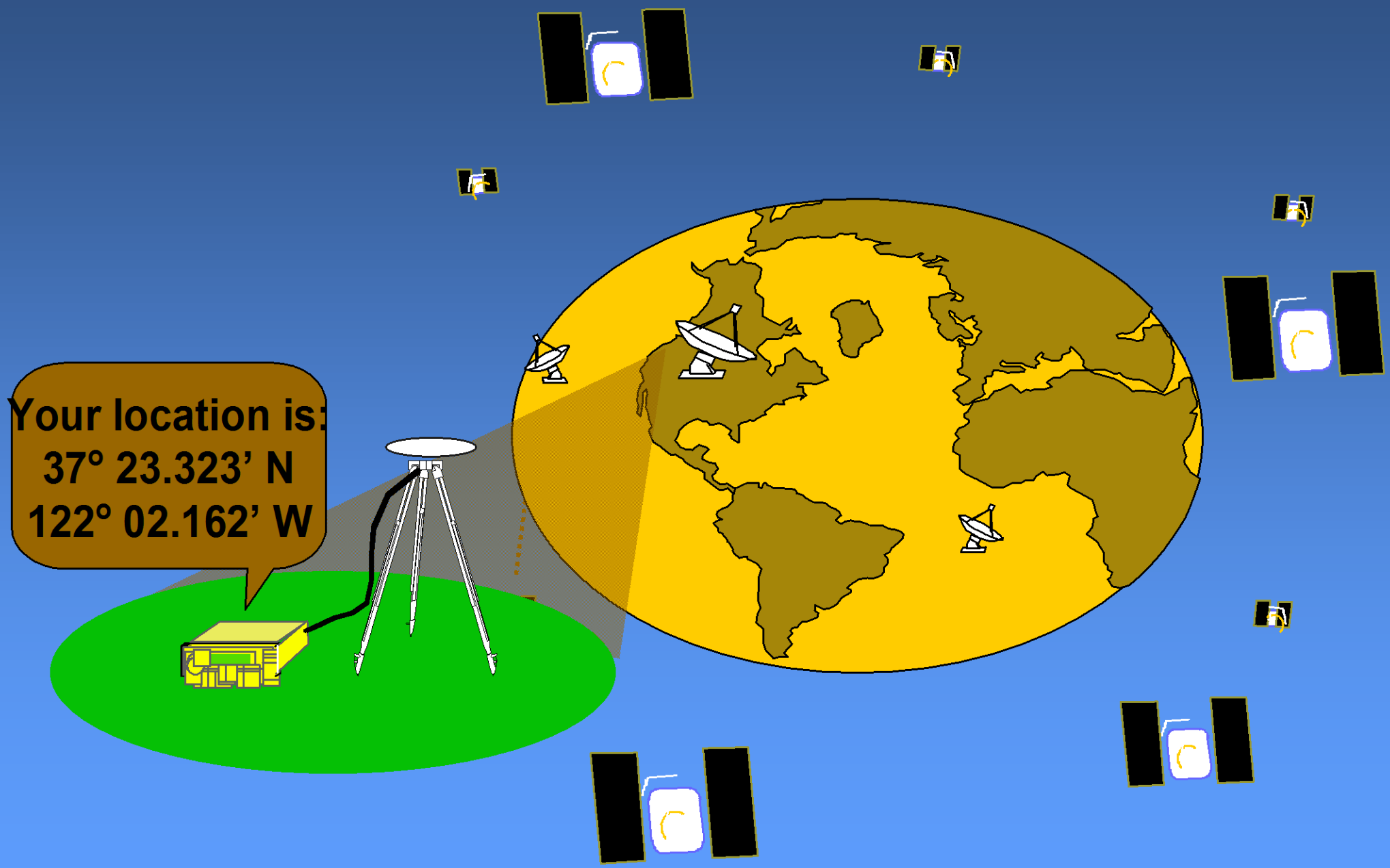
Ground vibration and airblast are the effects from blasting that typically result in complaints from nearby homeowners. Ground vibration and air blasts are similar in character in that they both represent vibration waves (vibrations). The greatest difference is the medium they travel through, the ground versus the air. Ground vibrations affect structures that are located in or on the ground and airblast can affect structures or portions of structures that are above the ground. The wall of the Chupka spring would not have been affected by airblast. Blasts are designed to detonate a series of explosives charges sequentially. The most influential elements of blast design to affect vibrations are the maximum amount of explosives in any charge of the detonation sequence and the distance from the blast to a point of concern. Vibrations decrease in intensity as distances from the blast increase. However, the effects are usually directional. Spatial relationships between the blast site and points of concern may influence vibrations in different directions from the blast site. This is due to consistency of the travel paths of the vibrations. On one side of the blast site the ground vibration may be higher and on the other the airblast may be higher. Spatial relationships, confinement, and timing of the sequence of explosive charges in the blast are also contributing factors in determining vibration levels. Due to the spatial relationship between the blasting and the Chupka spring resulting in a lack of an effective travel path for the ground vibration, the spring would not be greatly impacted by the ground vibration. This is due to the spring being below mine site on the slope of a valley. (See Figure 1 3D Site Map)

FIGURE 1. 3D SITE MAP



QUESTIONS?

Global Positioning System



GPS units

- Garmin eTrex Vista HCx
  - GPS
  - Quick guide
  - Owner’s manual
  - USB Cable
  - Trip and Waypoint Manager

APPENDIX

Specifications

Physical

Size: 4.2" H x 2.2" W x 1.2" D

Weight: 5.6 ounces (159 g) with batteries installed.

Display: 1.3" W x 1.7" H, 256-color, high resolution, transreflective TFT(176 x 220 pixels) backlit.

Case: Rugged, fully gasketed, water resistant, IEC-529, IPX7

Temp: 5 to 158°F (-15 to 70° C)*

*The temperature rating of the eTrex may exceed the usable range of some batteries. Some batteries can rupture at high temperatures.

Often 2-3 meters

Performance

Receiver: WAAS/EGNOS enabled, high-sensitivity

Acquisition Times: (approx.)
Hot start- 3 seconds
Warm start- 33 seconds
Cold start- 39 seconds

Update Rate: 1/second, continuous
Antenna: Built-in patch

Compass: (Vista HCx/Summit HC only) Accuracy; +/- 5 degrees, resolution; 1 degree, user calibrated

Altimeter: (Vista HCx/Summit HC only) Accuracy; +/- 10 feet, resolution; 1 ft., user calibrated

Power

Source: Two 1.5 volt AA batteries, 12 V DC Adapter Cable, or PC/USB Adapter

Battery Life: Up to 25 hours HCx units
Up to 14 hours HC units

Accuracy

GPS: <10 meters (33 feet) 95% typical*

*Subject to accuracy degradation to 100m 2DRMS under the U.S. DoD imposed Selective Availability (SA) Program when activated.

DGPS: 3 meters (10 feet) 95% typical*

*Wide Area Augmentation System (WAAS) accuracy in North America.

Velocity: 0.1 meter/sec steady state

Interfaces: Garmin Proprietary (USB)

Data Storage Life: Indefinite; no memory battery required

Map Storage: HCx units -Dependant on the formatted capacity of the microSD card.
HC units - 24 MB

Key Functions

IN/OUT Zoom keys

From the Map page, press to zoom the map in or out.

From any other page, press to scroll up or down a list or move a highlighted slider.

MENU/FIND key

Press and release to view the Options Menu for a page.

Press and hold to display the Find Menu.

ENTER/ROCKER key

Rock up or down or right or left to move through lists; highlight fields, on-screen buttons, or icons; enter data; or move the map panning arrow.

Press in and release to enter highlighted options and data or confirm on-screen messages.

Press in and hold at any time to MARK your current location as a waypoint.

QUIT/PAGE key

Press to cycle through the main pages.

Press and hold to turn the compass on or off (Vista HCx and Summit HC only).

POWER key

Press and hold to turn on or off.

Press and release for backlighting or to view time, date, and battery capacity.

Each button has a double purpose: Depress and hold for second function

Getting Started

Installing Batteries and Lanyard

The eTrex operates on two AA batteries (not included). Use Alkaline, NiMH, or Lithium batteries. See page 37 for setting the battery type.

To install the batteries:

1. Remove the battery cover by turning the locking ring 1/4 turn counter-clockwise and pulling the cover loose.
2. Insert the batteries, observing the proper polarity.

Remove the batteries when you do not plan to use the unit for several months. Stored data is not lost when batteries are removed.

To install the lanyard:

1. Place the loop of the lanyard through the slot at the base of the unit.
2. Route the strap through the loop, and pull tight.

Transferring Data to a microSD™ Card

The eTrex Vista HCx and Legend HCx are equipped with a microSD data card slot.

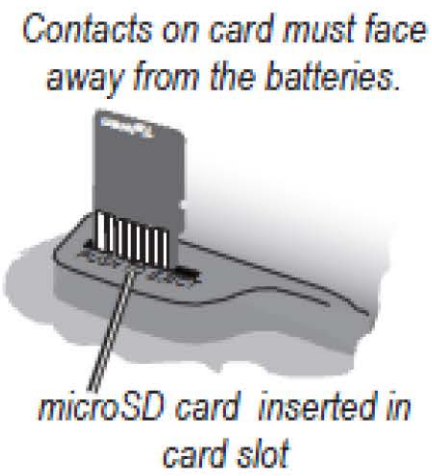
To install a microSD card:

1. Remove the battery compartment cover from the back of the unit.
2. Locate the card slot at the upper-left edge of the battery tray, and slide the card into the slot.
3. Press down on the card and release quickly to eject it from the slot and remove it from the eTrex.

To transfer map data to a microSD card:

1. Lift the weather cover from the USB port on the back of the unit.
2. Connect the USB cable to the USB port on your computer and to the mini-USB port on the back of the unit.
3. Follow instructions for selecting and downloading maps provided with the MapSource map data disk.

Accessing the microSD card slot

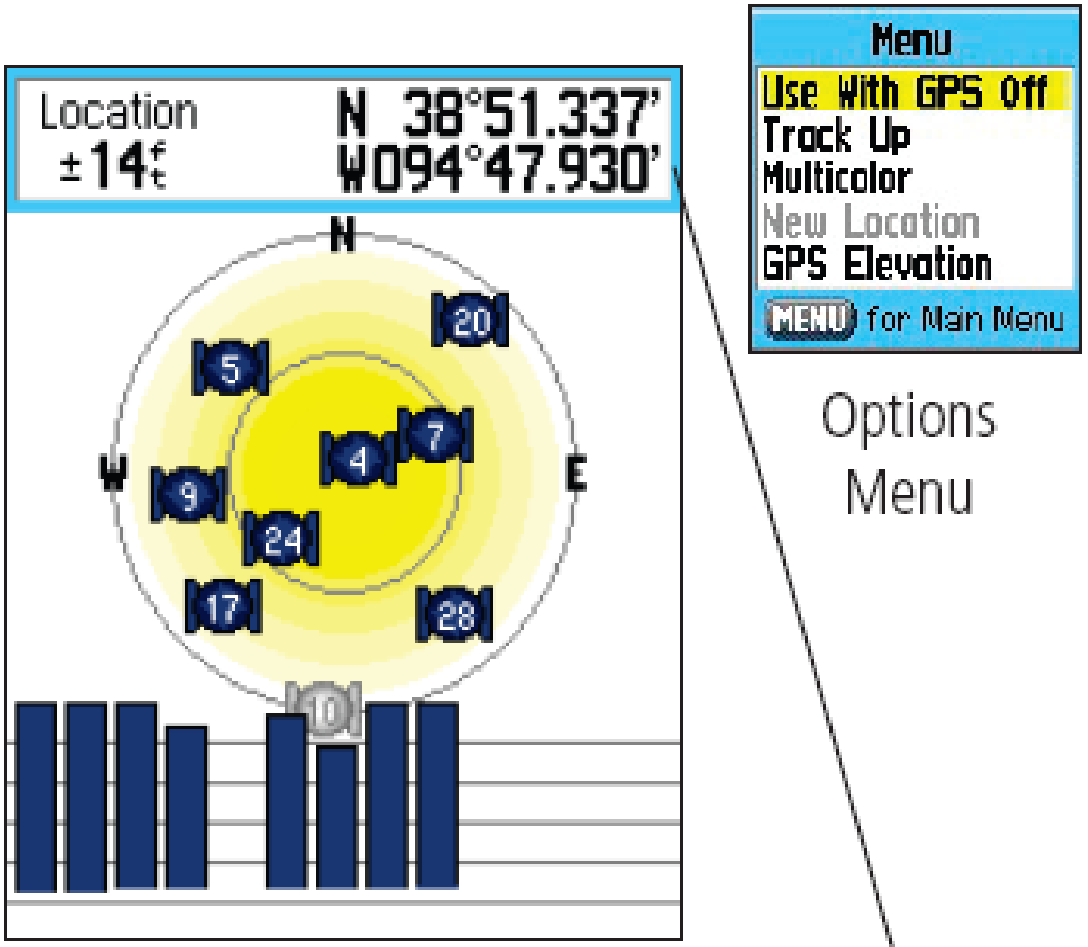


Installing and removing the microSD card

Accessing the USB port

Power on

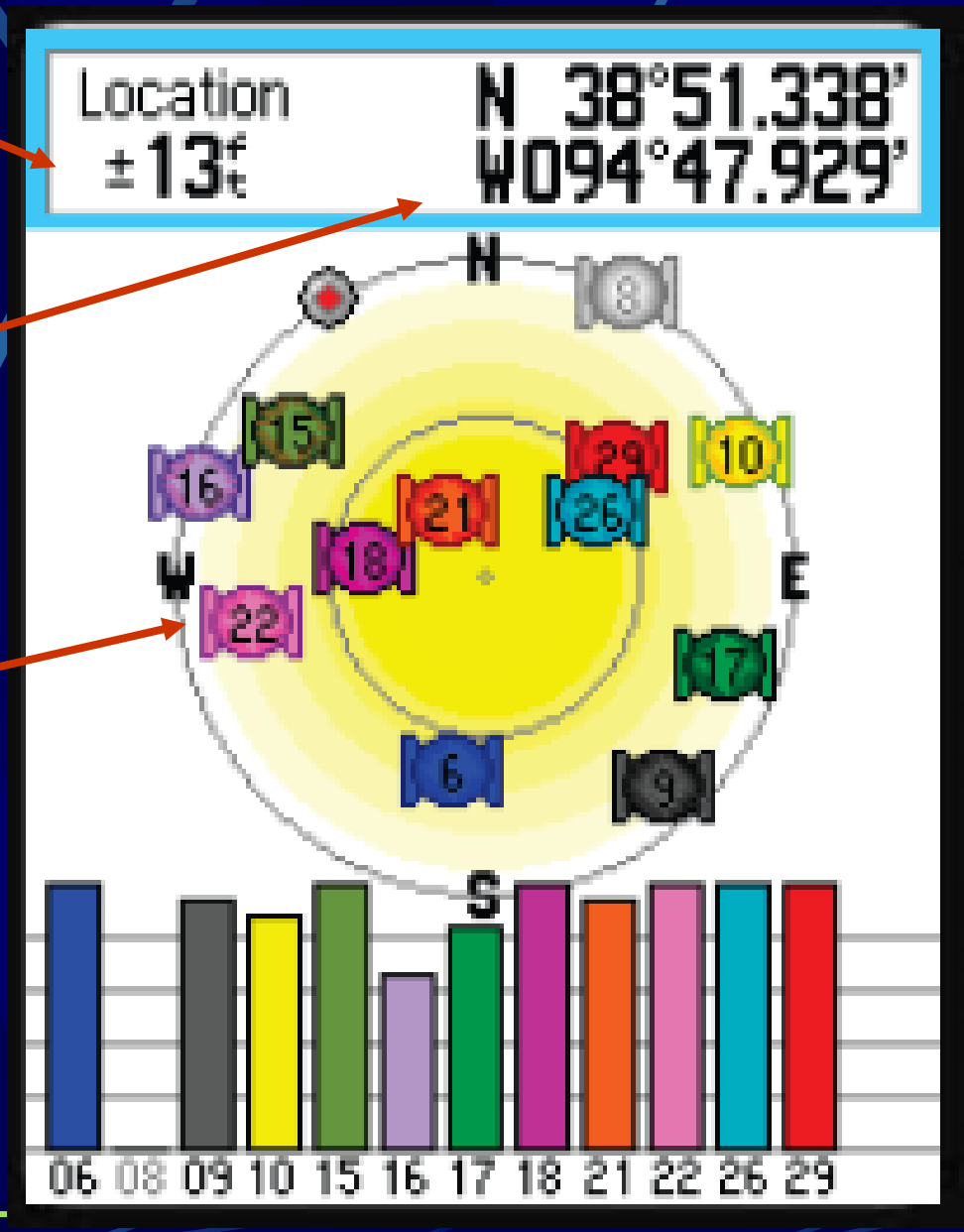
- Satellite page
- Menu button
- Thumbstick
- “Use with GPS Off”



Satellite Page displaying a location “Fix”

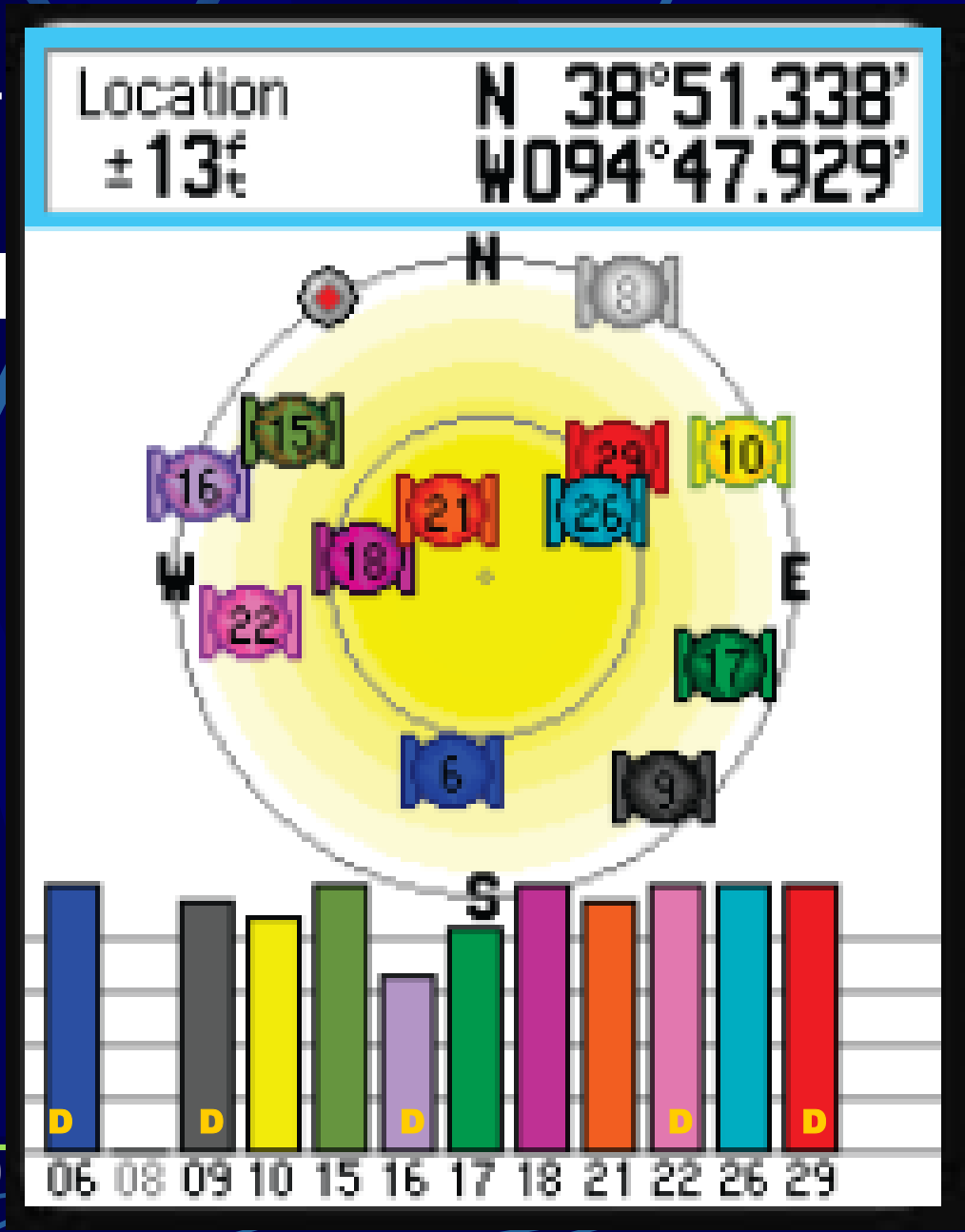
Satellite Page

- Location Accuracy
- Displays current location coordinates (dd mm.mmm or dd mm ss.s)
- Acquired satellites darken
- Outer ring – Horizon
- Inner ring – 45º of sky



WAAS

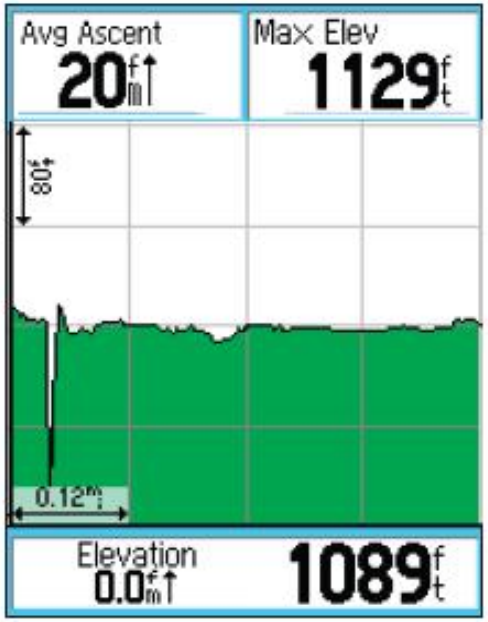
- Satellites 35, 48 and 51
- “D” indicates differential correction
- Begin data acquisition when accuracy is acceptable (almanac acquired)
- Best with a clear view of sky (like most mines)



SET PAGES

Map Page

Compass Page



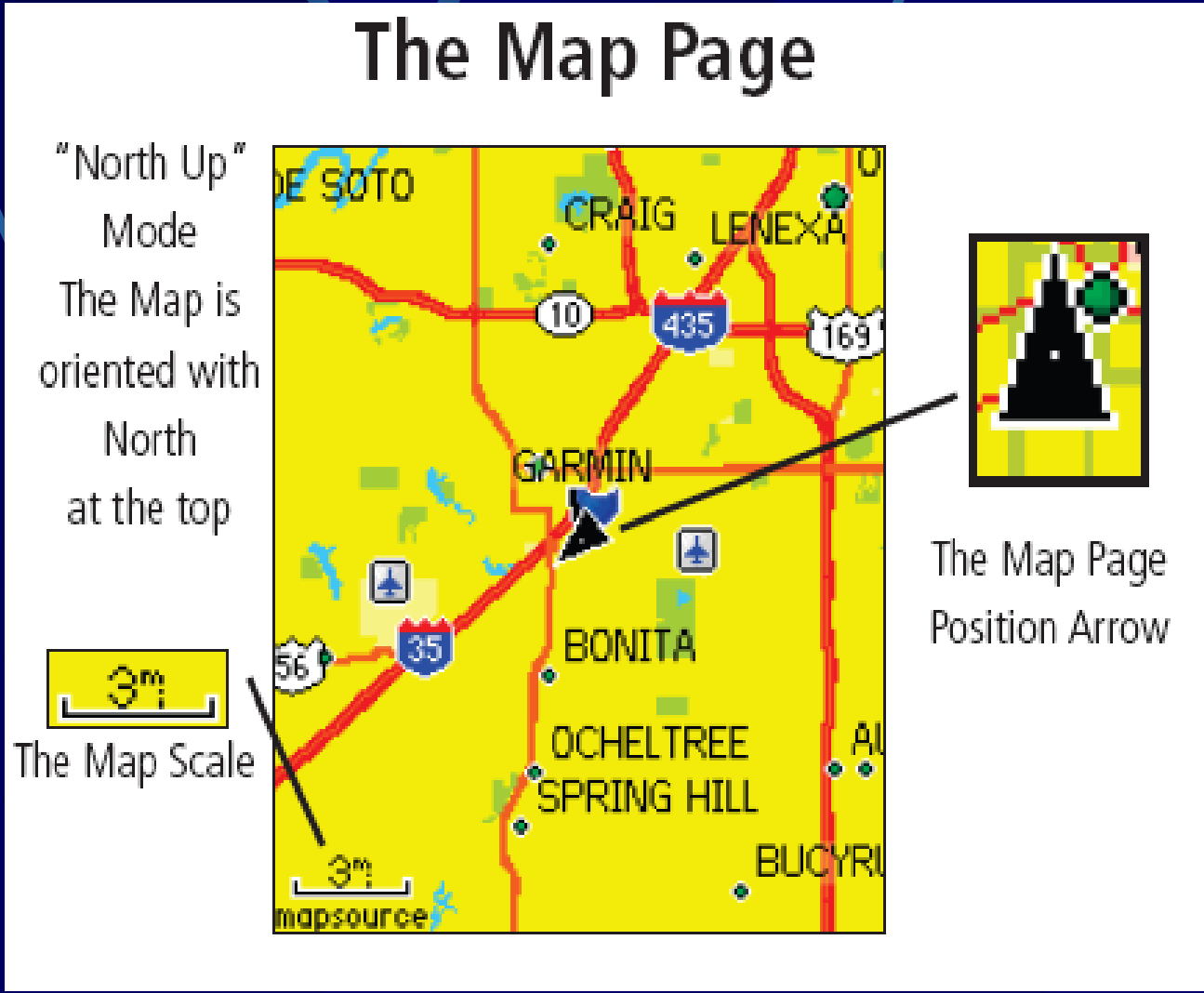
Altimeter Page

Main Menu

MAP **COMPASS** **ALTIMETER** **MAIN MENU**

Map Page

The black arrowhead represents you and the direction you are facing.

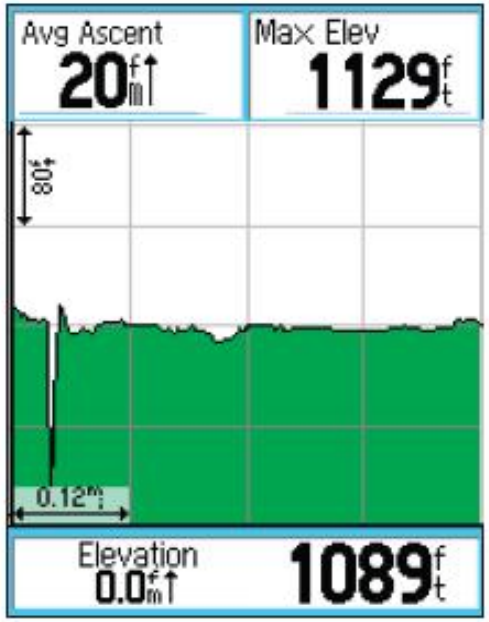


Inside

- Explore with Quit/Page Button
- Map Page
- Location?

Map Page

Compass Page



Altimeter Page

Main Menu

Inside

- Power button
  - Backlight
  - Status
  - Date/time
- Power off

The Main Page Features

Status Bar

Battery Power

Acquiring Satel-

Alarm is Set

USB is Connected

Auxiliary Power

2-Dimension Navigation

3-Dimension Navigation

Electronic Compass ON

Backlight Adjustment Slider
(Brightnesses varies according to battery power level.)

On-Screen Messages

Outside

- Power on
- South view
- Acquire satellites
- WAAS (35, 48, 51)
- Explore map page
- Zoom in and out
- Power off
- 15 minutes

Garmin Vista HCx Buttons

ZOOM IN/OUT

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

MENU/FIND

QUIT/PAGE/COMPASS: Used to cycle through pages

POWER Button