INTRODUCTION TO GPS USING GARMIN E-TREX VISTA HCx

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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
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
- 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!

Currently, GPS is considered the best technology available for locating and measuring areas due to its precision and widespread availability.
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 Augmentation System

Wide Area Reference Stations Monitor the GPS Satellites
How Does It Work?

Wide Area Augmentation System

GPS L1 & L2

The Information Collected by the Wide Area Reference Stations is Sent to the Wide Area Master Stations Who Will Calculate the Correction Message.
How Does It Work?

Wide Area Augmentation System

GEO Satellite

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.
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://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.”
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).”
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           

![Low end GPS](image1.png)
![Mid range GPS](image2.png)
![High end GPS](image3.png)
eTrex® HC series
personal navigator

(eTrex Vista HCx shown)
Waypoints

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

Your location is:
37° 23.323’ N
122° 02.162’ W
GPS units

- Garmin eTrex Vista HCx
  - GPS
  - Quick guide
  - Owner’s manual
  - USB Cable
  - Trip and Waypoint Manager
Often 2-3 meters
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.

Optional belt clip (attaches to belt or waistband)

Belt clip knob

USB connector port (under weather cap)

Auxiliary mount adapter (Do not discard. This adapter attaches to the unit for connection to mounting kits.)

Lanyard installation
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.

Battery compartment with cover removed

microSD card location

Contacts on card must face away from the batteries.

Installing and removing the microSD card

Accessing the microSD card slot

Accessing the USB port

USB port weather cover

USB port

microSD card inserted in card slot
Satellite page
Menu button
Thumbstick
“Use with GPS Off”
Satellite Page

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

COMPASS

ALTIMETER

MAIN MENU
The black arrowhead represents you and the direction you are facing.
Inside

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

- Power button
  - Backlight
  - Status
  - Date/time

- Power off

The Main Page Features

Status Bar

- Battery Power
- Acquiring Satellite
- Auxilary Power
- 2-Dimension Navigation
- 3-Dimension Navigation
- Alarm is Set
- Electronic Compass
- USB is Connected

External Power Lost

Turning off in 23
Press any key to run on battery power

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

On-Screen Messages

Batteries Too Low
For Backlight

ENTR
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