

# GPS FOR DISASTER RESPONSE OPERATIONS

## Instructor Guide

United States Fire Administration  
Emergency Management Institute



**FEMA**

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Total Time: **120 minutes (2.0 hours) includes 35-minute activity.**  
**60 minutes (1 hours) – Summary version without activity**

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## **COURSE OBJECTIVES**

Upon successfully completing this course, the participants will be able to:

- Explain basic GPS theory as applied to actual field use.
  - Explain FEMA’s use of coordinates.
  - List common problems and their prevention.
  - Demonstrate the ability to configure the unit, obtain, record, and verify coordinates in the field.
  - Demonstrate ability to determine USNG coordinates given a gridded map.
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## **RATIONALE**

FEMA has identified a training requirement to provide all FEMA personnel who obtain, enter, or use geospatial coordinates with a basic understanding of the GPS system, units, and issues that effect accurate coordinates. FEMA uses geospatial information to fulfill several important agency requirements. Collection of erroneous coordinates has been identified as a major problem. This course is designed to provide the training to address these requirements.

## **COURSE GOAL**

The purpose of this course is to educate FEMA staff about the proper use of GPS units and recording of coordinates.

**TARGET AUDIENCE** The target audience for this course is as follows:

<b>PRIMARY AUDIENCE</b>	<b>SECONDARY AUDIENCE</b>
FEMA /State: FEMA staff who use GPS units FEMA staff who enter GPS coordinates FEMA staff who use or interpret coordinates	State/Local level applicants for public assistance

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# GPS for Disaster Response Operations

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## COURSE STRUCTURE/STRATEGY

All participants will be prepared for an environment of interactive lectures, class participation, demonstrations, and working independently or in groups to complete designed group activities. Participants will be encouraged to apply their existing program skills and knowledge as well as those newly acquired in challenging and dynamic scenarios.

Students will be required to demonstrate their acquisition of the skills and knowledge through a practical exercise conducted outside (or wherever it is possible to acquire satellites). Students will complete a practical exercise worksheet.

Two manuals are provided for the course; a Student Manual and an Instructor's Guide. The student materials are produced from printing the PowerPoint presentation handouts (three or six to a page). The student's should also be given the GPS job aid.

## METHODOLOGY

**The course requires both delivery in the classroom environment and outside.** Since students are required to see screenshots from the GPS receivers (units) the class cannot be delivered solely outside unless teaching to less than three students. After introducing the section, the instructor will give a brief overview of the use of GPS coordinates and mapping. Current problems with the collection of accurate coordinates will be presented. Section two introduces basics of mapping, different coordinate systems, and how to use the US National Grid (USNG). In order to give students a better appreciation of why they are asked to follow certain operational protocol, the basics of GPS theory are covered in optional section three. Section four covers the features found in a Garmin Etrex Vista that are applicable to the collection of coordinates. In addition, during this section the students will either confirm or configure their GPS unit to the FEMA standards. This section will utilize both lecture and demonstration, thus requiring the student to have a GPS unit in hand. Section five covers field operations and shows the student steps required to standardize coordinate collection from a variety of sites. Scenarios are presented in pictures of actual sites that the class must determine the correct location to take a reading from. In section six the class moves outside in order to collect actual readings and conduct several exercises that demonstrate how the GPS unit works. In section seven the students return to the classroom setting to verify that the readings they obtained are accurate when compared to either web-based mapping programs or software based basic mapping programs. Both lecture and a demonstration of either the Internet programs or software applications are presented. In the summary the key points reviewed.

## Course Deployment/Delivery

The course will be delivered as a one-day course to FEMA staff and other affected staff at a Joint Field Office (JFO) or alternative training settings. The course material will be available through the DFTO.

# GPS for Disaster Response Operations

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## DURATION

This course is designed for 2.0 student hours. This time includes lecture, breaks, and a practical exercise. A shorter version is also available which requires 1 student hours. This version spends 30 minutes less on GPS theory and omits the outside practical exercise.

## SCHEDULE

A sample agenda is provided to assist the instructor with preparation of the course.

Section 1	Introduction	05 minutes	05 minutes
Section 2	Maps and Coordinates	10 minutes	10 minutes
Section 3	GPS – How Does it Work	25 minutes	Skip
Section 4	Unit Features	15 minutes	15 minutes
Section 5	Field Operations	15 minutes	15 minutes
Section 6	Practical exercise	35 minutes	Skip
Section 7	Quality Control	10 minutes	10 minutes
Section 8	Summary	05 minutes	05 minutes
<b>Total Time:</b>		<b>2.0 hours</b>	<b>1 hour</b>

## OVERVIEW OF COURSE UNITS AND EVALUATION

 **Section 1: Introduction** This section provides information about how FEMA uses coordinate information.

 **Section 2: Maps and Coordinates** provide a basic overview of the role of maps, coordinates, and how to use the US National Grid.

 **Section 3: GPS – How does it work?** Provides an explanation on how the GPS receiver determines its location. Emphasis is on those components that have field implications.

 **Section 4: Unit Features** provides information about the features of the Garmin Etrex Vista GPS units that are used in obtaining a correct set of coordinates.

 **Section 5: Field Operations** provide participants information about how to safely operate a GPS unit in the field. It also includes information on FEMA suggested practices on where to take a reading from.

# GPS for Disaster Response Operations

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**Section 6: Practical Exercise** provides participants an opportunity to practice with the units in an outside environment. The students will complete a worksheet that has several exercises. The students will then work in small groups to obtain coordinates for simulated disaster sites.

**Section 7: Quality Control** provides an overview of methods that can be used to verify coordinates relate to the actual position by using web-based mapping programs or programs that may be found at the JFO.

**Section 8: Summary** concludes the course and allows the instructor to review key points and ensure students understand the major steps in obtaining coordinates.

## COURSE REFERENCES

The materials listed below are used in this course.

- *GPS for Disaster Response Operations*, DF###, Instructor Guide
- *GPS for Disaster Response Operations*, DF###, Student Manual (PowerPoint Handout)
- Course Handouts
  - Student Evaluation Forms (one set per group instructor)
  - GPS Response Job Aid (brochure)
  - Emmitsburg Gridded Topographic map
  - NETC Gridded Orthographic map

## SUPPORTING PUBLICATIONS

The following publications are useful to support the delivery of this course.

- *Standards for a United States National Grid*, FGDC-STD-011-2001 ([www.fgdc.gov/usng](http://www.fgdc.gov/usng))
- *Revised Global Positioning System (GPS) Equipment Specifications Memo*
- *GARMIN Etrex Vista Owner's Manual* ([www.garmin.com](http://www.garmin.com))
- *GARMIN GPS Guide for beginner's* ([www.garmin.com/aboutGPS/manual.html](http://www.garmin.com/aboutGPS/manual.html))
- *GARMIN An Introduction to Using a GARMIN GPS with paper maps.* ([www.garmin.com/aboutGPS/manual.html](http://www.garmin.com/aboutGPS/manual.html))

# **GPS for Disaster Response Operations**

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## **SPACE REQUIREMENTS**

The following space requirements are recommended:

- Primary Room for Instruction
  - Room Dimensions – for class of 25-30 students, minimum 25 ft. x 50 ft., or similar capacity
  - Five to six tables, seating five to six people per table. Minimum table dimensions to accommodate students, instructors and course materials (manuals) 6 ft. x 8 ft.
  - Classroom may also be setup as chairs setup in rows.
  - Additional tables for additional materials and supplies, visual equipment (projector etc.), break foods (coffee, snacks)
- Outside Work area
  - An area outside (or able to receive strong satellite signals) must be scouted out prior to class. The area should be large enough to accommodate the class size with the students able to freely walk about. In most JFO settings this may be in the parking lot or landscaped area immediately adjoining the JFO. If the parking lot is busy confer with the safety officer to ensure a safe location is found for the practical exercise.

## **COURSE SUPPLIES AND EQUIPMENT**

### **Audio-Visual/Electronic Equipment**

- PowerPoint Software
- Computer and LCD Projector
- Overhead Projector and Screen (optional or as a backup)
- Hand-held microphones (two per class depending upon size of class)
- Lapel microphones for instructors (minimum of two depending upon size of class)
- Laser Pointer

### **Classroom Materials**

- Tables/Chairs (see Space Requirements)

# GPS for Disaster Response Operations

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- Easel Pads and Stands (one for instructor)

## Administrative Materials

- Class Roster
- Course Agenda
- Class Evaluation Form

## Student Supplies

- Highlighters for participants (minimum one per student)
- Computer disk with course materials
- GPS units (ideally one per student)

## INSTRUCTOR PREPARATION

- Download Instructional material from the DFTO website.
  - <http://www.training.fema.gov/emiweb/dfto/stantrn.asp>
  - Note: Two GPS courses exist, be sure to download the **Response Version DF###**.
- Make sure sufficient GPS units are available for students. Ideally, each student should have the GPS unit they are issued and will be using in the field. Obtaining units may require:
  - Making sure each student knows to bring their issued unit
  - Checking out units from Accountable Property Officer (APO) for the class
  - Checking out units from PA for the class
  - Obtaining additional units from the DISC
  - Obtain additional AA batteries
- If obtaining GPS units that have not been turned on at the disaster site consider turning on units outside prior to class. This eliminates delays associated with cold startups and may help identify non-functional units.
- Determine the GPS unit configuration policy being used for the particular disaster. Depending upon the needs of the disaster the units may be configured by:
  - Configured by the USAR team.
  - By the student during the class.
  - APO upon issuing the units
  - PA upon issuing the units
  - ESF 5, technical services, or GIS section after the unit is issued
  - Note: At this time the DISC does not configure the units

## GPS for Disaster Response Operations

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- Determine if any basic mapping programs are being loaded onto individual laptops. If so, be prepared to discuss how the software operates.
- Details for preparing for the practical exercise are covered in section six. The exercise must be conducted outside or in a location that it is possible to obtain satellite signals. If the class is being held outside, coordinate with the safety officer if the site poses any risk to the students. Coordination with security may also be required in order to allow the students to bring the units outside of the JFO.

### COURSE EVALUATION

**Level I:** The Emergency Management Institute (EMI) Course Evaluation Form (FEMA 95-41) will be used to document student feedback on the overall evaluation of the quality of the content, the instruction and the facilities. The form uses a 1–5 rating system, with 5 being the highest. At the end of the course, the Course Manager will lead a feedback session so students also have the opportunity to provide verbal feedback on the course content.

**Level II:** A Student Evaluation will be performed to assess the students' ability to demonstrate their proficiency in applying the knowledge and skills needed. The Student Evaluation will be integrated into the practical exercise. The students will record GPS coordinates from a fixed location. These coordinates will be verified to ensure the student and the student's GPS unit is able to obtain accurate coordinates.

### ENDORSEMENT DISCLAIMER

DHS/FEMA does not endorse or recommend any commercial products, processes, or services. Therefore, mention of commercial products, processes, or services in this training course cannot be construed as an endorsement or recommendation.

## Introduction

Overview  
5 minutes



Photo Credit: Martin Lockheed, used with permission

### GPS for Disaster Field Operations

- Welcome students
- Introduce instructor(s)
- Introduce students. In the JFO setting this course may be part of several additional components of training. If the class is a standalone more time should be spent on making the students familiar with the classroom setting and instructors.
- Provide a general introduction to the course
- Obtain feedback on the classes level of expertise with GPS units by asking the following questions

- How many have used GPS units before?
- How many have used a GARMIN Etrex or Vista?
- How many have configured a GPS unit?



Notes:

## Introduction

### Objectives

- Explain FEMA's use of coordinates.
- Explain basic GPS theory as applied to actual field use.
- List common problems and their prevention.
- Demonstrate the ability to configure the GPS unit, obtain, record, and verify coordinates in the field.
- Demonstrate ability to determine coordinates given a gridded map.

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### Objectives

- A GPS unit is a scientific instrument designed to collect geographic reference points known as coordinates. FEMA uses coordinates in many different ways.
- In order to collect more accurate coordinates it's important to understand some of the basic theory of maps and how the Global Positioning System or GPS works.
- Several different causes may lead to inaccurate coordinates, most of which are caused by human error and are preventable.
- In order to achieve the highest possible accuracy we will practice setting up the GPS units correctly and using them in the field.
- In the response environment, it is critical that users obtain coordinates from maps and find a location on a map given a set of coordinates.

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### Notes:



Who is responsible for configuration of the GPS unit will vary with different USAR teams and responders. All students need to know how to check configuration and potentially switch map datums.

## Introduction

### FEMA use of GPS Information

- If no physical address
- Road sign/address destroyed/flooded
- Coordinate with other response agencies
- Other FEMA program responsibilities



Photo Credit: FEMA/David Saville

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### FEMA's use of GPS Information

- FEMA currently uses the coordinates collected in several different ways
  - Providing a location, when no physical address exists.
  - Help finding a damaged site when the address marking has been destroyed or hidden by flooding.
  - Coordinate response activities with other local, state, and federal agencies.
  - Provide coordinates to other FEMA programs for recovery efforts.

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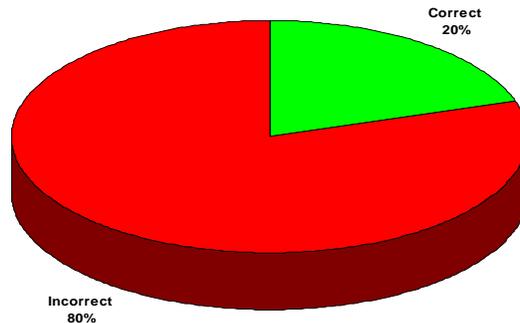
Notes:



## Introduction

### Current FEMA Performance

- 20% PW correctly entered coordinates
- Common mistakes
  - Transcription errors
  - Wrongly configured
  - Bad Conversions



**FEMA Requires Accuracy of 20 Meters**  
**Target Performance Goal: 95% Correct**

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### Current FEMA performance

- In 200X FEMA reviewed its performance of correctly entered coordinates on Project Worksheets. Coordinates were verified by GIS software to ensure they were accurate.
- It was found that only 20% of the coordinates were entered correctly.
- Common mistakes, which were caused by human error, included; failure to provide coordinates, transcription errors, wrongly configured GPS units, and improper conversion of coordinate formats.
- FEMA's goal and a major goal of this course are to make sure coordinates are entered correctly within 20 meters 95% of the time.



In order for the users of the coordinates to make proper decisions, the coordinates need to be accurate within 20 meters.

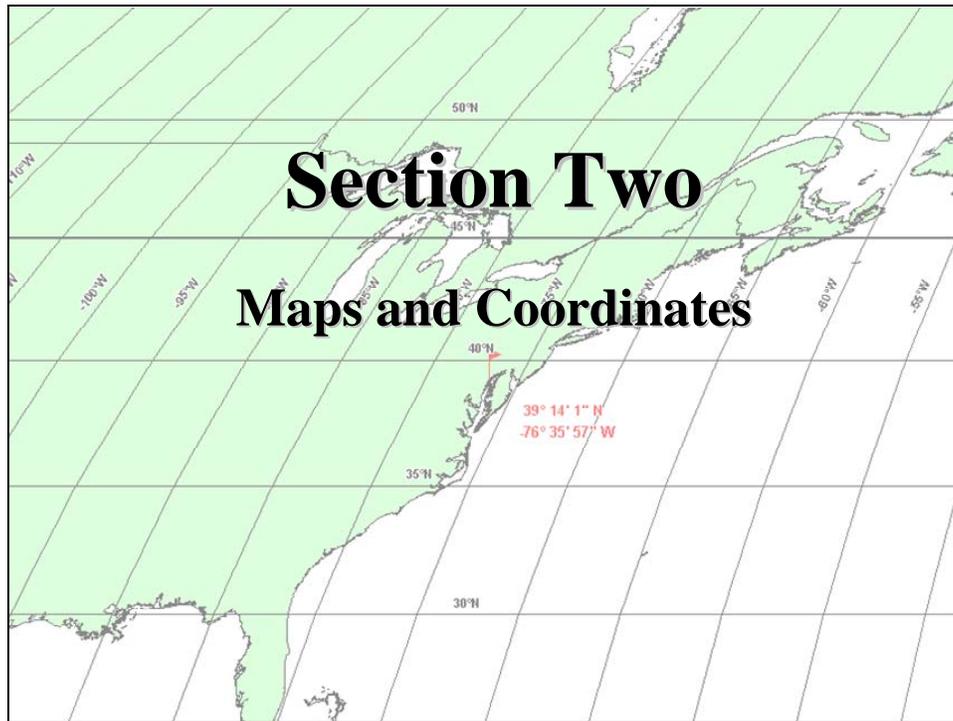
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### Notes:



## Maps and Coordinates

Maps &  
Coordinates  
10 minutes



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### Mapping and GPS Theory

- The purpose of this section is to provide the student some basic information about maps and show the student how coordinates relate to maps.
- The student is expected to both plot a USNG grid coordinate onto a gridded map and determine coordinates of features found on a gridded map.

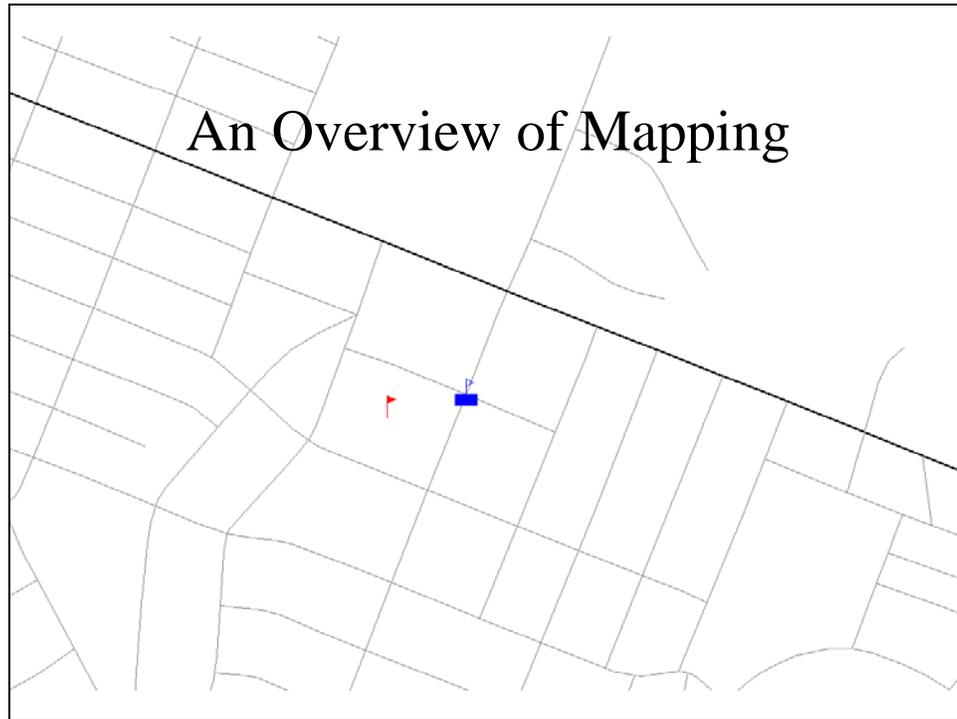
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### Notes:



Instructors are cautioned not to exceed the time allocated. The purpose is to provide an overview not an in-depth discussion of mapping and coordinate systems.

## Maps and Coordinates



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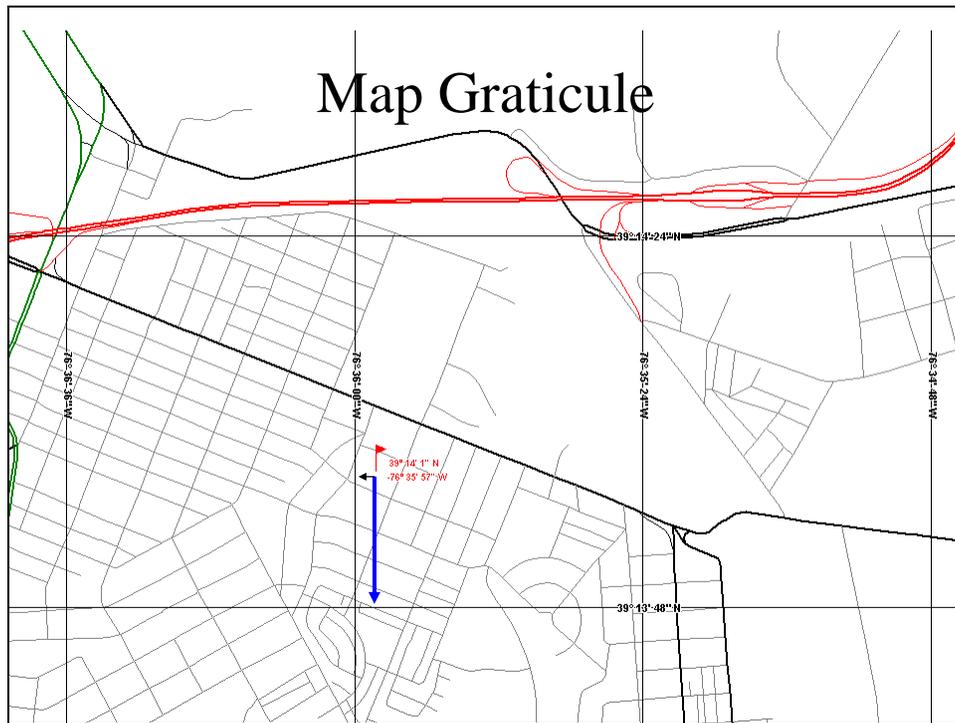
### An Overview of Mapping

- A map is a two-dimensional representation of a three dimensional world. When depicting larger areas it also has the additional challenge of projecting the surface of a sphere on to a flat piece of paper.
- A road map is the most familiar map for most of us. Common features of all maps include
  - Scale
  - Map orientation (usually the top of a map points to North)
  - Selectively only representing features that are of interest to the user
  - May or may not have a grid system laid over the map.
- Using a road map it is easy to locate an object that is at the intersection of two roads. Some road maps even give address numbers. Determining the location of the school represented in blue would be easy.
- However, it is difficult to give a location or find objects not on roads or near intersections or when address signs are missing or destroyed.



Notes:

## Maps and Coordinates



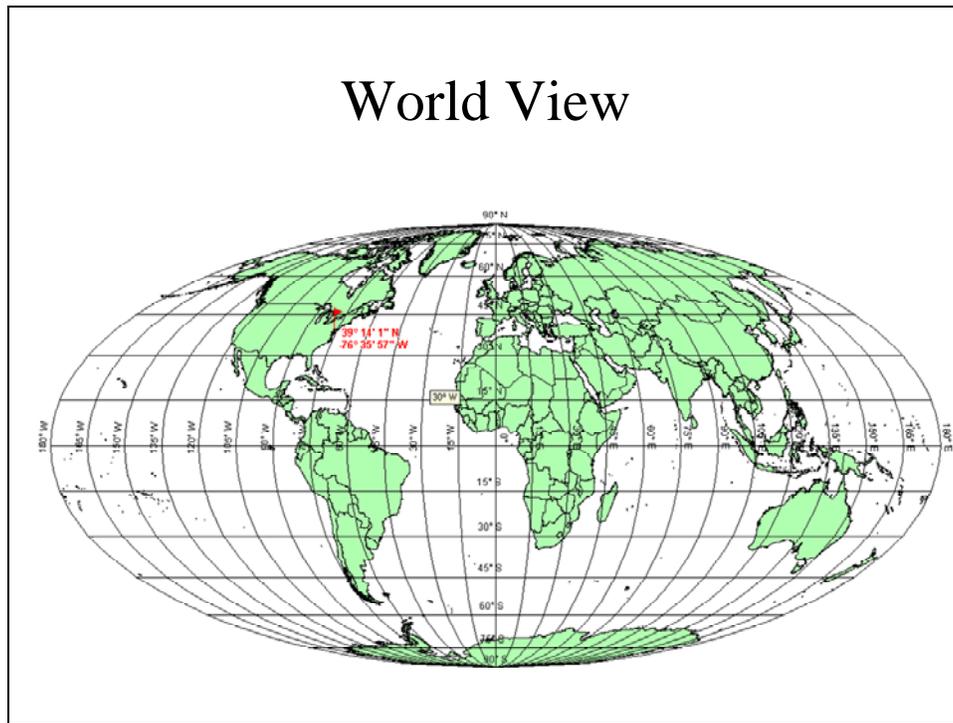
### Map Graticules

- Graticules (Grids that are not squares) are placed on maps to make it easier to identify any point on the map.
- Many different types of grids exist. From simple letter number combinations used in many road maps to longer sets of numbers. Different grid systems start from different locations.
- To locate an object on the surface of the earth its location East to West and North to South needs to be given.
- In this example the site of interest is 39 degrees 14 minutes 1 second North of the Equator and 76 degrees 35 minutes 57 seconds East of the prime meridian using lines of latitude and longitude.
- Notice how a Graticule of latitude and longitude does not form a square. Therefore, it is often difficult to determine a latitude-longitude coordinate without computer software. This is especially true when trying to find locations with a precision of 10 meters or less.

Notes:



## Maps and Coordinates



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### World View

- Latitude and Longitude is one of the oldest grid systems and can be used to give a precise location of any point on the earth.
- Lines of Latitude start at the equator and define your position north or south of the Equator up to the poles, which are  $90^{\circ}$ . Lines of latitude are parallel to each other.
- Notice how longitude narrows as it gets closer to the poles. It is known as a spherical coordinate system.
- Latitude and longitude are important in establishing the Grid Zone Designations used in the US National Grid (USNG).

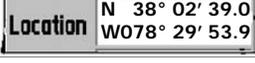
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### Notes:



## Maps and Coordinates

### Lat/Long Coordinate Formats

<ul style="list-style-type: none"><li>• Decimal Degrees hddd.ddddd° </li></ul>	<ul style="list-style-type: none"><li>• Easiest to enter into GIS</li><li>• Currently used by FEMA Public Assistance (PA)</li></ul>
<ul style="list-style-type: none"><li>• Degrees Decimal Minutes – hddd°mm.mmm </li></ul>	<ul style="list-style-type: none"><li>• Used by aviation and maritime since one arc minute equals one nautical mile</li><li>• Default setting on new GPS</li></ul>
<ul style="list-style-type: none"><li>• Degrees, Minutes, Seconds – hddd°mm'ss.s'' </li></ul>	<ul style="list-style-type: none"><li>• Historical</li></ul>

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### Latitude/Longitude Coordinate Formats

- Several different formats exist for giving coordinate positions. The two major formats are based upon latitude and longitude or a decimal based grid. Latitude and longitude coordinates are given in three different formats.
- Decimal Degrees is the easiest to program with and is used in many Geographic Information System (GIS) software programs. It is also the easiest to input into a computer. It is the format used by FEMA's Public Assistance program. However, it is nearly impossible to accurately plot Decimal Degree coordinates onto a paper map in the field without a computer program.
- Degrees Decimal minutes are historically used by aviation and mariners. One arc minute equals one nautical mile or the distance of one knot per hour. One nautical mile is slightly longer than a statute mile (1.14). Degrees Decimal minutes are the default setting on a Garmin Etrex GPS unit. Many users use this format since they don't know how to change the setting. This causes many user errors for FEMA.
- Some people may also be familiar with the degree, minute, and second format. Where 60 seconds make a minute.

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### Notes:



Coordinates are shown as they appear on the GPS unit and mark the same spot.

## Maps and Coordinates

### Plane Coordinate Systems

- Universal Transverse Mercator (UTM)

Location 18S 0300589  
4396488

- Decimal based coordinate system
- Easiest to use in field
- Least amount of errors
- Basis of USNG

- US National Grid (USNG)  
Military Grid Ref. System

Location 18S UJ 00589  
MGRS 96488

- USNG and MGRS functionally the same
- USNG Federal Grid Standard
- USNG FEMA Response Standard

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### Plane Coordinate Systems

- Universal Transverse Mercator (UTM) is considered a plane coordinate system since it is based upon a perfect square (plane). It is based upon meters making it possible to apply standard grids and make estimates. It is based upon how many meters north of the equator and how many meters east of a reference longitude line. In the above example the National Fallen Firefighters Memorial is located 300,589 meters east of the reference line of longitude and 4,396,488 meters north of the equator.
- The Military Grid Reference System (MGRS) builds upon the UTM system and reduces the number of digits by introducing a two letter 100,000 meter box designator. Note the final numbers are the same with UTM and MGRS.
- The US National Grid system is functionally the same as the MGRS. In using the older Garmin Etrex series of GPS units, MGRS is what will be displayed on the unit. Newer and updated software models will display USNG.
- The difference between MGRS and USNG is mostly semantics and how the USNG handles changing datums, which will be discussed shortly.
- The USNG is the federal standard for reporting coordinates and is therefore the FEMA response standard.

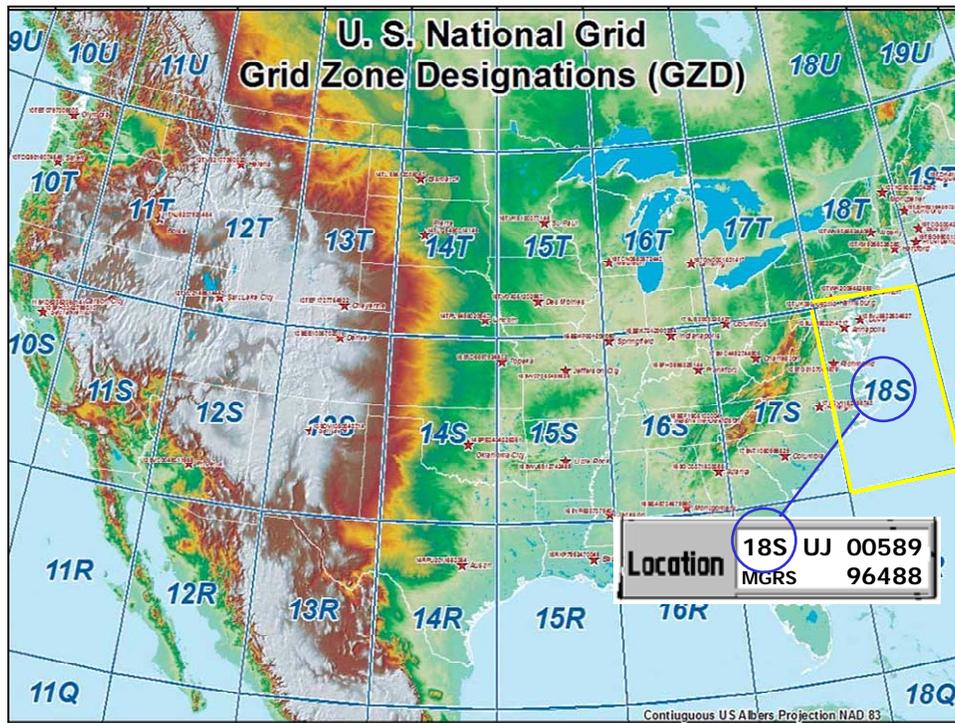
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### Notes:



USNG appears on the Garmin Vista C. As of December 2005 the Garmin Vista displays MGRS instead of USNG. Garmin plans a software update in 2006.

## Maps and Coordinates



### USNG Grid Zone Designations (GZD)

- The location box displays a USNG coordinate of the National Fallen Firefighters Memorial as it will appear on a Garmin Etrex Vista.
- The first component of a USNG coordinate is the Grid Zone Designation. Grid Zone Designations are based upon every 6 degrees of longitude (the number - 18) and every 8 degrees of latitude (the letter - S).
- The Grid Zone Designations are identical to UTM.

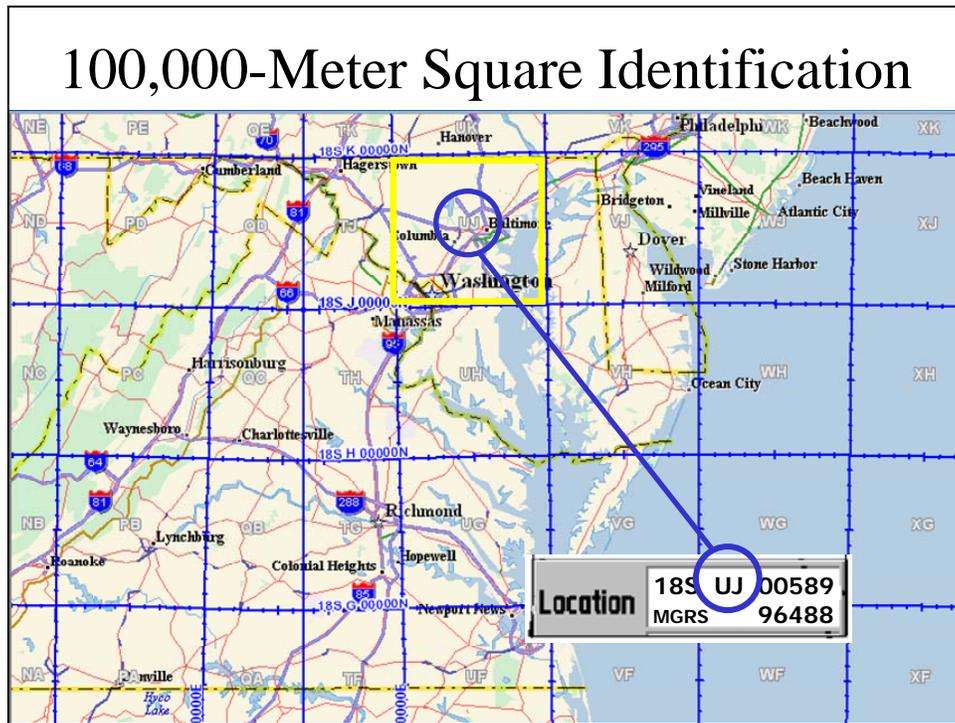
### Notes:



The last band of latitude (band X) is 12 degrees high.

# GPS for Disaster Response Operations

## Maps and Coordinates



### 100,000-meter Square Identification

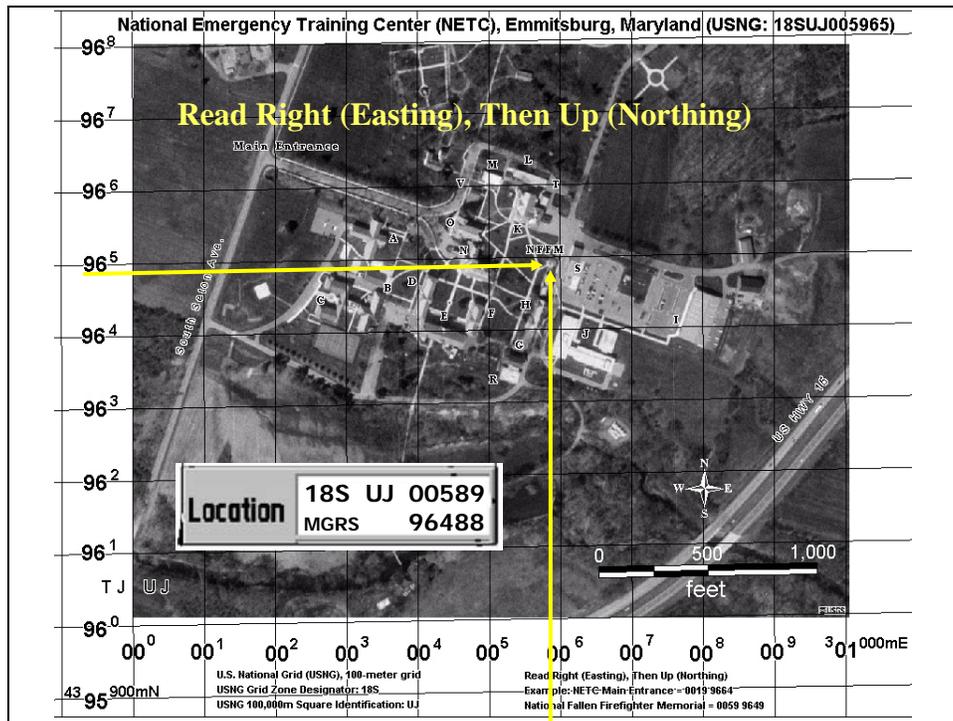
- The Grid Zone is further broken down into 100,000-meter boxes (62 miles on a side). Each 100,000 box is given a two letter code.
- Letters that might be easily confused with numbers are omitted.
- In our example UJ corresponds to most of Washington DC and vicinity.

Notes:



# GPS for Disaster Response Operations

## Maps and Coordinates



### Coordinates

- The illustration depicts almost a square kilometer including the National Emergency Training Center.
- A 100 meter grid has been applied over the illustration. Most maps show a more limited kilometer (1000 meter) grid.
- The National Fallen Firefighters Memorial is at the intersection of the two yellow lines.
- To either plot or determine a coordinate remember “Read Right, then up”. This means read the easting number (or x-coordinate) first, then the northing number (y-coordinate).
- Garmin Etrex will always display a coordinate precise to 1-meter in location.
- The USNG coordinate 18S UJ 00 96 (18SUJ0096) would define a 1 kilometer box and is the shortest USNG coordinate that can be given. If the goal was simply to locate NETC this might be sufficient.

### Notes:

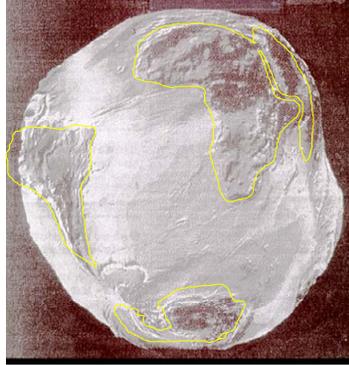


This map also exists has a student handout.

## Maps and Coordinates

### Datums- another user error

- What is a datum
  - Start point for measuring
  - World not sphere
- NAD83 default for USNG
- NAD83/WGS84 same
- Older maps use NAD27
- Shift of ~100 meters



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### Datums – another user error

- Another source of configuration error is something called a datum.
- Datums are needed because all maps need a start point for a model. The earth must be modeled because it is not a perfect sphere. It bulges in the equator due to its orbit and is a rather lumpy “potato” when viewed without water and clouds. The mathematical models accounts for the earth’s more ellipsoidal shape.
- The default GPS datum is for WGS84 (World Geographic System) established in 1984. It is identical to a datum known as NAD83 (North American Datum of 1983). Both of these datums used the center of the earth as the starting point. They were conducted using laser survey instruments and verified later by GPS.
- With the Garmin Etrex, once you shift the coordinate to MGRS the datum automatically switches to NAD83.
- Another common datum found on USGS topographic maps is NAD27 (North American Datum of 1927). This datum used Meades Ranch in Kansas as the starting point and was conducted using chains to work across the continent with many control points surveyed in the 1800’s.
- Therefore, the further away from Kansas the greater the error. On the west coast the difference between the two datums can cause a 100 meter error.

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### Notes:



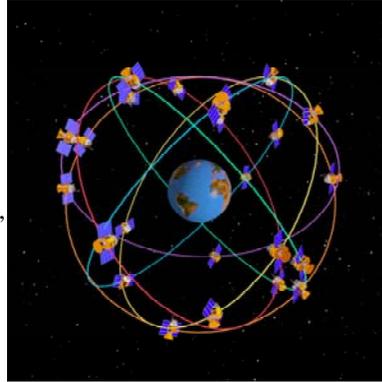
## GPS – How Does it Work

Section Three:  
25 minutes

Section  
Three is  
optional.

### Section Three GPS – How does it Work?

- Constellation of 24 + satellites in 6 orbits
- Microwave Radio Frequency
- Line of Sight
- Pass through clouds, glass, plastic
- Blocked by buildings, mountains, etc.
- Weaker under trees



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### GPS – How does it work?

- Currently 29 satellites in 6 different orbital planes, with at least four satellites in each orbital plane. Arranged so that at least 4 satellites are always visible anywhere on earth. Number varies as new satellites are launched and old ones stop working.
- Placed in high orbit 20,200 km (12,000 miles) above earth to increase visibility and decrease effects of atmosphere on orbit.
- Satellites come in and out of visibility. Therefore, the number actually visible varies from time to time.
- The satellite constantly transmits 500 watts at a civilian frequency of 1572.42 MHz
- The signal travels line of sight and is able to pass through clouds, glass, and plastic.
- Buildings and mountains block the signal.
- The canopy of trees weakens the signal.
- A simple rule of thumb is: To see a satellite you need to see the sky.

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### Notes:



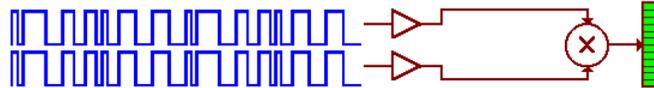
The current number of operational satellites can be obtained from:

<http://www.navcen.uscg.gov/ftp/gps/status.txt>. Newer satellites will transmit additional civilian signals.

## GPS – How Does It Work

### Signal Components

- Almanac (telemetry) updated location of all satellites
- Unique Satellite identification code
- Pseudorandom noise code – similar to a song
- Alignment of PRN code allows GPS receiver to



Offset = 68.2 milliseconds

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### Signal Components

- The satellite transmits three types of information
  - The Almanac or precise orbit information for every GPS satellite is sent. A ground control station updates this information every 4-6 hours.
  - Each satellite sends out a unique identification called its PRN or Pseudorandom Noise Code. This allows the GPS unit to know which satellite the radio signal is coming from.
  - The PRN is a series of 0 and 1s that can be likened to a song. The GPS unit knows exactly when the song was sent. The GPS unit measures the offset of when the song is received from the satellite to determine the time delay. The offset is similar to determining the distance of a lightning strike by counting the seconds until the thunder is heard.

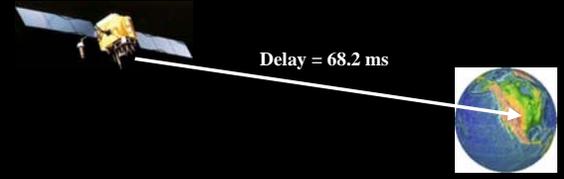
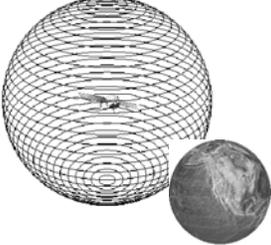
---

### Notes:



Animated GIF demonstrates how the GPS unit compares the PRN received and the once expected to determine time offset.

## GPS – How Does it Work

<p style="text-align: center;"><b>Time Delay = Distance</b></p> <ul style="list-style-type: none"><li>• Signal travels at speed of light (<math>c</math>)</li><li>• Time delay <math>\times c =</math> distance</li><li>• If delay = 0.0682 s then distance = 20,446 km</li></ul> 	<p style="text-align: center;"><b>Time Delay = Distance</b></p> <p>Therefore, we know we are located on a sphere 20,446 km from satellite</p> 
---	---

---

### Time Delay = Distance

- The time delay can then be used to calculate the distance, since we know time multiplied by the speed of light equals distance.
- In our example a delay of 68.2 milliseconds equals 20,446 kilometers.

### Second Slide

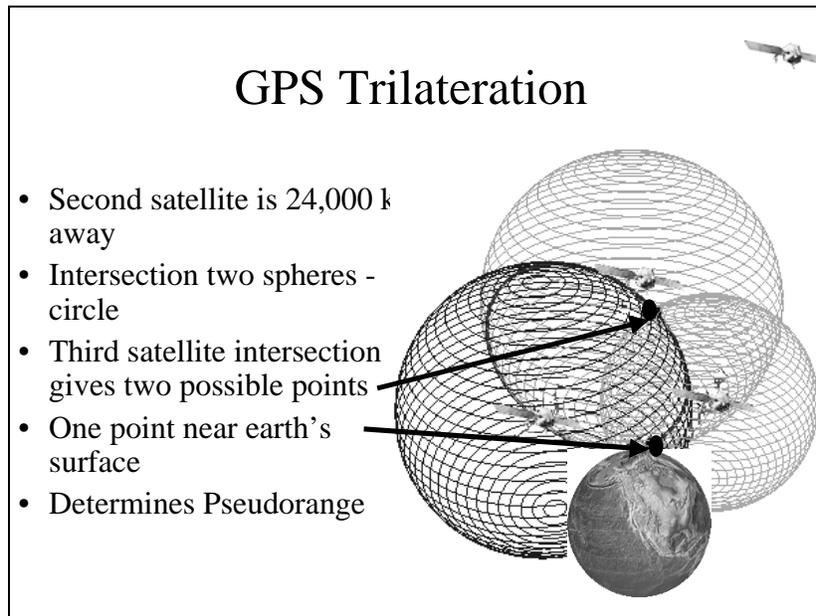
- This distance from the satellite defines a sphere that gives our possible locations.
- The exact location of the satellite is known from the downloaded telemetry or Almanac.

---

Notes:



## GPS – How Does it Work



---

### GPS “Trilateration”

- The process is called trilateration versus the more common term of triangulation. Triangulation involves angles and trilateration uses known distances from multiple reference points.
- If we acquire a second satellite and determine it is 24,000 km away we can draw a second sphere.
- The intersection of these two spheres makes a circle that represents our possible locations. This circle intersects with the surface of the earth in two locations.
- When we acquire a third satellite we can draw yet another sphere. It intersects in two unique points. One point is far away from the surface of the earth and moves rapidly, while the second point is at or near the earth's surface and moves at a much smaller speed.
- The point near the earth's surface is given as the coordinate
- If a fourth satellite is acquired then only one point of common intersection is possible.
- Pseudorange is a term given to the initial distance to each satellite. A final correction is made for minor differences in time, which will be explained in the next slide.

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### Notes:

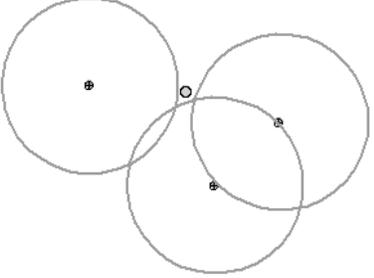


Slide contains animation. First click adds third sphere. Second click adds arrow to excluded spot. Third and final click adds arrow to location on earth.

## GPS – How Does it Work

### Time Correction

- Error of 1/1000 second = 186 m
- Atomic Clocks used in Satellites
- Quartz Clock in GPS receiver
- Needs to be corrected
- Corrected by seeing fourth satellite



---

### Time Correction

- Accurate time is critical to obtaining an accurate position.
- An error of one millisecond or 1/1000 of a second equals 186 meters.
- Onboard the GPS satellites are atomic clocks accurate to  $10^{-15}$  seconds.
- However, the GPS unit only has a quartz clock accurate to only  $10^{-6}$  seconds
- Therefore, the GPS unit must receive corrected time. This is done by receiving the signal from a fourth satellite and performing some simple algebraic equations.
- The illustrations demonstrate how the GPS unit determines the correct time.
  - (On screen) As previously discussed the distances of the three satellites should intersect at one discrete point near the earth's surface.
  - (First-click) However, if the GPS unit clock is running too fast the ranges will overlap.
  - (Second-click) If the GPS unit clock is running too slow the ranges will not touch
  - (Third-click) Therefore, the GPS solves the equation to adjust the clock so that the ranges will give a precise intersection.



Emphasize in order to fix a location four satellites are required.

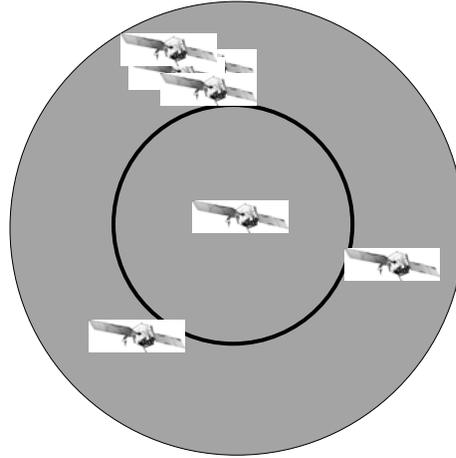
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Notes:

## GPS- How Does it Work

### More Satellites are Better

- Receiver selects best signal
- Geometry affects accuracy
- Watch satellite page
- If accruing signal from additional satellites good to wait
- Able to watch accuracy improve



---

### More Satellites are better

- Generally, the more satellites present the more accurate the coordinate.
- This relates to the overall geometry of the satellites.
- The more spread out over the sky the better the reading.
- Unfortunately, satellites near the horizon are more difficult to acquire when standing on the ground. High-end GPS units often exclude satellites within  $10^\circ$  of the horizon.
- GPS unit has a sky chart on the same page the coordinates are displayed.
- The sky chart can be used to check the geometry.
- It is worthwhile to wait to acquire additional satellites because accuracy dramatically improves. Initial illustration shows poor geometry. The second click shows ideal geometry of one satellite directly overhead with three others evenly spaced about the horizon.

---

### Notes:



The sky chart will be covered in more detail later. The initial illustration shows poor geometry (which is measured by PDOP- Positional Dilution of Precision). The second mouse click shows better geometry with additional satellites.

## GPS – How Does it Work

Error Source	Typical Error	DGPS Error
Selective Availability*	100 M	-
Ionosphere	10 M	-
Troposphere	1 M	-
SV Clock	1 M	-
SV Orbit	1 M	-
Pseudo – Range Noise	1 M	1 M
Receiver Noise	1 M	1 M
Multipath	0.5 M	0.5 M
<b>TOTAL ERROR</b>	<b>15 M</b>	<b>3 M</b>

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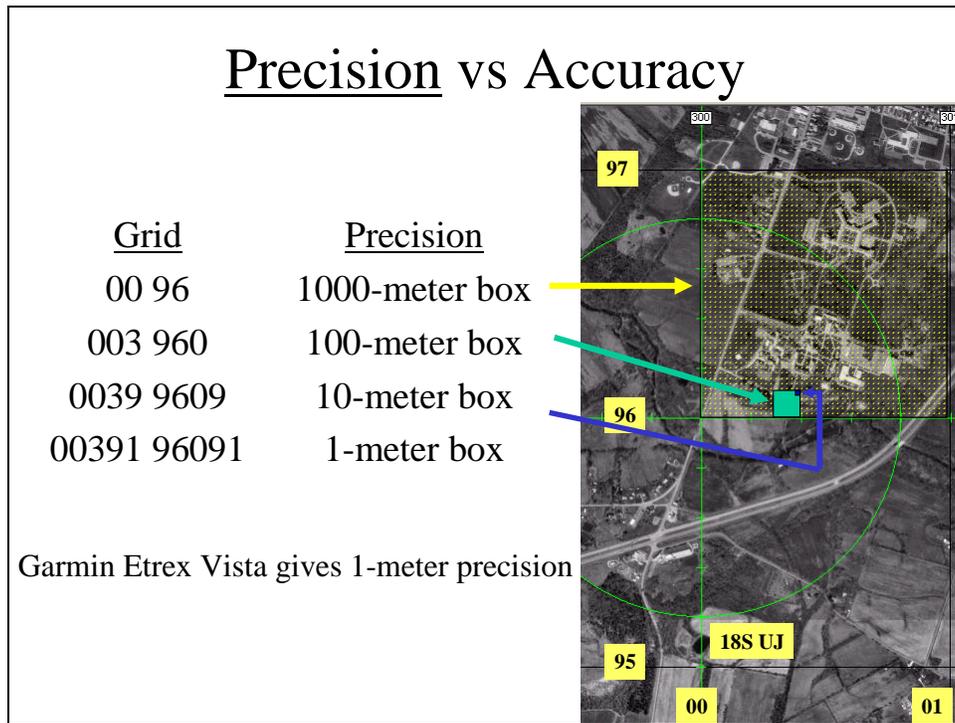
### Sources of Error

- The following chart summarizes all of the errors caused by the GPS system. Many of these errors can be corrected by using differential GPS (DGPS), which we will discuss later. All of these errors will be further magnified by poor satellite geometry.
- Prior to turning off selective availability in 2000 this was clearly the largest source of error.
- Bubbling within the ionosphere and troposphere, which delays the radio signal now causes the largest source of error. GPS becomes less accurate during solar flares and in the late evening due to the effects of “space weather”.
- Errors caused by the satellite include minor drifts in the atomic clocks and departures from the predicted orbits.
- Errors caused by the GPS units include minor errors in the offset delay of the PRN code and receiver noise.
- Multipath error is caused by the radio signal reflecting off mountains or buildings and taking slightly longer to reach the GPS unit.
- The overall accuracy of the GPS system is now 15 meters.
- Differential correction is able to correct for all the sources of error except for those caused by the GPS unit and multipath error and improves accuracy to 3 meters.



Emphasize GPS system errors are within the FEMA standard of accuracy of 20 meters. An explanation of dGPS will shortly follow.

## GPS – How Does it Work



### Precision vs. Accuracy

- The numbers of digits you record from the GPS define the precision of the coordinates.
- As an extra pair of digits is added to the coordinates the area defined becomes more precise.
- The displayed precision of the Garmin Etrex is one meter.
- This defines a unique address on the surface of the earth that is one meter by one meter in size. The addition of one more set of digits would make the precision define an area of 10 centimeters by 10 centimeters. The accuracy of consumer GPS units may approach 10 centimeters by 2010.

### Notes:

The one-meter precision is for USNG, which is used in the example since it is decimal based. Aerial photograph is of NETC. The blue 10-meter box is not drawn to scale but is depicted slightly larger than actual size.



## GPS – How Does it Work

### Precision vs Accuracy

- Unit precise to 1 meter  
**BUT**
- Accurate to 100 meter when selective availability was turned on
- Accurate to 15 m under current conditions
- Accurate to 3 m if WAAS (Wide Area Augmentation Signal) obtained



### Precision vs. Accuracy

- While the GPS unit may give a coordinate precise to a one-meter square, several factors will cause the coordinate given to be inaccurate to a certain extent.
- Prior to 2000 when selective availability was turned on the units were only accurate to 100 meters. This means 95% of the time the coordinates would have fallen in the red circle.
- GPS is now normally accurate to 15 meters (yellow circle).
- With differential correction (dGPS), the system and atmospheric errors cancel out and the accuracy improves to 3 meters (green circle).

Notes:



## GPS – How Does it Work

### Differential GPS - WAAS

- dGPS able to reduce several errors (<3m accuracy)
- Receiver able to pick up dGPS signal called WAAS
- Wide Area Augmentation System (WAAS) explanation



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### DGPS - WAAS

- The Garmin Etrex is able to pick up the differential GPS (dGPS) signal produced by the FAA called WAAS or Wide Area Augmentation System. The system was designed to allow aircraft to land using GPS.
- Ground stations throughout North America receive GPS coordinates. Since the stations' positions are known to within millimeters they record the difference between their actual position and what GPS says.
- These correction factors are then communicated to a ground station, which sends a correction factor back up to two satellites in geosynchronous orbit over the Atlantic and Pacific Ocean. The further north and the further away from the US Coasts, the more difficult to lock-on to the geosynchronous satellites.
- If you are able to lock-on to the Geo satellite then a differential correction is automatically loaded into your GPS unit.

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### Notes:



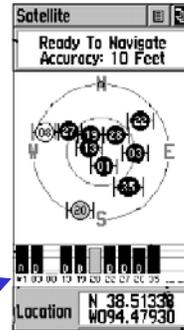
New Geosynchronous satellites have been launched that once activated (October 2006) will make it easier to obtain a WAAS signal in the middle of the continental United States. See illustration on the next page.

# GPS for Disaster Response Operations

## GPS – How Does it Work

### Can you tell if you have dGPS?

- Newer versions of GPS units are WAAS enabled
- Garmin Etrex series indicates differential data downloaded by a “D” on Satellite page.
- Accuracy improves



Satellite Page with 9 Satellites Being Tracked and WAAS Enabled  
WAAS Satellite is No. 35 and 'D' in Signal Bars for GPS Satellites

### Can you tell if you have dGPS?

- The Garmin Etrex units are all able to obtain a WAAS signal.
- However, the default configuration is set to turn this feature off.
- If you are in the Midwest – East coast you can tell you locked onto the WAAS satellite if you get a signal from satellite number 35. Shortly thereafter, you will see a D appear in the signal bar when the differential information for that satellite has been downloaded. You should also observe the accuracy improve.
- On the West coast the WAAS satellite over the Pacific is number 47.
- The WAAS satellites are scheduled to be switched from over the ocean to over the continental United States in order to improve reception in October 2006.



Current (2005) positions of WAAS satellites are at 176° E & 54° W. In 2006 the WAAS satellites will be positioned over the Alaska and continental US at 133° W & 102° W.

## Features

Features  
15 minutes

# SECTION FOUR

## Features



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### Section three - Features

- This section introduces the basic button, screens, and how to navigate between the screens in order to operate the GPS.
- We will also verify the proper configuration of the unit to make sure it meets FEMA response standards.

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### Notes:



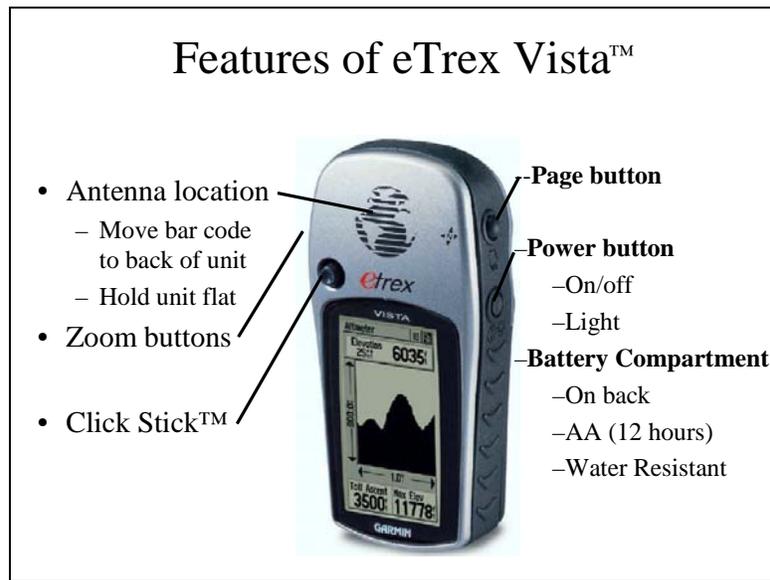
The IG covers the Garmin Etrex Vista, which was established as the standard unit for FEMA's Disaster Information Systems Clearinghouse (DISC). During the course of instruction other units may be present. This is especially true among response resources. The instructor should determine which units would be present prior to instructions.

Even if students are expected to bring their own GPS units, it is prudent to check out additional units including extra batteries.

# GPS for Disaster Response Operations

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## Features



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### Features of eTrex Vista

- Features located on the front
  - CLICK STICK – used to navigate screens, similar to a joystick, push straight in for enter.
  - Antenna – built in, located under world logo. Can be degraded by hand or bar codes. If issued a GPS unit with bar code on front, move it to the back. The antenna is designed to work best when the unit is held flat (horizontal) and away from body.
- Features located on the back
  - Battery compartment – water resistant if shut properly (1 meter of water for 30 minutes)
  - Data Connector – with supplied cable allows up and downloading information
- Left Side
  - Power Button – flat button with I and lamp icon. Press in at least a second to turn on/off.
  - Page Button – button on top with pages icon. Used to switch various pages.
- Right Side
  - Zoom button – magnify glass icon
  - Contrast button – two buttons with up and down arrows. Works only on skyplot page.

---

Notes:



## Features

### Notification Message

- After turning GPS on
- If inside – unable to find any satellites
- Error Message appears
- Acknowledge by using Click Stick™.



---

### Notification Message

- If turning unit on inside a substantial building the GPS unit will be unable to acquire a satellite.
- Therefore, an error message will appear stating “Poor Satellite Reception” and gives four choices.
- The highlighted option represents the currently selected option.
- Use the CLICK STICK to enter “Use With GPS Off” by pressing straight down. If you want to choose another option push the CLICK STICK down.

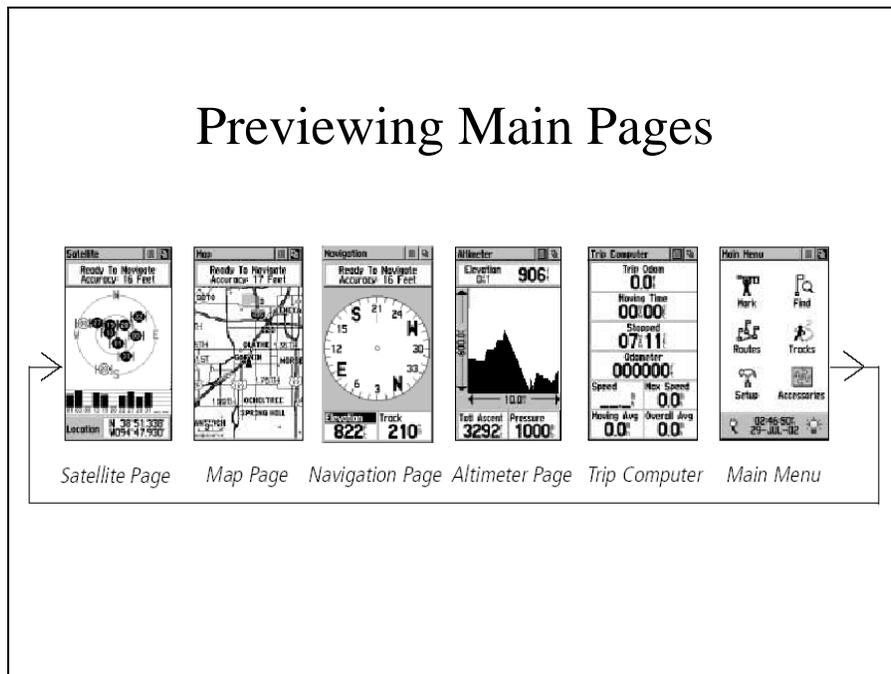
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### Notes:



The instructor should check the classroom before class to determine if a satellite can be acquired. If satellites can be acquired the class can proceed as planned but actual numbers and screens can be used to describe operation. The poor satellite reception message **must** be acknowledged (by hitting enter) before other pages can be viewed.

## Features



### Previewing Main Pages

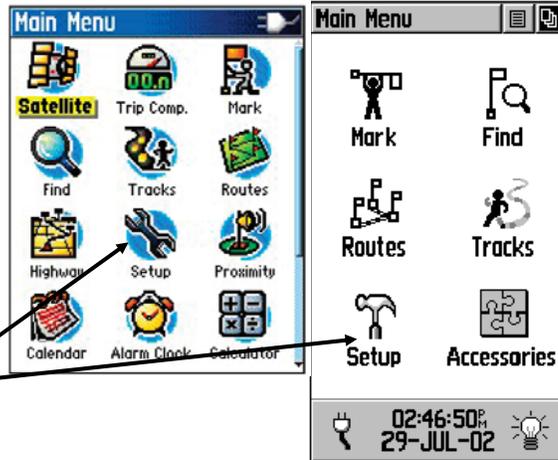
- Use the page button to view each of the main pages. The initial page will be the Satellite page. In field operations this will be only page that needs to be accessed to view coordinates. We will discuss this page in more detail later.
- Map Page – The Etrex has a built in world map. Major roads and towns of the entire US are also provided. You may zoom in and out of the map using the zoom buttons on the unit's right side.
- Navigation Page – The Vista has a built-in electronic compass. This page is also used when trying to navigate to a specific point.
- Altimeter Page – The Vista also has a built in Altimeter that measures barometric pressure.
- Trip Computer – The trip computer has a speedometer, odometer, and several other features.
- Main Menu Page – We will use this page to check the GPS unit's configuration settings. Once properly configured this page will not need to be checked again unless changing the map datum.

Emphasize the satellite page is the only page needed on a regular basis and will appear on its own. Main menu page only needed for initial configuration and checking battery status. The Altimeter should not be relied upon for flood survey work, GPS derived altitudes have an accuracy of only about 75 feet. With WAAS the vertical accuracy is good to about 10 feet.

## Features

### Main Menu

- Reached by page button
- Use Click Stick to move within page
- Need to configure/check settings when issued GPS
- All configurations changes/checks from **Setup** page.



### Main Menu

- Use the page button to move to the main menu.
- Six sub menus are available. We will only be using the setup menu to check configuration settings.
- Tell the class who will provide configuration on this disaster.
- Everyone needs to know how to check or reset to proper configuration.
- Use CLICK STICK to highlight setup icon and then push in.

### Notes:

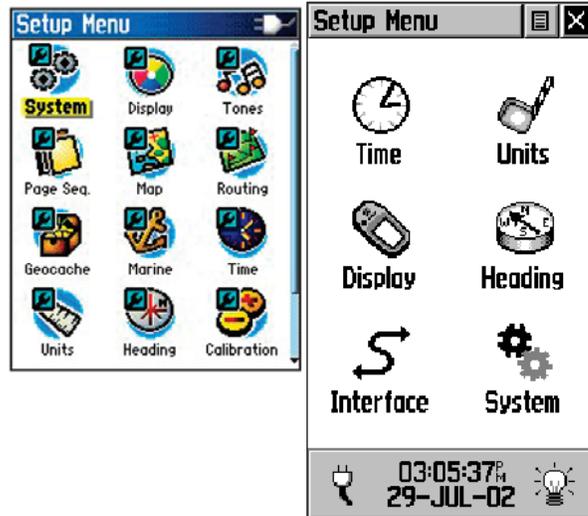


Prior to class the instructor should determine the configuration protocol for the particular disaster. Configuration may be done by the APO on checkout, by PA on checking out, by technical services/ESF 5/GIS section, or by the user. The units are not configured by DISC and FEMA configuration is different than the default settings. A job aid is provided that also gives configuration settings. Slide shows setup menu from both Vista C (color) and Vista (black and white).

## Features

### Setup Menu

- Options/Icons
- We will discuss
  - Units
  - System



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### Setup Menu

- Several icons are found on the setup menu. We will only need to discuss the units and system.
- Use CLICK STICK to highlight the **Units** icon and push down to enter.

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Notes:

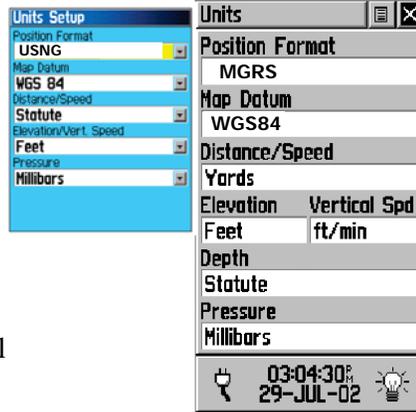


# GPS for Disaster Response Operations

## Features

### Units

- Position Format
  - MGRS (USNG newer models)
- Map Datum
- WGS84 inserted automatically(=NAD83)
  - May need to change if using old NAD27 map
- Other settings not critical



## Units

**Ask students, how many have the correct format of MGRS and the correct map datum?**

- The correct position format is the US National Grid, which is shown as MGRS. Since the default setting is decimal minutes, this might need to be changed. Use the CLICK STICK to highlight the position format box. Hit enter. Push the CLICK STICK up to scroll through the format types and locate the MGRS format option. Once MGRS is highlighted hit enter to save the setting. Newer models have USNG as an option. If USNG is available use this option.
- Upon entering the position format as MGRS, the datum automatically switches to WGS84. This is the correct datum to use. WGS84 is identical to NAD83. If using a old paper map that has been gridded to NAD27, the datum can be switched. Use the same procedure outlined above to make any changes
- The Distance/Speed, elevation, depth, and pressure are not important for recording coordinates. The default settings are all correct.
- Once complete – have class show instructor settings
- After showing instructor hit page and return to setup page.

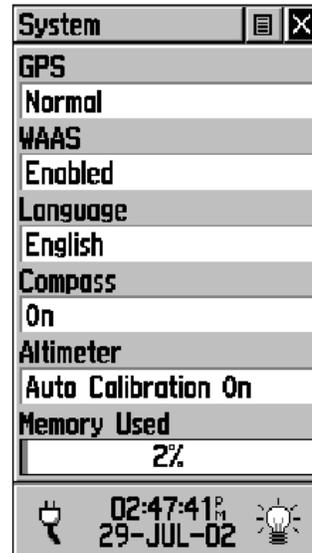
Notes:



## Features

### System

- GPS
  - Normal
  - Always switches to normal after being turned off.
- WAAS
  - Enabled



---

### System

- From Setup page highlight the system icon and hit enter.
- The correct setting for GPS is “normal”. However, if unable to obtain satellites it will read “GPS Off”. This is the only configuration setting that will change after turning the unit off. It will always revert back to GPS “normal” every time the unit is turned off and on. Therefore, this setting does not need to be changed. If the unit was turned on inside and then brought outside, simply turn the unit off and on while outside.
- WAAS default position is disabled. Highlight the box and change to “enabled”. Beginning in October 2006, it will be much easier to obtain the WAAS satellites since they will be located over the US instead of over the middle of the Atlantic and Pacific oceans.
- All other settings are not important for collecting coordinates. Although for most users “English” Language is preferred.
- Hit the page button and return to the setup menu.

---

### Notes:



## Field Operations

Field  
Operations  
15 minutes



Photo Credit: FEMA/Jocelyn Augustino

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### Field Operations

- In this section we will cover
  - Obtaining GPS coordinates
  - Where to be standing when taking coordinates
  - How to obtain and plot coordinates with gridded maps
  - How to best document the coordinates

---

Notes:



## Field Operations

### GPS Safety Tips

- Turn off while driving if not in use
- Do not place on dash
- Be aware of potentially dangerous conditions
- Avoid dangerous atmospheres



Photo Credit: FEMA/Andrea Booher

---

### GPS Safety Tips

- The GPS unit itself does not present any hazard – other than not using in dangerous atmospheres.
- The GPS unit should not be placed on the dash of your vehicle in case of an accident where it could become a missile. It should also not be placed where an airbag deployment could cause it to also become a missile.
- Its greatest threat is distracting the user from other safety hazards. It should be turned off while driving (unless you have a second person with you).
- When obtaining readings be aware of your surroundings and never place yourself in jeopardy to obtain a reading.

---

Notes:



## Field Operations

### Start-Up Location

- Travel to site
- Find safest initial location
  - Dash of vehicle: GPS radio signal goes through glass
- Flat and level – held away from body
- Open Area – Clear view of sky
- Stationary
- Wait!

---

#### Start up location

- Travel to the worksite with the GPS off.
- Upon arriving find a safe initial location. This may often be where you have parked. The GPS unit will be able to obtain a signal through a car's windshield in case of inclement weather.
- The GPS antenna is designed to work best when kept flat (horizontal). Either on a surface or in your hand. The antenna also works better when held away from the body.
- The more open the area the better the reception. When using the GPS unit for the first time at a disaster, a clear view of the sky is even more important.
- During initialization it is best to keep the unit still.

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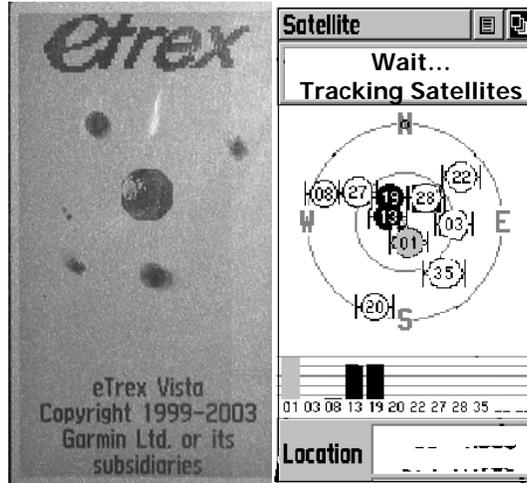
Notes:



## Field Operations

### Start-Up Sequence

- Press and hold power button
- Press Page button twice
- Satellite page



---

#### Start Up sequence

- Press and hold the power button for at least one second.
- The Etrex copyright page will appear. The six satellites represent the six orbital planes the actual satellites follow.
- Press the page button to move to the legal liability page. Press the page button a second time to get the satellite page.
- The message box will initially say “Wait...Tracking Satellites”. Most of the satellites in the sky plot will be white, meaning they have not been locked in. A few satellites may be gray, indicating a signal has been obtain. Satellites in black means the satellites has been acquired and locked in. Recall at least three satellites are required before a position can be fixed.

---

#### Notes:



## Field Operations

### Time to Acquire Reading

Start Condition	Description	Time
Hot	On within 4-6 hours	15 – 30 seconds
Warm	Within 500 miles	45 seconds
Cold	Moved over 500 miles	5 minutes*

---

#### Time to Acquire reading

- The time it takes to give you coordinates depends upon several factors.
- A hot start takes about 15-30 seconds. A hot start means the unit has already been turned on in the last 4-6 hours and all the almanac data has already been downloaded.
- A warm start is when the unit has not been turned on within 4-6 hours but it is within 500 miles of the last location is used. The additional time is required to download and update the satellite almanac, which gives the orbit information of each satellite.
- A cold start is when the unit has been moved more than 500 miles from the last location it was turned on. This can happen frequently within FEMA. Initial coordinates may require 5 minutes. The unit should be kept flat, stationary, and in an open area.
- **The very first start (new out of boxes) may require 12 minutes** for all of the Almanac data to be downloaded from the satellites to the GPS unit.

---

#### Notes:



The instructor should be familiar with the procedure to manually change the location. When poor reception message box appears, highlight and enter “New Location”, then highlight and enter “Use Map”. Use the right zoom buttons to adjust the map to the appropriate size. Use the CLICK STICK to move the cursor to the current location and then click enter.

## Field Operations

### Cold Starts

- Allow unit to attempt on startup (5 minutes)
- On Poor Satellite window choose new location. Then map
- Scroll triangle to location. Press ENTER
- Wait, try second location



---

### Cold Starts

- The first time a GPS unit is turned on at a disaster will be the longest wait. Afterwards, it becomes progressively easier to use the GPS unit.
- The unit will display a Wait...Tracking Satellites when turned on. If unable to acquire satellites it will display a poor satellite reception window that gives four options. For cold starts choose the “New Location” option. Then select the “Use Map” option.
- Once the map is displayed, use the CLICK STICK to scroll to an approximation of your current location. Within 500 miles is usually sufficient. Press ENTER.
- If the unit is unable to obtain coordinates after about 5 minutes try a different location in a more open area, turn the unit off, then try again. If this fails, make sure the batteries are fresh and try again. If this also fails, find the most open location, keep the unit still and flat, make sure nothing is blocking the antennae and allow the unit to acquire. If this fails, seek assistance. Consider the unit may be defective.

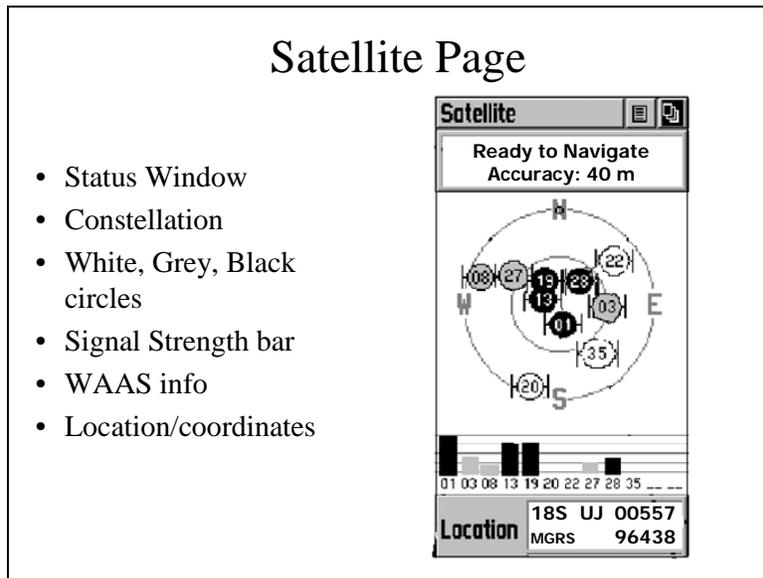
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### Notes:



Cold starts are the most frustrating part of using GPS units. Upon obtaining a GPS unit it best to turn it on first in an ideal location with sufficient time. The dash of a car is a good location.

## Field Operations



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### Satellite Page

- The satellite page gives several pieces of important information
- The status window at top tells you if still acquiring satellites or once coordinates acquired the current accuracy. Note initial accuracy often poor, wait at least a minute.
- The sky plot shows the current position of all satellites above the horizon. Satellites in the center are directly overhead. The inner circle represents 45 degrees. The outer circle represents the horizon. The letters represent North, South, East and West. North is always at the top, regardless of what direction the GPS unit is facing. The initial location of the satellites is based upon the last time the unit was turned on.
- White circles indicate a signal has not been received from the satellite. Gray circle represent the satellite has been found but not locked on. Black circles represent satellites that are fully acquired.
- The signal bar gives the relative strength of the signal from each satellite. It will display a small D once it receives WAAS correction information.
- The bottom location window gives the current coordinates.

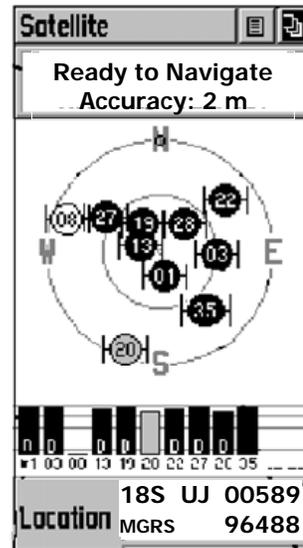


Emphasize initial accuracy poor. Waiting an additional minute or two often greatly improves the accuracy of the coordinate.

## Field Operations

### After initial location reading

- Accuracy improves with time
- Walk around
- Observe constellation
- Wait for better geometry



---

### After initial location reading

- The accuracy of the coordinates improves with time. Therefore, don't record the initial coordinates that first appear.
- Walk around to verify the coordinates are changing as you walk. The last digit represents about a meter. A small change in location may help acquire additional satellites.
- Look at the sky plot. If some satellites are still in gray, it is often worthwhile to wait until they are acquired.
- Look at the status of satellite 35 or 47. If gray or black it is worthwhile to wait until they download the dGPS information. D should start appearing in the signal strength bar.
- Look at the overall geometry. If all the currently available satellites are in close together try waiting until additional satellites become available.

---

### Notes:



## Field Operations

### Where to take readings

- Safest location at site
- See satellites
- Close to center
- Front (address/Side A)
- Linear

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#### Where to take readings

- Once several satellites are acquired you are ready to take a reading
- The first priority is choosing a location is your safety.
- The second priority is a location that allows you to see satellites. For this reason you may not be able to stand in the middle or even right next to a large structure.
- The third priority is to get as close to the center of the facility or location as possible. It may not always be possible to achieve this.
- If unable to get to the center, move to the front of the facility on the side it has a physical address if applicable. Typically called side A.
- For linear features take two readings. One at the start and one at the end.

---

#### Notes:



## Field Operations



Photo Credit: FEMA/Bob McMillan

### Example of choosing location

- Tell class they will be looking at four different facilities with damage caused by different types of events. They should look at each facility and determine where they would stand to obtain GPS coordinates. The location should be based upon
  - Safety
  - Ability to see satellites
  - Centered
  - Front
  - Linear

#### Solution:

- Safety: Several potential hazards inside a flooded building. Still may need to be searched.
- See Satellites: Unlikely will pick up satellites inside the structure.
- Centered: Unlikely to pick up satellites inside.
- Front: Best to move outside structure to side that represents the front of the structure.

## Field Operations



Photo Credit: FEMA/Marvin Nauman

### Example: House Search

- The damaged facility is a flood-damaged house. Ask the class to determine the location from which to take a GPS reading based upon safety, satellite visibility, centering, frontage, and linear.

#### Solution

- Safety- House is safe from the outside. Although potential hazards may exist.
- Satellite visibility – Will be unable to obtain coordinates inside building will need to be outside. Standing next to the front door would result in half the satellites being blocked.
- Centered – Centered would be inside building so will not work
- Frontage – Best location outside of building at “front” door (side A) a couple of meters away from the wall. If the building has an address take from side of building address comes from.
- Linear – Not applicable



#### Notes:

Show pictures, let students discuss, then give solution.

## Field Operations



Photo Credit: FEMA/Robert Eplett

---

### Example of choosing location

- Bridge collapse due to earthquake. Determine where to take GPS reading from.

#### Solution:

- Safety: Earthquake, possible aftershocks. Avoid climbing on fallen slab, standing under standing parts of bridge. Rule of thumb, keep back 1.5 times height of structure.
- See Satellites: Should be good except for under bridge
- Centered: May use a centered approach near where bridge inspectors are standing
- Linear: Also acceptable, standing at the two approaches for the bridge on stable ground.



Notes: Show pictures, let students discuss, then give solution.

## Field Operations



Photo Credit: FEMA/George Armstrong

### Example: Building

- The damaged facility is a public building destroyed by a tornado. Ask the class to determine the location from which to take a GPS reading based upon safety, satellite visibility, centering, frontage, and linear.

#### Solution

- Safety- Avoid scrambling to the top of the debris pile, unless a 1 meter accurate reading is required for life safety.
- Satellite visibility – Should be good
- Centered – Getting to the center would require climbing the debris pile.
- Frontage – Best location outside of building at former “front” door a couple of meters away from the former wall.
- Linear – Not applicable

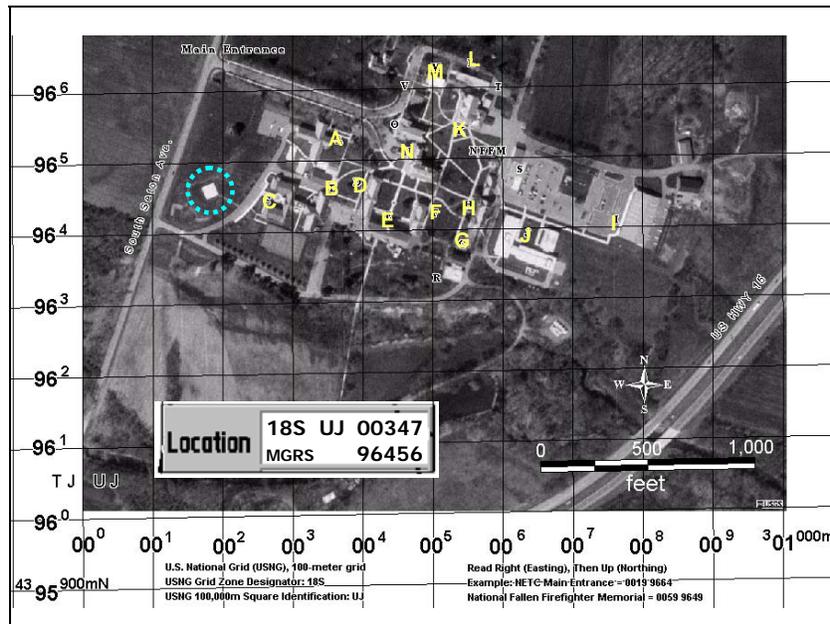
Notes:



Show pictures, let students discuss, then give solution.

# GPS for Disaster Response Operations

## Field Operations



### Using Grid Coordinates

- The students are asked to perform two tasks. The first is to use coordinates, in the second to obtain coordinates.
- Using the supplied coordinates (18S UJ 00347 96456) ask the students to determine which building letter corresponds to those coordinates. In order to increase participation, ask the class to write down the letter before revealing answer.
- For the second part of the exercise, point out the helicopter landing pad circled in red. Ask the students to write down the USNG coordinate.
- A copy of the map is available in the student handout section.

### Solution

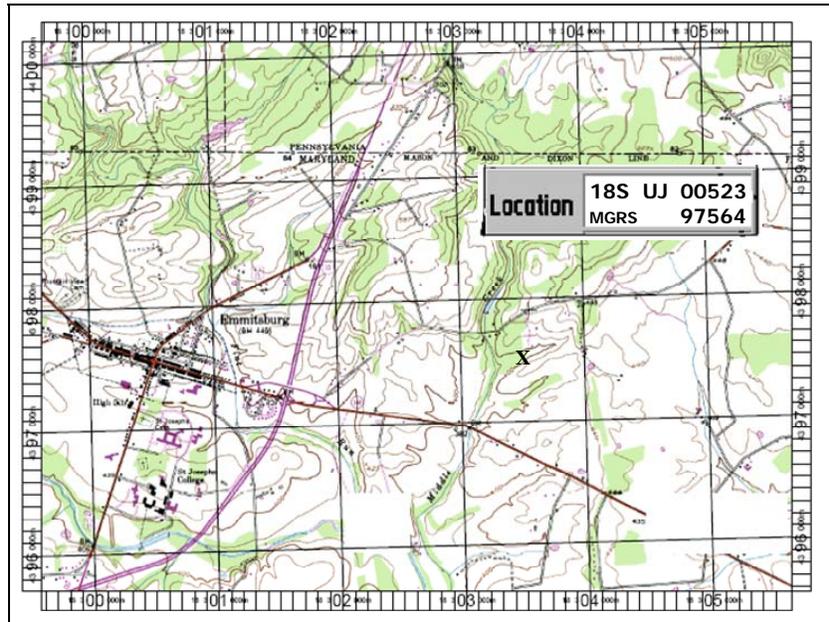
- Part 1. The coordinates 18S UJ 00347 96456 corresponds to **building B**
- Part 2. The coordinates of the helipad are **18S UJ 0018 9645**. This would be precise to 10 meters. Since the helipad is certainly larger than a meter, this is all the precision that is required. Any more digits are difficult to read off the map and depend upon which part of the helipad the user has in mind.
- It would also be correct to write the coordinate as: 18SUJ00189645 (NAD83).



### Notes:

Students have copy of slide in student handouts.

## Field Operations



### Using Grid Coordinates – Topographic Map

- A commonly used paper map is a USGS 7.5 minute topographic map or quadrangle.
- These maps may be printed from several different commercial software pages that have scanned in original USGS maps. They may then be printed with a UTM or MGRS/USNG grid overlaid.
- Care must be taken to determine if the grid was based upon NAD83/WGS84 or NAD27.
- **Ask the students to determine where the coordinate (18S UJ 00523 97564) is located.**
- **Ask the students to give the coordinate required to direct a team in Emmitsburg to location “X” within 100 meters over the radio.**

#### Solution

- The coordinate 18S UJ 00523 97564 corresponds to the intersection of S. Seton Ave and Main St. in the center of Emmitsburg.
- If the team is local then the coordinate would only need to be 035 975

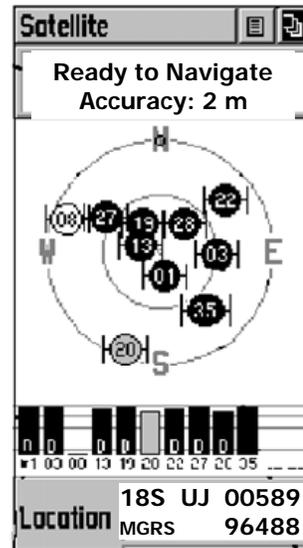
#### Notes:



## Field Operations

### Documentation

- Coordinates taken from GPS satellite page.
- Check format
  - MGRS or USNG
- Write down as appear on unit (include GZD & 100,000-meter Sq ID)
- Consider Way Point
- **TAKE TIME TO WRITE CLEARLY**



---

### Documentation

- The coordinates from the GPS unit need to be recorded onto field notes. During this step the potential for several significant errors is possible.
- The coordinates are found on the location window of the satellite page.
- Make sure the format is MGRS or USNG. If the unit is configured for another format it should be changed in the field.
- Write down all the components shown in the location box.
- Locations may also be stored in the GPS unit by using Way points. Press and hold the enter/ClickStick until the way point page appears. The way point may be named or given a default name. Refer to the user's manual to learn more about how to use way points.

---

### Notes:



## Field Operations

### Field Notes to PW

- Some digits easily confused
- 9 and 4
- 1 and 7
- 0 and 6
- 2 and 7

7709



---

### Field Notes to PW

- In reading other people's handwriting certain digits are commonly misinterpreted, as noted on the slide.
- Use care with all digits.

**Ask the class: What is the number?**

---

### Notes:



The correct number is 7209, which will be displayed on the second click on the mouse.

## Practical Exercise

**Practical  
Exercise  
35 minutes**

# Section Six Practical Exercise

- Partners/Groups
- GPS Unit
- Follow GPS Practical Exercise form
- Document marked locations
- Return
- Review exercise



Photo Credit: FEMA/Jocelyn Augustino



## Practical Exercise

### Prior to Class

- Select a location where it is possible to acquire satellites, large enough for the entire class, within easy proximity to the classroom, and safe for the students.
- Some coordination with safety and security may be required prior to the class.
- Also select a spot that allows for a plausible response scenario.

### While in the Classroom

- Passout GPS Practical Exercise handout
- Review instructions in handout
- Remind class to reassemble in classroom after exercise at specified time.

### During Practical Exercise

- Point out scenario locations, for the second scenario, consider a discrete spot that can be compared in the classroom.
- Assist students

### Practical Exercise Review

- Upon returning to the classroom, review the results of the exercise.
- Place on the board the coordinates of the scenarios. If any students had significantly different answers, check their configurations.

### Alternative Practical Exercise

- Select one discrete location and ask students to obtain a coordinate.

<b>GPS Practical Exercise</b>	1. Name	2. Location	3. Date/Time

**Section A - Initialization**

**Instructions:** Please record the requested information. If the block is grayed-out it is not required to fill in the box. 4. Turn on the GPS outside (if already on, turn off and then back on), and go to the satellite page by pressing the page button twice. Record the total number of satellites the unit has initially acquired. 5. The moment the GPS unit gives coordinates, record the initial accuracy, then record the total number of satellites. 6. One minute after recording the initial accuracy record the new accuracy and number of satellites. 7. Two minutes later once again record the accuracy and number of satellites. 8. Wait for a differential signal indicated by the letter D in the signal bar (satellite #35 or #47), wait an additional two minutes then record the accuracy and number of satellites. If after a total of 5 minutes unable to get a dGPS signal, skip to section B.

EVENT	Time	Accuracy	# of Satellites
4. Turn On Unit			
5. Initial Coordinates			
6. One minutes after Initial Coordinates			
7. Two minutes later			
8. Two minutes after Differential Signal			

**Section B - Interference**

**Instructions:** Section B allows the user to experiment with various factors that may block or weaken the GPS signal. The GPS unit must be on the satellite page for all activities in order to view the accuracy. 9. Record the accuracy and number of satellites while standing in the open. This may be the same reading recorded in line seven. 10. Place your hand over the antennae (located under the globe logo) for 30 seconds and record the accuracy and number of satellites. After recording the information allow at least a minute to allow the GPS unit to normalize before proceeding to the next measure. 11. Hold the GPS unit in a vertical position then record the accuracy and number of satellites. 12. Walk next to a substantial building then record the accuracy and number of satellites. 13. Walk under a tree (if available), then record the accuracy and number of satellites.

EVENT	Accuracy	# of Satellites
9. Under Open Sky		
10. Hand over antennae		
11. Hold GPS unit upright		
12. Reading close to building		
13. Reading under a tree		

**Section C - Unit Comparison**

**Instructions:** Find a partner to make teams of two. Move to an open safe location and place the two GPS units side by side. Record the coordinates from both units.

	USNG	
Your Coordinate		
Partner's Coordinate		

**Section D - Scenario's**

**Instructions:** Your instructor will give you one or two scenarios of damaged facilities. Determine the best location to take a GPS reading from and record your coordinates.

	USNG	
Scenario 1		
Scenario 2		

## Quality Control

Quality Control  
10 minutes

# Section Seven

## Quality Control

---

### Introduce Unit Seven – quality control

- After coordinates have been obtained the user should verify the coordinates.
- Quality control consists of entering the coordinates into a mapping program and seeing if the plotted coordinates matches the actual location. This quality control step will catch most of the significant sources of error.
- Both basic web-based and software based mapping programs will be discussed.

---

### Notes:



If time and logistics permit, the web-based software can be demonstrated if an Internet connection exists. The instructor should use the coordinates recorded from the practical exercise. The software based programs if available from the JFO should be loaded onto the presentation machine. Otherwise, the screen shots provided in the PowerPoint presentation may be used.

### Quality Control

## Quality Control

- Are your coordinates correct?
- Several different methods to check.
- Compare to original field notes
- Enter coordinates into mapping program
- Other users bring quality problems to your attention – least desirable

---

### Quality Control

- Since coordinates are simply strings of letters and numbers it is difficult to quickly verify that the numbers you obtained are the correct coordinates.
- We will discuss several different methods to verify the coordinates.
- The simplest is to compare the coordinates against the original field notes.
- A better quality check is to enter the coordinates into a basic mapping program to verify the location.
- Users of the coordinates may also bring quality problems to the attention of the user once they attempt to use them in the field. However, this is the least desirable method of quality control.

---

Notes:



## Quality Control

### Web-based US National Map

- **nationalmap.gov**
- Input USNG coordinates
- Obtain coordinates
- View satellite or topographic map
- Extensive layers



### Web-based mapping programs

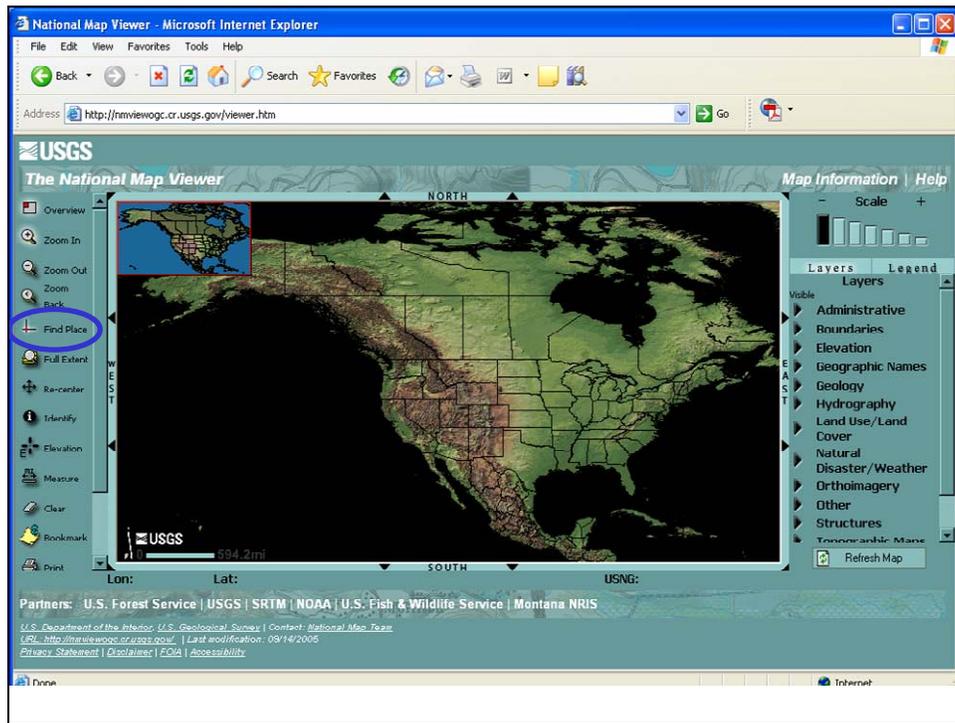
- While several web-based mapping programs are available, the US National Map maintained by the USGS is configured to use the USNG.
- The US National Map contains many different layers and allows viewing topographic maps, satellite pictures, high resolution urban satellite pictures, forest cover, weather radar, among others.
- The URL for the US National Map is : <http://nationalmap.gov>
- Then click on the “Go to Viewer” tab on the left hand side.

### Notes:



The next seven pages are screen shots from the USGS National Map. If an Internet connection is available the actual program may be used. A broadband connection is suggested.

## Quality Control



### Finding a Place

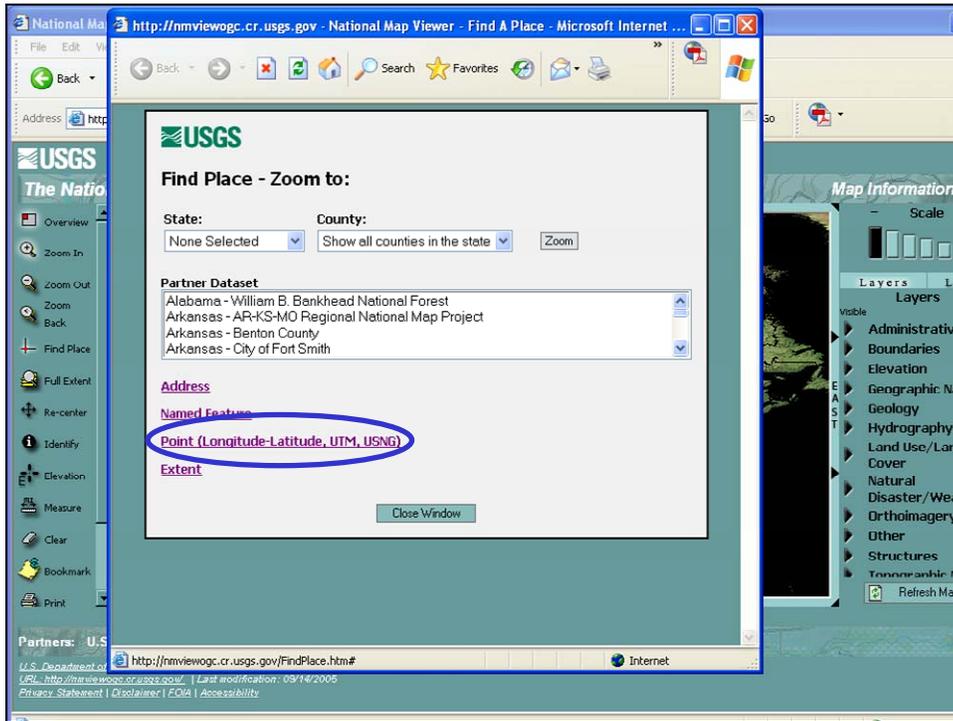
- In order to verify a coordinate obtained from a GPS unit, or one that has been given to the user is valid, the National Map Viewer can locate a USNG coordinate.
- Once the main screen of the National Map Viewer opens, click on “**Find Place**” on the left hand side.

Notes:



# GPS for Disaster Response Operations

## Quality Control



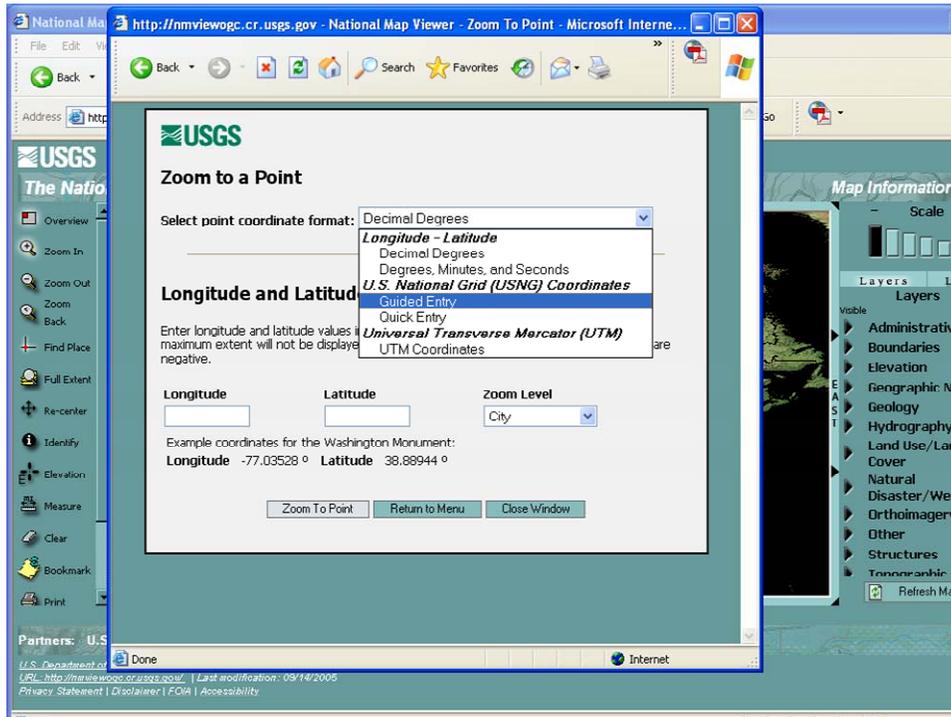
### Find Place – Zoom to:

- Once the Find Place – Zoom to: box opens click on the Point (Longitude-Latitude, UTM, USNG) underlined text.

### Notes:



## Quality Control



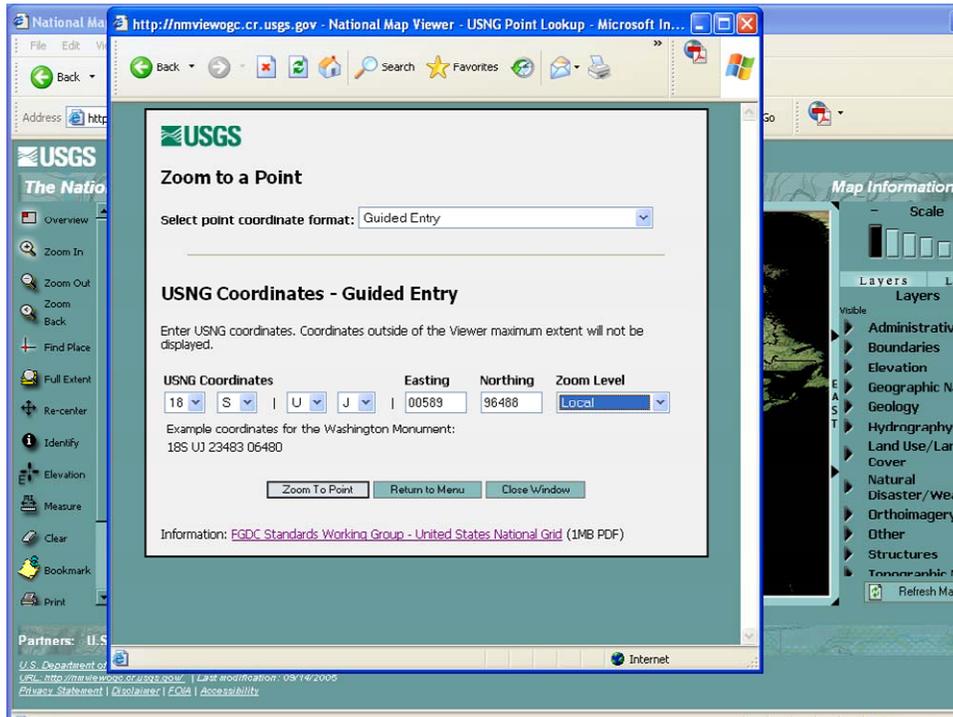
### Zoom to a Point

- The window will switch to “Zoom to a Point”.
- On the Select point coordinate format pulldown box select US National Grid (USNG) Coordinates – Guided Entry.
- Guided entry or quick entry is acceptable. The guided entry will break the USNG coordinate into all of its components while the quick entry provides a single box where the coordinates are entered as one string.

### Notes:



## Quality Control



### Zoom to a Point – USNG Guided Entry

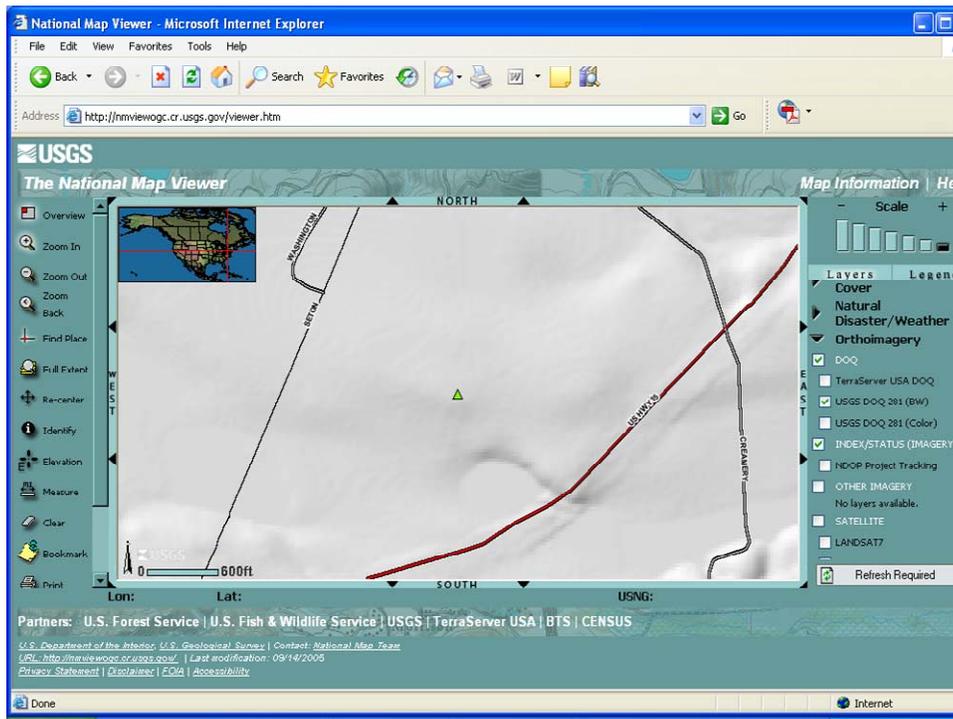
- Enter the USNG coordinates into the boxes. Guided entry is shown. The coordinates used are for the National Fallen Firefighters Memorial.
- Hit enter or “Zoom to Point”

### Notes:



# GPS for Disaster Response Operations

## Quality Control



### Plotted Point

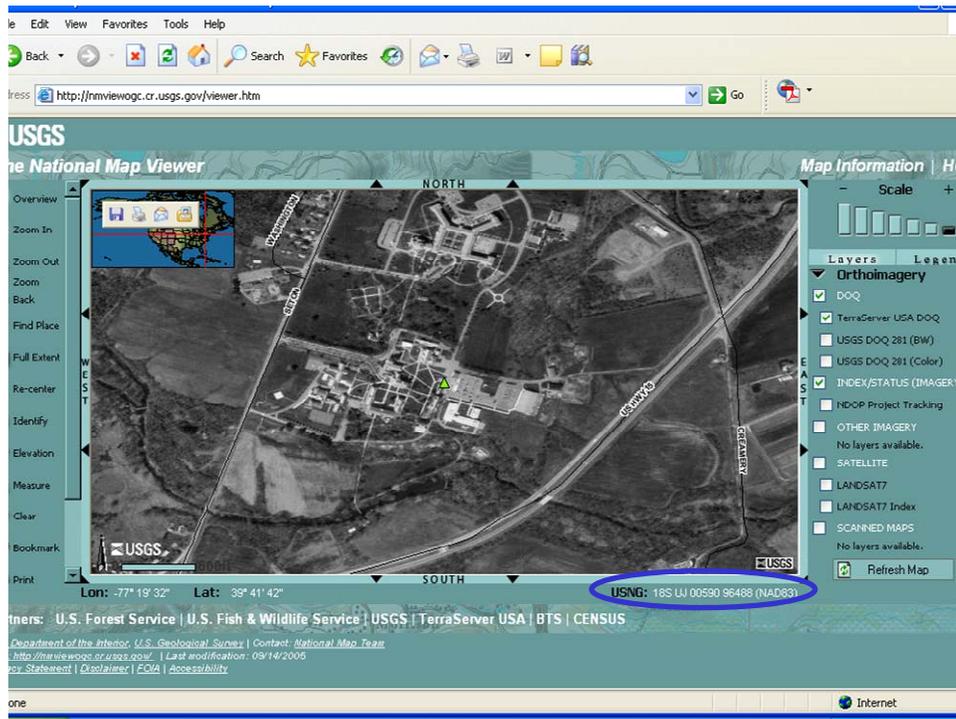
- The National Map Viewer will then locate the point and mark it with a green triangle.
- The scale may be zoomed in or out in the top right hand corner.
- Unless the point falls at the intersection of two major roads more detail is usually required to determine if the coordinates are accurate.
- The National Map Viewer has extensive layer options found on the right hand side.
- In order to layer on a satellite photograph, click on the black triangle next to Orthoimagery.
- Then click on USGS DOQ 281 B&W box. Other options may appear. In urban areas highly detailed color images will be available.
- Then click on “Refresh Required”

### Notes:



# GPS for Disaster Response Operations

## Quality Control



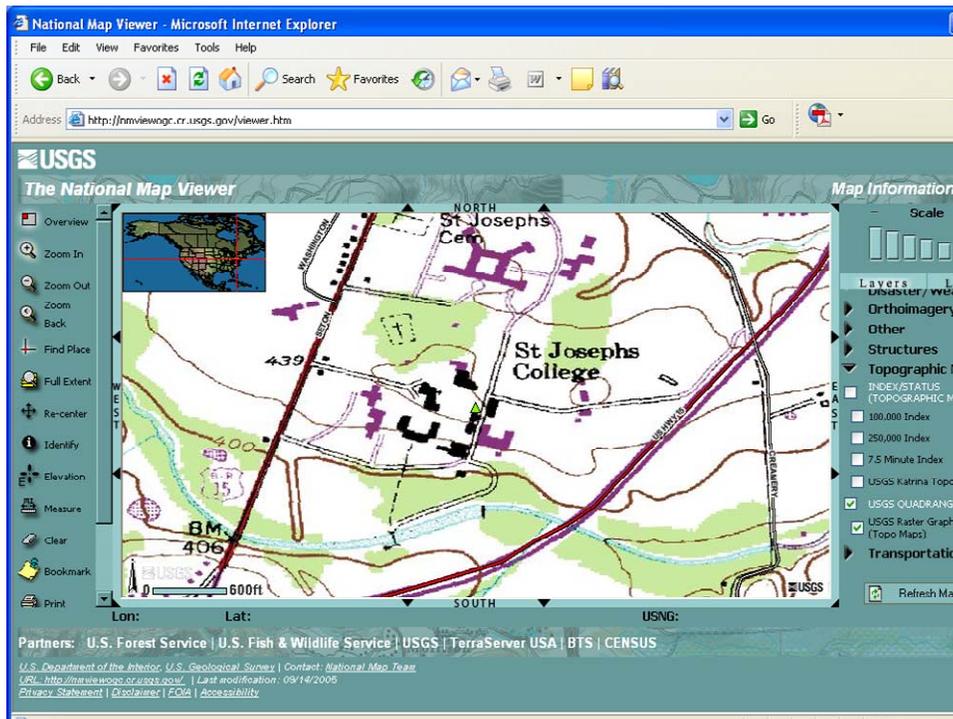
### Image Displayed

- After hitting “Refresh Map” the following image is displayed.
- The green triangle matches the location of the National Fallen Firefighters Memorial.
- You can move the cursor over the map and you will be shown the USNG coordinates of the cursor on the bottom right hand side of the display.

### Notes:



## Quality Control



### Topographic Map

- To see the location plotted onto a USGS 7.5 minute topographic map, uncheck the green checkbox on Orthoimagery.
- Click on the Topographic Map black triangle.
- Click on the white USGS Raster Graphic (Topo Map) box.
- Click on the “Refresh Map” box.
- A topographic map is displayed with the green triangle marking the entered coordinates.
- The USGS has already updated several topographic maps online with changes caused by Hurricane Katrina.

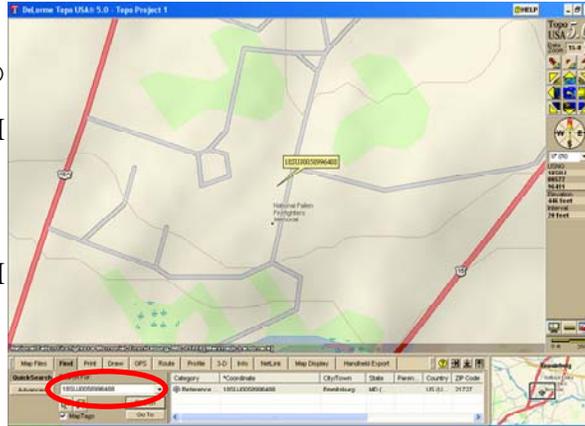
### Notes:



## Quality Control

### Basic Consumer Mapping Programs

- Delorme Topo USA®
  - USNG, MGRS, UTM
- Maptech® Terrain Navigator
  - USNG, MGRS, UTM
- Microsoft® Streets & Trips
  - DD.DDD only



### Basic Consumer Mapping Programs

- Several different consumer and professional mapping programs exist.
- Listed are some of the more common commercial consumer level programs.
- Delorme Topo USA fits the entire US on a single DVD and allows plotting of USNG, MGRS, and UTM (among others). The illustration shows Topo USA. On the Find tab enter the USNG coordinate and the map will display the site.
- Maptech Terrain Navigator consists of multiple CDs. It is also capable of showing USNG, MGRS, and UTM (among others). It displays a more detailed USGS topographic map.
- Microsoft Streets and Trips is commonly found on FEMA public assistance laptops. However, it is only able to find and plot Decimal degree format coordinates.

### Notes:



DHS/FEMA does not endorse or recommend any commercial products, processes, or services. Therefore, mention of commercial products, processes, or services in this training course cannot be construed as an endorsement or recommendation.

## Summary

Summary  
5 minutes

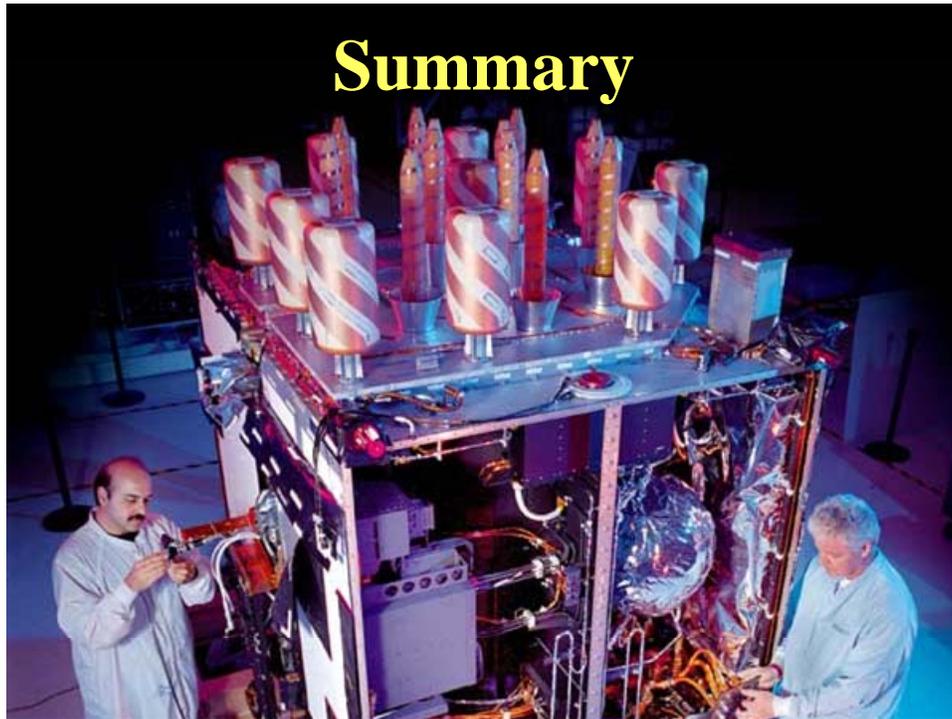


Photo Credit: Lockheed Martin, used with permission

### Introduce Summary section

In order to summarize the class and review the objectives ask the students the following questions.

- Who uses coordinates obtained in the field?
- A GPS receiver determines its position by measuring what?
- List a reason a GPS cannot pick up a signal from a satellite?
- The Federal standard for reporting coordinates is \_\_\_\_\_?
- When looking at a gridded map remember to read how?

- Notes:
- 
1. Other response personnel, Federal, State, and local resources.
  2. The time it takes a radio signal from the satellite to reach the receiver.
  3. Blocked by buildings, mountains, or obstructed by trees.
  4. US National Grid (USNG) which is functionally the same as the MGRS.
  5. Read right, then up.

## Summary

### Summary Source of Error

Type of Error	Source of Error	Effect
dGPS	GPS system	3 m
GPS	GPS system	15 m
Wrong Datum	Configuration	0.1 km
Wrong Format	Configuration	50 km
Transposing Digits	Human	5,000 km
Wrong Sign	Human	Half the world

---

### Sources of Error

- FEMA tolerance for coordinates is 20 meters.
- A properly configured GPS is capable of being accurate to 3 meters when it receives a differential WAAS signal, or accurate to 15 meters without the extra signal.
- If the wrong datum as been configured the error will range between 5 – 100 meters. In Alaska the error can be 200-400 meters.
- If the wrong format as been configured the error may be as much as 50 km.
- By accidentally transposing digits it is possible to create an error of 5000 km.
- Entering the wrong sign for longitude will create an error exactly half the world away.



The GPS system is rapidly becoming more accurate and available to the general public. Most of the error in the future will be human error caused by not knowing how to use the information or GPS units.

---

### Notes:



## Summary

### Summary Field Operation

- Good safe location
- Turn on unit
- Wait for good satellite signal
- Walk to proper location
- Record coordinates
- Quality check data upon return

---

### Summary of Field Operations

- GPS units are designed to be as easy to use as possible. The procedure to obtaining a good coordinate once the unit has been properly configured is quite straightforward.
- Travel to a safe location.
- Turn the unit on.
- Wait for a good satellite signal.
- Walk to the location where you need to obtain coordinates.
- Record the coordinates.
- Quality-check your coordinates upon return to the office.

---

Notes:



## Summary

### Additional Resources

- User's manual – [www.garmin.com/](http://www.garmin.com/)
- Tutorial on GPS
  - Trimble site [www.trimble.com](http://www.trimble.com)
  - Garmin book [www.garmin.com](http://www.garmin.com)
- WAAS Information FAA site [gps.faa.gov](http://gps.faa.gov)
- USGS Mapping and Datums [www.usgs.gov](http://www.usgs.gov)
- USCG GPS Site [www.navcen.uscg.gov](http://www.navcen.uscg.gov)

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### Additional Resources

- This course was designed to only touch upon the essentials required to obtain good coordinates with a civilian GPS unit. The unit is capable of several additional functions. To learn more about the features of the GPS unit refer to your user's manual, which should have been included in the box with the GPS. If not included, it may be obtain on-line directly from Garmin at [www.garmin.com](http://www.garmin.com).
- Two sites give a more detailed tutorial on how the GPS works.
- The FAA has a site that gives additional information on the current system with several links.
- For more information on mapping and Datums visit the US Geological Survey page.
- The US Coast Guard also maintains a web page that gives a daily map of what areas of the US will have good or bad satellite geometry.

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### Notes:



**Summary**

**Questions?**

---

**Questions**

- Ask students if any questions remain.

---

Notes:



# GPS for Disaster Response Operations

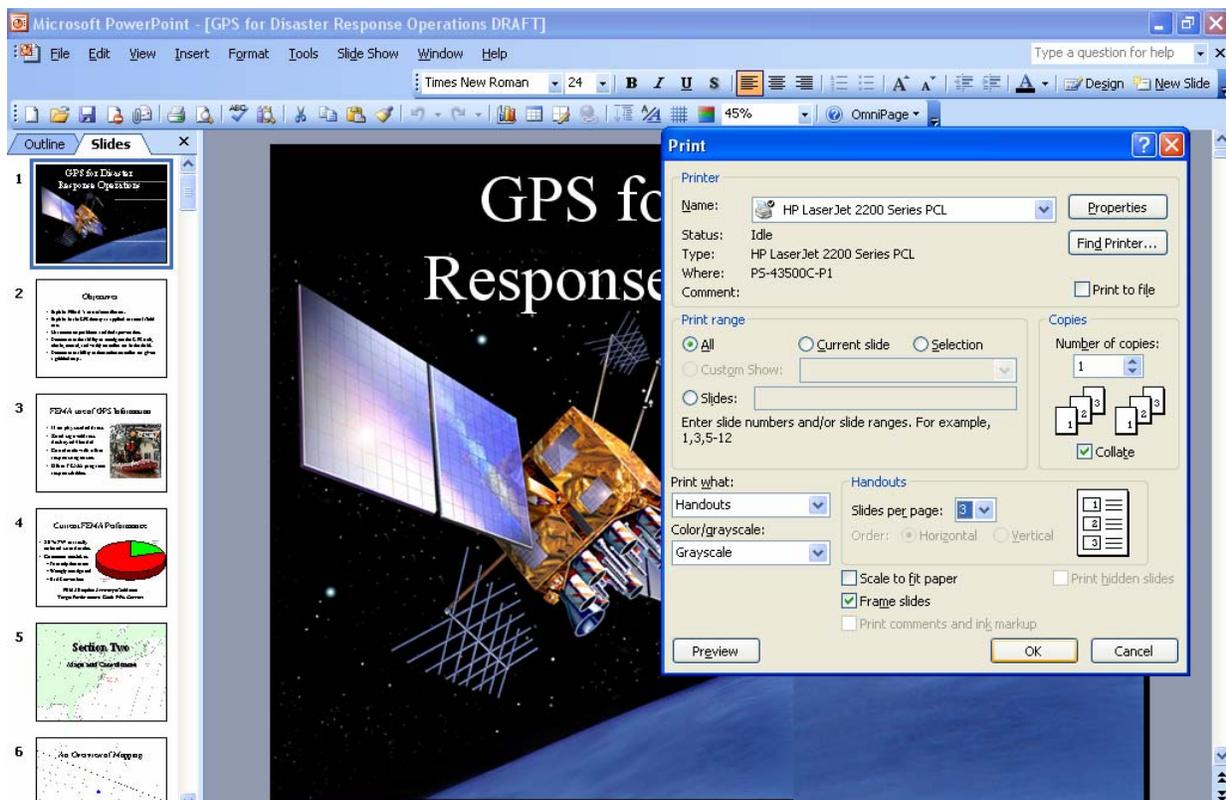
## Appendix A. Instructions for Printing Student Manual

The student manual consists of the following parts:

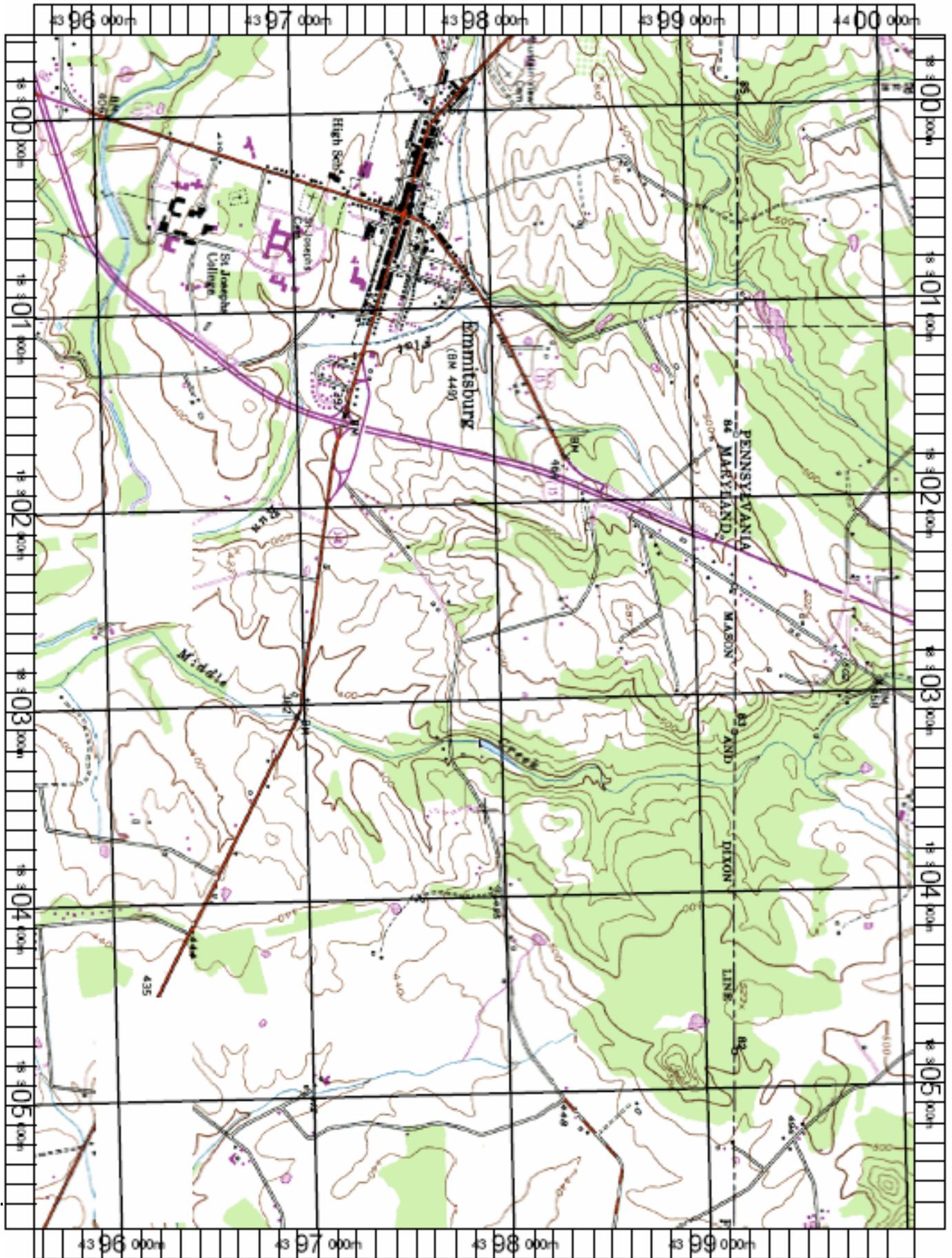
- Printing PowerPoint slide handouts notes (3 per page)
- Copy of NETC Orthographic map (PDF version available) (Appendix B)
- Copy of Emmitsburg topographic map (PDF version available) (Appendix C)
- Copy of Practical Exercise Worksheet (Appendix D)
- Copy of GPS Job Aid (Appendix E)

### Printing Student Manuals from Slides:

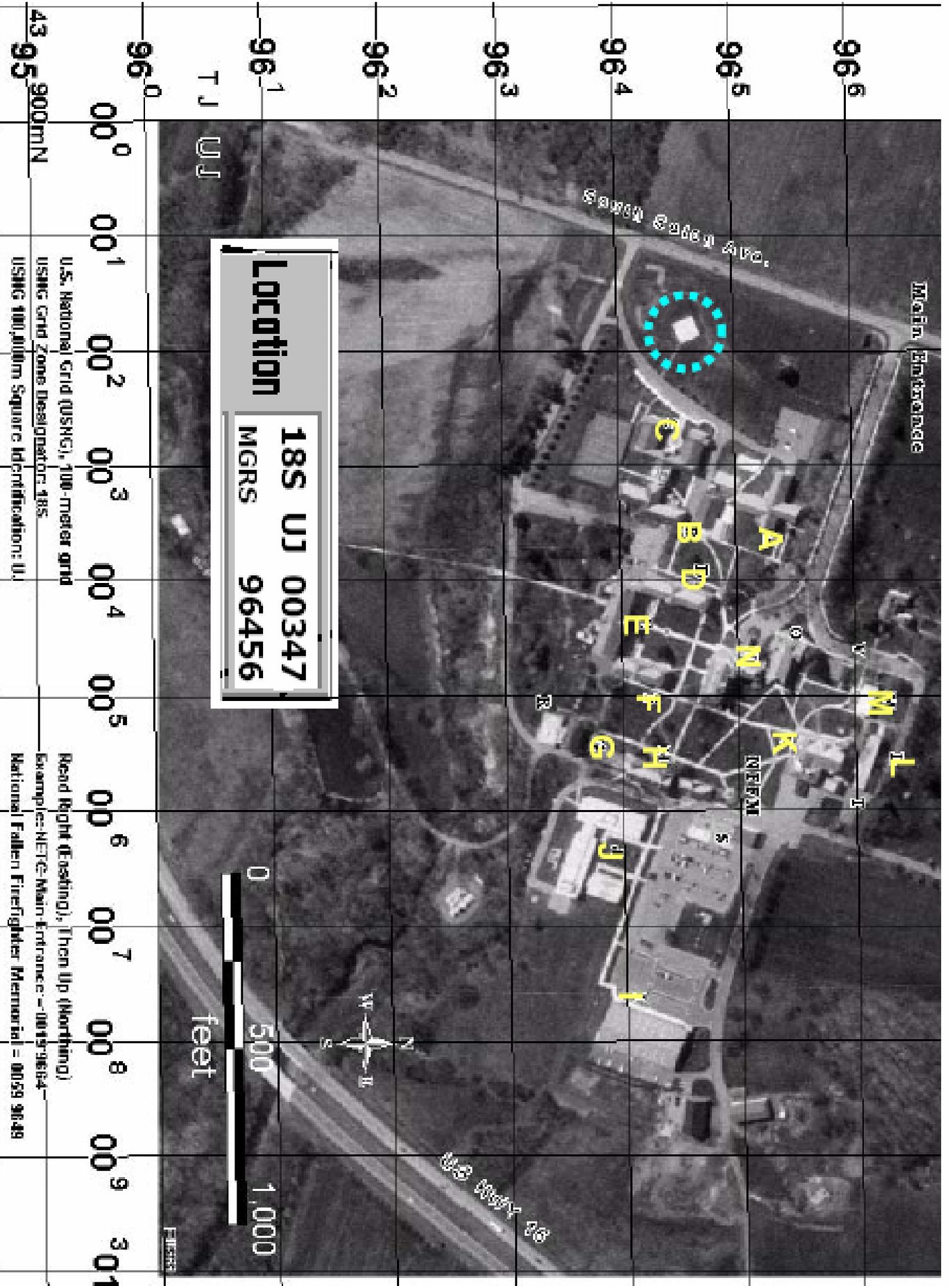
- Open the PowerPoint “presentation”
- From the file menu go to “print”
- On the print screen menu
  - Change from color to pure **Grayscale**
  - Use the arrow down key to choose **Handouts**
  - Change the slides per page to 3 (lines will be included automatically)
- Then click OK



# GPS for Disaster Response Operations



# GPS for Disaster Response Operations



96 0	00 0	00 1	00 2	00 3	00 4	00 5	00 6	00 7	00 8	00 9	3 01
96 1	00 0	00 1	00 2	00 3	00 4	00 5	00 6	00 7	00 8	00 9	
96 2	00 0	00 1	00 2	00 3	00 4	00 5	00 6	00 7	00 8	00 9	
96 3	00 0	00 1	00 2	00 3	00 4	00 5	00 6	00 7	00 8	00 9	
96 4	00 0	00 1	00 2	00 3	00 4	00 5	00 6	00 7	00 8	00 9	
96 5	00 0	00 1	00 2	00 3	00 4	00 5	00 6	00 7	00 8	00 9	
96 6	00 0	00 1	00 2	00 3	00 4	00 5	00 6	00 7	00 8	00 9	
96 7	00 0	00 1	00 2	00 3	00 4	00 5	00 6	00 7	00 8	00 9	
96 8	00 0	00 1	00 2	00 3	00 4	00 5	00 6	00 7	00 8	00 9	
96 9	00 0	00 1	00 2	00 3	00 4	00 5	00 6	00 7	00 8	00 9	
97 0	00 0	00 1	00 2	00 3	00 4	00 5	00 6	00 7	00 8	00 9	

43 95 900mN  
 USNG 100,000m Square Identification: UJ

U.S. National Grid (USNG), 100-meter grid  
 USNG Grid Zone Designator: 18S  
 USNG 100,000m Square Identification: UJ

<b>GPS Practical Exercise</b>	1. Name	2. Location	3. Date/Time

**Section A - Initialization**

**Instructions:** Please record the requested information. If the block is grayed-out it is not required to fill in the box. 4. Turn on the GPS outside (if already on, turn off and then back on), and go to the satellite page by pressing the page button twice. Record the total number of satellites the unit has initially acquired. 5. The moment the GPS unit gives coordinates, record the initial accuracy, then record the total number of satellites. 6. One minute after recording the initial accuracy record the new accuracy and number of satellites. 7. Two minutes later once again record the accuracy and number of satellites. 8. Wait for a differential signal indicated by the letter D in the signal bar (satellite #35 or #47), wait an additional two minutes then record the accuracy and number of satellites. If after a total of 5 minutes unable to get a dGPS signal, skip to section B.

EVENT	Time	Accuracy	# of Satellites
4. Turn On Unit			
5. Initial Coordinates			
6. One minutes after Initial Coordinates			
7. Two minutes later			
8. Two minutes after Differential Signal			

**Section B - Interference**

**Instructions:** Section B allows the user to experiment with various factors that may block or weaken the GPS signal. The GPS unit must be on the satellite page for all activities in order to view the accuracy. 9. Record the accuracy and number of satellites while standing in the open. This may be the same reading recorded in line seven. 10. Place your hand over the antennae (located under the globe logo) for 30 seconds and record the accuracy and number of satellites. After recording the information allow at least a minute to allow the GPS unit to normalize before proceeding to the next measure. 11. Hold the GPS unit in a vertical position then record the accuracy and number of satellites. 12. Walk next to a substantial building then record the accuracy and number of satellites. 13. Walk under a tree (if available), then record the accuracy and number of satellites.

EVENT	Accuracy	# of Satellites
9. Under Open Sky		
10. Hand over antennae		
11. Hold GPS unit upright		
12. Reading close to building		
13. Reading under a tree		

**Section C - Unit Comparison**

**Instructions:** Find a partner to make teams of two. Move to an open safe location and place the two GPS units side by side. Record the coordinates from both units.

	USNG	
Your Coordinate		
Partner's Coordinate		

**Section D - Scenario's**

**Instructions:** Your instructor will give you one or two scenarios of damaged facilities. Determine the best location to take a GPS reading from and record your coordinates.

	USNG	
Scenario 1		
Scenario 2		

# GPS for Disaster Response Operations

## Turning on Unit

### Turning on Unit

While traveling to a work site it is best to keep the unit turned off to conserve batteries. Upon arrival at a site where GPS coordinates are required keep in mind the following:

- Find a safe location free from hazards
- Choose a open location with a good view of the sky and free of obstructions
- Keep the eTrex Vista flat and level
- Keep the eTrex Vista stationary
- Turn the Unit on.
- The following table gives typical times before a reading is obtained.
- After getting the initial reading wait at least a minute to allow accuracy to improve.
- Wait longer if unit is about to lock onto additional satellites or WAAS signal.
- The new out of box startup time may take 12 minutes.

### LAST STARTUP

Condition	Description	Time
Hot	On within 4-6 hours	15-30 seconds
Warm	Within 500 miles	45 seconds
Cold	Moved over 500 miles	5 minutes

### References

- Vista Owner's Manual  
[www.garmin.com/manuals/eTrexVista\\_OwnersManual.pdf](http://www.garmin.com/manuals/eTrexVista_OwnersManual.pdf)  
 Garmin Basic GPS Tutorial  
[www.garmin.com/aboutGPS/](http://www.garmin.com/aboutGPS/)  
 US National Map  
[www.nationalmap.gov](http://www.nationalmap.gov)

## Choosing Reading Locations

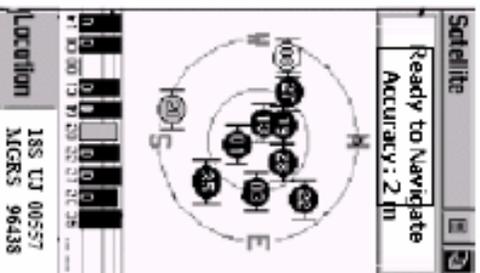
### Choosing Location for Reading

FEMA has established the following procedure for choosing the location of where to take coordinate readings at disaster site.

- The location must be safe. At no times place yourself in jeopardy.
- In order to obtain a reading choose a location it is possible to see satellites. This may preclude readings taken inside of damaged buildings.
- Be as close to the center of the site as possible (safety may preclude the exact center)
- If unable to take reading at center, move to the front of the facility (as determined by address). May need to step away from walls of buildings to see satellites
- For linear features (roads, some utilities, etc.) obtain two readings. One at each end.

### Satellite Page

Record the coordinates from the satellite page. The format must be in MGRS or USNG and look similar to the one illustrated. Use the sky plot to determine if it is worthwhile to wait longer to obtain additional satellites.



## GPS Response Job Aid



**GARMIN**  
 Step-by-Step Instructions  
 to Get You Started  
 (Run this page and begin with Step 7) →

### Installing the Batteries

The eTrex Vista operates on two AA batteries, which are placed in the back of the unit. Rechargeable Alkaline, NiMH, NiCad, or Lithium batteries may be used, but cannot be charged in the unit.

Stored data will not be lost when changing the batteries.

To install the Batteries:

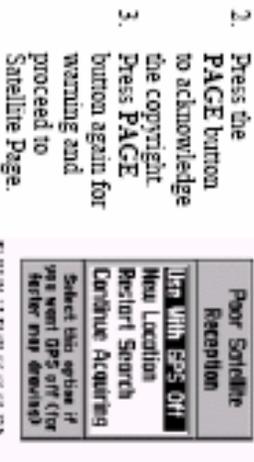
1. Remove the battery cover from the back of the unit by turning the D-ring  $\frac{1}{4}$  turn counter-clockwise and pulling out.
2. Insert the batteries observing proper polarity as shown at the right.
3. Reinstall the battery cover by turning the D-Ring  $\frac{1}{4}$  turn clockwise.



### Start Up Sequence

Turn the unit On:

1. Press and hold the **POWER** button.
2. Press the **PAGE** button to acknowledge the copyright.
3. Press **PAGE** button again for warning and proceed to Satellite Page.



The first time you use the unit it may take up to 5 minutes to establish a position. Find a safe initial start up location which allows a clear view of the sky in an open area. Keep the Vista flat, level, and stationary.



If unable to acquire satellites unit displays poor satellite reception window.

- Select new location option
- Then select "Use MAP" option
- Use **CLICK STICK** to scroll to current location and Press **ENTER**.

### Using the Button Functions

The **ZOOM IN** and **OUT** buttons:

- When on the Satellite Page, Press to adjust the screen contrast.
- When on the Map Page, press to Zoom in and out.

The **CLICK STICK**:

- (When moved or pressed in, this button "clicks")
- Press to enter highlighted options or confirm messages.
  - MoveUp/Down or Right/Left to move through lists, highlight fields, on-screen buttons, icons, enter data or move the map panning arrow.



- The **PAGE** button:
- Press to cycle through main Pages.
- The **POWER** button:
- Press and hold to turn the unit On/Off
  - Press to toggle backlighting On/Off

### Previewing the Main Pages

All of the information you need to operate the eTrex Vista is found on the five Main Pages (or display screens). To preview these pages, press the **PAGE** button to cycle from one page to the next.



**Satellite Page** - Coordinates, visual reference of satellites being tracked.

**Map Page** - Displays movements on map

**Navigation Page** - Used with go to functions.

**Altitude Page** - Current elevation ascent into

**Trip Computer** - Trip and navigation data

**Main Menu** - Used to set configuration

### Configuration Settings

It is critical that your eTrex Vista is properly configured to FEMA Response standards. From the Main Menu go to the Setup Menu. The correct configuration for the Units and System are below.

Units	System
Position Format	GPS
MGRS or USNG	Normal
Map Datum	WMS
WGS 84	Enabled
Distance/Speed	Language
Yards	English
Elevation	Compass
Feet	On
Depth	Altimeter
Slabute	Auto Calibration
Pressure	On
Millibars	Memory Used
	2%