#### **GPS and Land Navigation**

Objectives

- Understand basic topographic map reading and symbology
- Identify and discuss the differences between Coordinate Systems and Datums
- Review Basic GPS Information and Components

# What is a Topographic Map?

- Topographic map graphic representation of a portion of the earth's surface as seen from above, drawn to scale.
  - contour lines hills, mountains, valleys, and canyons.
  - streets
  - buildings
  - streams
  - woods

#### Reading the "lay of the land"...

- Widely spaced contour lines = gradual slope.
- More packed together contour lines = steeper terrain
- Contours that form circles = peaks (generally)
- A summit is often marked with an **X** or a  $\Delta$ ; the number indicates the elevation of that peak.

#### Reading Contours

The narrower intermediate and supplementary contours found between the index contours help to show more details of the land surface shape.

Does the hill shading help?



#### **Reading Contour Exercise**

Match the Contour to the Section





#### Reading Contours...

- A contour is a line of equal elevation
- Contours shaped as V's with streams generally indicate a valley



#### Using topographical features to find yourself on the map...

- Relate topographical features on the map to what you see on the ground.
- Find features on the ground that are also on the map. (Stream, Draw, Peak, etc.)
- Find your location on the map, using terrain features.

# What Are Contour Lines?

- Contours are imaginary lines that join points of equal elevation.
- Contours make it possible to measure the height of mountains and steepness of slopes.



# What is a Topographic Map?



![](_page_9_Picture_0.jpeg)

#### **Elevation Symbols**

Neace

₽-

CONTOURS

#### CONTROL DATA AND MONUMENTS Aerial photograph roll and frame number\* 3-20 Horizontal control Neace Third order or better, permanent mark Δ BM A 4 BM With third order or better elevation Checked spot elevation **△**19.5 Coincident with section corner Cactus Cartus Unmonumented\* +Vertical control <sup>BM</sup>× 16.3 Third order or better, with tablet × 120.0 Third order or better, recoverable mark BM Bench mark at found section corner 18.6 Spot elevation × 5.3

#### **Boundary monument**

With tablet	BM 8M 21.6 +71
Without tablet	171.3
With number and elevation	67 <sub>0</sub> 301.1
U.S. mineral or location monument	

Topographic	
Intermediate	
Index	$\sim$
Supplementary	
Depression	e
Cut; fill	<del>Reft</del>
Bathymetric	
Intermediate	
Index	
Primary	/
Index Primary	/
Supplementary	

#### **ICS SYMBOLS for FIRE MAPS**

![](_page_11_Figure_1.jpeg)

\* = To be used on incident briefing and action plan maps (no color)

#### What Data Can Be Found in the Collar of a Topographic Map?

![](_page_12_Figure_1.jpeg)

Around the edge of topographic maps, you'll find critical information for accurate map interpretation and use.

#### The Collar of a Topographic Map (Upper Left Corner)

![](_page_13_Figure_1.jpeg)

#### The Collar of a Topographic Map (Upper Right Corner)

![](_page_14_Figure_1.jpeg)

![](_page_15_Figure_0.jpeg)

![](_page_16_Figure_0.jpeg)

#### The Collar of a Topographic Map (Lower Right Corner)

![](_page_17_Figure_1.jpeg)

#### Introduction to Coordinate Systems & Datums

#### Latitude and Longitude

![](_page_19_Figure_1.jpeg)

 Latitude and longitude is a grid system, used to actually determine a location or a place on earth.

#### Latitude

 Coordinates form the horizontal or lateral lines of the geographic grid system. Referred to as "parallels", the latitudinal coordinates form concentric circles around the Earth that are both parallel from the equator and parallel to each other

#### Longitude

 Coordinates form the vertical or longitudinal lines of the geographic grid system. Referred to as meridians and beginning at the Prime Meridian (located at Greewich, UK), the longitudinal coordinates form the circles around the Earth and intersect through the North and South Poles.

#### Map Datums

- A datum describes the model that was used to match the location of features on the ground to coordinates and locations on the map.
- **2 PRIMARY DATUMS** 
   –NAD83 (Topographic Maps)
   –NAD27 (Topographic Maps)
   –WGS84 (Aircraft)

What is the difference in distance?

# **Coordinate Systems**

- Coordinate Systems are different ways a particular location can be displayed.
  - Degrees Minutes Seconds (DATUM = NAD27 / TOPO)
    - N 43° 40' 55.8"
    - W 116° 17' 14.1"
  - Degrees Decimal Minutes (DATUM = WGS84 / AIRCRAFT)
    - N 43° 40.930'
    - W 116° 17.235'

# **Coordinate Systems**

Different coordinates representing the same location:

Degrees Minutes Seconds (TOPOS) hddd<sup>0</sup> mm' ss.s": N 43<sup>0</sup> 40' <u>55.8"</u> X W 116<sup>0</sup> 17' 14.1" (<u>55.8"</u> / 60 = .930') Degrees Decimal Minutes (AIRCRAFT) hddd<sup>0</sup> mm.mmm': N 43<sup>0</sup> <u>40.930'</u> X W 116<sup>0</sup> 17.235'

#### **Datums and Projections**

![](_page_25_Figure_1.jpeg)

![](_page_26_Figure_0.jpeg)

# What datums and coordinate systems are used on incidents?

- Varies...type of incident
- GIS/IAP Maps

- Ask GIS Specialists what datum they use?

• USGS Topographic Maps

![](_page_28_Picture_0.jpeg)

# Four Primary Functions of GPS

- Position and coordinates.
- The distance and direction between to points.
- Travel progress reports.
- Accurate time measurement.

![](_page_29_Figure_5.jpeg)

![](_page_30_Picture_0.jpeg)

#### Using Maps with GPS

- Make sure you' re in the right datum and coordinate system...
- TOPOS
  - NAD 27
  - Degrees Minutes Seconds
- AIRCRAFT
  - WGS84
  - Degrees Decimal Minutes
- OTHERS?
  - UTM

#### **Basic GPS Terminology**

Waypoints (Lat/Long)

-Point

Tracklogs – "bread crumb trail"

-Line

#### When to make Waypoint?

- Start/stop location
- Safety Zones
- Helispots
- Hospitals
- Major Features
- Fireline changes
- Road Junctions
- Others...

# When to make Tracklogs?

- Fireline
- Escape routes
- Trails
- Roads

![](_page_35_Picture_0.jpeg)

- No mapping program is supported over another
  - Avenza
    - A free app where you can download maps either free of purchased
    - If processed, it will track your location similar to a hand held GPS
    - Many incidents are moving digitally by adding QR codes to the corner of IAP's and maps to be downloaded by firefighters