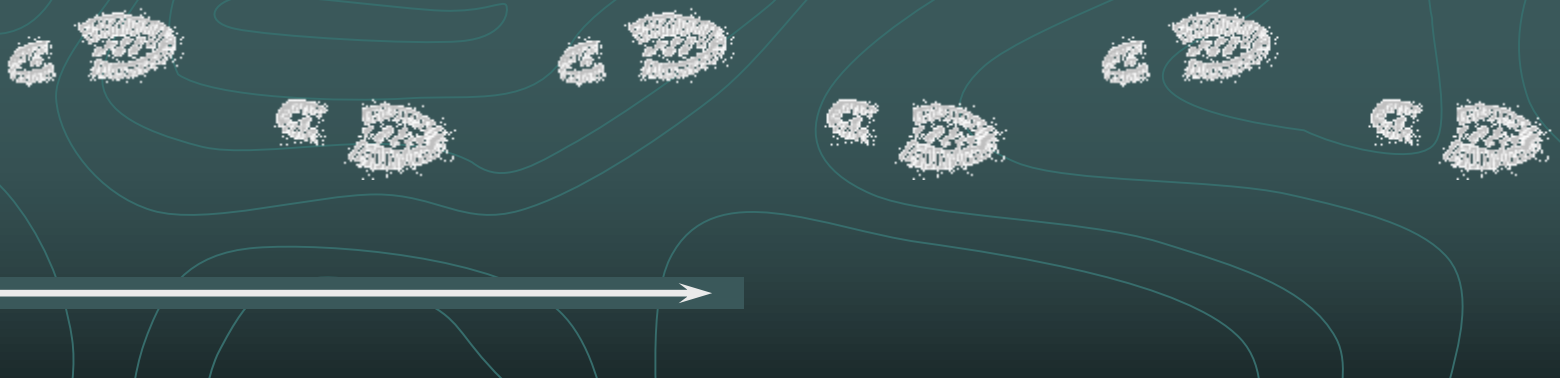
Land Navigation



Hall County EMA
Search And Rescue Team Training

Ken Hughey

January 2010

Disclaimer

- Safety comes first. No action should be taken in Search and Rescue if the individual isn't completely comfortable that risks are controlled, the activity is safe, and they are personally prepared for the proposed activity.
- This presentation does not complete any level of training or provide for any type of certification. Formal education from qualified instructors and a long-term, personal commitment to continued training and practice is required for proficiency.
- Hall County EMA SAR makes no claims to the value or accuracy of the topics contained in this presentation. This is only provided for general knowledge of a key topic to help the Hall County EMA SAR team.

Presentation Material Usage

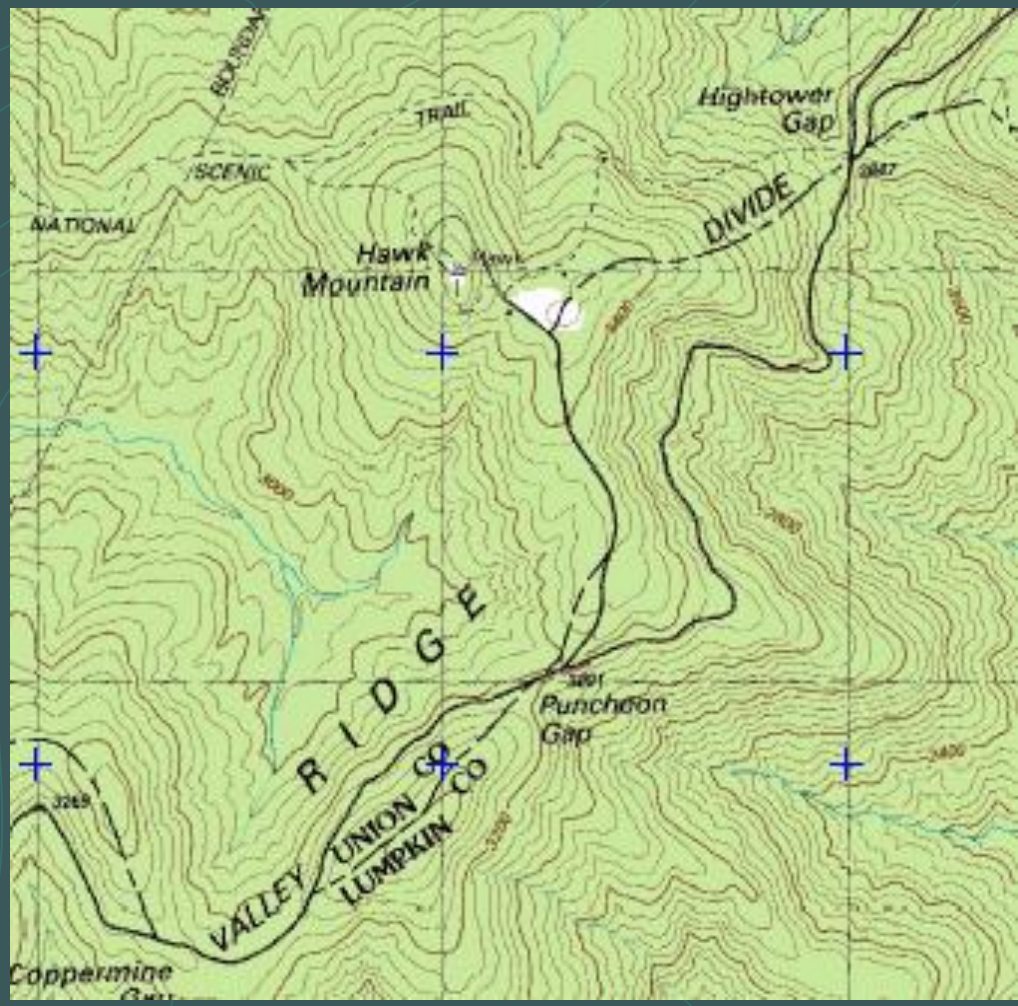
- Please provide citation information for any use of this material.
- Each citation should reference Hall County EMA Search & Rescue Team and related references included in this presentation.

Objectives

- This training presentation is designed to provide a basic land navigation overview for the Hall County EMA Search & Rescue Team.

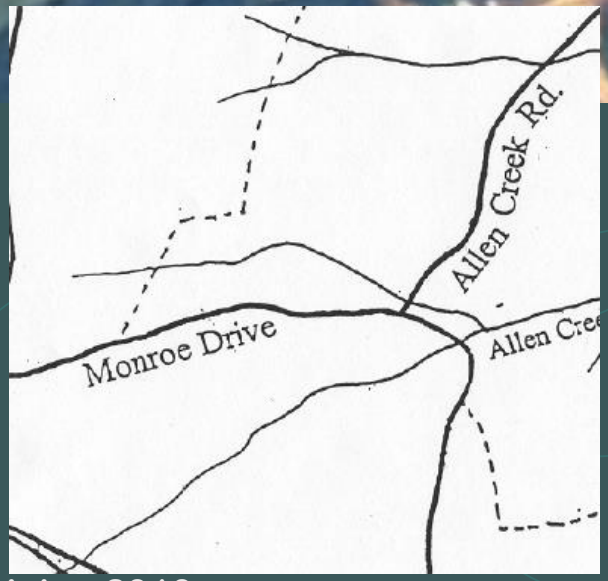
Agenda

- Types of Maps used in SAR
- Marginal Information
- Map Colors
- Contour Lines
- Terrain Features
- UTM Grid System
- Distance & Direction
- Magnetic Declination
- Polar Coordinates
- Intersection & Resection



Maps used in SAR

- Traditional Road Maps
- County Road Maps
- Ariel Photography Maps
- Topographical Maps
- “Hand Written Maps”



Topographical Map

- Primary type of map used in SAR operations
- Known as “Topos”
- Primary type of USGS Topo Map used is the 1:24,000 scale (1” on map = 24,000” on ground)
- Modern software allows us to view / modify and print these maps (or portions of these maps) on our own printers.

Topo Maps

- Portray the shape and elevation of the terrain
- Show graphic representation of selected manmade and natural features to scale

Topo Maps

- USGS publishes topo maps in a variety of scales.
  - Most popular for land SAR is the 7.5-minute map. (1:24,000 scale)
- 7.5-minute maps have quadrangle dimensions of 7.5 minutes.

Topo Maps

- USGS maps are supposed to be updated every 5 to10 years, but often it is longer.
- They accurately depict terrain and relief (elevation and slope).
- Manmade features may differ.

Topo Maps

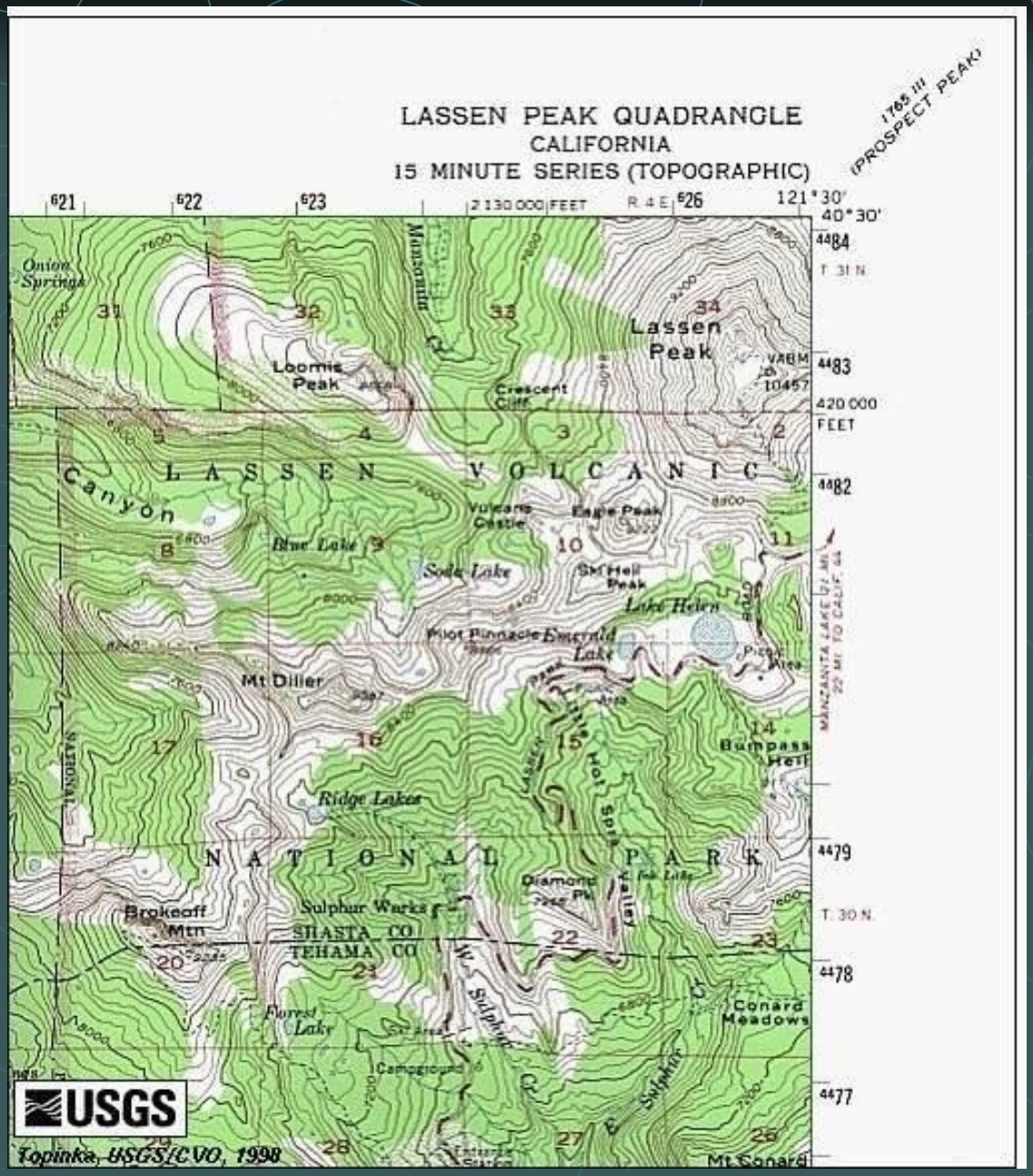
- Top of the map is always true north.
- Vertical lines of longitude point north and south.
- Horizontal lines of latitude point east and west.
- Space outside the margin line identifies and explains the map. (Marginal Information)

Marginal Information
or

What's all that stuff along the edges of the map?

Map Name

- Topos are identified in the upper right margin by quadrangle name, state or states in which it is located, series, and type
- Quadrangle is also called a “Quad”
- Usually named after a prominent, immoveable place or landmark within the mapped area

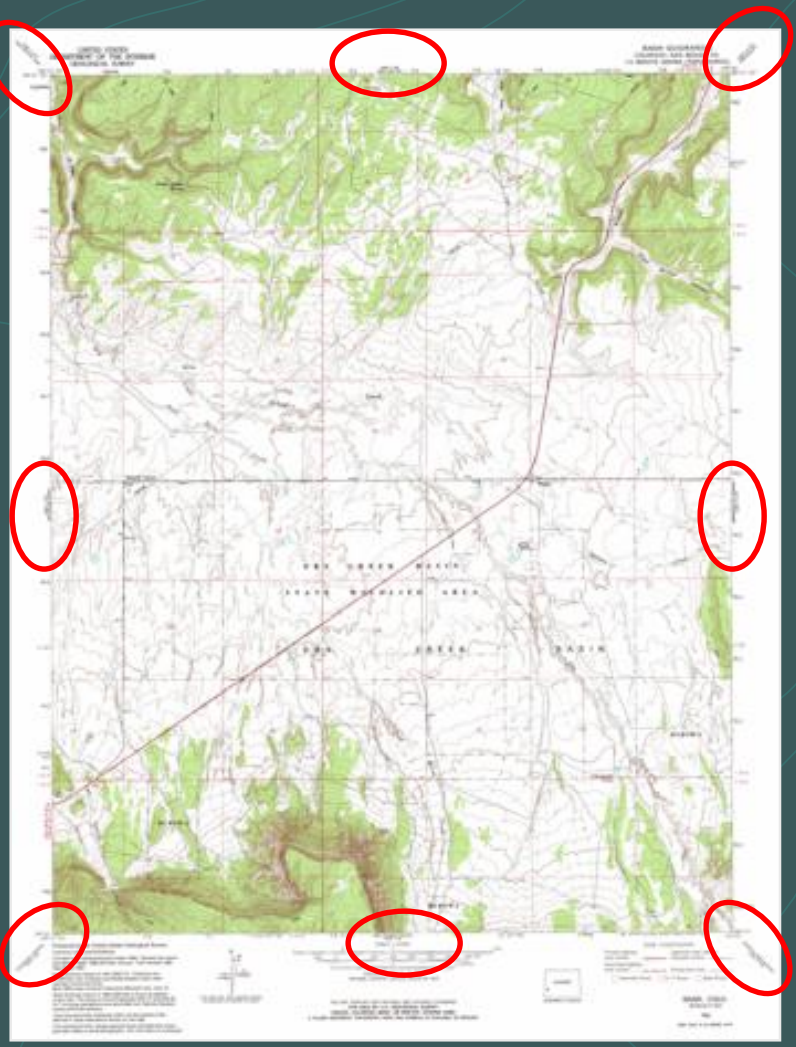

LASSEN PEAK QUADRANGLE
CALIFORNIA
15 MINUTE SERIES (TOPOGRAPHIC)
1765 III
(PROSPECT PEAK)
621
622
623
2 130 000 FEET
R 4 E
626
121°30'
40°30'
4484
T. 31 N.
Onion Springs
Loomis Peak
Crescent Cliff
Lassen Peak
VABM
10457
4483
420 000
FEET
4482
L A S S E N V O L C A N I C
N A T I O N A L P A R K
Canyon
Vulcans Castle
Eagle Peak
Blue Lake
Solle Lake
Ski Hill Peak
Lake Helen
Pilot Pinnacle
Emerald Lake
Mt Diller
Ridge Lakes
Bumpass Hell
Hot Spring
Diamond Peak
Brokeoff Mtn
Sulphur Works
SHASTA CO
TEHAMA CO
T. 30 N.
4479
4478
Forest Lake
Campground
Conard Meadows
4477
USGS
Topinka, USGS/CVO, 1998
Mt Conard

Map Name

- Title block in lower right margin shows quad name, state name, date, any revisions (photo revised)
- Geographic coordinates are shown at all four map margin corners

Adjoining Map Names

- Adjoining Map (Quad) names are shown on each corner and each side of the map

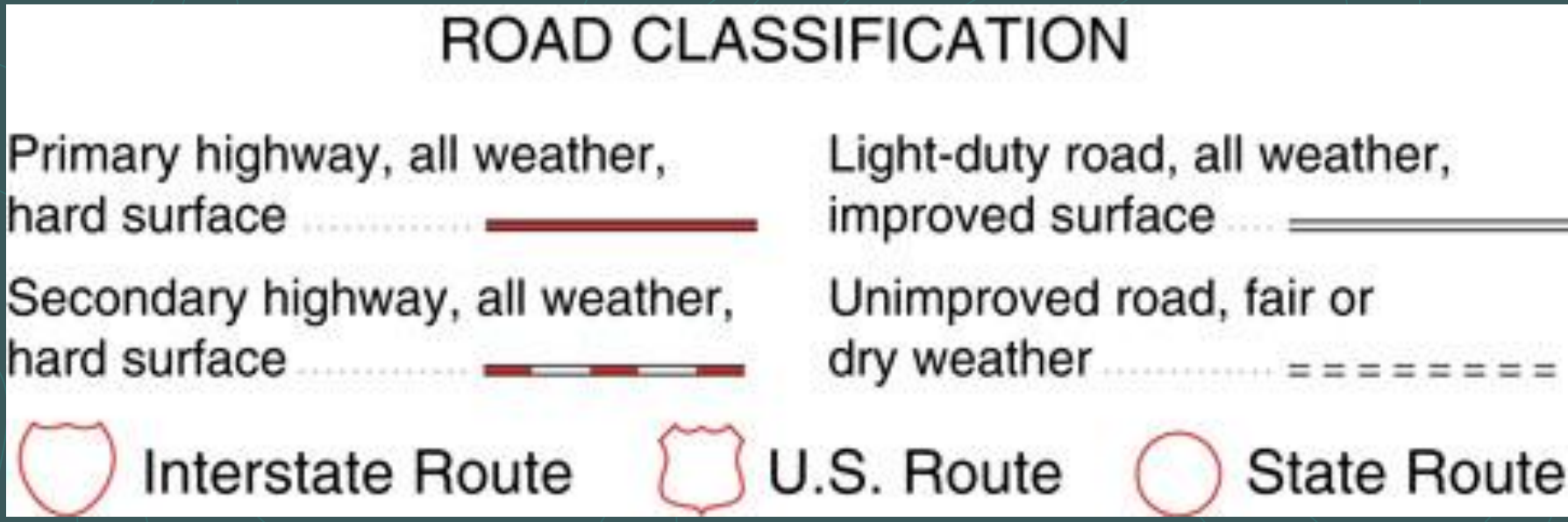


Road Classification

- Road Classification Legend is placed in the lower right margin.
- Tailored for each map to include only classes of roads and route markers that are shown in the body of the map
- Trails are not included in the legend unless there are no roads on the map.

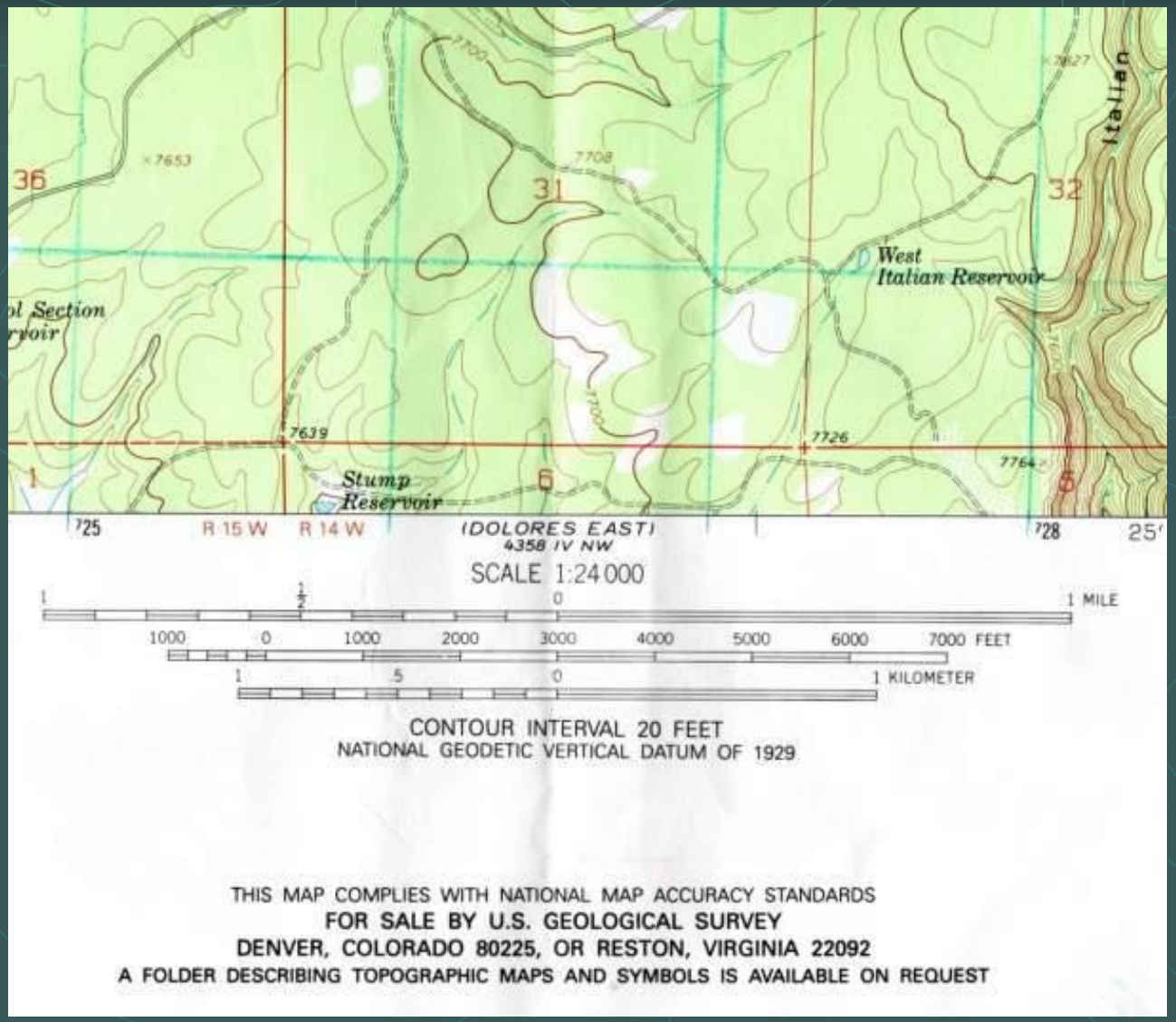
Hall County EMA SAR Team Training 2010

Road Classification



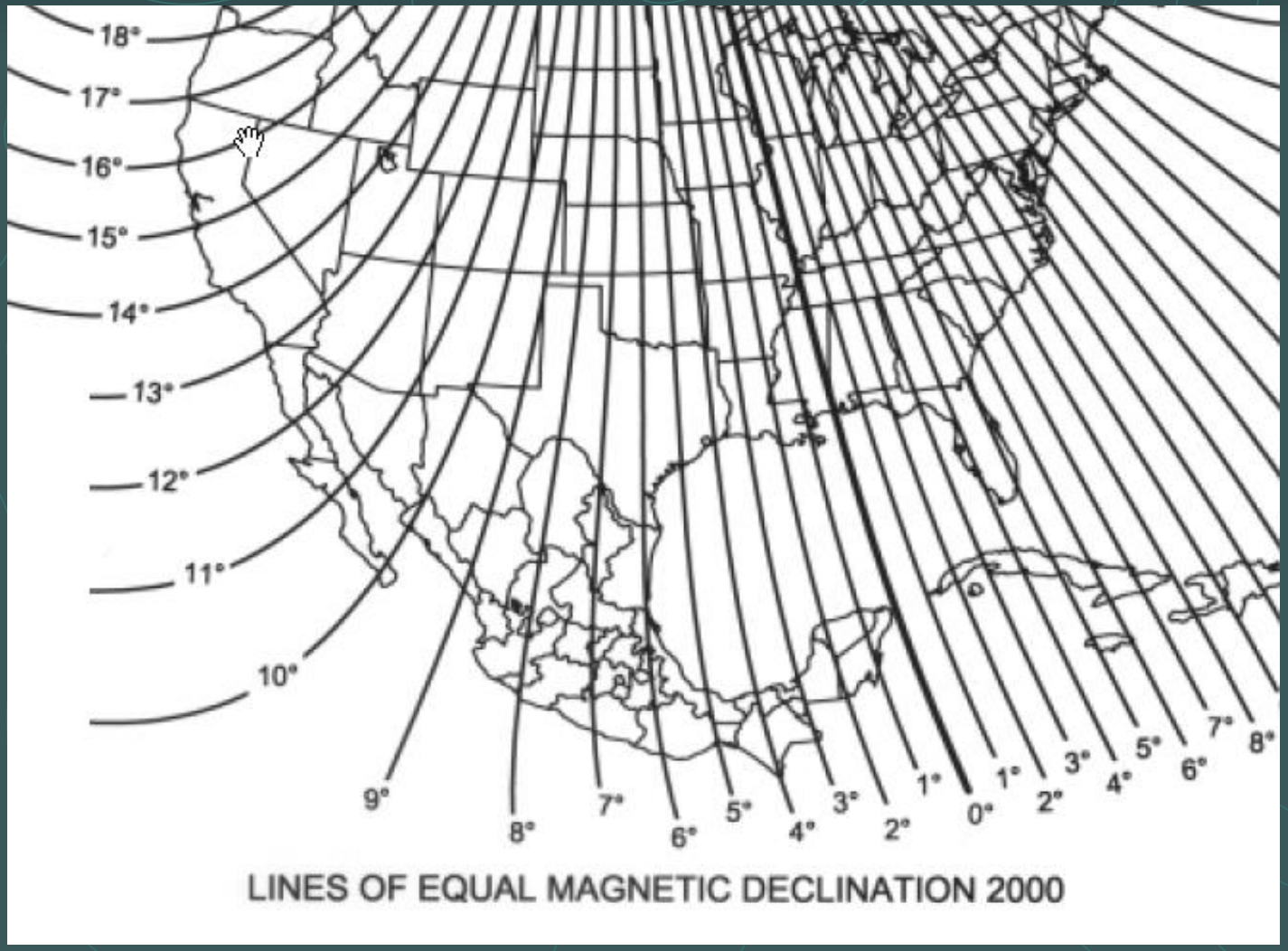
Map Scale

- Center of the lower margin contains:
  - Map Scale expressed as a ratio (1:24:000, 1” on map = 24,000” on ground)
  - Distance Scales (miles, feet, kilometers)
  - Contour-interval


36
31
32
6
1
7653
7708
7700
7627
7639
7726
7764
West
Italian Reservoir
Italian
Stump
Reservoir
ol Section
rvoir
725
R 15 W
R 14 W
(DOLORES EAST)
4358 IV NW
728
25'
SCALE 1:24 000
1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 KILOMETER
CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929
THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U.S. GEOLOGICAL SURVEY
DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

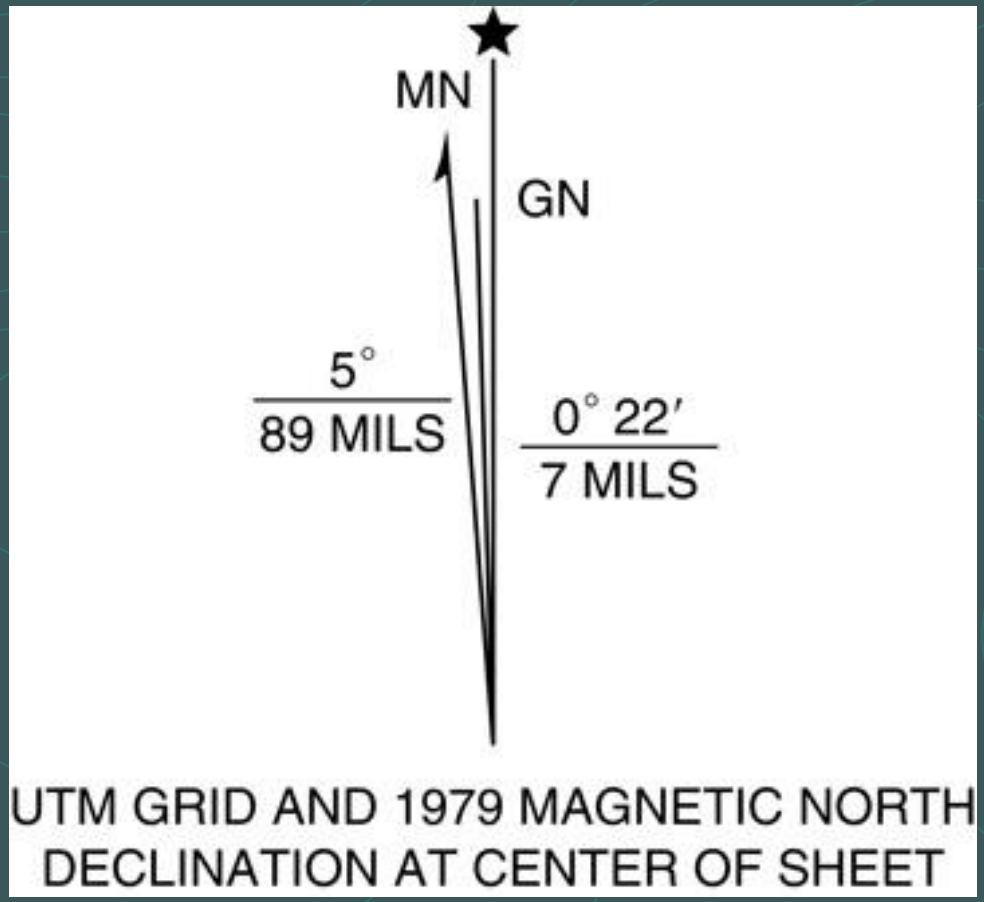
Magnetic Declination Info

- Magnetic declination for the year of filed survey or revision
  - Determined to the nearest 0.5 degree from the latest isogonic chart
  - Shown by a diagram centered between the credit legend and bar scale
- The declination diagram indicates the angular relationship between true north, grid north, and magnetic north.



LINES OF EQUAL MAGNETIC DECLINATION 2000

Magnetic Declination Info



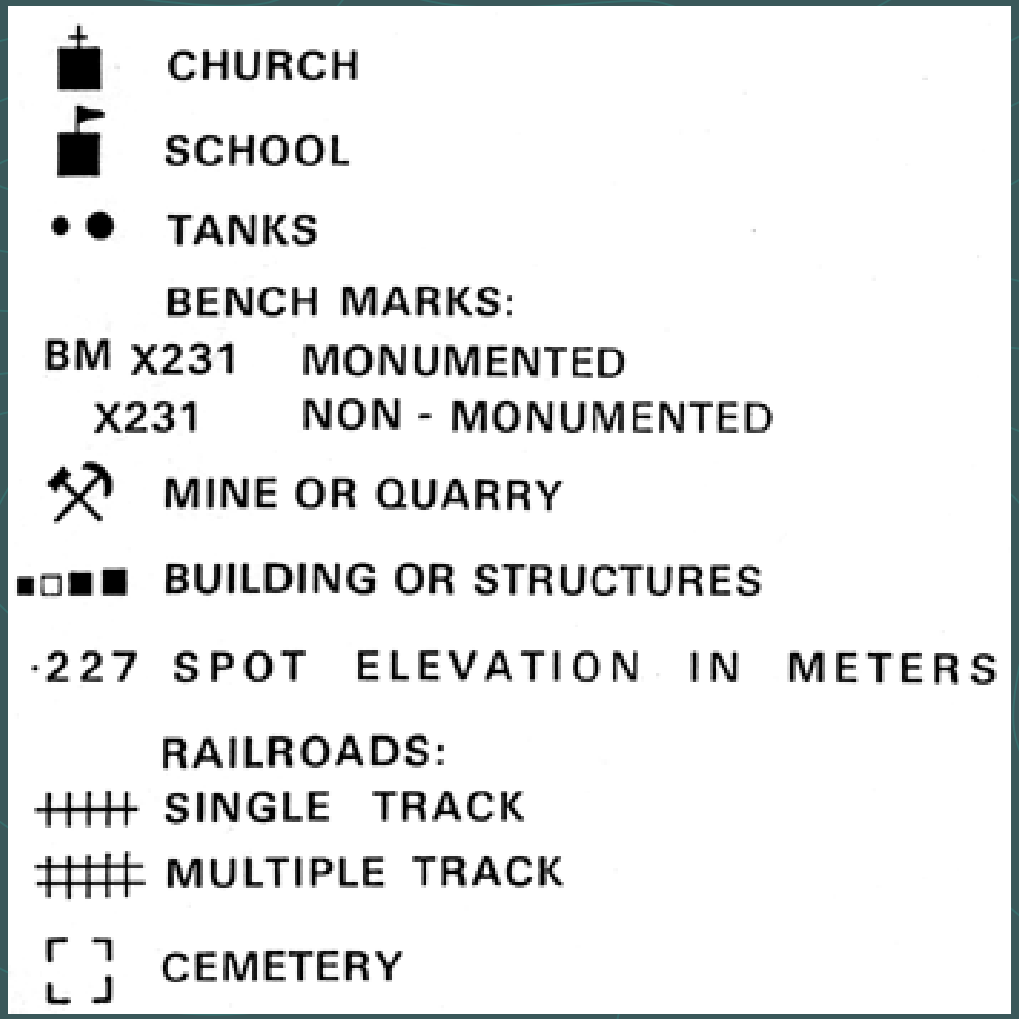
UTM GRID AND 1979 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

Map Colors
and
Map Symbols

Map Colors

- Brown: Contour lines
- Green: Vegetation
- Blue: Water
- Black: Manmade objects
- Red: Roads and built-up areas
- Purple: New changes or updates on the map

Map Symbols


CHURCH
SCHOOL
TANKS
BENCH MARKS:
BM X231 MONUMENTED
X231 NON - MONUMENTED
MINE OR QUARRY
BUILDING OR STRUCTURES
·227 SPOT ELEVATION IN METERS
RAILROADS:
SINGLE TRACK
MULTIPLE TRACK
CEMETERY

Contour Lines and Elevation

Contour Lines

- Represent relative elevation
- Every point along a continuous line is at the same elevation

Contour Lines

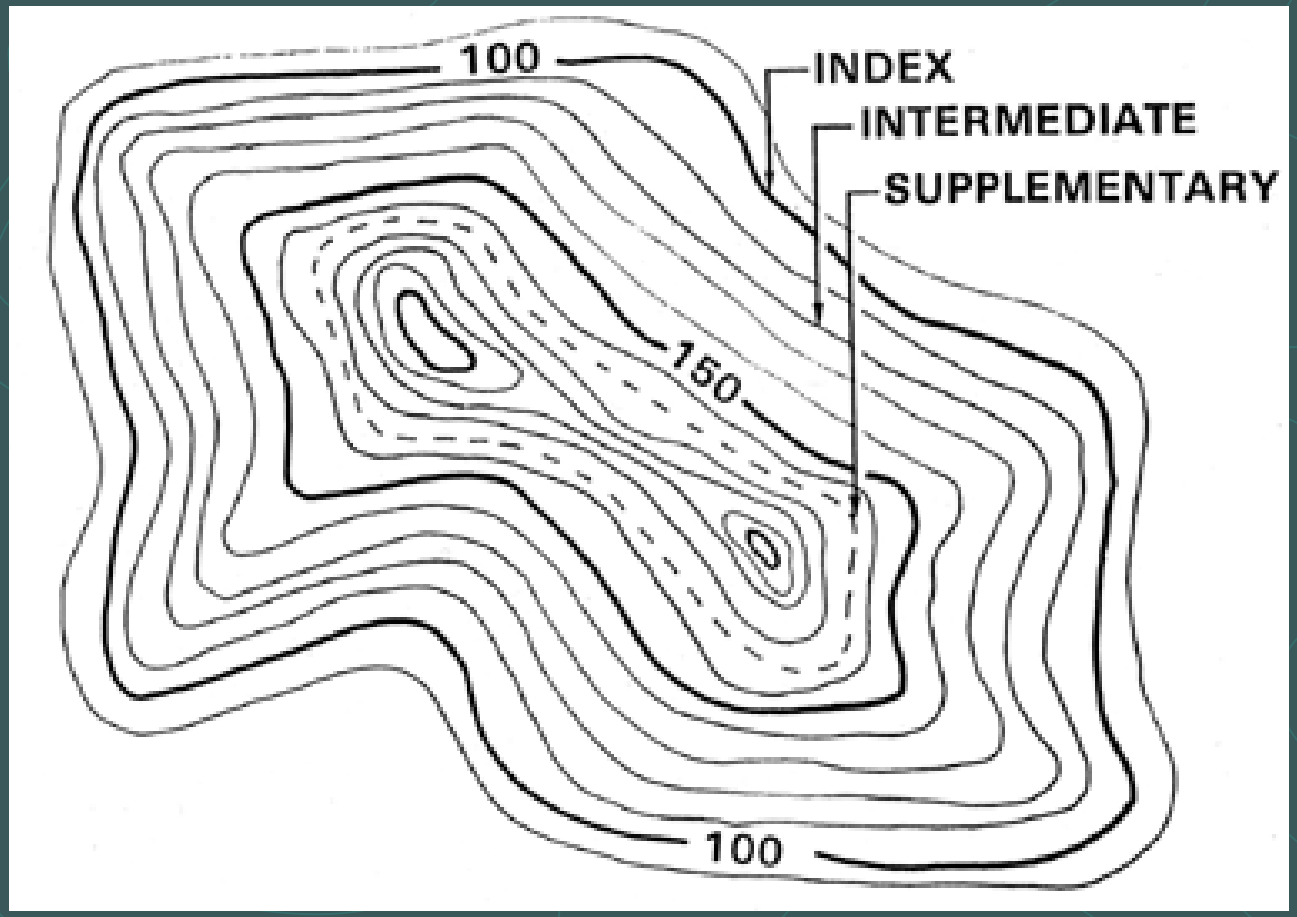
- Three types:
  - Index
  - Intermediate
  - Supplementary
- Every fifth line is darker.
- Have numbers superimposed on them indicating the elevation along that particular line

Intermediate Contour Lines

- Lighter brown lines
- Fall between index lines
- Are not numbered

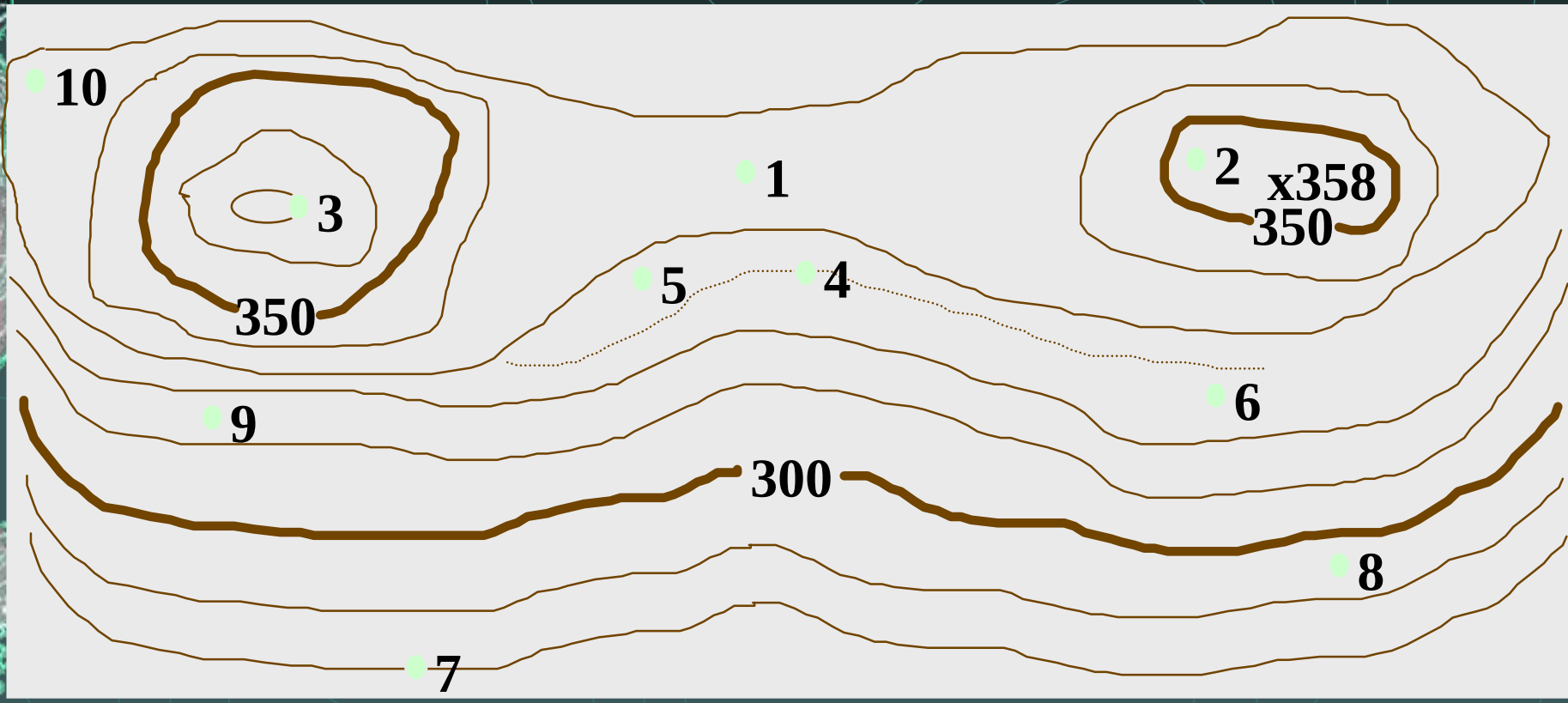
Supplementary Contour Lines

- Dashed lines that may be used when:
  - The terrain is very flat
  - There are large distances between contour lines
- Shows a difference in elevation that is half of the elevation of the contour lines between which it falls

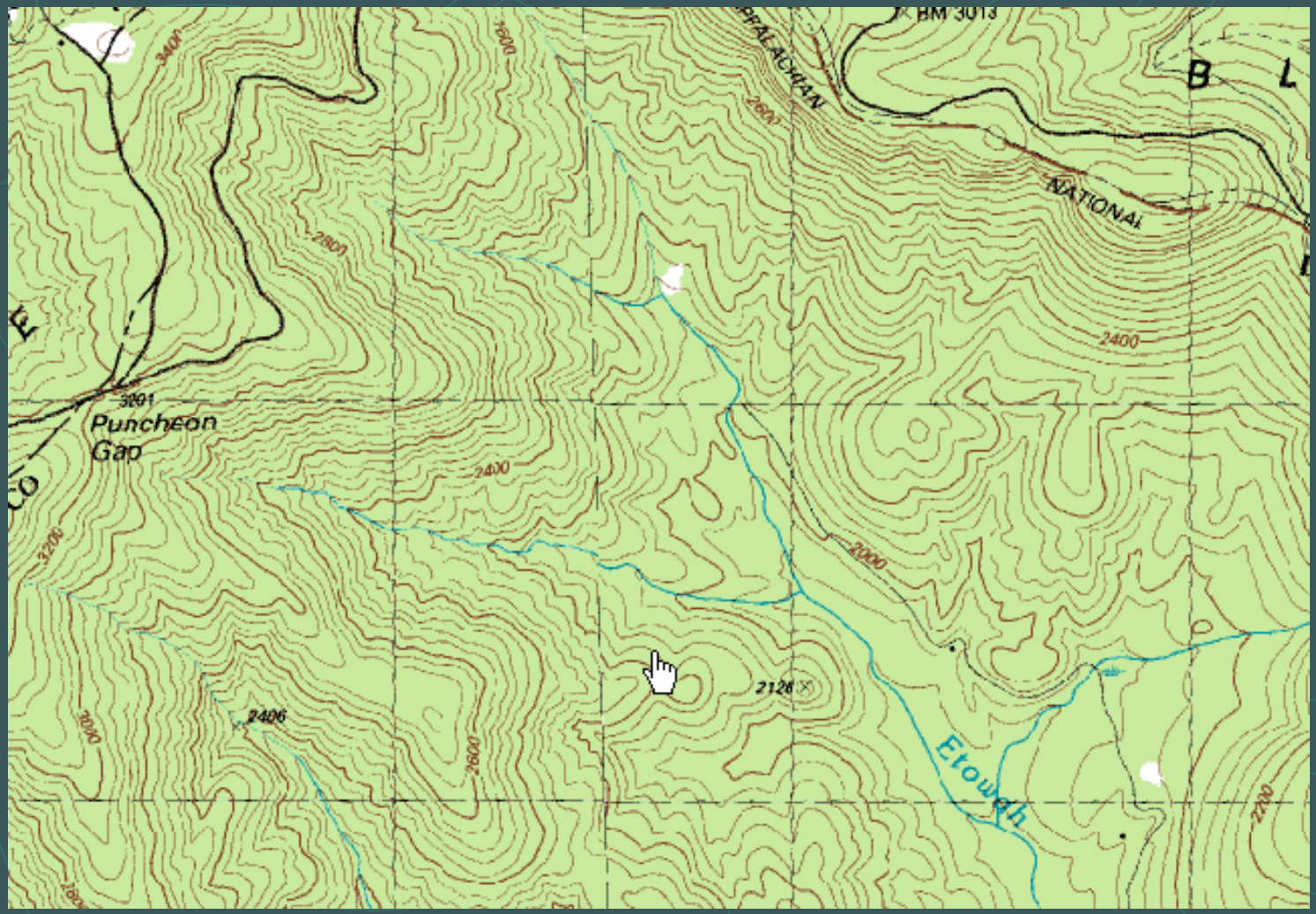

100
INDEX
INTERMEDIATE
SUPPLEMENTARY
150
100

Determine Elevation

1. Check contour interval
2. Find given elevation
3. Determine direction of the slope
4. Count contour intervals



Elevation of Point: 7 = ? 3 = ? 9 = ? 1 = ? 4 = ?
8 = ? 10 = ?

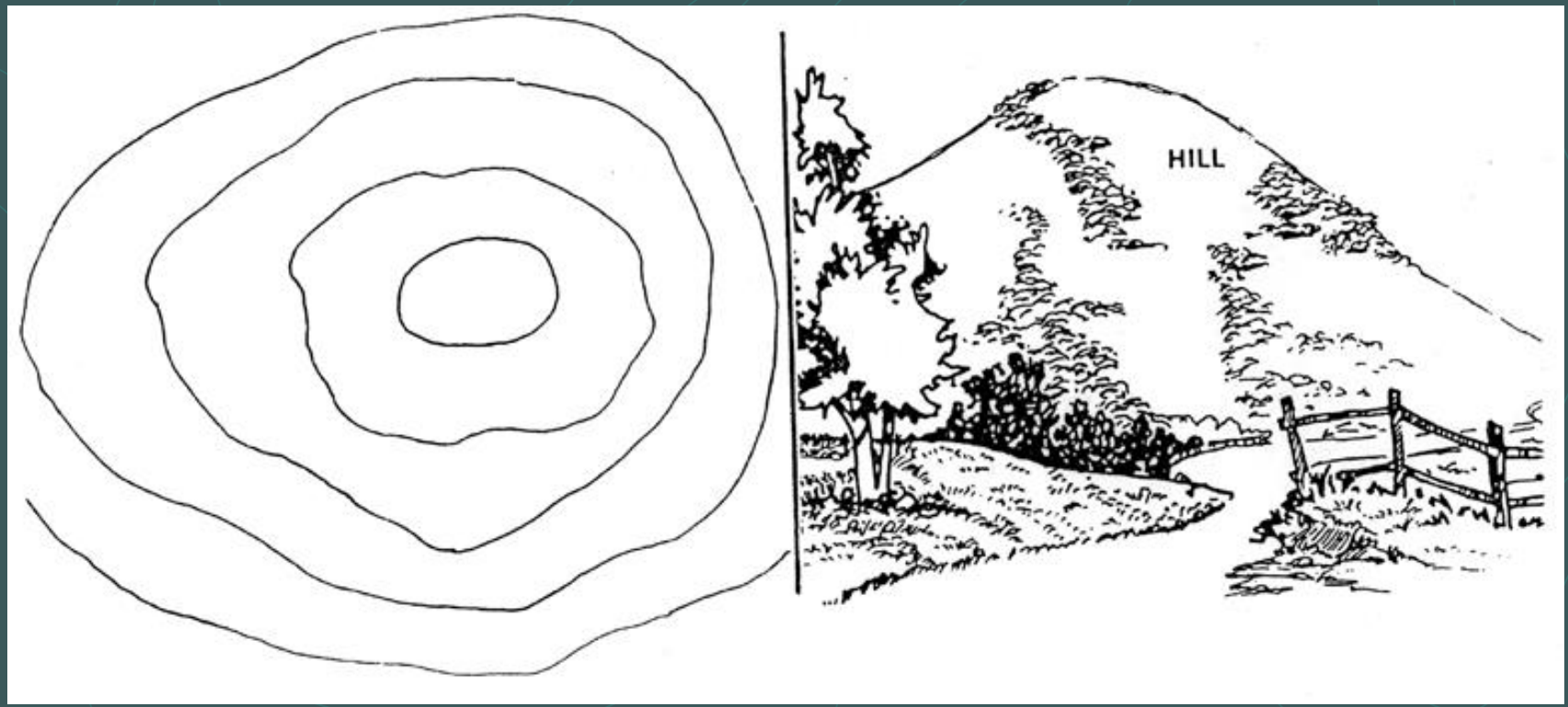


Hall County EMA SAR Team Training 2010

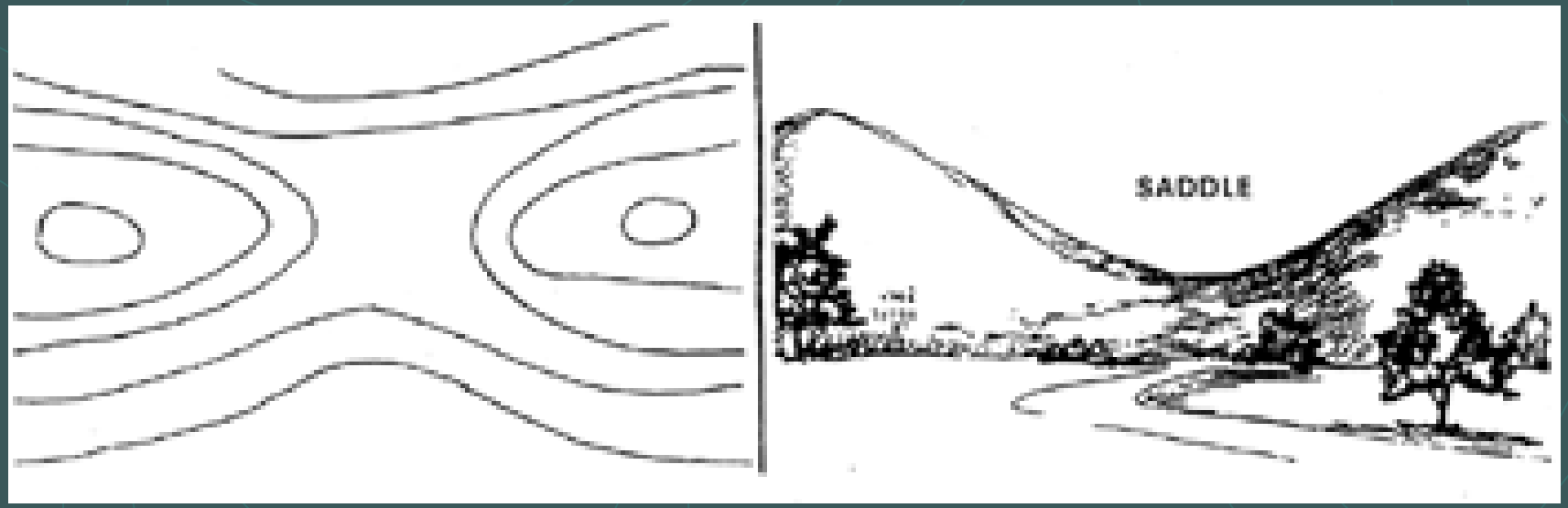
Terrain Features on the Topo

Ridgeline

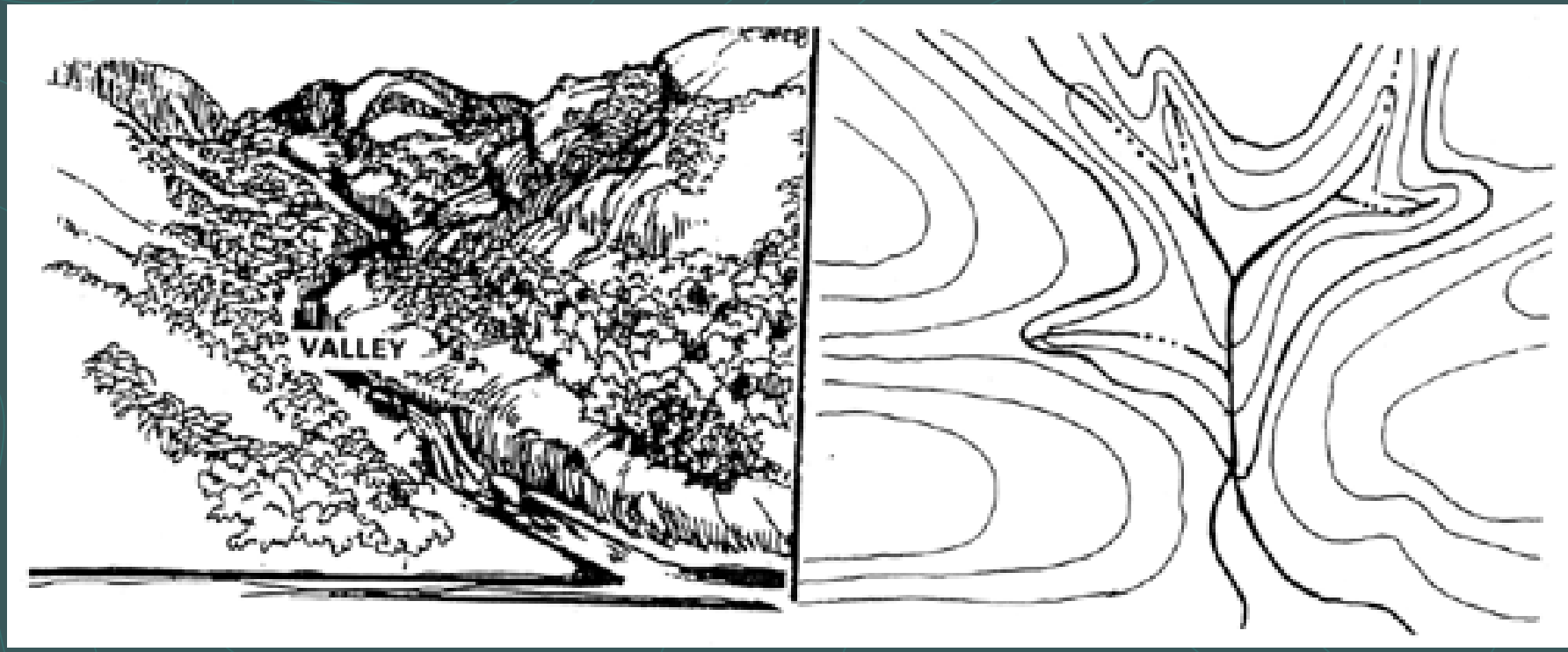
Hill



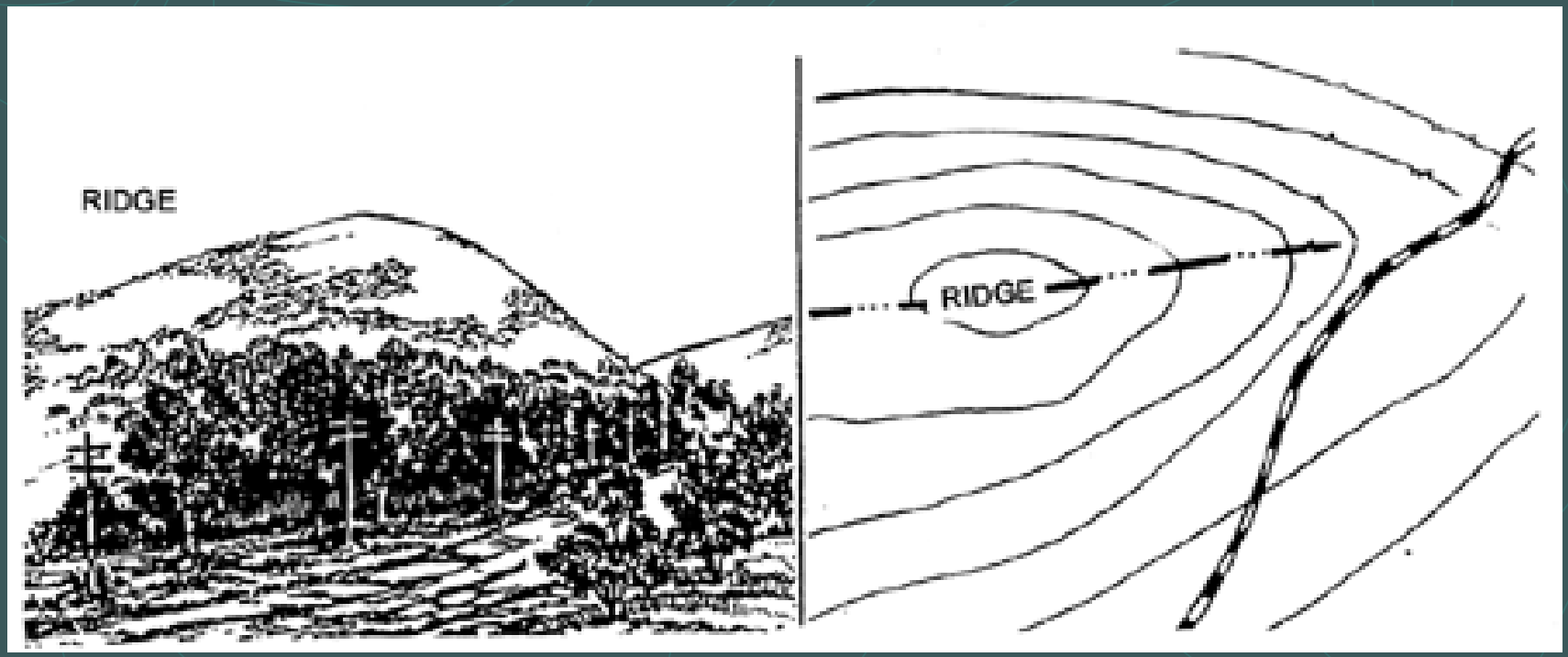
Saddle



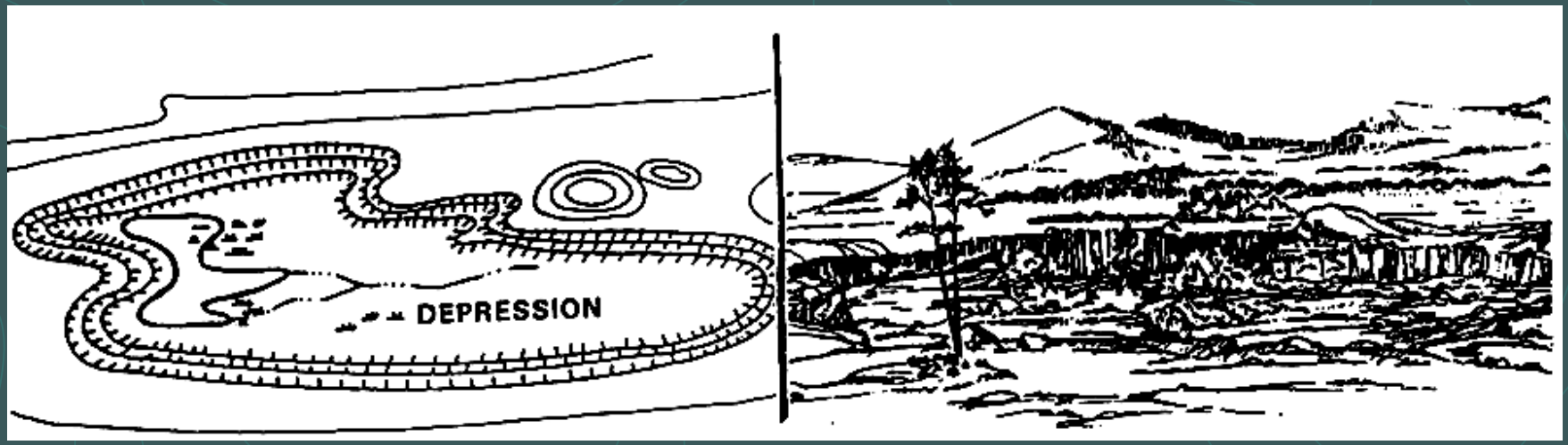
Valley



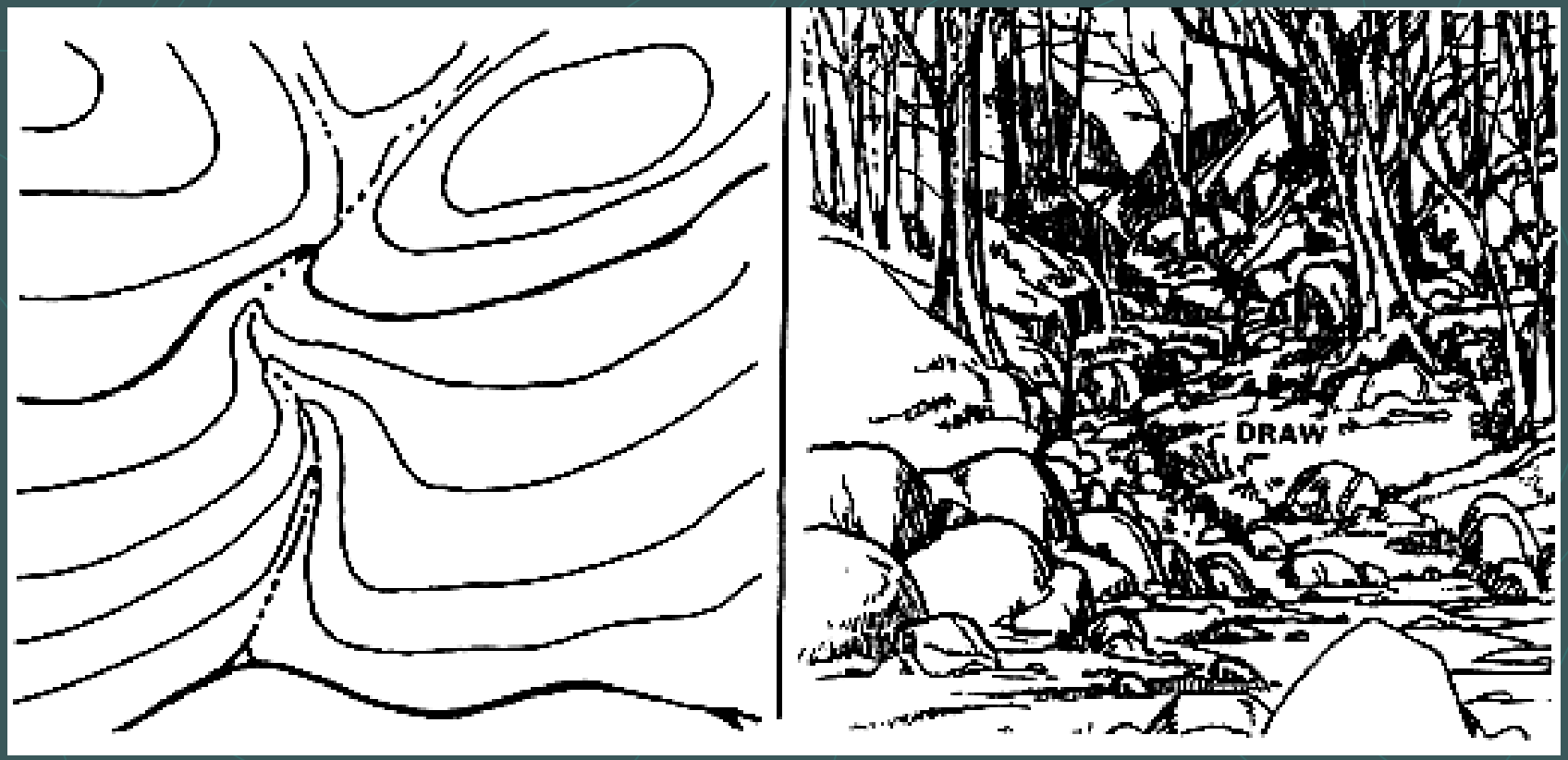
Ridge



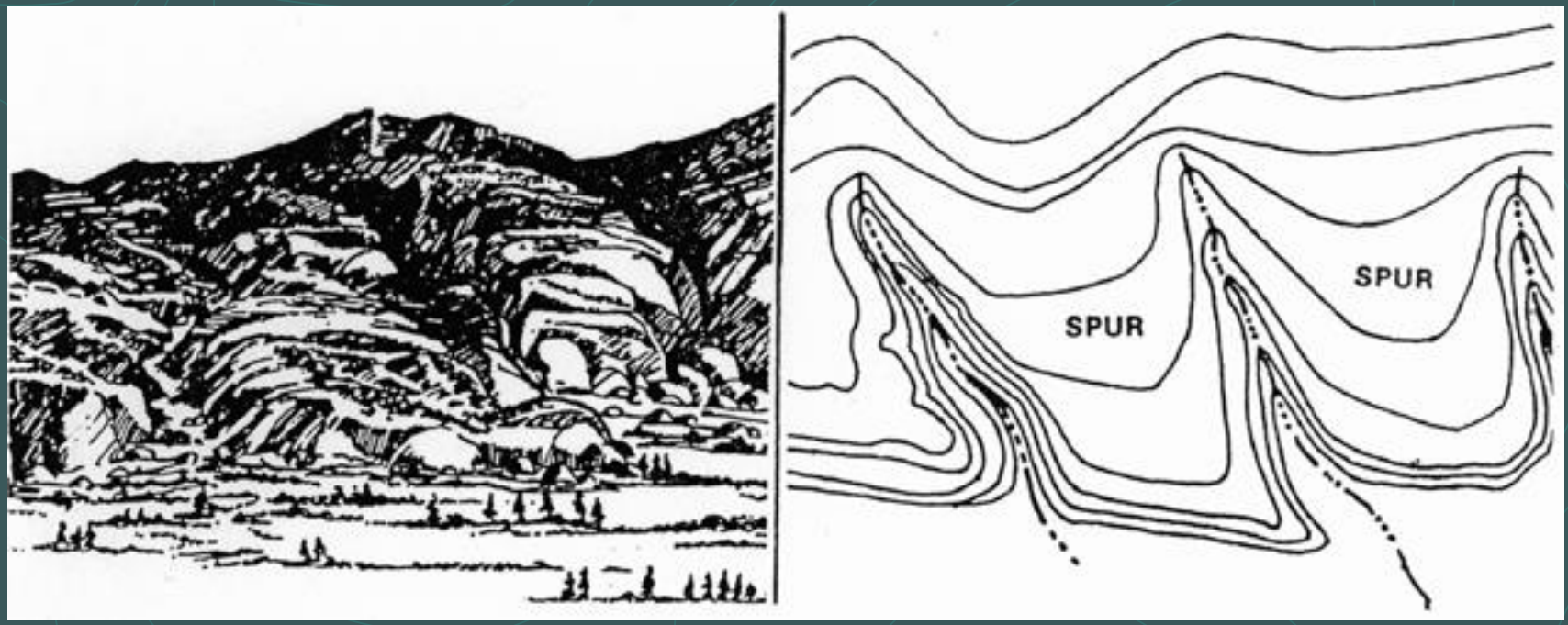
Depression



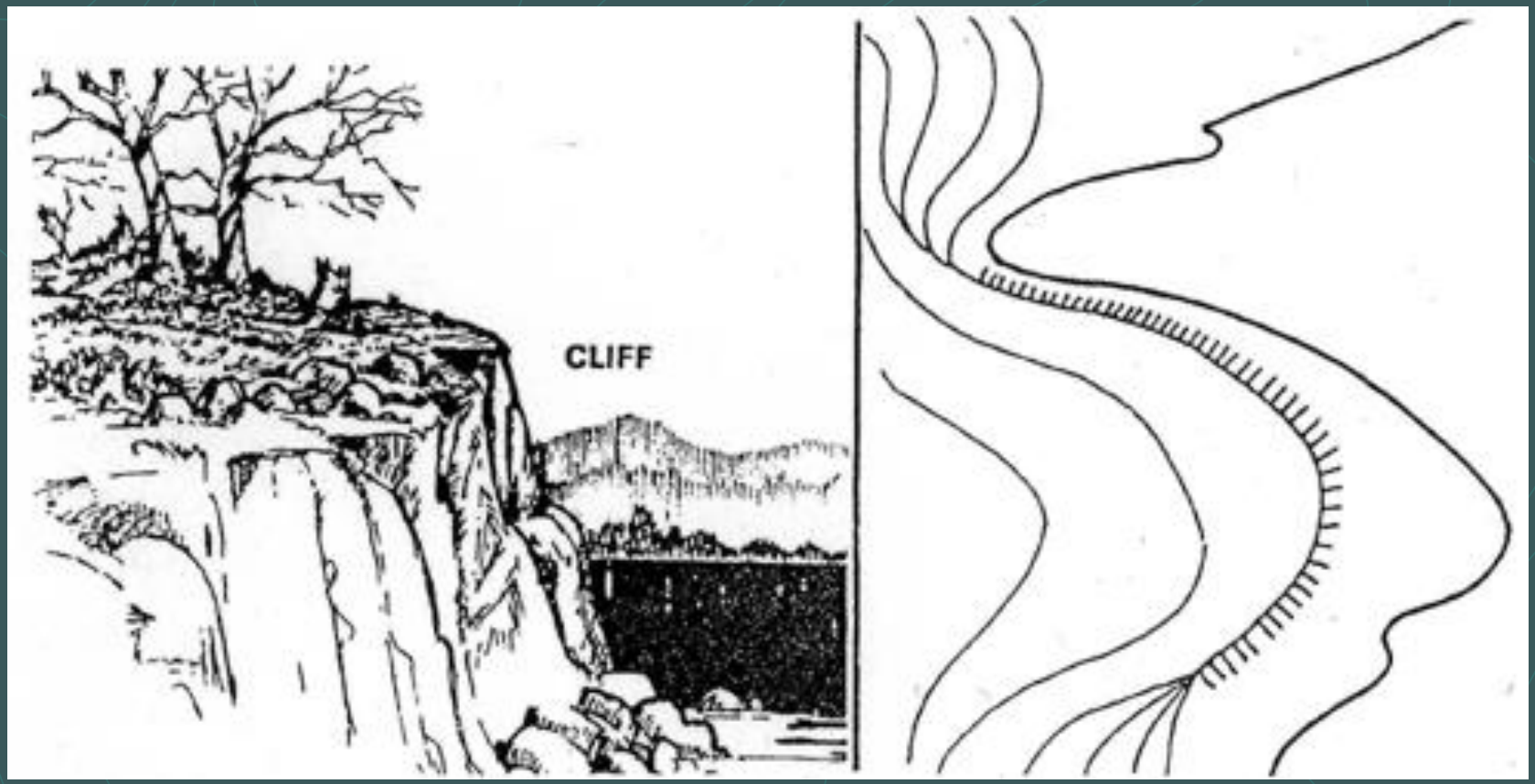
Draw



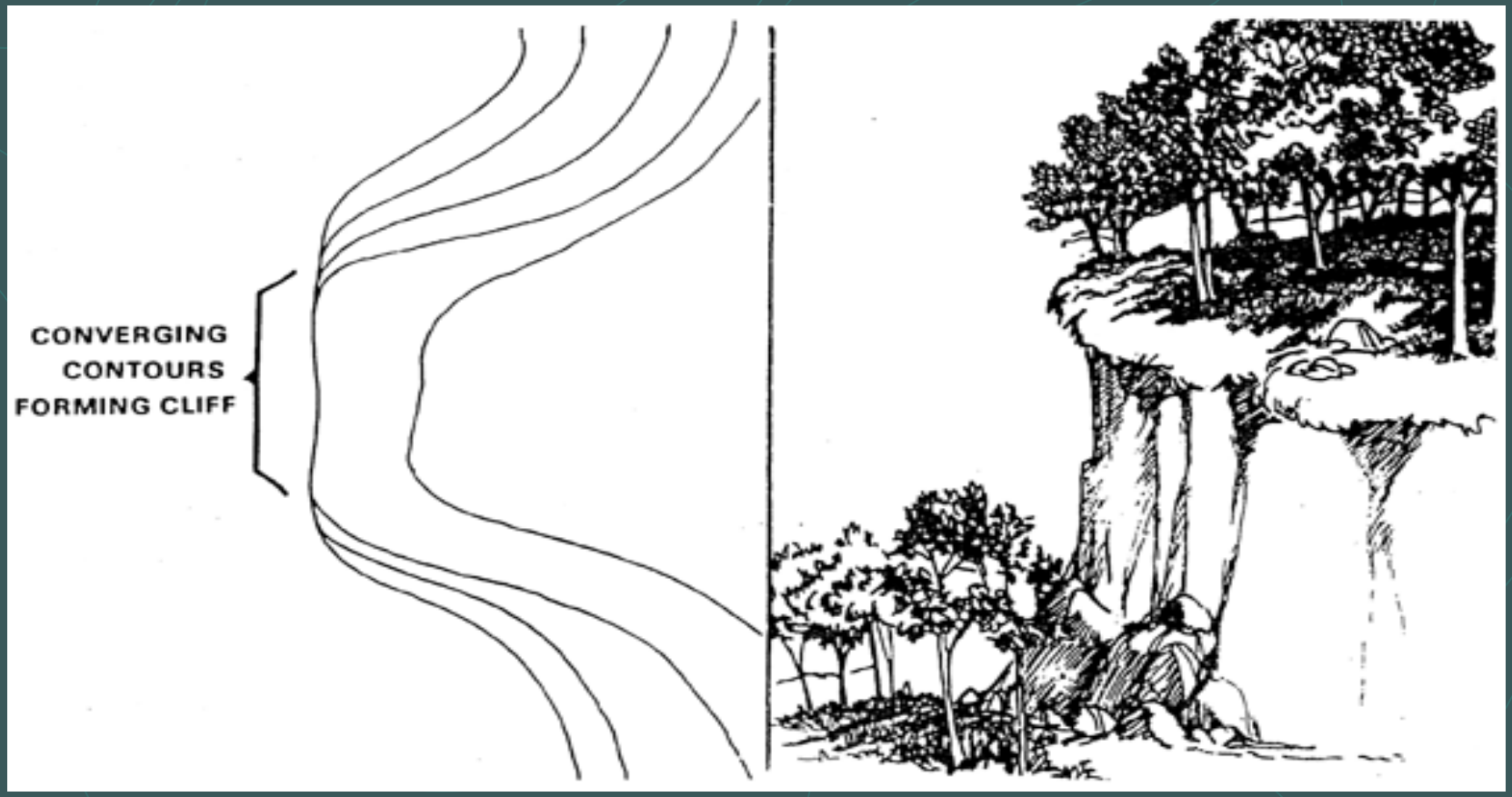
Spur



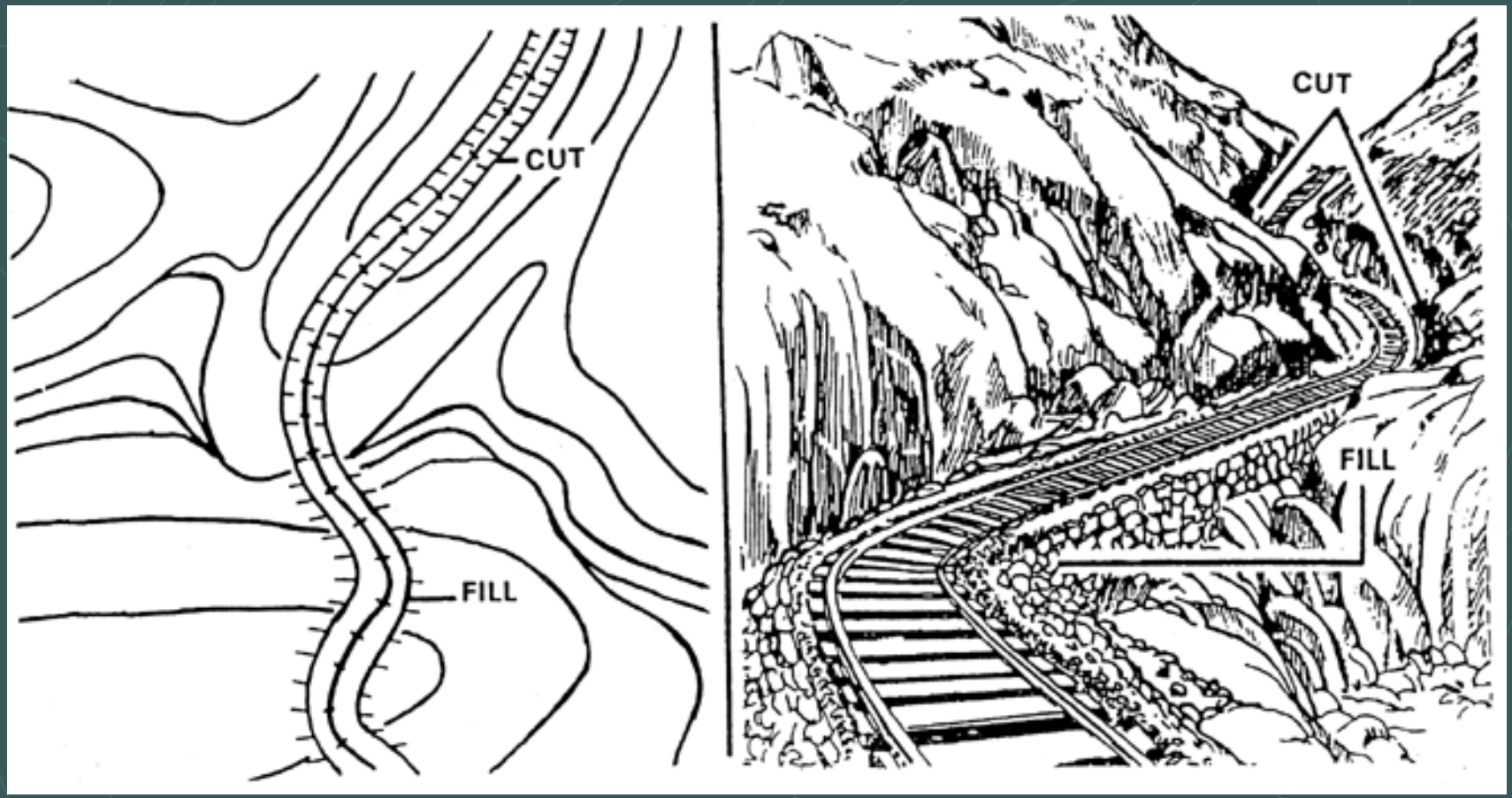
Cliff

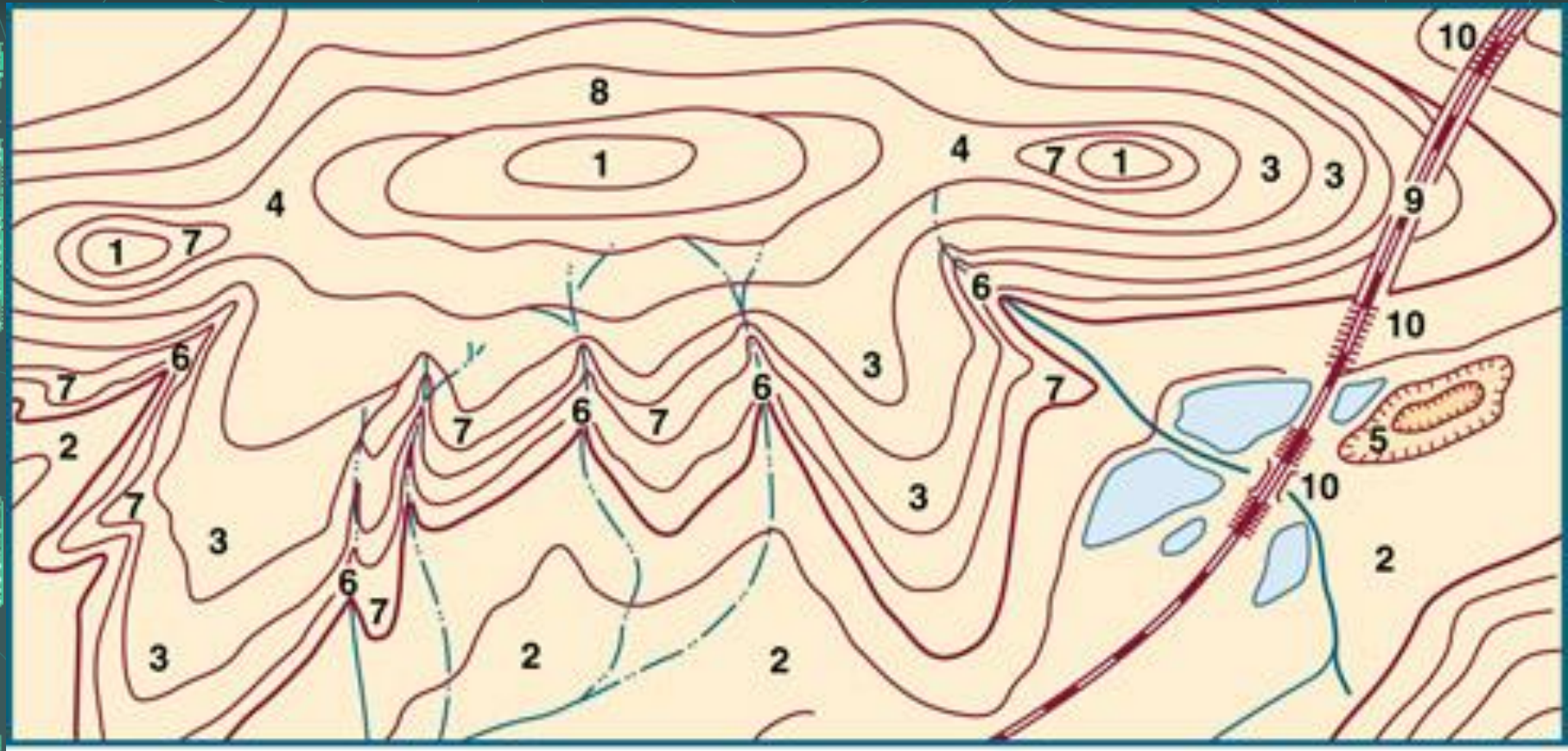


Cliff

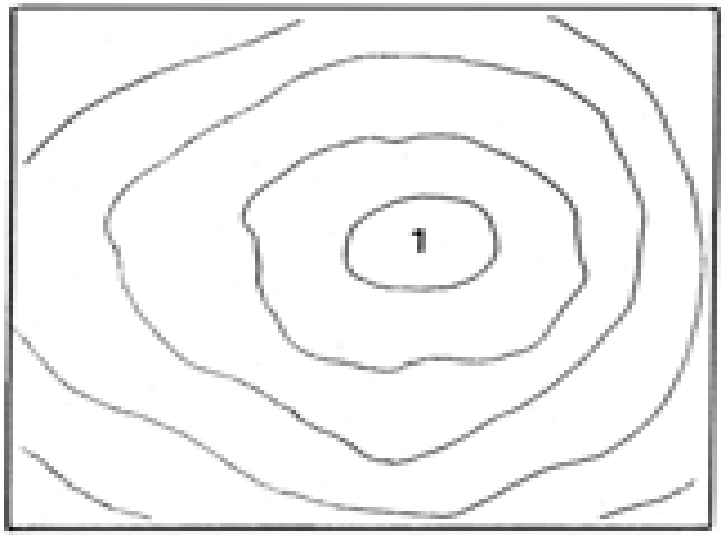


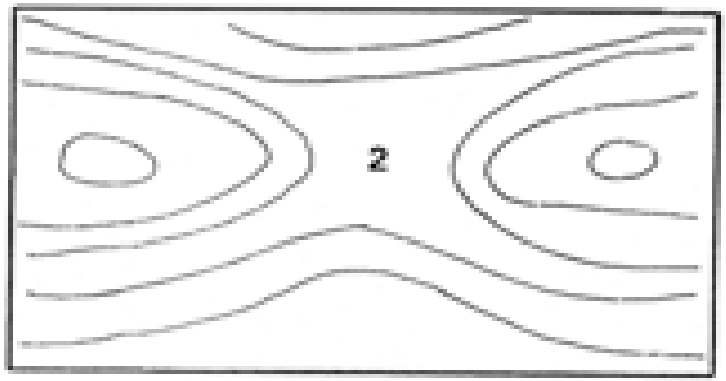
Cut & Fill

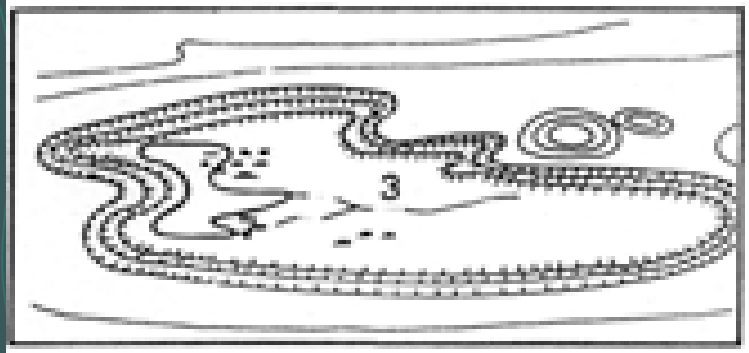


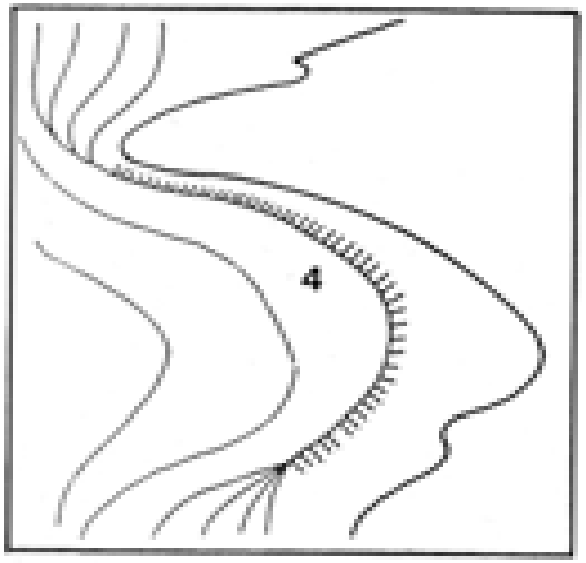


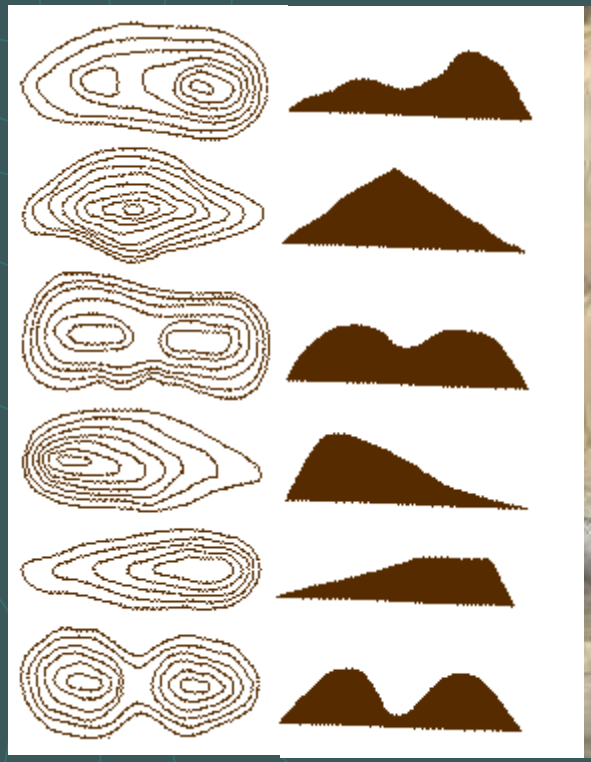
1. Hill
2. Valley
3. Ridge
4. Saddle
5. Depression
6. Draw
7. Spur
8. Cliff
9. Cut
10. Fill

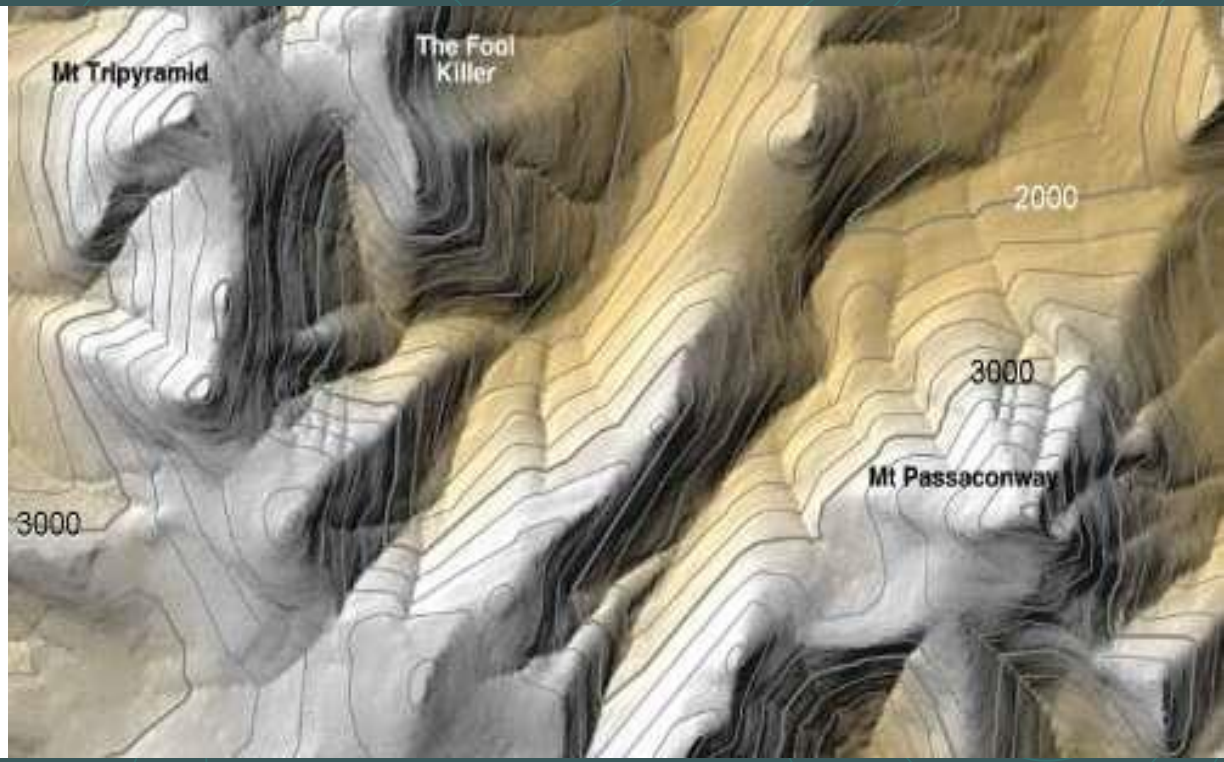

1


2


3


4




Mt Tripyramid
The Fool Killer
2000
3000
Mt Passaconway
3000

Grid Systems

UTM / MGRS
And
The US National Grid
(USNG)

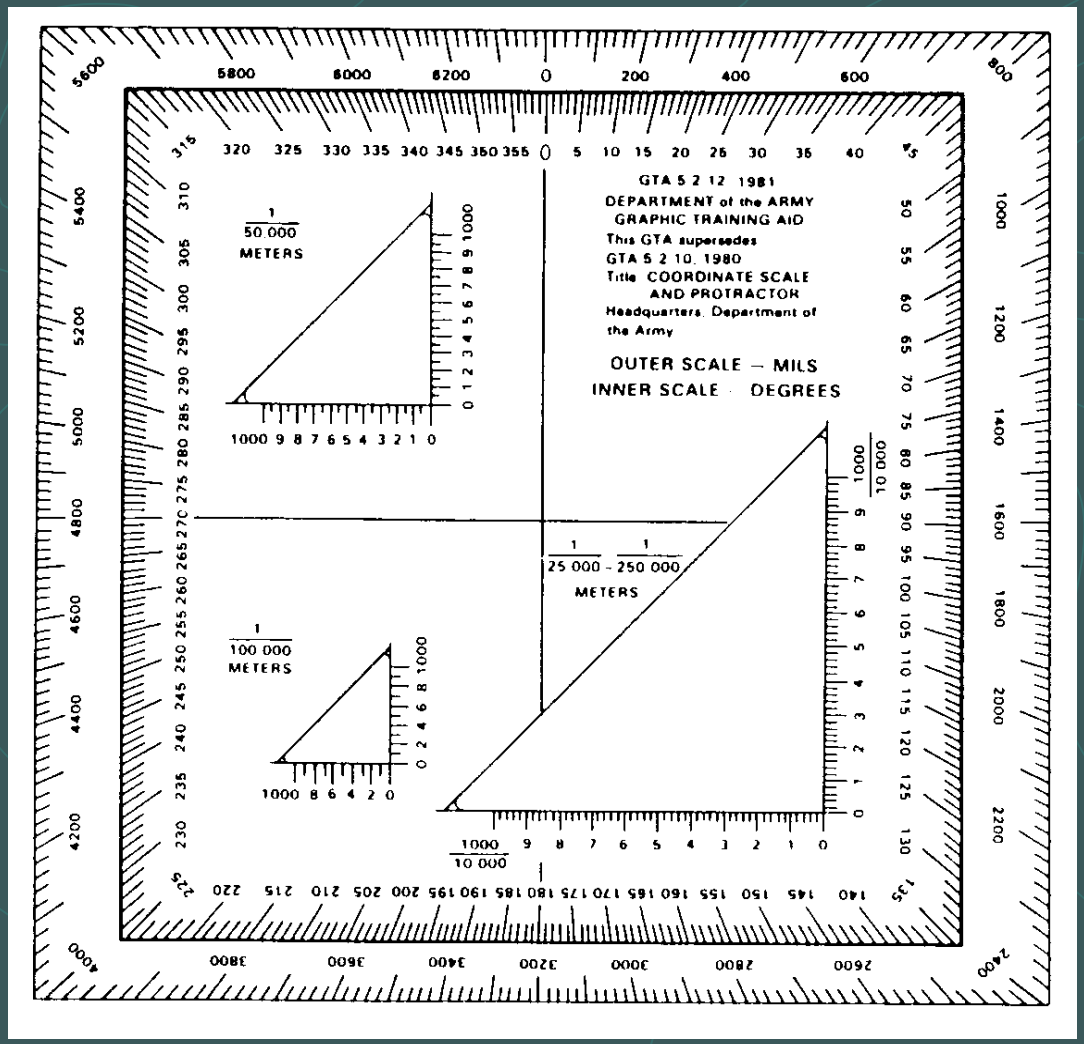
Discuss Grid Systems

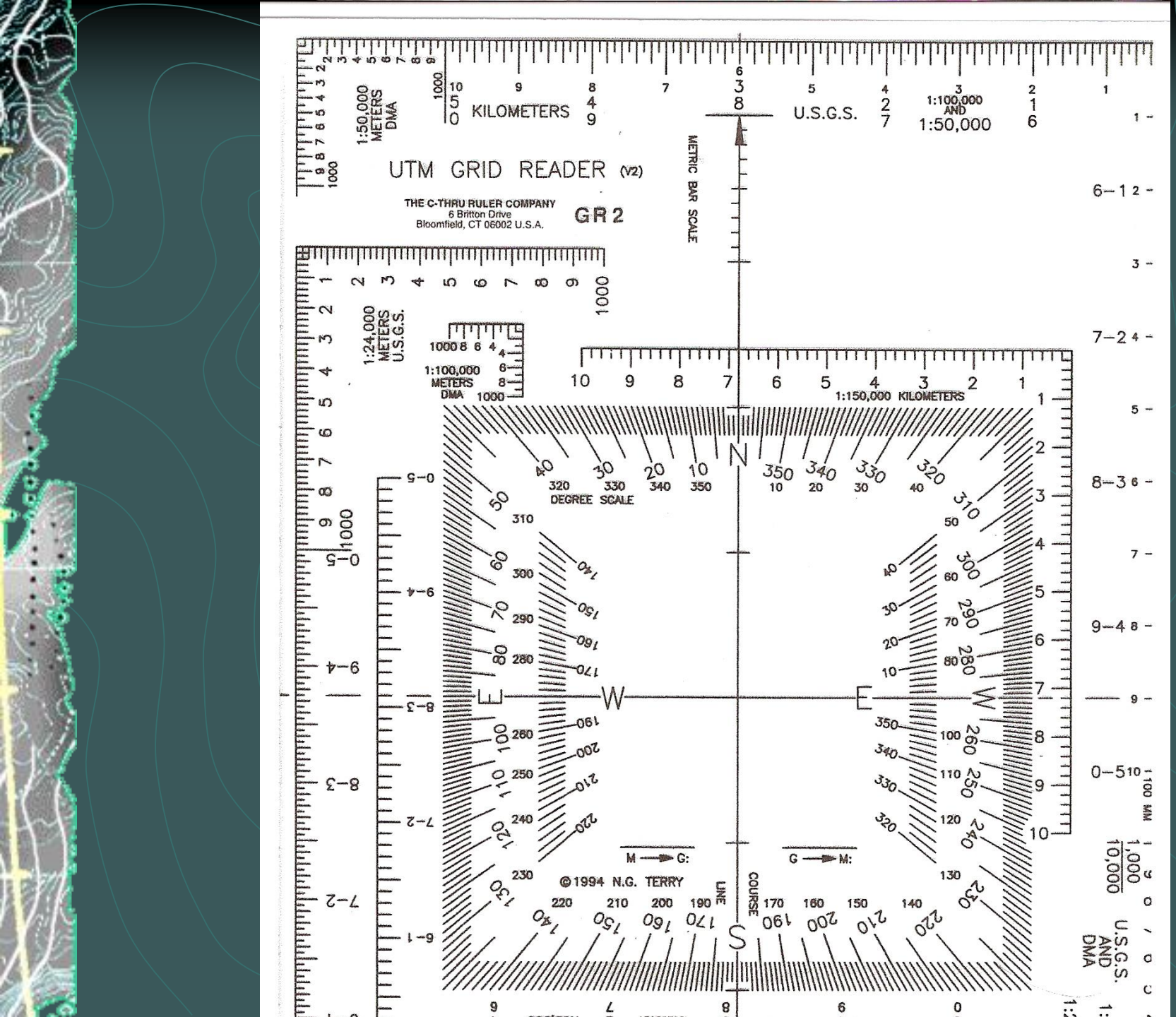
- Goal of unified UNGS.
- Practical Issues of Grid Systems and Actual SAR Missions.
- Older maps with pre-printed Grids with older Datum.
- Search teams and Command MUST be on the same system or nothing is accurate !!

This Exercise

- For this exercise, we're using MGRS with the older NAD27 Datum, in order to utilize pre gridded topo maps.
- For the field team, the principles of plotting MGRS / UTM coordinates is the same for the USNG coordinates.

Protractors

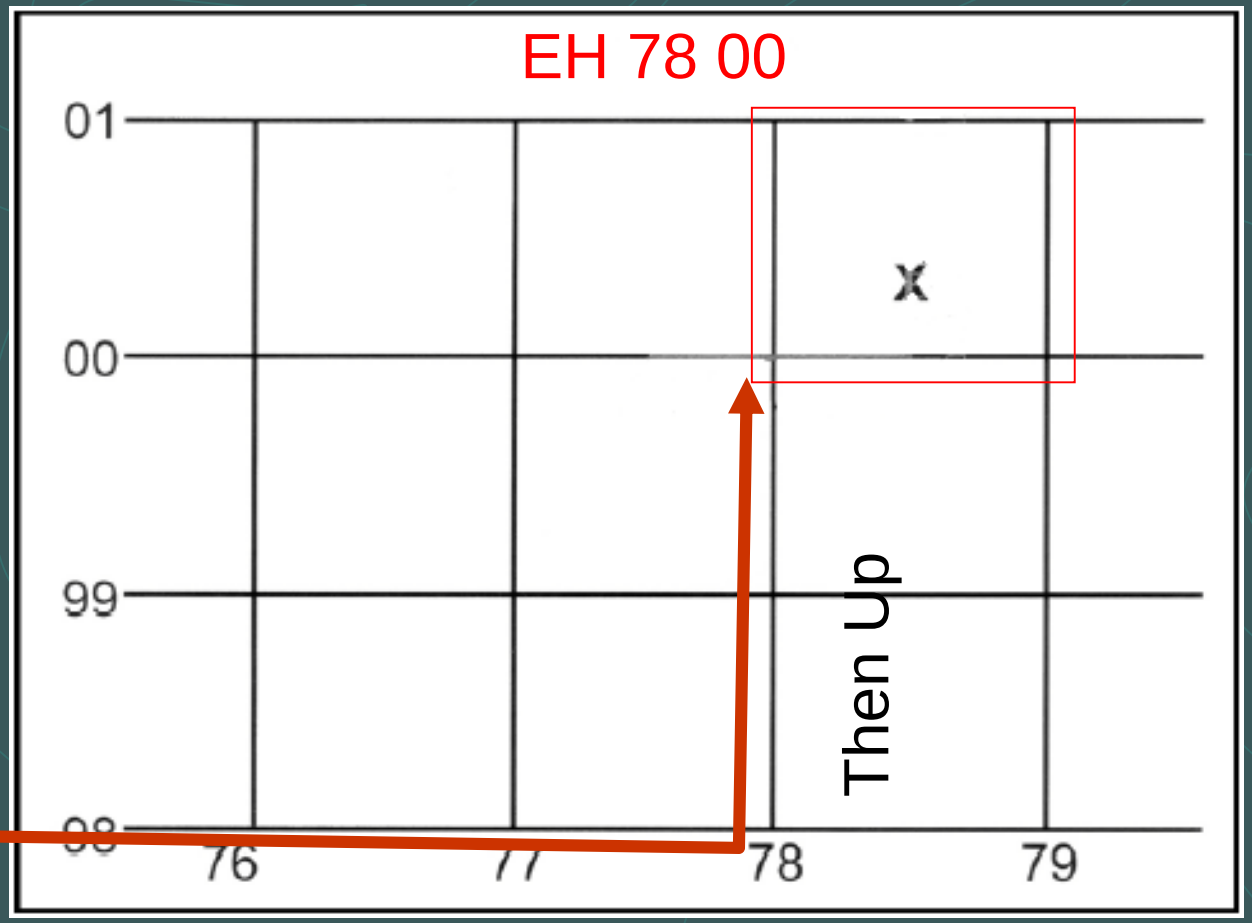


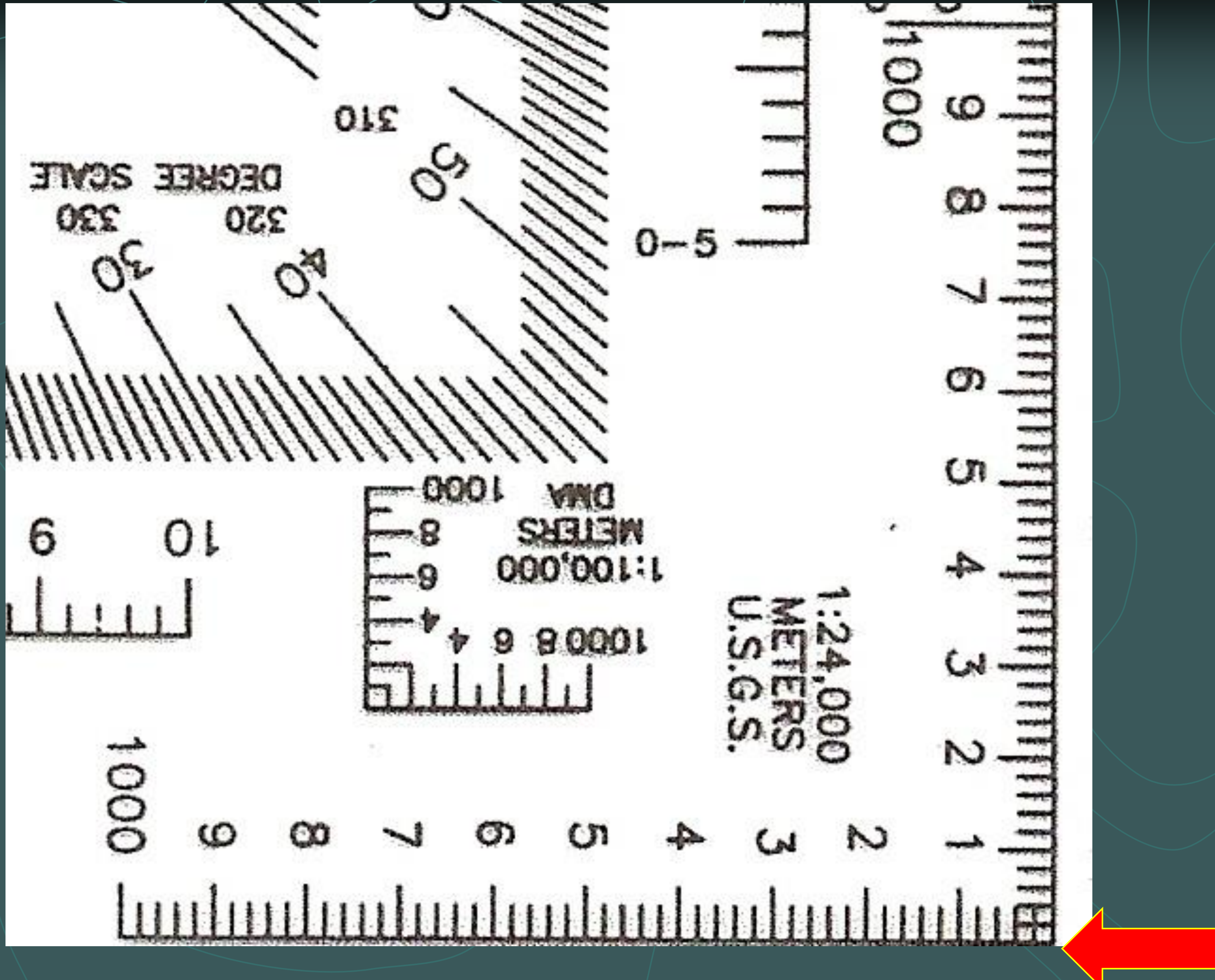

UTM GRID READER (V2)
THE C-THRU RULER COMPANY
6 Britton Drive
Bloomfield, CT 06002 U.S.A.
GR 2
1:50,000 METERS DMA
KILOMETERS
U.S.G.S.
1:100,000 AND 1:50,000
METRIC BAR SCALE
1:24,000 METERS U.S.G.S.
1:100,000 METERS DMA
1:150,000 KILOMETERS
DEGREE SCALE
M → G:
G → M:
©1994 N.G. TERRY
COURSE LINE
1:100 MM
1,000/10,000
U.S.G.S. AND DMA

Determining UTM Grid Coordinates

- Select the correct scale on the protractor.
- Place the horizontal scale on the grid line with the “0 mark” at the lower left-hand corner of the grid square.
- Slide scale right into until the vertical scale intersects the center of your plot point.
- Read right then read up

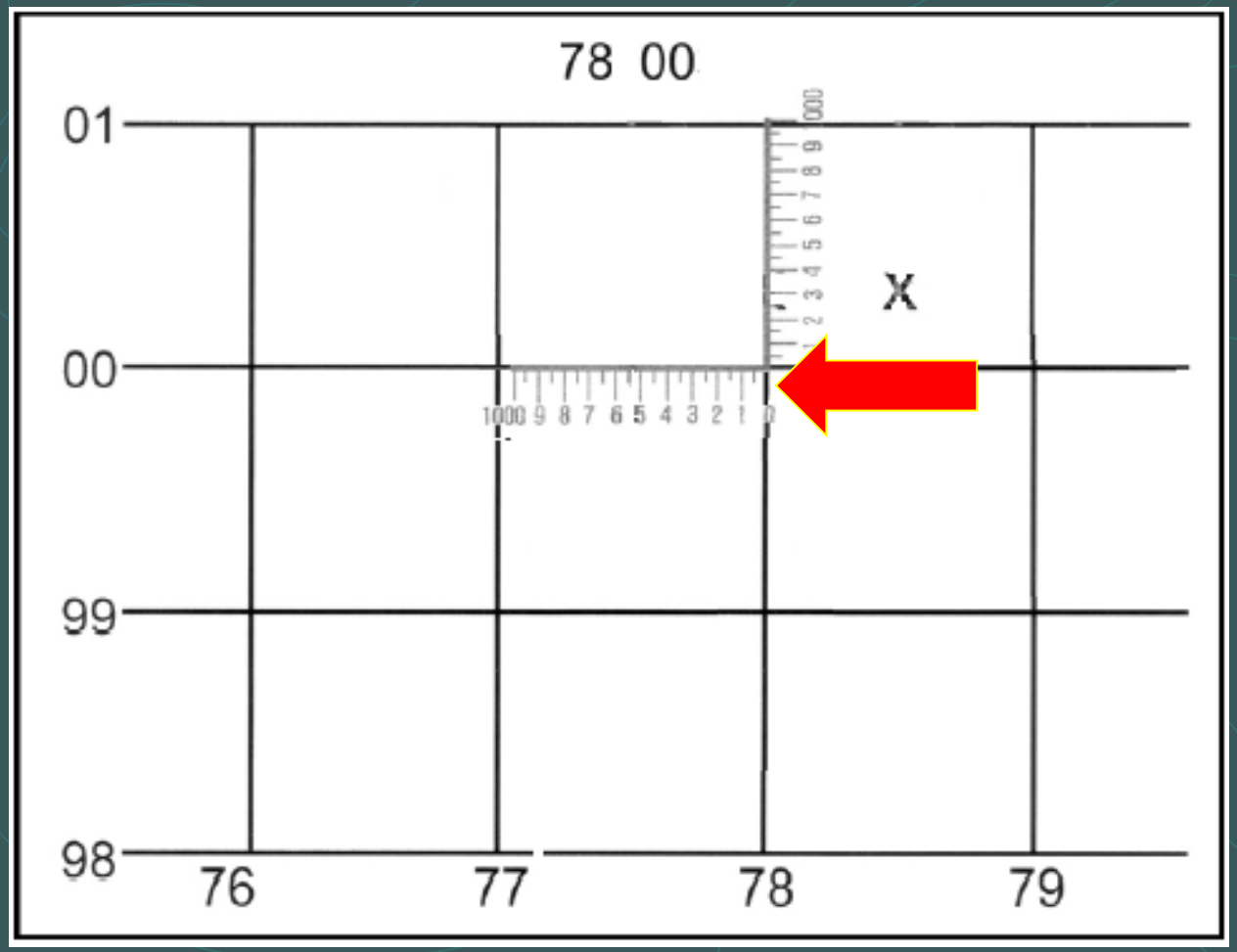
4 Digit Grid Coordinates (1000 Meters)
78 00





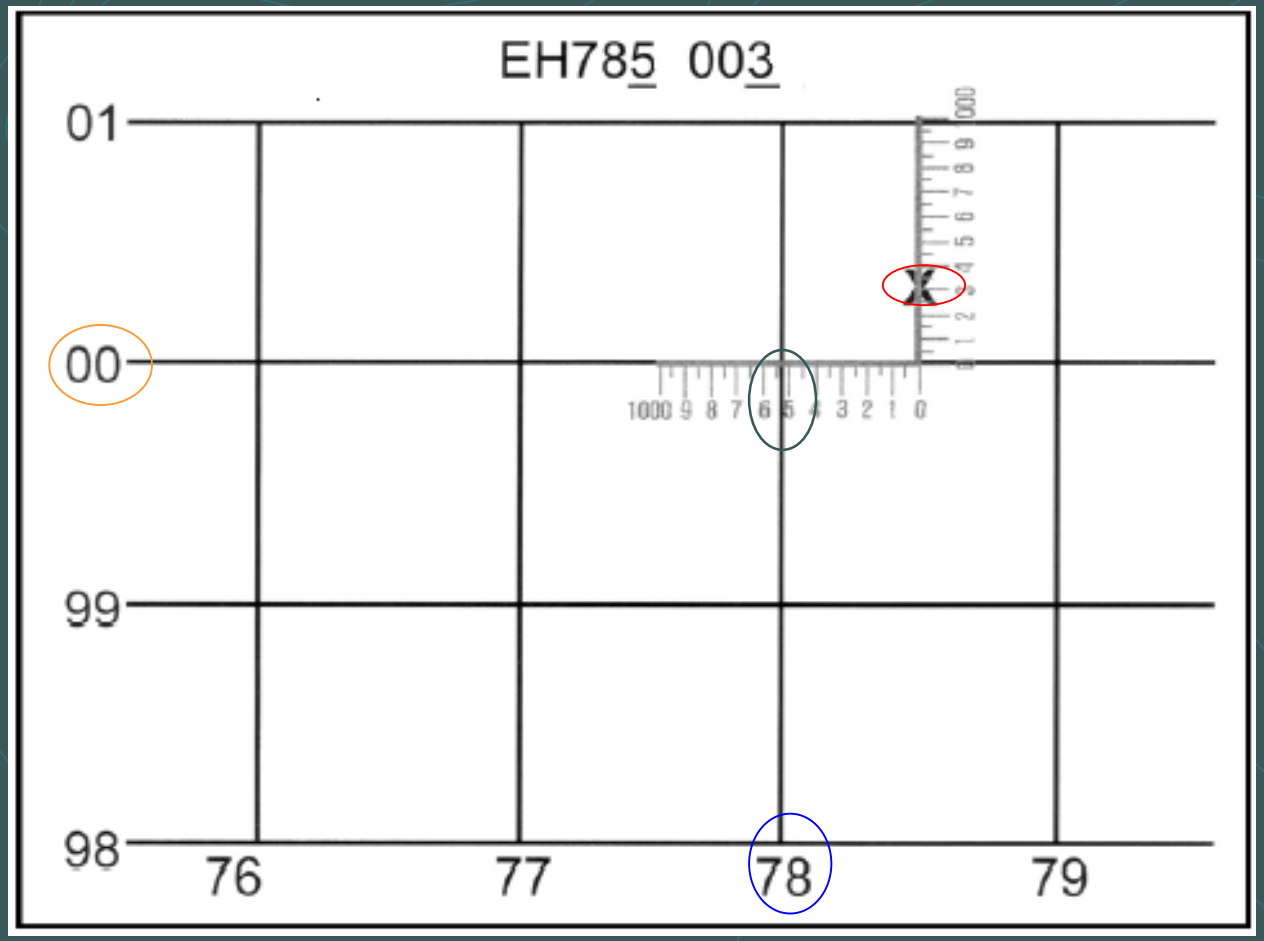
1:24,000
METERS
U.S.G.S.
1:100,000
METERS
DMA
DEGREE SCALE

Zero “0” Mark



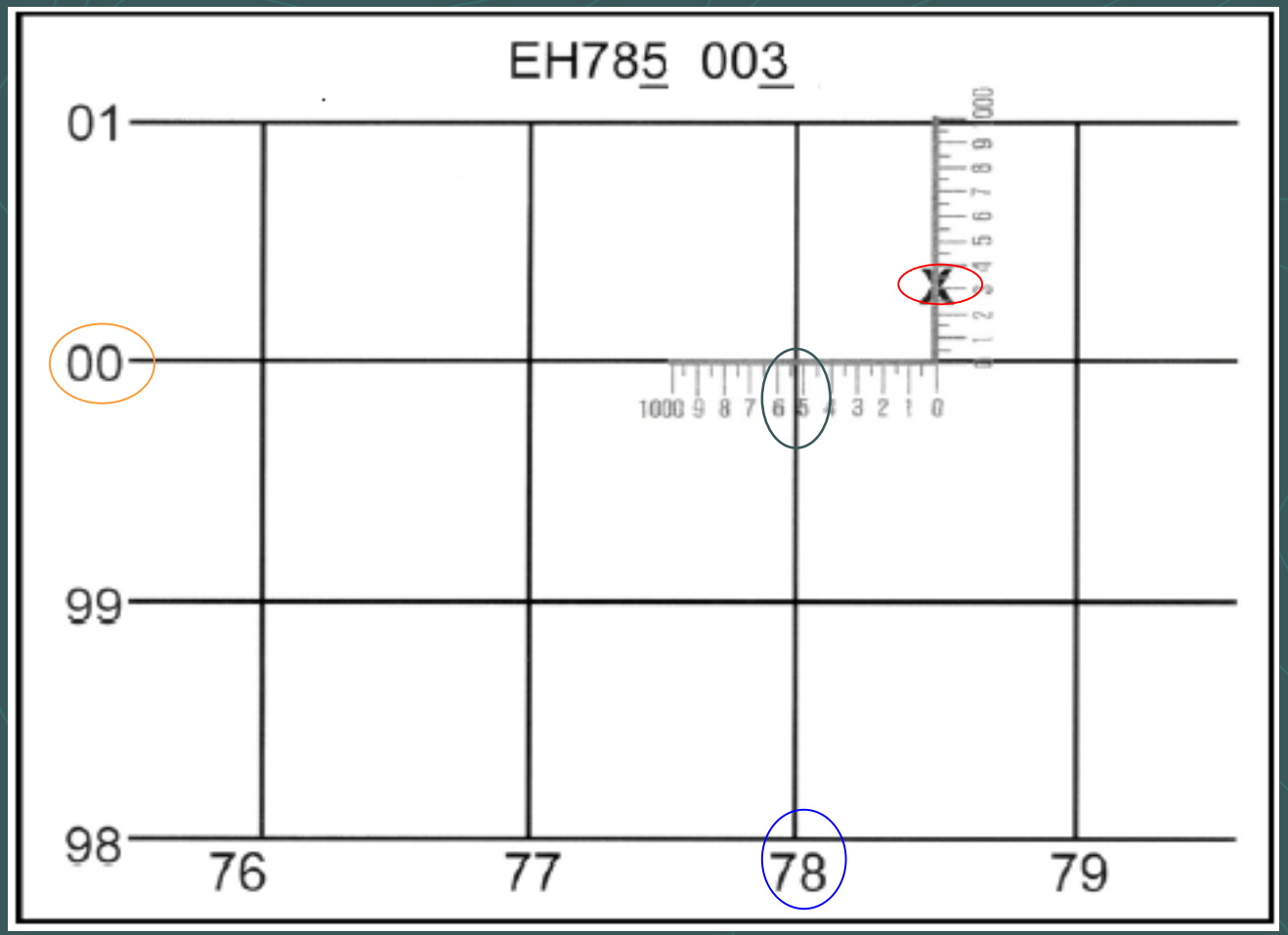
6 Digit Grid Coordinates (100 Meters)

785003

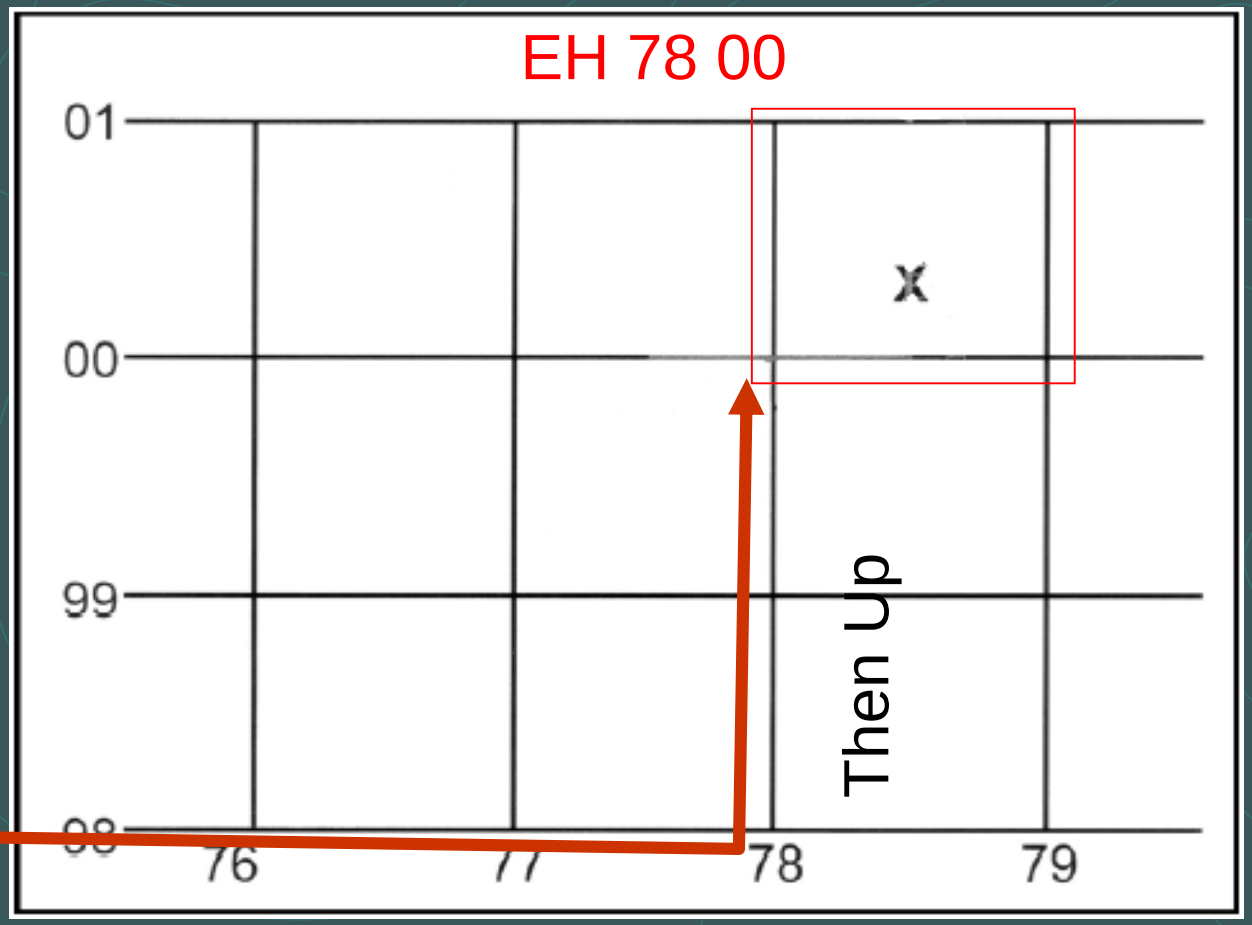


8 Digit Grid Coordinates (10 Meters)

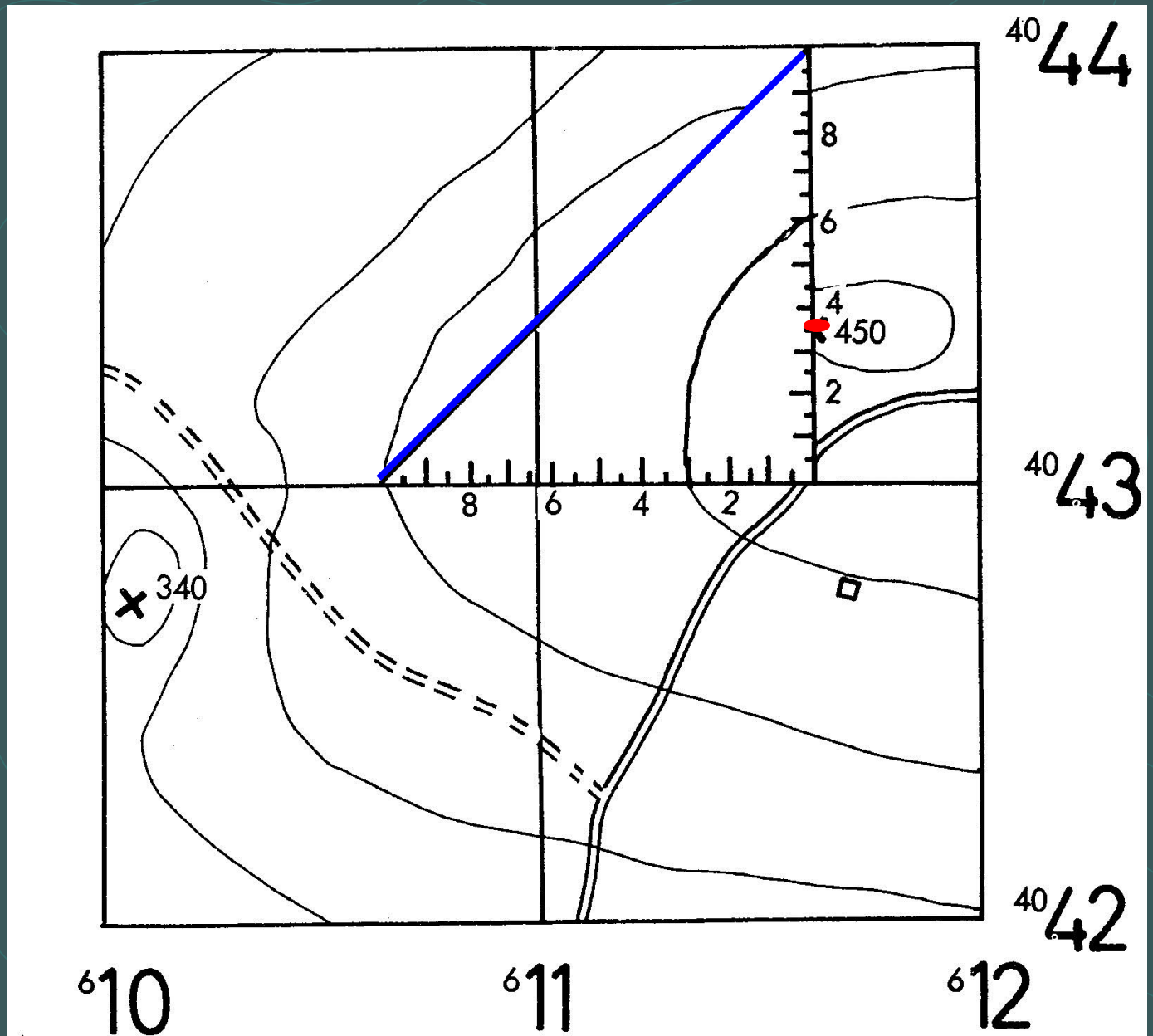
78530032



4 Digit Grid Coordinates (1000 Meters)



What is the 4, 6 and 8 digit UTM?



Distance Measurement

Distance Determination

- Straight Line Distance
- Road / Curved Path Distance

Azimuth Plotting

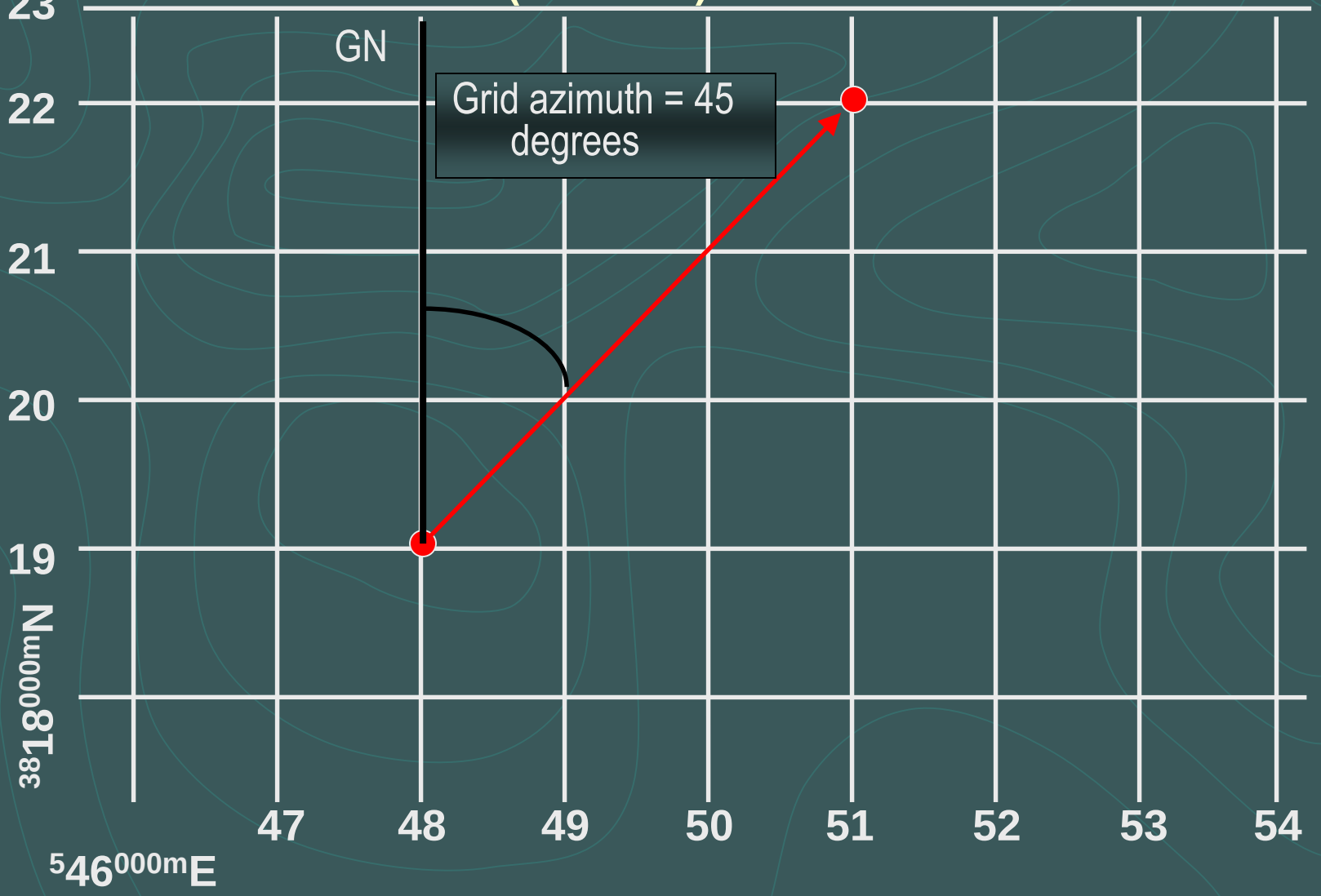
Azimuths

- An azimuth is a direction
- Defined as a horizontal angle measured clockwise from a baseline
- There are two types dealt with
  - magnetic azimuths measured with true north as its base
  - grid azimuths measures with grid north as base

Measuring Azimuths

- Plot two coordinates on the map
- Connect them with a straight line
- Place the index point pf the protractor on the point the azimuth its to be measured from
- Ensure the protractor grid lines are parallel to N-S gridlines on a map
- Where the line crosses the protractor indicates azimuth

Azimuths (cont.)

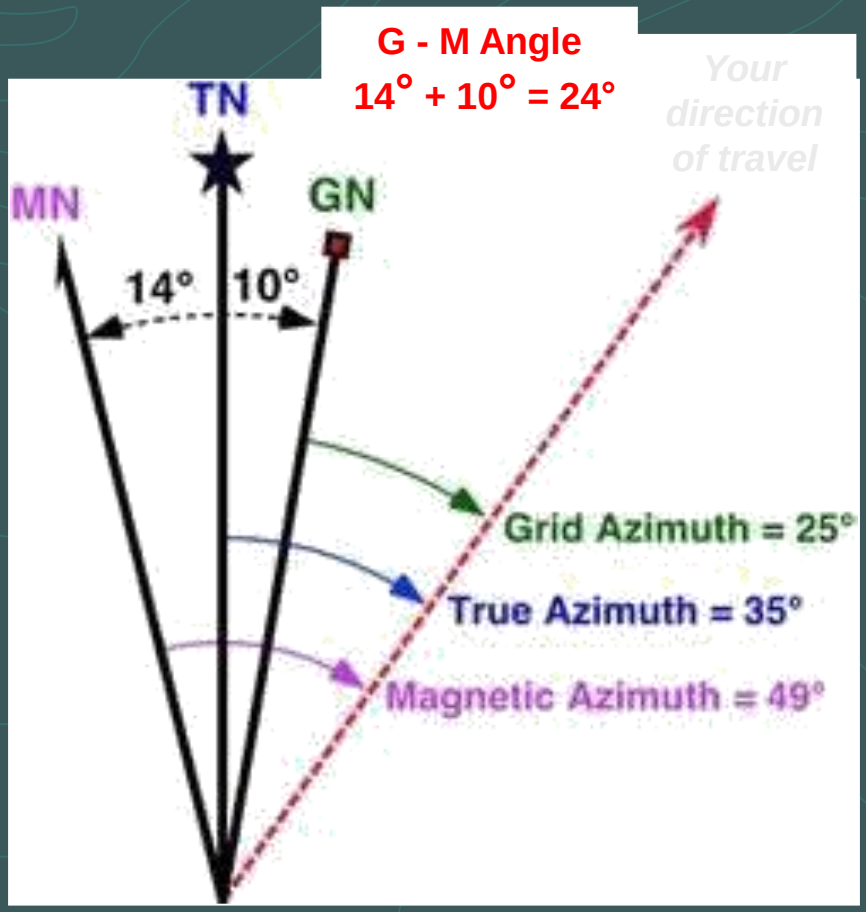


Map Information – Direction

- **True North.** A line from any point on the earth's surface to the north pole. Is represented by a star.
- **Magnetic North**. The direction to the north magnetic pole, as indicated by the north-seeking needle of a magnetic compass. The magnetic north is usually symbolized by a line ending with half of an arrowhead.
- **Grid North.** The north that is established by using the vertical grid lines on the map. Symbolized by the letters GN. Used for UTM grid by military and rescue teams for its accuracy and simplicity.

Map Information – Direction

G-M ANGLE. The angular difference between GN and MN.



Map Information – Direction

Why do we need to know all this?

So that we can navigate using a **map**, the **ground** (we often forget the ground is important) and **compass**.

You cannot follow a GN with a compass; nor can you plot a MN with a protractor. To assist you in making the conversion from MN to GN, and vice versa, a declination diagram is placed on the map margin.

Map Information – Direction

Remember the following.

When using a **map** - use a protractor to measure **GRID** Bearings. Do not use the compass magnetic needle.

(*unless map has MN Lines Drawn on it*)

When using the **ground** – use a **Compass** to Measure **MAGNETIC** Bearings.

With GN and G-M ANGLE you can find the MN.

With MN and G-M ANGLE you can find the GN.

Converting Azimuths

- Use the GM angle to convert grid to magnetic and magnetic to grid
- When going from Grid to Magnetic (our area)
  - LARS (Left Add/ Right Subtract)
- Magnetic to Grid
  - LSRA (Left Subtract/Right Add)

Map Information – Direction

CONVERSION
(example 1)

G - M Angle
14 + 10 = 24°

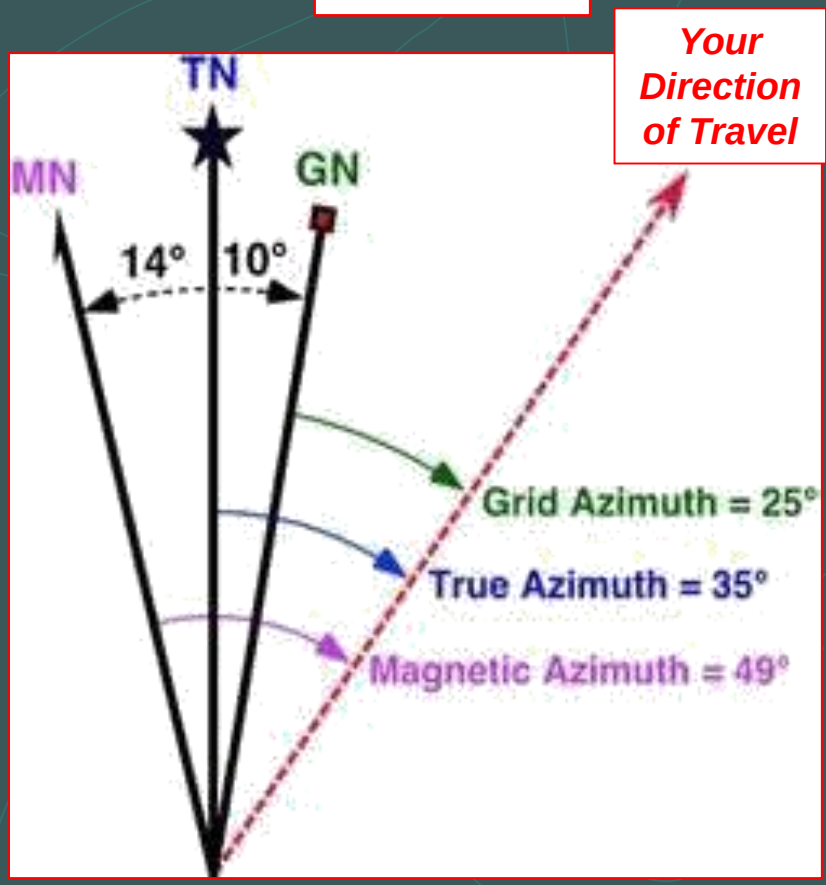
HOW?

*From **map** to **compass (GRID to MAGNETIC)**.*

1. You measure the bearing of a point on the map with a protractor. It is **25°** GN.
2. The G-M ANGLE on the Map is **24°**
3. So GN to MN **ADD** **25°** + **24°** = **49°** MN (Put this on your compass)

*From **compass** to **map** (MAGNETIC TO GRID)*

1. You measure the bearing of a landmark on the ground with a compass. It is **49°** MN.
2. The G-M ANGLE on the Map is **24°**
3. So MN to GN **SUBTRACT** **49°** - **24°** = **25°** GN (Draw this on your map)



Map Information – Direction

PROTRACTOR (with a protractor the map does NOT have to be oriented)

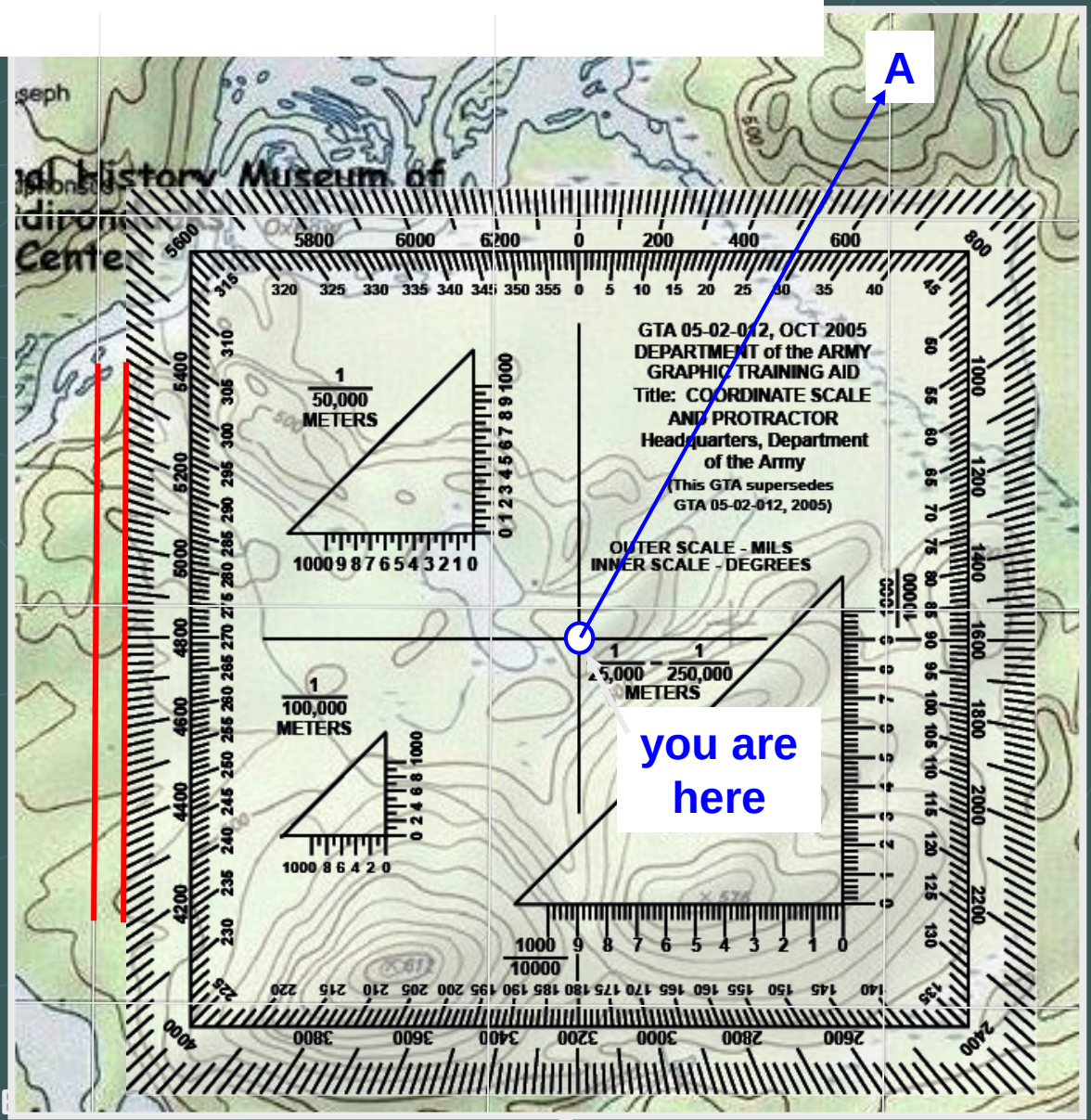
From **map** to **compass**.

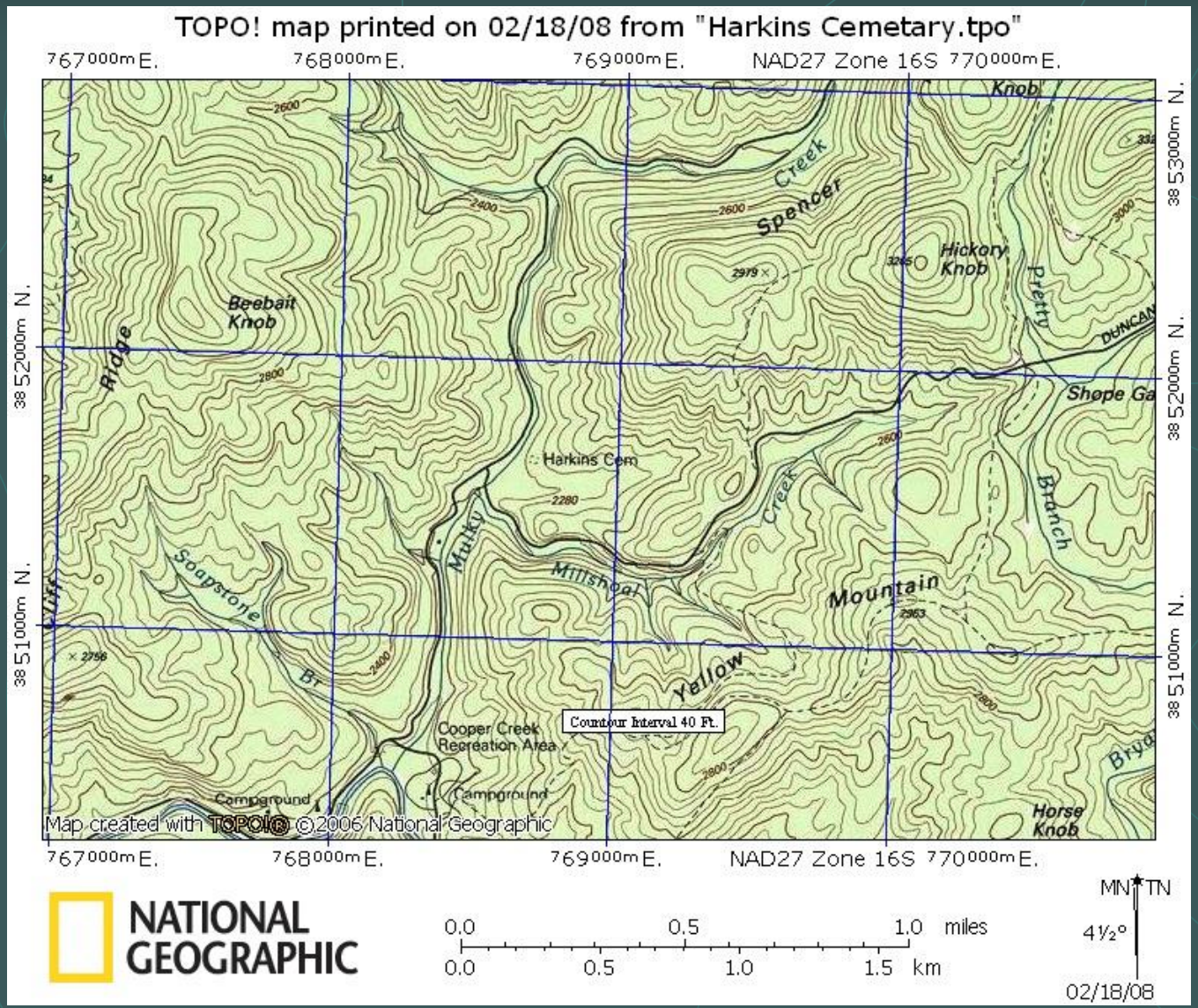
1. You are in thick woods and cannot see any landmarks. But you decide to go to a hill (**A**) on the map.

2. With protractor aligned with GRID LINES drawn on the map and the center of the protractor aligned on your map position (**you are here**).

3. You see that the azimuth is **29°**

4. Convert this to MN azimuth and put this on your compass.




TOPO! map printed on 02/18/08 from "Harkins Cemetary.tpo"
767000m E.
768000m E.
769000m E.
NAD27 Zone 16S
770000m E.
38 53000m N.
38 52000m N.
38 51000m N.
Knob
Creek
Spencer
Hickory Knob
Pretty
DUNCAN
Beebait Knob
Ridge
Shope Ga
Harkins Cem
Muddy
Creek
Branch
Millshoal
Mountain
Soapstone
Yellow
Br
Contour Interval 40 Ft.
Cooper Creek Recreation Area
Campground
Campground
Horse Knob
Map created with TOPO!® ©2006 National Geographic
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
MN TN
4½°
02/18/08

Advanced Techniques

Attack Points

- A clear, obvious point near the objective that you can use as a base for attacking (final leg of your navigation) it.
- Look for something clear, like a trail intersection or obvious terrain feature, not too far away.

Handrails

- When possible try to make use of easy-to-follow linear features, such as trails, creeks, fences, or stone walls.

Catching Feature

- You can use a large, easy-to-find feature beyond your target (“a catching point”) or on the way to your target (“a collecting point”) to help plan.

Aiming Off

- You probably will drift off your bearing, particularly in open woods. A nice trick is to just accept this, look for a nice catching feature to one side of the target, and DELIBERTELY AIM OFF, so you hit that feature and then know which direction to turn for the final attack point to the target.

Your Teams Mission

- Your located at UTM 67455212 (Point #1).
- What is the name of this location?
- What type of terrain feature is this?
- What is the elevation at this point?
- Your next point to recon is …..

UTM 68755322 (Pt 2)

- Describe this location?
- What is the map bearing from Pt 1 to Pt 2?
- What is the Magnetic Azimuth from Pt 1 to Pt 2?
- What is the distance from this point to the nearest hill top?
- How many creeks do you cross between Pt 1 and Pt 2?
- Your next point to recon is …..

UTM 69925466 (Pt 3)

- Describe this location?
- You take a magnetic bearing to the nearest hill West of your location. That bearing is 264 Deg. You decide to plot a bearing from your location to this hill. What is the bearing you will plot on the map?
- What is the map bearing from Pt 3 to Pt 2?
- Your next point to recon is …..

UTM 70325394 (Pt 4)

- This point represents a campsite along a dirt road. Between the road and a creek.
- Your next point to recon is …..

UTM 70575382 (Pt 5)

- Describe the terrain that this point is located on?
- What is the distance from Pt 4 to Pt 5?
- What is the elevation change from Pt 4 to Pt 5?
- Are you going up or down as you go from Pt 4 to Pt 5?
- Your next point to recon is …..

UTM 71195254 (Pt 6)

- Describe this point?
- You see a large hill at magnetic azimuth of 267 Deg. What is the name of this hill?
- Your next point to recon is …..

UTM 70615228 (Pt 7)

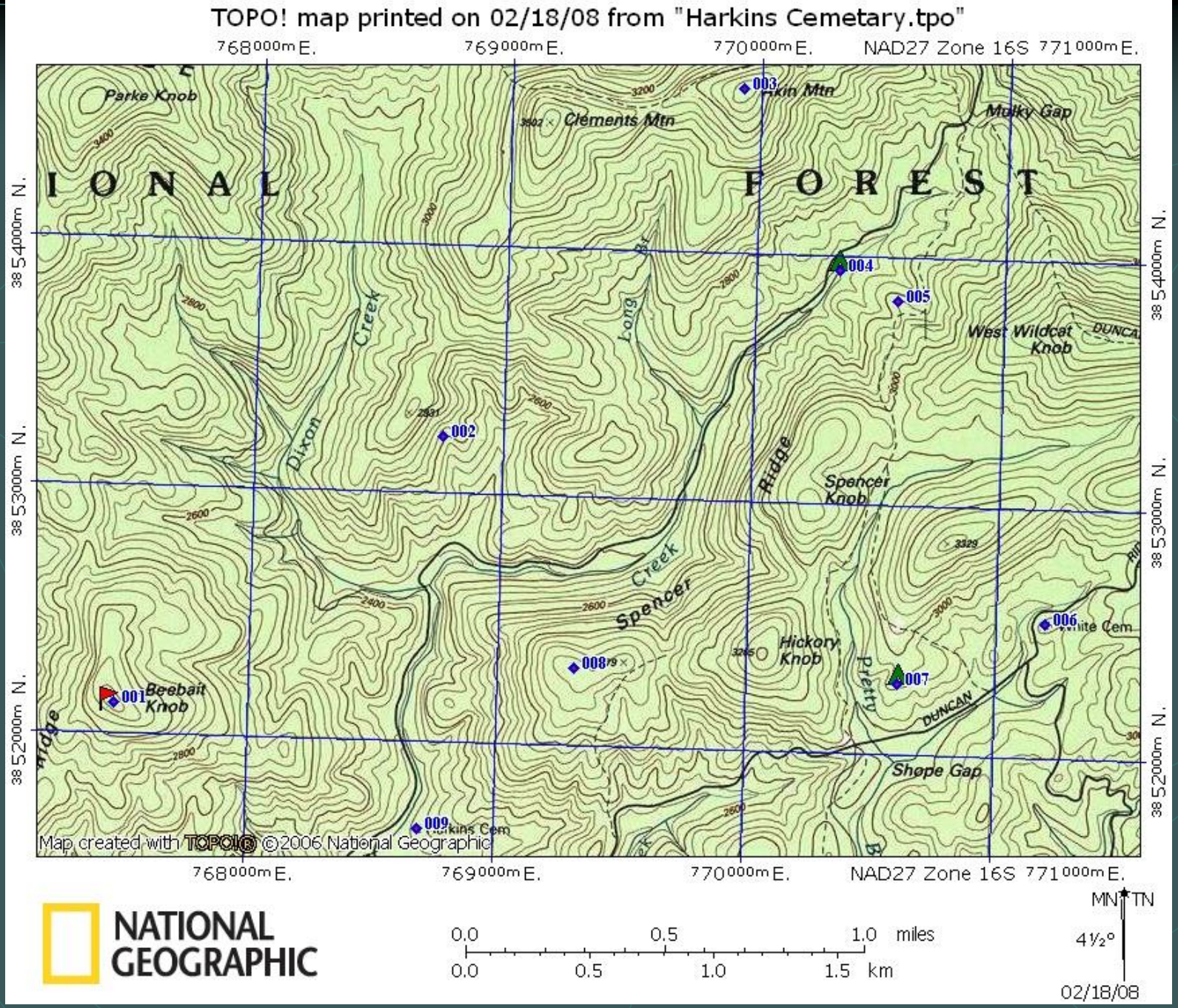
- Point 7 represents another remote campsite.
- How many meters to the nearest creek?
- What is the elevation of this campsite?
- Your next point to recon is …..

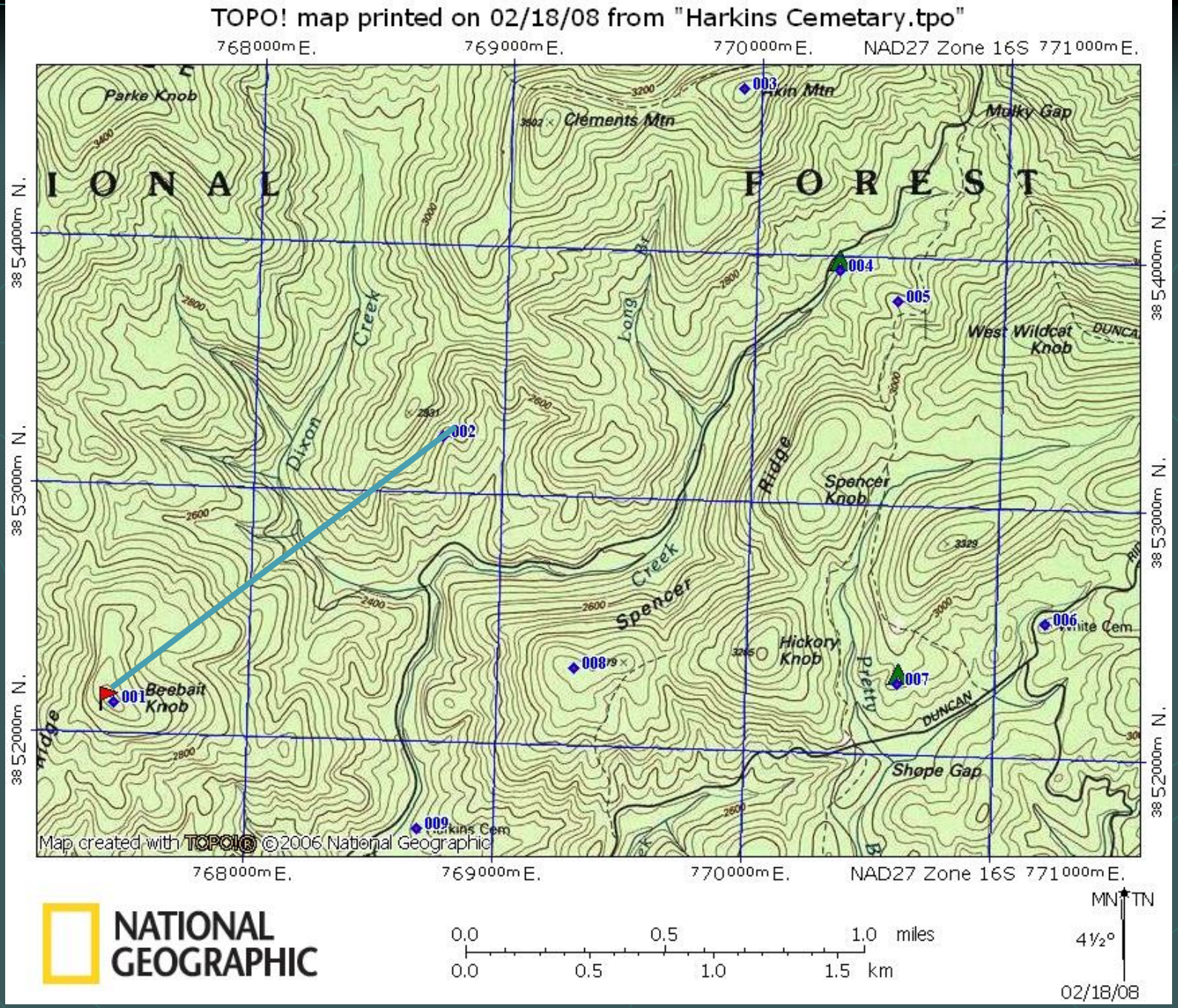
UTM 69305230 (Pt 8)

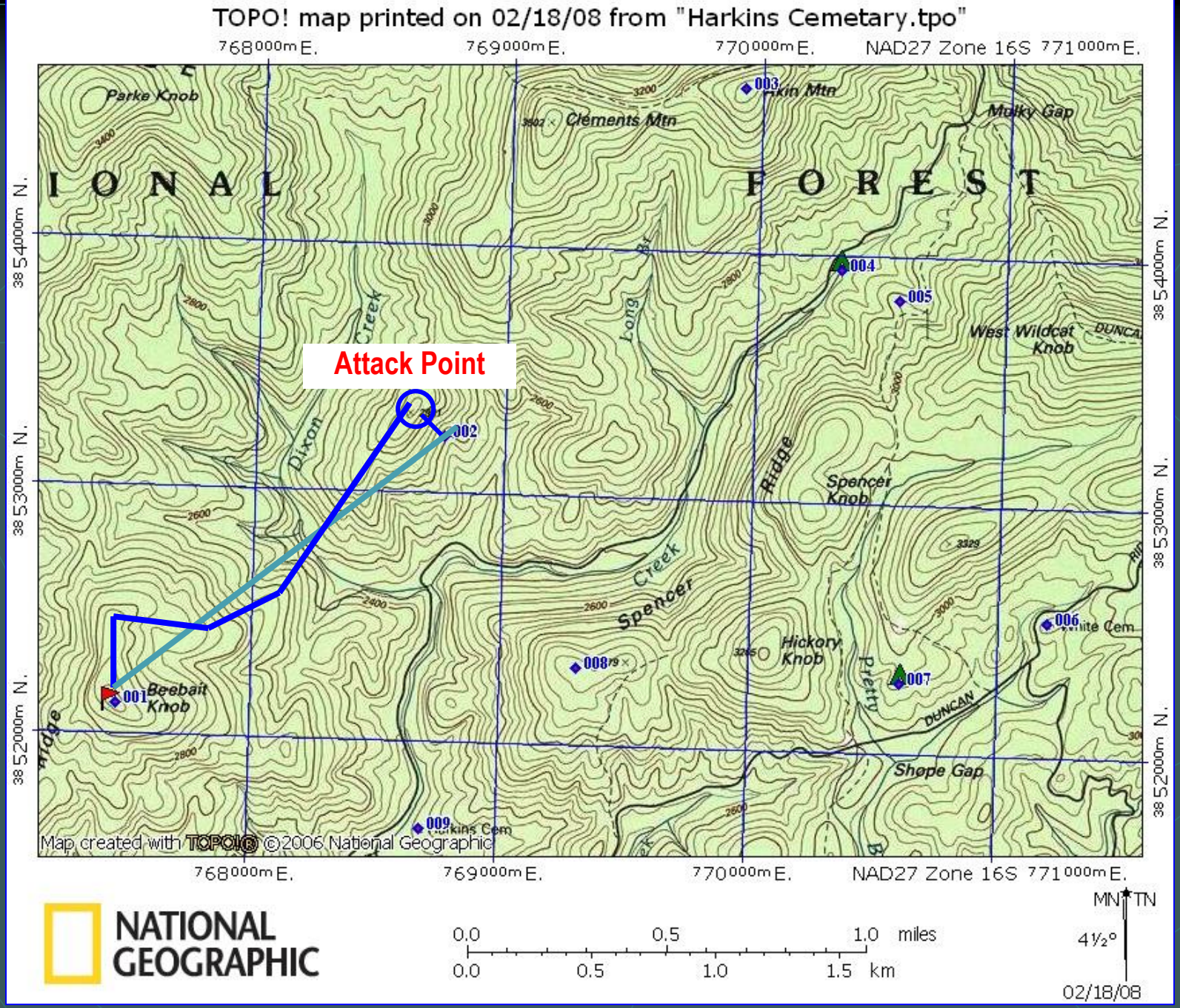
- What kind of terrain feature is this?
- What is the grid azimuth from Pt 7 to Pt8?
- Describe the trip if you follow this azimuth?
- Your last point to recon is …..

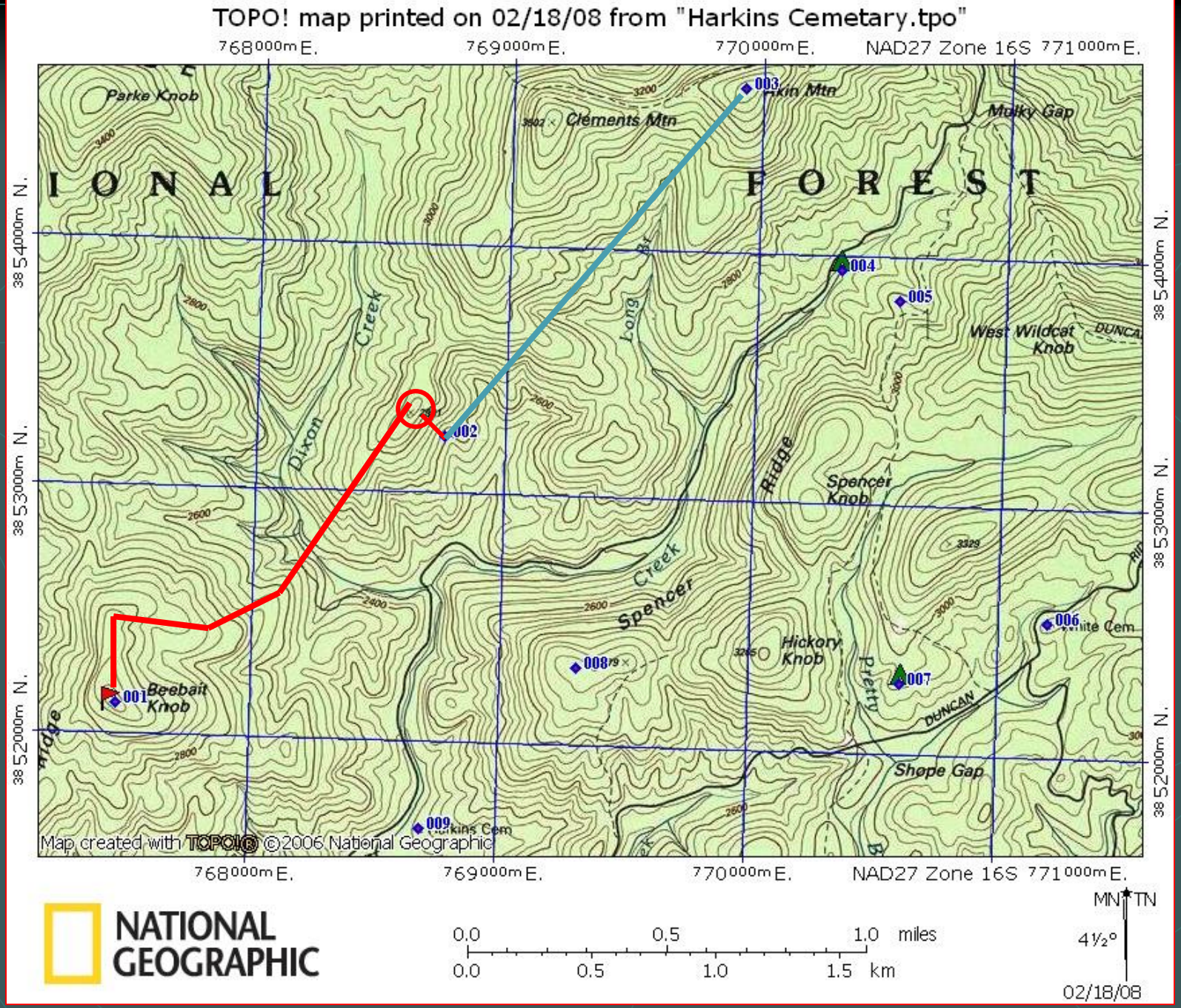
UTM 68695164 (Pt 9)

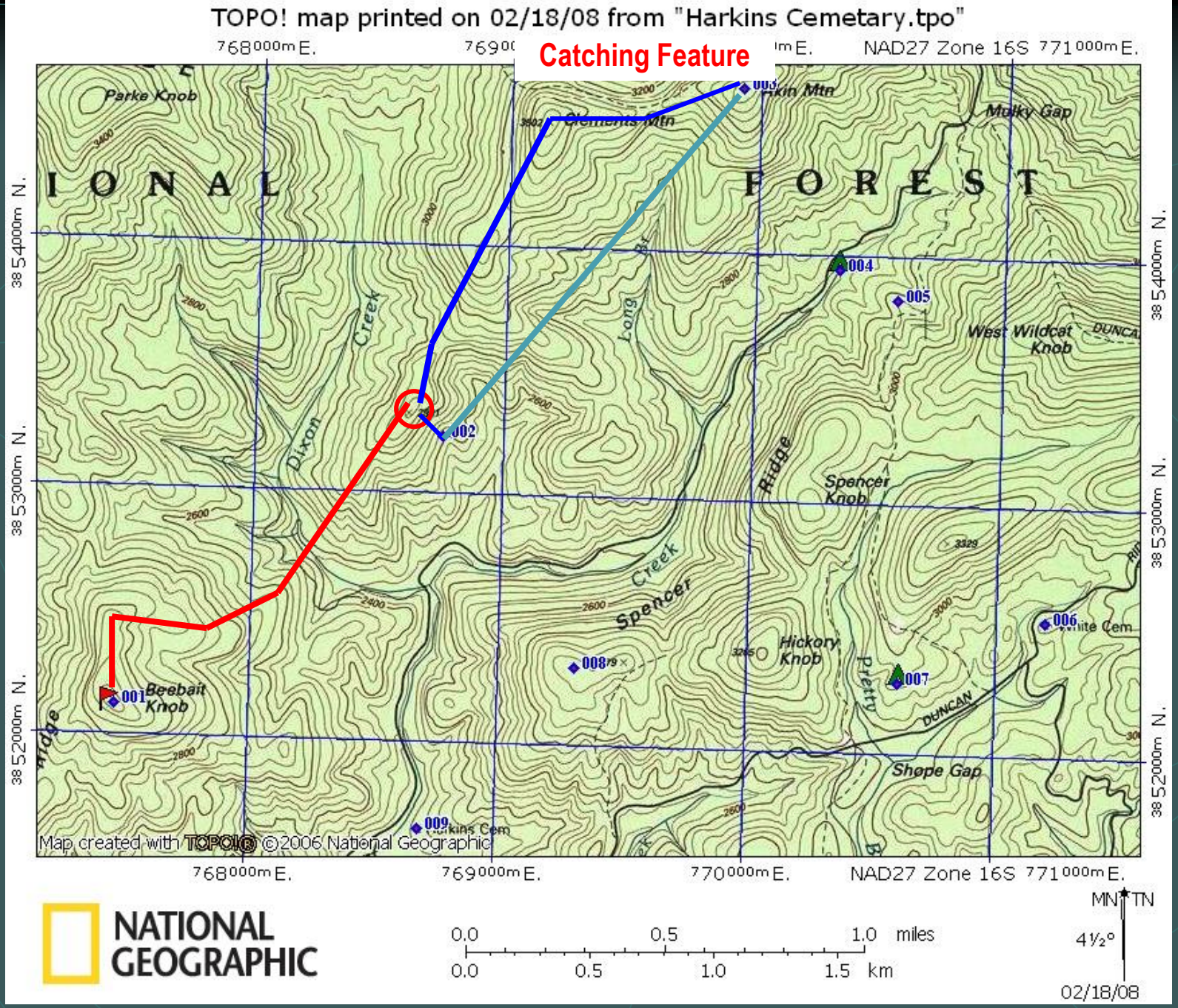
- What is at this point?.
- From this point you travel 270 Deg grid azimuth until you hit a road. From that point, what is the road distance to Pt 4?
- Now the real fun begins…..this part sets the professionals from the wannabes.

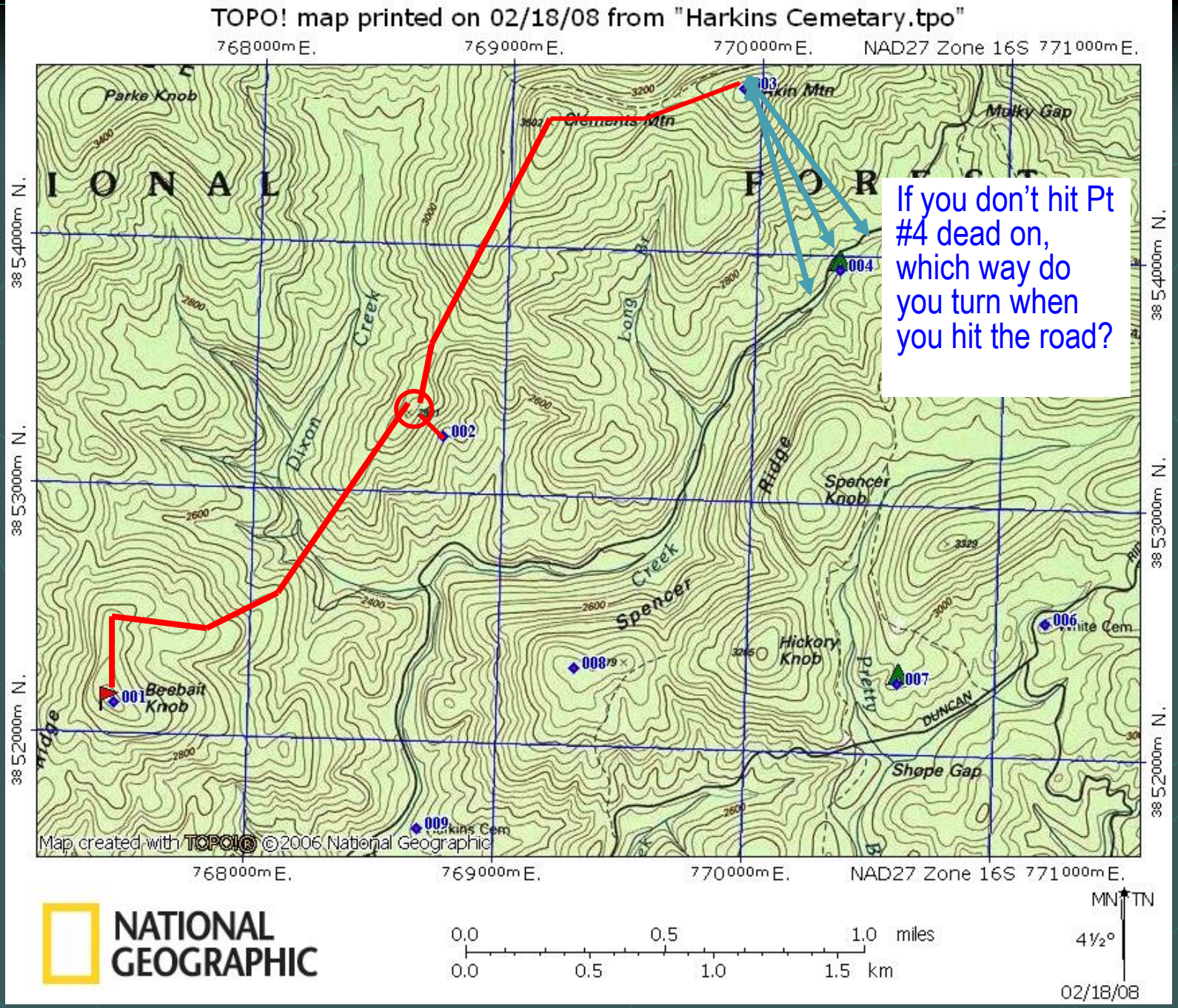

TOPO! map printed on 02/18/08 from "Harkins Cemetary.tpo"
768000m E.
769000m E.
770000m E.
NAD27 Zone 16S
771000m E.
38 54000m N.
38 53000m N.
38 52000m N.
Parke Knob
Clements Mtn
Kin Mtn
Mulky Gap
I O N A L
F O R E S T
West Wildcat Knob
Long Ridge
Dixon Creek
Spencer Ridge
Spencer Knob
Spencer Creek
Hickory Knob
Pretty
DUNCAN
Shope Gap
Beebait Knob
001
002
003
004
005
006
007
008
009
Map created with TOPO!® ©2006 National Geographic
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
MN TN
4½°
02/18/08

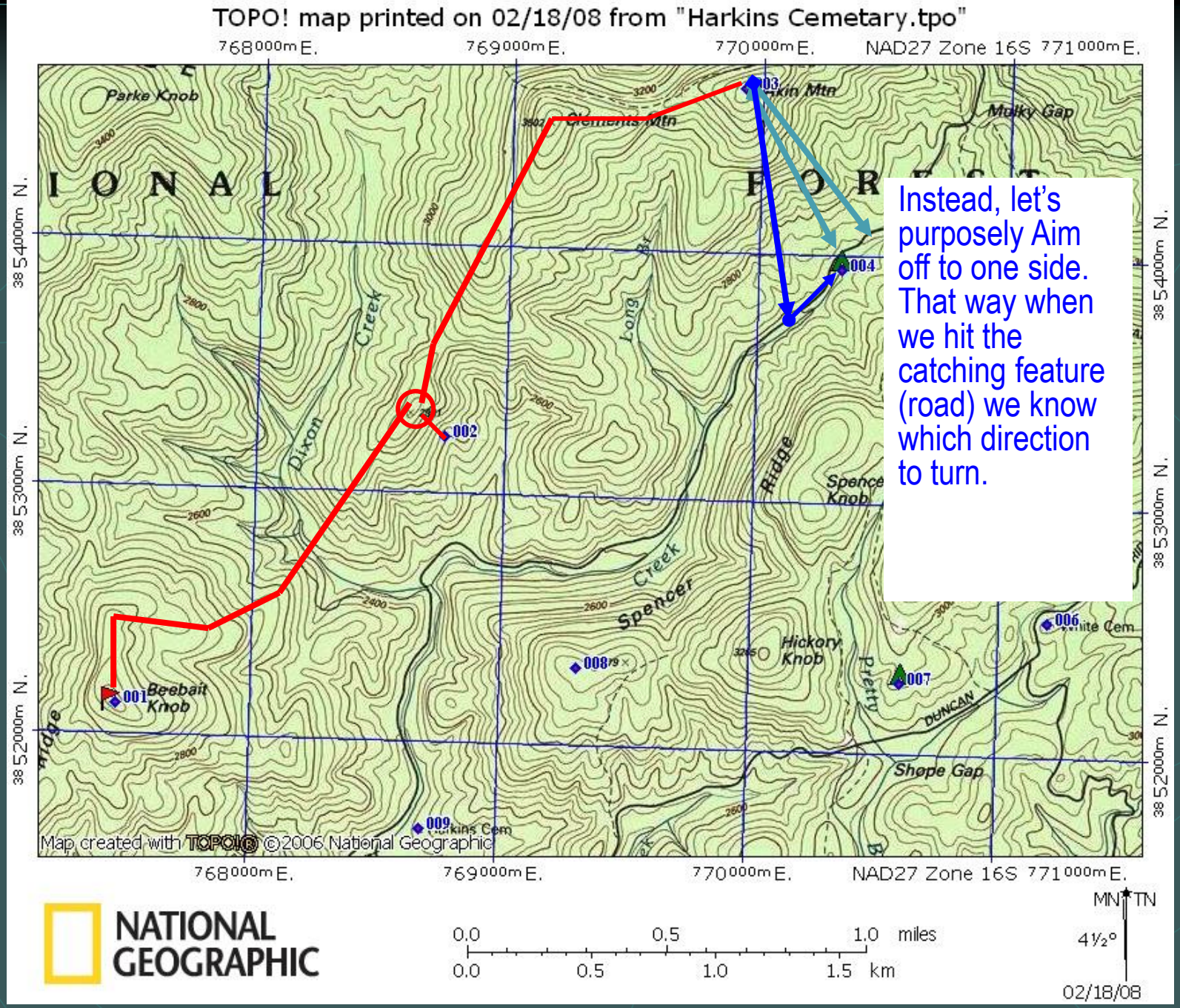

TOPO! map printed on 02/18/08 from "Harkins Cemetary.tpo"
768000m E.
769000m E.
770000m E.
NAD27 Zone 16S
771000m E.
38 54000m N.
38 53000m N.
38 52000m N.
Parke Knob
Clements Mtn
Kin Mtn
Mulky Gap
I O N A L
F O R E S T
Long Ridge
Creek
Dixon Creek
West Wildcat Knob
Spencer Knob
Spencer Creek
Hickory Knob
Pretty
DUNCAN
Shope Gap
Beebait Knob
Ridge
001
002
003
004
005
006
007
008
009
Map created with TOPO! ©2006 National Geographic
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
MN TN
4½°
02/18/08

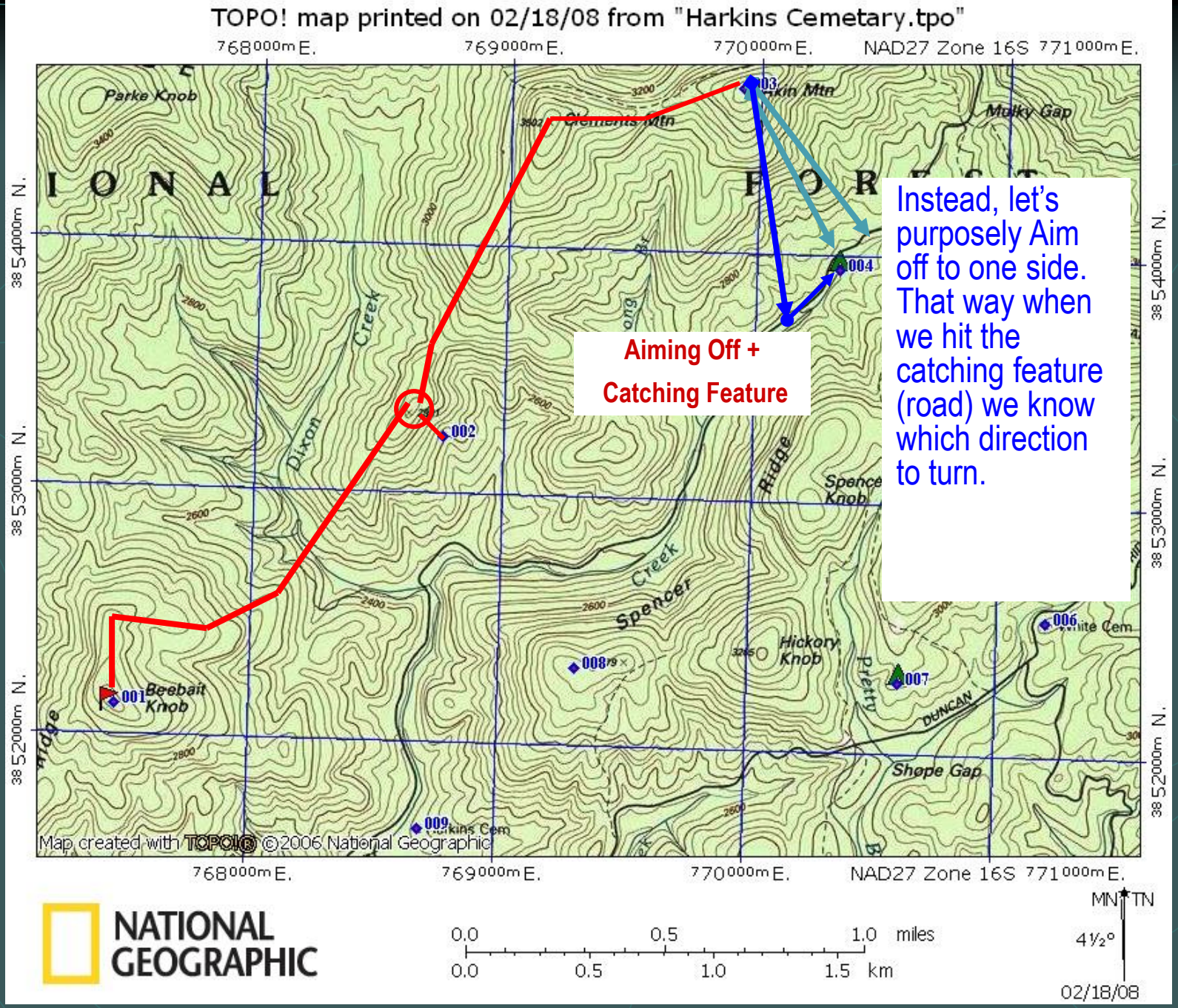

TOPO! map printed on 02/18/08 from "Harkins Cemetary.tpo"
768000m E.
769000m E.
770000m E.
NAD27 Zone 16S
771000m E.
38 54000m N.
38 53000m N.
38 52000m N.
Parke Knob
Clements Mtn
Kin Mtn
Milky Gap
I O N A L
F O R E S T
West Wildcat Knob
Attack Point
Dixon Creek
Long Ridge
Spencer Knob
Spencer Creek
Hickory Knob
Pretty
DUNCAN
Shope Gap
Beebait Knob
001
002
003
004
005
006
007
008
009
Map created with TOPO!® ©2006 National Geographic
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
MN TN
4½°
02/18/08

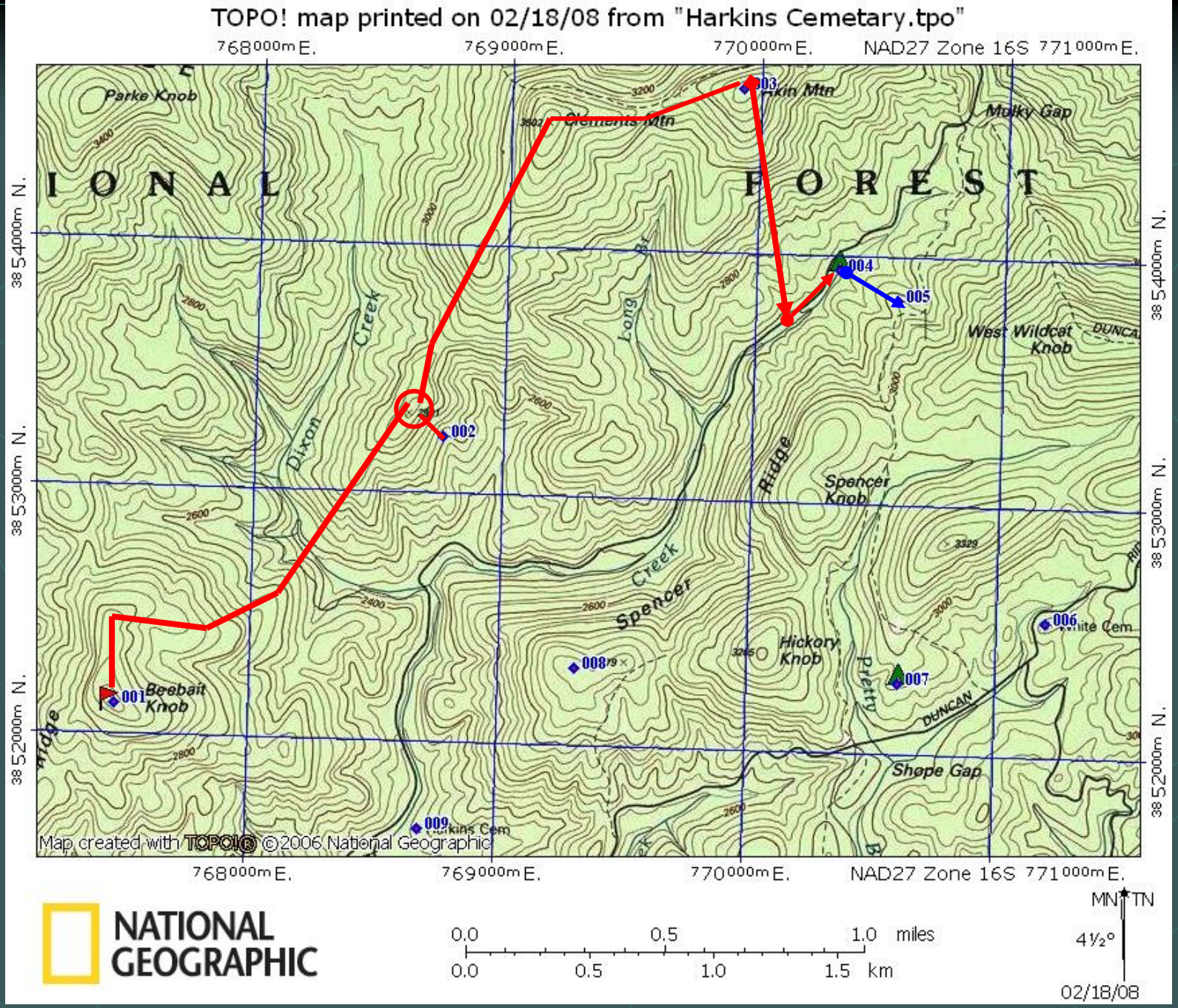

TOPO! map printed on 02/18/08 from "Harkins Cemetary.tpo"
768000m E.
769000m E.
770000m E.
NAD27 Zone 16S
771000m E.
38 54000m N.
38 53000m N.
38 52000m N.
Parke Knob
Clements Mtn
Kin Mtn
Mulky Gap
IONAL FOREST
Dixon Creek
Long Ridge
West Wildcat Knob
Spencer Knob
Spencer Creek
Hickory Knob
Pretty
DUNCAN
Shope Gap
Beebait Knob
001
002
003
004
005
006
007
008
009
Map created with TOPO! © 2006 National Geographic
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
MN TN
4½°
02/18/08

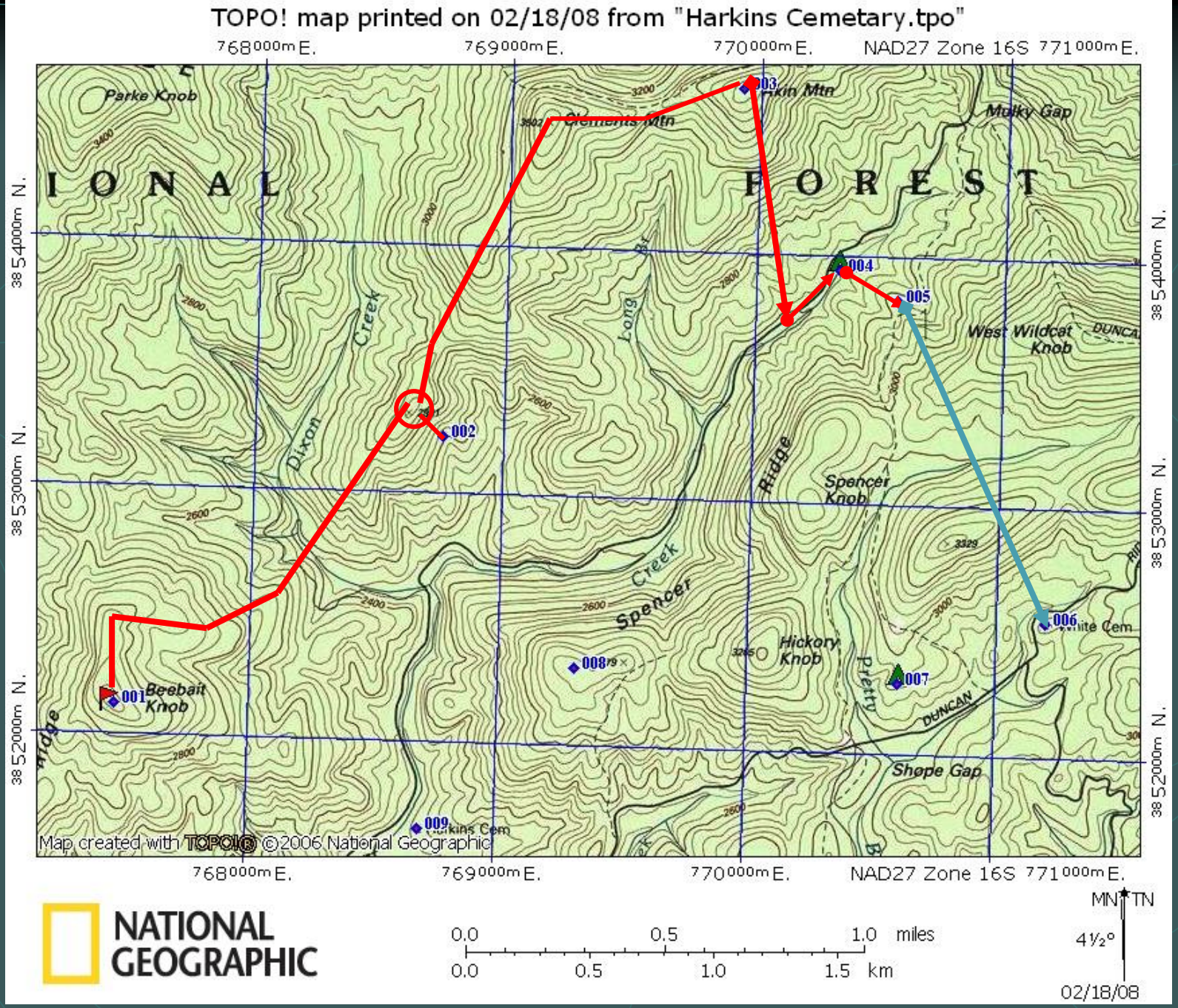

TOPO! map printed on 02/18/08 from "Harkins Cemetary.tpo"
Catching Feature
768000m E.
769000m E.
770000m E.
771000m E.
NAD27 Zone 16S
38 54000m N.
38 53000m N.
38 52000m N.
Parke Knob
Clements Mtn
Milky Gap
West Wildcat Knob
Dixon Creek
Long Ridge
Spencer Knob
Spencer Creek
Hickory Knob
Pretty Ridge
DUNCAN
Shope Gap
Beebait Knob
001
002
004
005
006
007
008
009
Map created with TOPO!® ©2006 National Geographic
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
MN TN
4½°
02/18/08

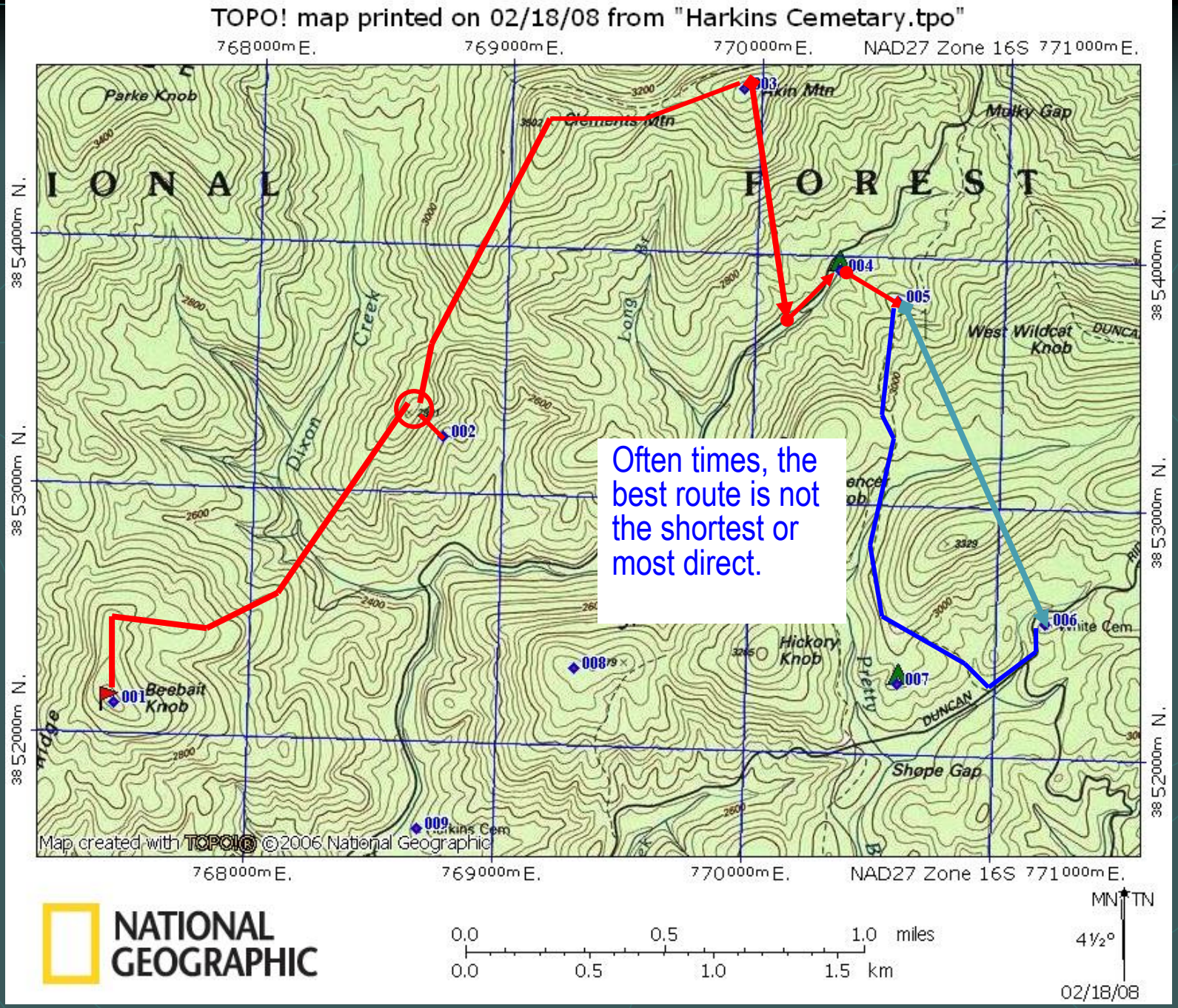

TOPO! map printed on 02/18/08 from "Harkins Cemetary.tpo"
768000m E.
769000m E.
770000m E.
NAD27 Zone 16S
771000m E.
38 54000m N.
38 53000m N.
38 52000m N.
Parke Knob
Clements Mtn
Milky Gap
Long Creek
Dixon Creek
Ridge
Spencer Knob
Spencer Creek
Hickory Knob
Pretty
DUNCAN
Shope Gap
Beebait Knob
001
002
003
004
006
007
008
009
If you don't hit Pt #4 dead on, which way do you turn when you hit the road?
Map created with TOPO! ©2006 National Geographic
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
MN TN
4½°
02/18/08

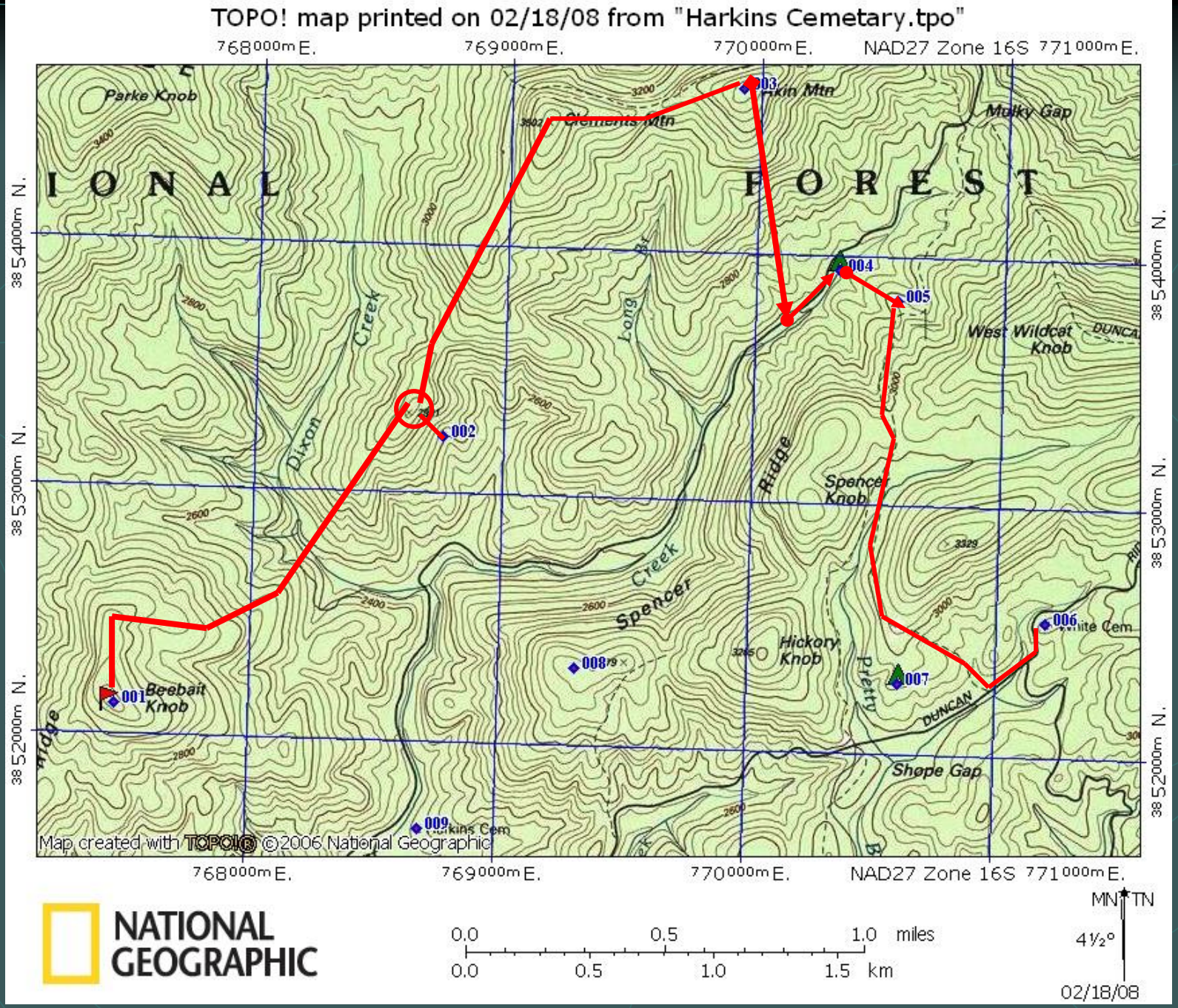

TOPO! map printed on 02/18/08 from "Harkins Cemetary.tpo"
768000m E.
769000m E.
770000m E.
NAD27 Zone 16S
771000m E.
38 54000m N.
38 53000m N.
38 52000m N.
Parke Knob
Clements Mtn
Kin Mtn
Molly Gap
Dixon Creek
Long Ridge
Spence Knob
Spencer Creek
Hickory Knob
Pretty
DUNCAN
Shope Gap
Beebait Knob
001
002
003
004
006
007
008
009
Instead, let's purposely Aim off to one side. That way when we hit the catching feature (road) we know which direction to turn.
Map created with TOPO! ©2006 National Geographic
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
MN TN
4½°
02/18/08

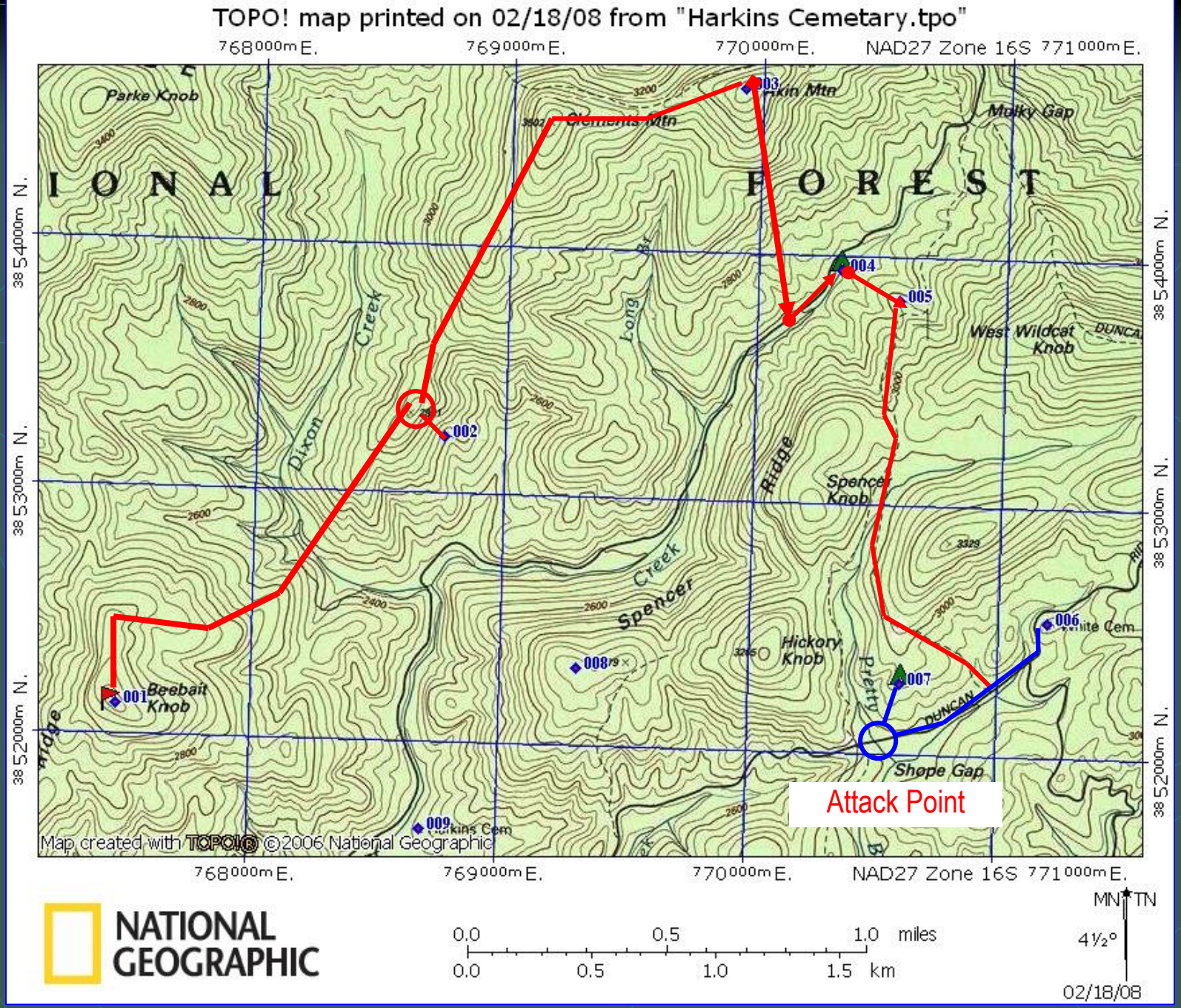

TOPO! map printed on 02/18/08 from "Harkins Cemetary.tpo"
768000m E.
769000m E.
770000m E.
NAD27 Zone 16S
771000m E.
38 54000m N.
38 53000m N.
38 52000m N.
Parke Knob
Clements Mtn
Kin Mtn
Molly Gap
Dixon Creek
Ridge
Spence Knob
Spencer Creek
Hickory Knob
Pretty
DUNCAN
Shope Gap
Beebait Knob
001
002
003
004
006
007
008
009
Aiming Off + Catching Feature
Instead, let's purposely Aim off to one side. That way when we hit the catching feature (road) we know which direction to turn.
Map created with TOPO!® ©2006 National Geographic
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
MN TN
4½°
02/18/08

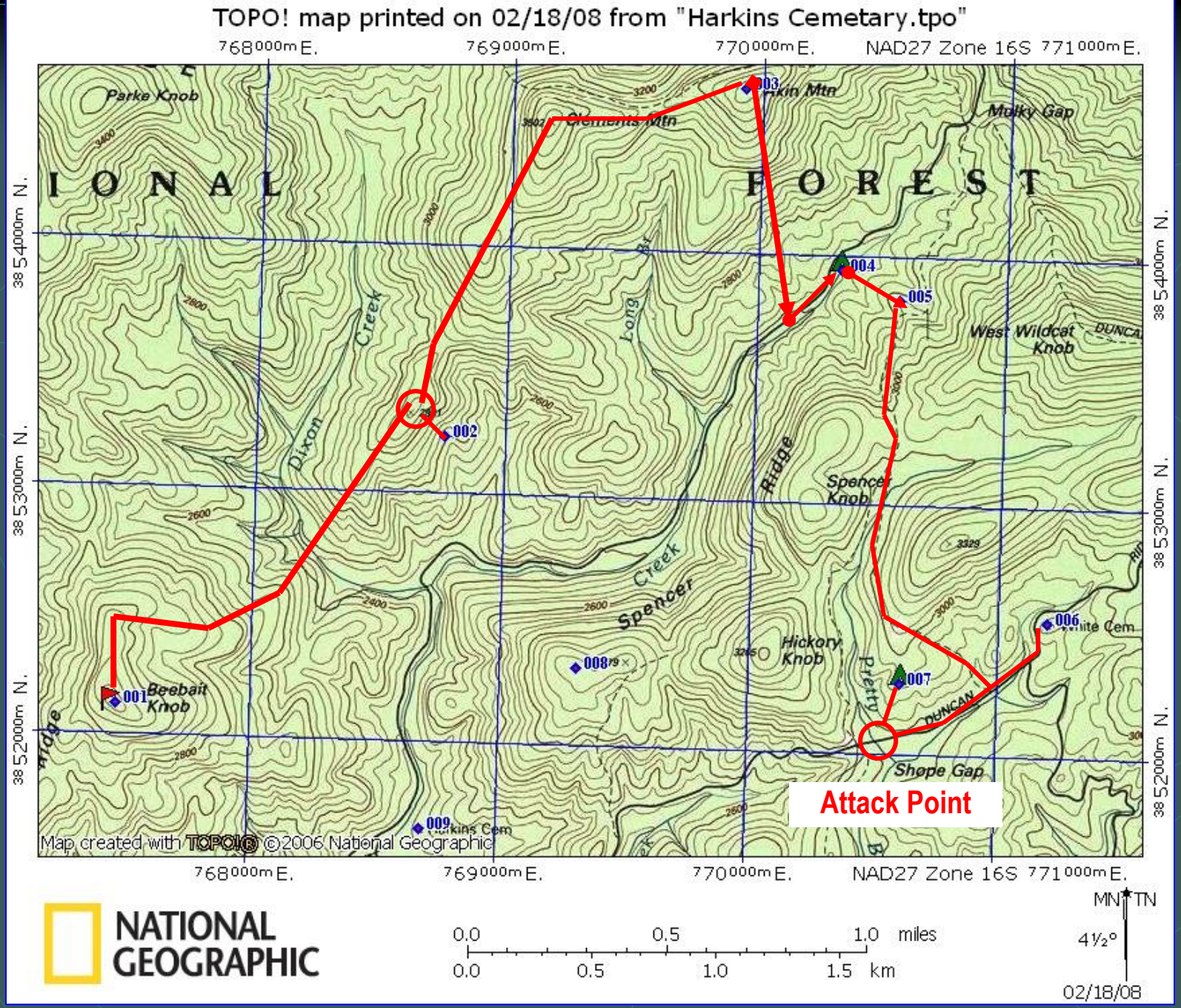

TOPO! map printed on 02/18/08 from "Harkins Cemetary.tpo"
768000m E.
769000m E.
770000m E.
NAD27 Zone 16S
771000m E.
38 54000m N.
38 53000m N.
38 52000m N.
Parke Knob
Clements Mtn
Kin Mtn
Milky Gap
IONAL
FOREST
Long
Creek
Dixon
Creek
West Wildcat Knob
Ridge
Spencer Knob
Spencer
Creek
Hickory Knob
Pretty
DUNCAN
Shope Gap
Ridge
001 Beebait Knob
002
003
004
005
006
007
008
009
Map created with TOPO!® ©2006 National Geographic
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
MN TN
4½°
02/18/08

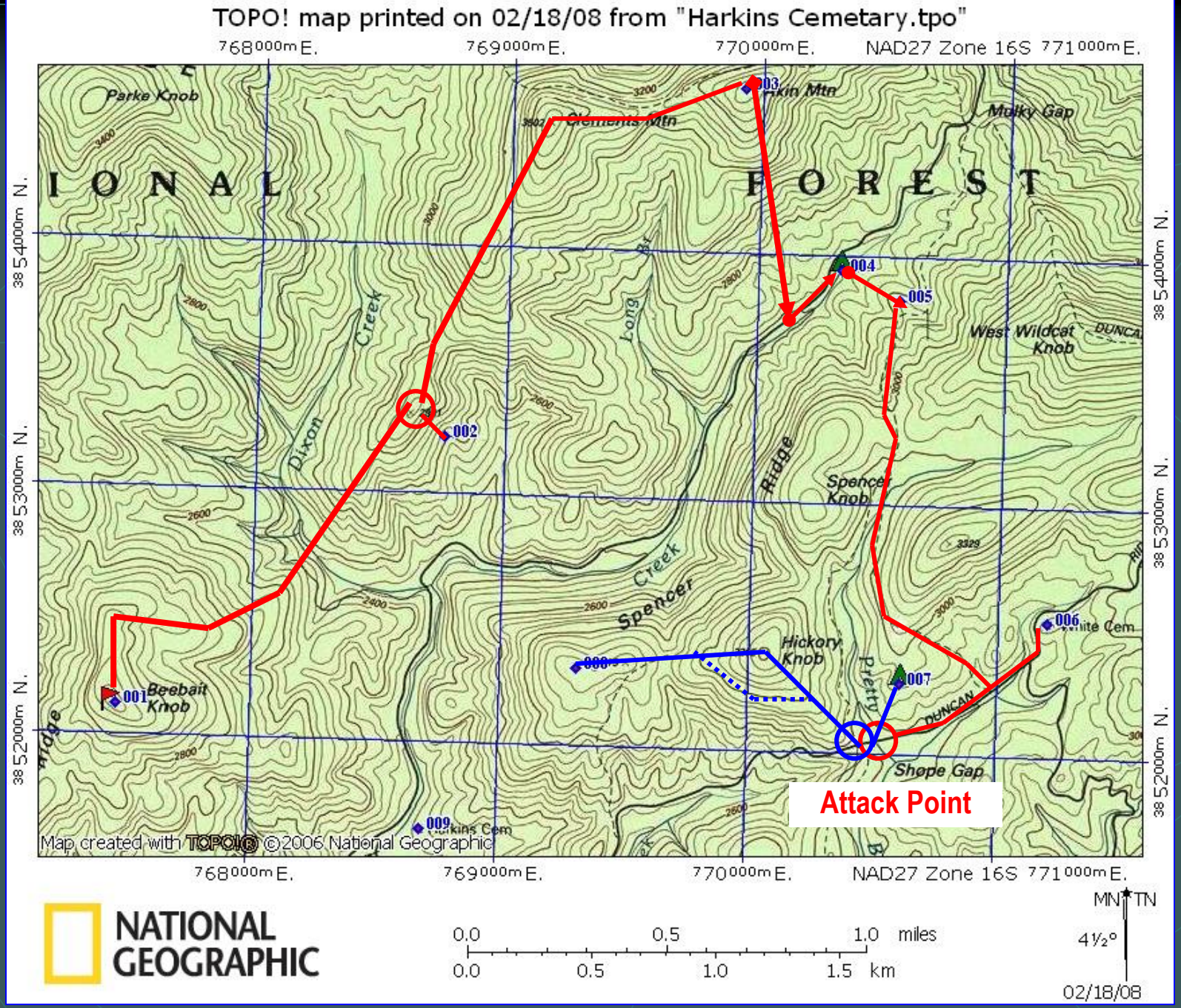

TOPO! map printed on 02/18/08 from "Harkins Cemetary.tpo"
768000m E.
769000m E.
770000m E.
NAD27 Zone 16S
771000m E.
38 54000m N.
38 53000m N.
38 52000m N.
Parke Knob
Clements Mtn
Kin Mtn
Mulky Gap
IONAL
FOREST
Dixon Creek
Long
West Wildcat Knob
Spencer Knob
Ridge
Spencer Creek
Hickory Knob
Pretty
DUNCAN
Shope Gap
Beebait Knob
001
002
003
004
005
006
007
008
009
Harkins Cem
Map created with TOPO!® ©2006 National Geographic
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
MN TN
4½°
02/18/08

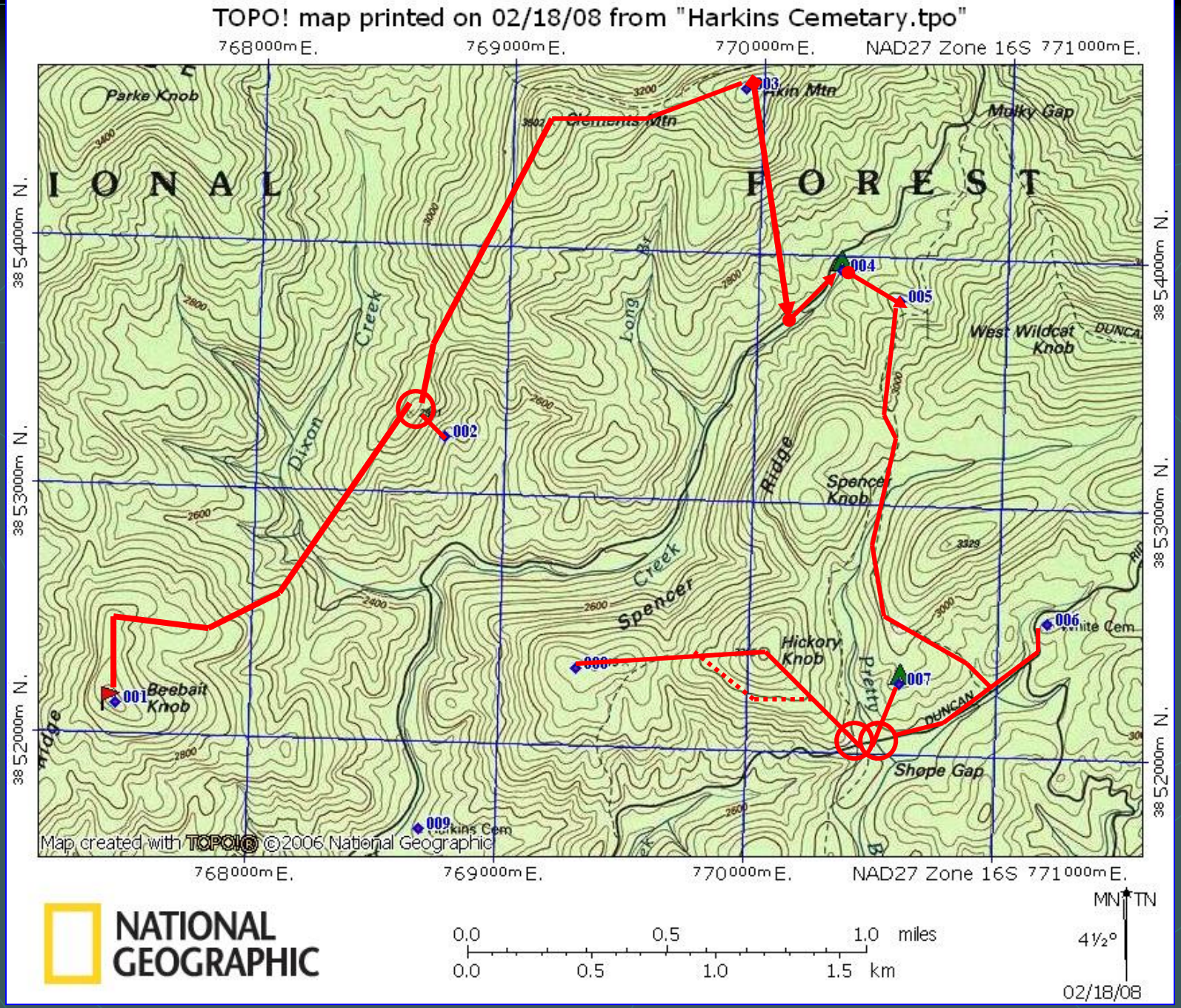

TOPO! map printed on 02/18/08 from "Harkins Cemetary.tpo"
768000m E.
769000m E.
770000m E.
NAD27 Zone 16S
771000m E.
38 54000m N.
38 53000m N.
38 52000m N.
Parke Knob
Clements Mtn
Kin Mtn
Molly Gap
IONAL FOREST
Long Br
Creek
Dixon
West Wildcat Knob
DUNCA
001 Beebait Knob
002
003
004
005
006
007
008
009
Hickory Knob
Pretty
DUNCAN
Shope Gap
Harkins Cem
Map created with TOPO! ©2006 National Geographic
Often times, the best route is not the shortest or most direct.
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
MN TN
4½°
02/18/08

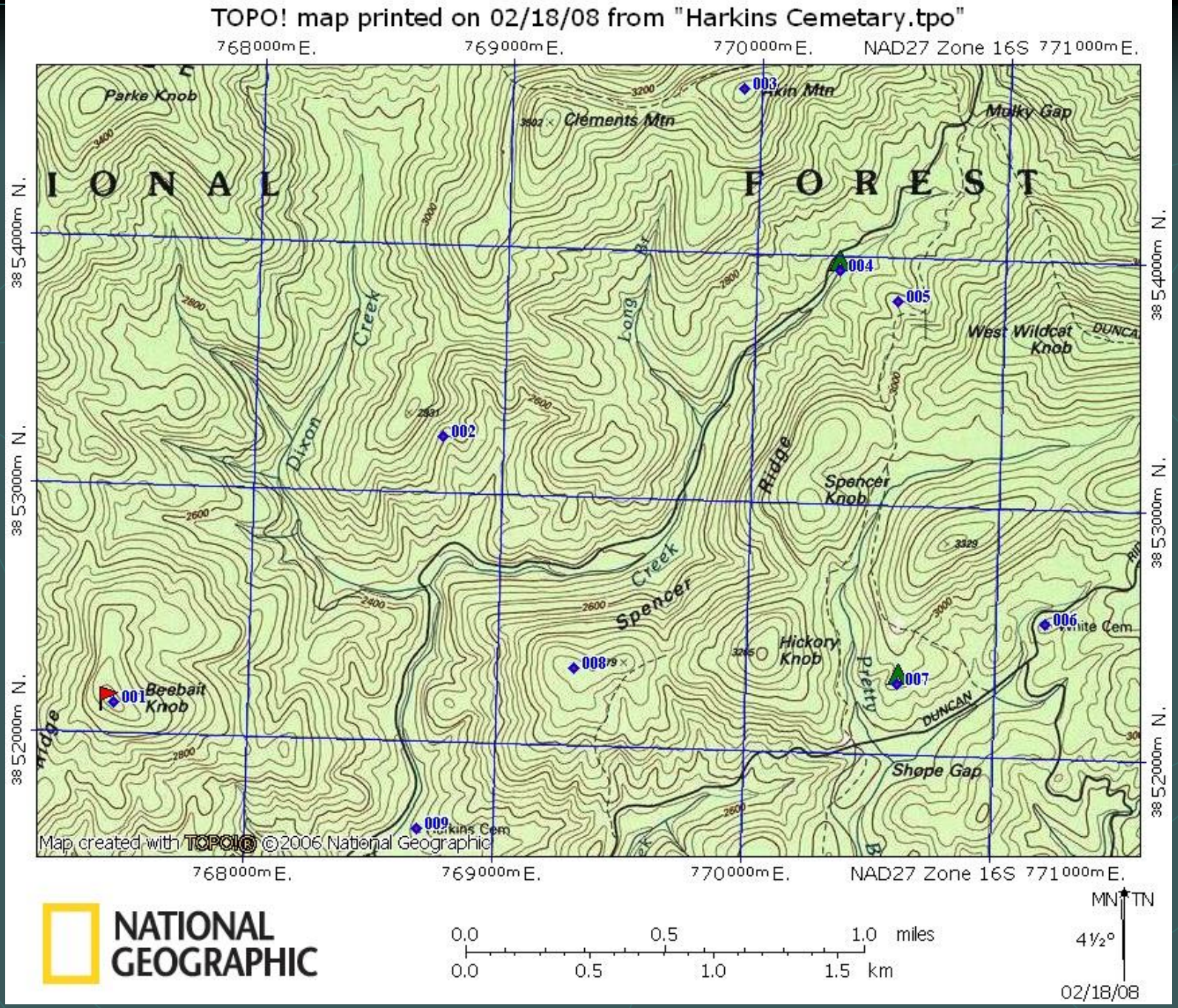

TOPO! map printed on 02/18/08 from "Harkins Cemetary.tpo"
768000m E.
769000m E.
770000m E.
NAD27 Zone 16S
771000m E.
38 54000m N.
38 53000m N.
38 52000m N.
Parke Knob
Clements Mtn
Kin Mtn
Mulky Gap
FOREST
West Wildcat Knob
Long Ridge
Dixon Creek
Spencer Knob
Spencer Creek
Hickory Knob
Pretty Ridge
DUNCAN
Shope Gap
Beebait Knob
001
002
003
004
005
006
007
008
009
Map created with TOPO! ©2006 National Geographic
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
MN TN
4½°
02/18/08

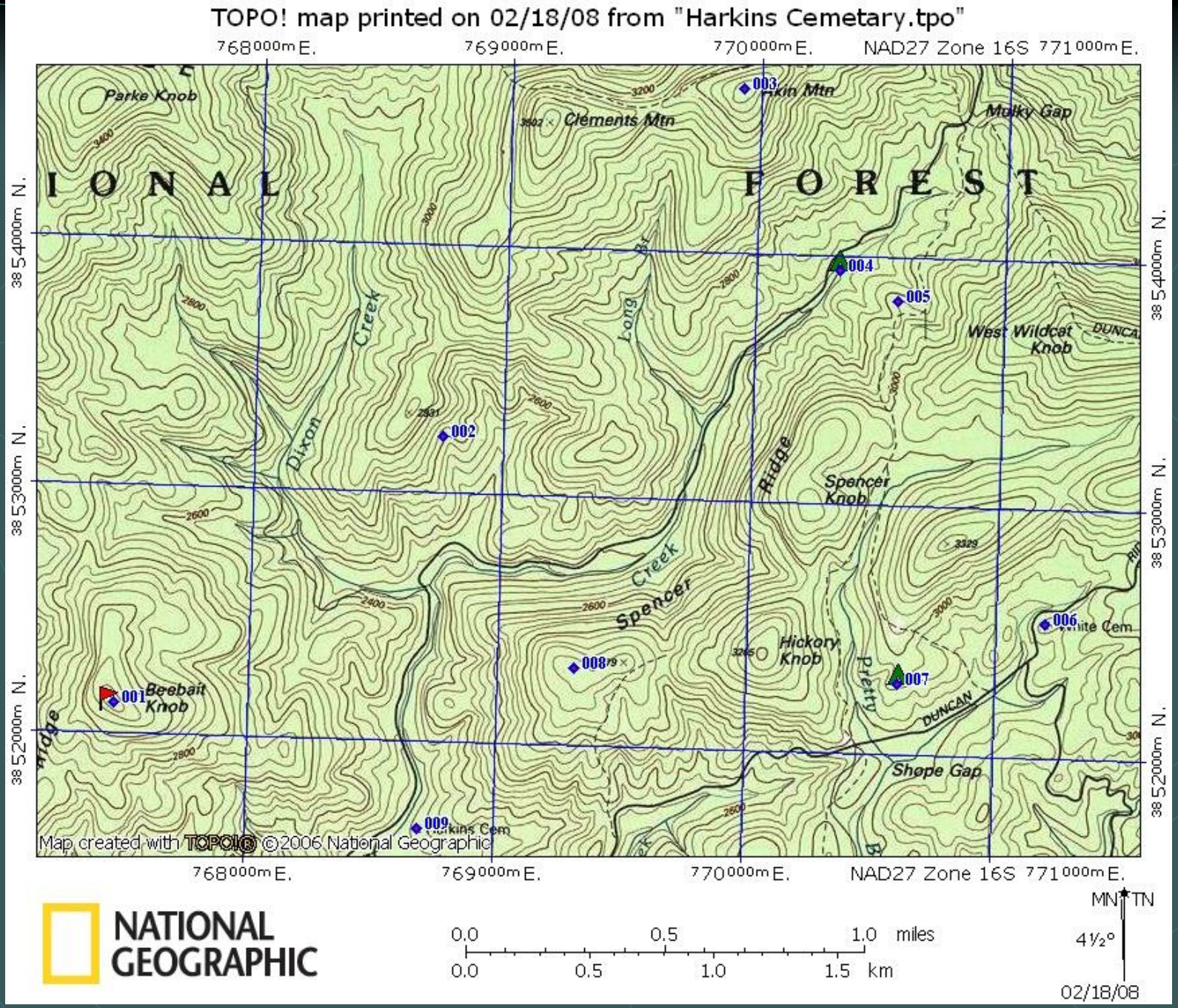

TOPO! map printed on 02/18/08 from "Harkins Cemetary.tpo"
768000m E.
769000m E.
770000m E.
NAD27 Zone 16S
771000m E.
38 54000m N.
38 53000m N.
38 52000m N.
Parke Knob
Clements Mtn
Kin Mtn
Mulky Gap
FOREST
West Wildcat Knob
Long Ridge
Dixon Creek
Spencer Knob
Spencer Creek
Hickory Knob
Pretty Ridge
Shope Gap
Beebait Knob
001
002
003
004
005
006
007
008
009
Attack Point
Map created with TOPO! ©2006 National Geographic
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
MN TN
4½°
02/18/08

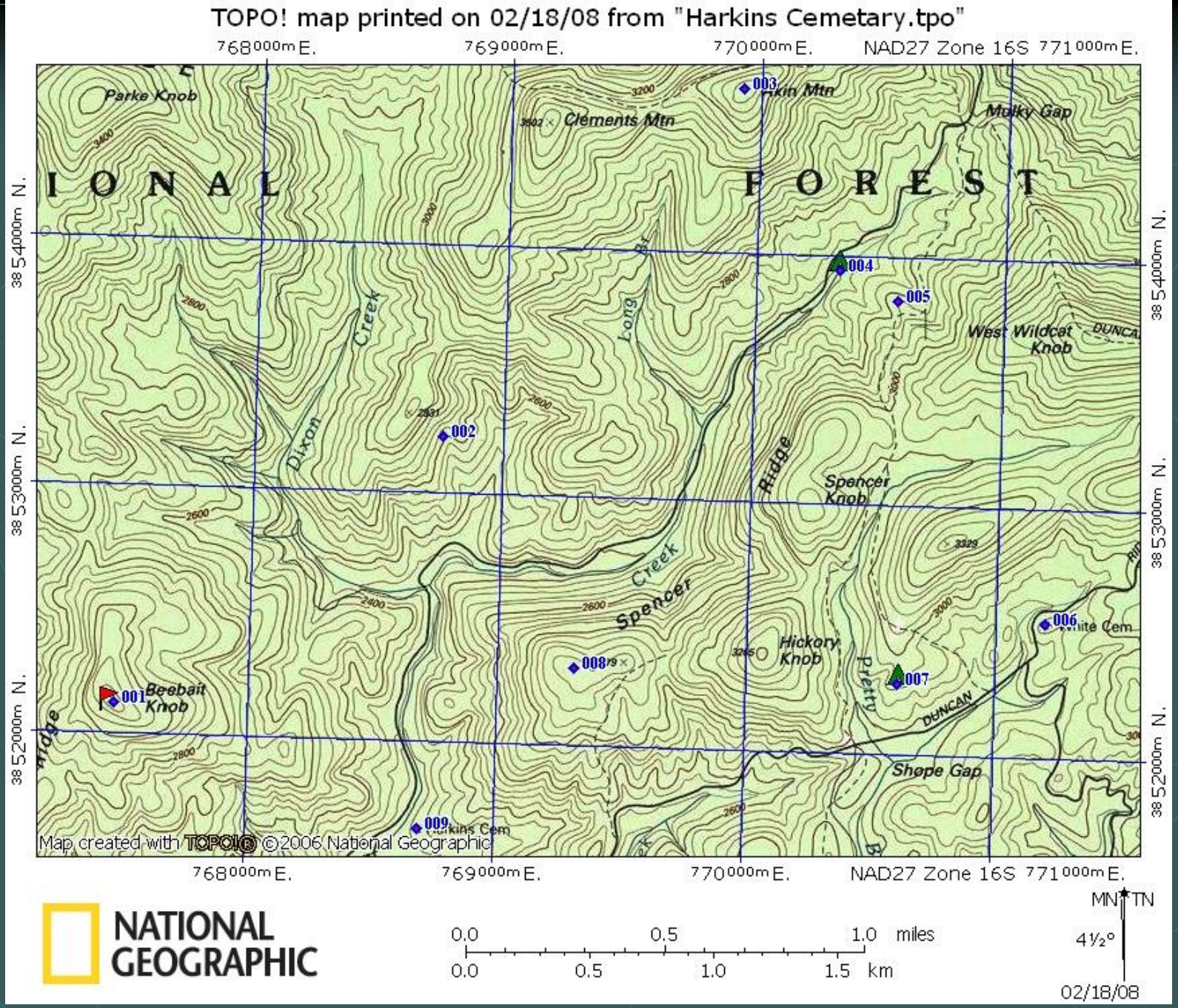

TOPO! map printed on 02/18/08 from "Harkins Cemetary.tpo"
768000m E.
769000m E.
770000m E.
NAD27 Zone 16S
771000m E.
38 54000m N.
38 53000m N.
38 52000m N.
Parke Knob
Clements Mtn
Kin Mtn
Mulky Gap
I O N A L
F O R E S T
West Wildcat Knob
Dixon Creek
Long Ridge
Spencer Knob
Spencer Creek
Hickory Knob
Pretty Ridge
Shope Gap
DUNCAN
001 Beebait Knob
002
003
004
005
006
007
008
009
Attack Point
Map created with TOPO! ©2006 National Geographic
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
MN TN
4½°
02/18/08


TOPO! map printed on 02/18/08 from "Harkins Cemetary.tpo"
768000m E.
769000m E.
770000m E.
NAD27 Zone 16S
771000m E.
38 54000m N.
38 53000m N.
38 52000m N.
Parke Knob
Clements Mtn
Kin Mtn
Mulky Gap
I O N A L
F O R E S T
West Wildcat Knob
Dixon Creek
Long Ridge
Spencer Knob
Spencer Creek
Hickory Knob
Pretty Ridge
Beebait Knob
Shope Gap
001
002
003
004
005
006
007
009
Attack Point
Map created with TOPO!® ©2006 National Geographic
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
MN TN
4½°
02/18/08


TOPO! map printed on 02/18/08 from "Harkins Cemetary.tpo"
768000m E.
769000m E.
770000m E.
NAD27 Zone 16S
771000m E.
38 54000m N.
38 53000m N.
38 52000m N.
Parke Knob
Clements Mtn
Kin Mtn
Milky Gap
I O N A L
F O R E S T
West Wildcat Knob
Dixon Creek
Long Ridge
Spencer Knob
Spencer Creek
Hickory Knob
Pretty Ridge
Shope Gap
Beebait Knob
001
002
003
004
005
006
007
009
Map created with TOPO! ©2006 National Geographic
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
MN TN
4½°
02/18/08


TOPO! map printed on 02/18/08 from "Harkins Cemetary.tpo"
768000m E.
769000m E.
770000m E.
NAD27 Zone 16S
771000m E.
38 54000m N.
38 53000m N.
38 52000m N.
Parke Knob
Clements Mtn
Kin Mtn
Mulky Gap
I O N A L
F O R E S T
West Wildcat Knob
Long Ridge
Dixon Creek
Spencer Ridge
Spencer Knob
Spencer Creek
Hickory Knob
Pretty
DUNCAN
Shope Gap
Beebait Knob
001
002
003
004
005
006
007
008
009
Map created with TOPO!® ©2006 National Geographic
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
MN TN
4½°
02/18/08


TOPO! map printed on 02/18/08 from "Harkins Cemetary.tpo"
768000m E.
769000m E.
770000m E.
NAD27 Zone 16S
771000m E.
38 54000m N.
38 53000m N.
38 52000m N.
Parke Knob
Clements Mtn
Kin Mtn
Mulky Gap
I O N A L
F O R E S T
West Wildcat Knob
Long Ridge
Dixon Creek
Spencer Ridge
Spencer Knob
Spencer Creek
Hickory Knob
Pretty
DUNCAN
Shope Gap
Beebait Knob
001
002
003
004
005
006
007
008
009
Map created with TOPO!® ©2006 National Geographic
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
MN TN
4½°
02/18/08


TOPO! map printed on 02/18/08 from "Harkins Cemetary.tpo"
768000m E.
769000m E.
770000m E.
NAD27 Zone 16S
771000m E.
38 54000m N.
38 53000m N.
38 52000m N.
Parke Knob
Clements Mtn
Kin Mtn
Mulky Gap
I O N A L
F O R E S T
West Wildcat Knob
Long Ridge
Dixon Creek
Spencer Ridge
Spencer Knob
Spencer Creek
Hickory Knob
Pretty
DUNCAN
Shope Gap
Beebait Knob
001
002
003
004
005
006
007
008
009
Map created with TOPO!® ©2006 National Geographic
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
MN TN
4½°
02/18/08

What's Next....

Go out and actually do this in the field every month

...month after month

...for hundreds of hours

And then

You will be a great navigator!

The End