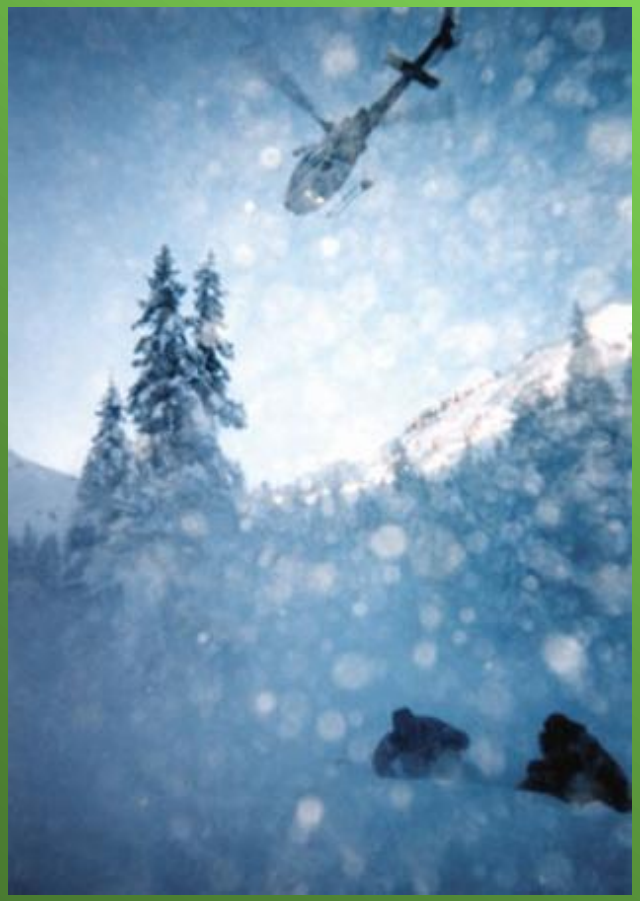
Tahoe Nordic Search and Rescue Team, Inc.

Map and Compass



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GOAL

To be fully versed and practiced in land navigation using a topographic map, magnetic compass, and a GPS.

Photo by Jeff Rieger

OBJECTIVES (9)

1) Understand different map datums
2) “Read” topographic contour lines
3) Understand four different coordinate systems
4) Locate a specific coordinate on a map
5) Learn the anatomy of a compass
6) Understand magnetic declination
7) Orient a map to true north
8) Lay out a bearing (travel) line
9) Triangulate your position

WHY MAP AND COMPASS WHEN WE HAVE GPS?

Not practiced with GPS

GPS damaged

Dead batteries

Heavy tree cover

Steep, confining terrain

Maps on GPS screen difficult to use/read

"*Every* Team member active in the backcountry during a search/rescue must carry—*and be proficient with*—a map, compass, and GPS."

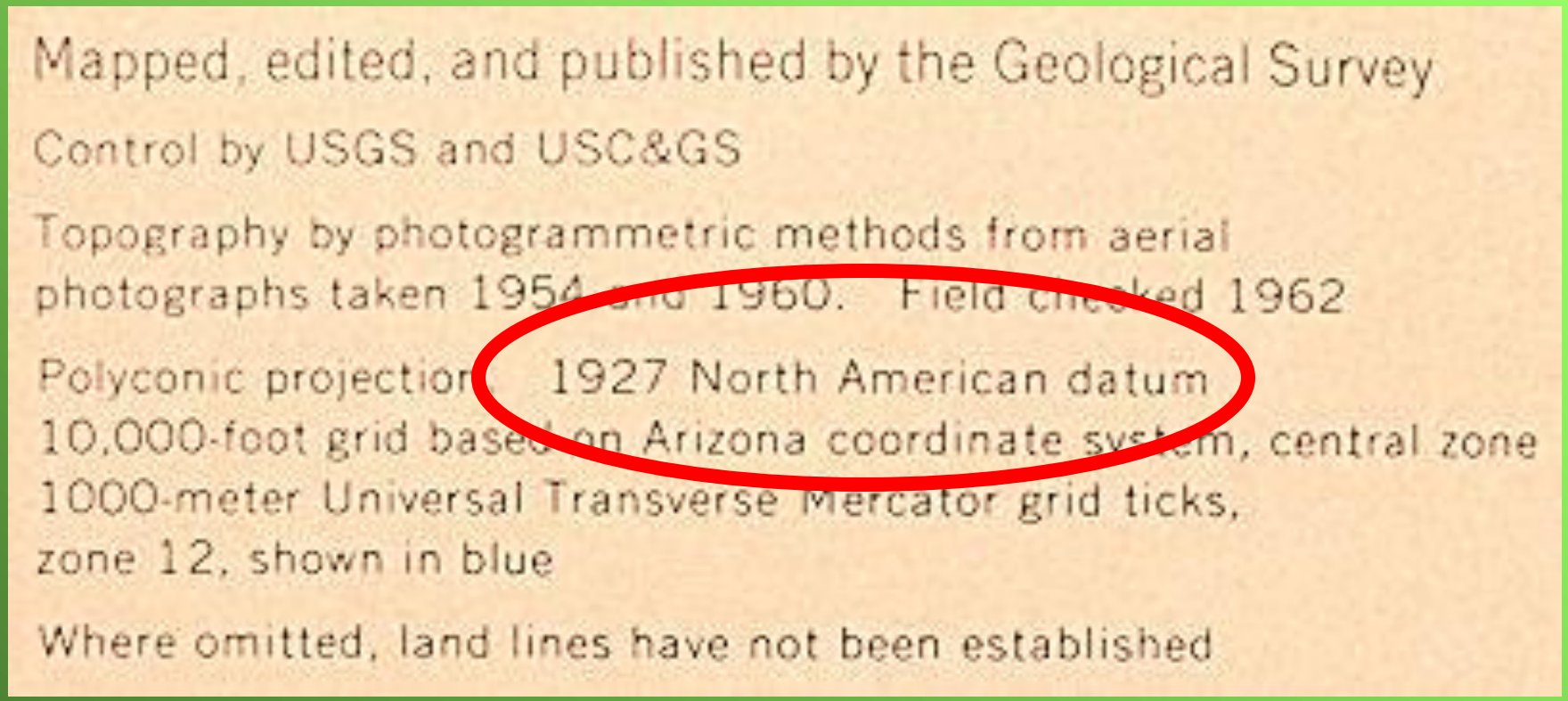
(1) **Map Datum** (the data used to produce the map)

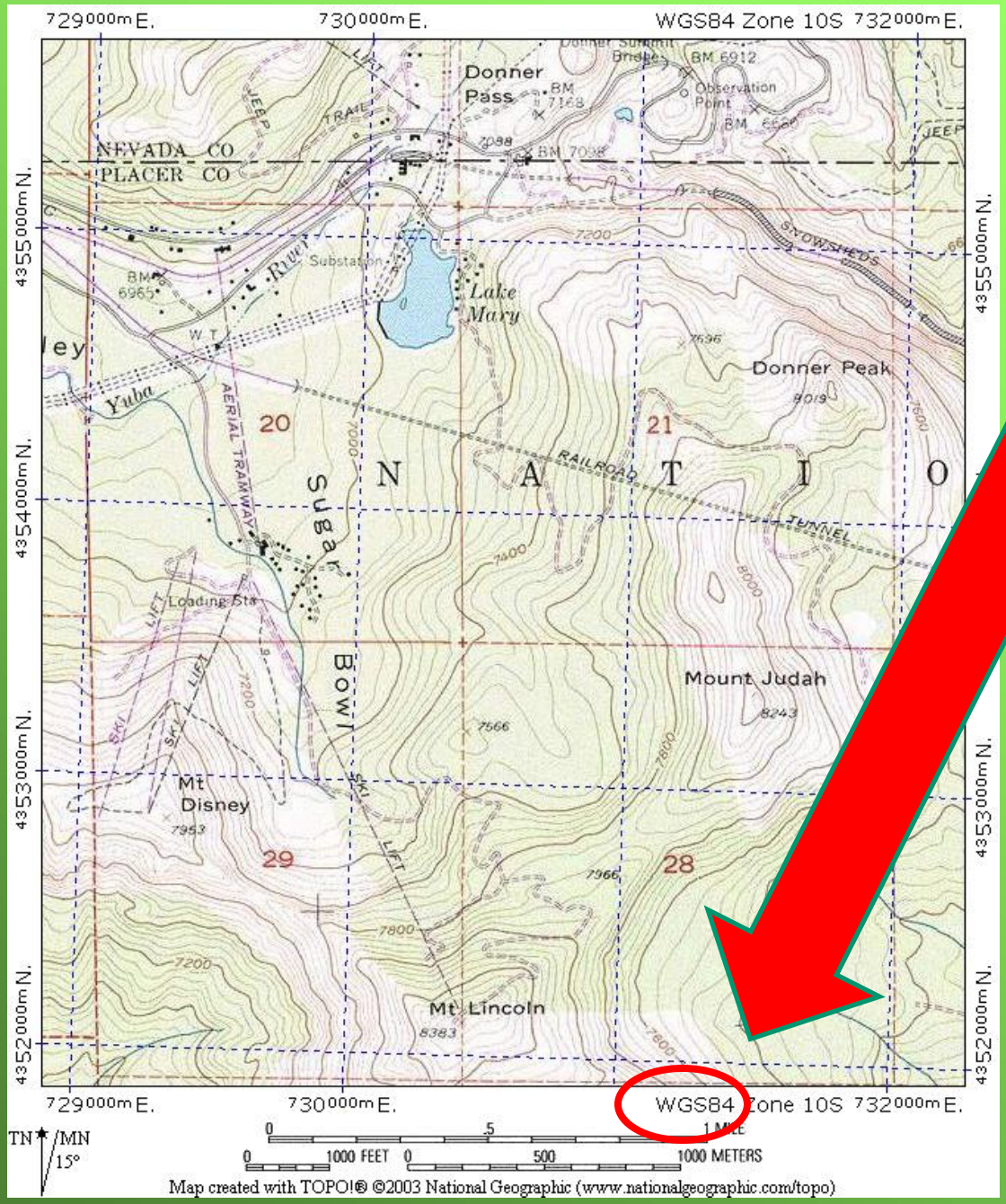
- (NAD 27) North American Datum 1927
- (WGS 84) World Geodesic Survey 1984

Over the same mapped terrain, any single position defined by these different datum can differ more than 200 meters.

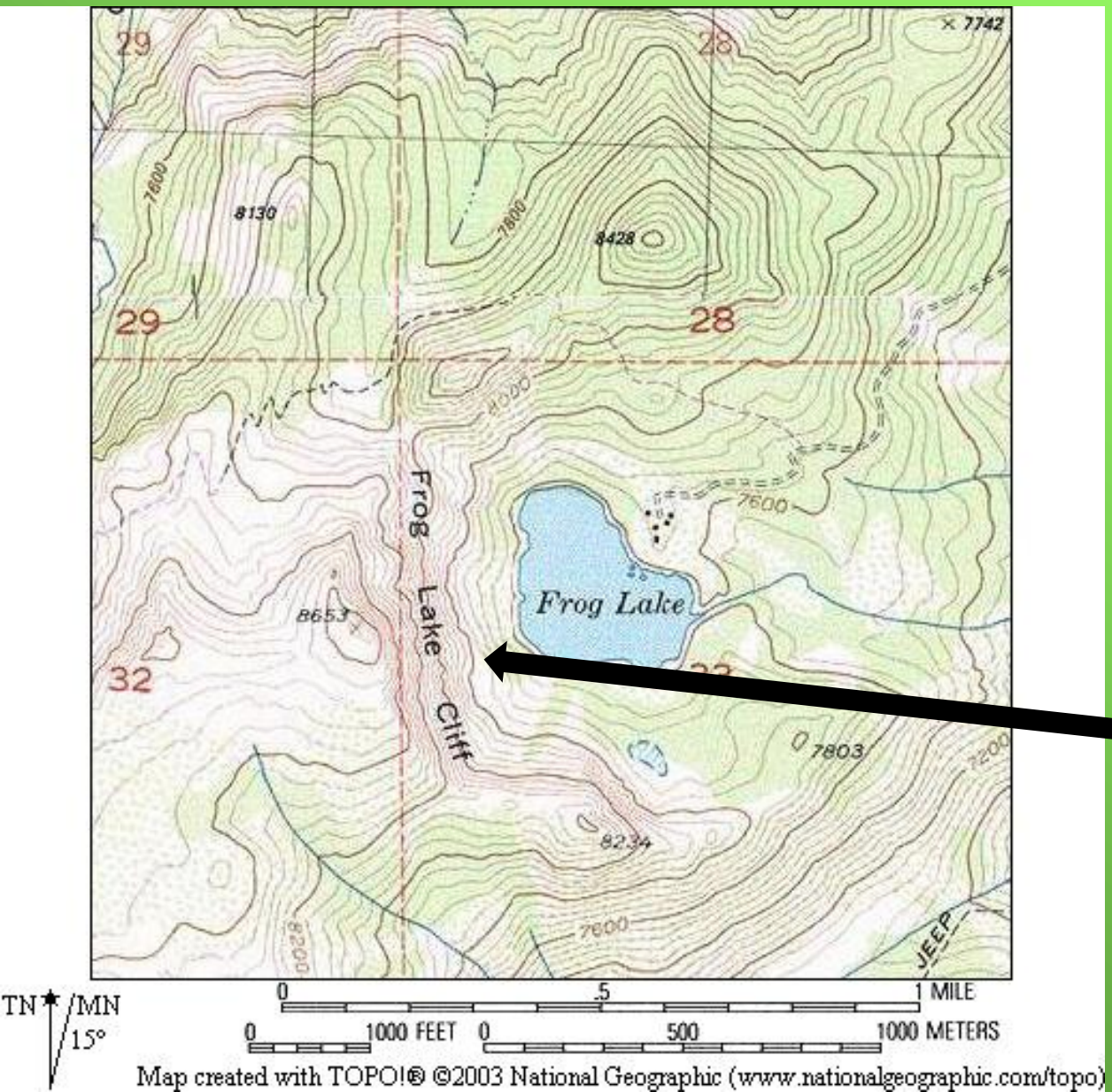
WGS 84 is the modern standard and should be our default. If you're using NAD 27 or another datum, make sure those with whom you're communicating know this.

The datum used to produce the map will be listed on the map's marginalia.




729000m E.
730000m E.
WGS84 Zone 10S
732000m E.
4355000m N.
4354000m N.
4353000m N.
4352000m N.
Donner Pass
BM 7168
BM 6912
Observation Point
NEVADA CO
PLACER CO
Substation
BM 6965
Lake Mary
Donner Peak
8019
Yuba River
AERIAL TRAMWAY
RAILROAD
TUNNEL
SNOWSHEDS
20
21
29
28
Sugar Bowl
Loading Sta
Mt Disney
7953
Mount Judah
8243
Mt Lincoln
8383
7566
7966
7696
TN
MN
15°
0
1000 FEET
0
500
1000 METERS
Map created with TOPO!® ©2003 National Geographic (www.nationalgeographic.com/topo)

(2) “Reading” Topo Contours



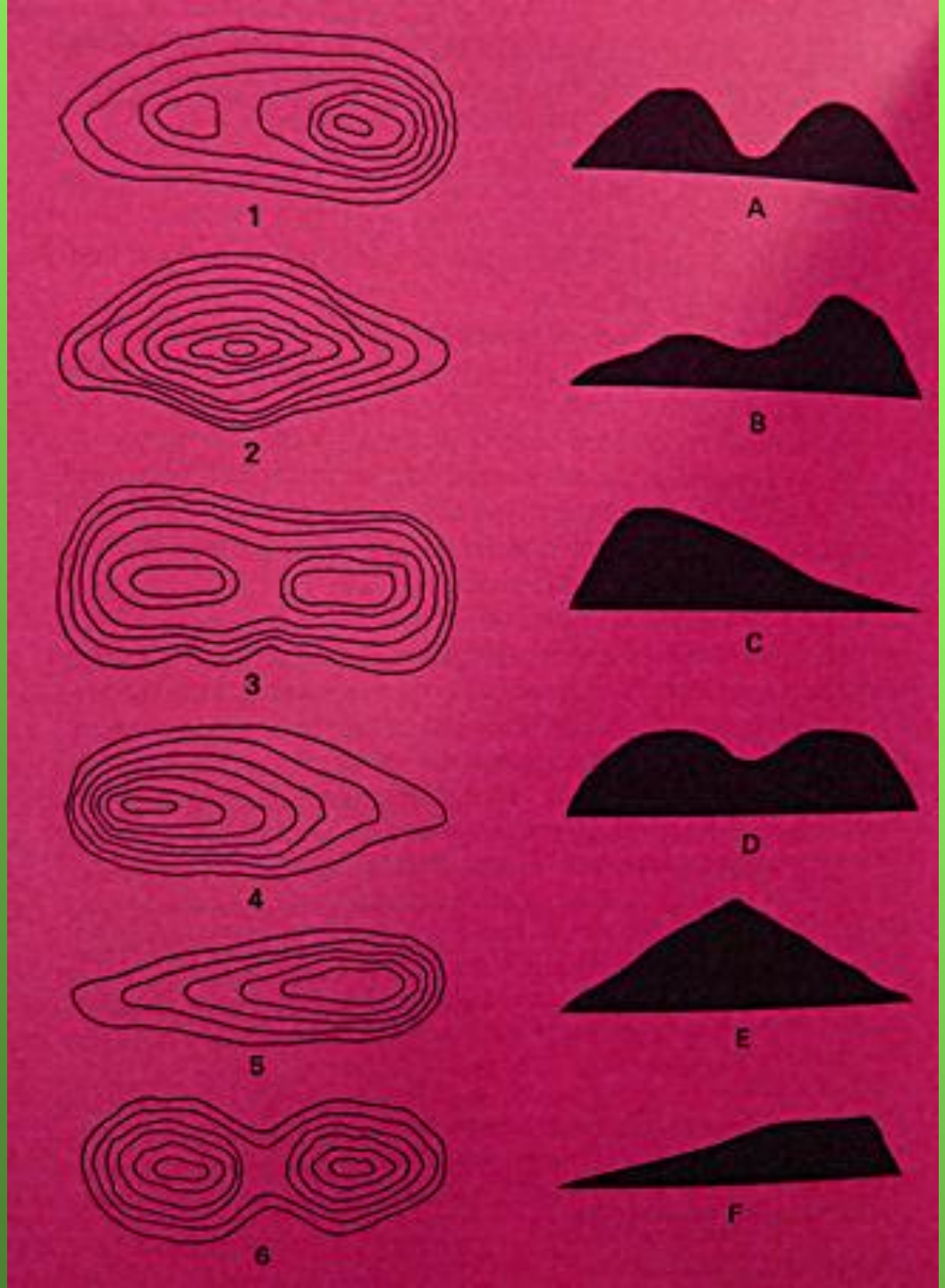
Any contour line describes a line of equal elevation.

The closer the lines are to each other, the steeper the terrain.

A compass can tell us slope aspect.

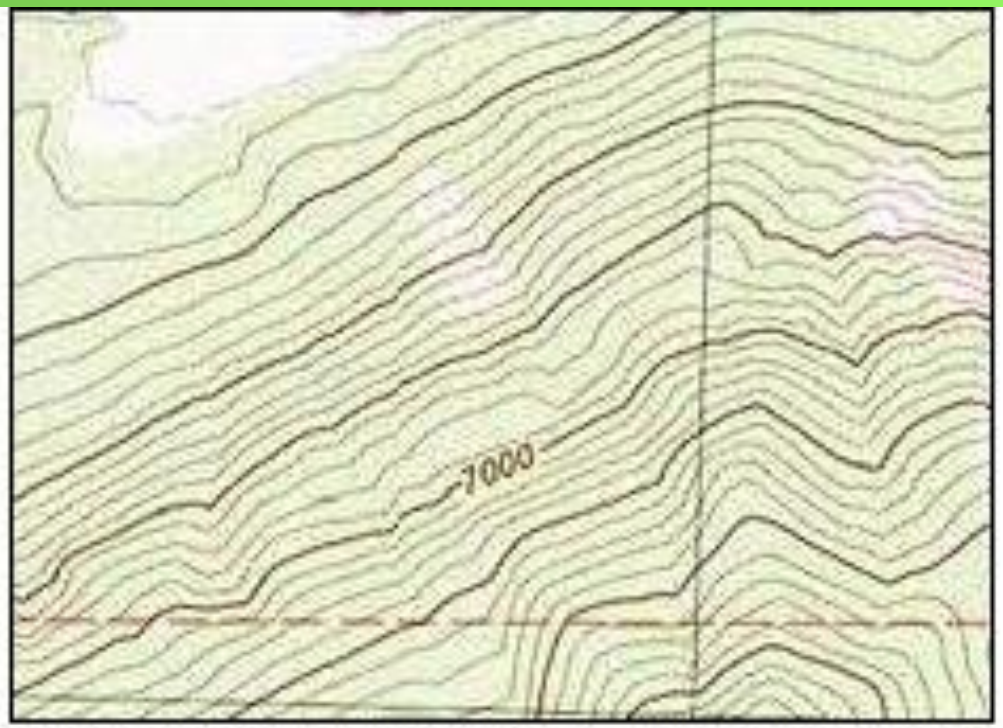
Cliffs facing east

Match number diagram to letter diagram.



1B, 2E, 3D, 4C, 5F, 6A

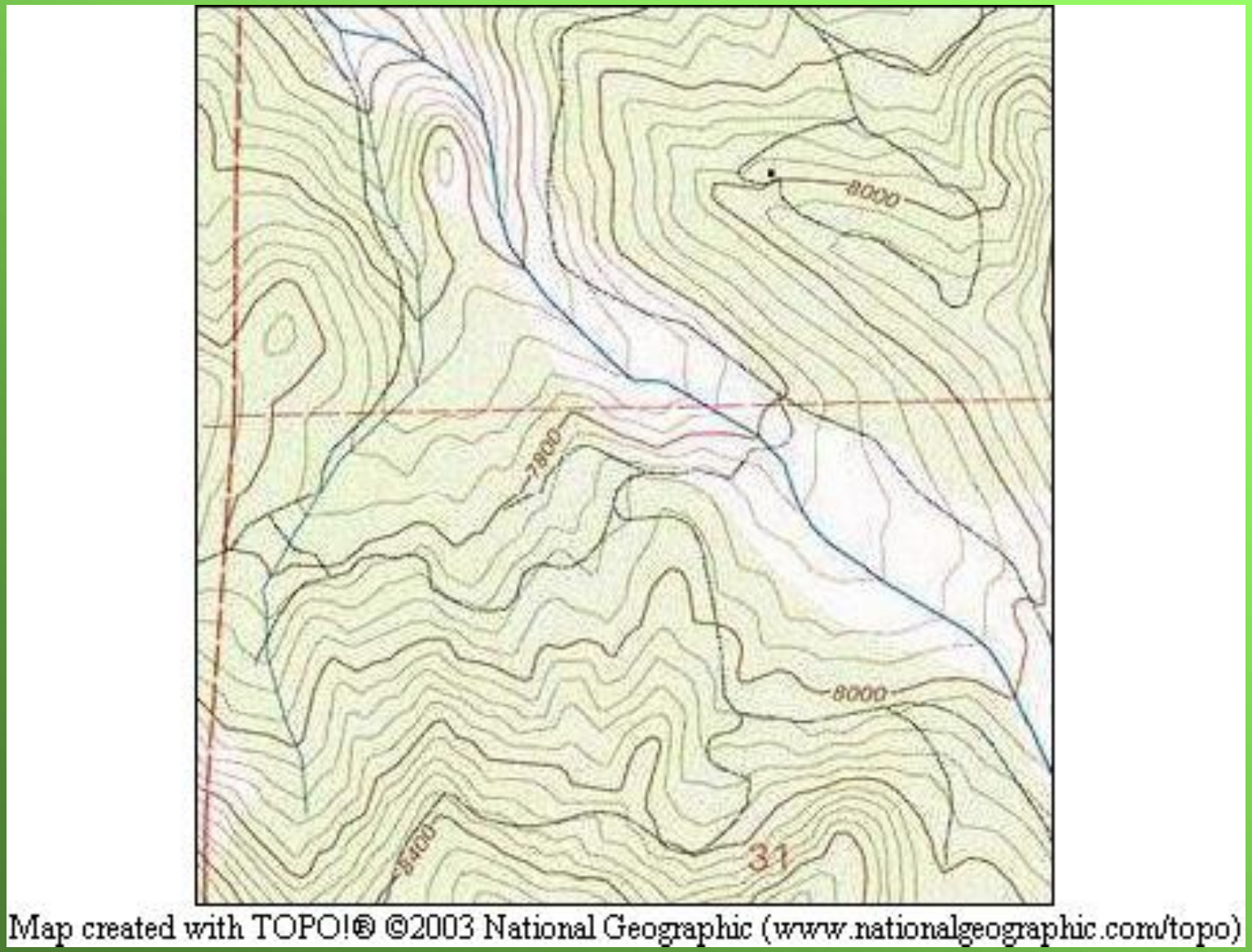
Which way is up?



Map created with TOPO!® ©2003 National Geographic (www.nationalgeographic.com/topo)

Without at least two elevation notations we can't be sure.

It can be challenging to identify your position in terrain without strong topographic features, especially in dense trees.



(3) Coordinate Systems

Coordinate Systems use a pair of numbers to describe a point on the map. One number describes the latitude (how far north or south of the equator), and one the longitude (how far east or west of Greenwich, England).

We need to be familiar with four different coordinate systems.

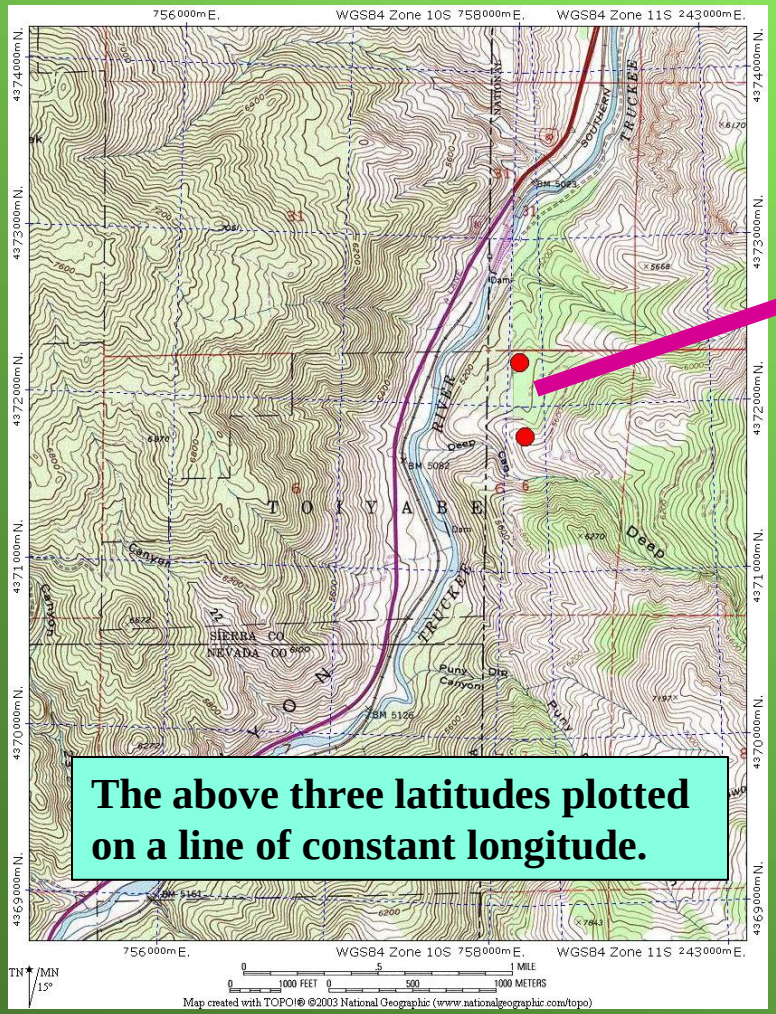
(3) Coordinate Systems

Degrees, minutes, seconds
39º 27’ 43” N
“39 degrees, 27 minutes (27/60 of a degree), 43 seconds (43/60 of a minute) north.”

Degrees, decimal minutes
39º 58.993’ N
“39 degrees, 58 and 99/100 minutes north.”

Decimal degrees
39.14266º N
“39 and 14/100 degrees north.”

39º 27’ 43” N ≠ 39º 27.43’ N ≠ 39.2743º N



The above three latitudes plotted on a line of constant longitude.

(3) Coordinate Systems

(UTM) Universal Transverse Mercator

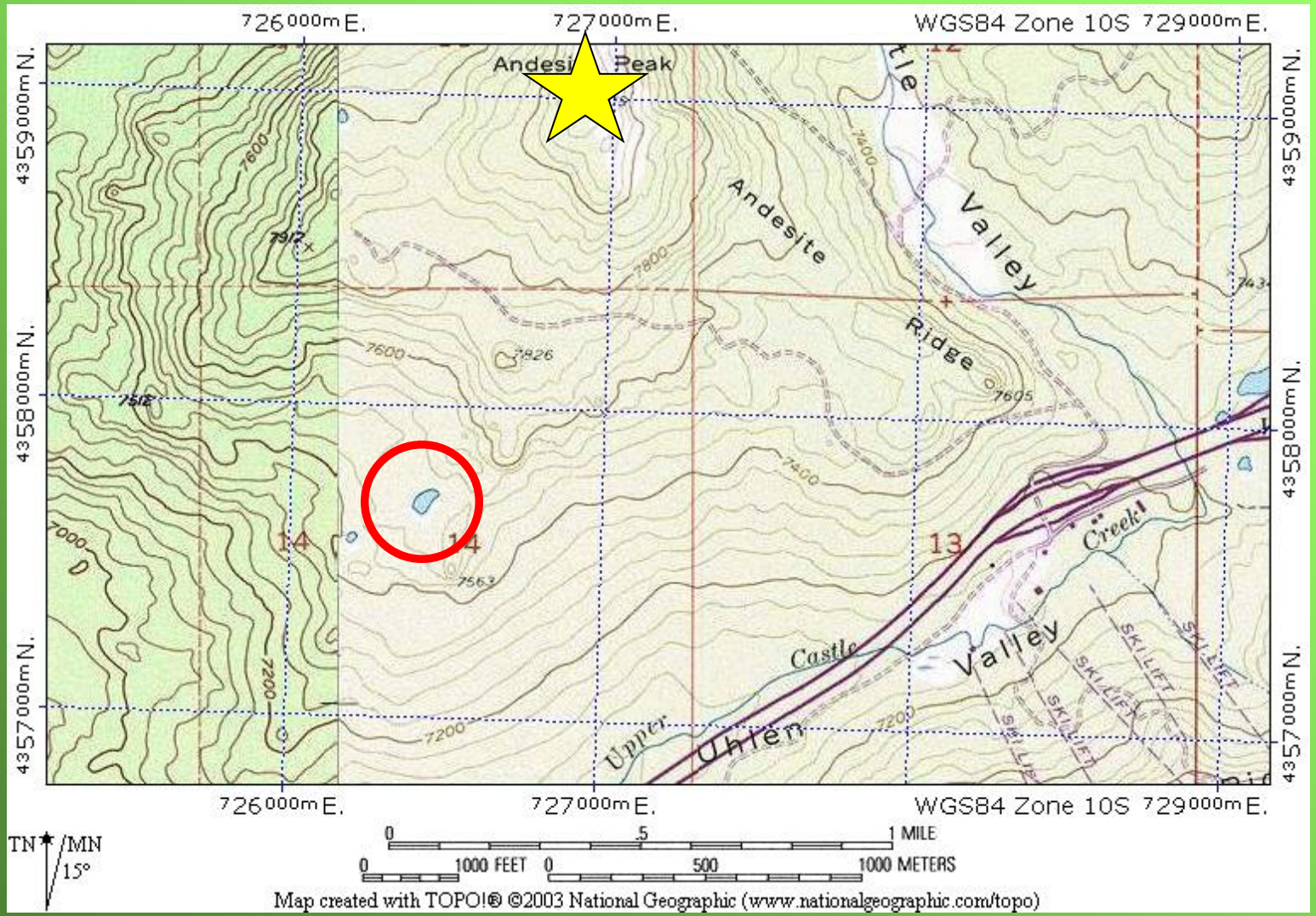
1000 m (1 km) grid

UTMs are zone dependent

A lot, but not all, of the Tahoe Sierra is Zone 10S

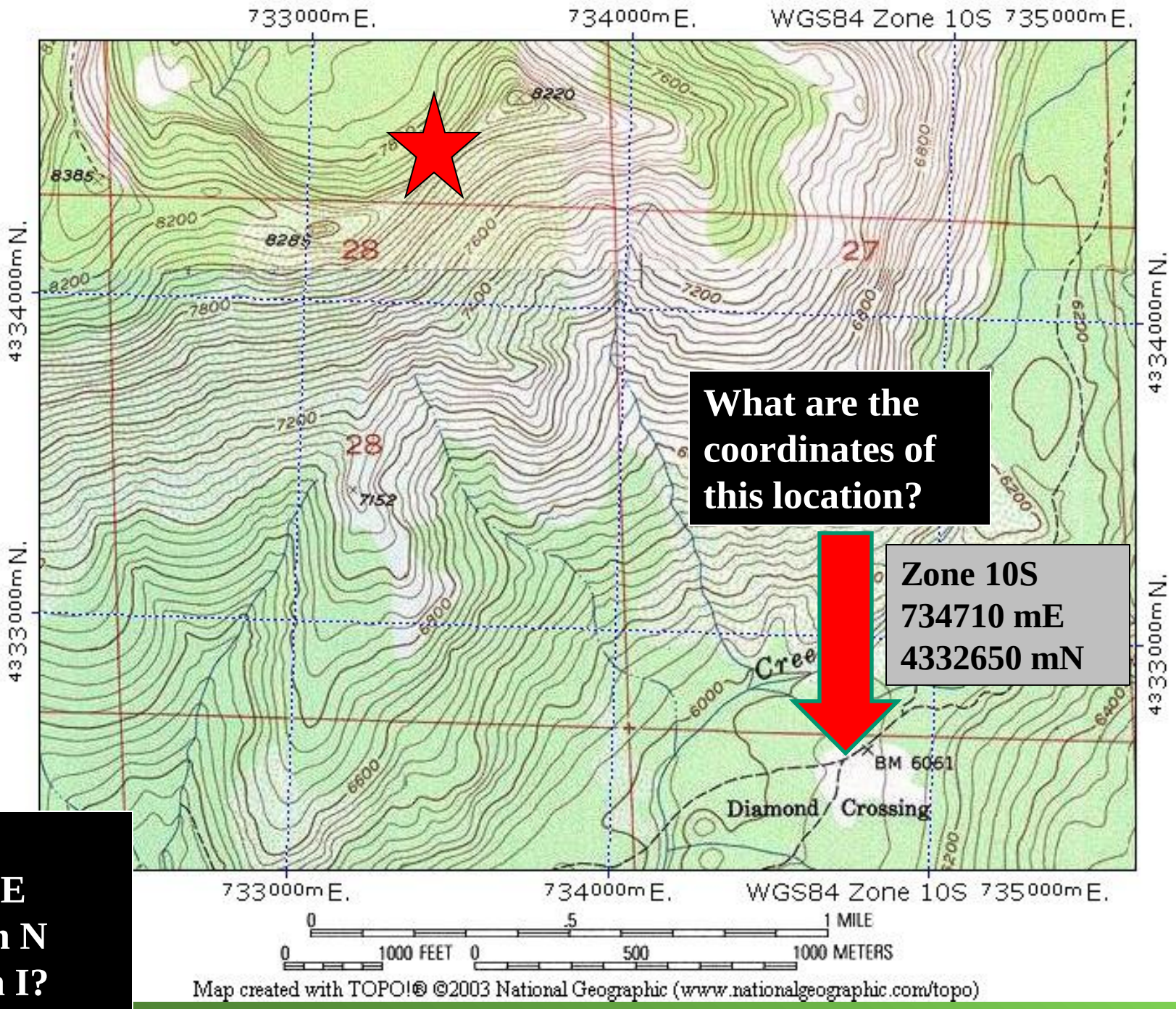
We like UTMs because it is the easiest coordinate system with which to describe a position on a paper map.

(4) Finding a Coordinate

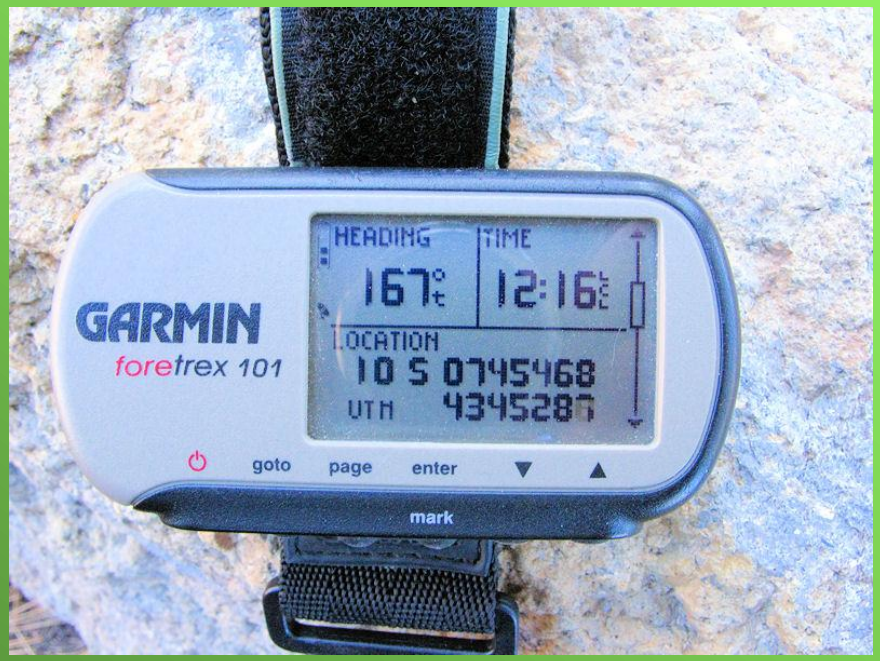


Zone 10S, 726418 m E, 4357696 m N (small lake)

Zone 10S, 726904 m E, 4359040 m N (?)



Zone 10S
733417 m E
4334450 m N
Where am I?



Three coordinates systems describing the same location.

(5) Anatomy of a Compass

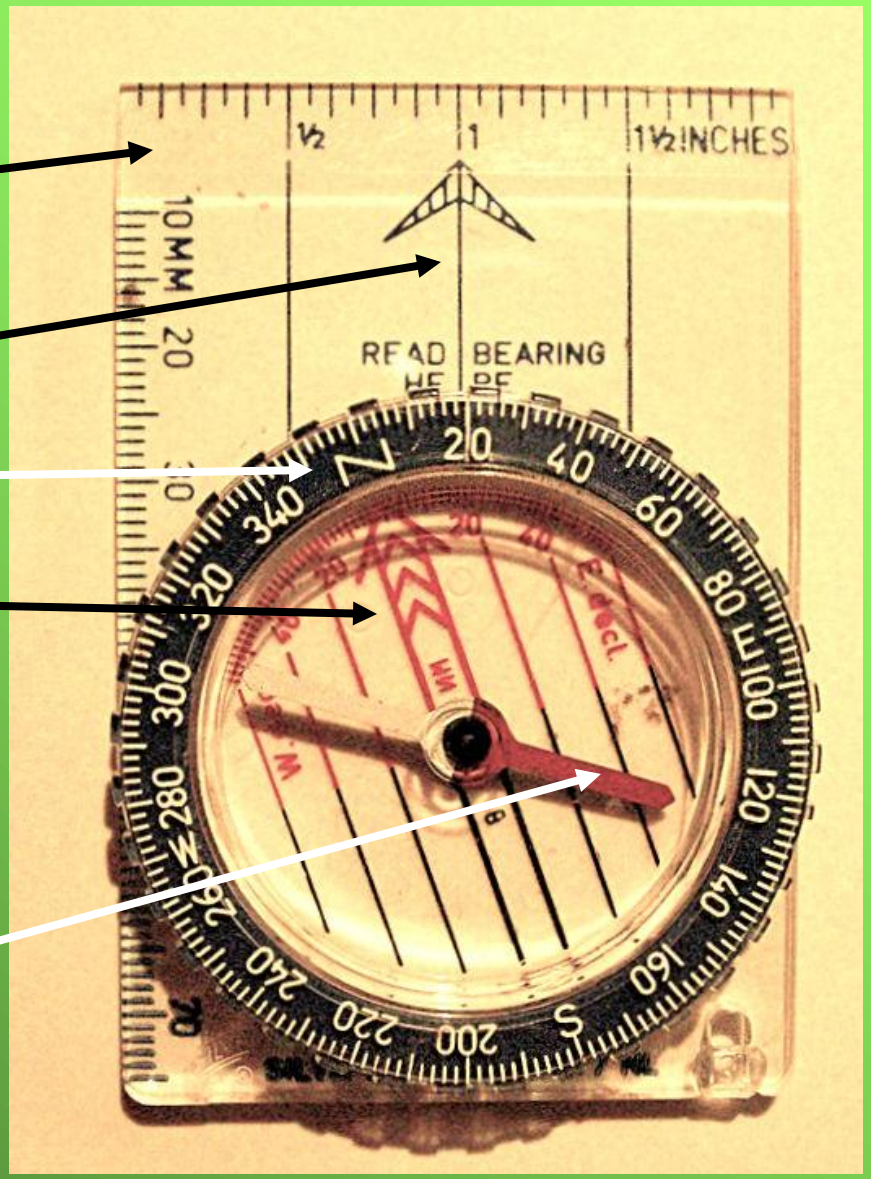
Base plate

Direction of travel arrow

Housing

Orienteering arrow

Magnetic needle



A compass's needle is a very sensitive magnet. When using the compass, keep it away from metal and electronics (GPS, radio, avalanche transceiver, watch). Some rocks and minerals contain large amounts of iron. These will also deflect a compass's needle.

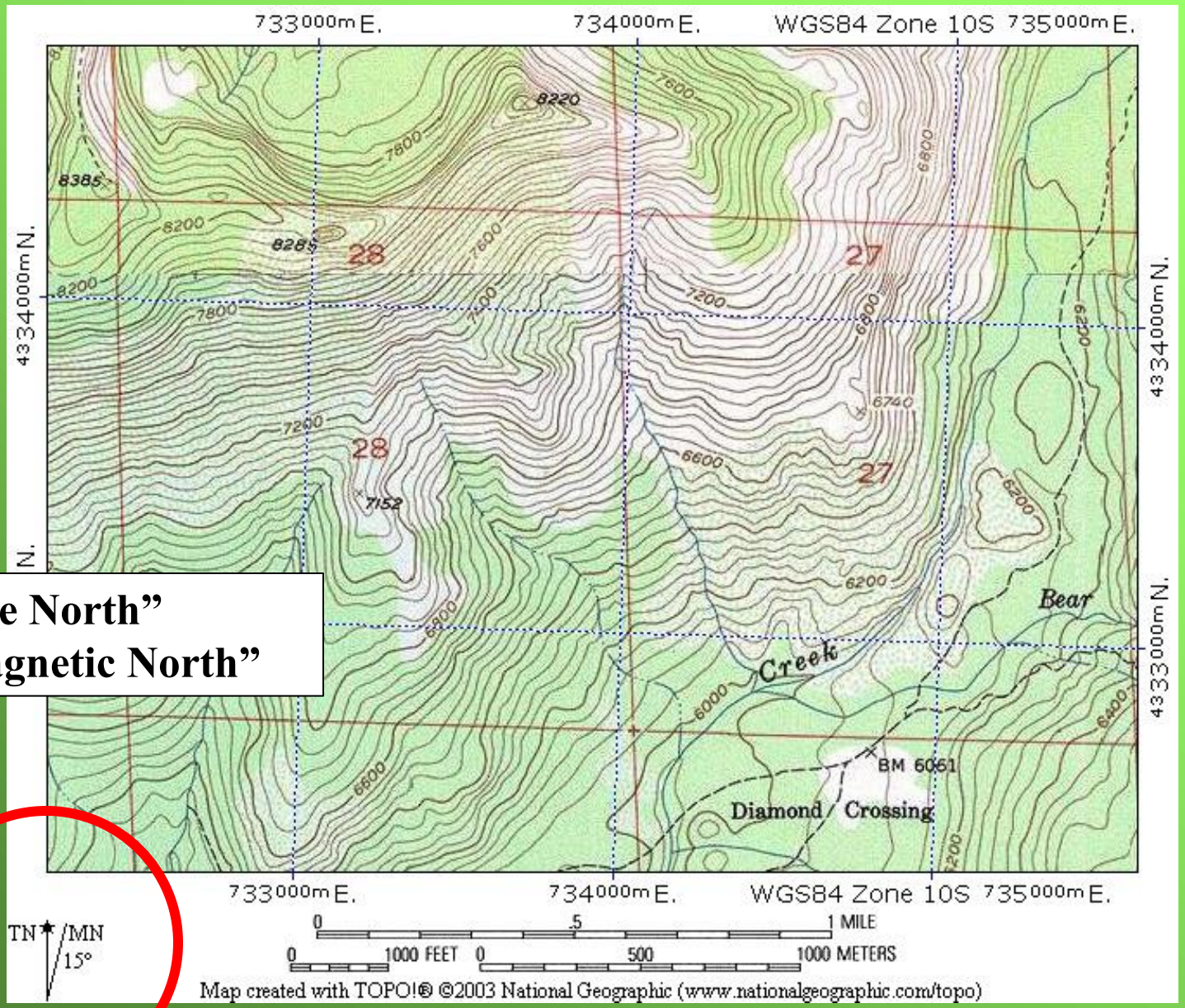
(6) Understanding Magnetic Declination

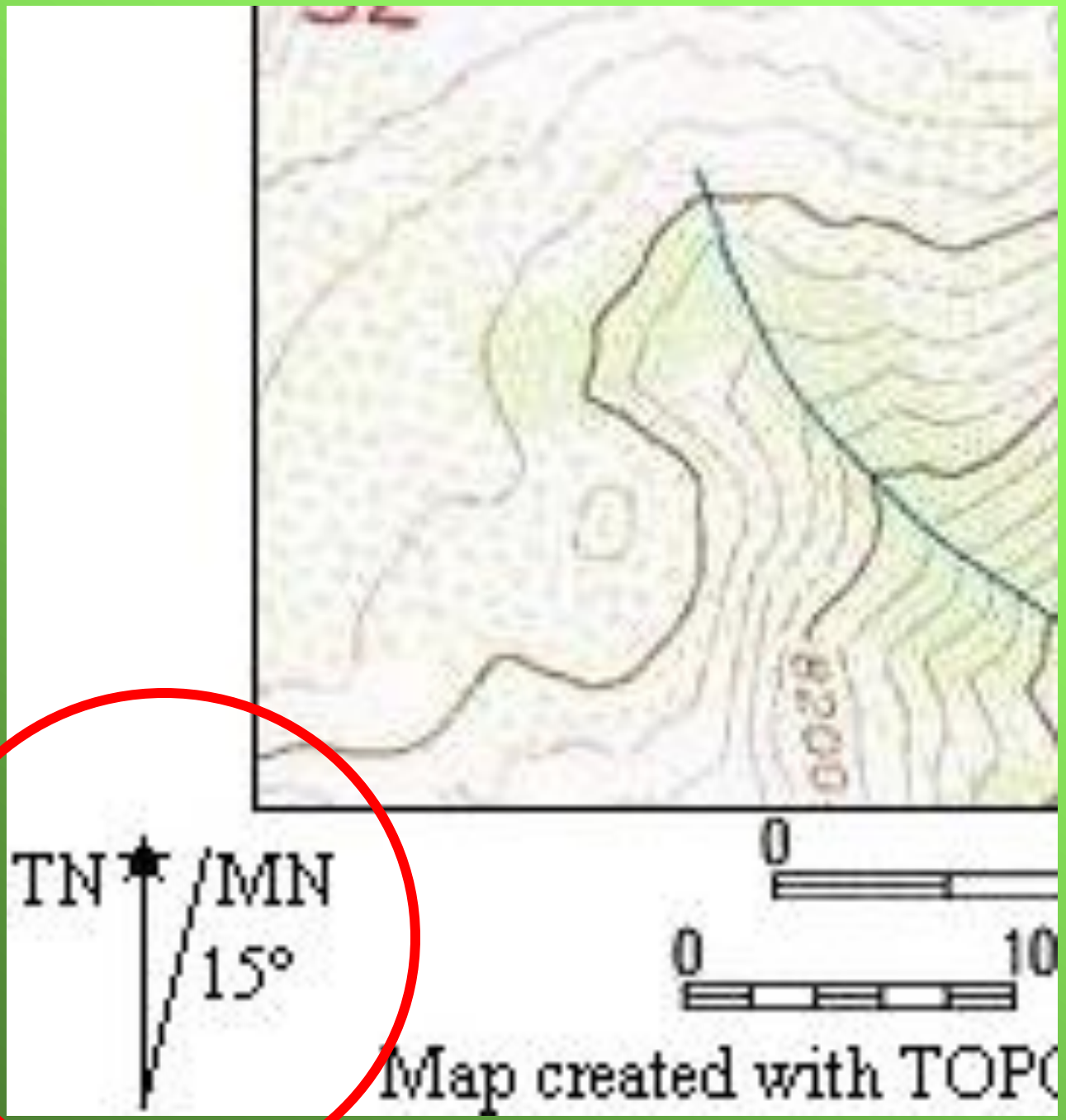
Magnetic declination is simply the measured difference (in degrees) between true north (a straight line from you to the North Pole) and the direction your compass points (toward Earth's magnetic core). This difference is a function of time and your position on Earth.

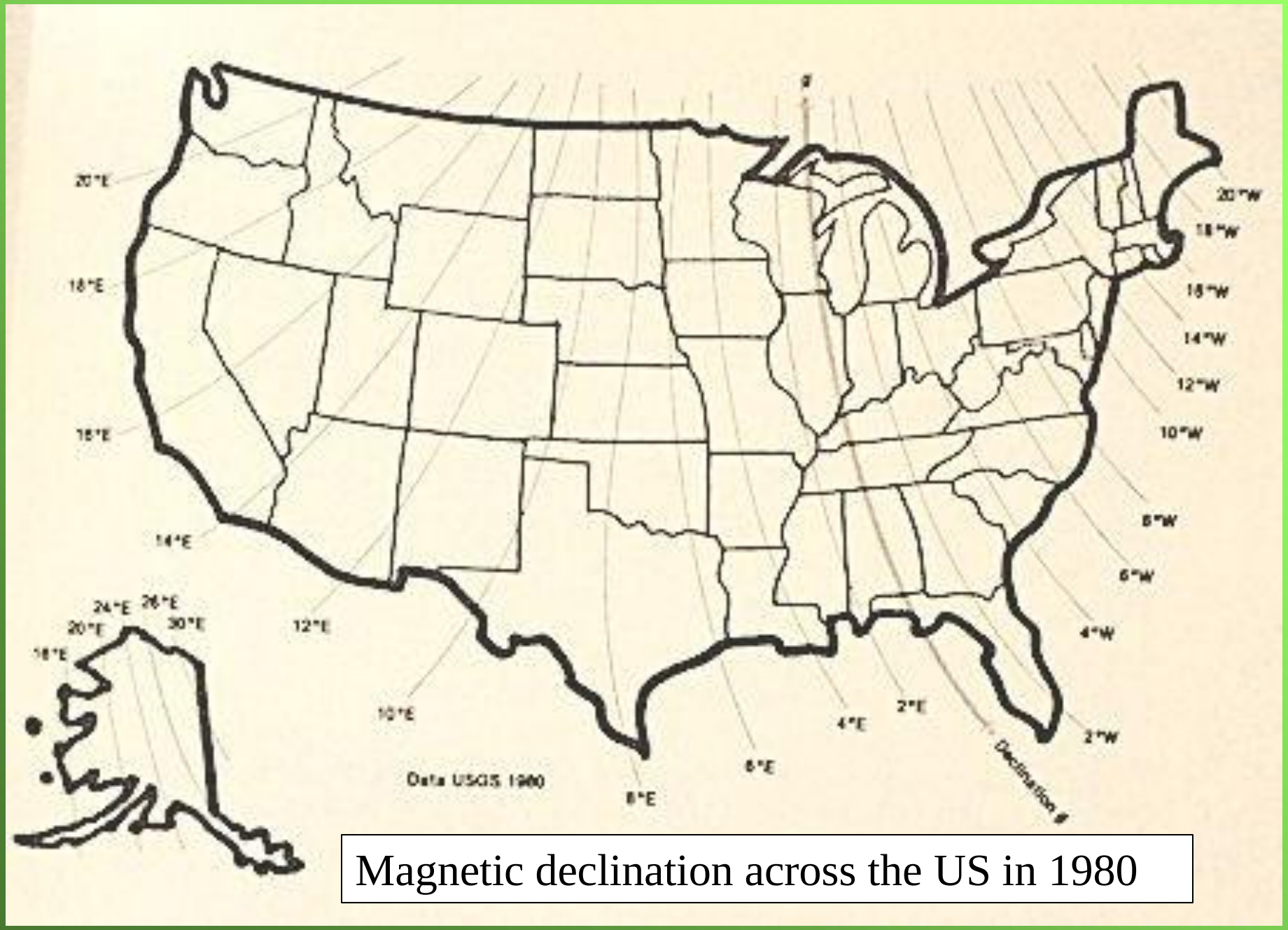
The magnetic declination at Kings Beach on October 28, 2010 was 14º 10' E (14.17º E). It is forecast to change about 0º 6' W (.1º W) per year.

www.ngdc.noaa.gov/geomagmodels/declination.jsp

TN = “True North”
MN = “Magnetic North”




TN
/MN
15°
0
0
10
Map created with TOPO

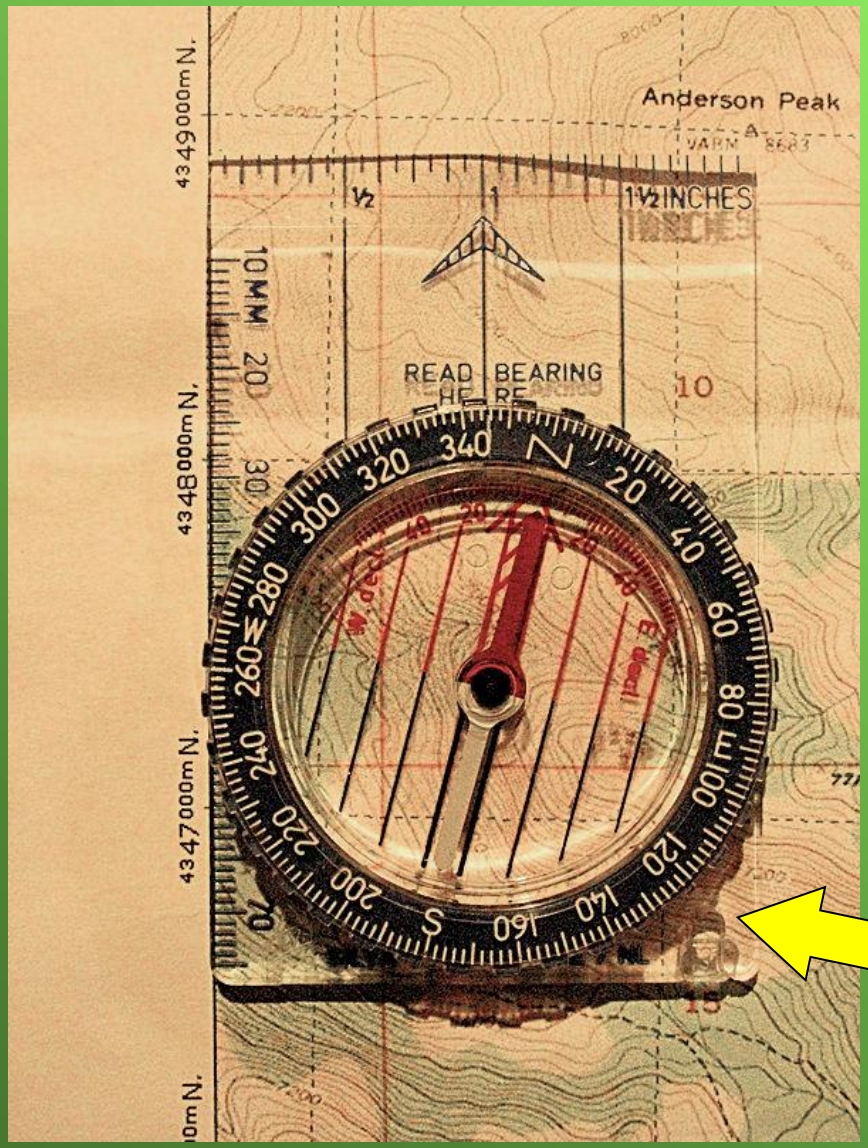


Magnetic declination across the US in 1980

(7) Orienting the map to true north

In order to reckon terrain features with those depicted on the map, we have to be able to orient the map coincident with the terrain.

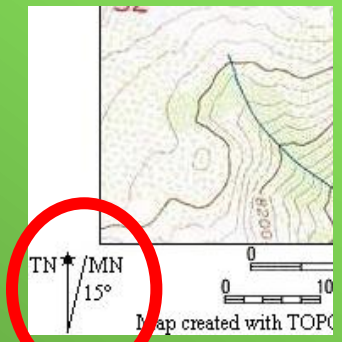
(7) Orienting the map to true north



Set your compass bearing to 346º (True north - 14º (mag declination)).

Align edge of compass base plate and N/S edge of map.

Hold map and compass together and turn until the compass's magnetic needle aligns with the compass's orienteering arrow (**RED** on **RED**).



(8) Lay out a bearing, or travel, line

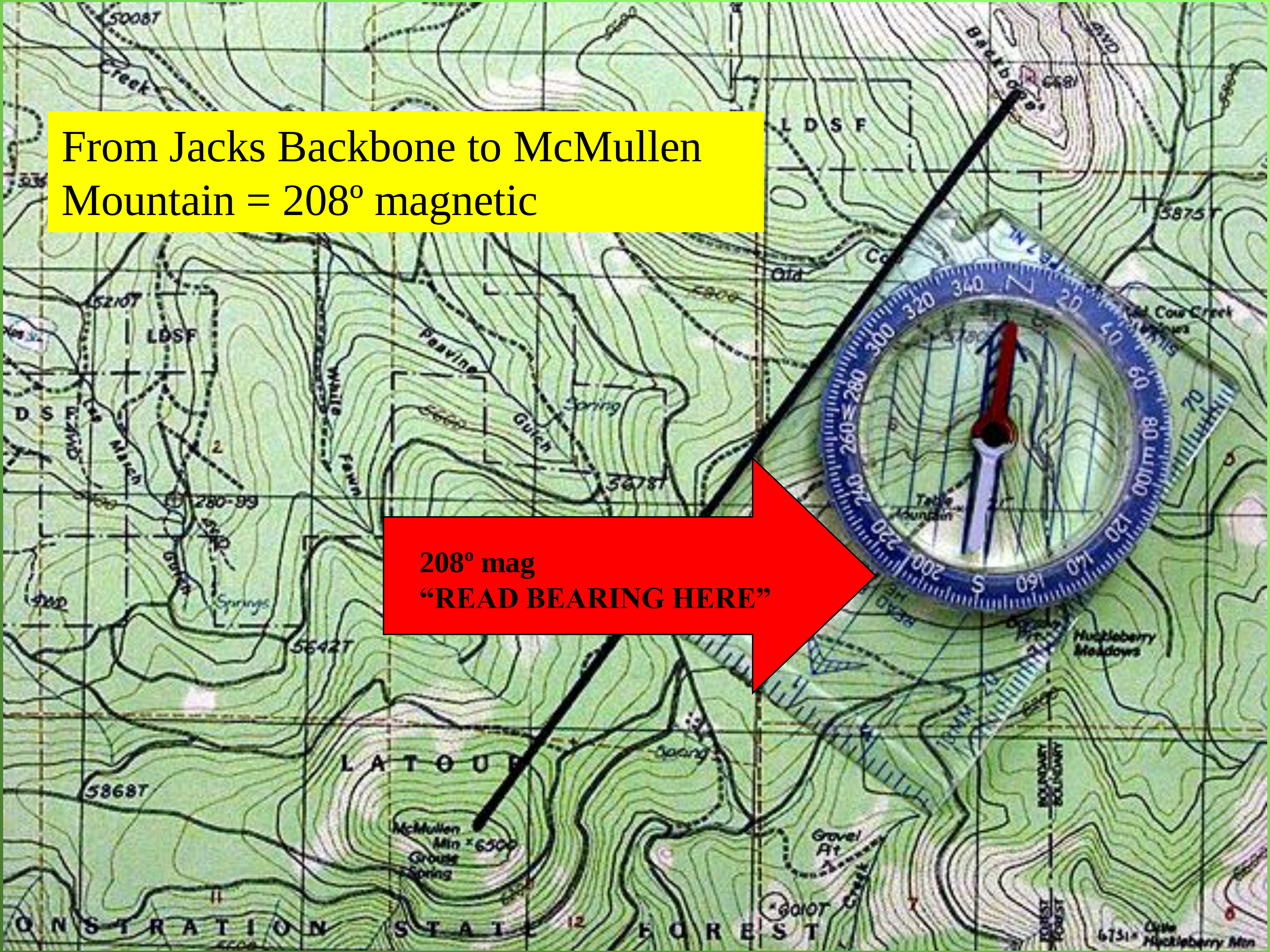
Orient the map to true north.

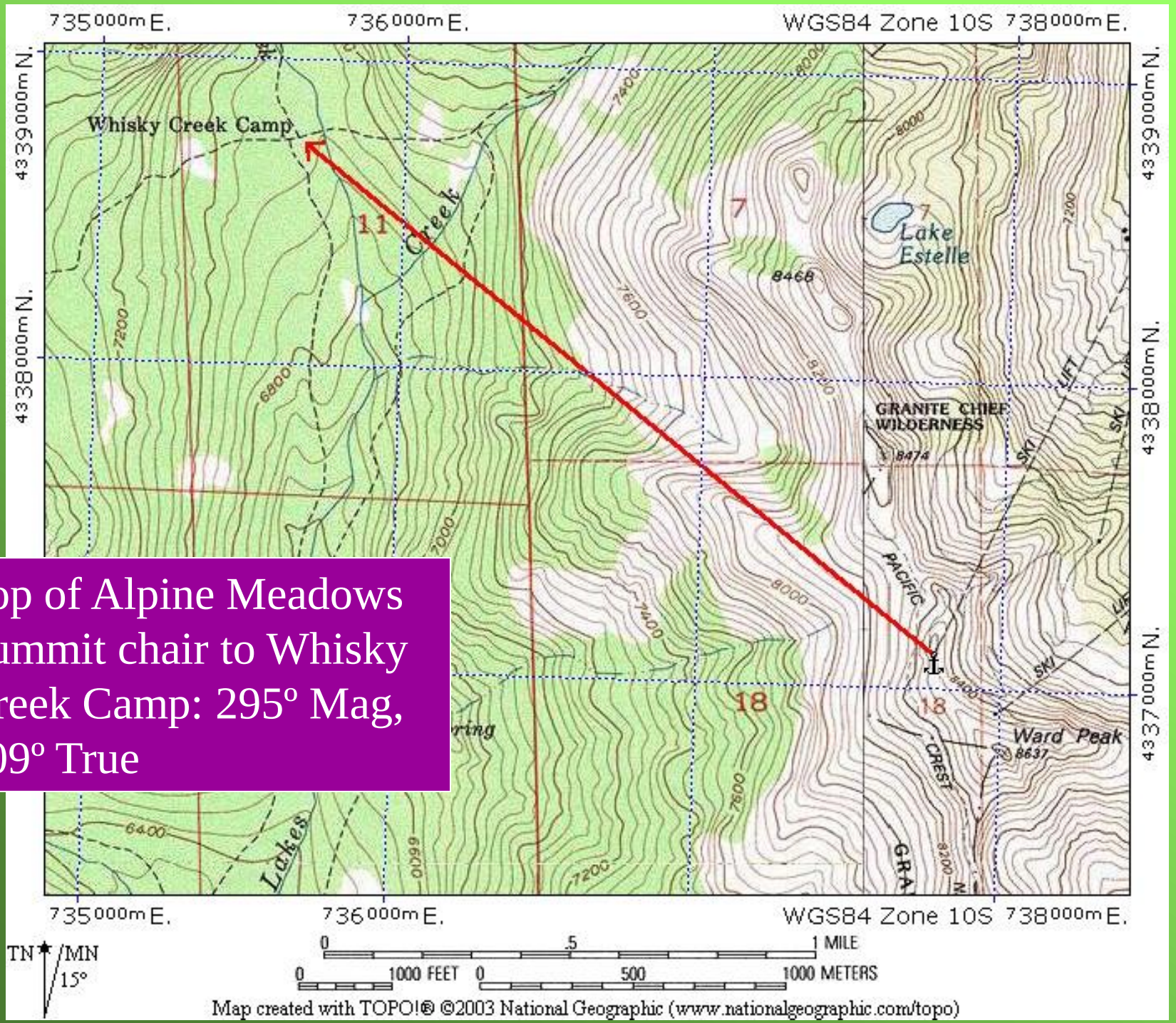
Draw a line between points of travel.

Put compass along line and align needle and orienteering arrow (**RED** on **RED**). This will be the *magnetic* bearing.

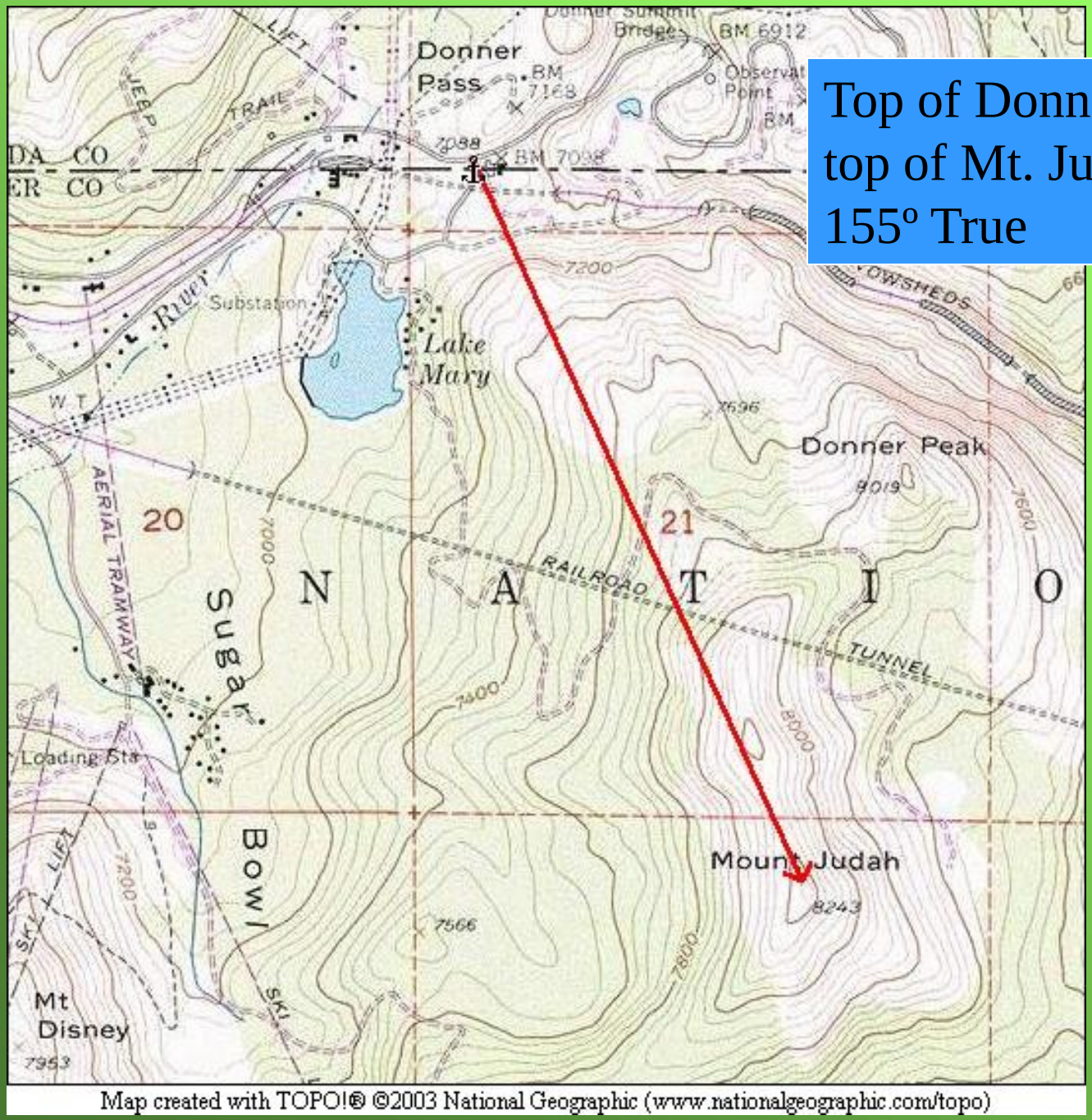
To get *true* bearing, add declination.

From Jacks Backbone to McMullen Mountain = 208º magnetic





Top of Alpine Meadows Summit chair to Whisky Creek Camp: 295º Mag, 309º True



Top of Donner Pass Road to top of Mt. Judah 141º Mag, 155º True

Bearing:

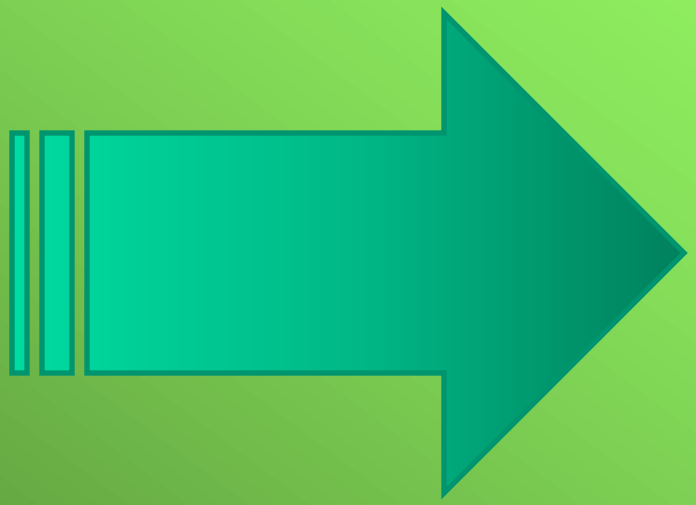
310º magnetic

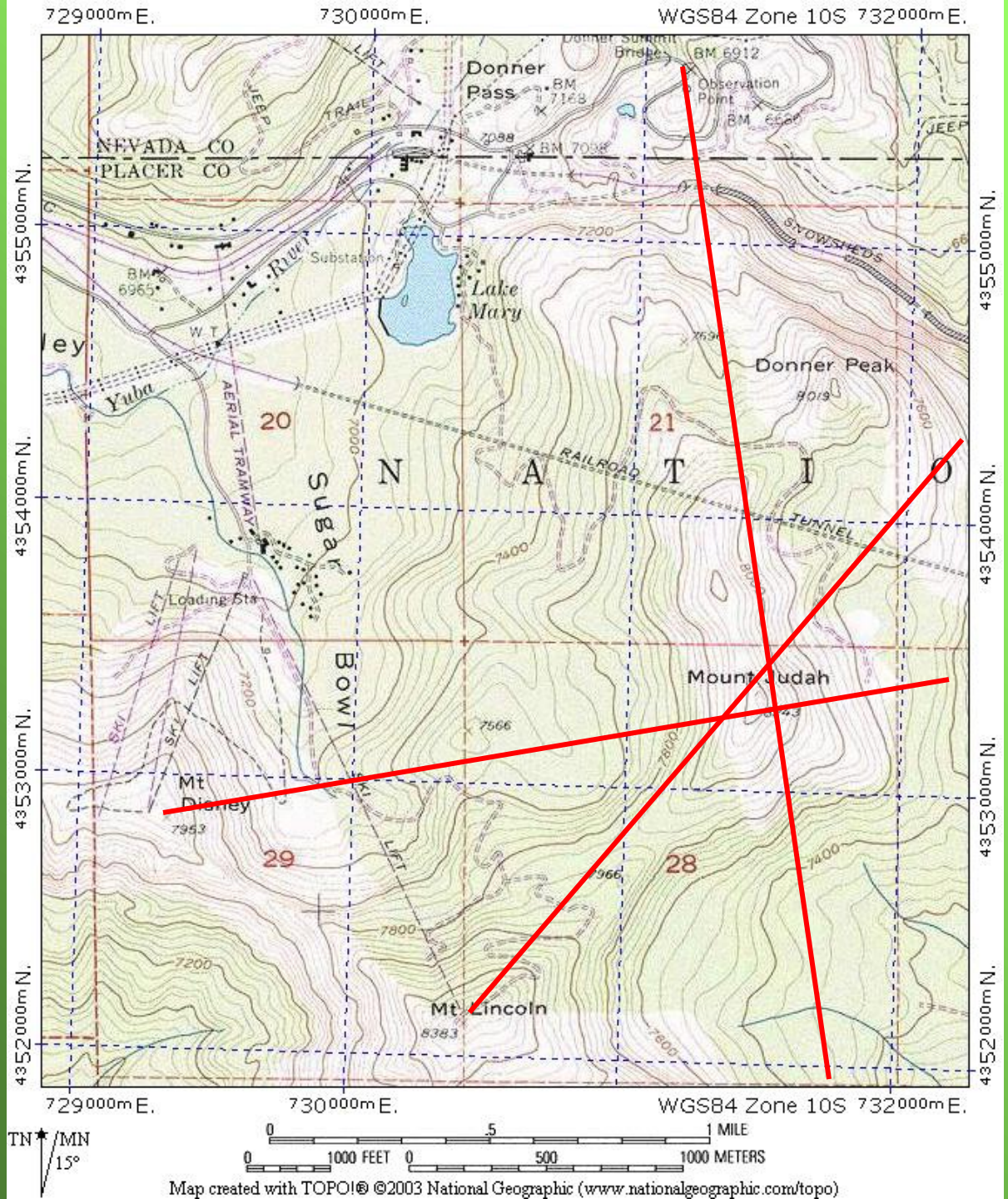
Note: RED on RED

(9) Triangulating your position

1) Orient the map to true north.
2) Take compass bearings from locations you can ID from both the landscape and the map. Scribe these bearing lines on the map.
3) Where these lines cross will (theoretically) be your position.
4) In practice, *three* bearing lines will define a triangle. You're somewhere in the triangle.

We’re somewhere on Donner Summit. Let’s take bearings off the bridge on Donner Pass Road, Mt. Lincoln, and Mt. Disney…




729000m E.
730000m E.
WGS84 Zone 10S
732000m E.
4355000m N.
4354000m N.
4353000m N.
4352000m N.
Donner Pass
BM 7168
BM 6912
Observation Point
NEVADA CO
PLACER CO
Lake Mary
Substation
BM 6965
Donner Peak
8019
Yuba
AERIAL TRAMWAY
RAILROAD
TUNNEL
Sugar Bowl
Loading Sta
SKI LIFT
Mount Judah
8243
Mt Disney
7953
Mt Lincoln
8383
20
21
29
28
N A T I O
SNOWSHEDS
JEEP TRAIL
7200
7400
7600
7800
TN 15° MN
0 .5 1 MILE
0 1000 FEET 0 500 1000 METERS
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THANK YOU !

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