

UTM

Universal Transverse Mercator Coordinates

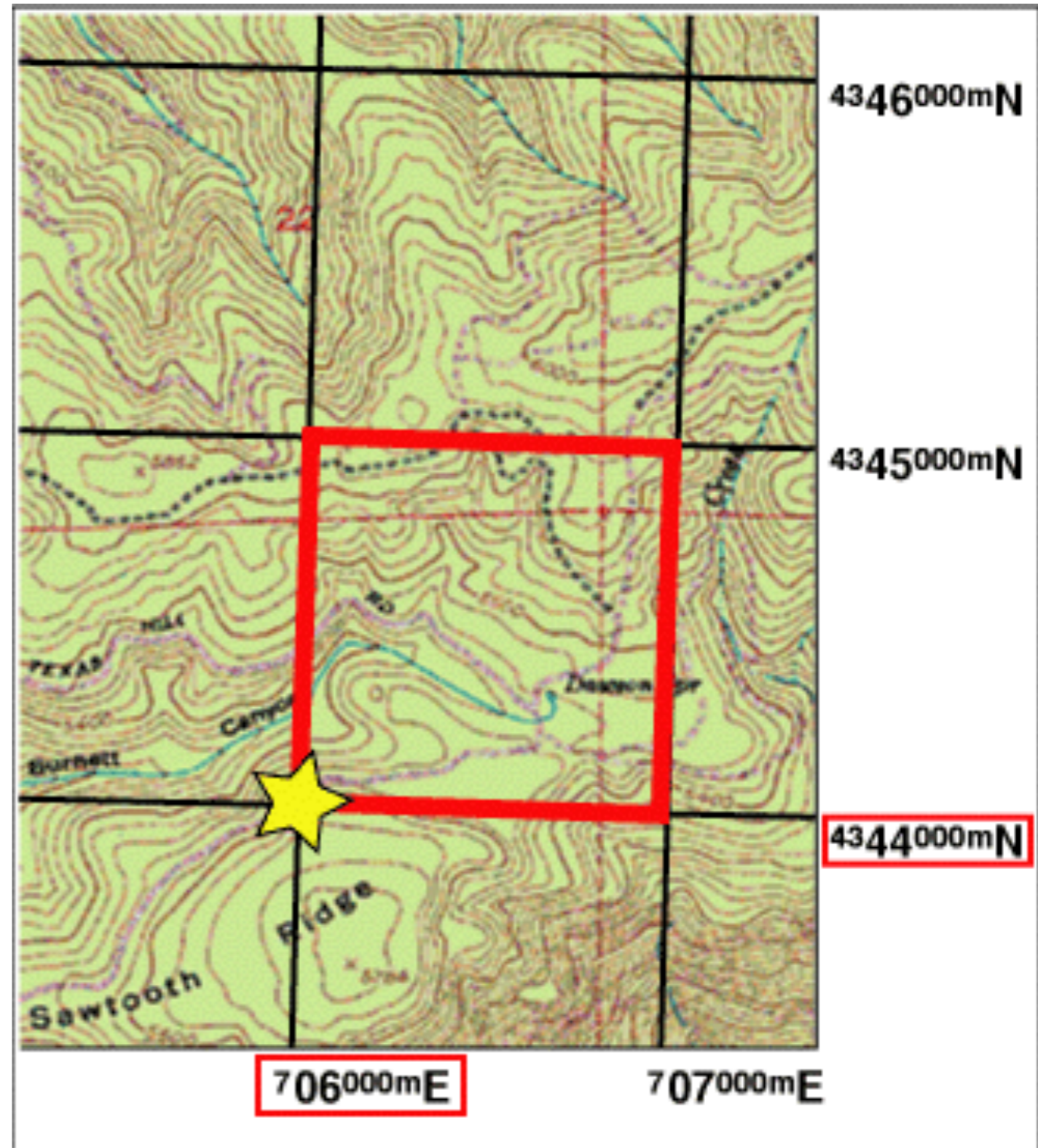


*UTM Exercise
Locating the Grid
UTM Guide
USNG Sheet*

- This 1km square is located at

706km E 4344km N

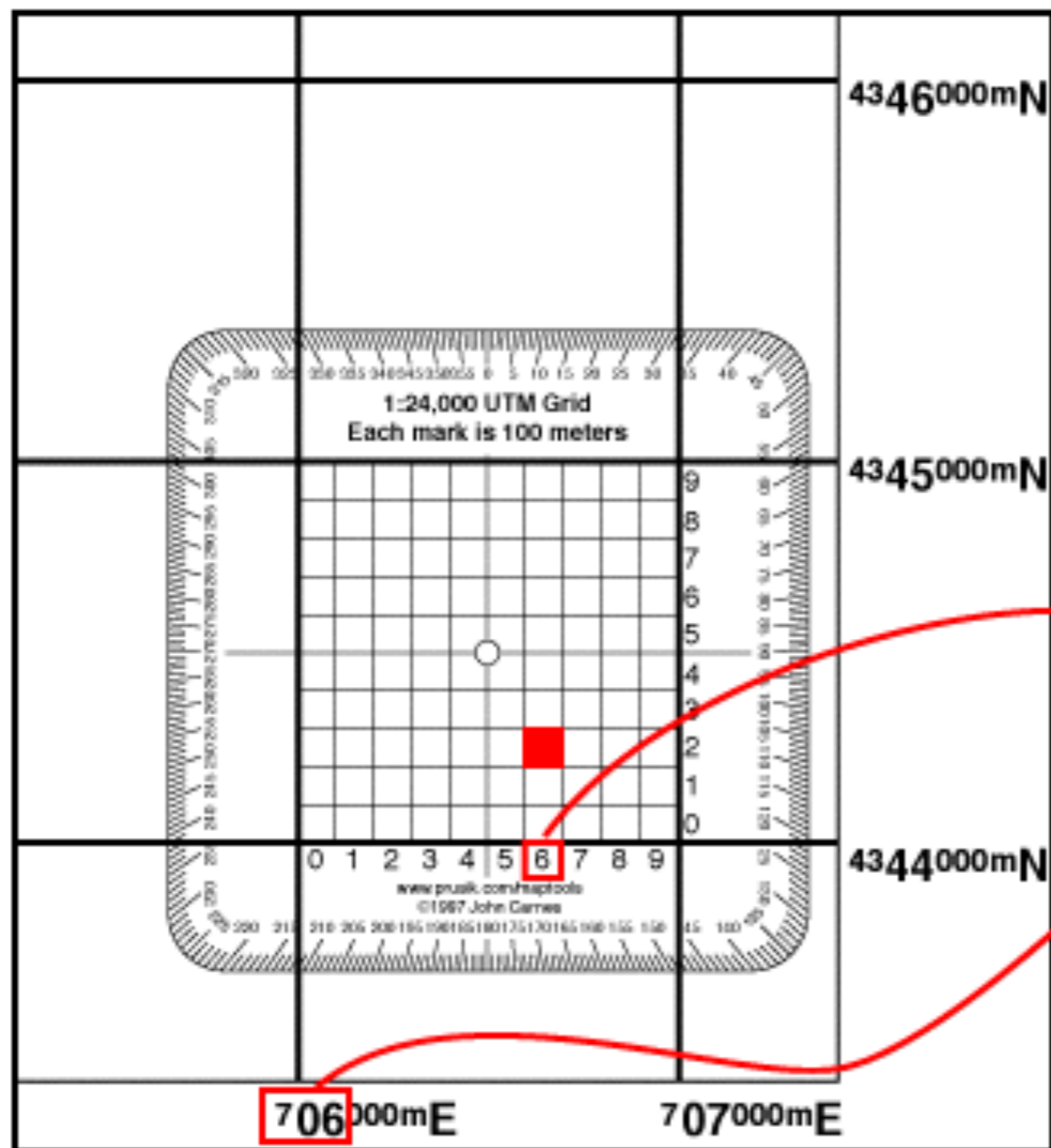
- Usually we need to be a bit more precise about a location!



Using UTM is Easy

- Take a look at the “UTM Practice Map” handout.
- Can you quickly determine what map feature is at:

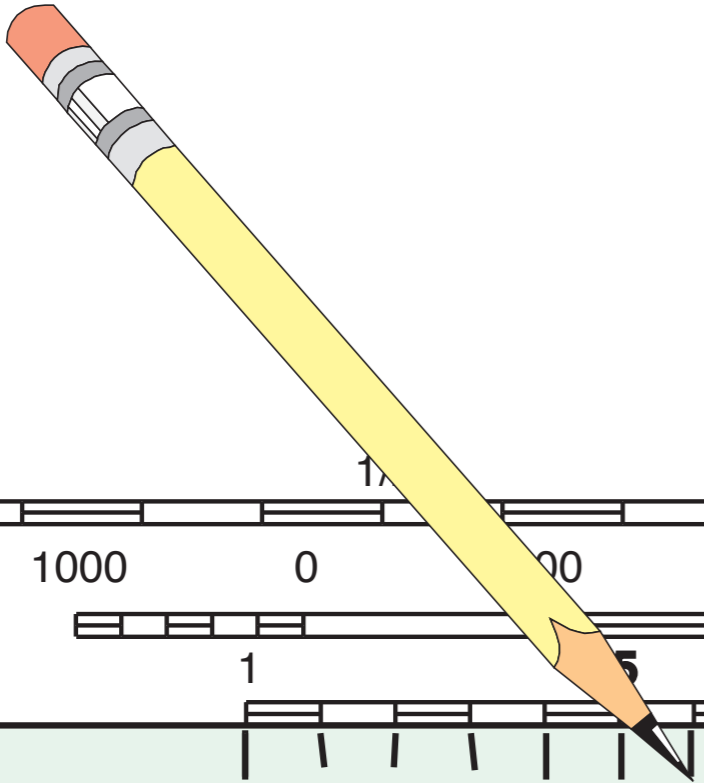
755.2 km E 4255.4 km N



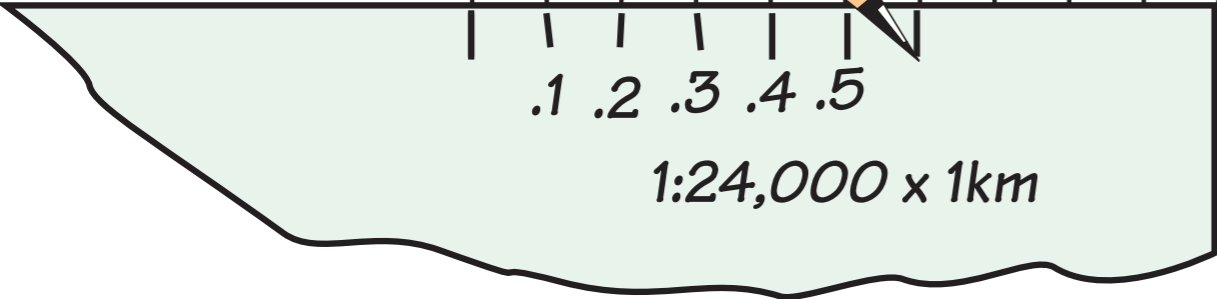
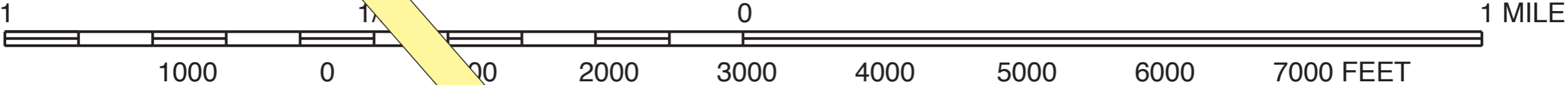
A simple UTM Grid tool will quickly locate a 100m square.

This 100m square is located at:

706.6km E 4344.2km N



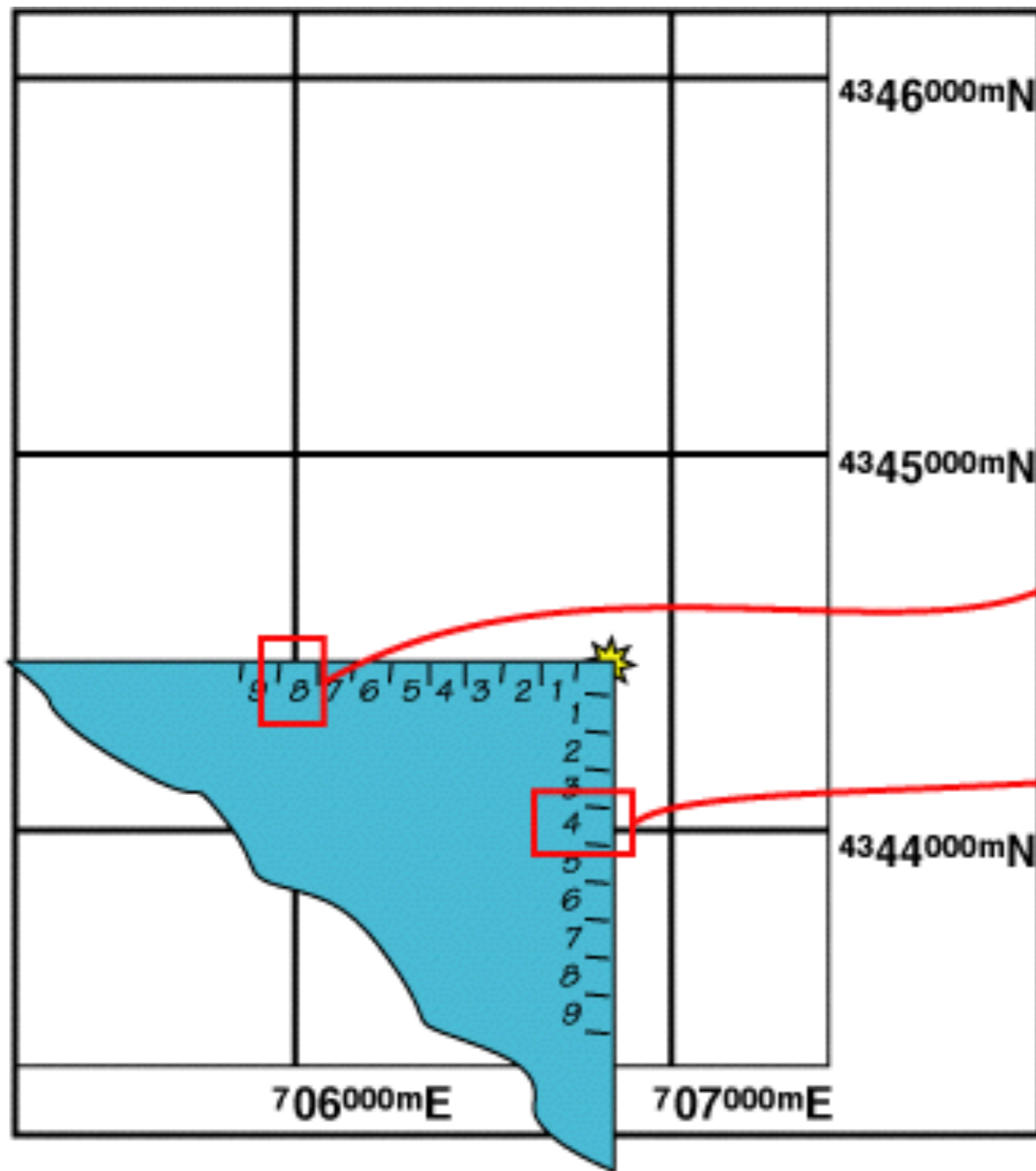
SCALE 1:24,000




.1 .2 .3 .4 .5

1:24,000 x 1km

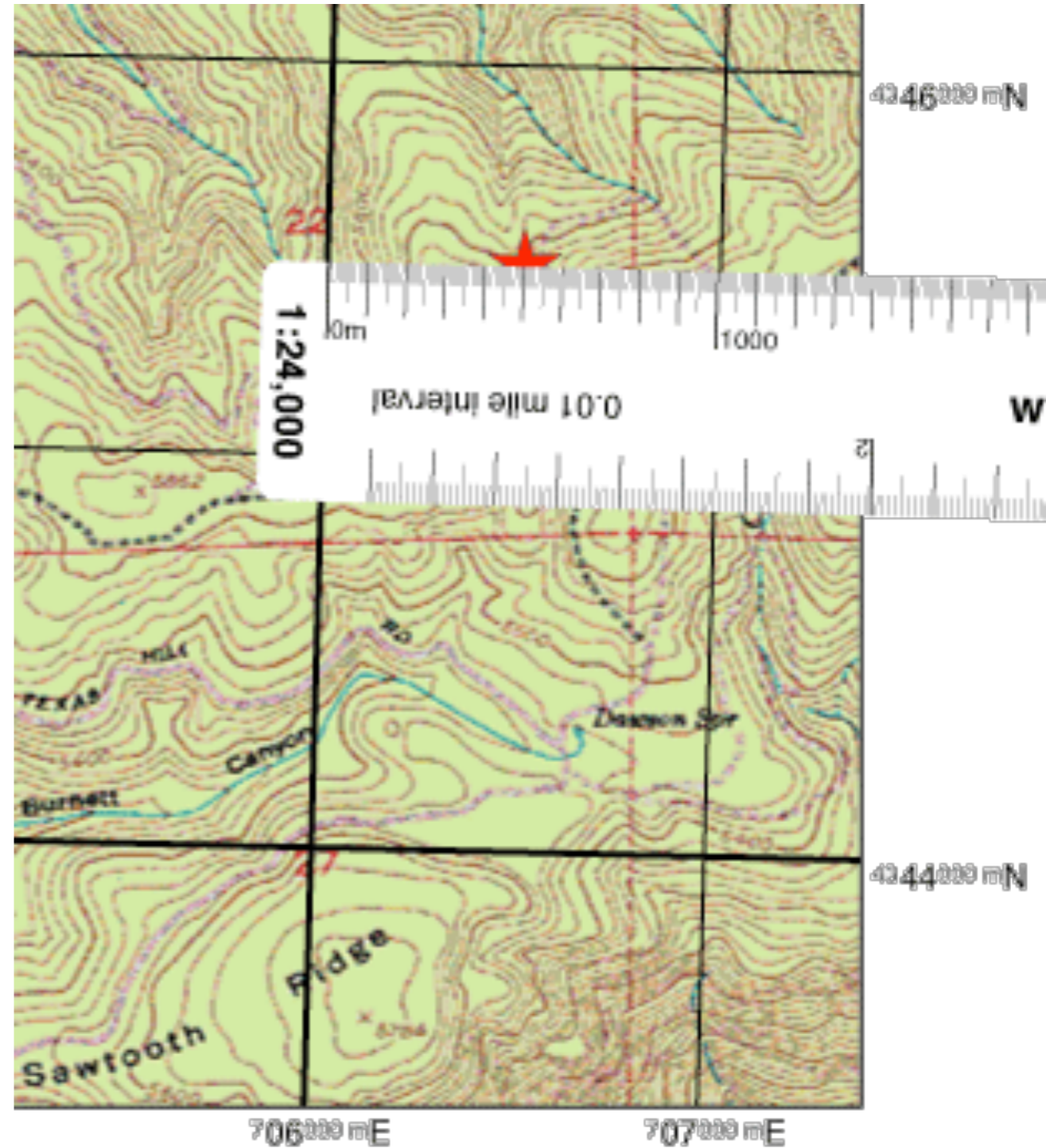
INTERVAL 40 FEET



The  is located at:

706.8km E 4344.4km W

Using a distance scale, marked in meters, to measure UTM coordinates



There are many ways to write the same position...

P
r
e
c
i
s
i
o
n
|
|
V

Kilometers

Meters

755km E 4255km N

755000m E 4255000m N

755.2km E 4255.4km N

755200m E 4255400m N

755.23km E 4255.48km N

755230m E 4255480m N

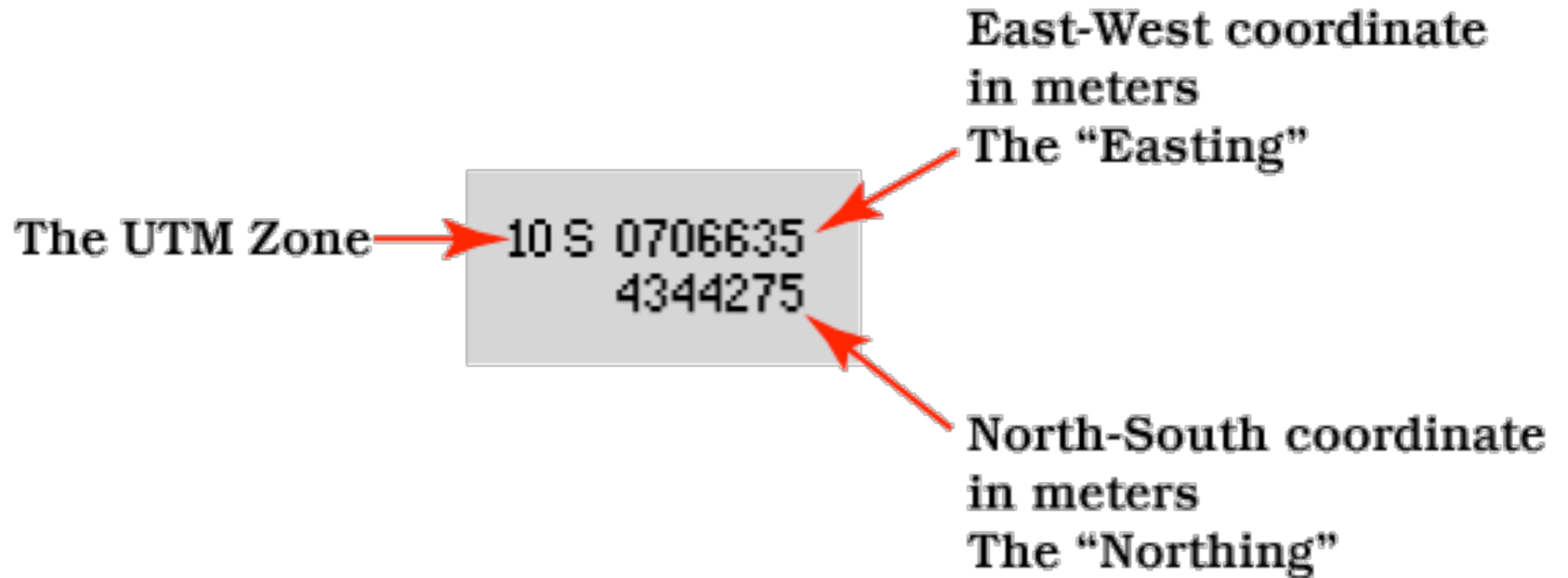
755.234km E 4255.483km N

755234m E 4255483m N

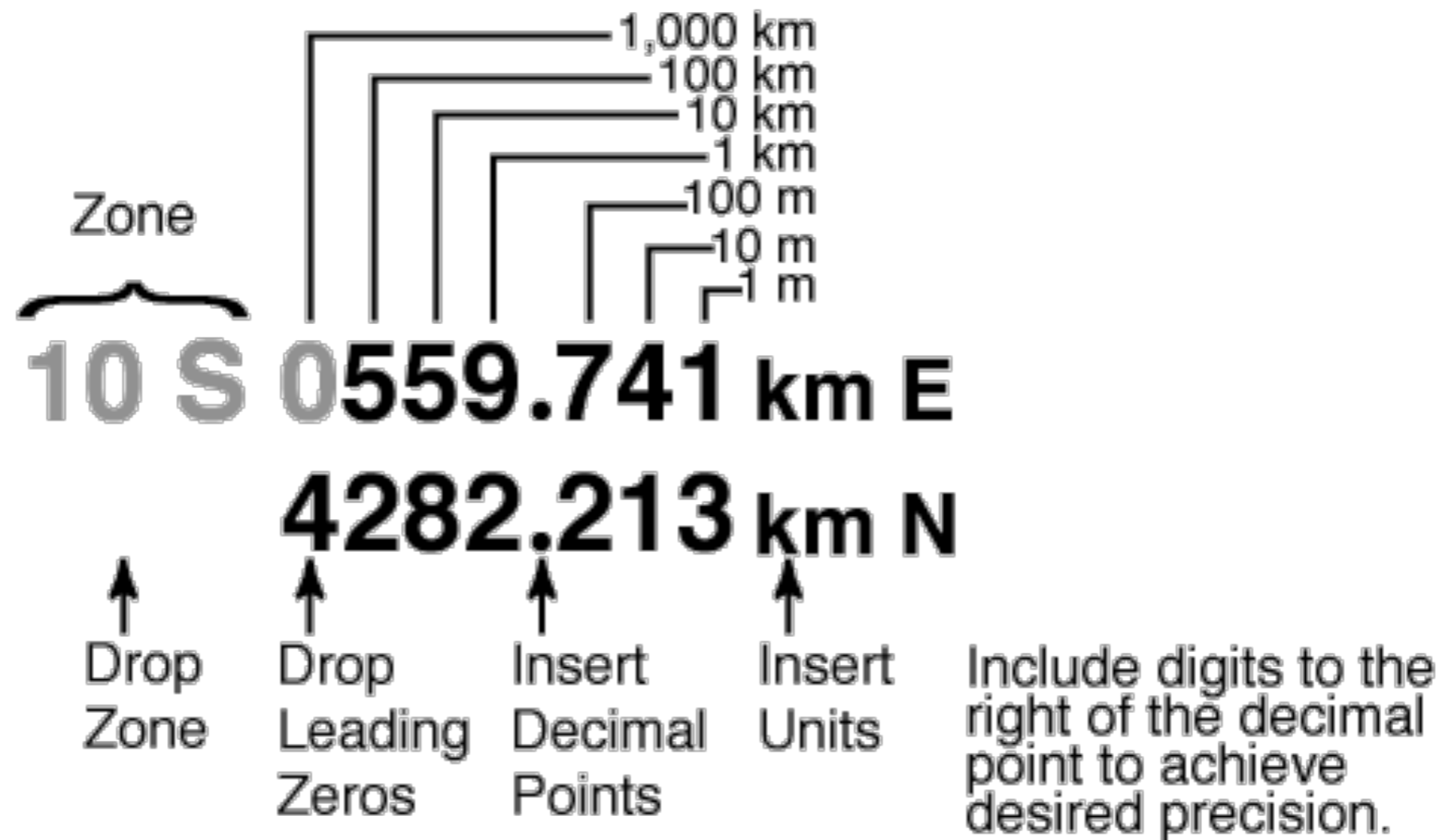
755.200km

755 200m

UTM Display on a GPS Receiver

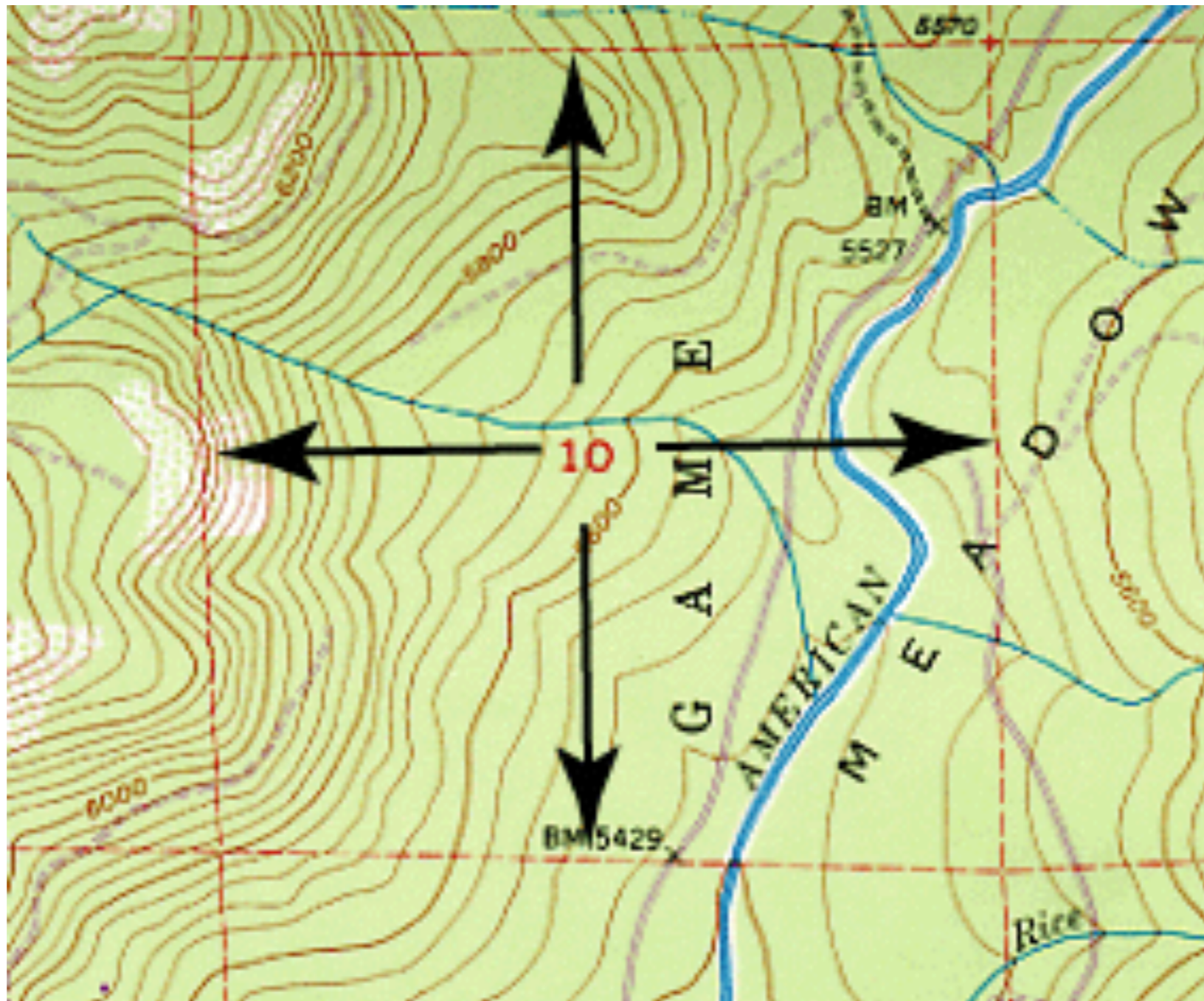


Reporting your position in UTM kilometers

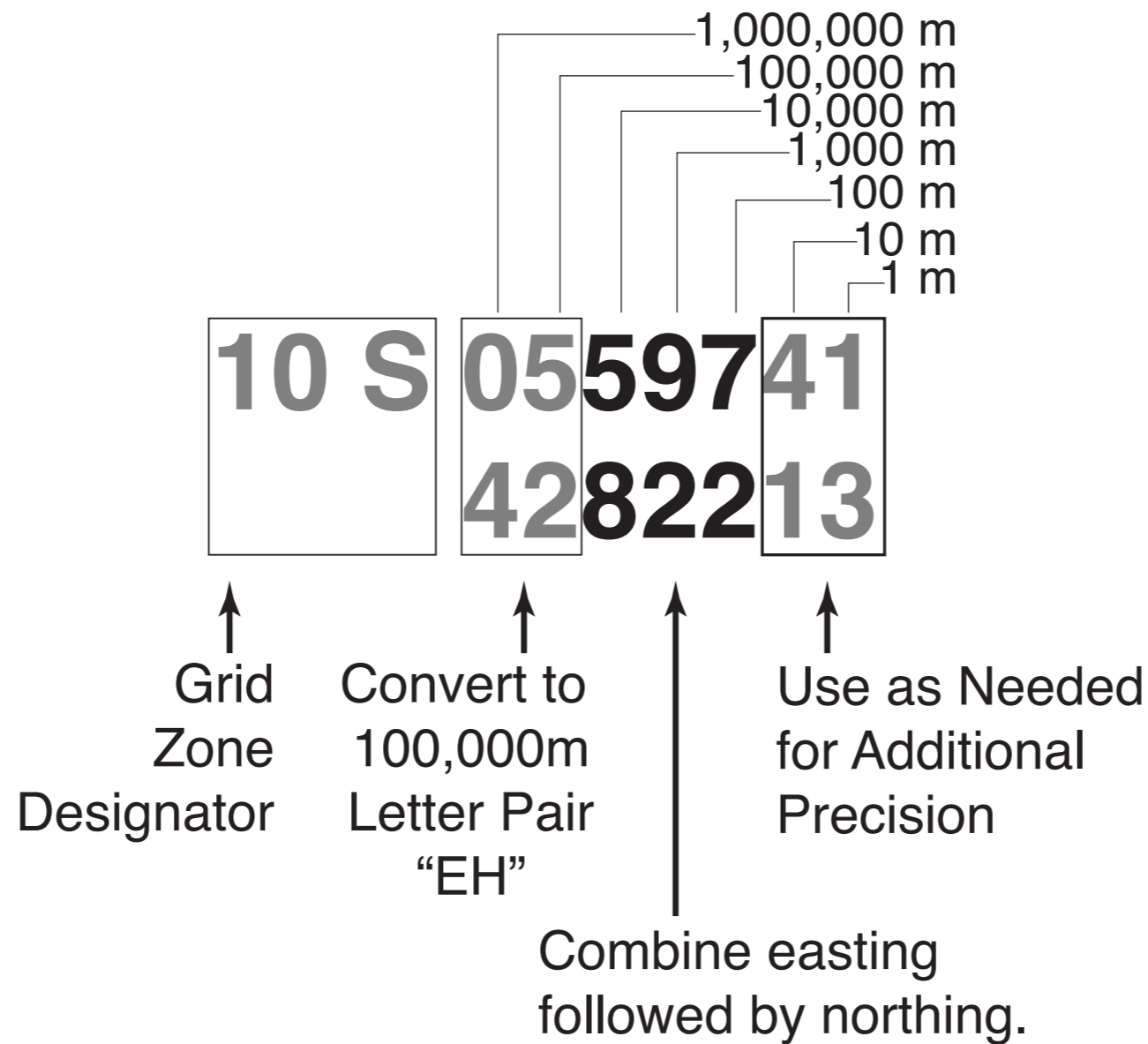


559.74km E 4282.21km N

This is a
Township & Range Section,
NOT a UTM Grid

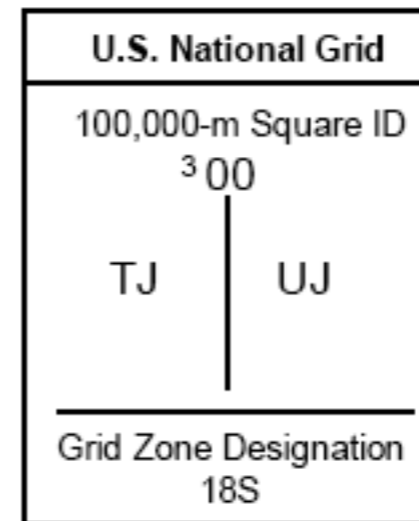
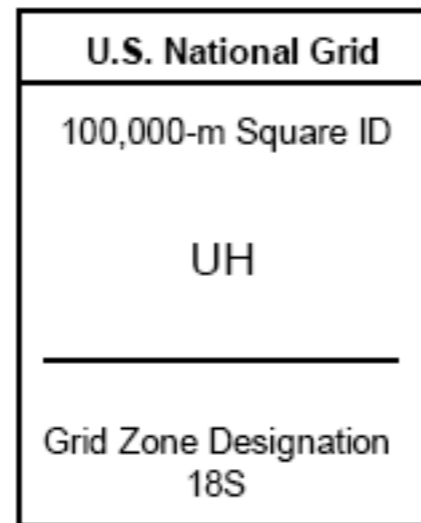


U.S. National Grid (USNG) Coordinates



Full MGRS Coordinate with 100m Precision: **10SEH597822**
Abbreviated MGRS Coordinate with 100m Precision: **597822**

Printed Grid Reference Box



U.S. National Grid could make many location signs “GPS Compatible”

House Numbers



Upgraded Highway Mile Post



Trail
Markers



Rural Fire Numbers



Make a mark between digits
from the grid | within the grid

USGS

1:24,000

1000m grid

755|230m E 4255|480m N

755|.23km E 4255|.48km N

Campus Air Photo

1:5490

100m grid

5874|60m E 41246|20m N

587.46km E 4124.62km N

Plotting and Reading UTM Classroom Exercise



More about UTM

Transverse Mercator Projection

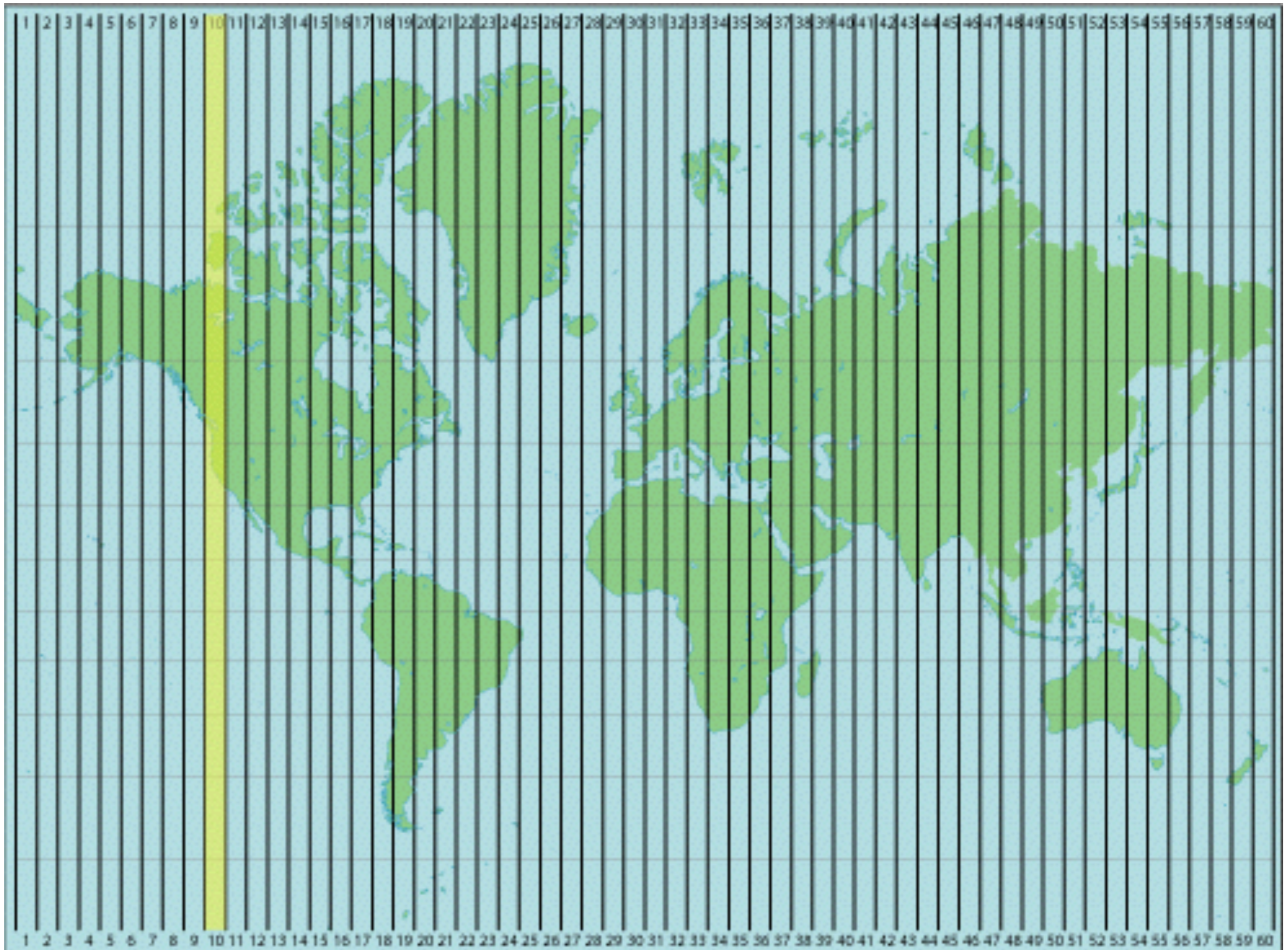
- Central meridian is selected by the map maker and touches the cylinder.
- Maps using the projection can show the whole Earth, but directions, distances, and areas are reasonably accurate only within 15° of the central meridian.



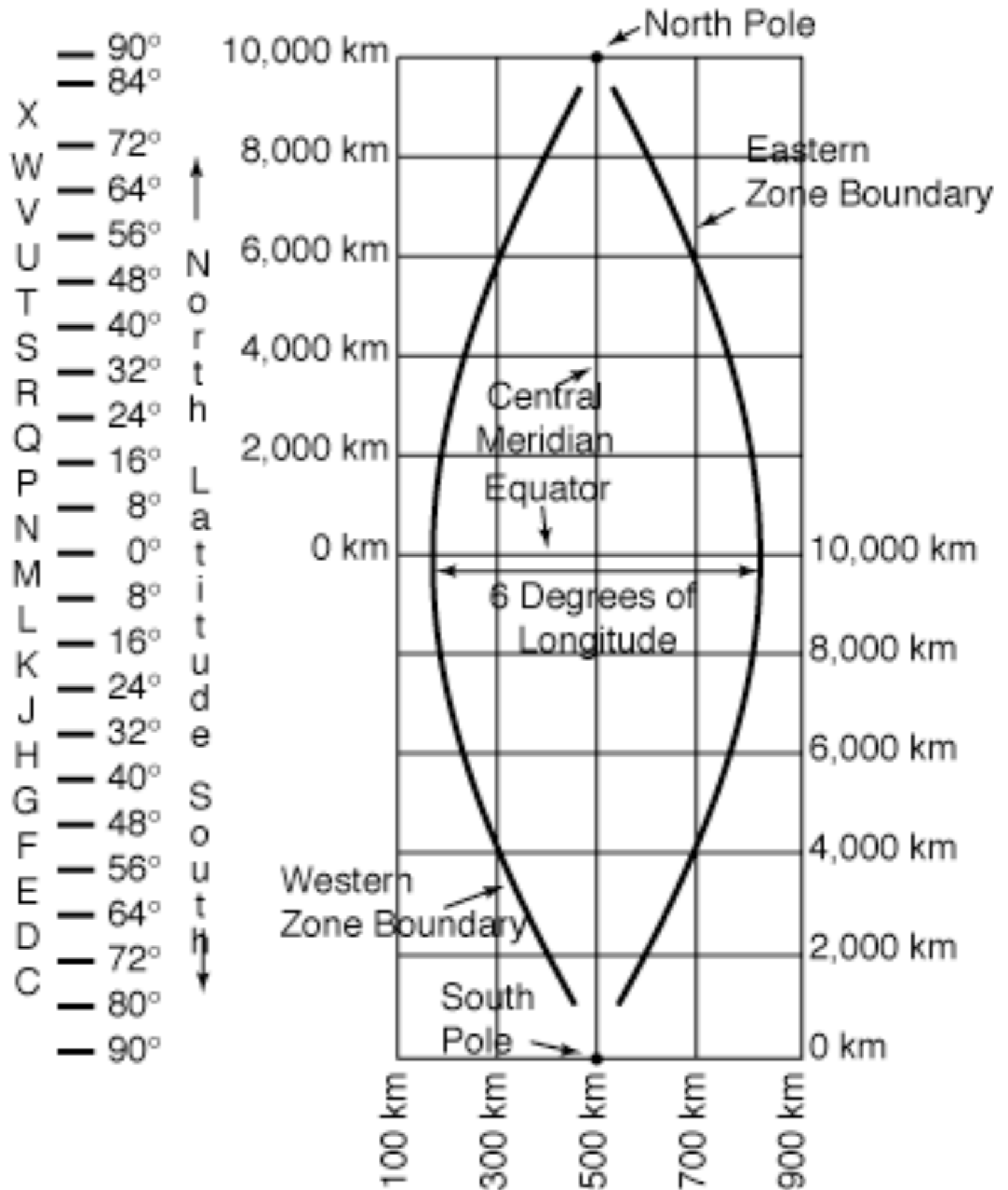
UTM Zones

- World is divided into 60 zones.
- Each zone is 6° of longitude wide.
- Zones are numbered 1 to 60, starting at 180° and progressing to the east.

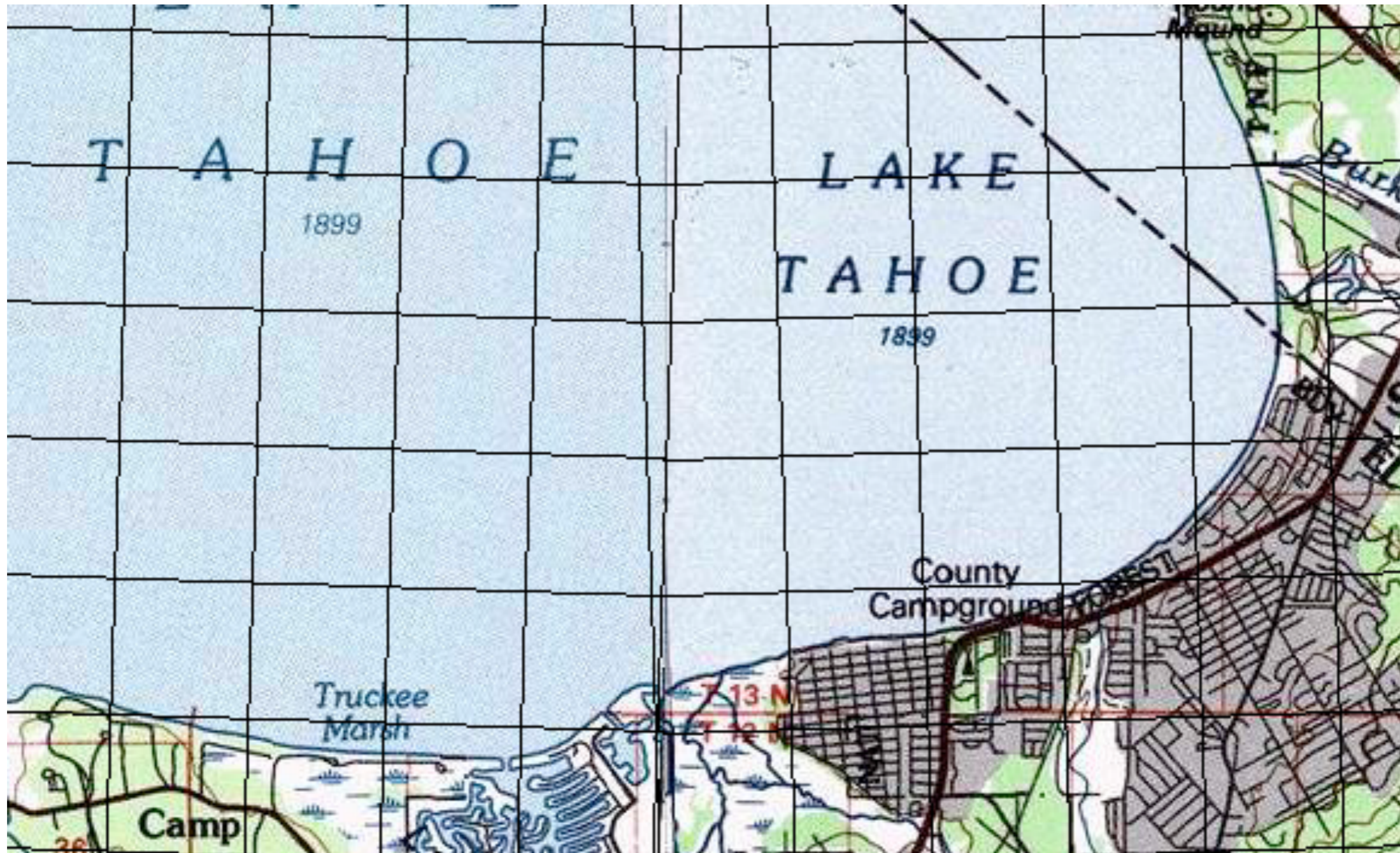
UTM Zones



UTM Zone Details



Boundary between UTM zones



Converting Lat/Lon to UTM

$$UTM \text{ North} = k_0 \{ A' \cdot K1 \cdot \phi - B1 \cdot \sin 2\phi +$$

$$\left. \frac{[.36(\lambda_0 - \lambda)]^2 \cdot a \cdot \sin \phi \cdot \cos \phi \cdot K2}{\sqrt{1 - e^2 \sin^2 \phi}} \right\}$$

$$UTM \text{ East} = 500,000 \pm \{ .36(\lambda_0 - \lambda) \cdot K3 \cdot \cos \phi +$$

$$[.36(\lambda - \lambda_0)]^3 \cdot K4 \cdot \cos^3 \phi (1 - \tan^2 \phi + e'^2 \cos^2 \phi) \} / \sqrt{1 - e^2 \sin^2 \phi}$$

Converting UTM to Lat/Lon

$$N = k_0 (A' K_1 \phi' - B' \sin 2\phi' + 17.209 \sin 4\phi')$$

$$\phi = \phi' - \left(q^2 \left[\frac{\tan \phi' (1 + e'^2 \cos \phi) \cdot (1 - e'^2 \sin^2 \phi') \cdot 10^{12}}{2 \cdot a^2 \cdot k_0^2 \cdot \sin 1''} \right] + \right.$$

$$q^4 \left\{ \frac{\tan \phi' (1 - e'^2 \sin^2 \phi)^2 \cdot 10^{24}}{24 \cdot a^4 \cdot k_0^4 \cdot \sin 1''} \times \right.$$

$$\left. \left. \left. (5 + 3 \cdot \tan^2 \phi' + 6 \cdot e'^2 \cos^2 \phi' - 6 e'^2 \sin^2 \phi' - 3 e'^4 \cos^4 \phi' - 9 e'^4 \cos^2 \phi' \sin^2 \phi') \right) \right\} \right\} / 3600$$

$$\lambda = \lambda_0 \pm \frac{q \cdot \sec \phi' \cdot \sqrt{1 - e'^2 \sin^2 \phi} \cdot 10^6}{a \cdot k_0 \cdot \sin 1'' \cdot 3600} -$$

$$\frac{q^3 \cdot \sec \phi' (1 - e'^2 \sin^2 \phi)^{1.5} \cdot (1 + 2 \tan^2 \phi' + e'^2 \cos^2 \phi') \cdot 10^{18}}{6 \cdot a^3 \cdot k_0^3 \cdot \sin 1'' \cdot 3600}$$

Converting between Lat/Lon and UTM

- Save a waypoint in the position format you have the coordinate in.
- Switch to the position format you want to convert to.
- Recall the waypoint