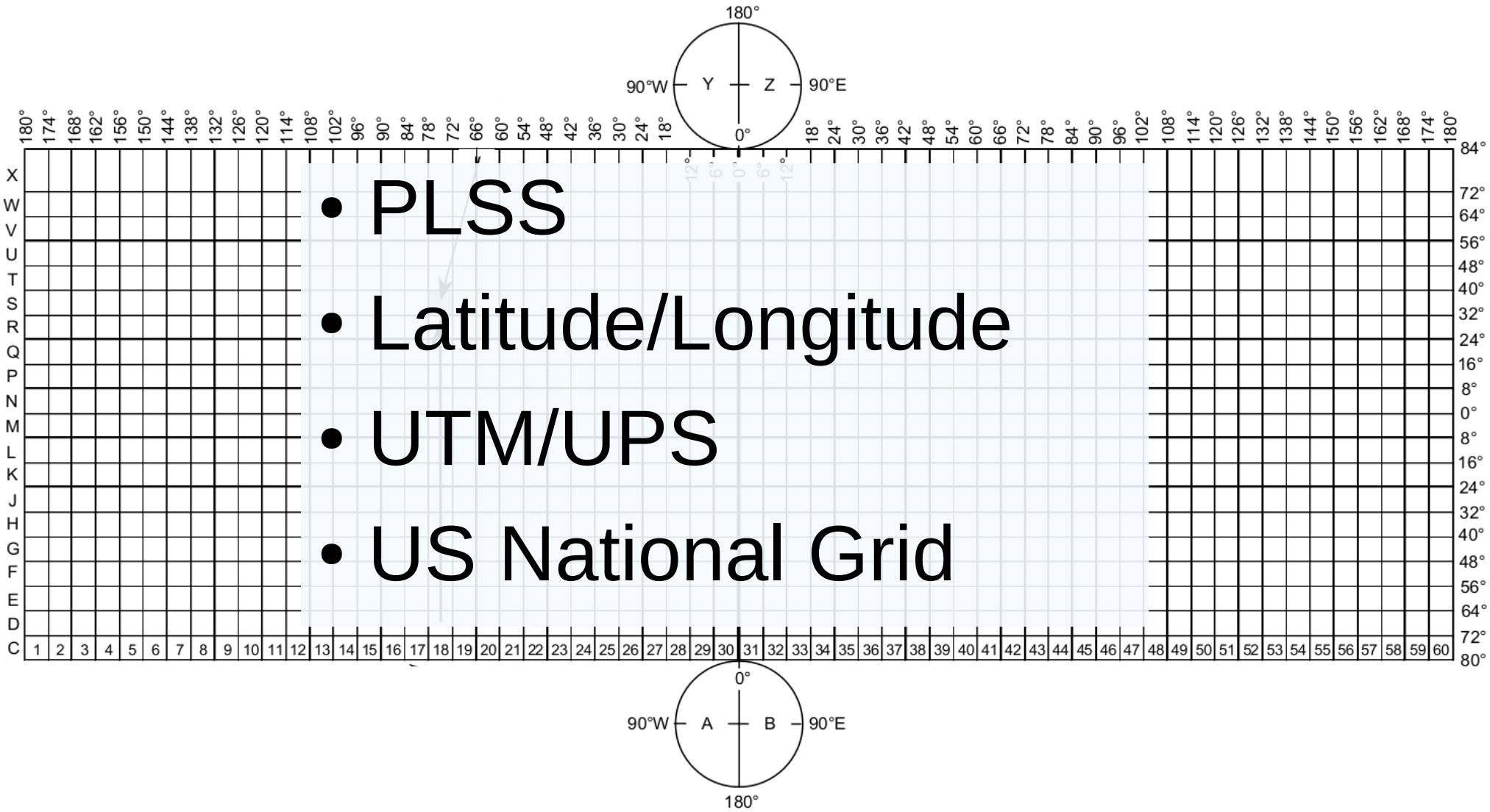
Land Navigation VII
Communicating Location

Describing location on a map

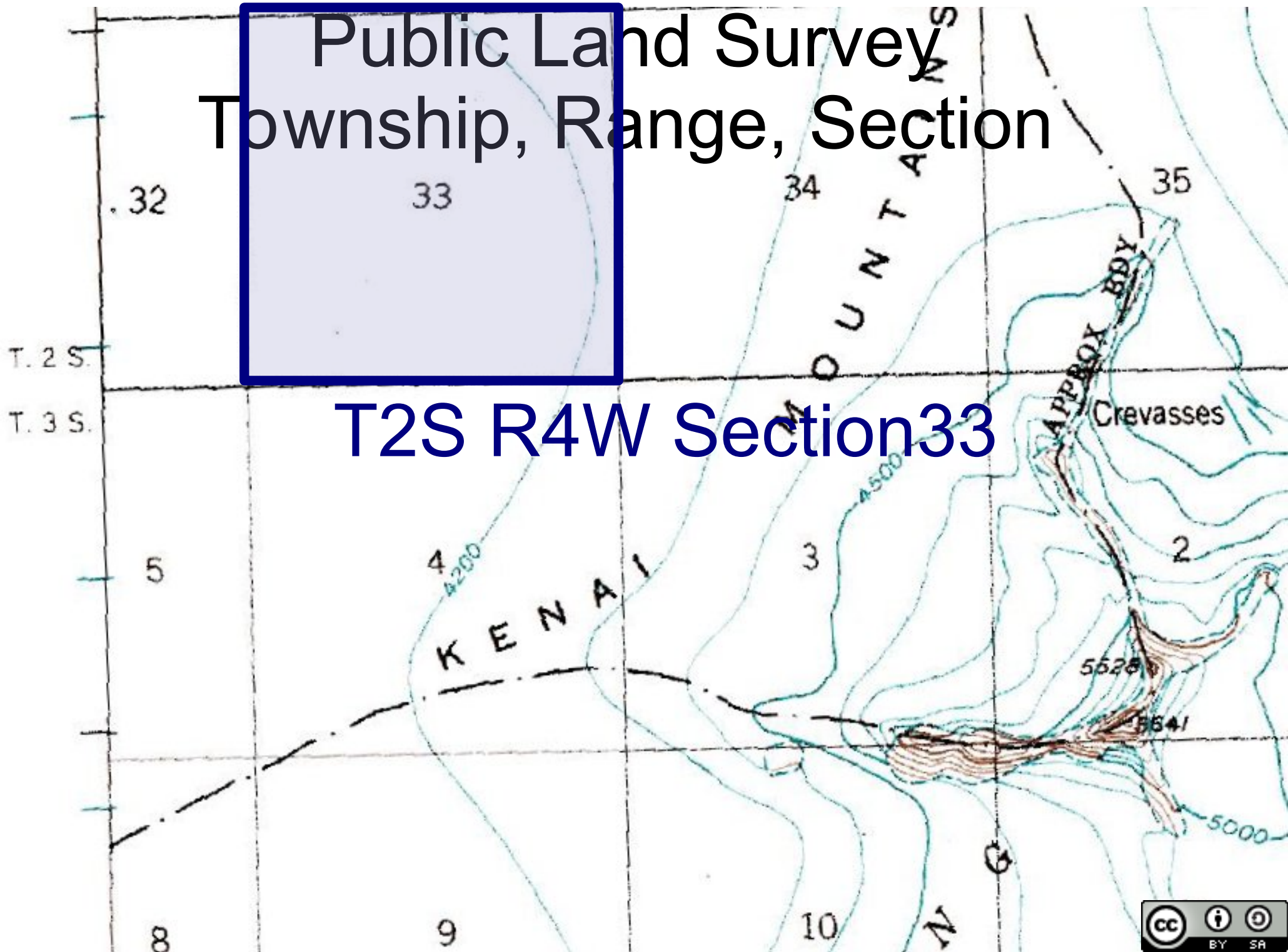
- PLSS = Township, Section, Range
- Latitude and Longitude (Geographic coordinate system)
- UTM: Universal Transverse Mercator
- MGRS: Military Grid Reference System
- USNG: US National Grid
- UPS: Universal Polar Stereographic
- Ordinance Survey (GB) Grid
- State Plane Feet
- etc....

Map Grids



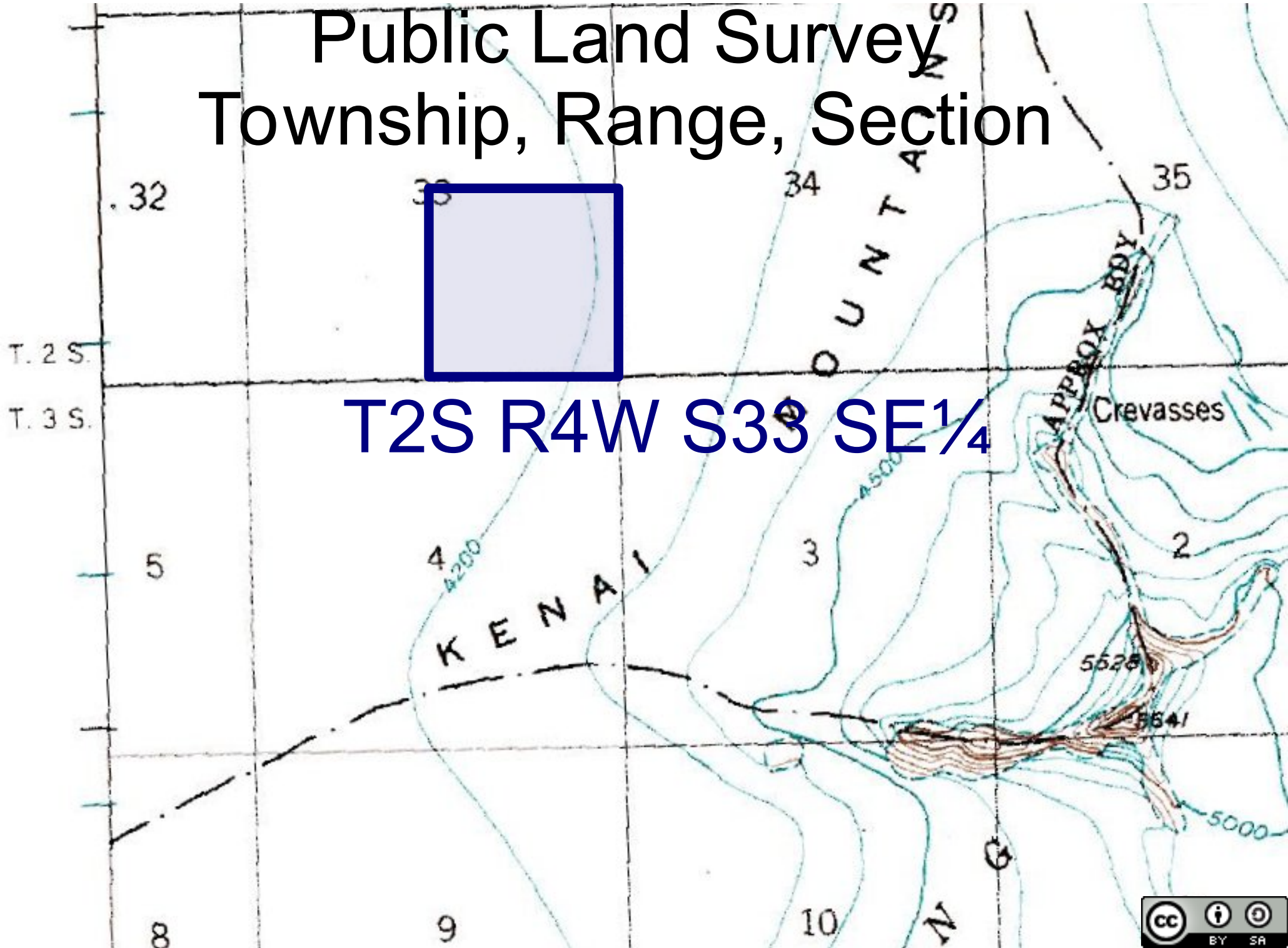
- PLSS
- Latitude/Longitude
- UTM/UPS
- US National Grid

Public Land Survey Township, Range, Section

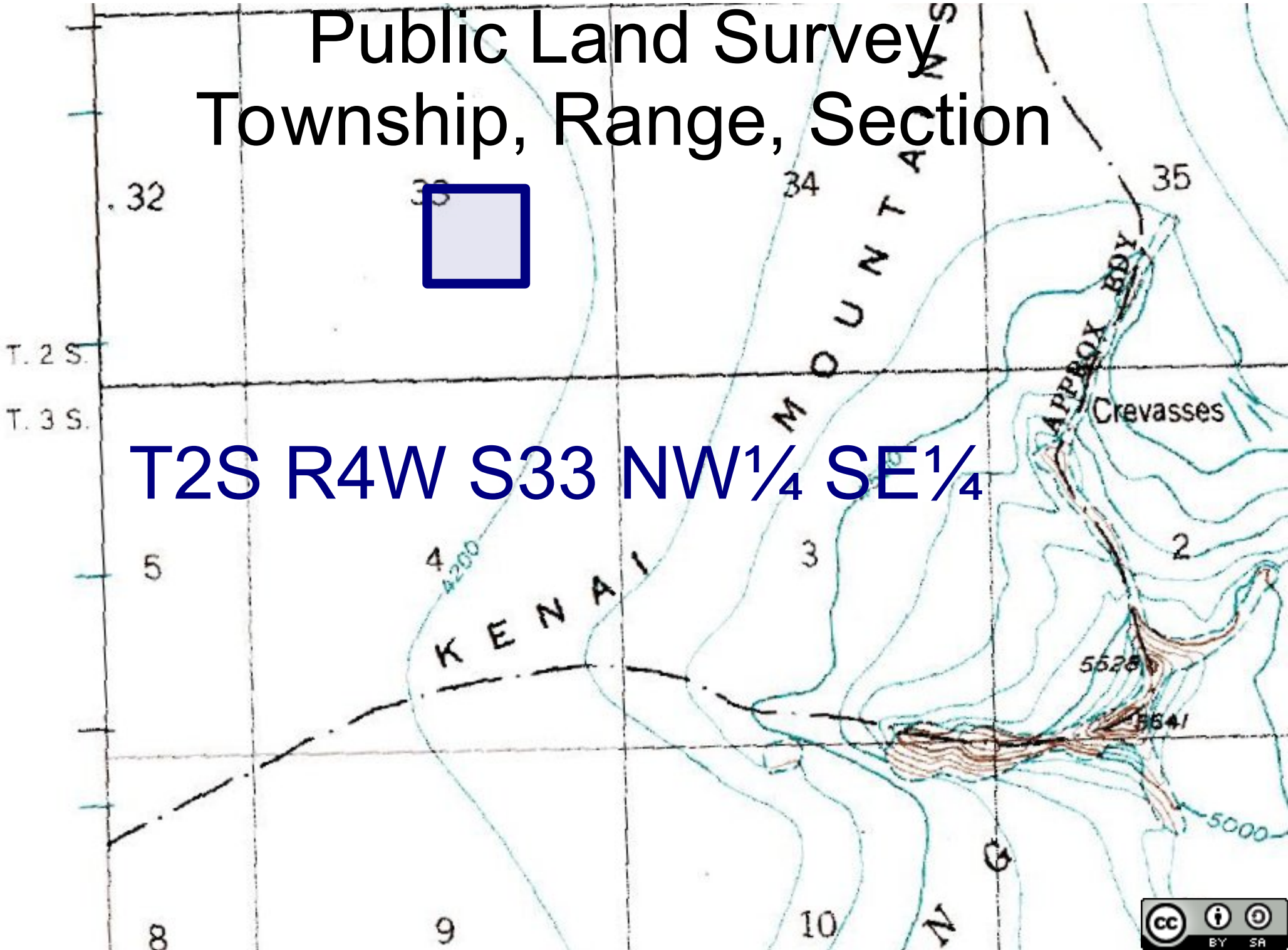


T2S R4W Section33

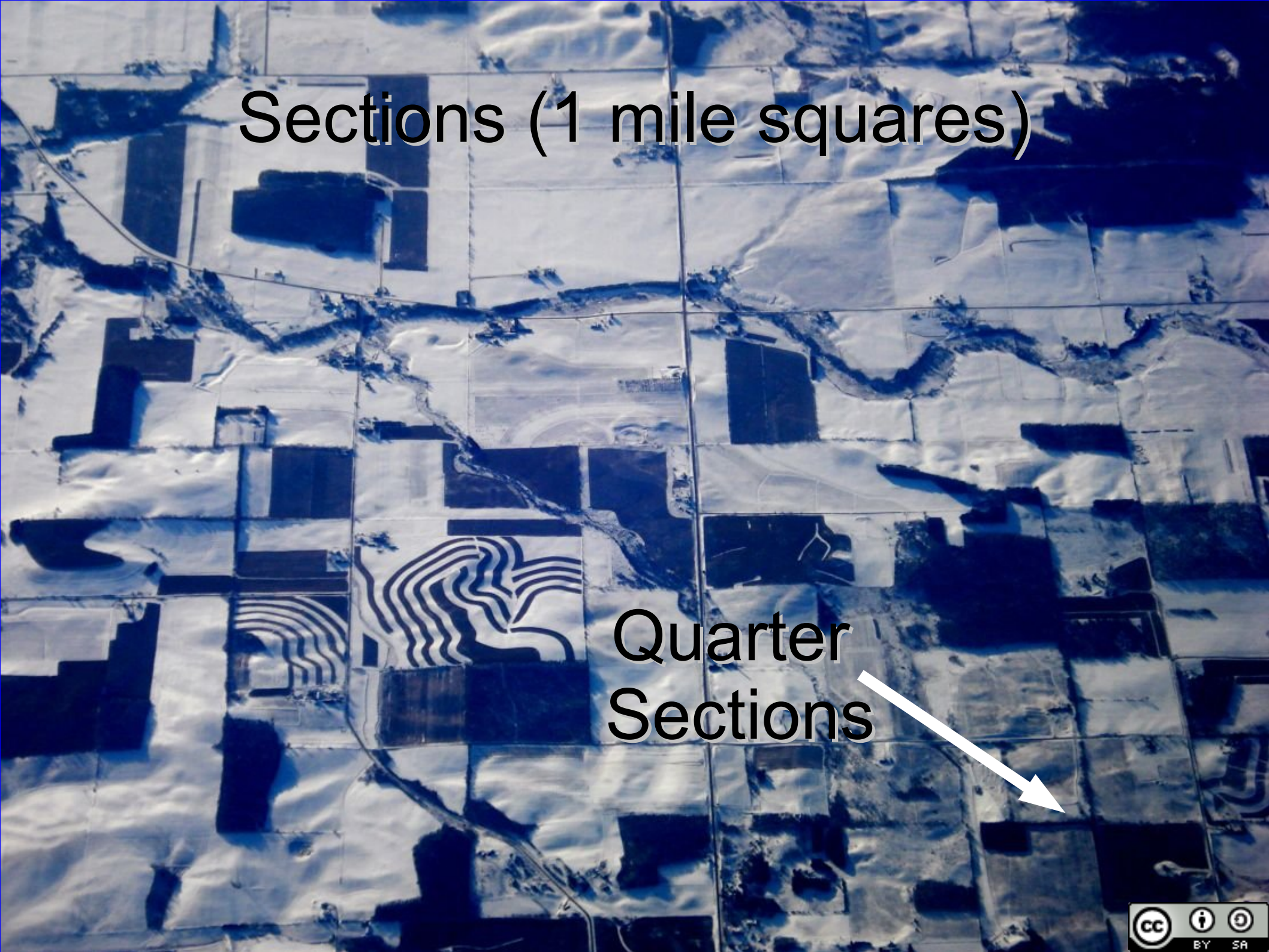
Public Land Survey Township, Range, Section



Public Land Survey Township, Range, Section



T2S R4W S33 NW¼ SE¼

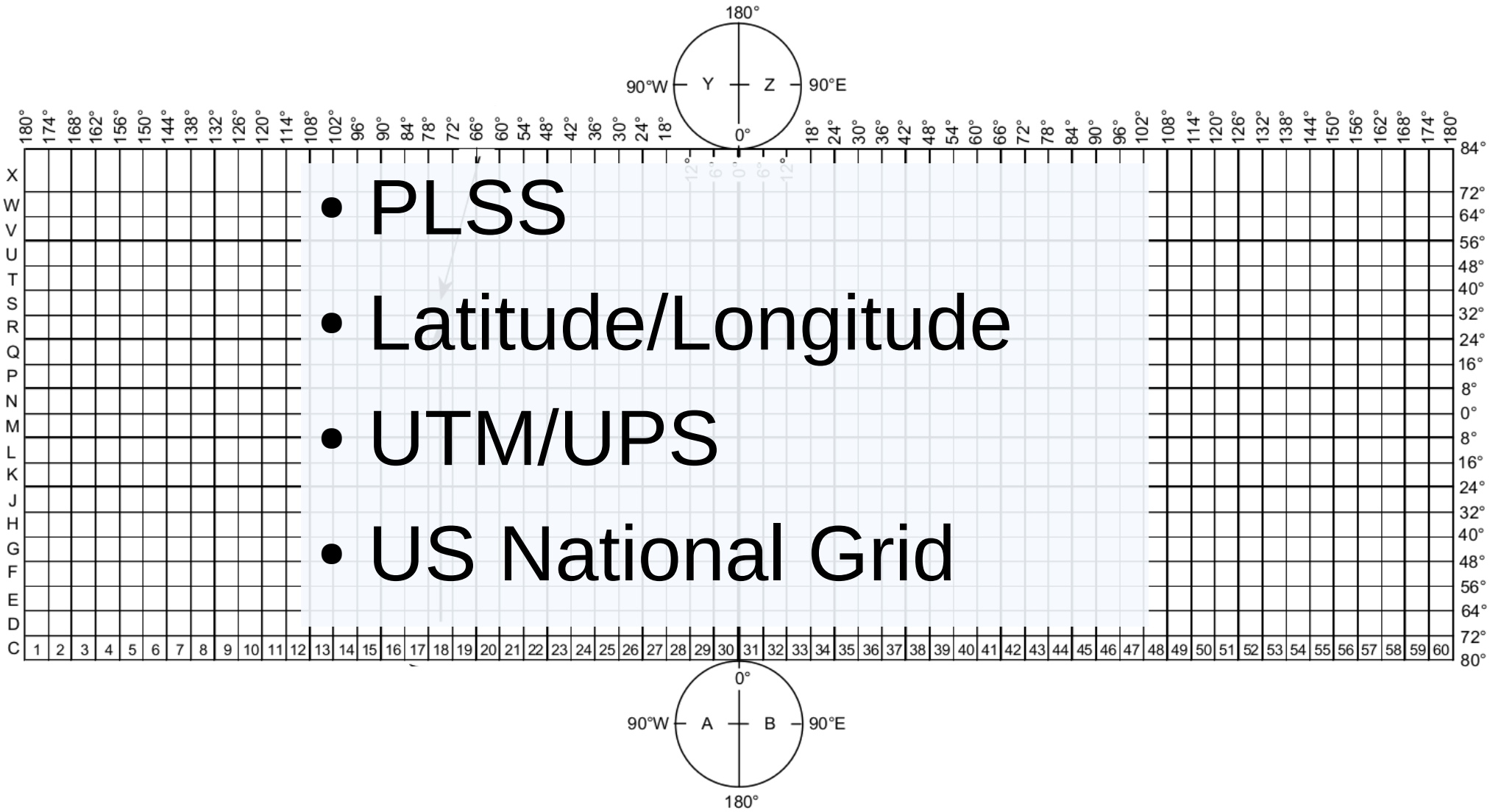


Maine

Variant PLSS used in sparsely populated areas in northern Maine, Multiple different baselines for the grids, sometimes several per county. Some unorganized townships are known by their Township/Range and baseline rather than name.

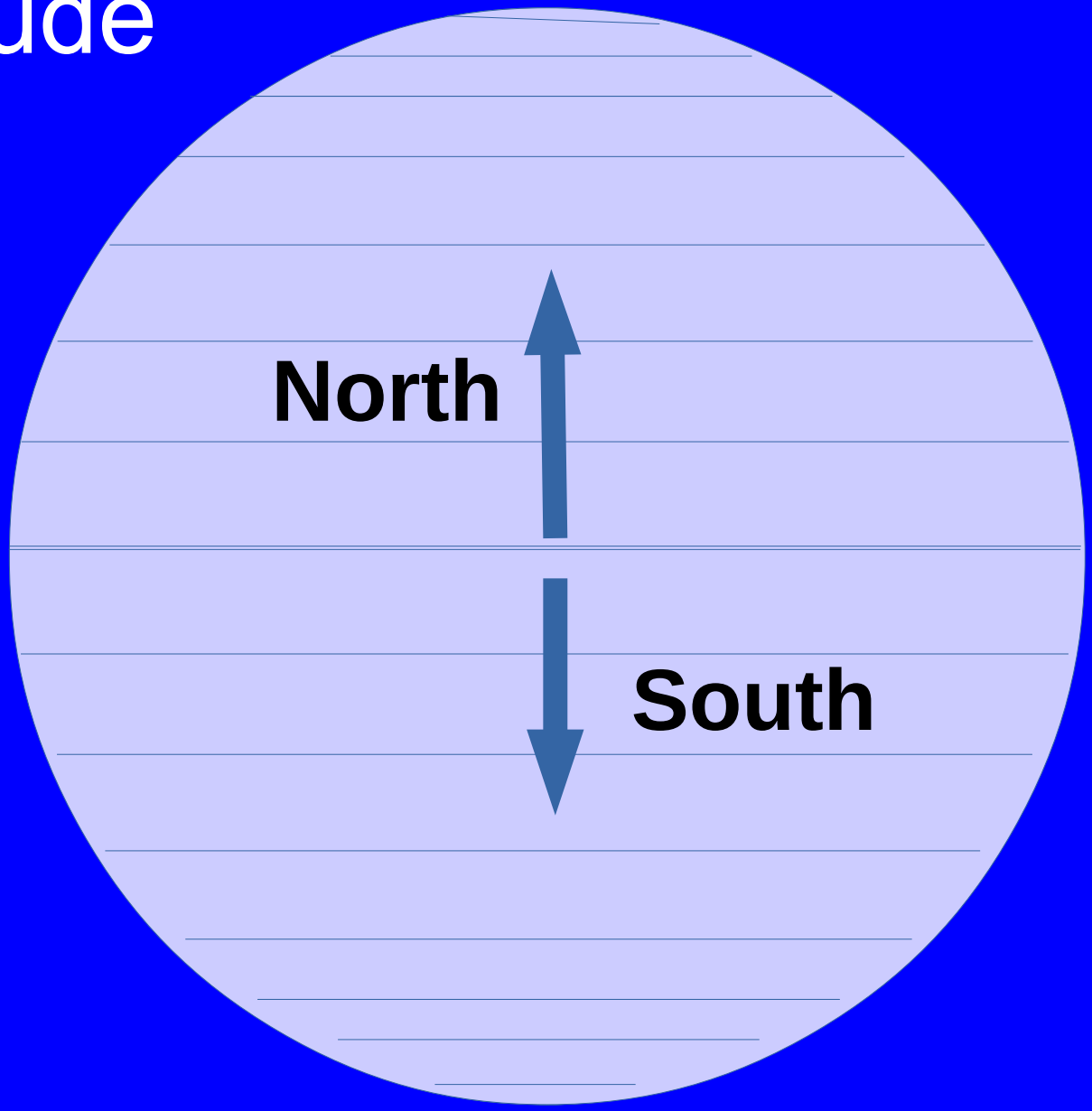
T6R9 WLSS
T1R2 WBKP

Map Grids

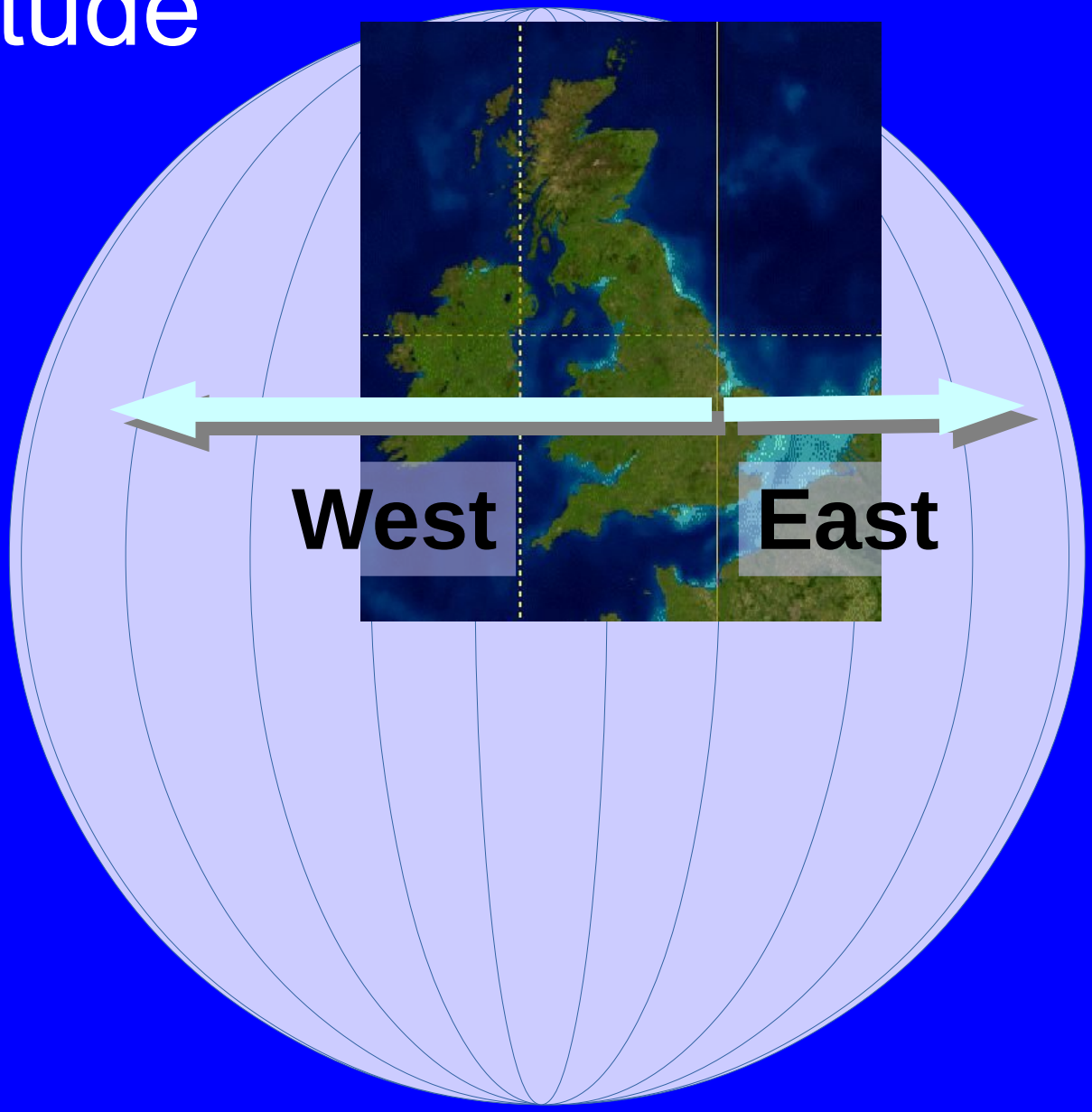


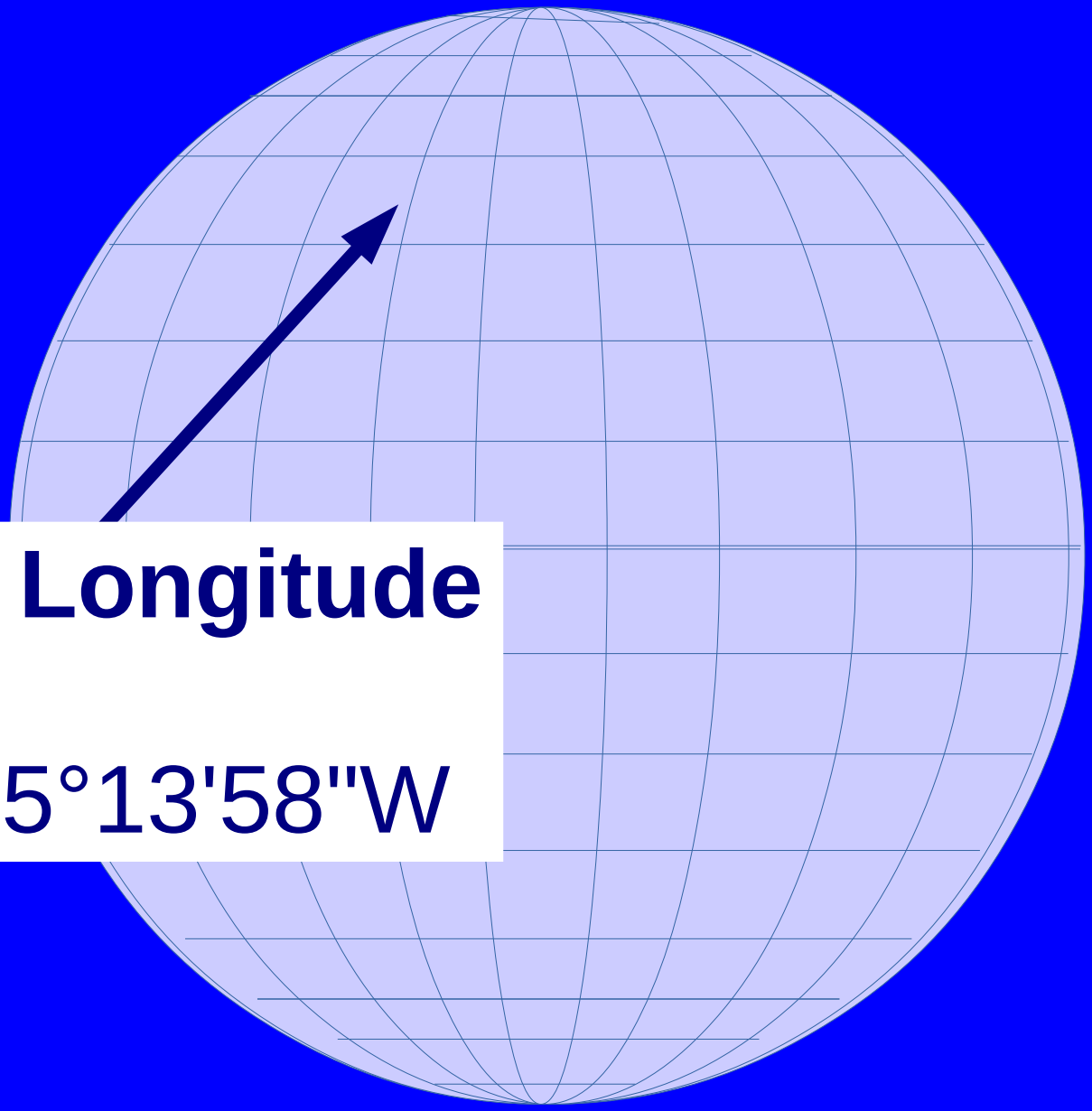
- PLSS
- Latitude/Longitude
- UTM/UPS
- US National Grid

Latitude



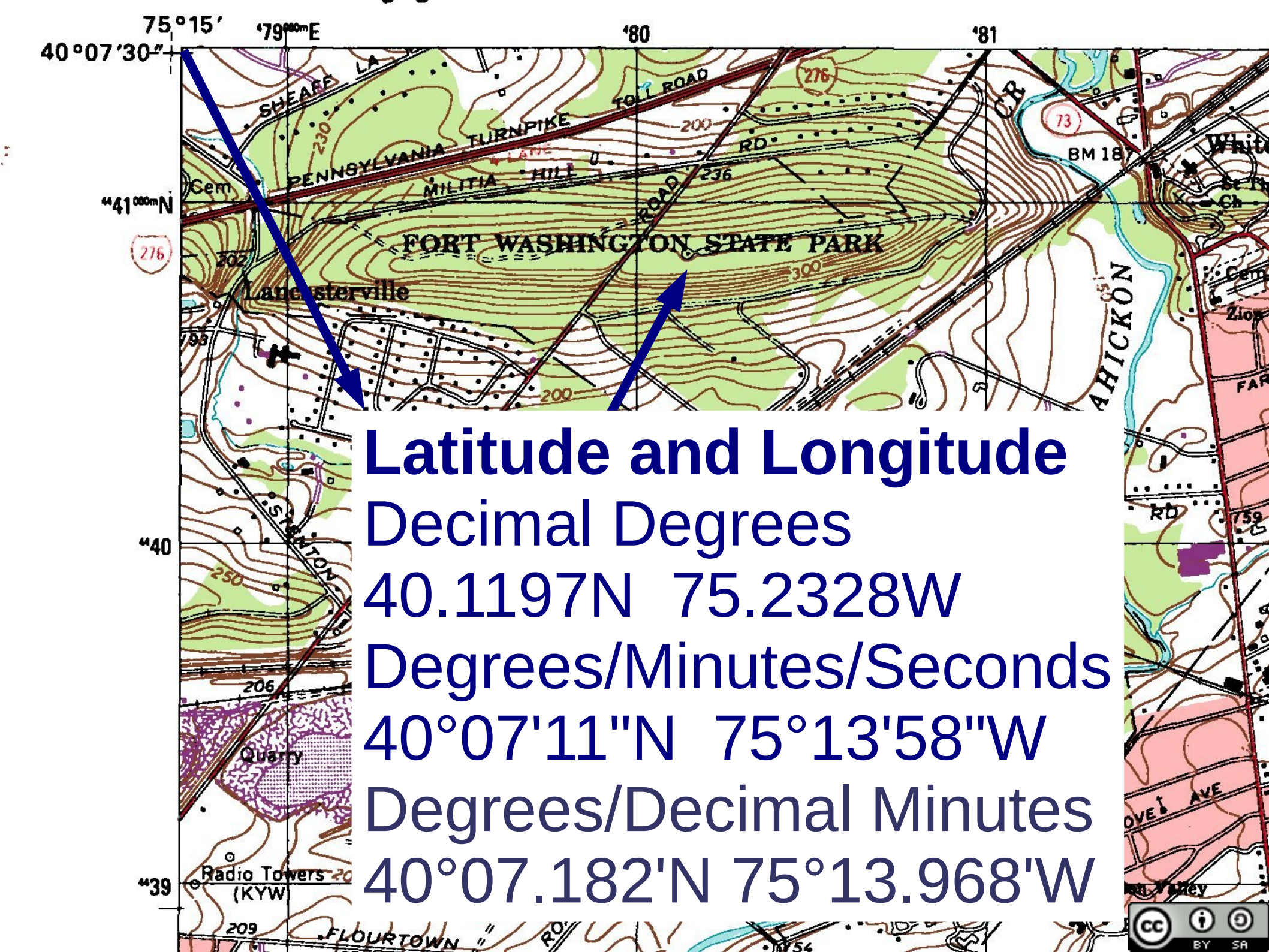
Longitude





Latitude and Longitude

40°07'11"N 75°13'58"W



Latitude and Longitude

Decimal Degrees

40.1197N 75.2328W

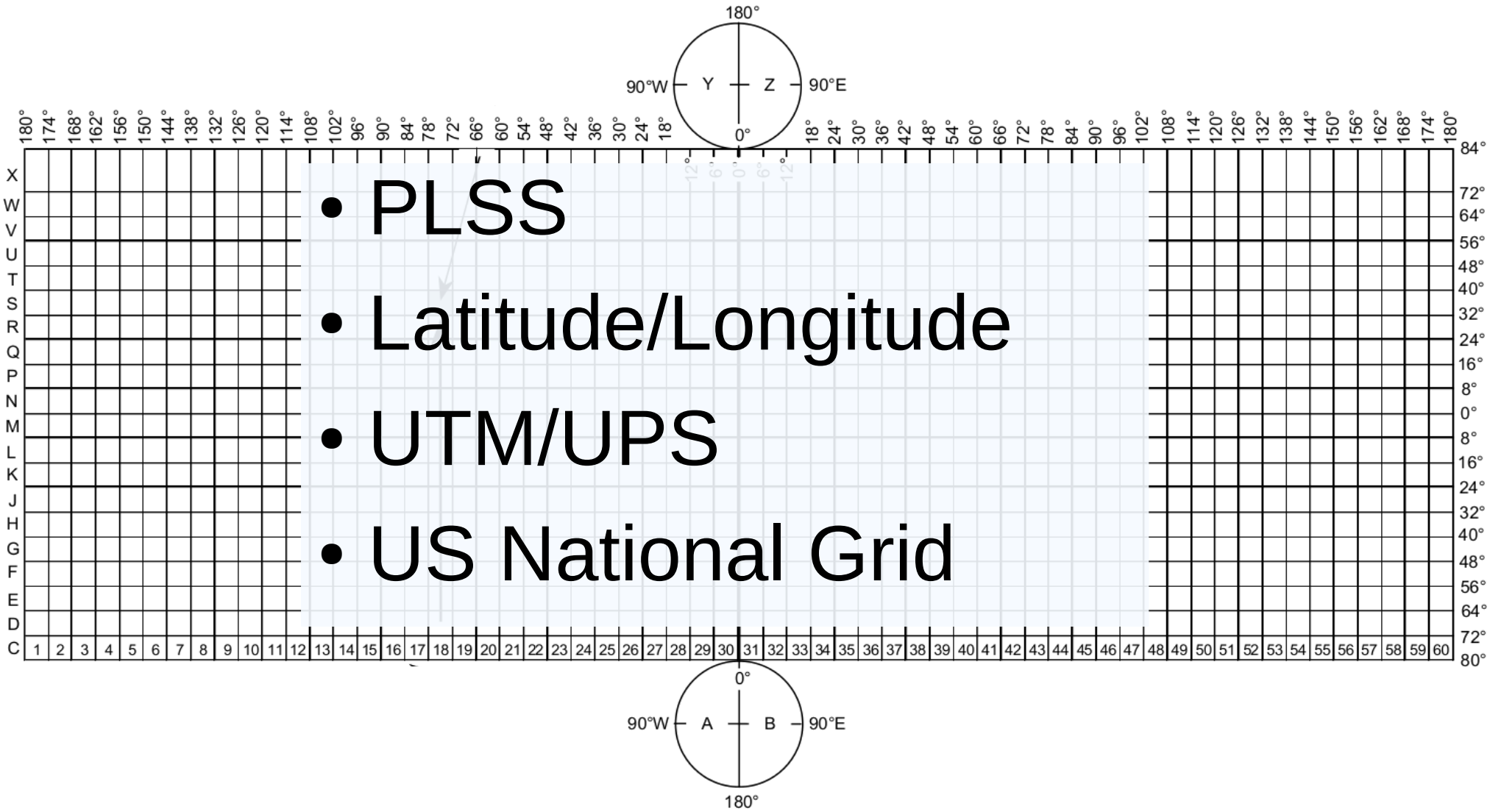
Degrees/Minutes/Seconds

40°07'11"N 75°13'58"W

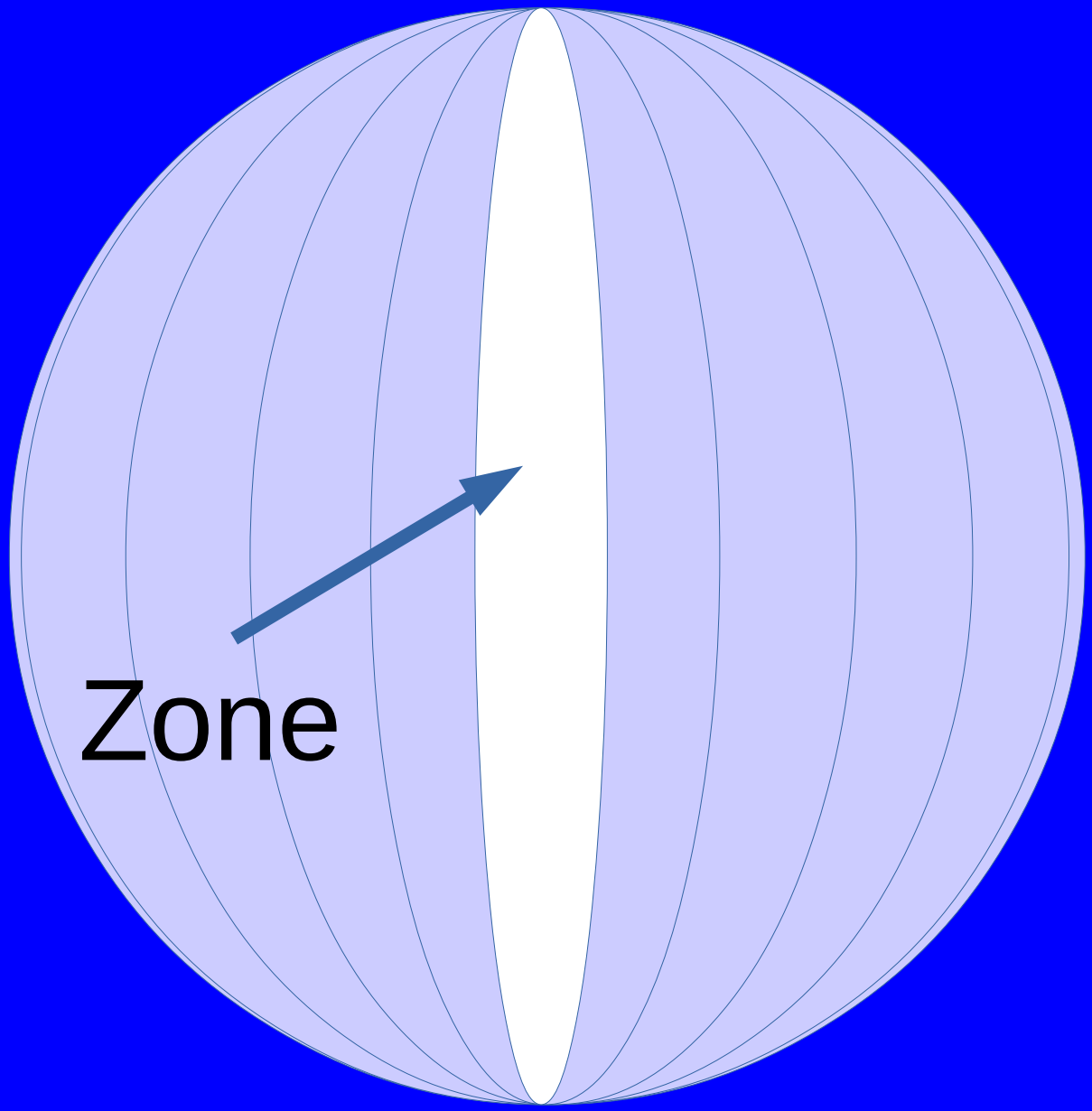
Degrees/Decimal Minutes

40°07.182'N 75°13.968'W

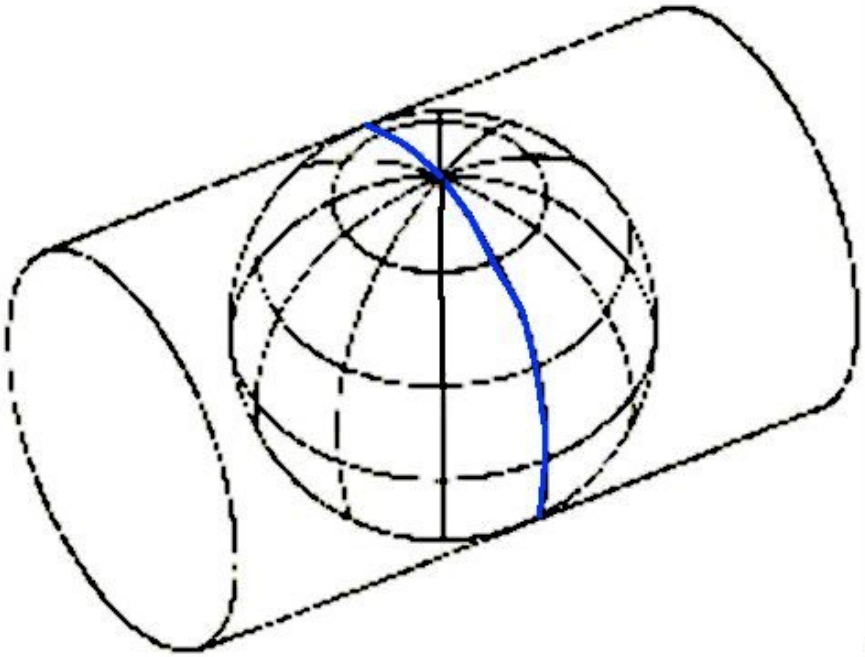
Map Grids

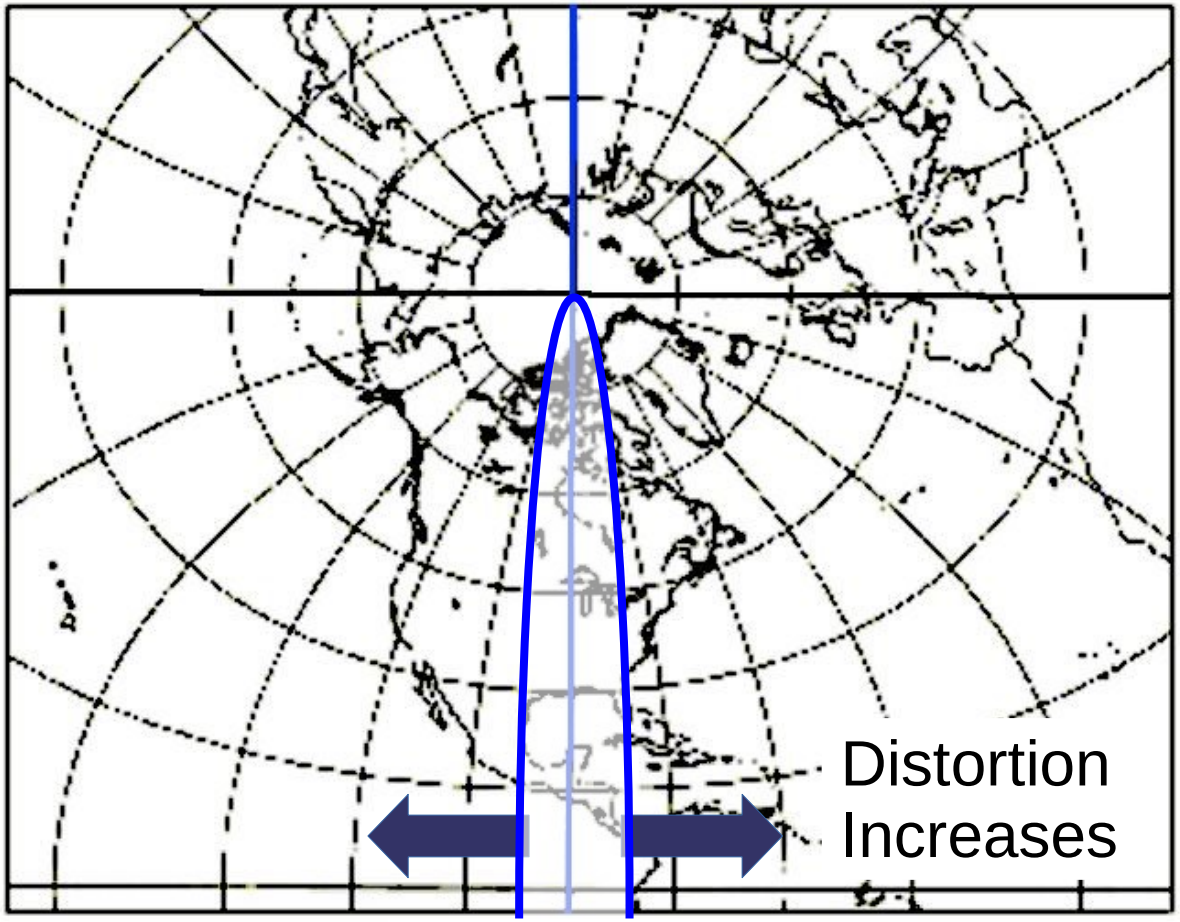


- PLSS
- Latitude/Longitude
- UTM/UPS
- US National Grid



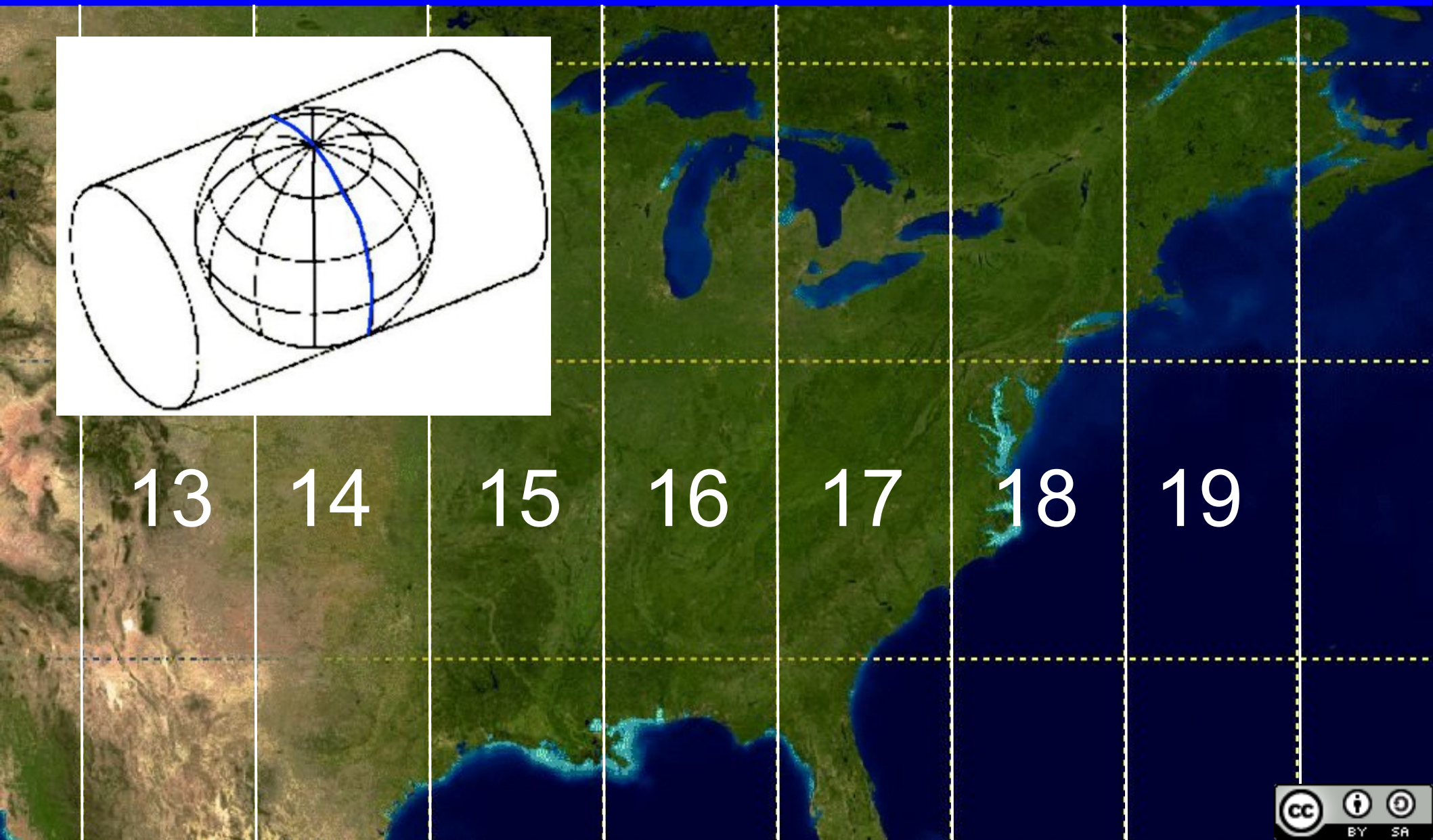
Transverse Mercator Projection



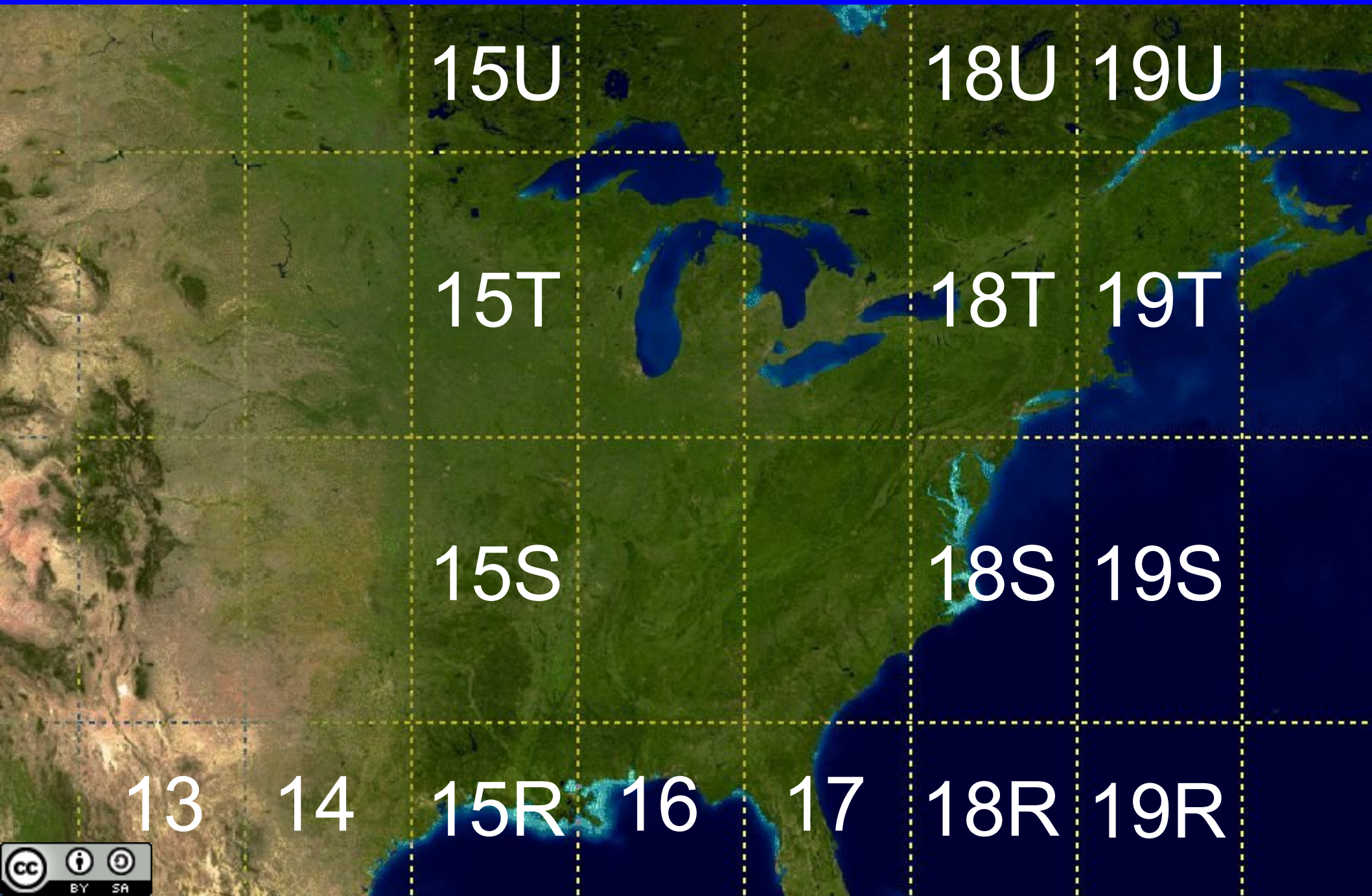


Project the globe onto a cylinder wrapped pole to pole. Unroll the cylinder into a flat map. The line where the cylinder touches the globe has the least distortion, the further you move East or West of that line, the greater the distortion. UTM: Repeat 60 times.

UTM Zones
6º wide, numbered 1 to 60



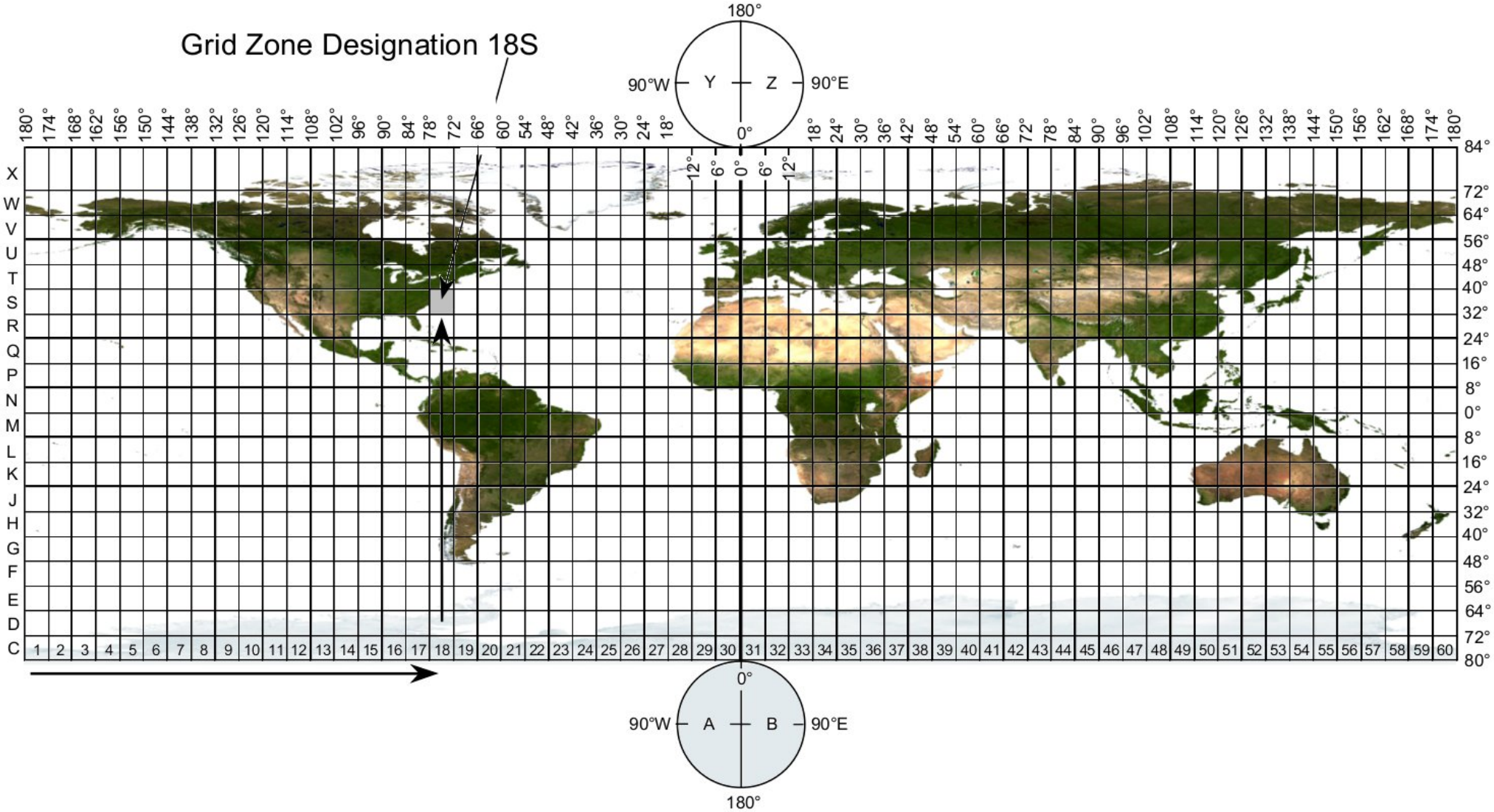
UTM Zone Letters (Latitude bands)

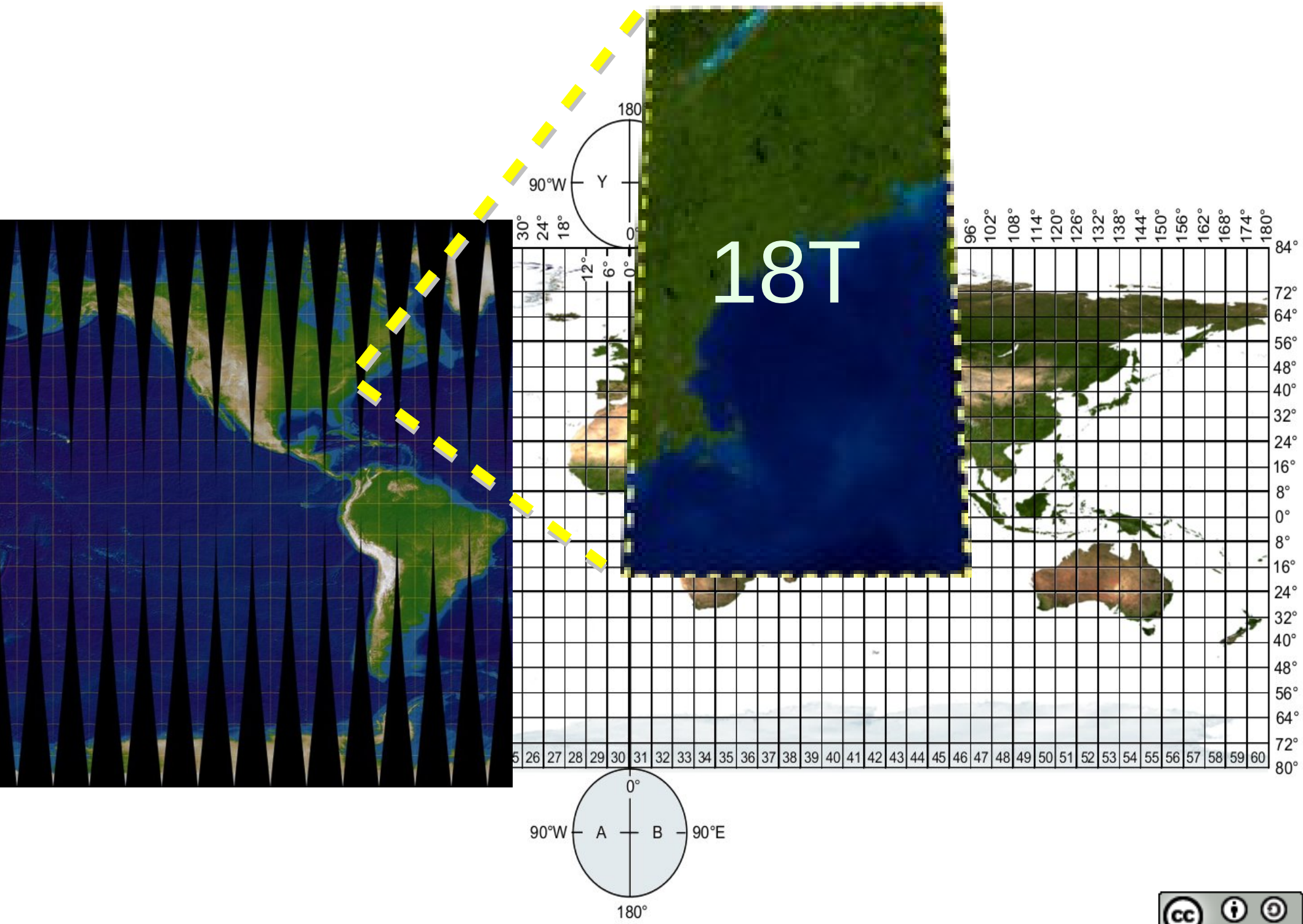


Latitude Band Letters

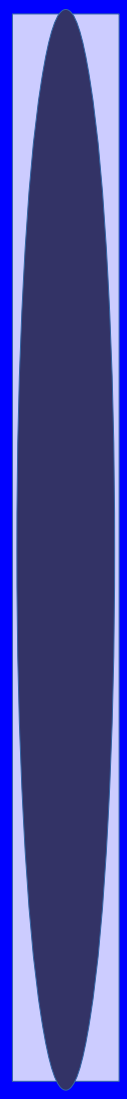
- 8 degree tall bands (except for X)
- Starts with C at 80 to 72 degrees south.
- C-M, southern hemisphere
- N-X, Northern Hemisphere
- (N is the first zone north of the equator)
- No O or I (can be confused with 0 and 1)
- A,B South of 80 degrees south (UPS).
- Y, Z, North of 84 degrees north (UPS).

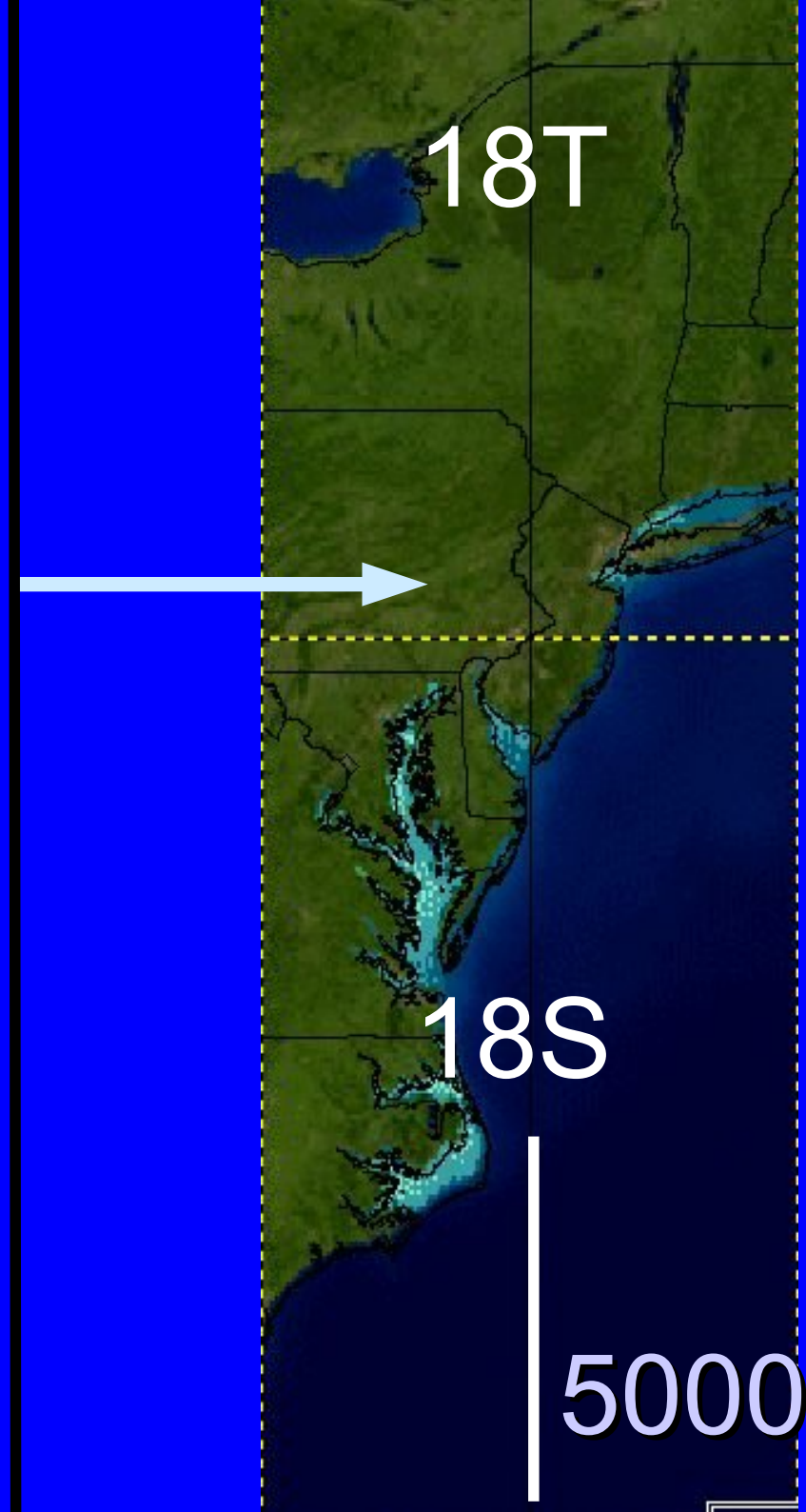
Grid Zone Designator




18T
180
90°W
Y
30°
24°
18°
12°
6°
0°
96°
102°
108°
114°
120°
126°
132°
138°
144°
150°
156°
162°
168°
174°
180°
84°
72°
64°
56°
48°
40°
32°
24°
16°
8°
0°
8°
16°
24°
32°
40°
48°
56°
64°
72°
80°
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
0°
90°W
A
B
90°E
180°

Easting
Meters into zone

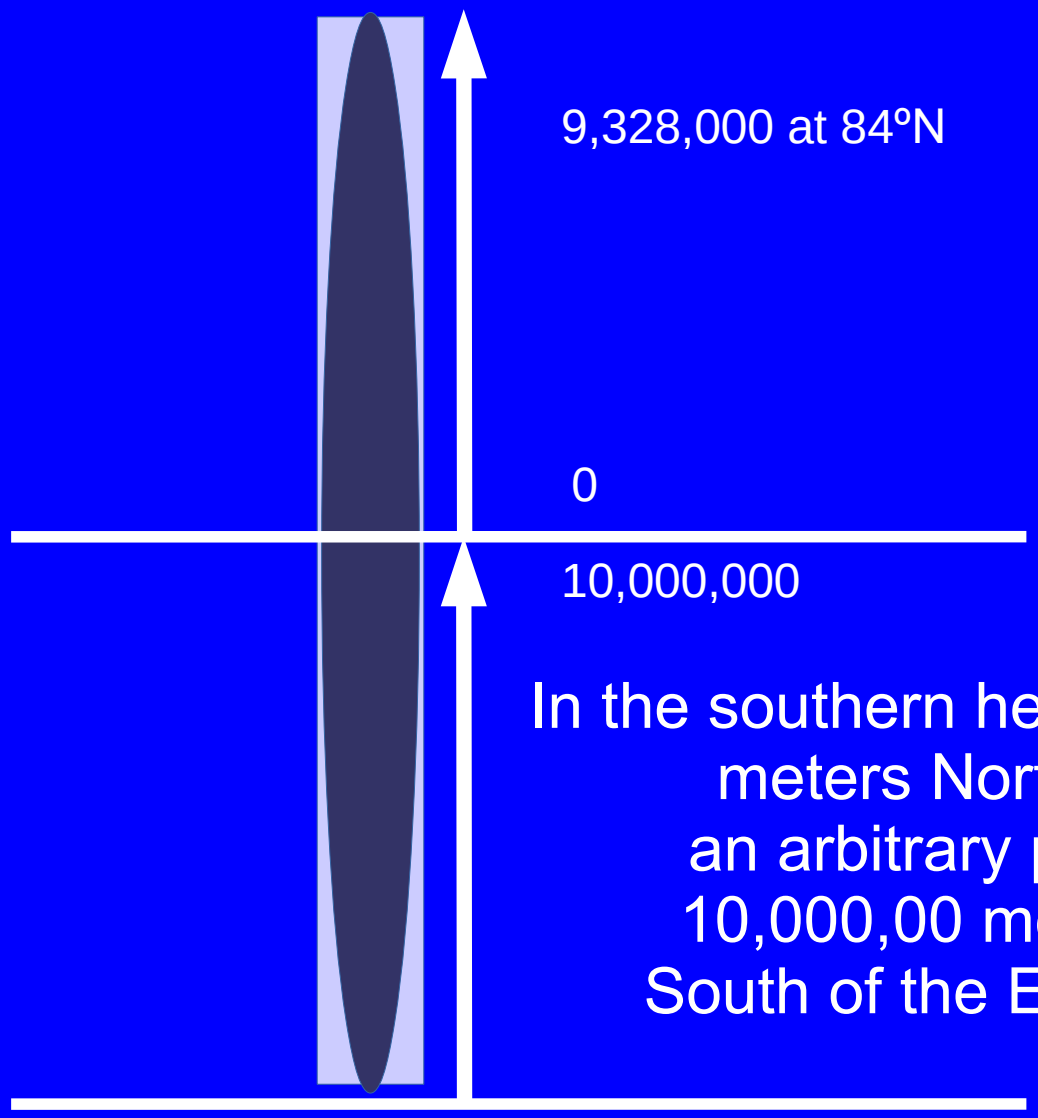




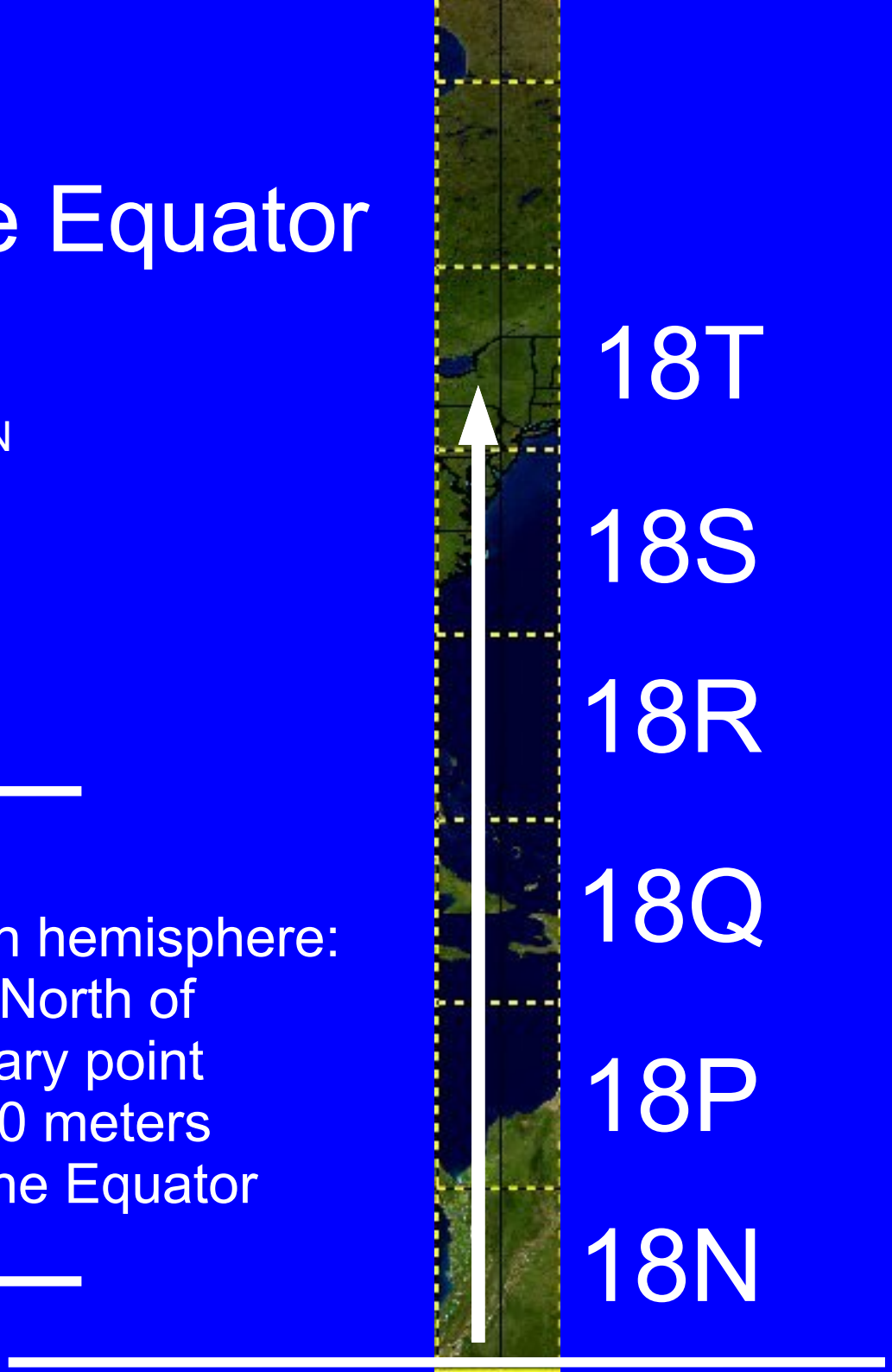
0

500000

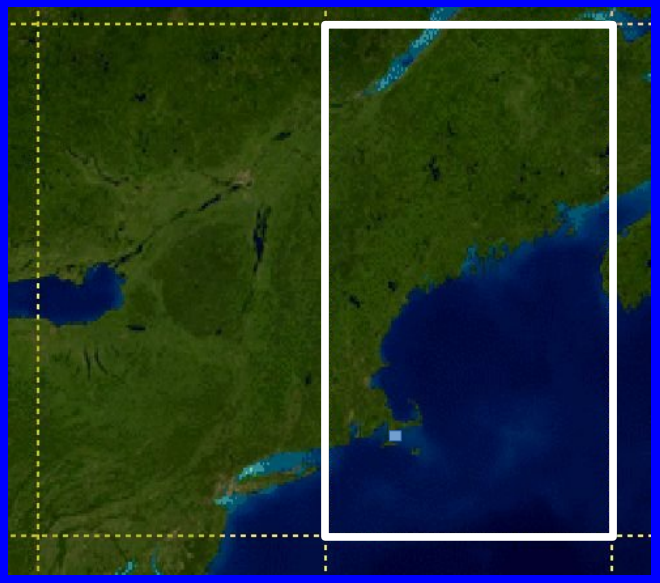
Northing
Meters North of the Equator



In the southern hemisphere:
meters North of
an arbitrary point
10,000,00 meters
South of the Equator



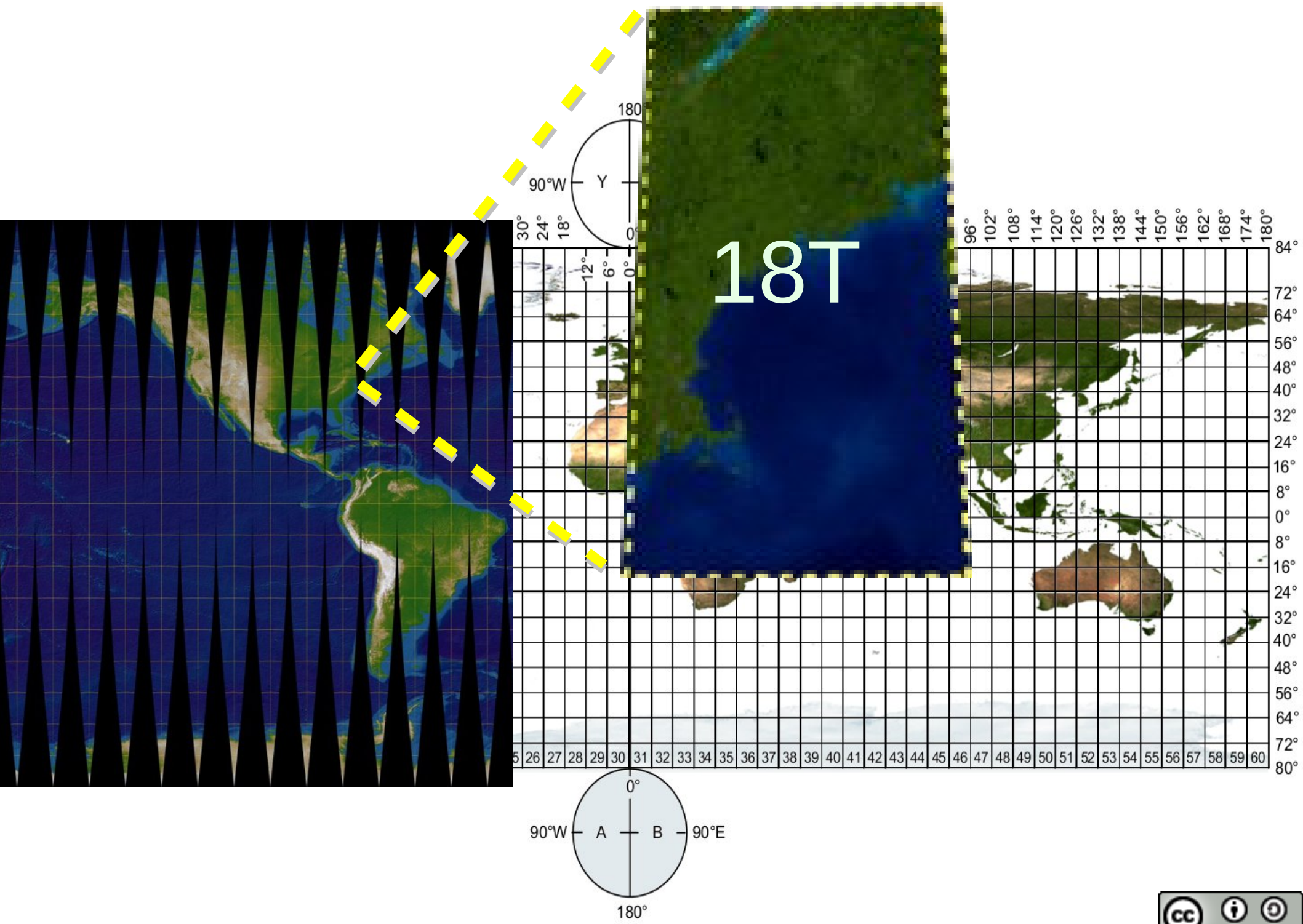
Putting it all together



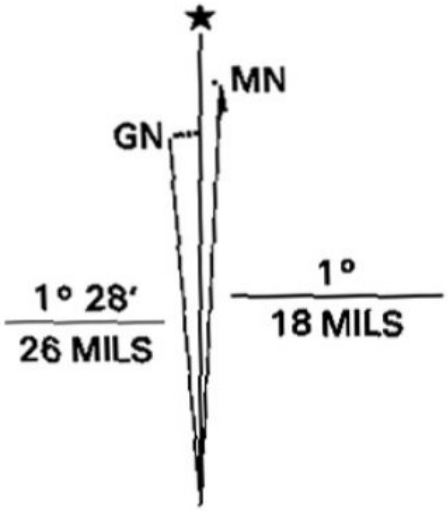
19T 0355000 4612500

Zone Band Easting Northing

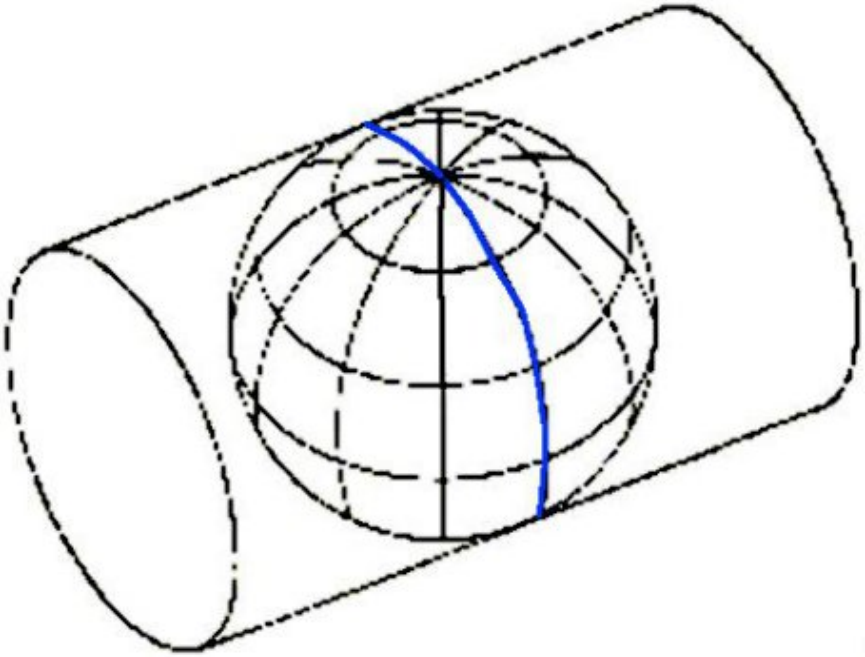
Grid Zone 19T

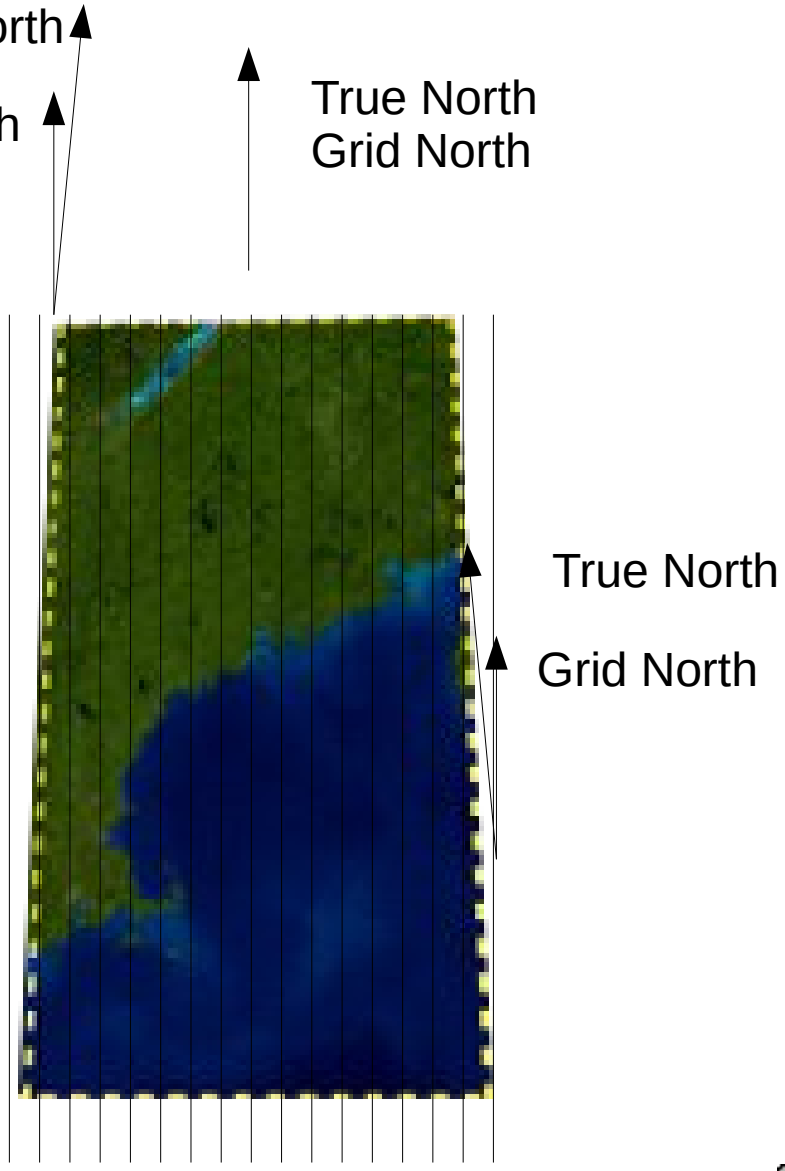

18T
180
90°W
Y
30°
24°
18°
12°
6°
0°
96°
102°
108°
114°
120°
126°
132°
138°
144°
150°
156°
162°
168°
174°
180°
84°
72°
64°
56°
48°
40°
32°
24°
16°
8°
0°
8°
16°
24°
32°
40°
48°
56°
64°
72°
80°
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
0°
90°W
A
B
90°E
180°

Grid North and True North



UTM GRID AND 2000 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET





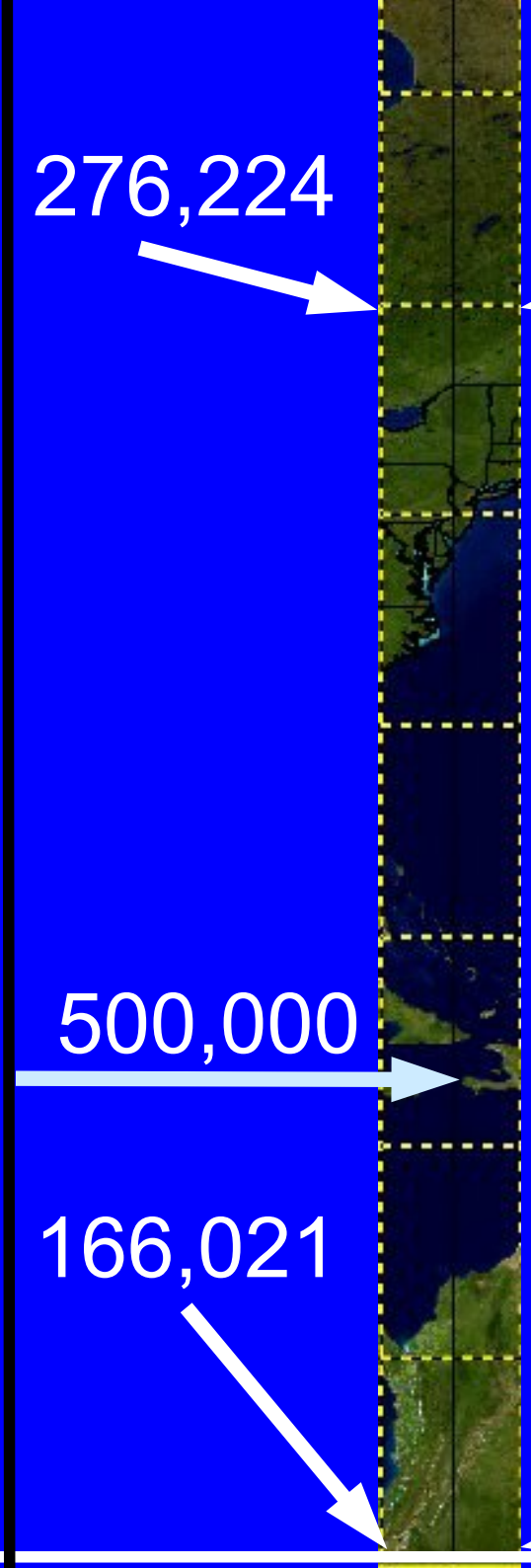
Easting

Zones narrow
away from the equator

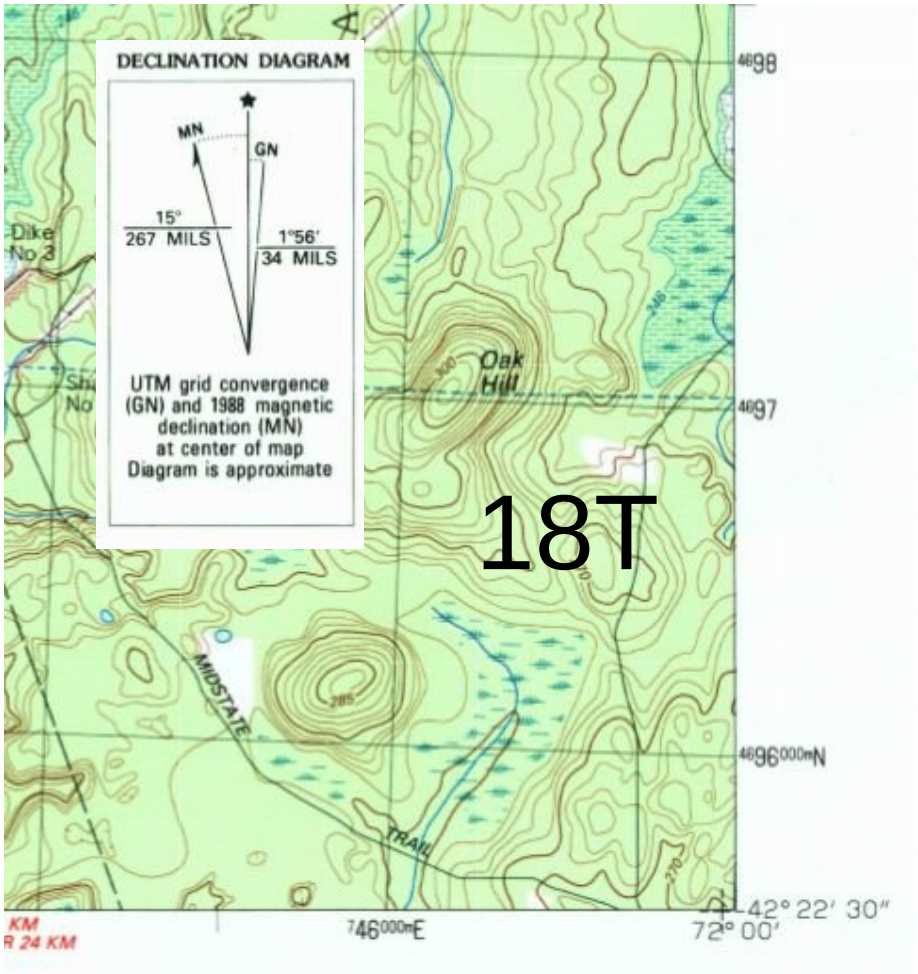
6º = 448km at 48ºN

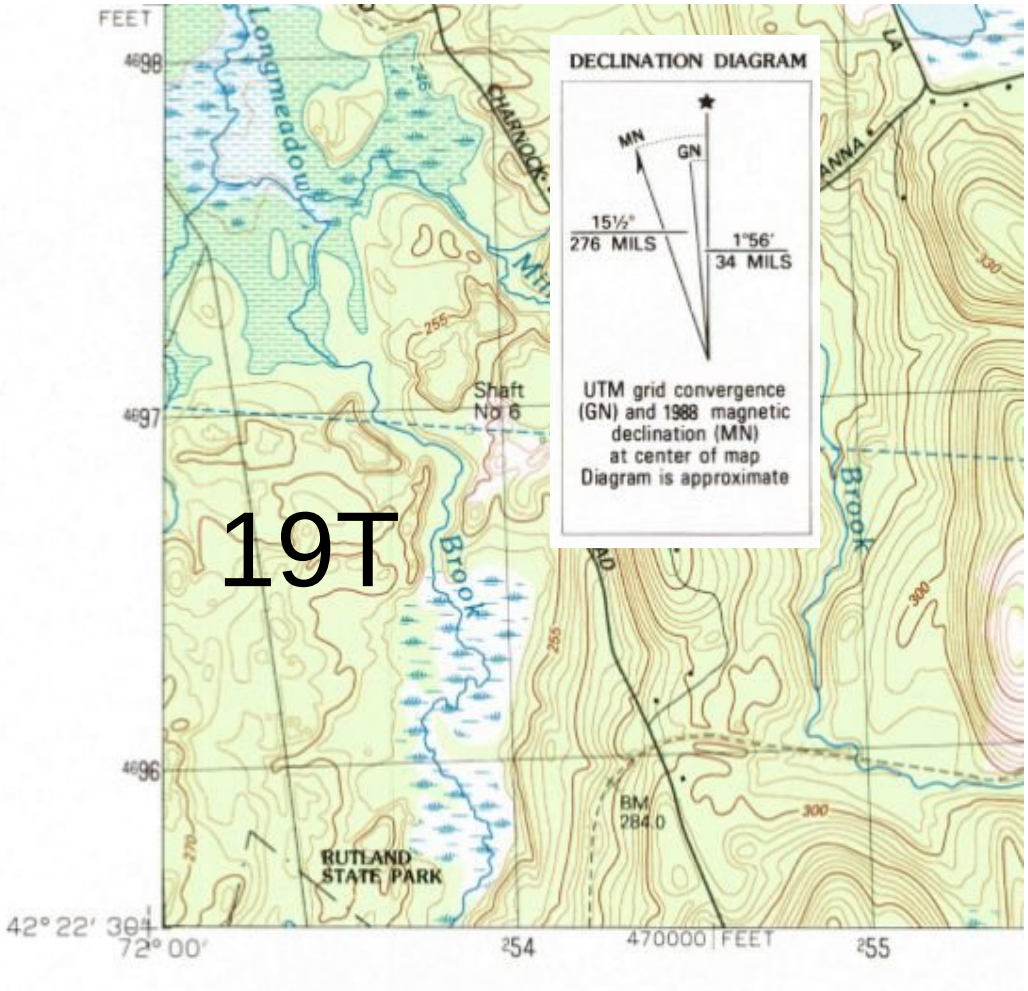
6º = 667km at 0º

Easting of 0 isn't a real place



Grids at a zone boundary





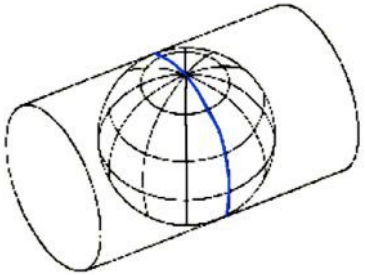
$^{07}46$

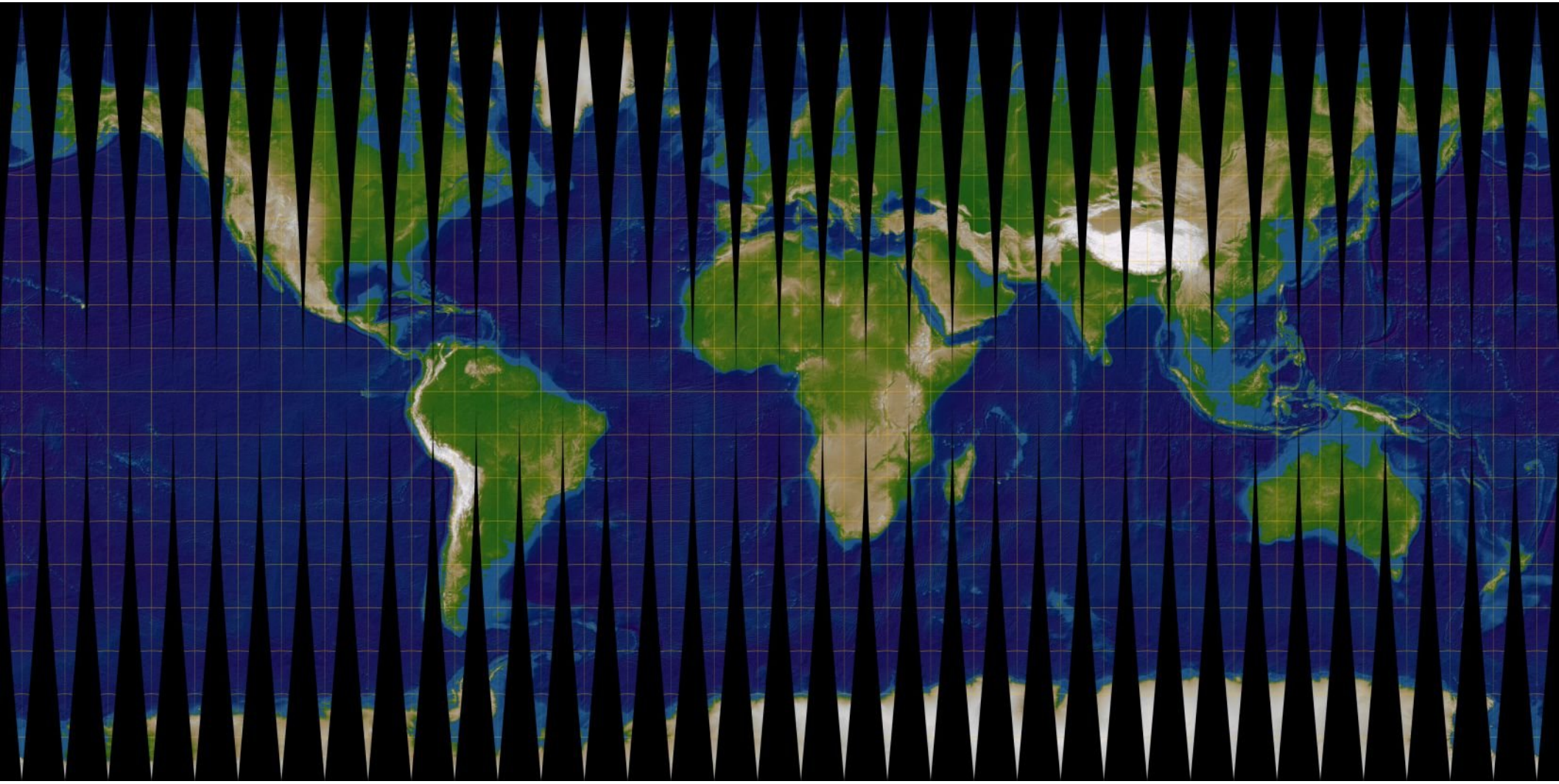
Grid North 1º56’ E

$^{02}54$

Grid North 1º56’ W

What about the poles?





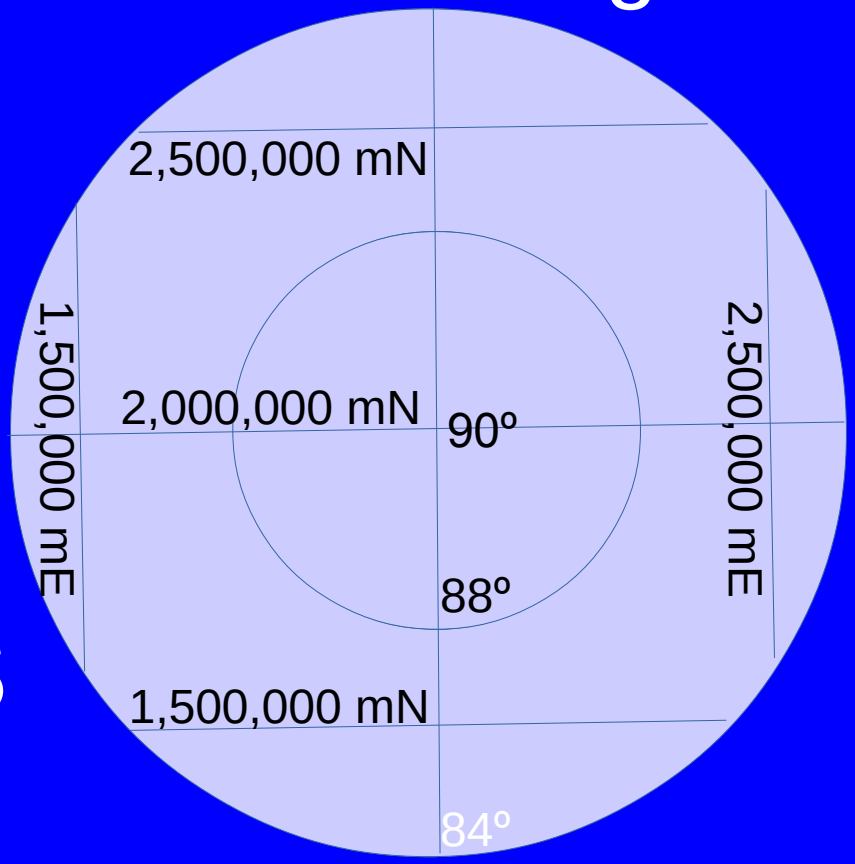
http://commons.wikimedia.org/wiki/File:Transverse_Mercator_meridian_stripes_10deg.jpg

Universal Polar Stereographic

North of 84 degrees N

Special cases for places you aren't very likely to go.

UTM grid doesn't work well at the poles

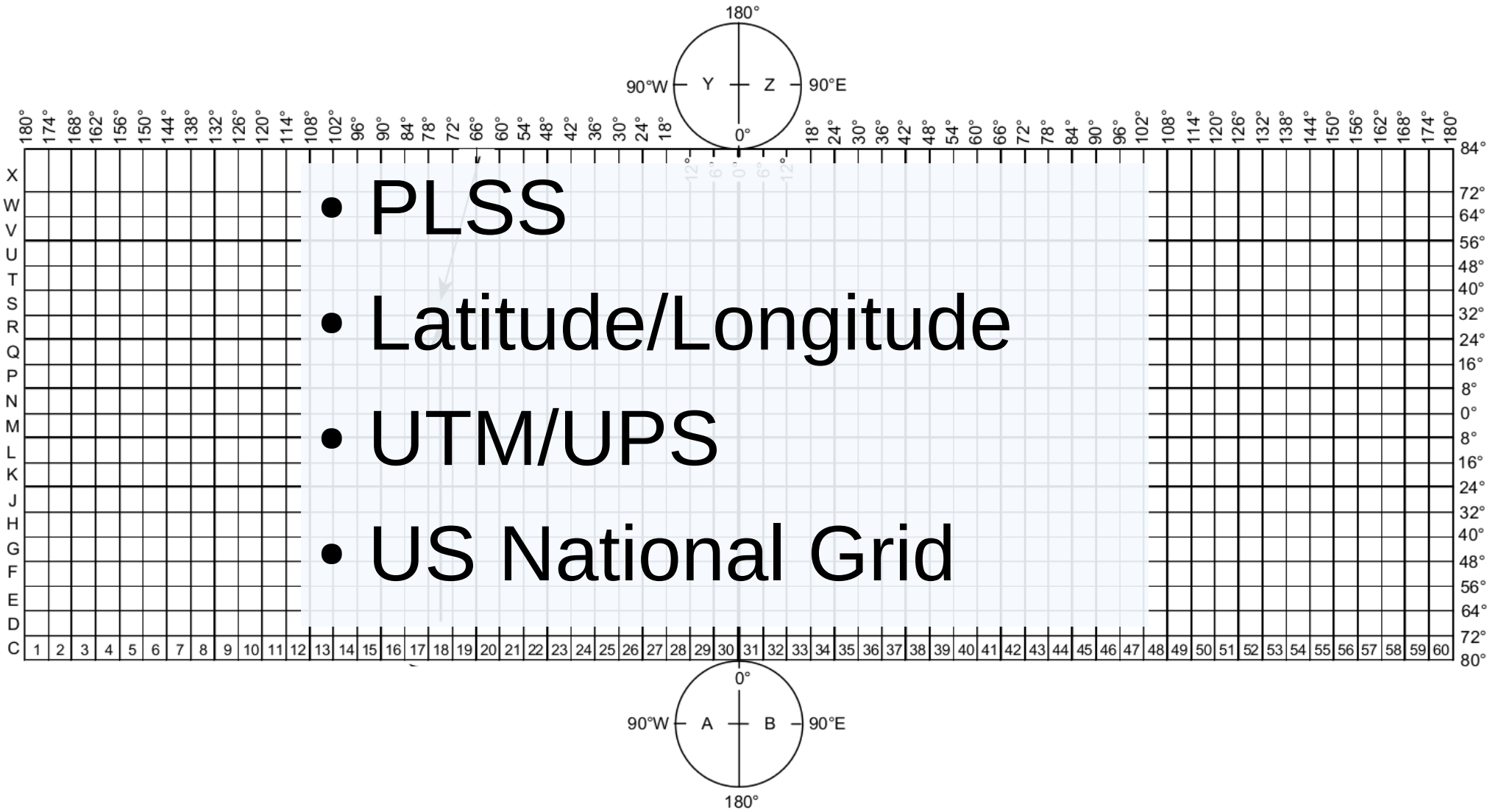


UTM / UPS
MGRS
use UPS
for the poles

South of 80 degrees S

Also, for Svalbard and SW Norway:
MGRS 31V,32V,31X,33X,35X,37X are non-standard in size.

Map Grids



- PLSS
- Latitude/Longitude
- UTM/UPS
- US National Grid

MGRS

- Divides grid zones into 100,000 meter squares
- Drops the first two digits of easting and northing

18T VJ 8026040830

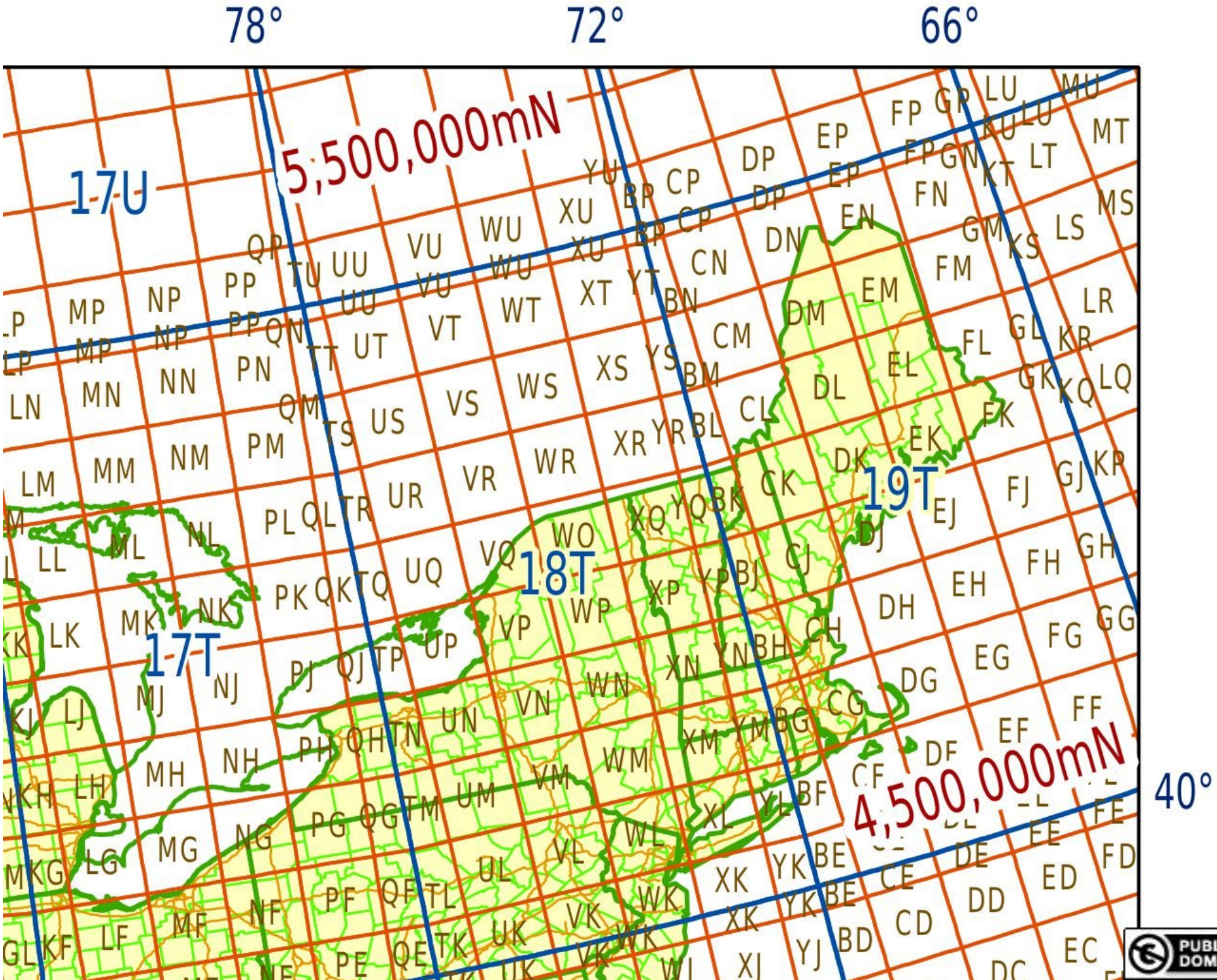
Zone
Grid Zone 19T

Band

100,000 meter square
(100 km square)

Easting

Northing



US National Grid

- FGDC standard: FGDC-STD-011-2001
- http://www.fgdc.gov/usng

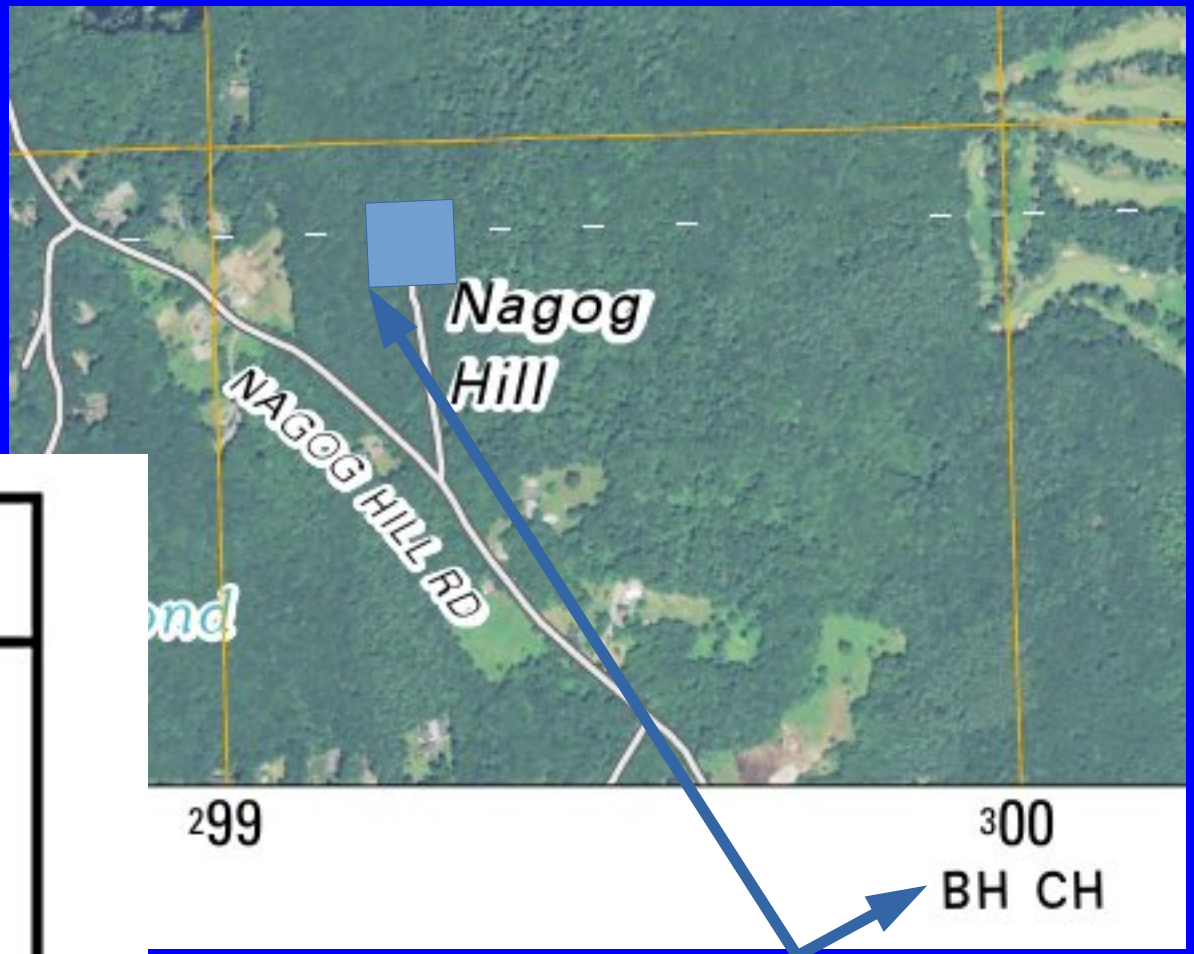
18T VJ 8026040830
VJ 8026040830
8026040830
80264083

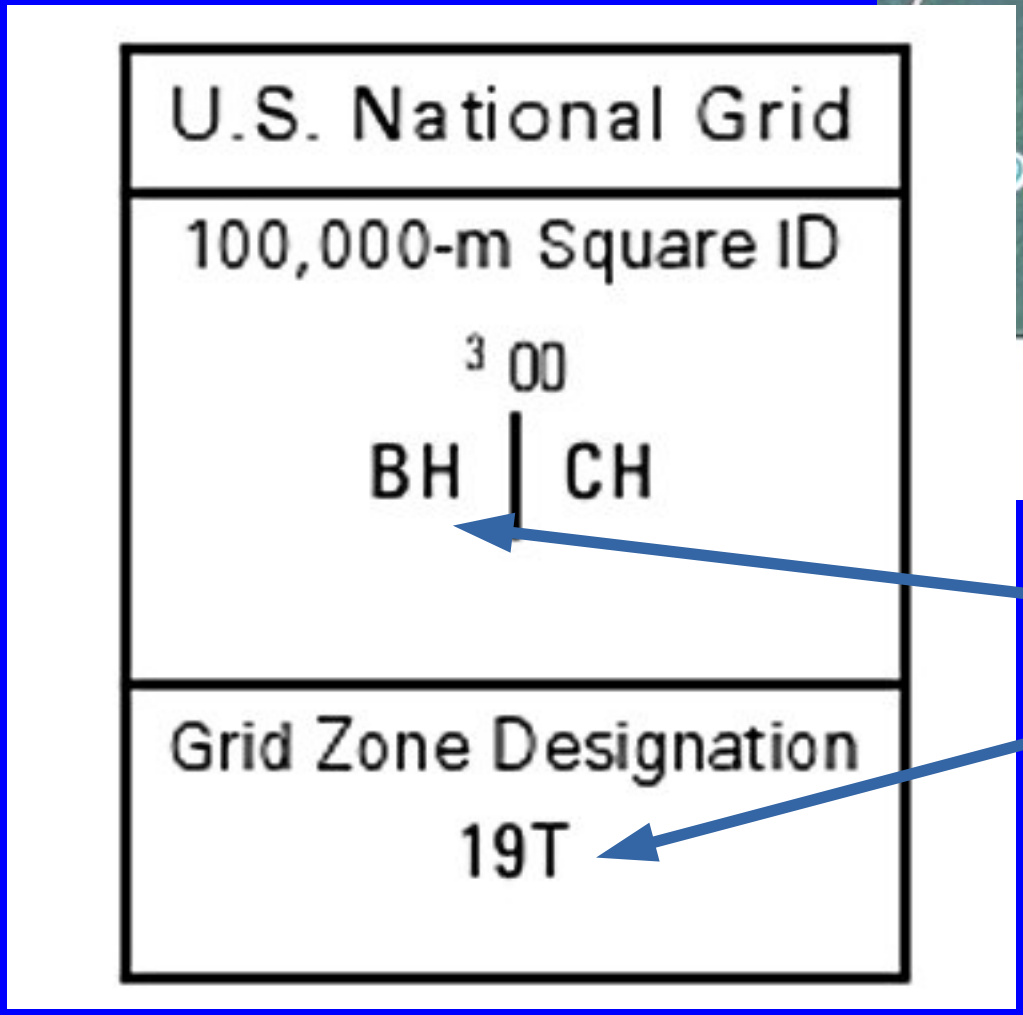
“USNG coordinates shall be identical to the MGRS numbering scheme over all areas of the United States including outlying territories and possessions.”

USNG not defined for N of 84ºN, or S of 80ºS (UTM and USNG grids differ from MGRS in Svalbard and SW Norway)

US National Grid: Simplifying

- 18T VJ 8026040830
- VJ 8026040830
  - Leave off grid zone
- 8026040830
  - Leave off grid zone and grid square
- 18T VJ 802408
  - Leave off some numbers (leave off 2 = 100 m square)
- 802408
  - Leave off grid zone, grid square, and some numbers





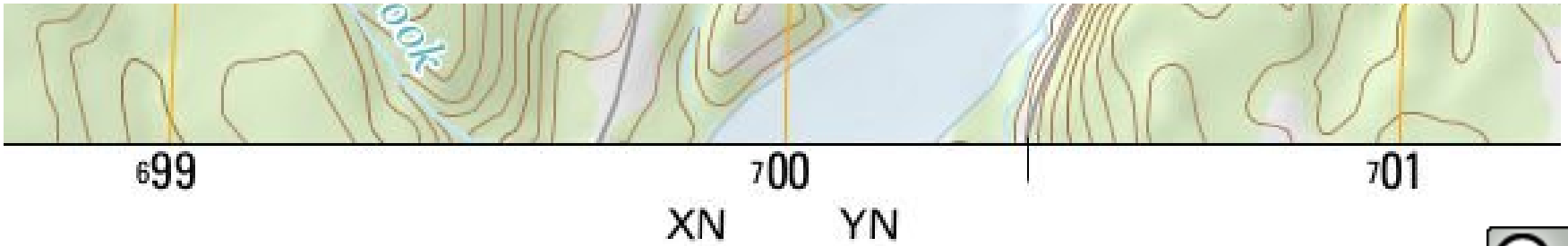
19T BH 992088

US Topo: Grid Zone and Square ID

U.S. National Grid
100,000-m Square ID YN
Grid Zone Designation 18T

U.S. National Grid
100,000-m Square ID ^{3}00 BH | CH
Grid Zone Designation 19T

U.S. National Grid
100,000-m Square ID ^{7}00 XN | YN ^{47}00 XM | YM
Grid Zone Designation 18T



Produced by the United States Geological Survey in cooperation with Massachusetts Department of Public Works

Control by USGS, NOS/NOAA, and Commonwealth of Massachusetts agencies

Compiled by photogrammetric methods from aerial photographs taken 1980. Field checked 1981. Map edited 1988

Supersedes Athol and Templeton 1:25,000-scale maps dated 1970

Projection and 1000-meter grid, zone 18
Universal Transverse Mercator

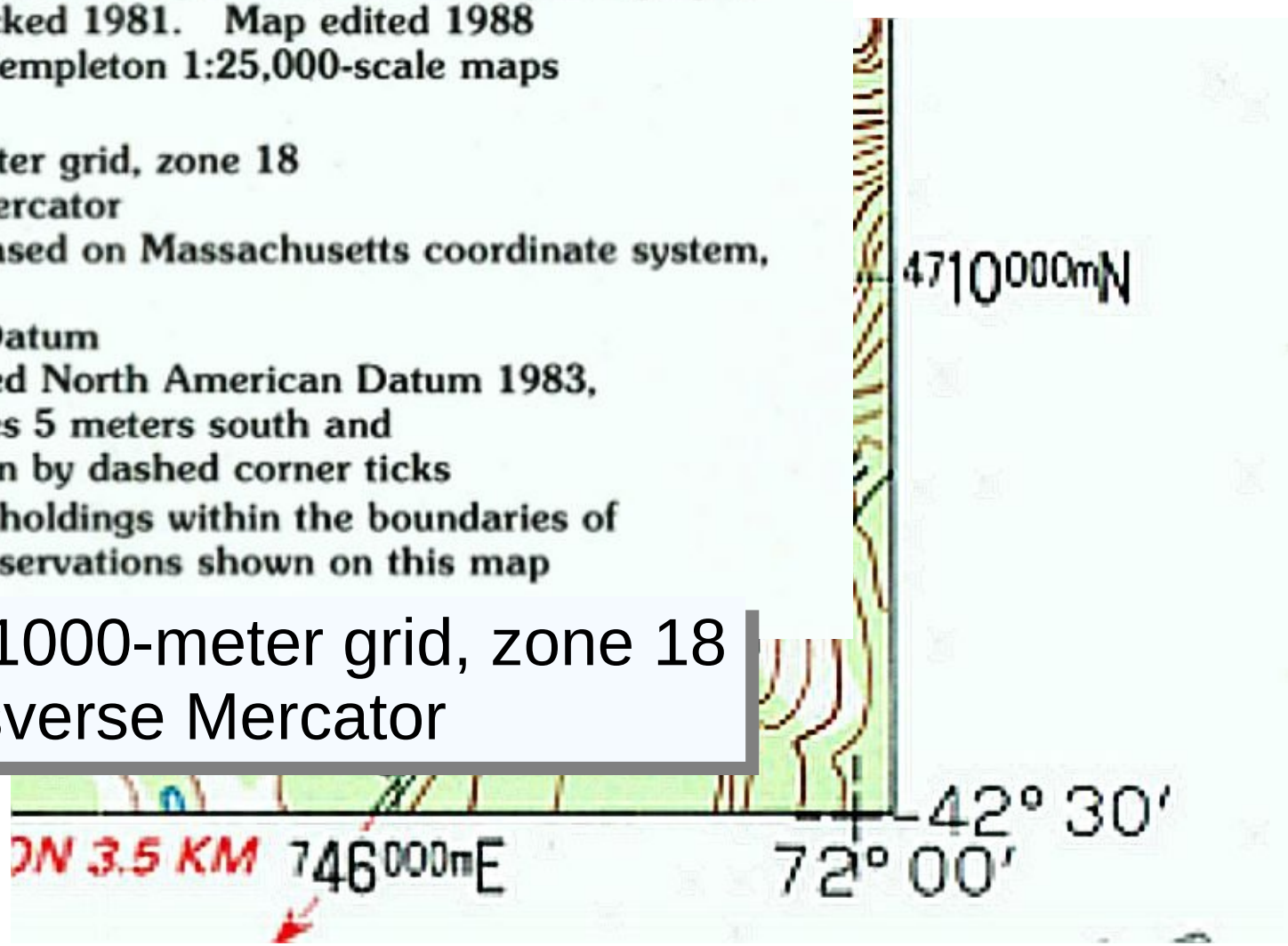
10,000-foot grid ticks based on Massachusetts coordinate system, mainland zone

1927 North American Datum

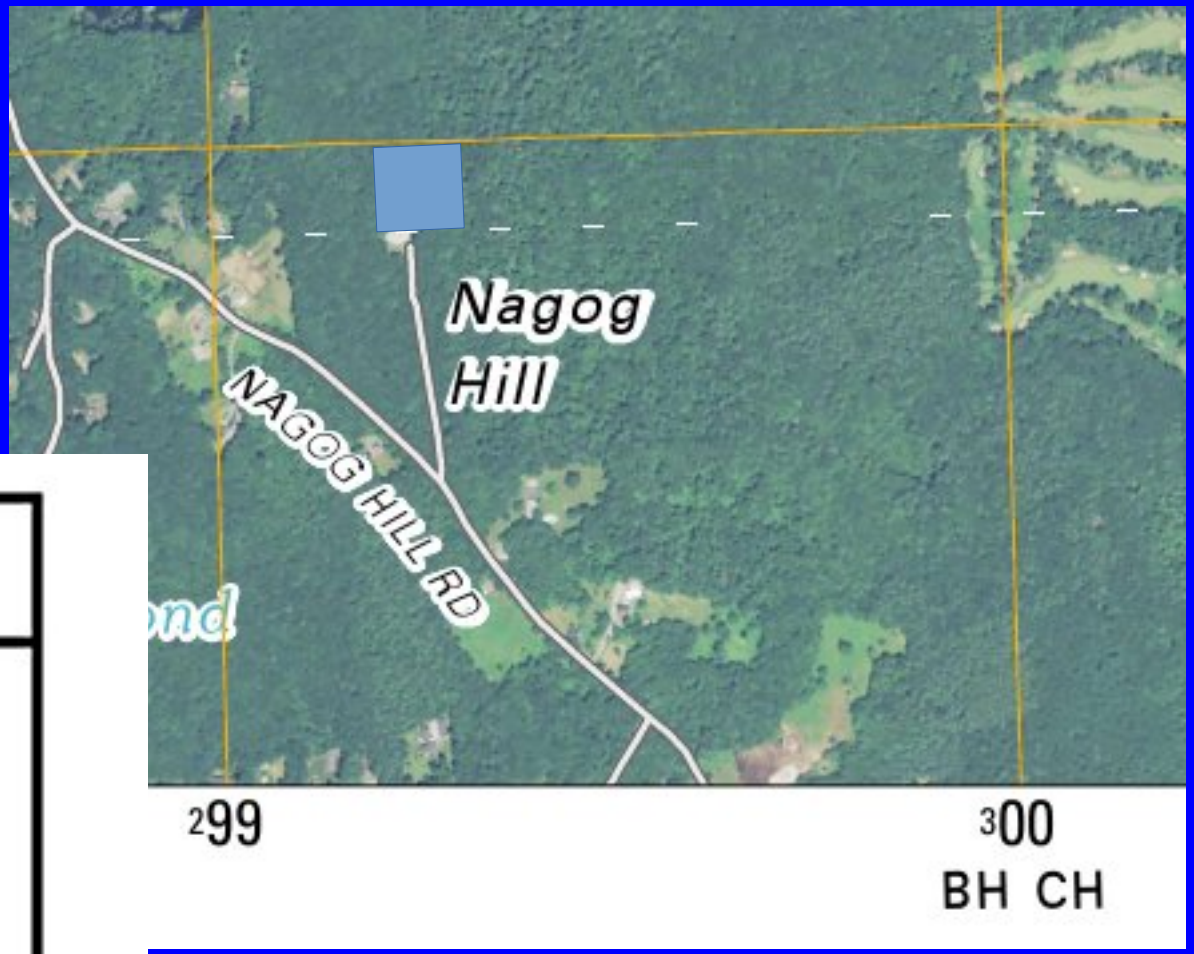
To place on the predicted North American Datum 1983, move the projection lines 5 meters south and 39 meters west as shown by dashed corner ticks

There may be private inholdings within the boundaries of the National or State reservations shown on this map

Projection and 1000-meter grid, zone 18
Universal Transverse Mercator



USNG

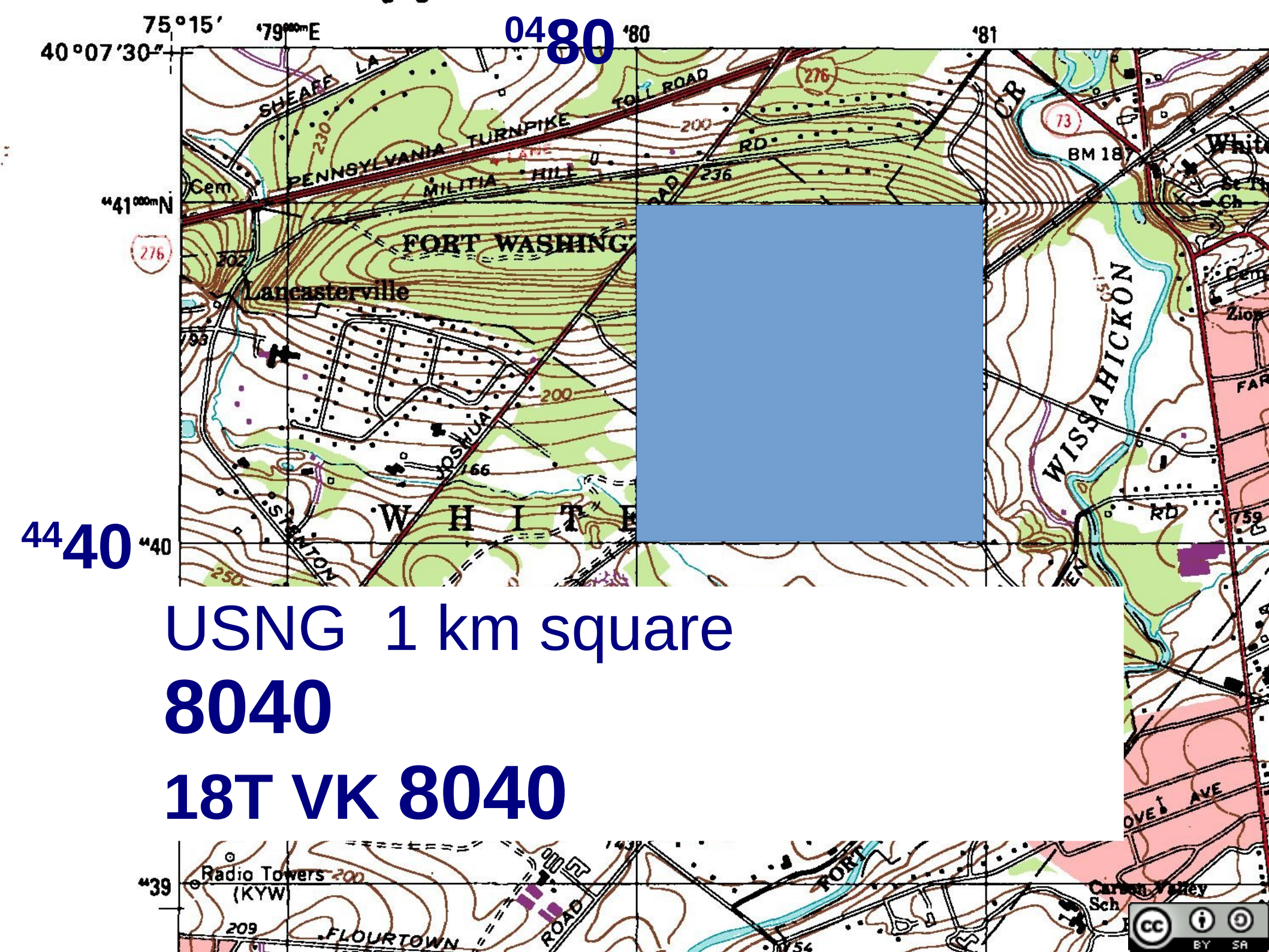


U.S. National Grid
100,000-m Square ID 3 00 BH | CH
Grid Zone Designation 19T

992089

BH 992089

19T BH 992089



USNG 1 km square

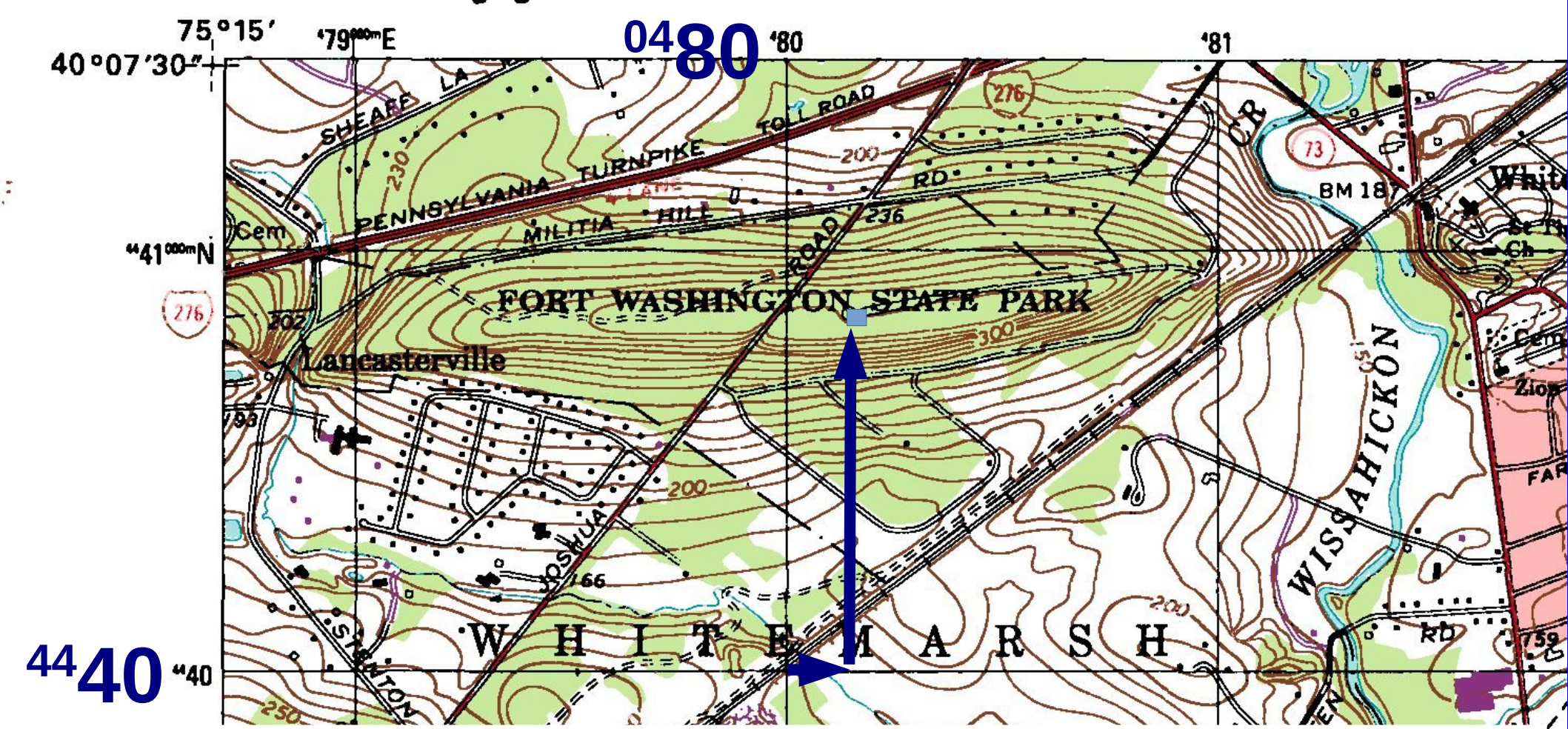
8040

18T VK 8040

USNG 1 km square

8040

18T VK 8040



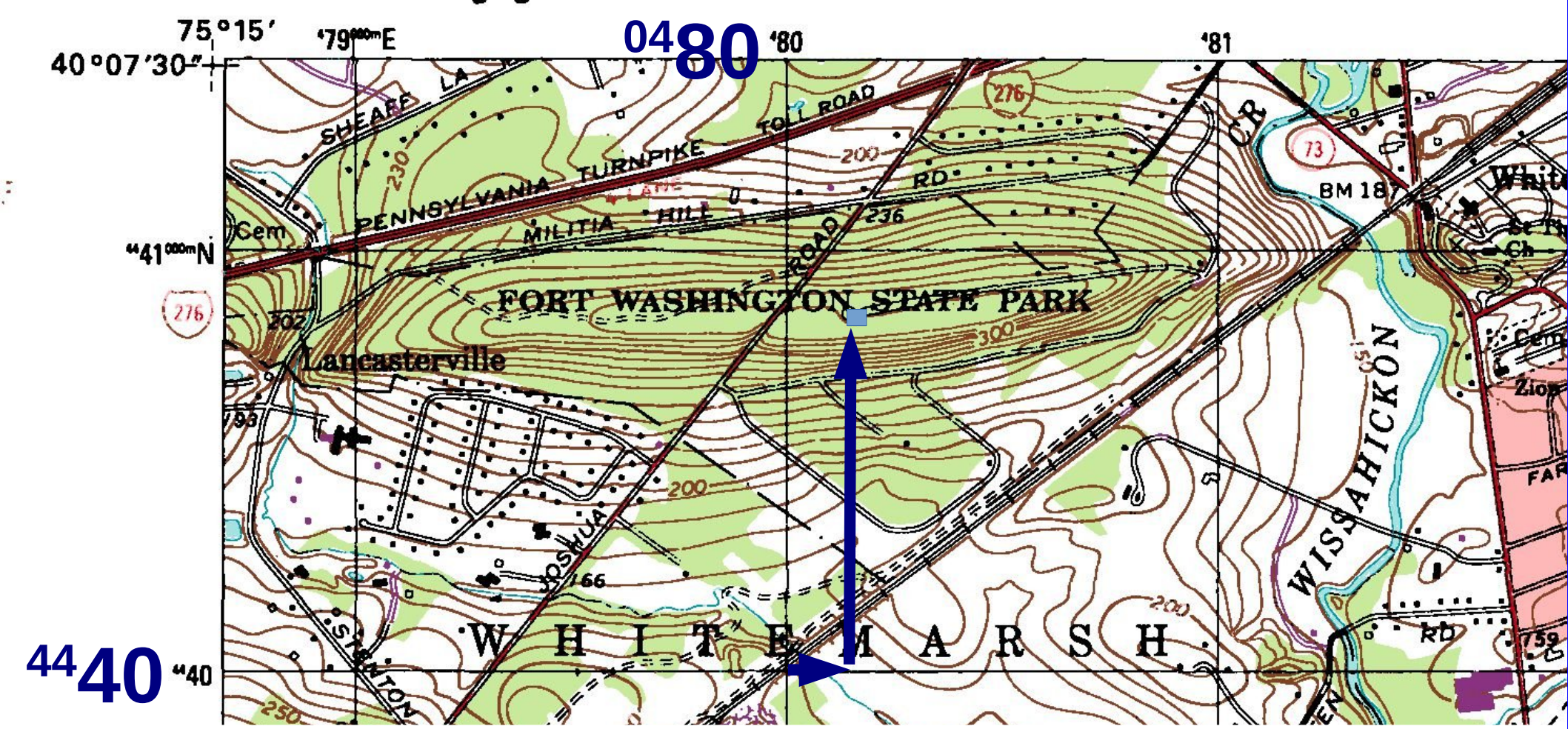
USNG 10 meter square

80254**0**85

18T VK **80254085**

UTM: 18T 0480250 4440850

Zone **18T** Square **VK** Easting **8025** Northing **4085**



USNG **80**25**40**85

Split into Easting and Northing: 8025 4085

Split into big numbers and rest: **80** 25, **40** 85

Add zeroes to make rest 3 digits (meters): **80** 250, **40** 850

Find the **80** Easting line. Go 250 meters further East.

Find the **40** Northing line. Go 850 meters further North.

US National Grid
Describing a 10 meter square

Local: 99250895
Regional: BH 99250895
Global: 19T BH 99250895

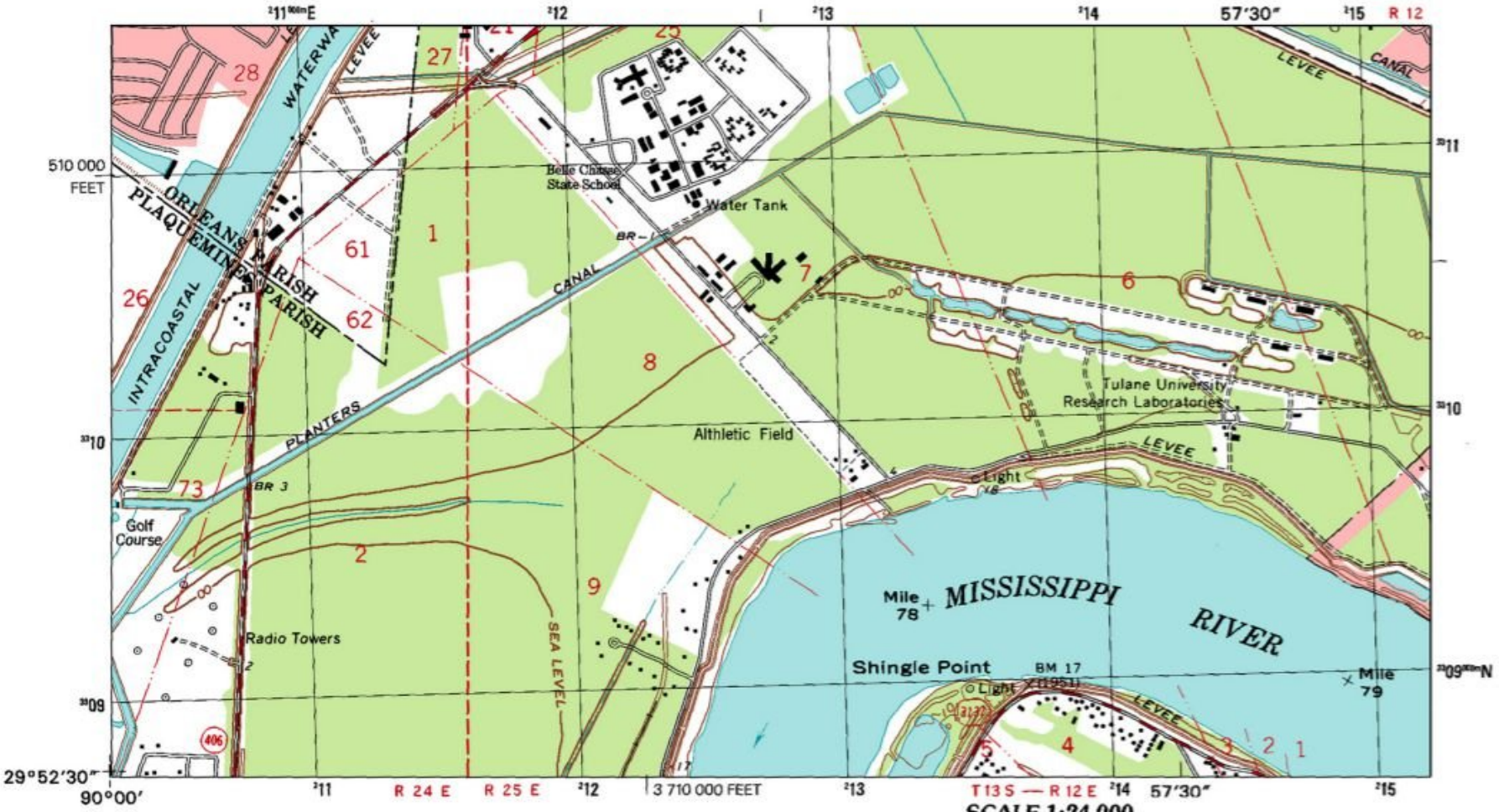
For GPS: 19T BH 9925**0**0895**0**

US National Grid
Describing a 1 meter square

Local: 9925308956
Regional: BH 9925308956
Global: 19T BH 9925308956

For GPS: 19T BH 9925308956

US National Grid Training Map



Produced by the United States Geological Survey

Topography compiled 1964. Planimetry derived from imagery taken 1998 and other sources. Public Land Survey System and survey control current as of 1967

North American Datum of 1983 (NAD 83). Projection and 1 000-meter grid: Universal Transverse Mercator, zone 16
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There may be private inholdings within the boundaries of the National or State reservations shown on this map

City of New Orleans and Orleans Parish are coextensive

This quadrangle covers a subsidence area

Landmark buildings verified 1967

QUADRANGLE LOCATION

1	2	3
4		5
6	7	8

1 Spanish Fort
2 Little Woods
3 Chef Menteur
4 New Orleans East
5 Martello Castle
6 Bertrandville
7 Belle Chasse
8 Delacroix

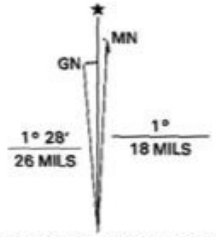
ADJOINING 7.5' QUADRANGLE NAMES
LA 200A

SCALE 1:24 000

KILOMETERS: 1 0.5 0 1 2
METERS: 1000 0 1000 2000
MILES: 1 0.5 0 1
FEET: 1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929
TO CONVERT FROM FEET TO METERS, MULTIPLY BY 0.3048

U.S. National Grid
100,000-m Square ID
BU
Grid Zone Designation
16R



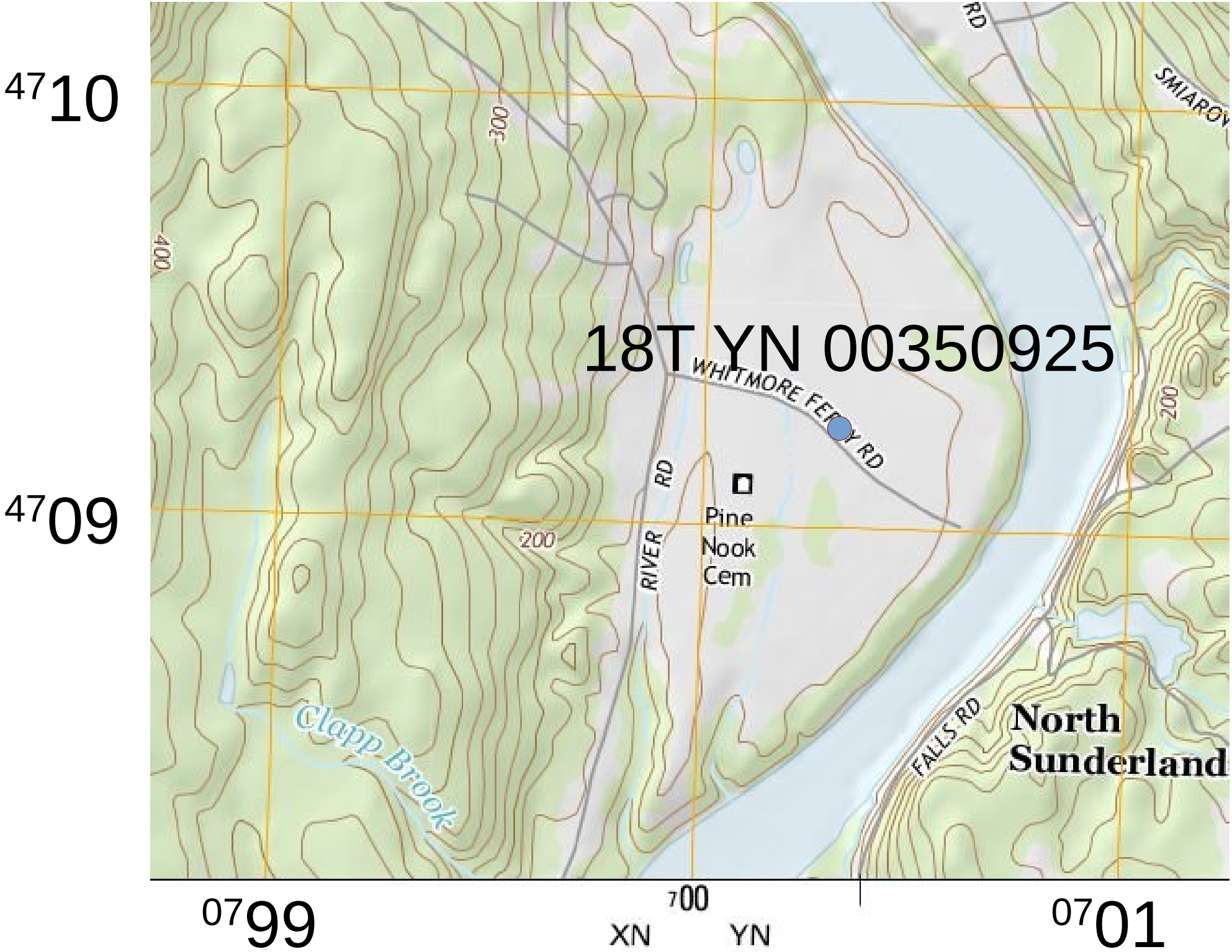
UTM GRID AND 2000 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Which Is Which?

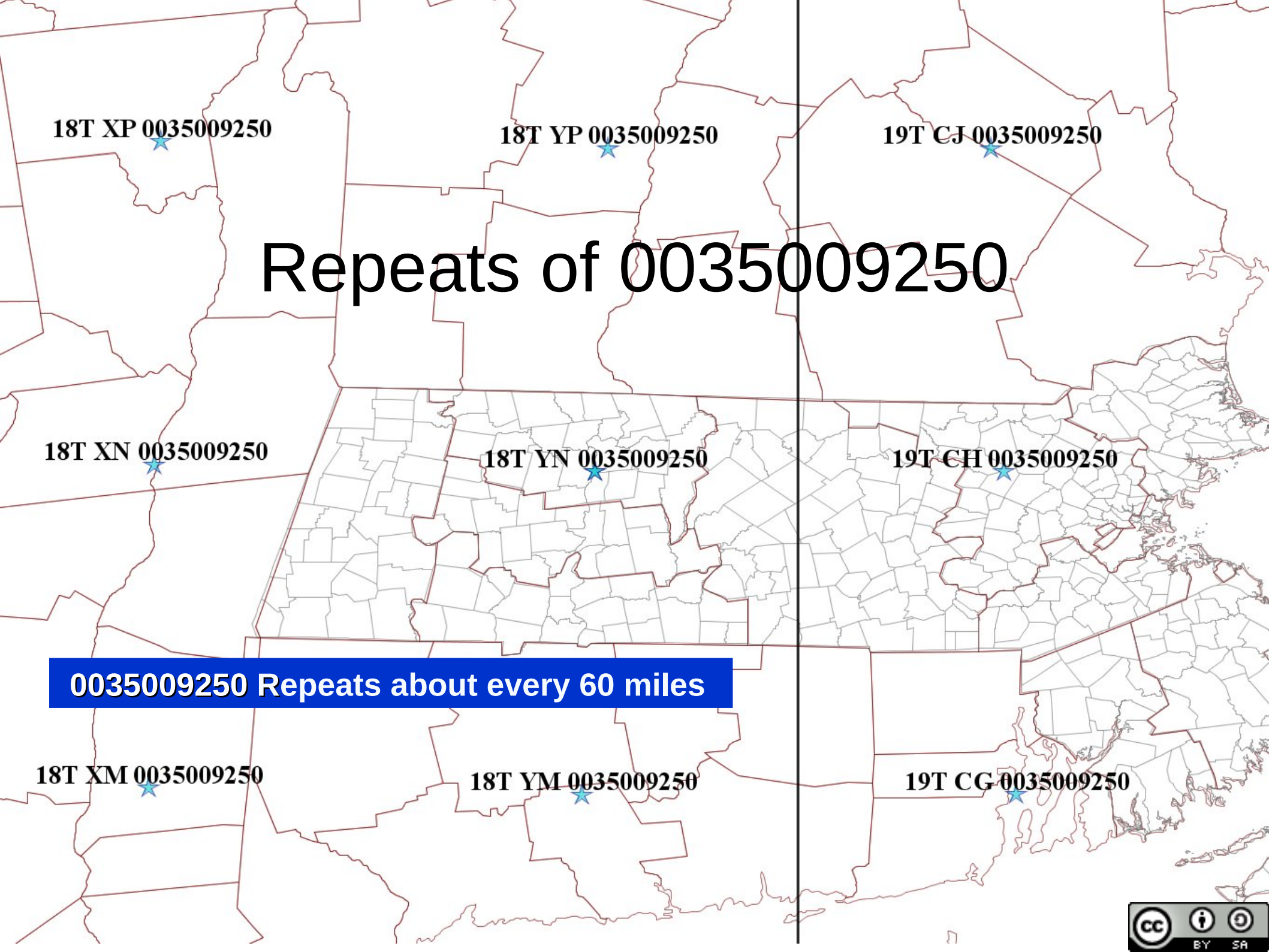
(1) 19T 0355000 4612500
(2) T2S R4W S33 NW¼
(3) BH 99250895
(4) 40.1197N 75.2328W
(5) 19T BH 9925308956
(6) 40°07'11"N 75°13'58"W

Which Coordinate System do I use?

- MA Land SAR: USNG with WGS84.
- NSARC Georeferencing Matrix:
  - Land SAR Responder
    - USNG Primary, Lat/Long Secondary
  - Land SAR coordination with Incident Command
    - USNG Primary, Lat/Long Secondary
  - Land SAR Responder with Aeronautical SAR
    - USNG Primary, Lat/Long Secondary


4710
4709
0799
7 00
0701
XN
YN
18T YN 00350925
WHITMORE FERRY RD
RD
RIVER
Pine
Nook
Cem
Clapp Brook
FALLS RD
North
Sunderland
SMIARDY
300
400
200

Repeats of 0035009250



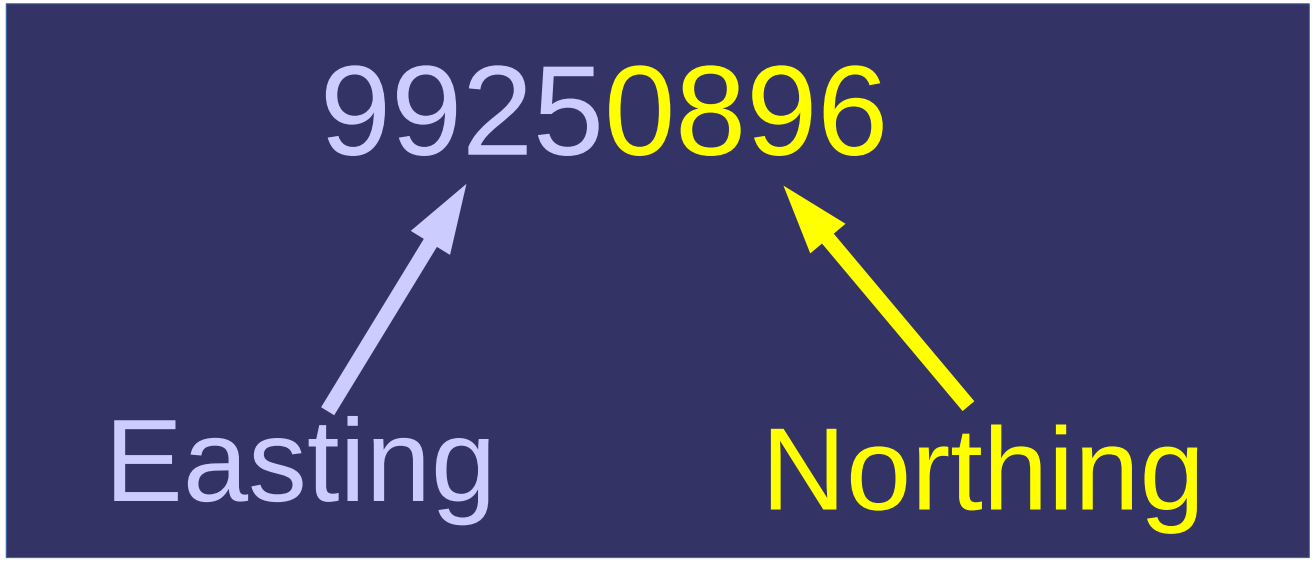
0035009250 Repeats about every 60 miles

Repeats of YN 0035009250

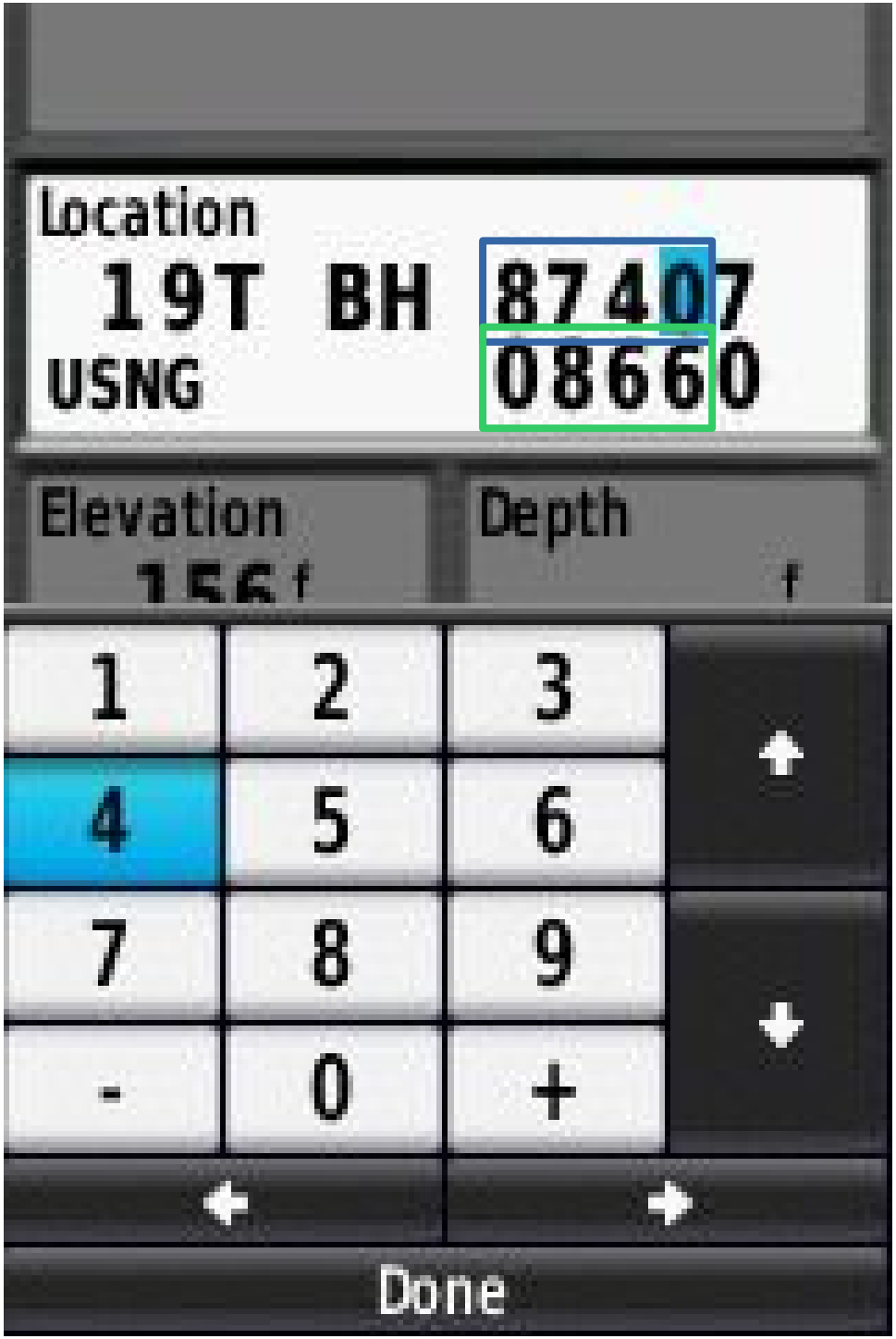
YN 0035009250 Repeats about every 1000 miles

US National Grid
Local coordinates

100 meter grid square: 992089
10 meter grid square: 99250896
1 meter grid square: 9925308966



Ready to copy location?



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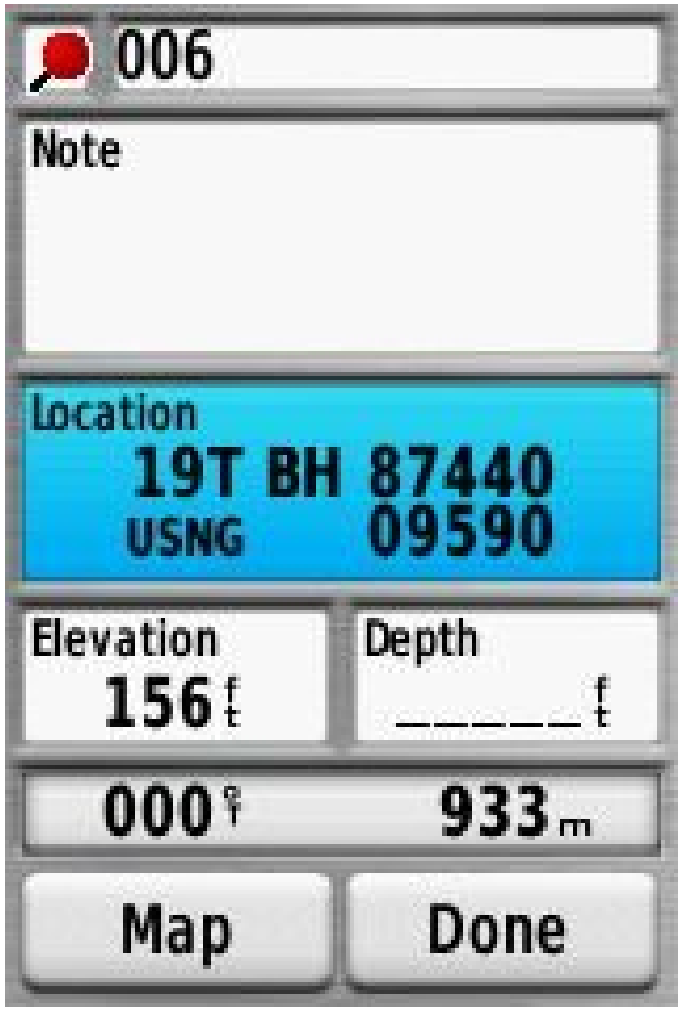
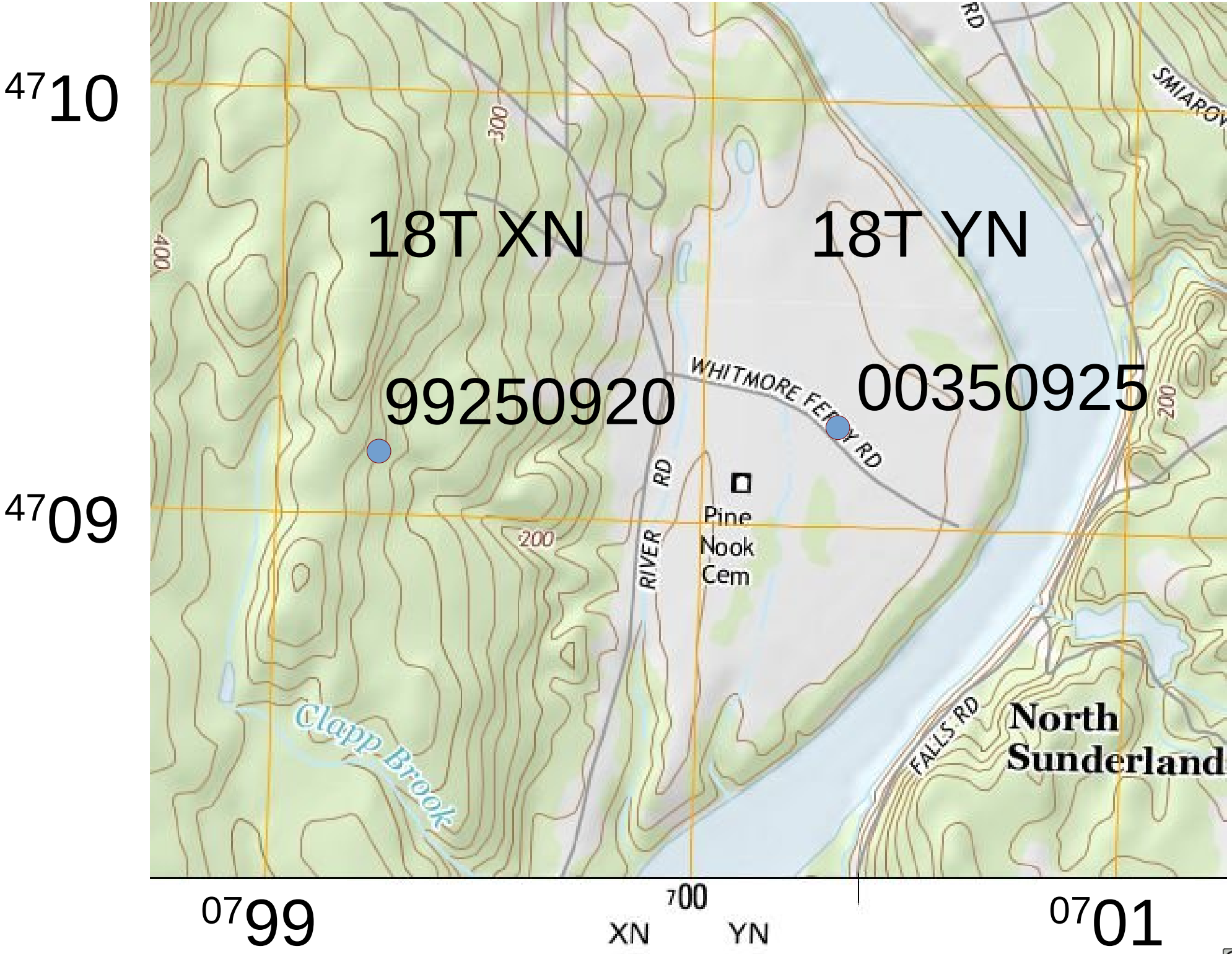
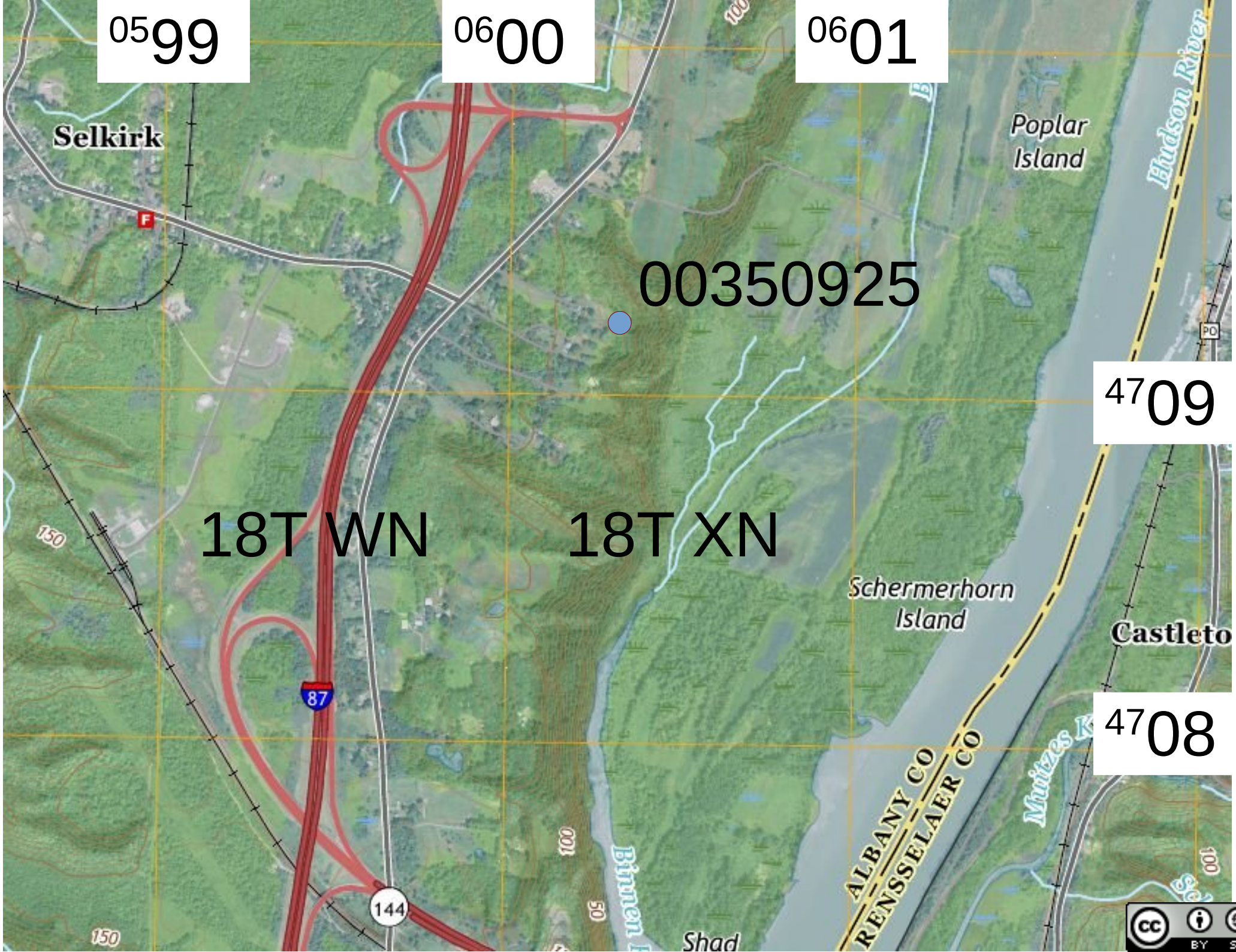
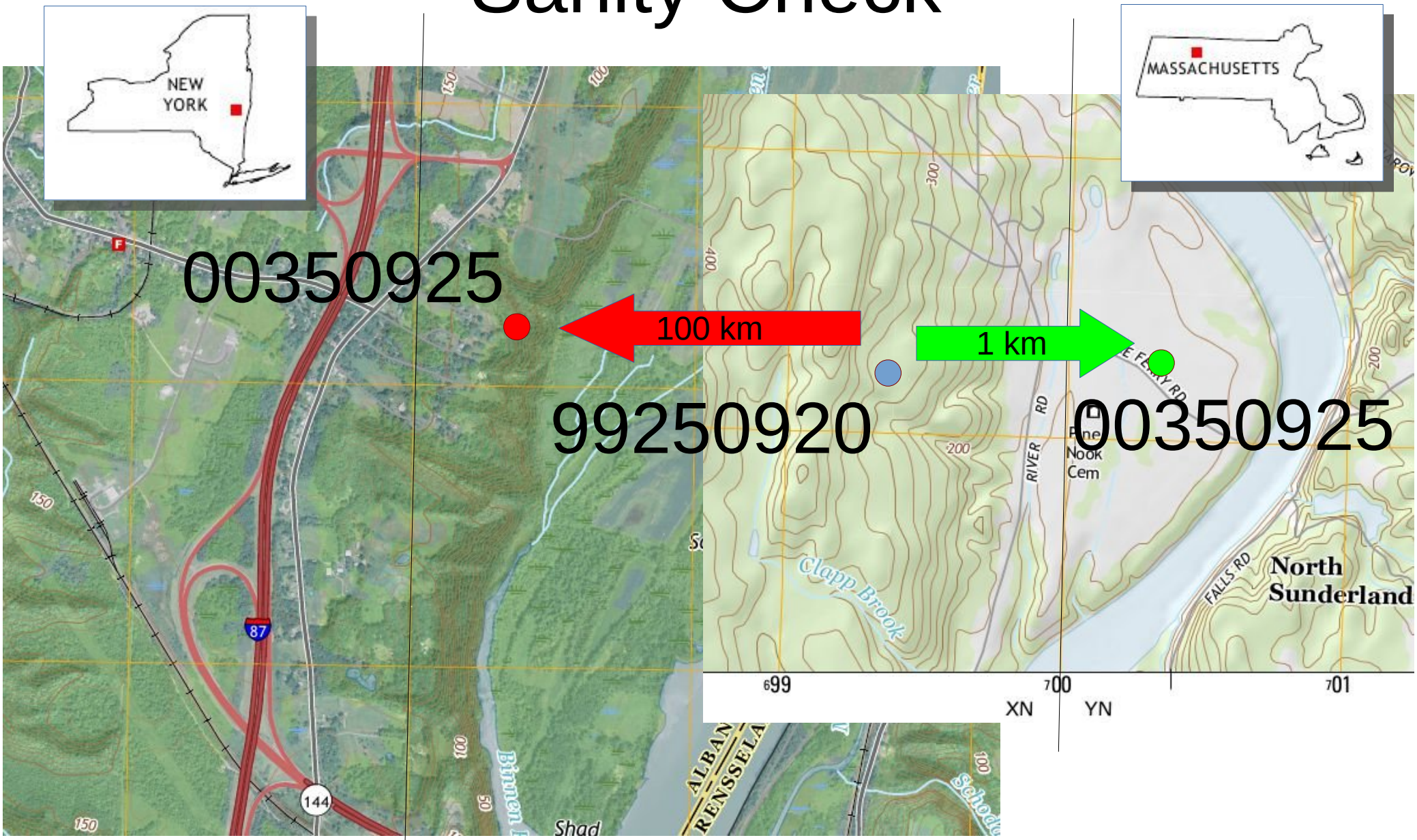



4710
4709
0799
0701
700
XN
YN
18T XN
18T YN
99250920
00350925
WHITMORE FERRY RD
RIVER RD
Pine Nook Cem
Clapp Brook
FALLS RD
North Sunderland
SMIARDY RD
300
400
200


0599
0600
0601
Selkirk
Poplar Island
Hudson River
00350925
4709
18T WN
18T XN
Schermerhorn Island
Castleto
4708
87
144
ALBANY CO
RENSSELAER CO
Muitzes K
Binnen
Shad
150
100
50

Sanity Check



18T WN

18T XN

18T YN

UTM
Conventionally:

19 Tango
0287367
Break
4709474

USNG as:

19 Tango
Bravo Hotel
8736709474

or

87450959

42 Degrees
30 Minutes
30 decimal 7
Seconds
North

71 Degrees
35 Minutes
16 decimal 2
Seconds
West

US National Grid Training Map

Produced by the United States Geological Survey

Topography compiled 1964. Planimetry derived from imagery taken 1998 and other sources. Public Land Survey System and survey control current as of 1967

North American Datum of 1983 (NAD 83). Projection and 1 000-meter grid: Universal Transverse Mercator, zone 16
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SCALE 1:24 000

KILOMETERS: 1 — 0.5 — 0 — 1 — 2
METERS: 1000 — 0 — 1000 — 2000
MILES: 1 — 0.5 — 0 — 1
FEET: 1000 — 0 — 1000 — 2000 — 3000 — 4000 — 5000 — 6000 — 7000 — 8000 — 9000 — 10000

CONTOUR INTERVAL 5 FEET
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U.S. National Grid
100,000-m Square ID
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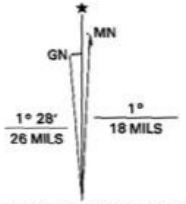
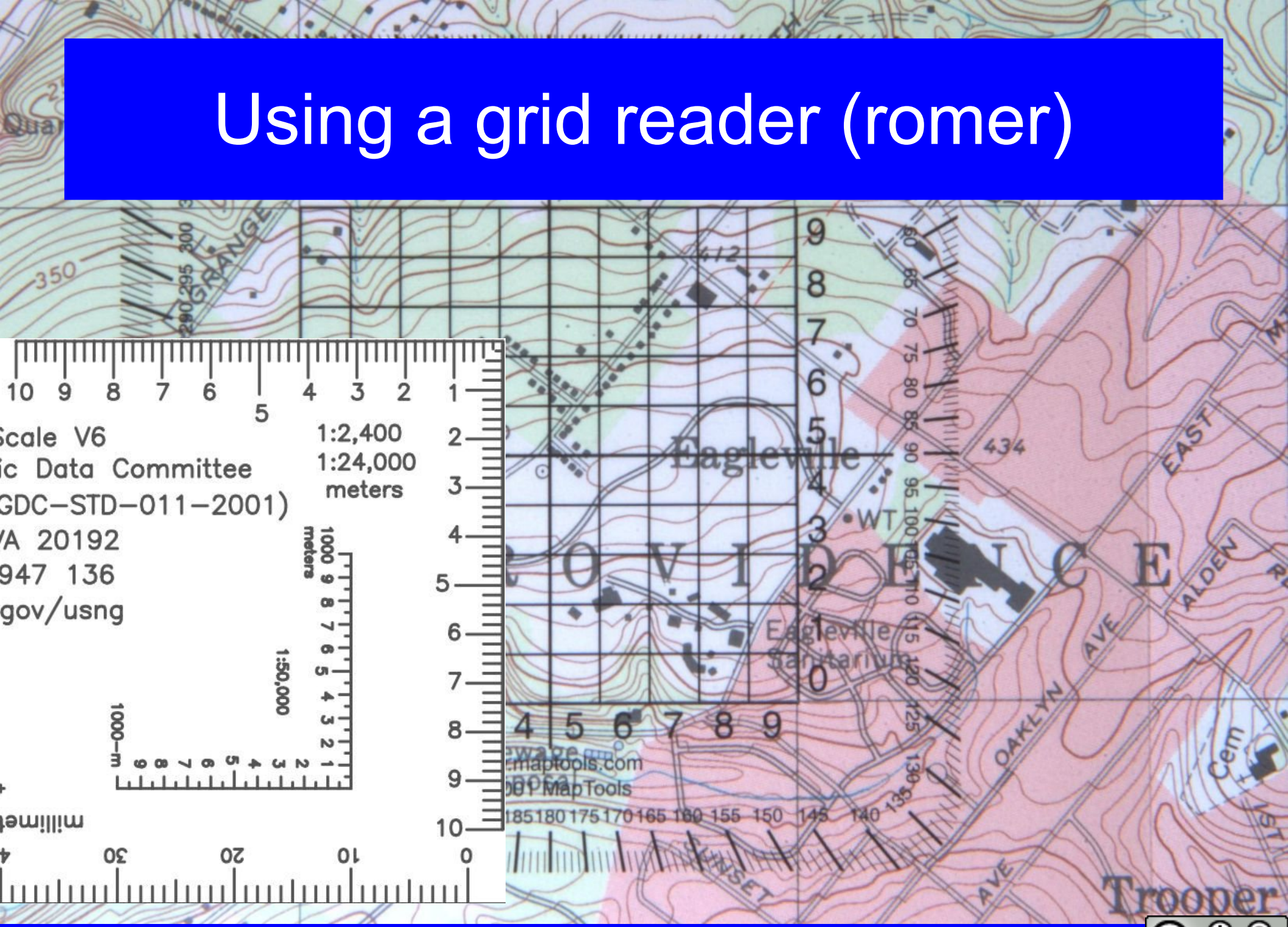


UTM GRID AND 2000 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

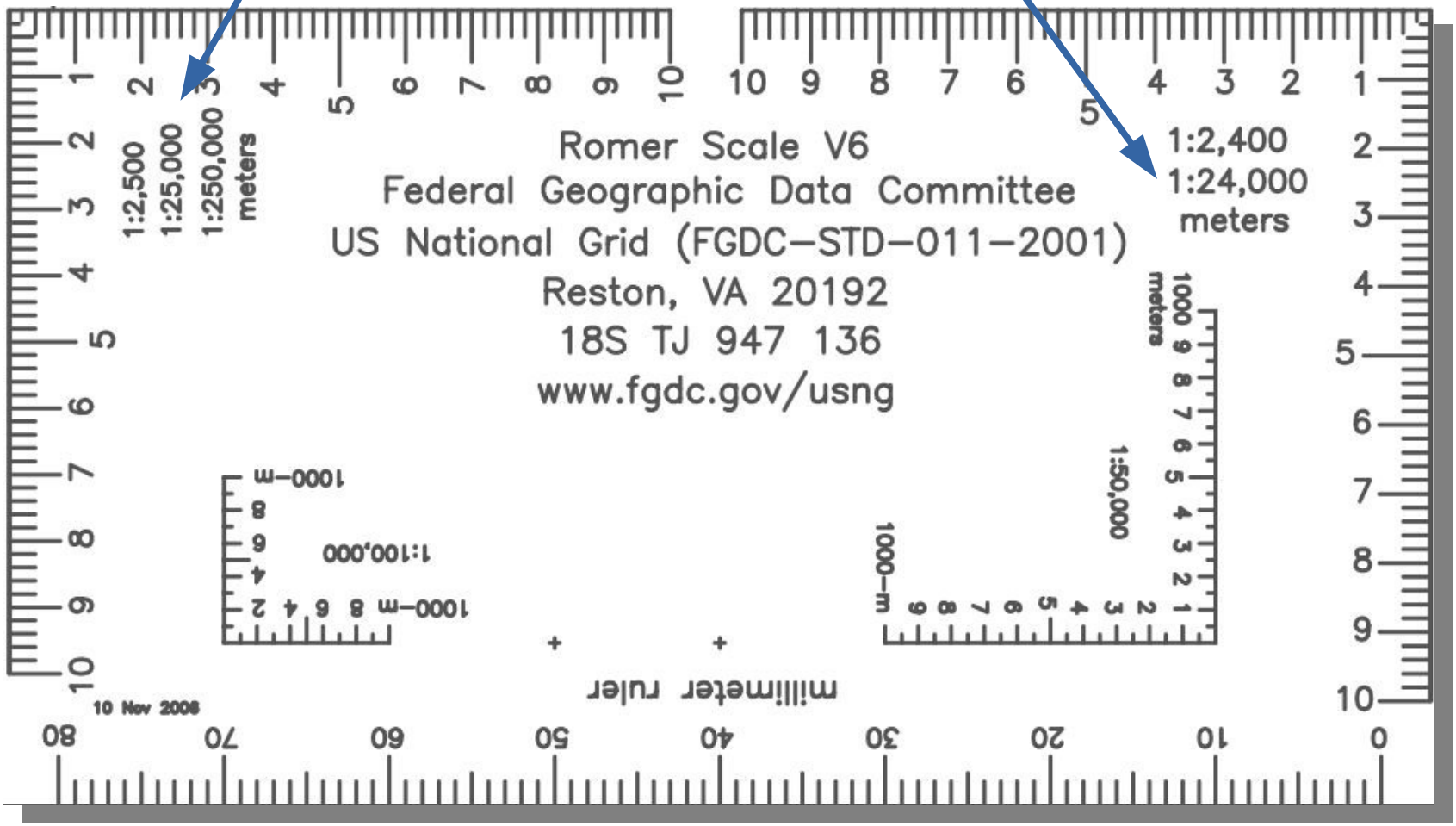
Advantages and Disadvantages

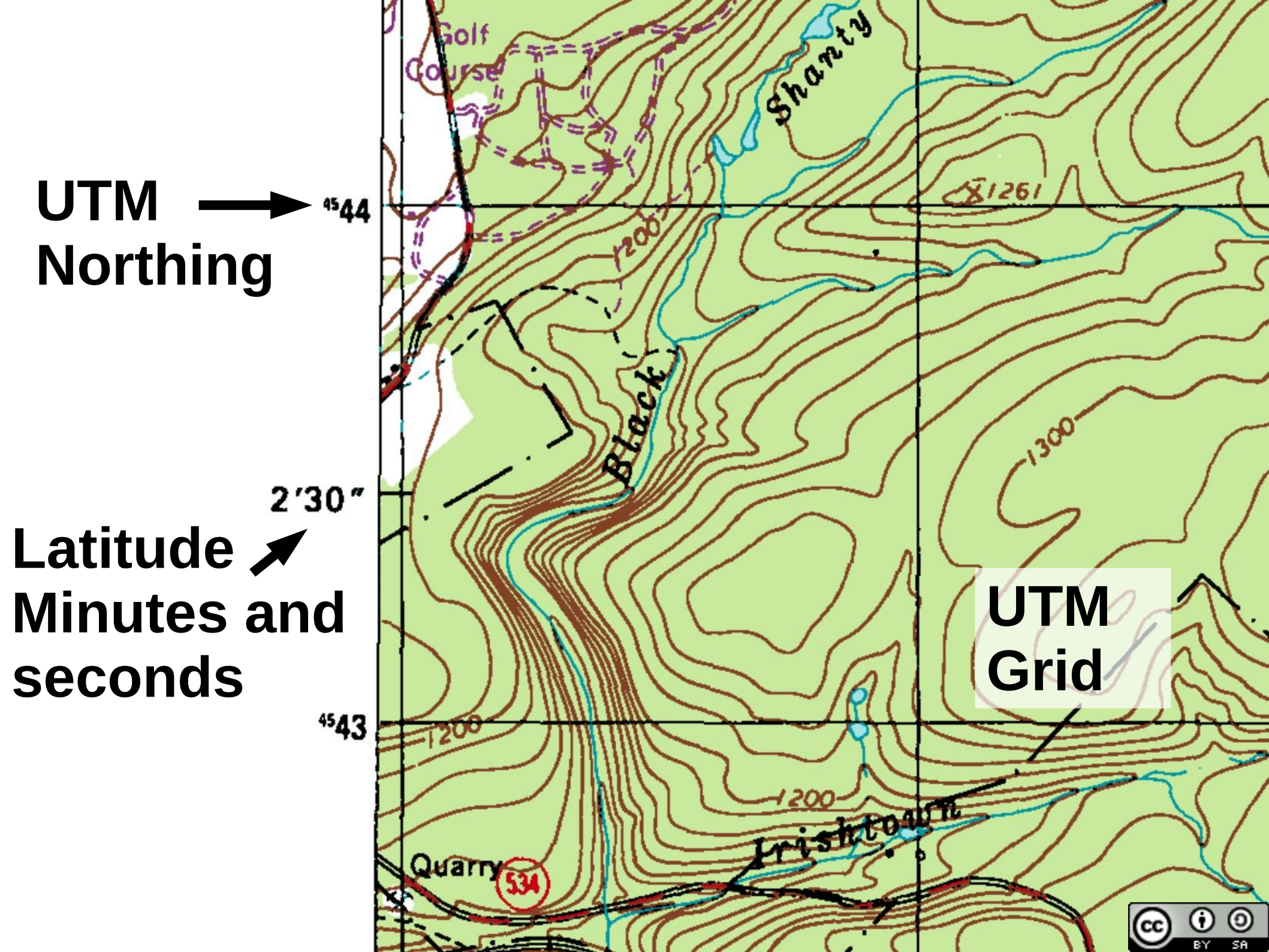
Using a grid reader (romer)



Map
Scale
1:25,000

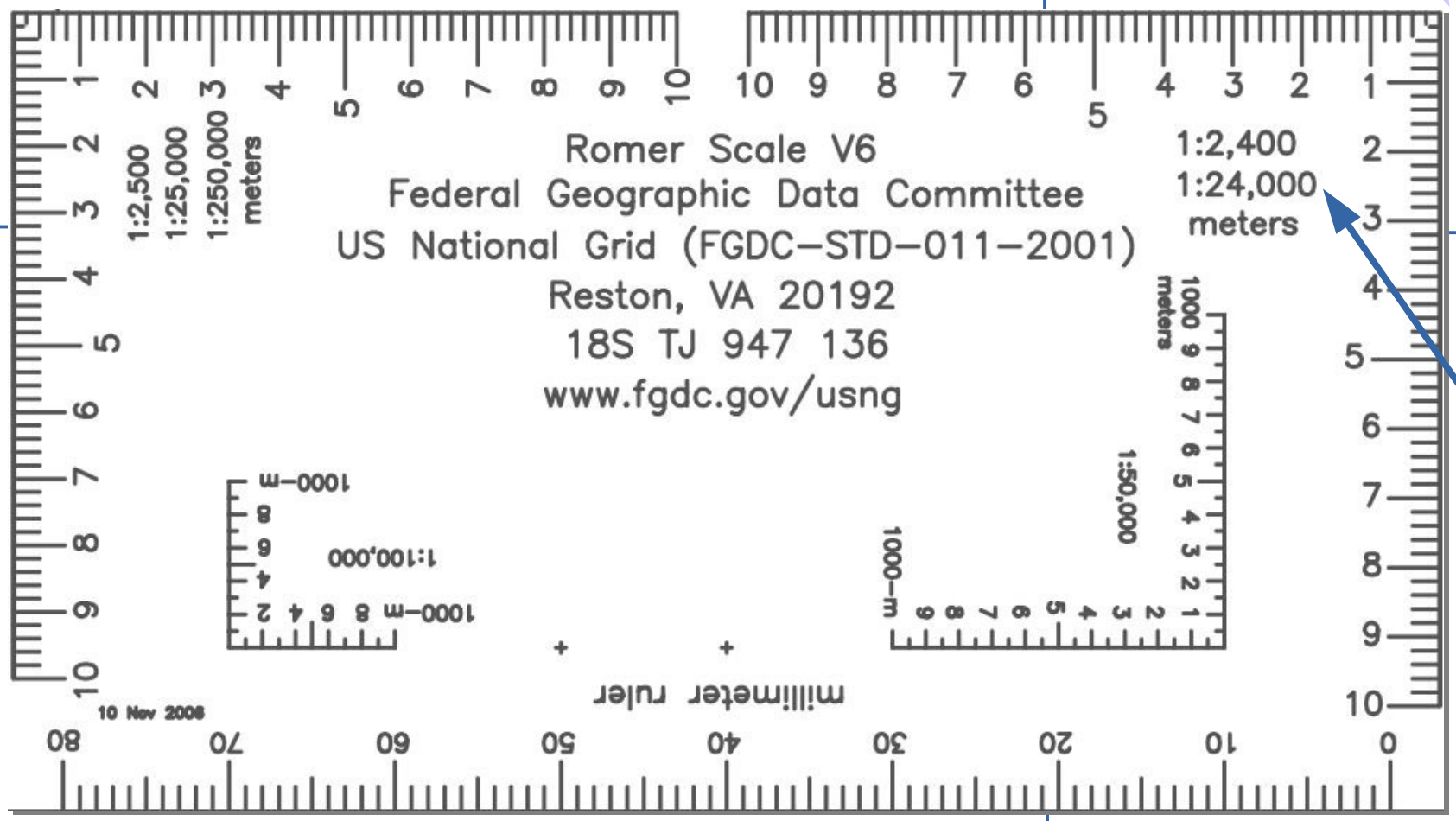
Map
Scale
1:24,000




UTM Northing
45 44
2'30"
Latitude Minutes and seconds
45 43
UTM Grid
Golf Course
Shanty
Black
Irishtown
Quarry
534
1200
1300
1261

44585232

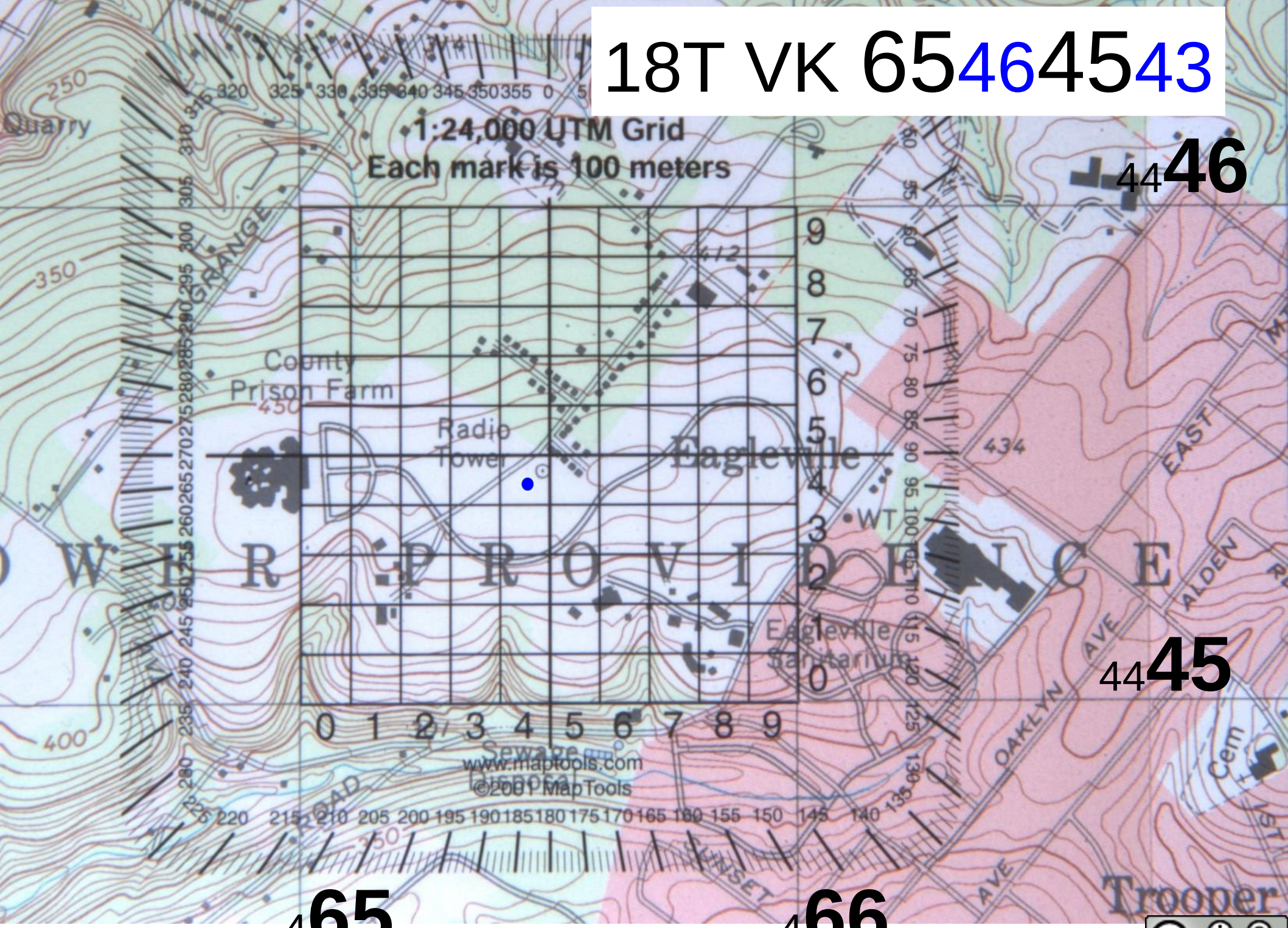
Point of interest



Map Scale 1:24,000

16 52

2 44


18T VK 65464543
1:24,000 UTM Grid
Each mark is 100 meters
4446
4445
4465
4466
Quarry
County
Prison Farm
Radio
Tower
Eagleville
Eagleville
Sanitarium
Sewage
Disposal
WT
434
412
GRANGE
ROAD
SUNSET
OAKLYN
AVE
ALDEN
EAST
Cem
Trooper
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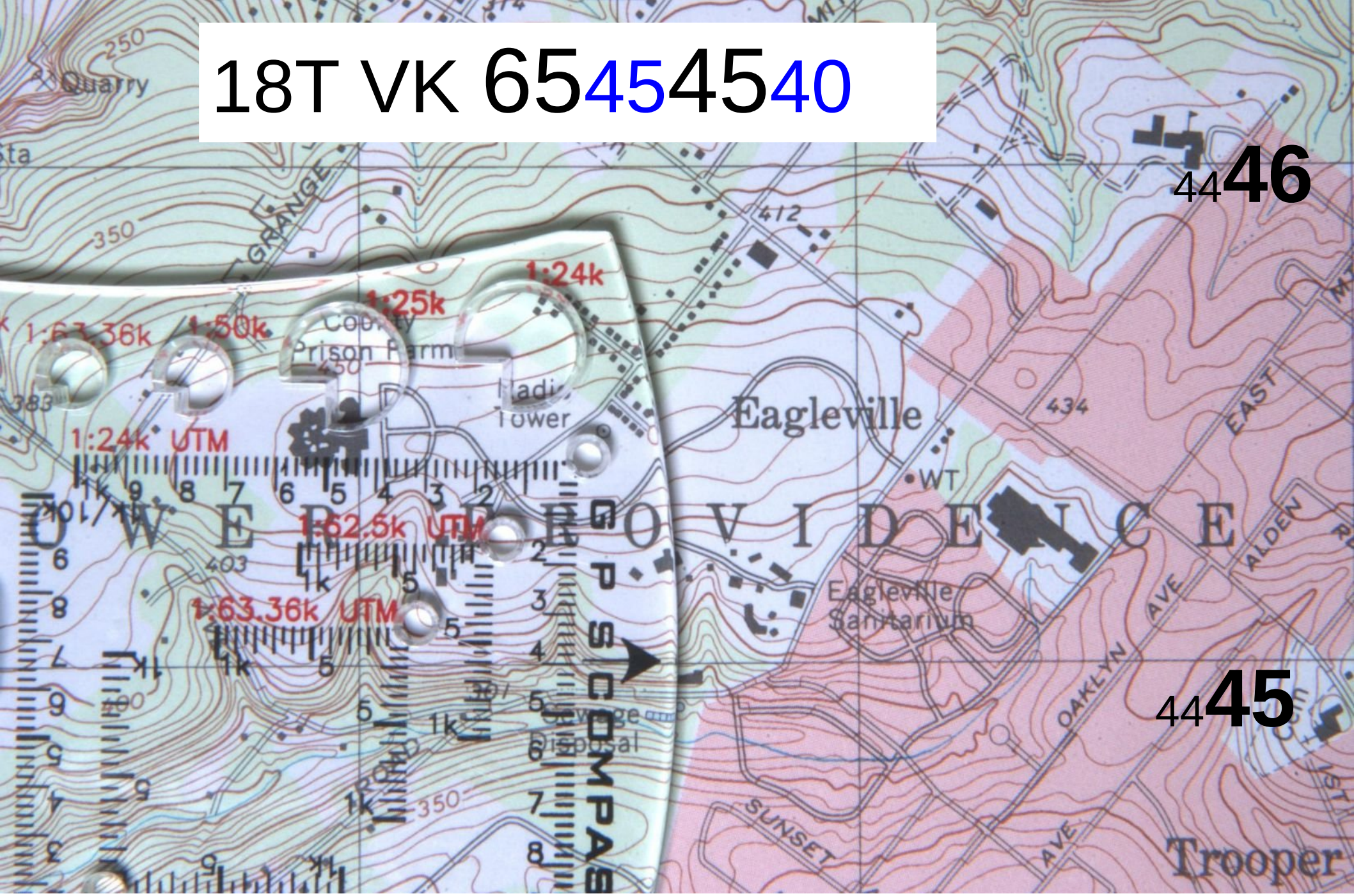
18T VK 6545454 0



04 65

04 66

SDMRT coordinates

- Everyone has identical maps.
- Communicate points on the map from measurements in inches on the map from the edge of the map (read in like Easting, read up like Northing, but in inches measured on the printed map.
- Maps must be exactly identical (they can’t be copied in different resolutions or positions).