Land Navigation VIII
Using GNSS Receivers

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Some Key GNSS receiver Settings

- Position format:
  - Latitude/Longitude
    - Decimal Degrees
    - Degrees, Minutes, Seconds
  - **USNG**, UTM/UPS, MGRS
- Datum: NAD27, NAD83, WGS84, etc.
  - Use **WGS84**
  - Unless using a map with a different datum
- Units (elevation, speed): English, Metric
- Bearings: Magnetic, True
- WAAS (on, off)

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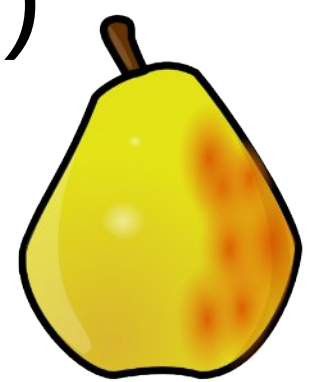
Datum (geodetic datum)



- The Earth is not a perfect Sphere
- A geodetic datum is a reference model for the shape of the surface of the Earth
- The same coordinate in two different datums may differ in position by hundreds of meters or even kilometers
- (Distinct from vertical datum for elevation)

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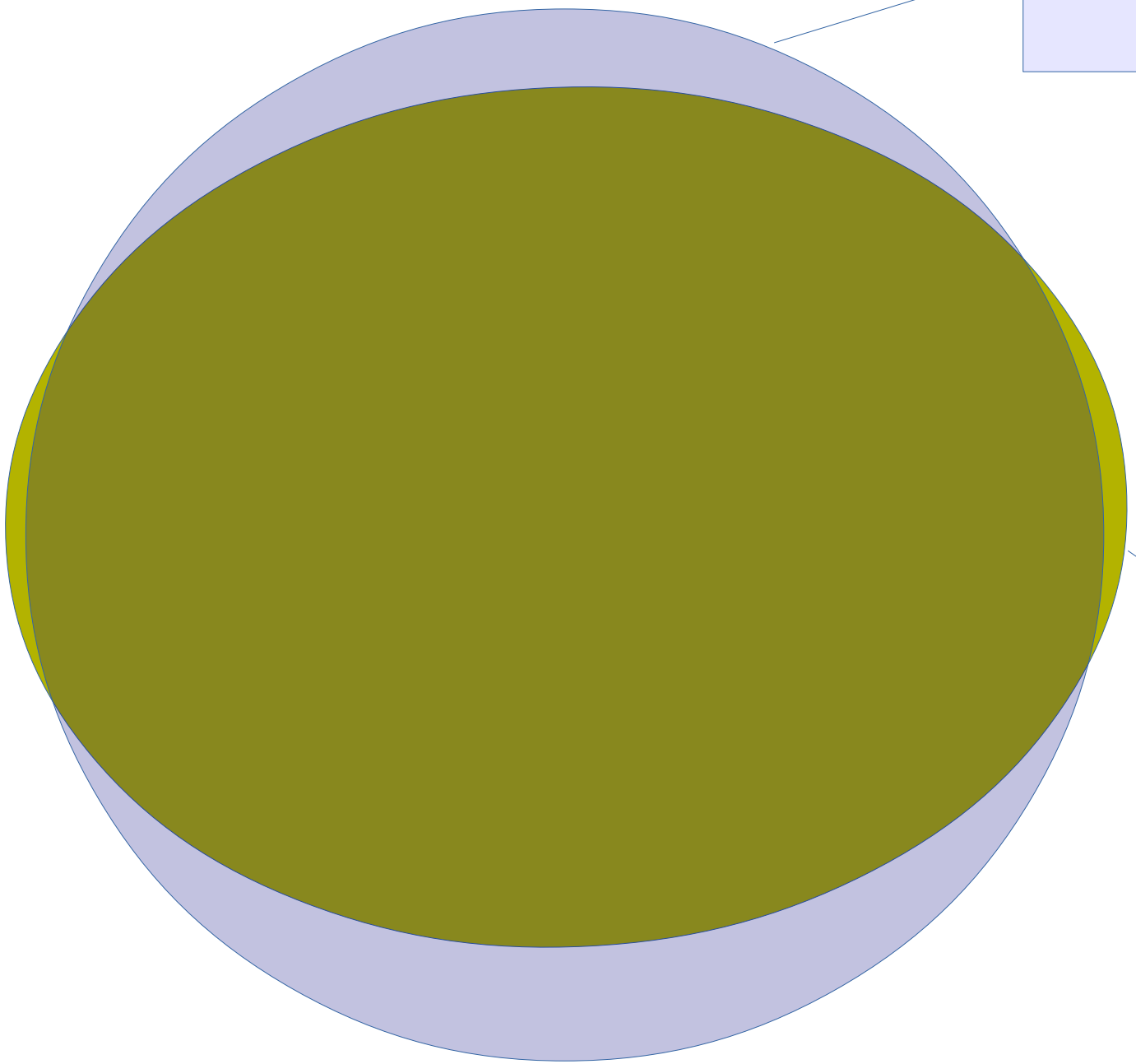
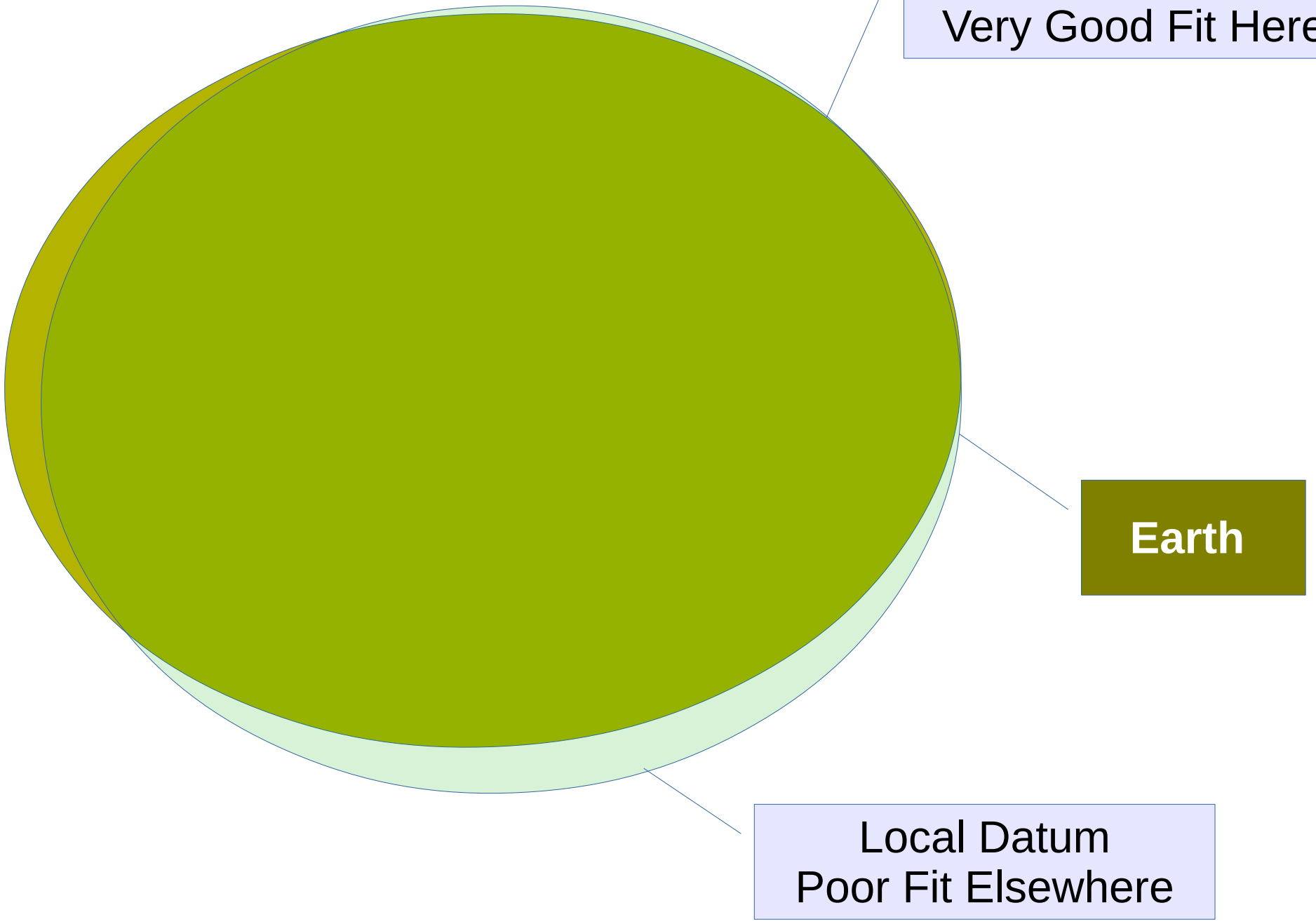
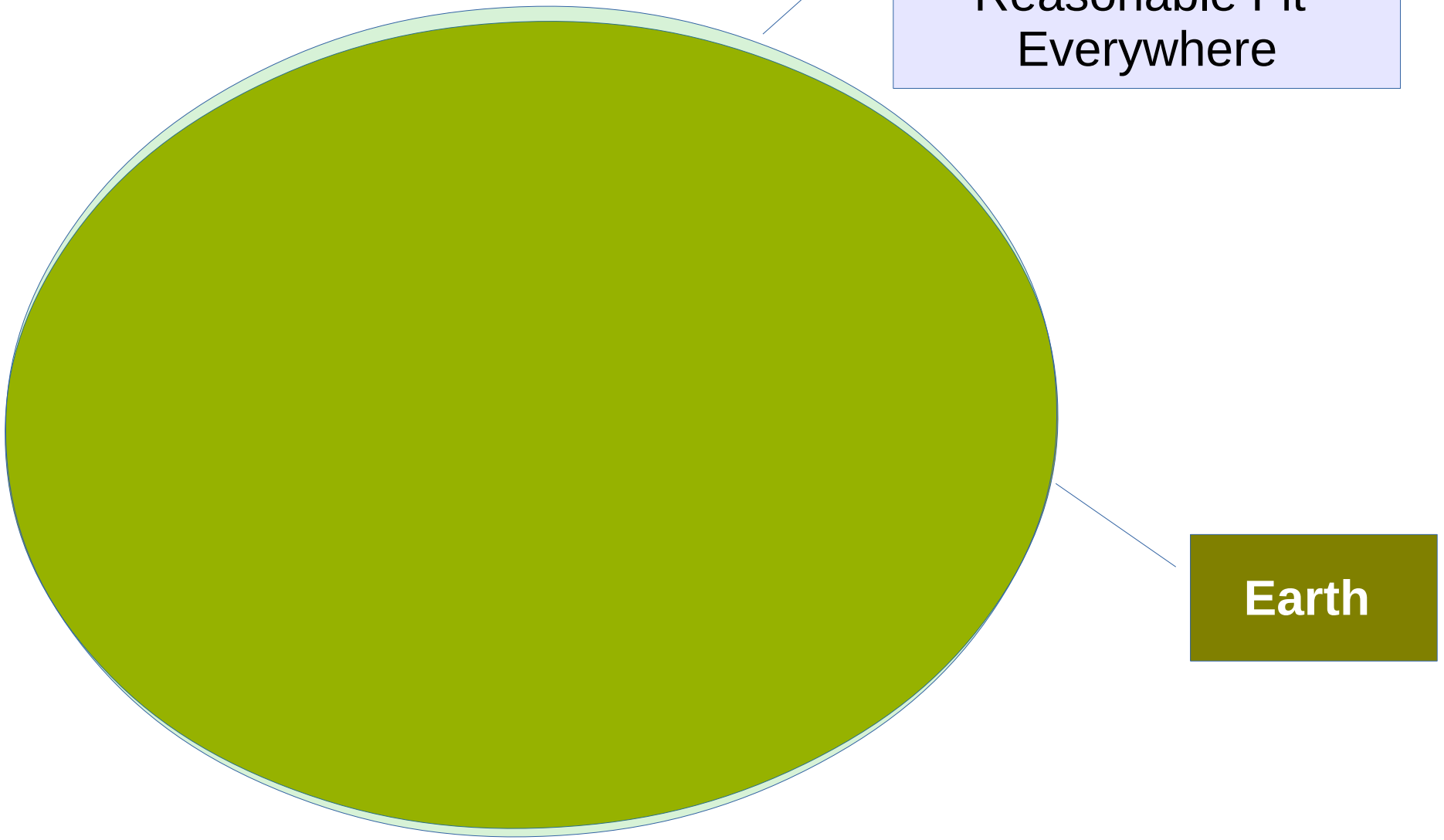

Sphere
Earth

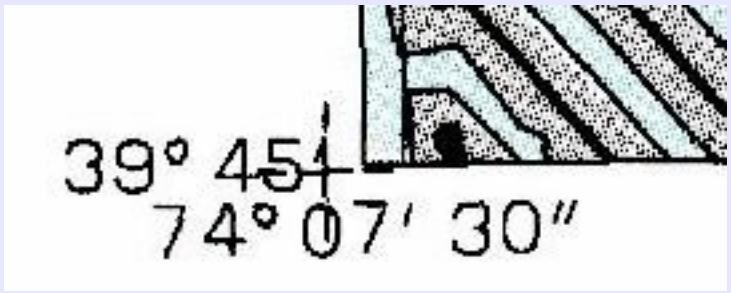

Local Datum
Very Good Fit Here
Earth
Local Datum
Poor Fit Elsewhere


Global Datum
Reasonable Fit
Everywhere
Earth

Universal Transverse Mercator projection, 1927 North American datum
10,000-foot grid based on Alaska coordinate system, zone 5
1000-meter Universal Transverse Mercator grid ticks,
zone 5, shown in blue

NAD27

1000-meter Universal Transverse Mercator grid, zone 18
1927 North American Datum
To place on the predicted North American Datum 1983,
move the projection lines 6 meters south and
34 meters west as shown by dashed corner ticks



NAD27 with offset for NAD83
(dashed corner ticks)

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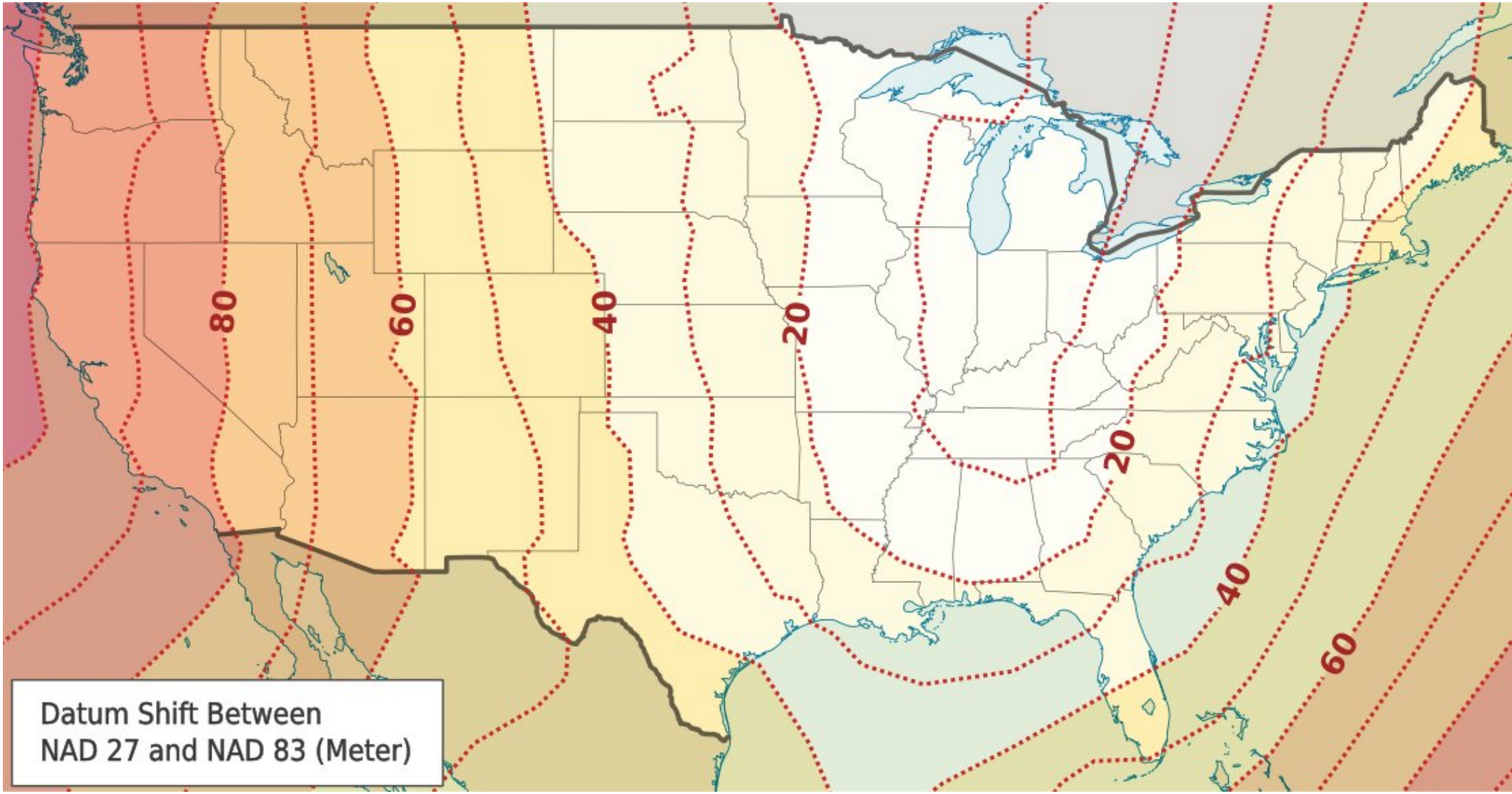
Horizontal difference in meters between NAD27 and NAD83



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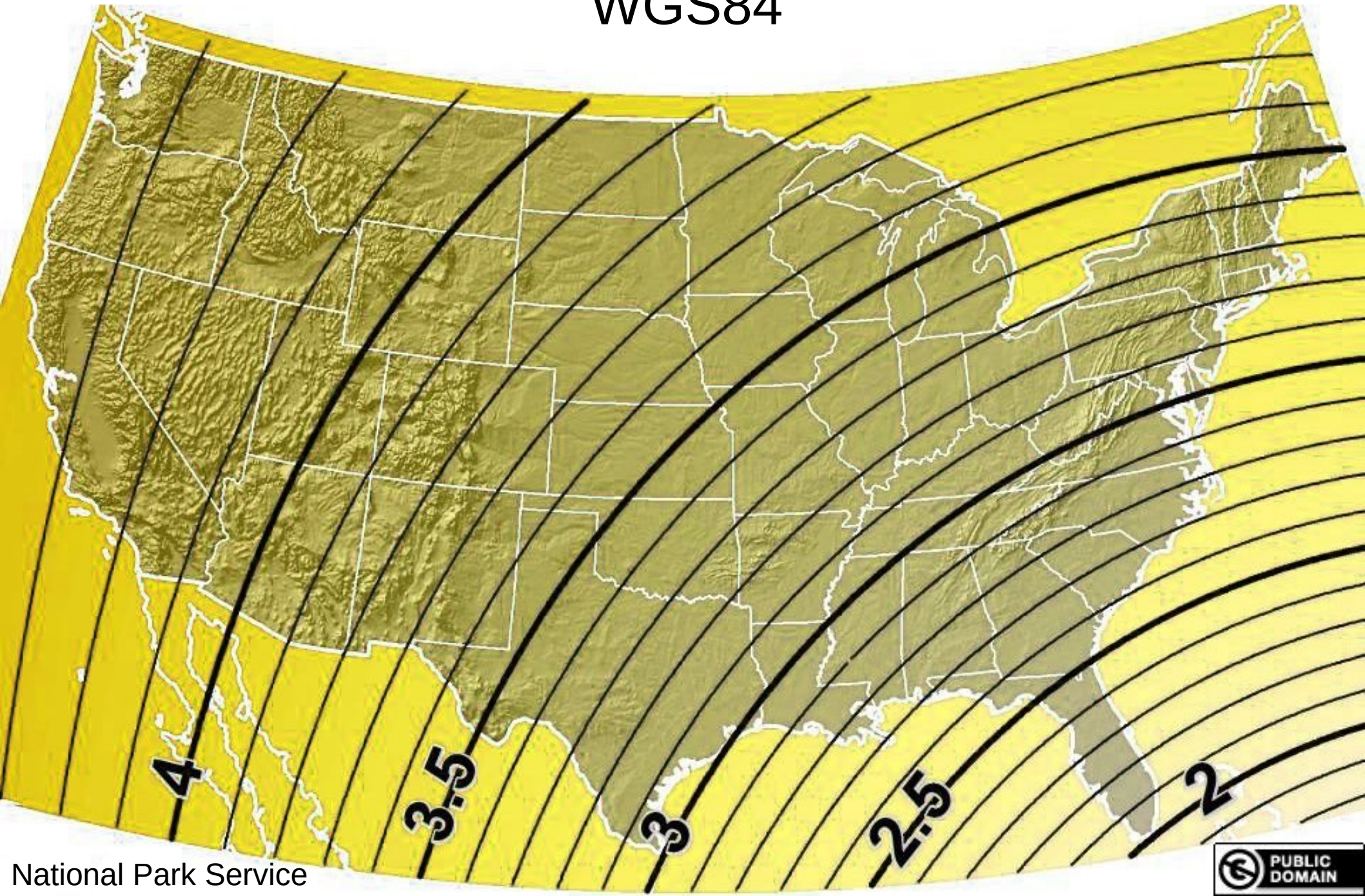
Horizontal difference in feet between NAD83 and WGS84



National Park Service

PUBLIC DOMAIN

Athol, MA 1:24,000
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 the dashed corner ticks

Produced by the United States Geological Survey
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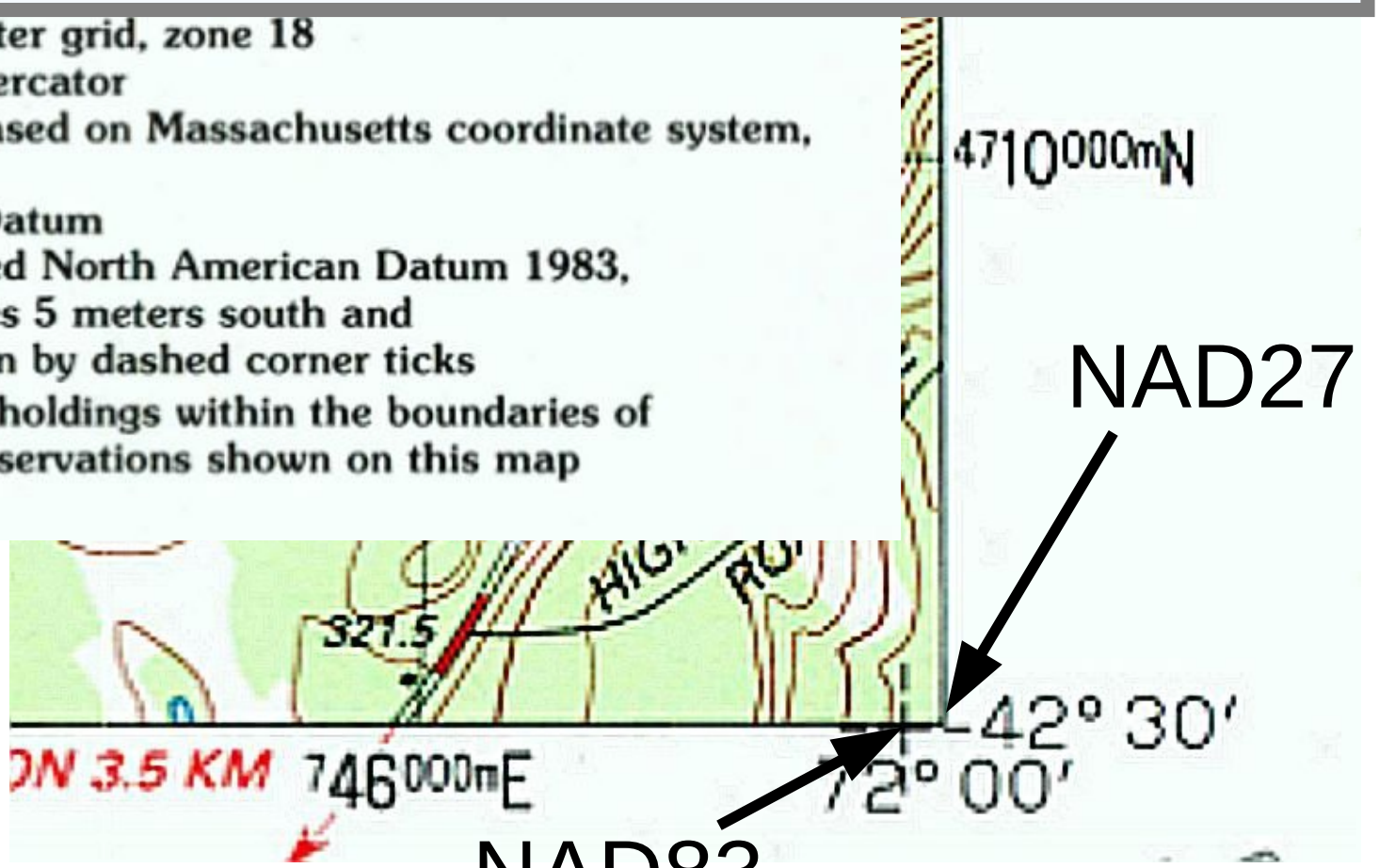
take
Sup
date
Projection and 1000-meter grid, zone 18
Universal Transverse Mercator
10,000-foot grid ticks based on Massachusetts coordinate system,
mainland zone
1927 North American Datum
To place on the predicted North American Datum 1983,
move the projection lines 5 meters south and
39 meters west as shown by dashed corner ticks
There may be private inholdings within the boundaries of
the National or State reservations shown on this map



NAD27

NAD83

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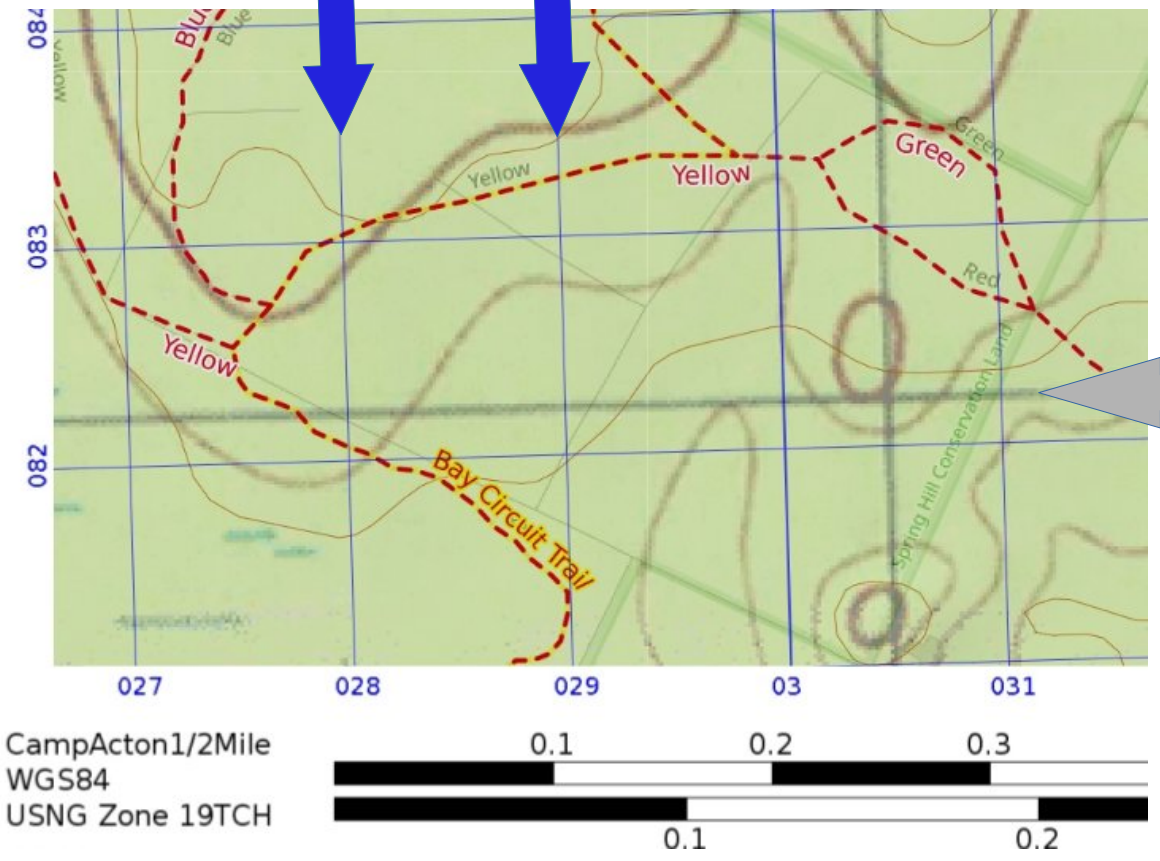
Grids on scanned paper maps as layers in print on demand maps

100m USNG grid, with WGS84 datum
Added to Print on Demand map.



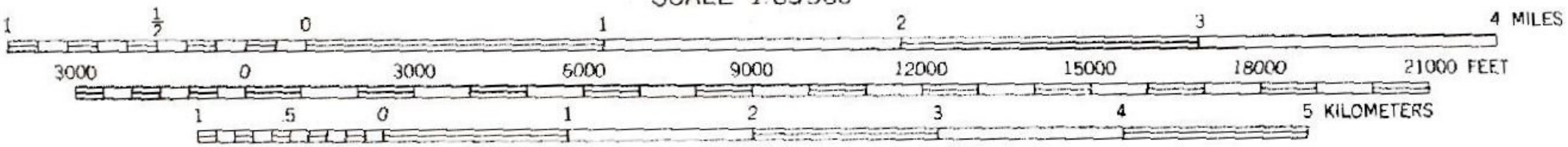
1 km UTM grid, with NAD27 datum
Printed on paper map scanned and added as layer to Print on Demand map.

Vertical Datum

CONTOUR INTERVAL 5 FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929
DEPTH CURVES AND SOUNDINGS IN FEET–DATUM IS MEAN LOWER LOW WATER
THE RELATIONSHIP BETWEEN THE TWO DATUMS IS VARIABLE
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
THE MEAN RANGE OF TIDE IS APPROXIMATELY 1 FOOT IN INLAND WATERS
AND 4 FEET ALONG THE OCEAN

SCALE 1:63360



CONTOUR INTERVAL 100 FEET
DATUM IS MEAN SEA LEVEL
DEPTH CURVES AND SOUNDINGS IN FEET–DATUM IS MEAN LOWER LOW WATER
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
THE AVERAGE RANGE OF TIDE IS APPROXIMATELY 8 FEET

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Main Menu->Settings->Units

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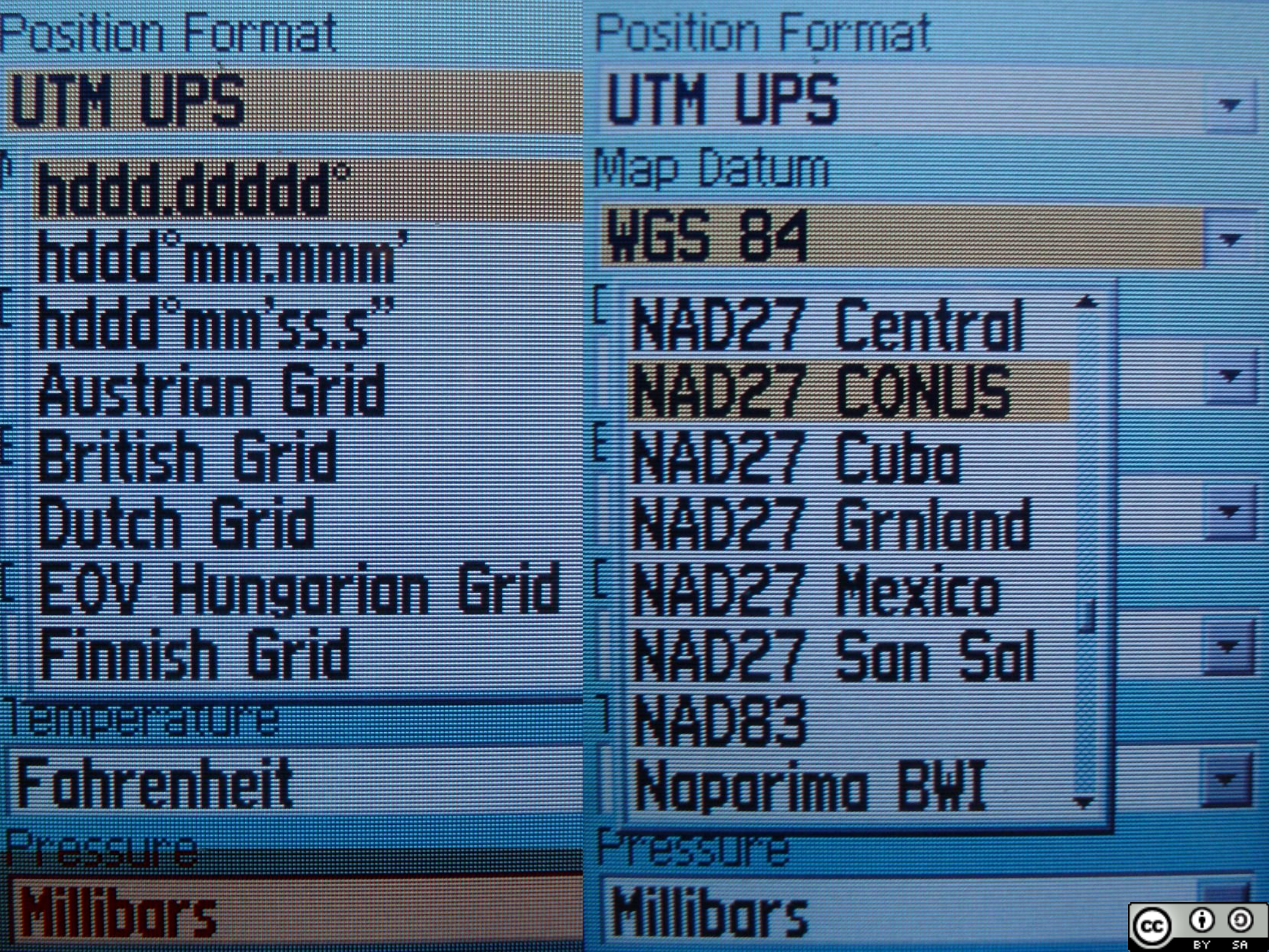
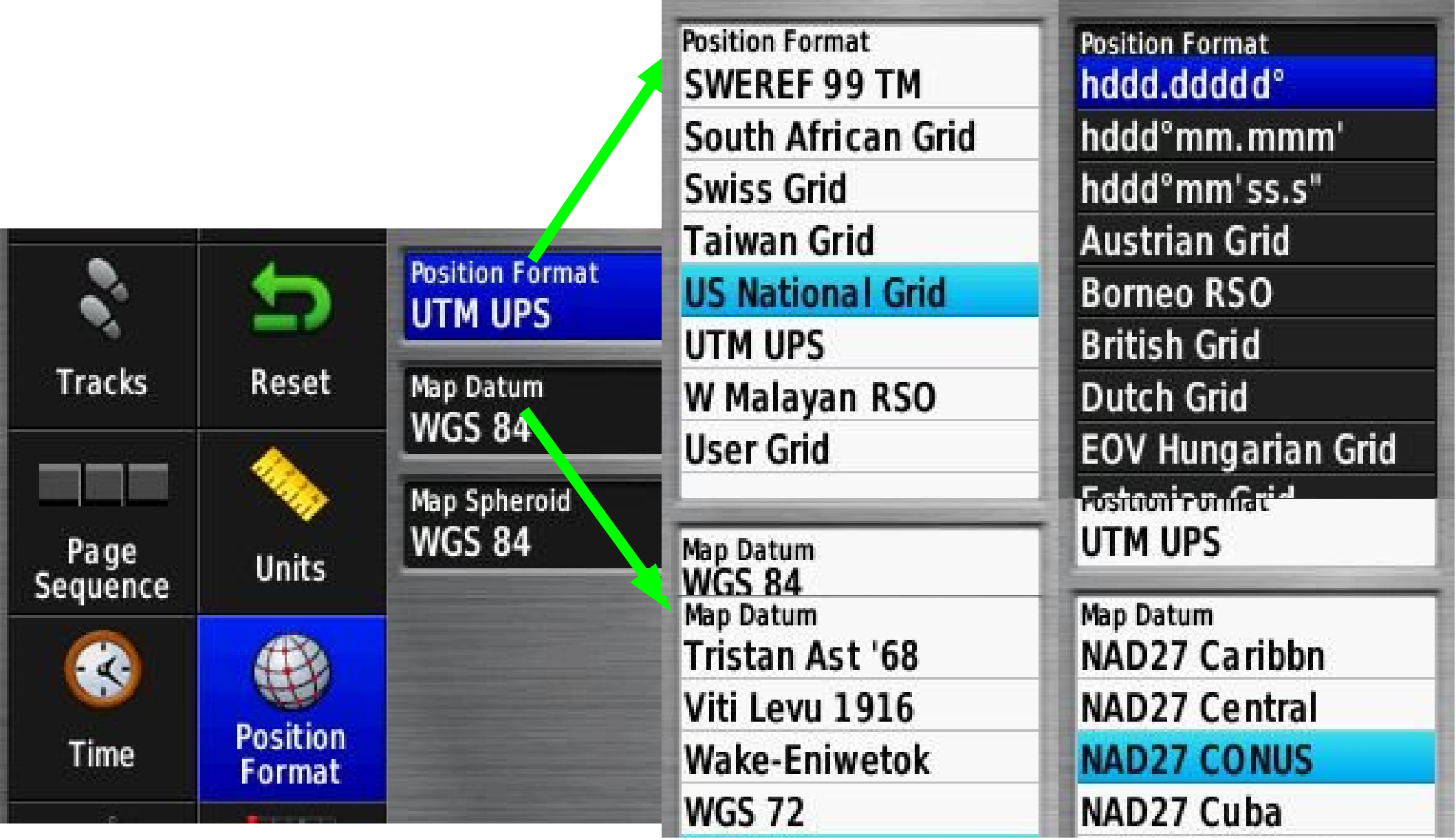

Position Format
UTM UPS
hddd.ddddd°
hddd°mm.mmm'
hddd°mm'ss.s"
Austrian Grid
British Grid
Dutch Grid
EOV Hungarian Grid
Finnish Grid
Temperature
Fahrenheit
Pressure
Millibars
Position Format
UTM UPS
Map Datum
WGS 84
NAD27 Central
NAD27 CONUS
NAD27 Cuba
NAD27 Grnland
NAD27 Mexico
NAD27 San Sal
NAD83
Naparimo BWI
Pressure
Millibars



Main Menu->Settings->Position Format

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With your GNSS Receiver, Set:

- Position readout to Latitude/Longitude
- Latitude/Longitude Format to Decimal Degrees
- Datum to NAD27
- Units to Feet/Yards/Miles
  - Write down your location

Now change to:

- Position readout to USNG
- Datum to WGS84
- Units to Metric
  - Write down your location

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Plot location on a map

- What coordinate system and datum is used by the map?
  - Does it have a UTM grid?
- Change the GPS coordinate system and datum to match the map.
  - View the coordinates (current, in a waypoint)
  - Plot the coordinates on the map.

Converting with a GNSS

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Startup: Practice Good Habits

- Before you start:
  - Check/Change your batteries.
  - Check Datum, Coordinate System, distance units
- When you get out at the drop off point
  - Make sure your GPS has an accurate position.
  - Mark a waypoint with your GPS.
  - Save and clear the current track (dog's too).
  - Make sure that your GPS is recording the track.
  - Calibrate the compass.
- When you start your assignment
  - Mark a waypoint
- When you complete your assignment
  - Save the track for the assignment with clear name.

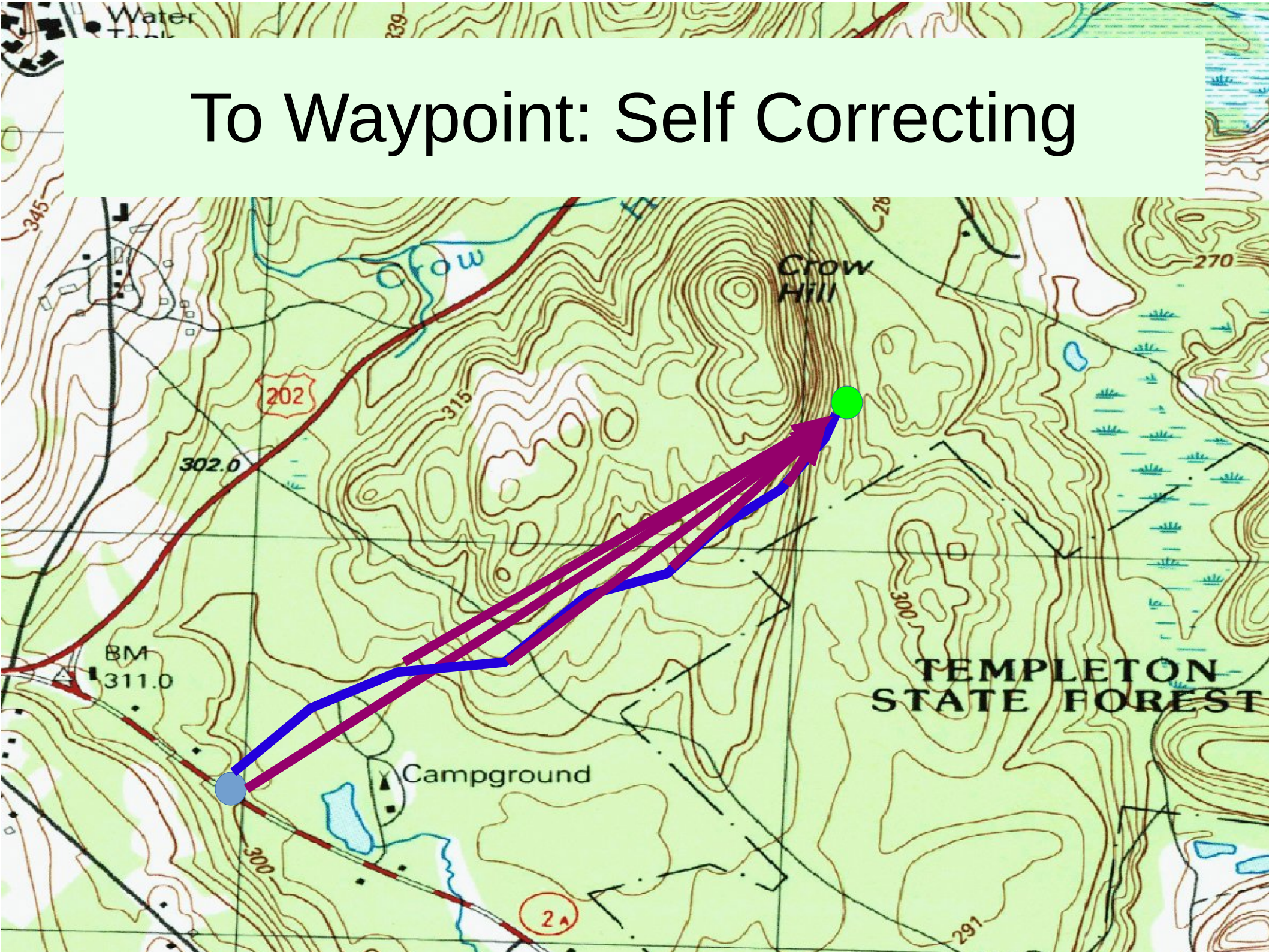
Create Waypoints By:

- Mark Current Position
- Create a waypoint and enter the coordinates.
- Select a position on the map.
- Project a waypoint.

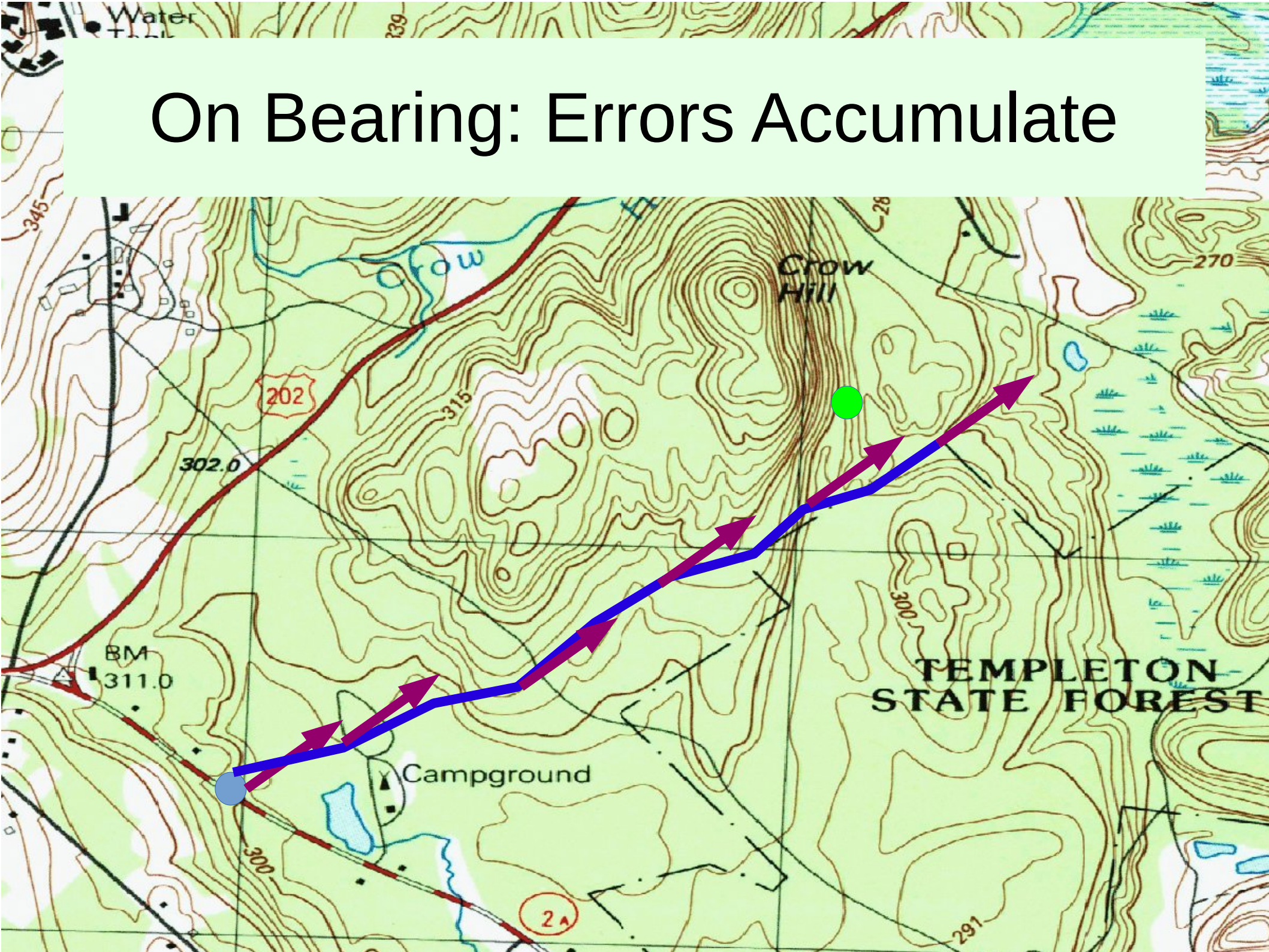
Navigating with GPS

- Enter a waypoint, go to waypoint.
  - Self correcting navigation.
  - (Enter a route, follow route).
- Project a waypoint a distance on a bearing.
  - Self correcting navigation
- Backtrack
- Navigate with the GNSS compass on a bearing
  - Errors accumulate.

To Waypoint: Self Correcting

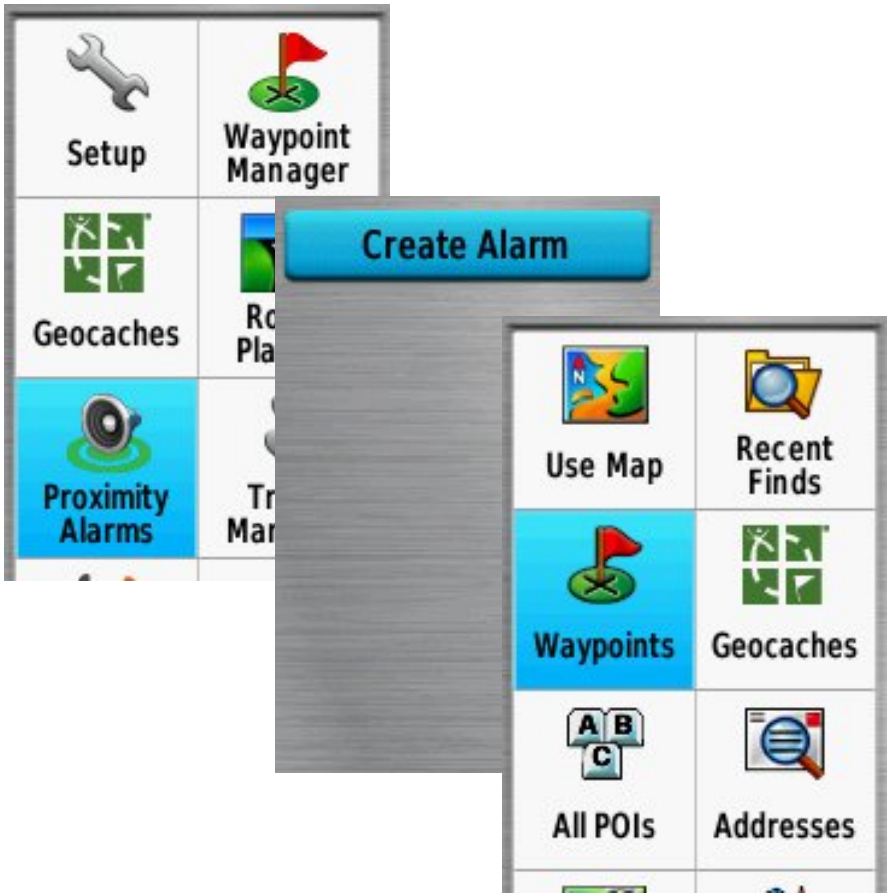


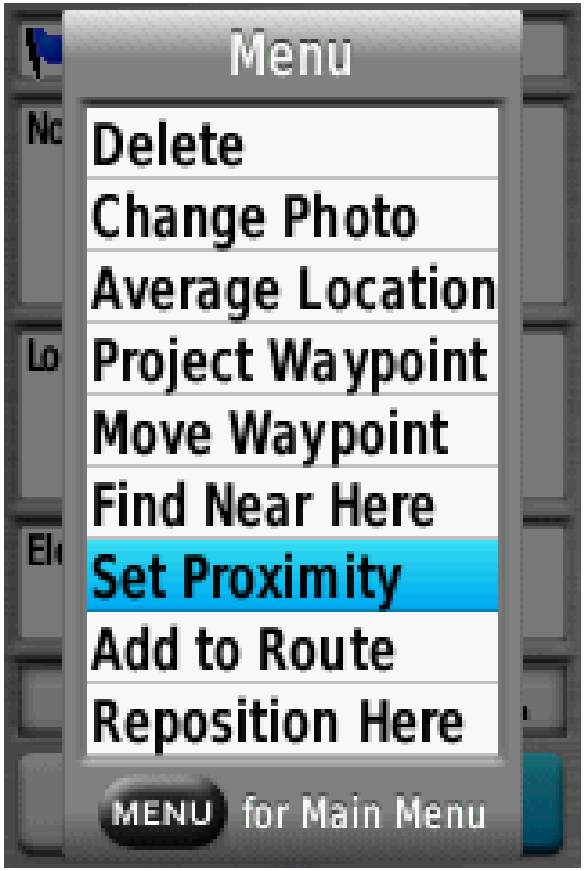
On Bearing: Errors Accumulate



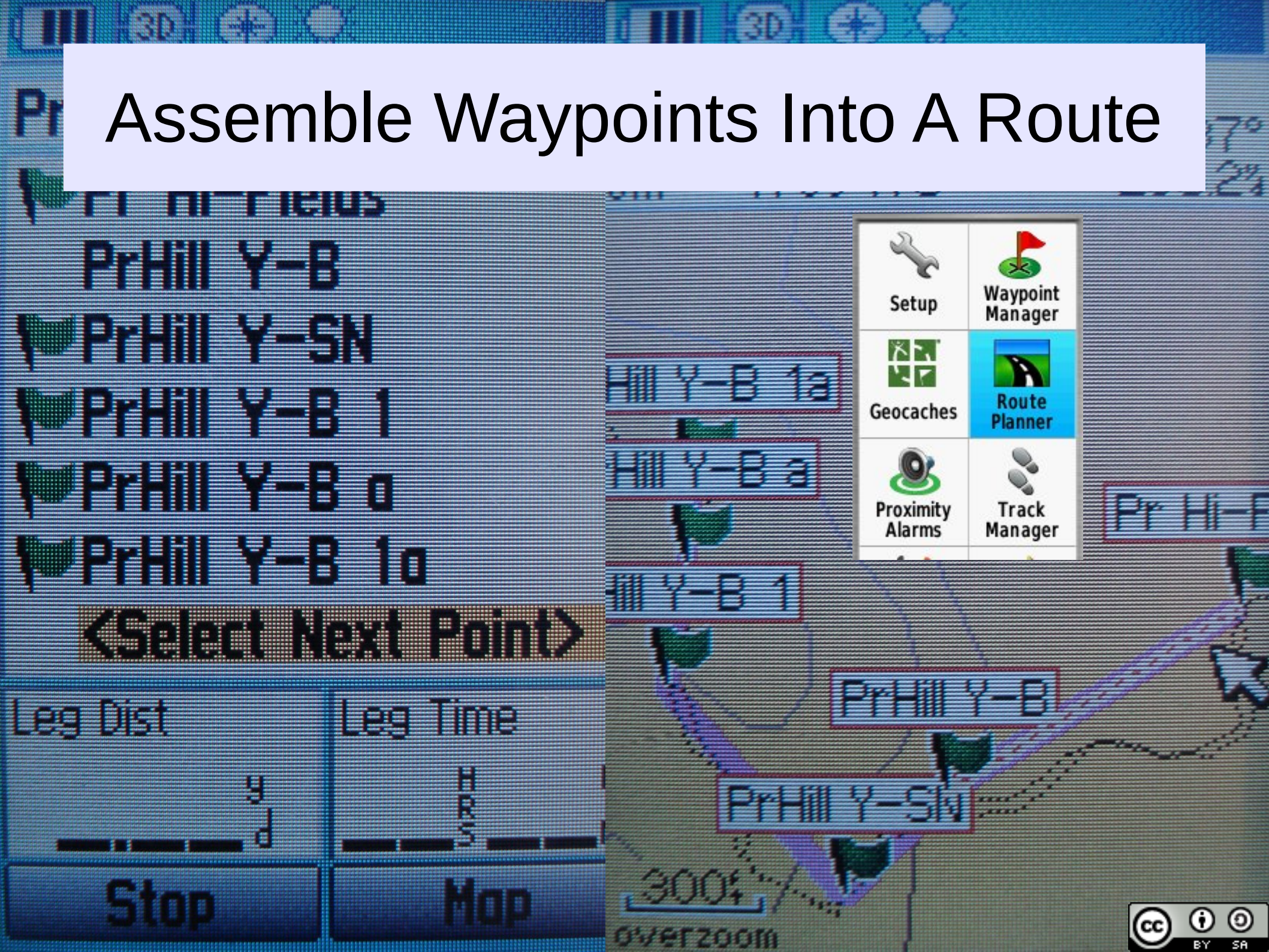
Are we there yet?

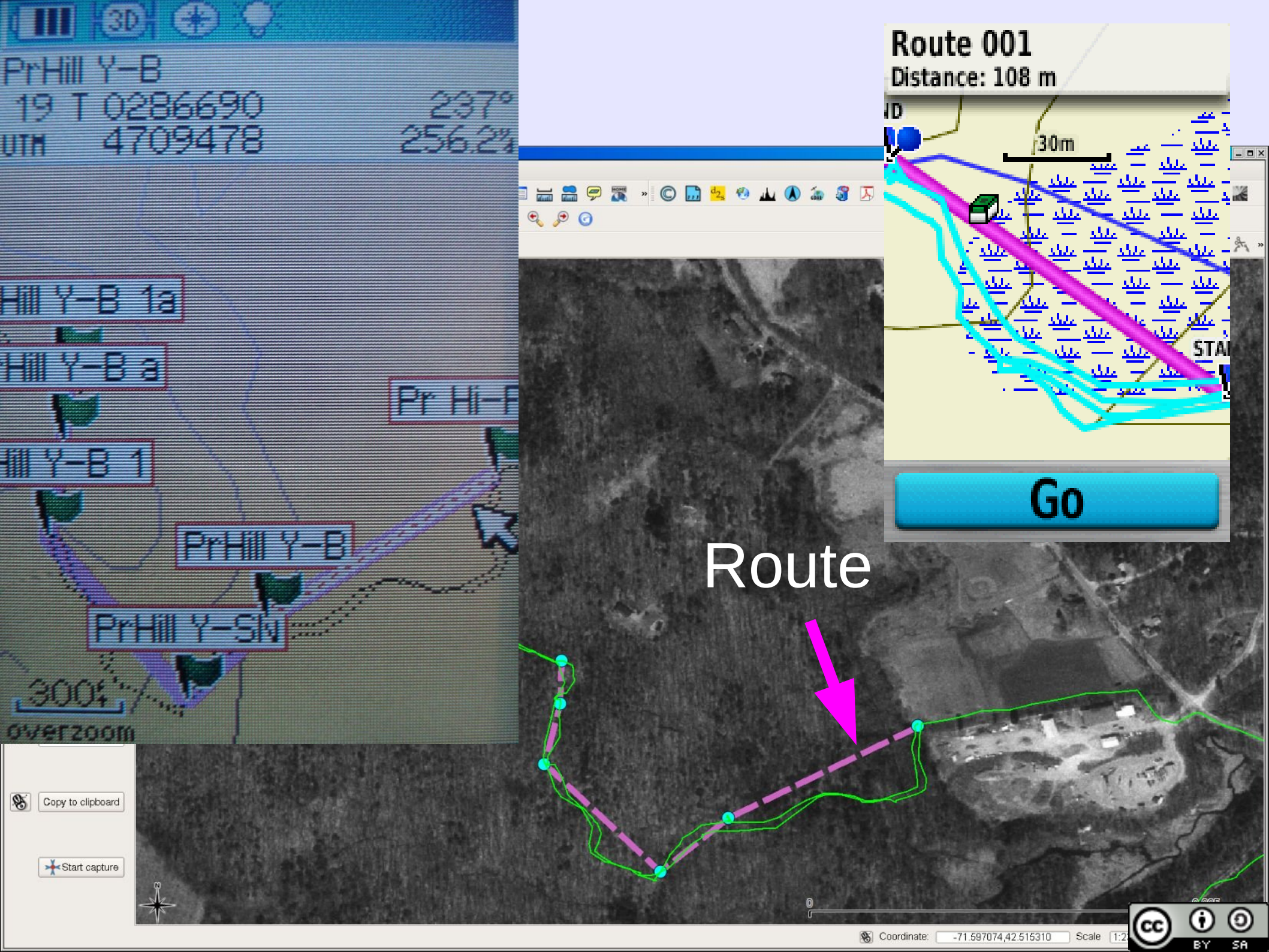
- Proximity alerts.



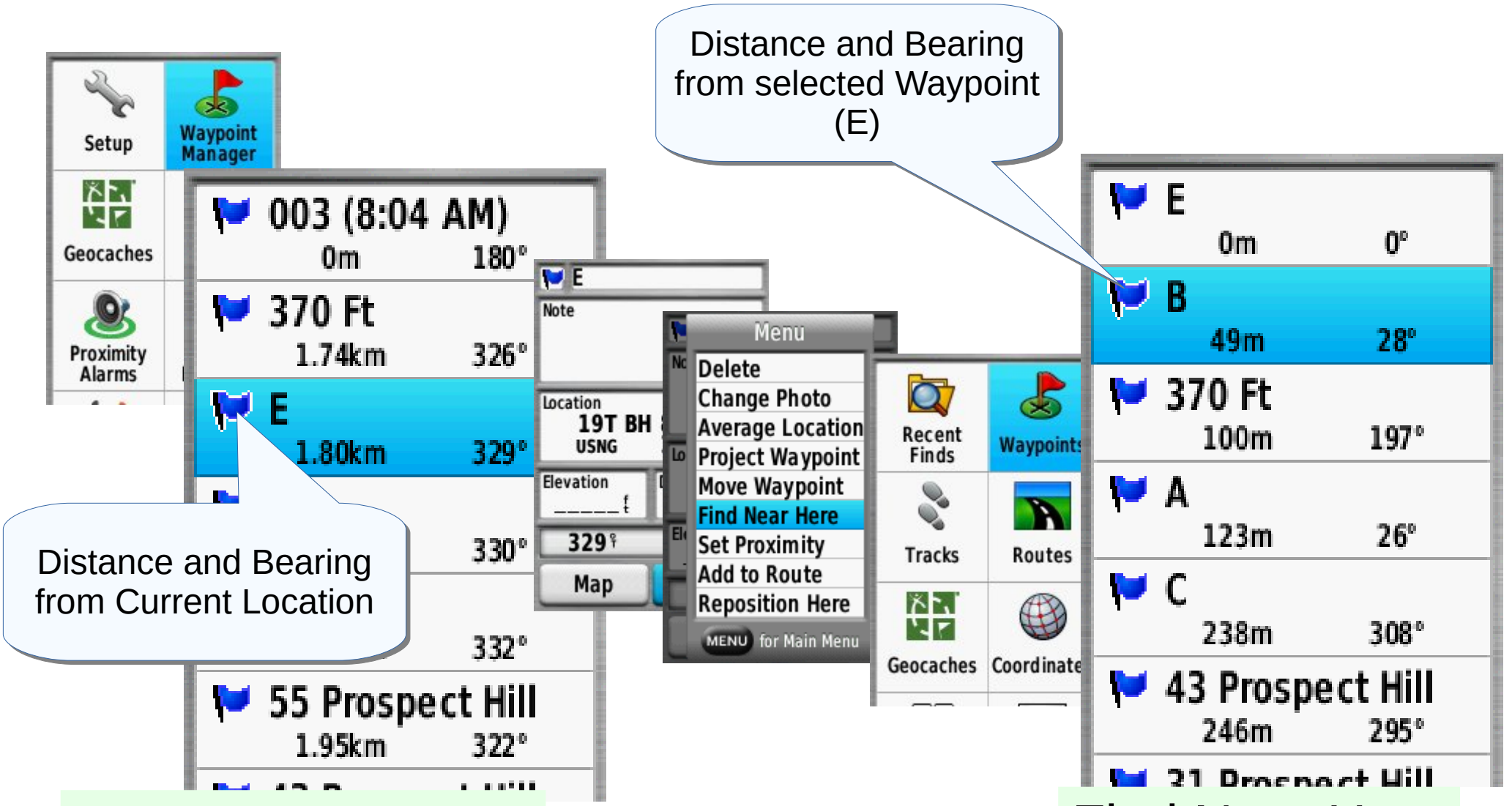


Assemble Waypoints Into A Route

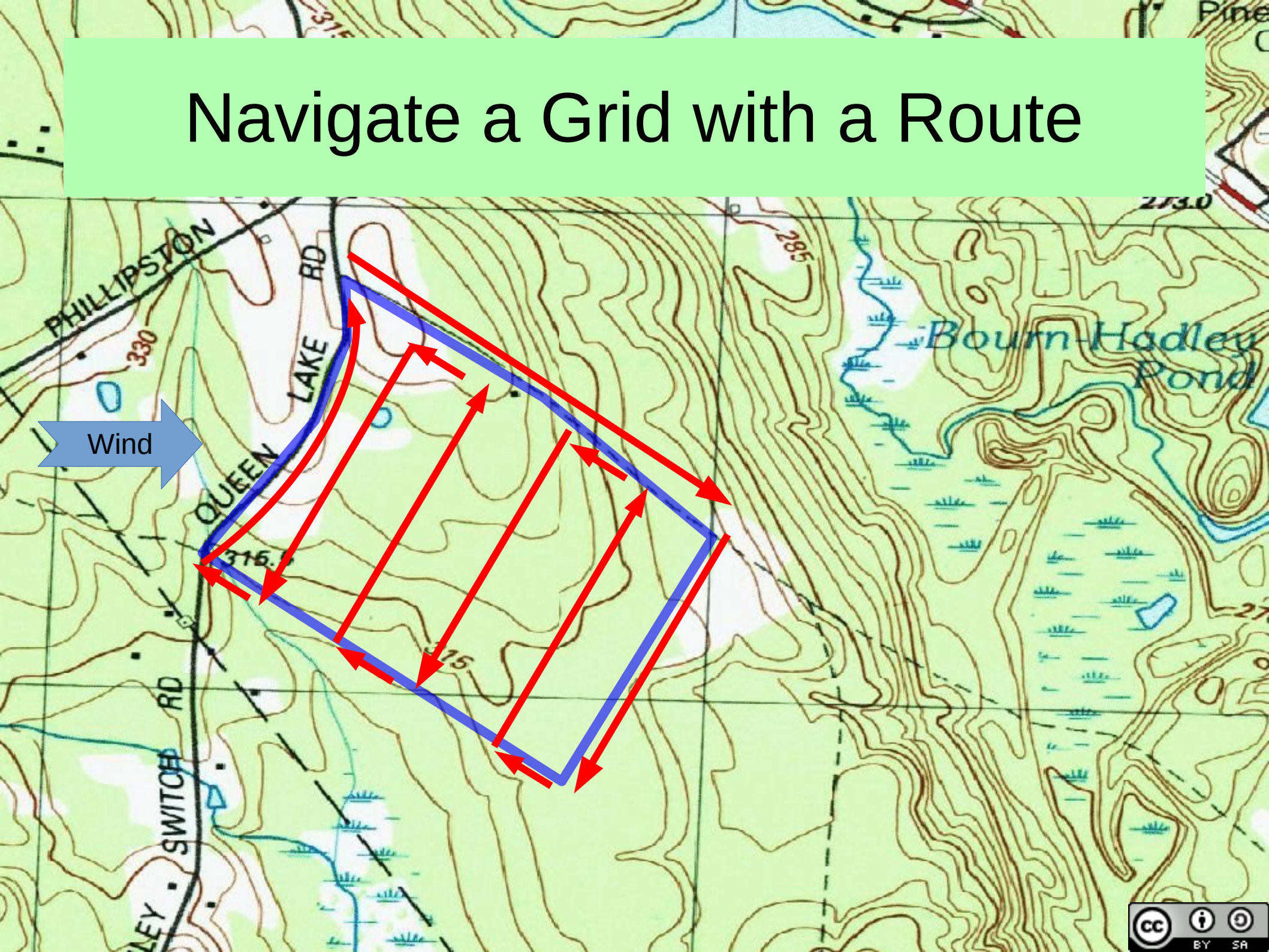



PrHill Y-B
19 T 0286690
UTM 4709478
237°
256.2%
Hill Y-B 1a
Hill Y-B a
Pr Hi-F
Hill Y-B 1
PrHill Y-B
PrHill Y-SW
300ft
overzoom
Route 001
Distance: 108 m
30m
Go
Route
Copy to clipboard
Start capture
Coordinate:
-71.597074,42.515310
Scale

Determine Distance and Bearing between two waypoints



Navigate a Grid with a Route



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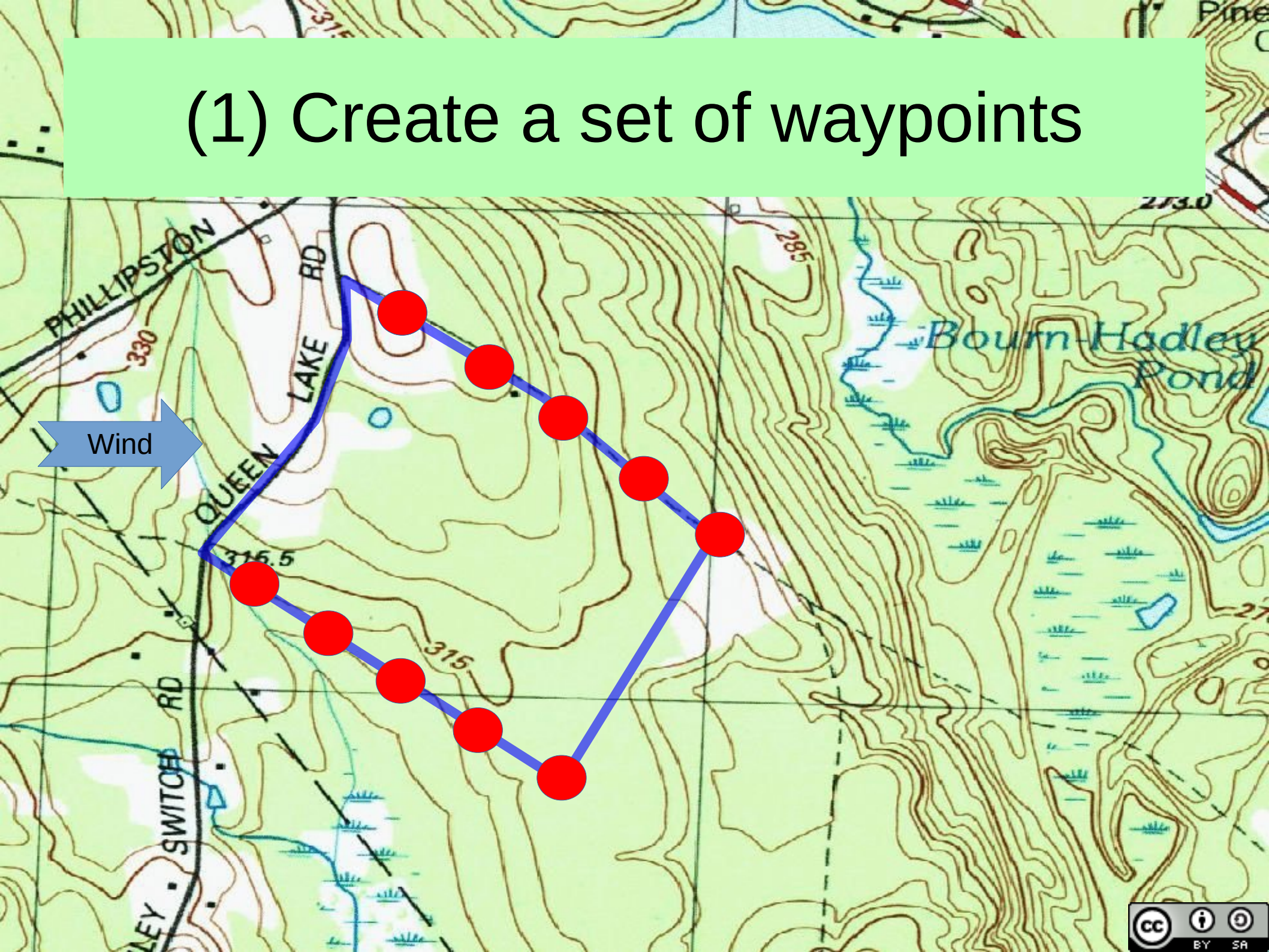
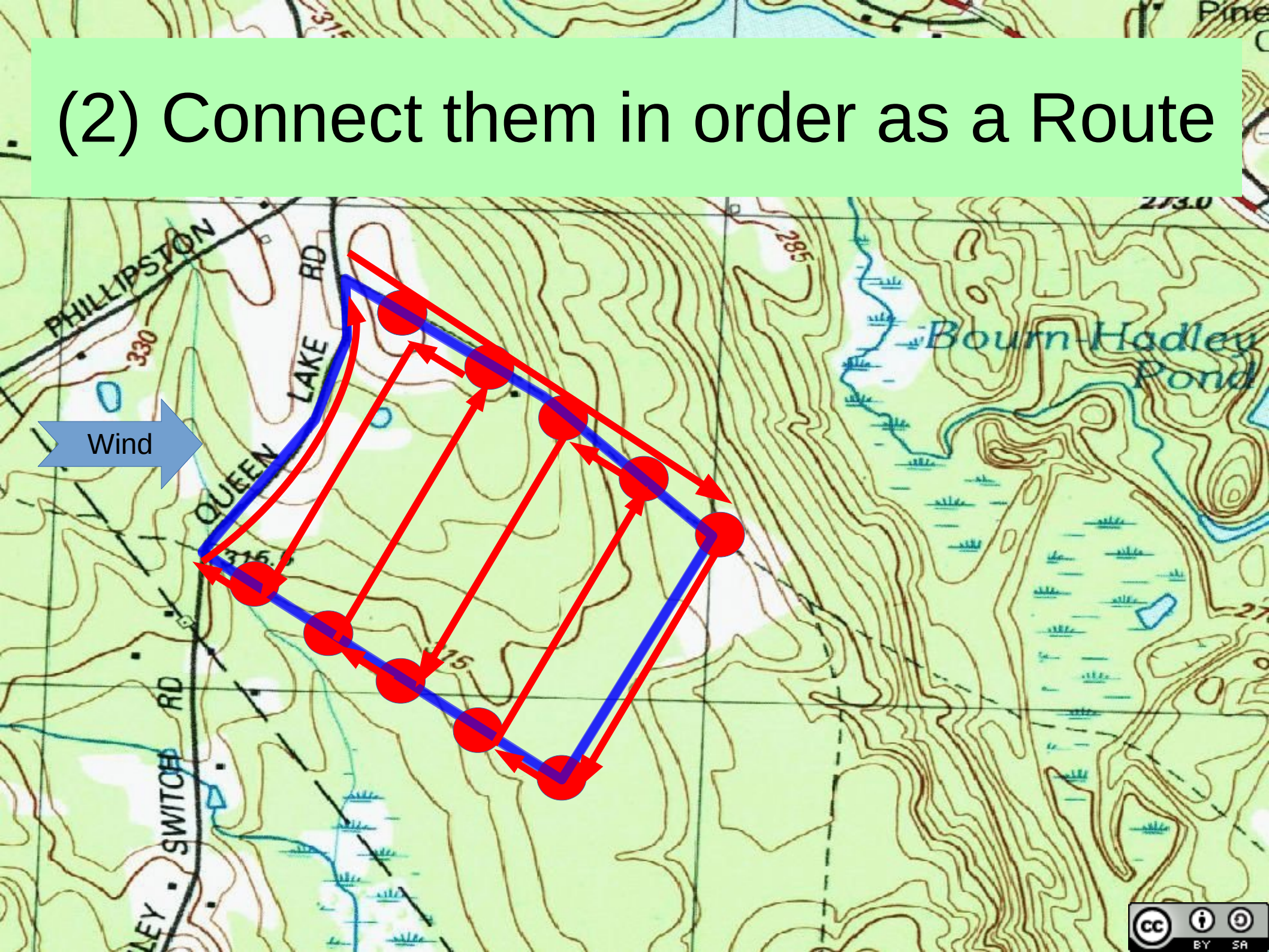
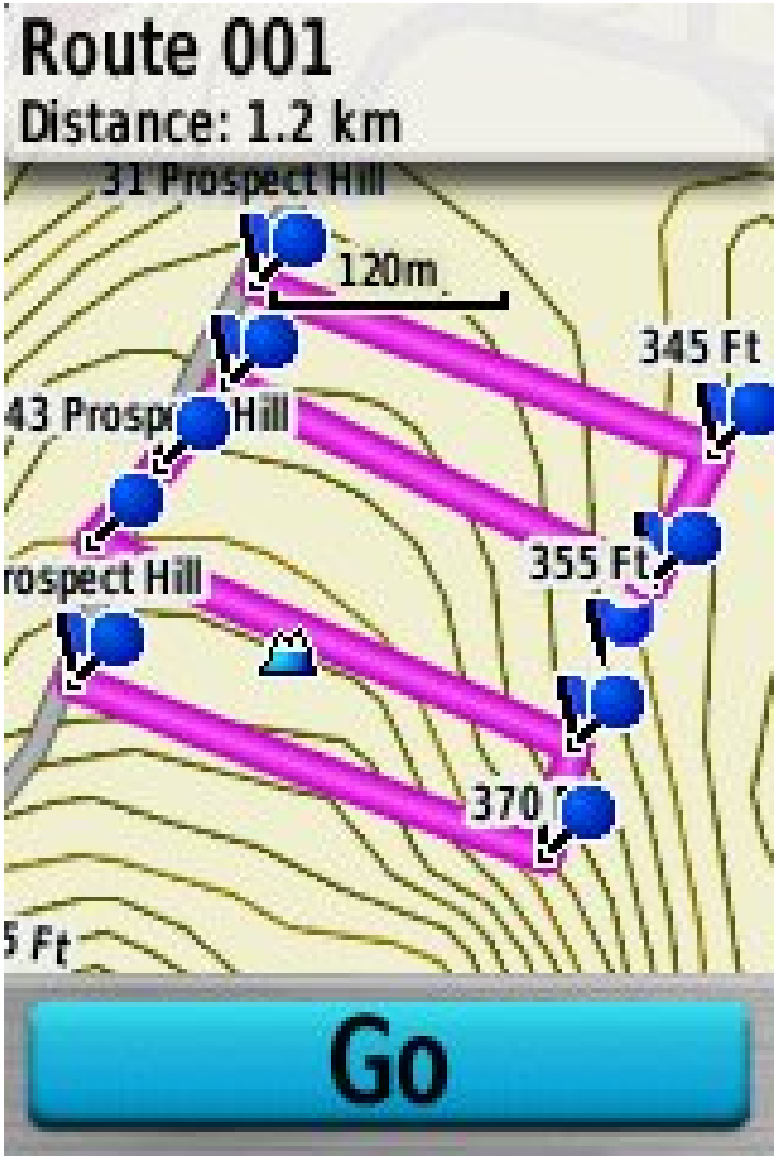
(1) Create a set of waypoints



(2) Connect them in order as a Route



Select the route and navigate it



Backtrack

- Manually
  - Use GPS map and pointer to work out bearings to points along track.
- Automatically (some GPS units)
- You need to be recording the track....

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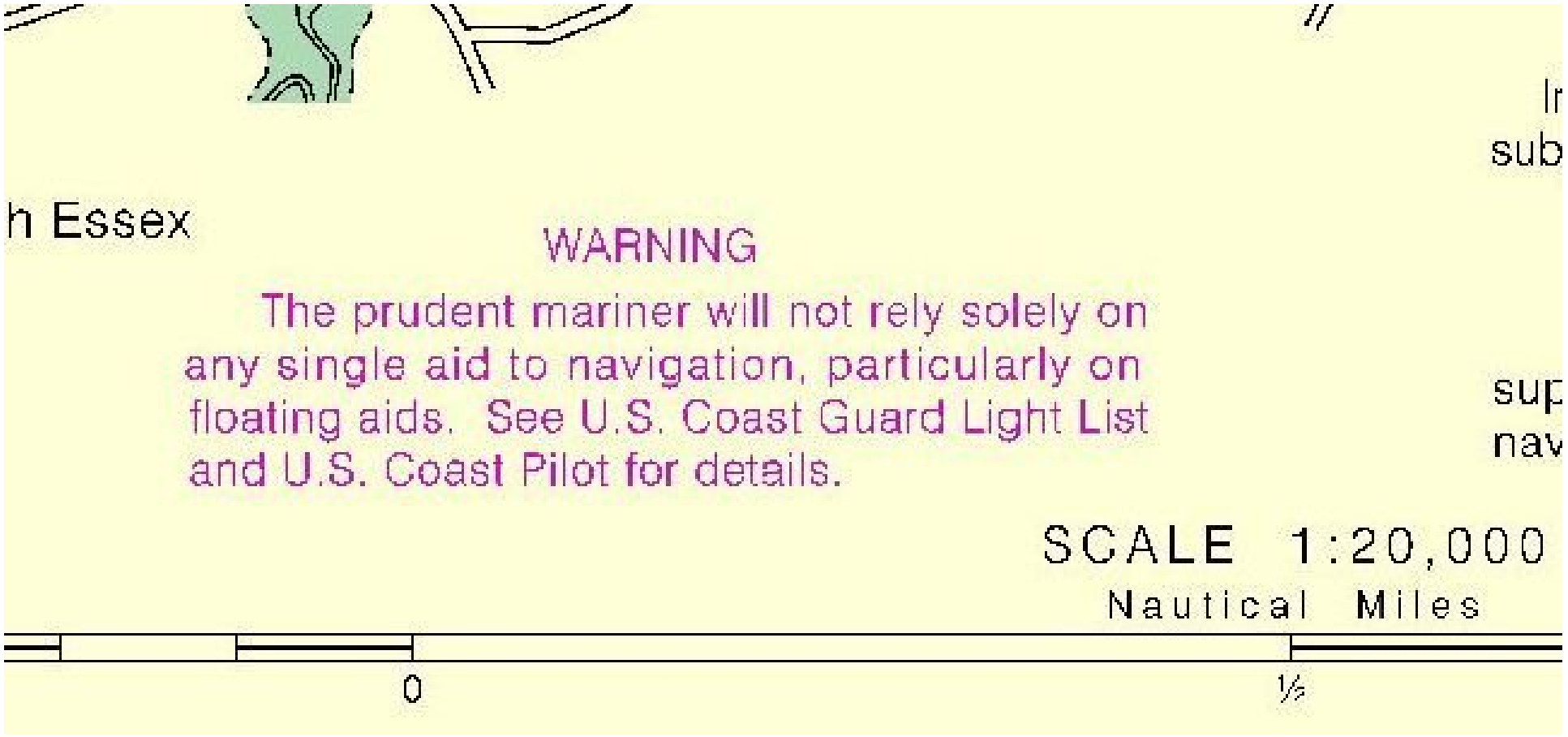
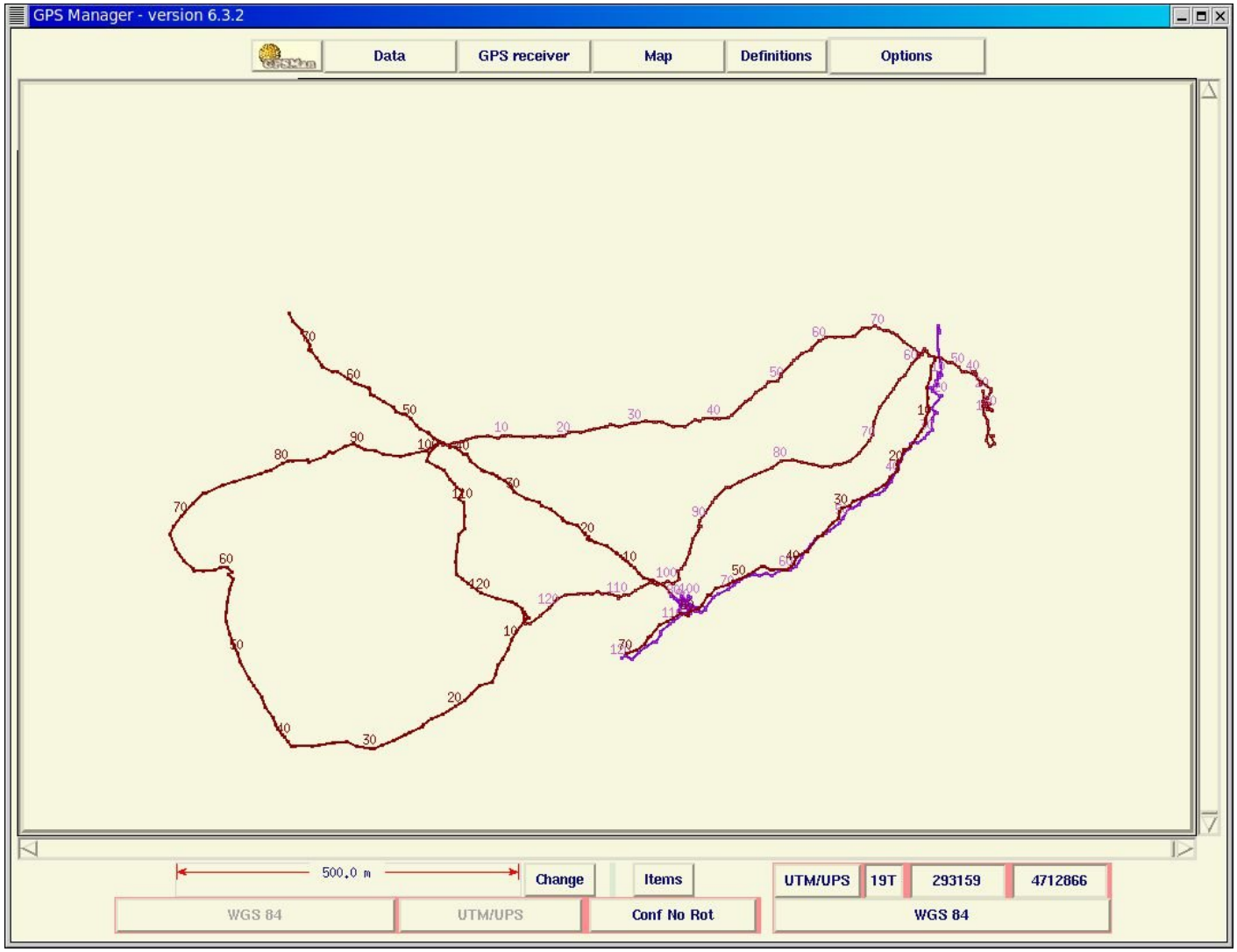
Navigation Errors....



"The prudent mariner will not rely solely on any single aid to navigation"

Download Tracks, Waypoints, or Routes from GPS to Computer



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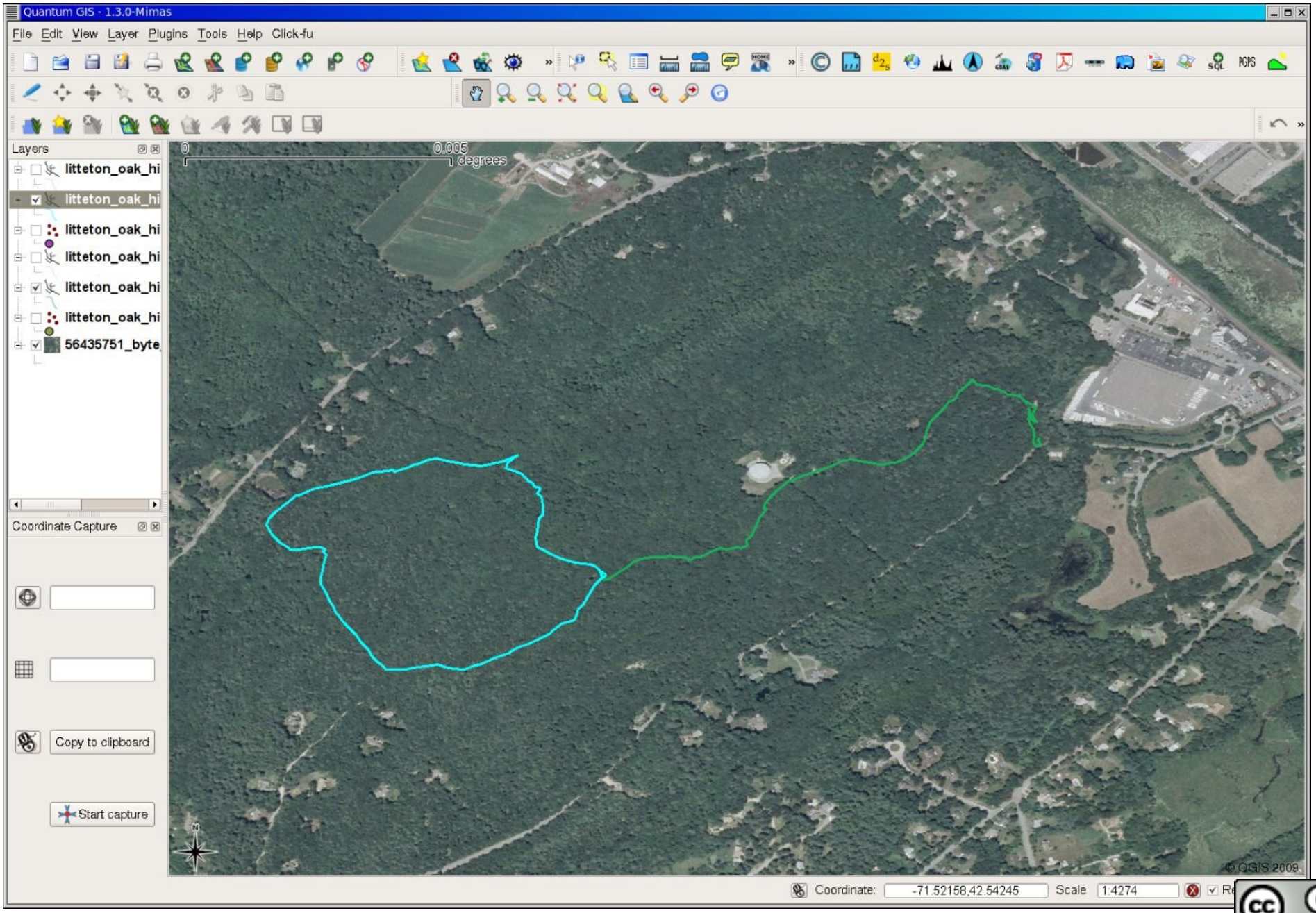
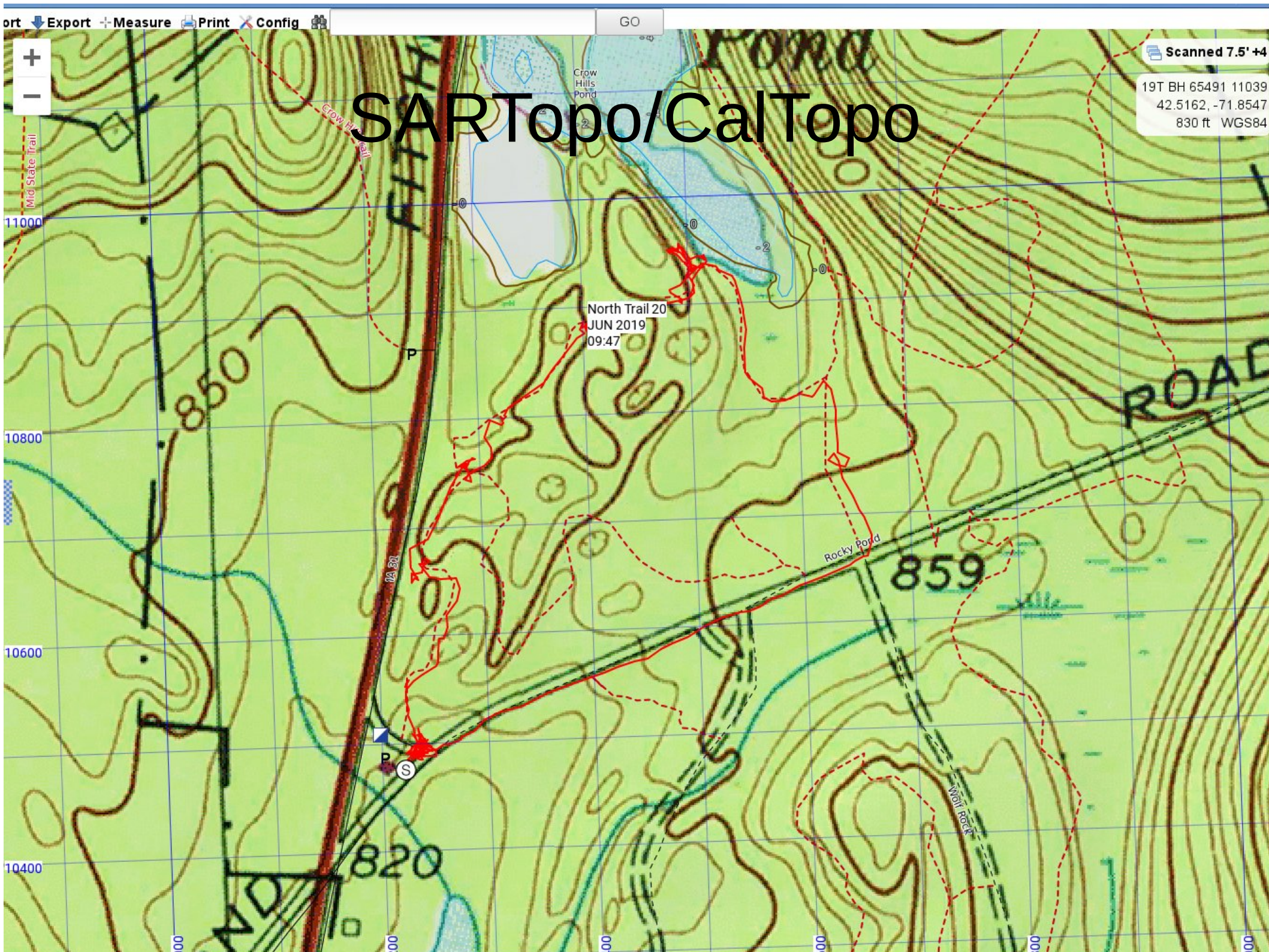
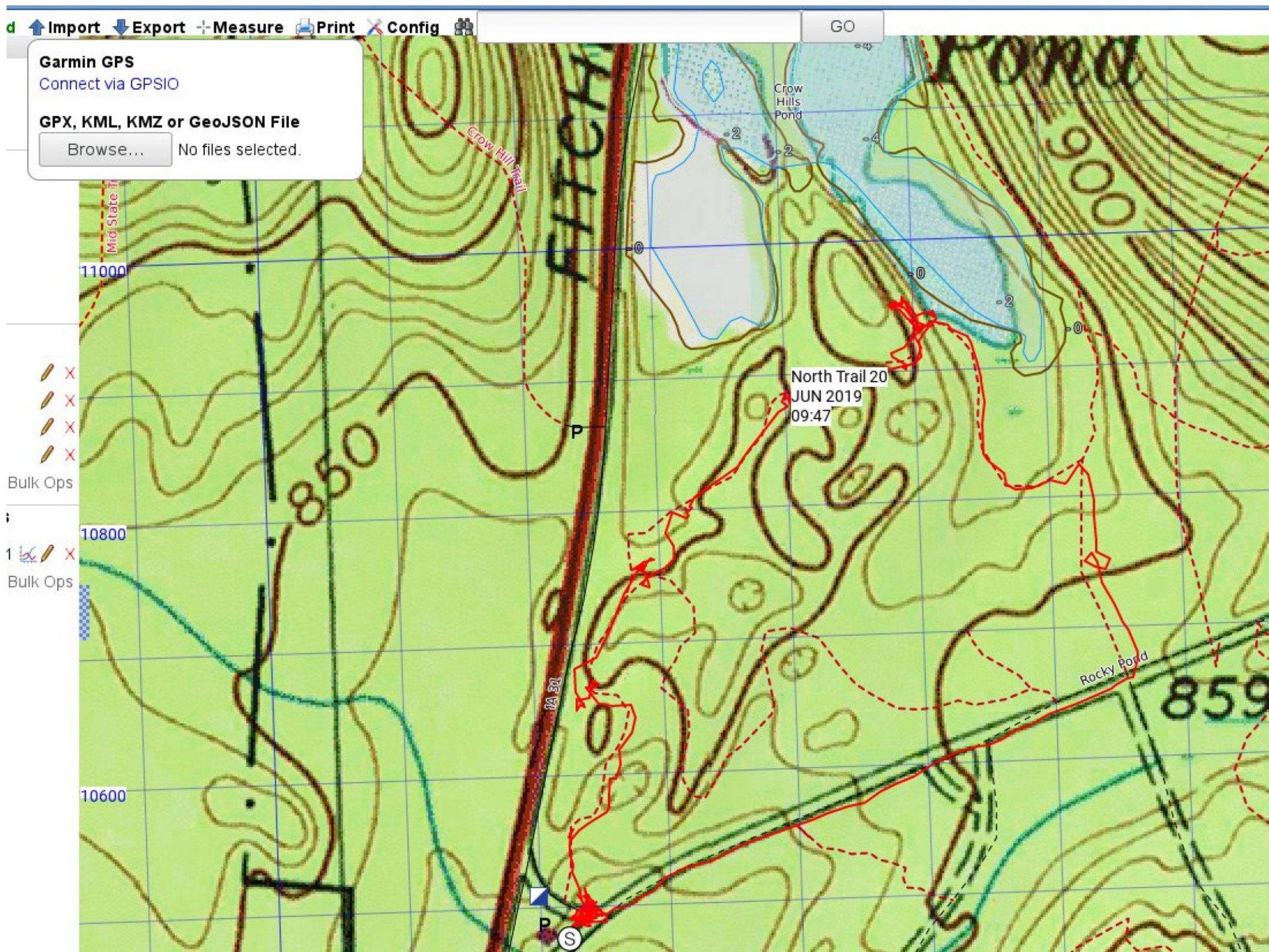
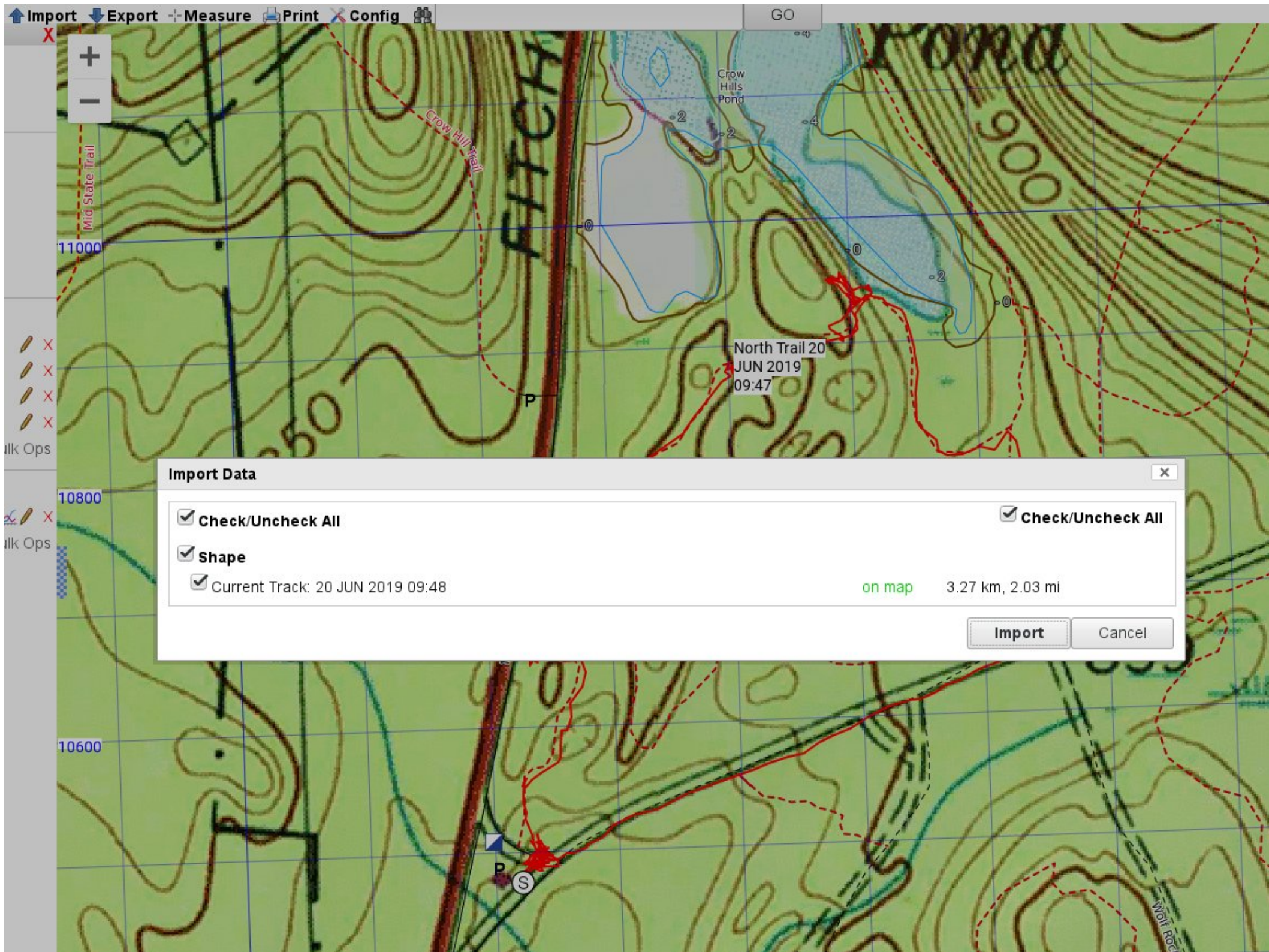
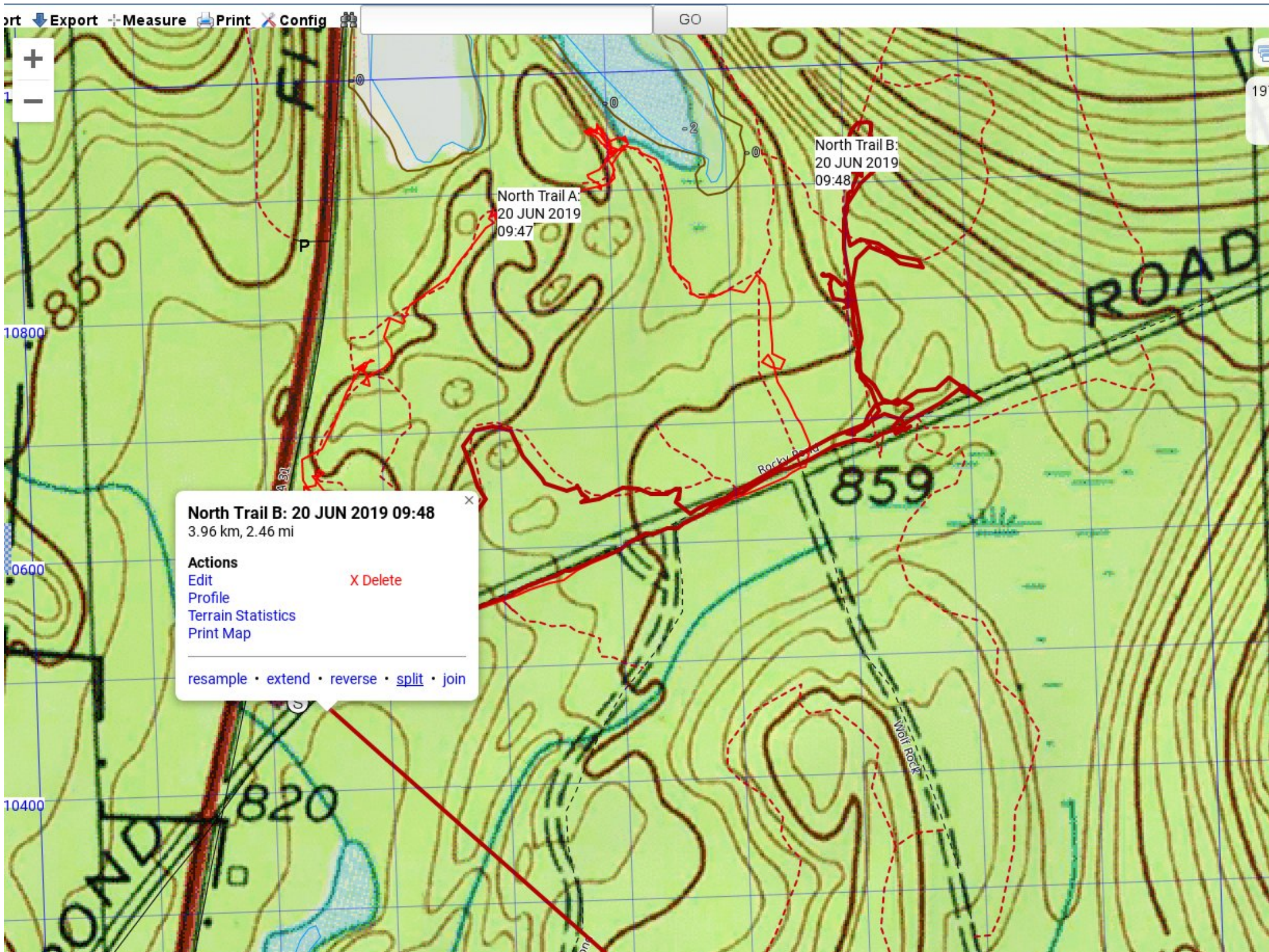
Add as Layers in a GIS Application




Export
Measure
Print
Config
GO
SARTopo/CalTopo
Scanned 7.5' +4
19T BH 65491 11039
42.5162, -71.8547
830 ft WGS84
Crow Hills Pond
Crow Hill Trail
Mid State Trail
North Trail 20
JUN 2019
09:47
Rocky Pond
Wolf Rock
ROAD
850
859
820
11000
10800
10600
10400


Import
Export
Measure
Print
Config
GO
Garmin GPS
Connect via GPSIO
GPX, KML, KMZ or GeoJSON File
Browse...
No files selected.
Bulk Ops
Bulk Ops
Crow Hills Pond
Crow Hill Trail
North Trail 20
JUN 2019
09:47
Rocky Pond
11000
10800
10600
850
900
859

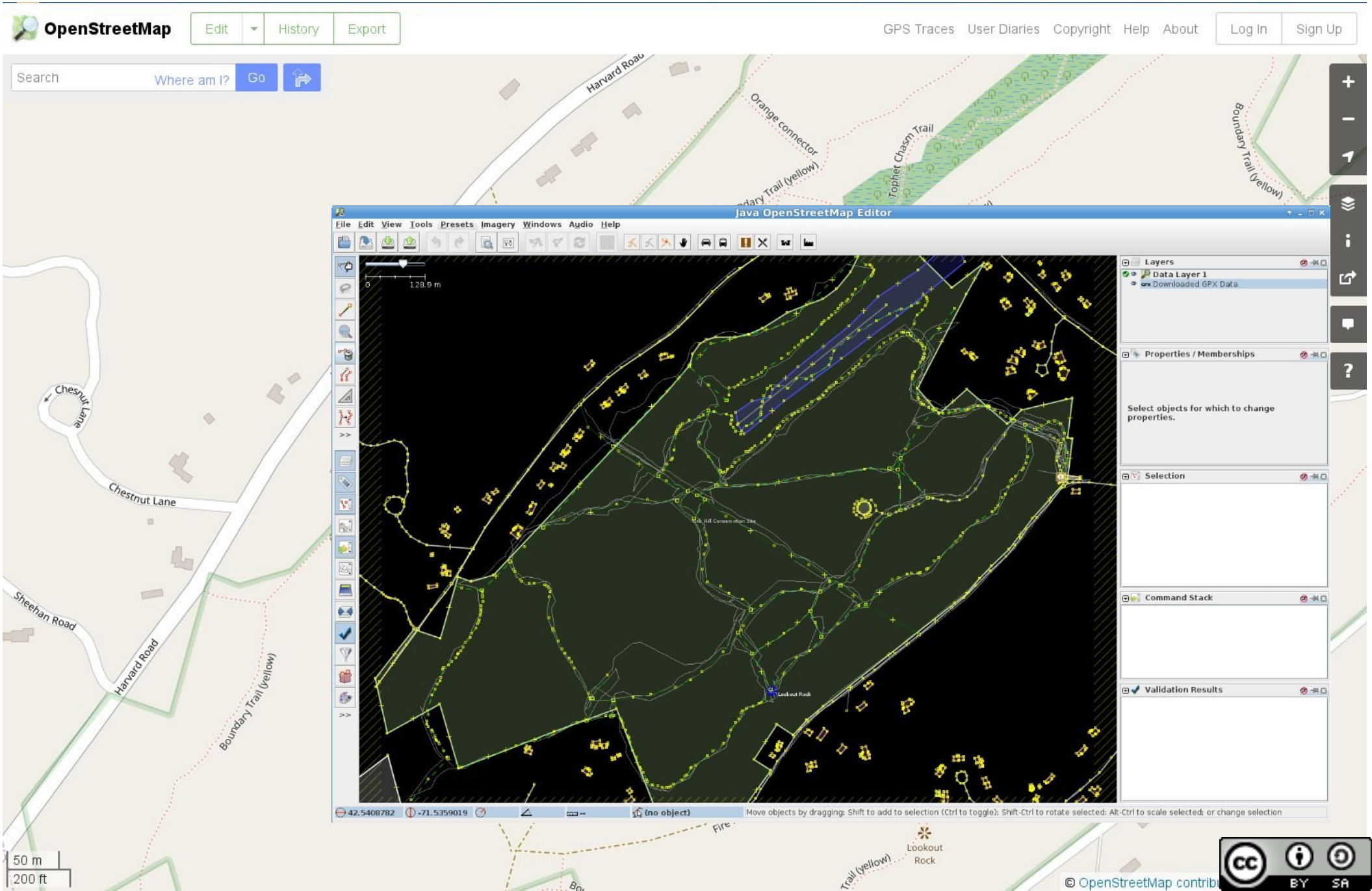

Import
Export
Measure
Print
Config
GO
Crow Hills Pond
Crow Hill Trail
Mid State Trail
11000
10800
10600
North Trail 20
JUN 2019
09:47
Import Data
Check/Uncheck All
Check/Uncheck All
Shape
Current Track: 20 JUN 2019 09:48
on map
3.27 km, 2.03 mi
Import
Cancel


Export
Measure
Print
Config
GO
North Trail A:
20 JUN 2019
09:47
North Trail B:
20 JUN 2019
09:48
ROAD
859
820
Wolf Rock
10800
10600
10400
North Trail B: 20 JUN 2019 09:48
3.96 km, 2.46 mi
Actions
Edit
X Delete
Profile
Terrain Statistics
Print Map
resample • extend • reverse • split • join

Saving Tracks

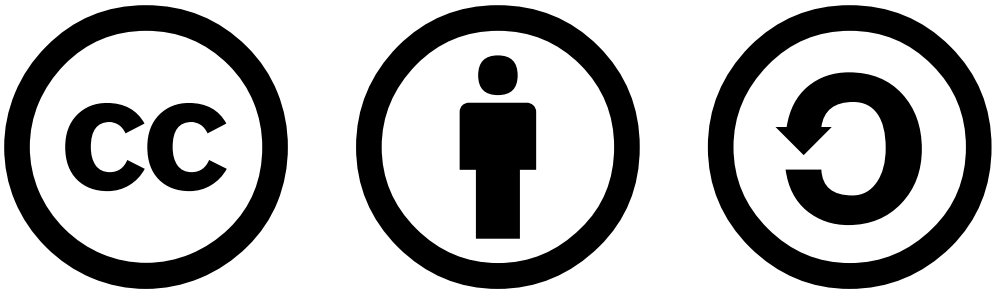
- Save a separate track for each assignment (documenting your search effort for that assignment).
  - Reduce clutter and work for the Planning Section.
  - Some GNSS Receivers limit the number of points in a track. Saving very large tracks can reduce precision of fit between the track and your route.
- Establish a routine – use on every training.
- Make sure tracking is on, start new/save with each assignment.

Contribute to Open Street Map



Load Maps into your GNSS receiver

- Options may include (see your user manual)
  - Maps on a micro SD card.
  - Maps uploaded from a computer.
  - Maps loaded over a wireless connection.



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