



# Enabling GPS Users in our National Parks

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Resource Information Services Division

# Our Mission

*"...to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."*

1916 NPS Organic Act



# Presentation Overview

- Reliance on GPS/GNSS
  - Increasingly Simple Data Collection
- Connecting data between users
- Managing position accuracy

*Mount Rainier National Park - Washington*



# Reliance on GPS/GNSS

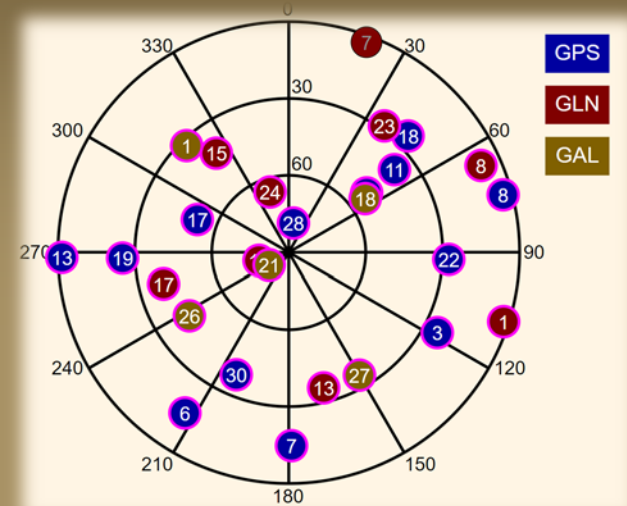


*Acadia National Park - Maine*



# Simplified Data Collection

Death Valley National Park (Devil's Hole) - Nevada



18.09.20T11:41:14Z (UTC)

Jean Lafitte National Historical Park and Preserve - Louisiana



# Simplified Data Collection



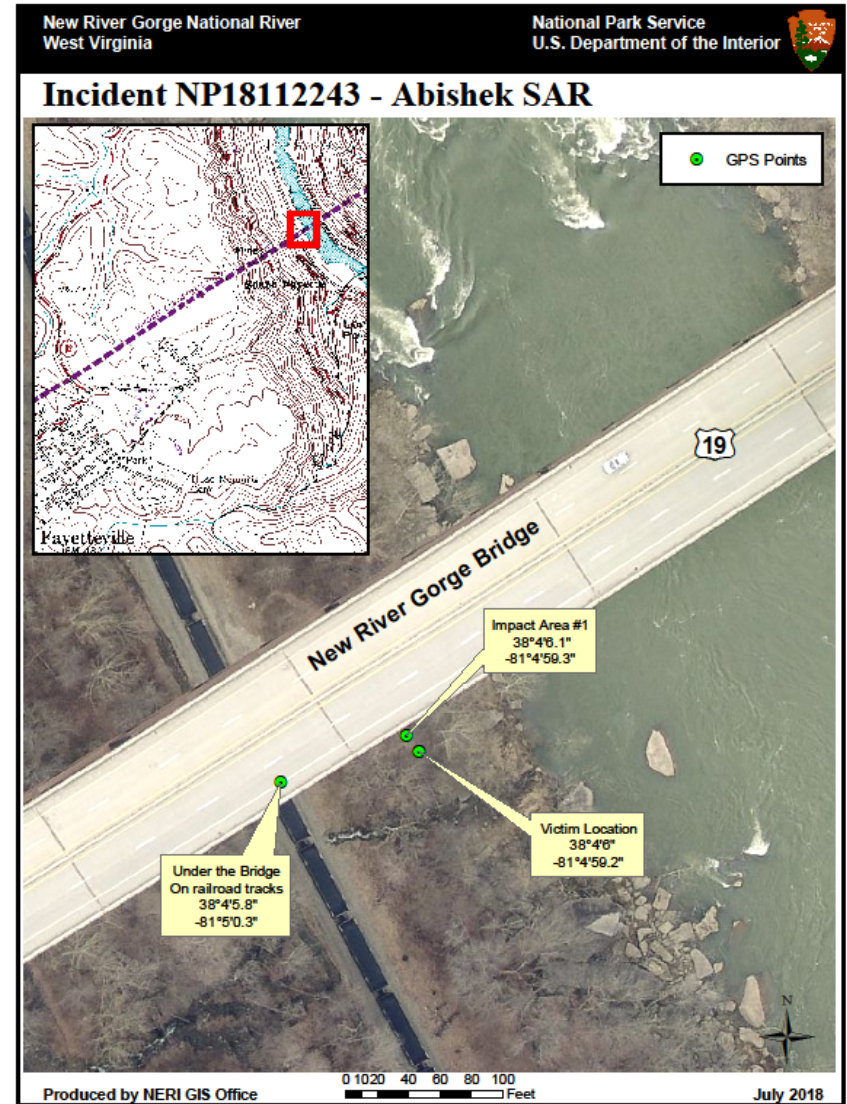
*New River Gorge National River – West Virginia*



# Simplified Data Collection



New River Gorge National River – West Virginia



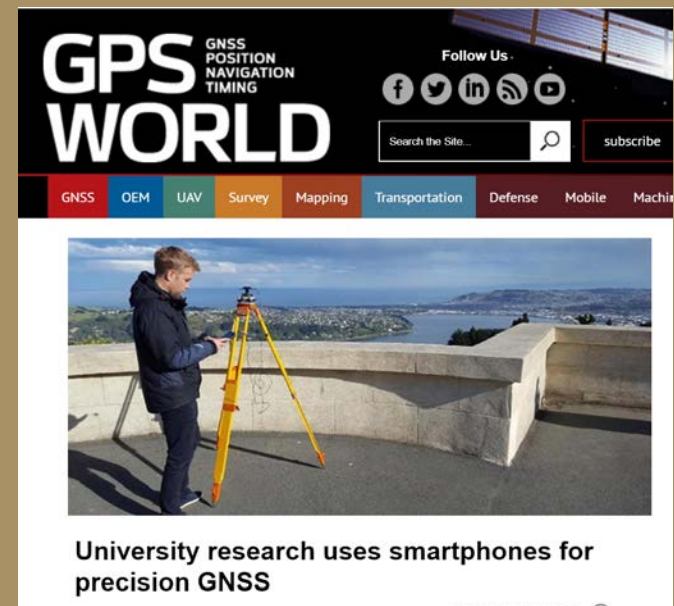
# Equipment Acquisition Change

- 2012 – Decimeter precision = \$11,200
- 2016 – Decimeter precision = \$1,500-\$7,500
- 2018 – US DOI credit card purchase limit increase from \$3,500-\$10,000



The screenshot shows the top portion of the GPS World website. The header includes the site logo "GPS WORLD" with the tagline "GNSS POSITION NAVIGATION TIMING". To the right of the logo are social media icons for Facebook, Twitter, LinkedIn, RSS, and YouTube, with the text "Follow Us." above them. Below the logo is a search bar with the placeholder text "Search the Site..." and a magnifying glass icon, and a "subscribe" button. A horizontal navigation bar below the search bar contains the following categories: GNSS, OEM, UAV, Survey, Mapping, Transportation, Defense, Mobile, and Machine. Below the navigation bar is a large image of a blue smartphone with a colorful, abstract wallpaper.

**Dual-frequency GNSS smartphone hits the market**



The screenshot shows the top portion of the GPS World website, identical to the one on the left. Below the navigation bar is a large image of a person in a dark jacket standing on a concrete ledge, using a yellow tripod-mounted GNSS receiver. The background shows a scenic view of a city and a body of water under a blue sky.

**University research uses smartphones for precision GNSS**



# Data Connectivity – Field Data Collection



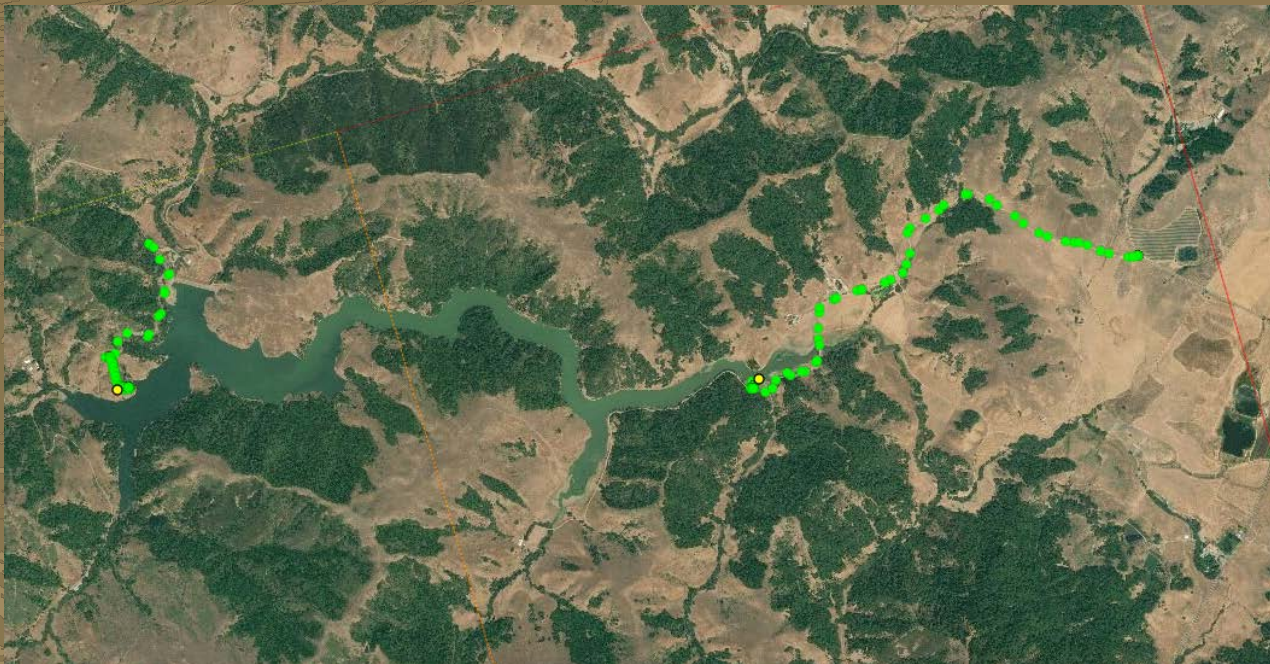
*Cape Cod National Seashore - Massachusetts*

*Yosemite National Park – Ferguson Fire - California*



# Data Connectivity – Resource Management

## Point Reyes National Seashore - California



| LocationID | Parking or Fire Road                               | Route Notes   | ETA_Truck To Detector | Distance in miles |
|------------|--|---|-----------------------|-------------------|
| 84538_NE   | 3221 Vineyard Rd, Novato                           | Big Trees trailhead, L past Rebelo Ln<br>~1.8mi hike S. Find spot   | 55mins                | 4.76              |
| 84538_NW   | Devil's Gulch Creek Trailhead                      | Access to fire road Z-key or hike NE 1mi  | 25mins                | 0.97              |
| 84538_SE   | 110 Nicasio Valley Rd                              | Nicasio Valley Rd. trailhead, .2mi E  | 5mins                 | 0.23              |
| 84538_SW   | Upper Peters Dam Rd. just before<br>Shafter Bridge | .8mi from bridge. Find spot off trail   | 20mins                | 0.08              |
| 92050_NE   | Muir Woods overflow lot                            | Walk NE along trail towards Visitor's<br>Center cut back/down at trail towards<br>creek Along Redwood Creek/trail, .3mi | 6mins                 | 0.85              |
| 92050_NW   | Whitegate Ranch Trailhead                          | Walk E towards Webb Creek   | 10mins                | 1.17              |
| 92050_SE   | Muir Beach Parking or Pelican Inn                  | Walk just S of Hwy 1 curve,   | 6mins                 | 0.46              |
| 18154_SE   | Turn OUT on platform road                          | tracklog from visit with Taylor.<br>Bushwhacking  | unknown               |                   |

# Data Connectivity - Interpretation

← → ↻ https://isea.maps.arcgis.com/apps/MapSeries/index.html?appid=c418d8fecac641af9bc2f613a7039d4



## Top Invasive Plant Species at Sleeping Bear Dunes

A Story of Invasive Plants within Sleeping Bear Dunes National Lakeshore



About the Park and Project

Invasives at Sleeping Bear Dunes

Baby's Breath

Thistle (3)

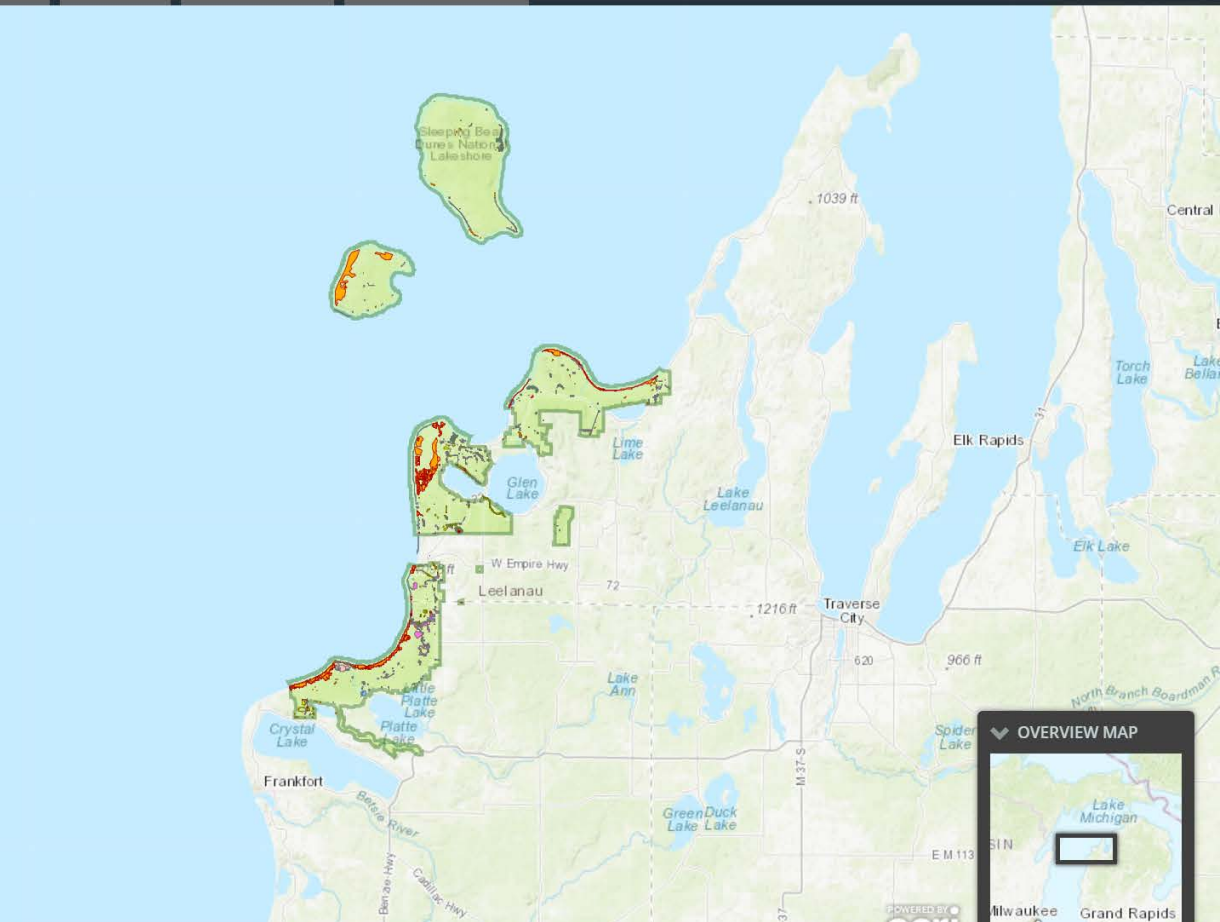
Garlic Mustard

How You Can Help



Rangers on the dunes

Invasive plants can be found throughout most environments at Sleeping Bear Dunes. However, the degree of negative impact by the invasive plants varies based on many factors such as time elapsed since the initial invasion, habitat conditions, and treatments. In the map to the right, our park boundaries are represented by the green shaded areas, and within those shaded areas, the most prevalent and abundant invasive plants recorded by our rangers are represented by **colored polygons**.



# Data Connectivity – Public Information

NPS.gov / Home / Apps

## National Park Service Apps

Heading to a park and want to enhance your visit with your phone or tablet? You can download free iOS and Android apps to help plan your trip and discover the stories that make our parks special.

Here's a selection of parks that offer apps produced by the National Park Service. For a full list or to download these apps, visit the National Park Service [iTunes](#) or [Google Play](#) stores.

- Cape Hatteras
- Golden Gate
- Herbert Hoover
- Independence Junior Ranger
- Klondike Gold Rush
- National Mall
- Statue of Liberty & Ellis Island
- Yellowstone

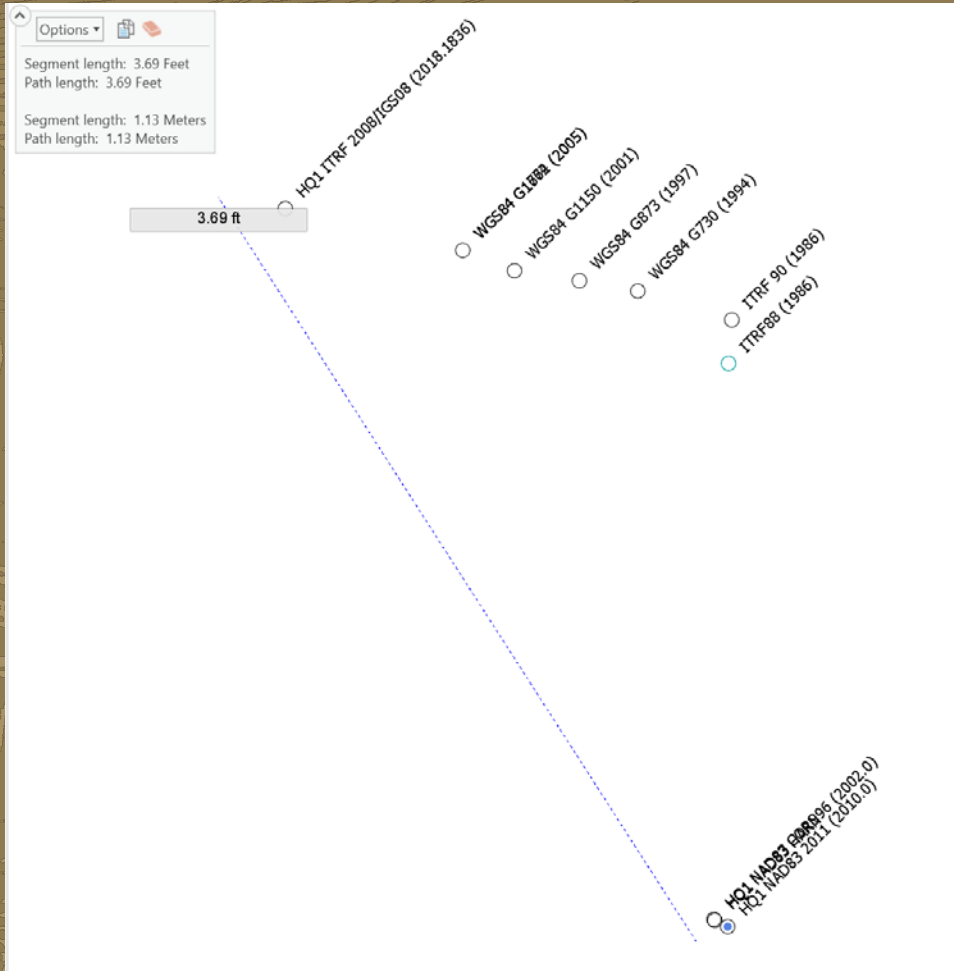


*Several national parks offer apps available for free download.*

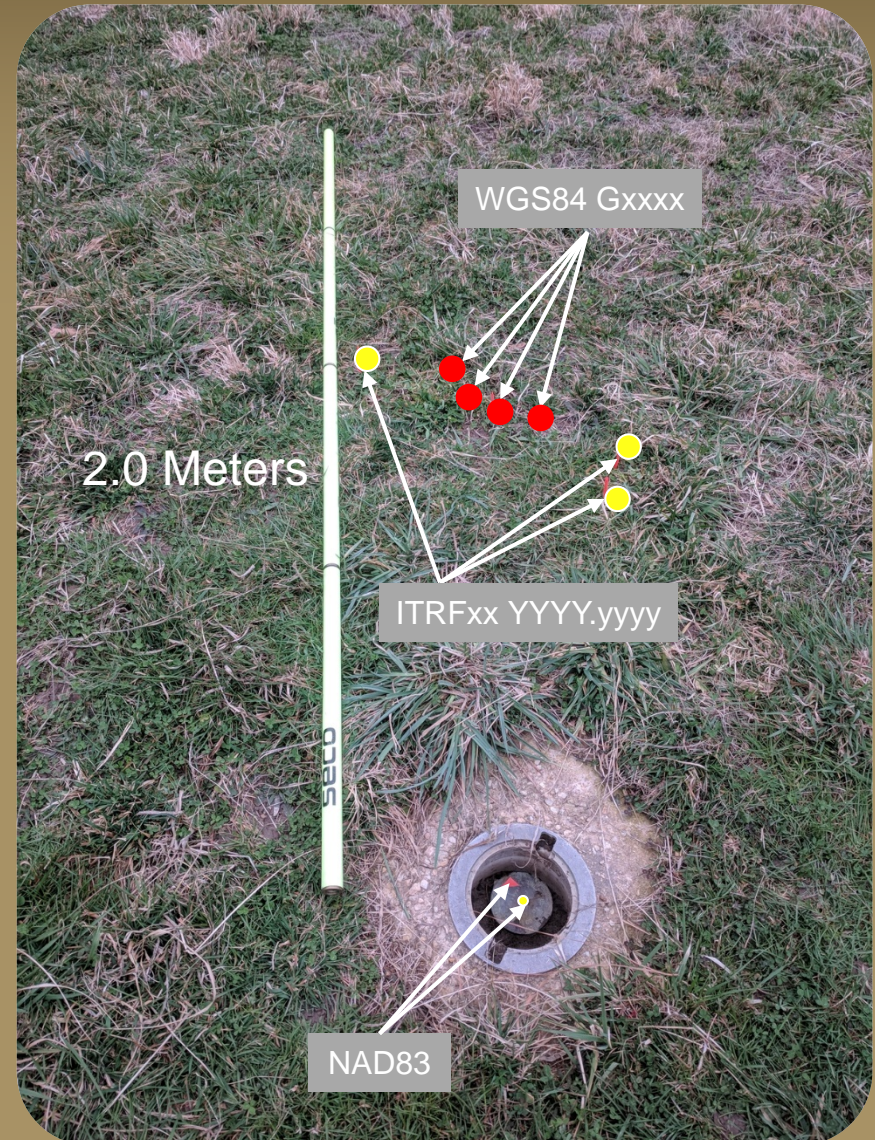
<https://www.nps.gov/subjects/digital/nps-apps.htm>

# Managing Position Accuracy

Assateague Island National Seashore - Maryland



Datum Conversion Source: HTDP



# Managing Position Accuracy



## NGS OPUS SOLUTION REPORT

=====

All computed coordinate accuracies are listed as peak-to-peak values.  
For additional information: <https://www.ngs.noaa.gov/OPUS/about.jsp#accuracy>

USER: [neil\\_winn@nps.gov](mailto:neil_winn@nps.gov)  
RINEX FILE: 0241153s.17o

DATE: June 15, 2017  
TIME: 16:09:42 UTC

SOFTWARE: page5 1603.24 [master90.pl](#) 160321 START: 2017/06/02 18:38:00  
EPHEMERIS: igr19515.eph [rapid] STOP: 2017/06/03 17:55:00  
NAV FILE: brdc1530.17n OBS USED: 59086 / 61782 : 96%  
ANT NAME: TRMR10 NONE # FIXED AMB: 197 / 217 : 91%  
ARP HEIGHT: 1.7 OVERALL RMS: 0.017(m)

REF FRAME: NAD\_83(2011)(EPOCH:2010.0000) IGS08 (EPOCH:2017.4199)

|    |                 |          |                 |          |
|----|-----------------|----------|-----------------|----------|
| X: | -719099.726(m)  | 0.006(m) | -719100.534(m)  | 0.006(m) |
| Y: | -5618584.924(m) | 0.013(m) | -5618583.427(m) | 0.013(m) |
| Z: | 2921850.552(m)  | 0.011(m) | 2921850.342(m)  | 0.011(m) |

|            |                 |          |                                    |          |
|------------|-----------------|----------|------------------------------------|----------|
| LAT:       | 27 26 34.59894  | 0.015(m) | 27 26 34.61359                     | 0.015(m) |
| E LON:     | 262 42 23.75194 | 0.008(m) | 262 42 23.71583                    | 0.008(m) |
| W LON:     | 97 17 36.24806  | 0.008(m) | 97 17 36.28417                     | 0.008(m) |
| EL HGT:    | -22.207(m)      | 0.006(m) | -23.530(m)                         | 0.006(m) |
| ORTHO HGT: | 3.346(m)        | 0.016(m) | [NAVD88 (Computed using GEOID12B)] |          |

Padre Island National Seashore - Texas

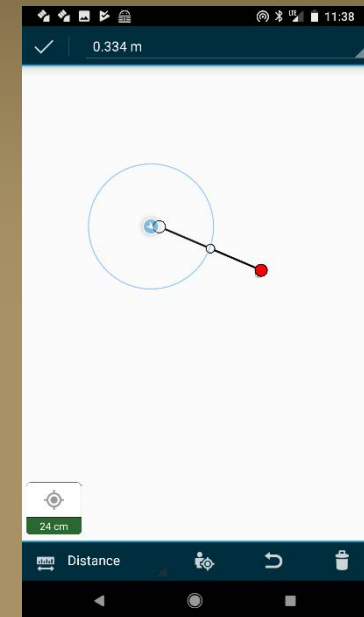
# Managing Position Accuracy

VELOCITIES IN MM/YR RELATIVE TO ITRF2008 or IGS08/IGB08

HQ1

|                             |                              |
|-----------------------------|------------------------------|
| LATITUDE = 38 14 55.28221 N | NORTH VELOCITY = 4.28 mm/yr  |
| LONGITUDE = 75 9 25.14195 W | EAST VELOCITY = -14.31 mm/yr |
| ELLIPS. HT. = -34.446 m     | UP VELOCITY = 0.00 mm/yr     |
| X = 1284792.612 m           | X VELOCITY = -14.51 mm/yr    |
| Y = -4848004.367 m          | Y VELOCITY = -1.10 mm/yr     |
| Z = 3927138.134 m           | Z VELOCITY = 3.36 mm/yr      |

*Assateague Island National Seashore - Maryland*



|                            |        |                  |         |          |          |            |            |            |            |
|----------------------------|--------|------------------|---------|----------|----------|------------|------------|------------|------------|
| ITRF 2008 To NAD 1983 2011 | 108360 | Coordinate_Frame | 0.99343 | -1.90331 | -0.52655 | 0.02591467 | 0.00942645 | 0.01159935 | 0.00171504 |
|----------------------------|--------|------------------|---------|----------|----------|------------|------------|------------|------------|

- This transformation converts NAD83 2011 (2010.0) to ITRF2008 (2005.0)
- WAAS reference frame = ITRF2008 (2018.5) ~ updated every six months
- 2018.5-2005.0 = 13.5 years
- 13.5 years x 1.493cm/yr = 20.155cm
  - TLDR – position moves within the circle

# Managing Position Accuracy



*Jean Lafitte  
National Historical Park and Preserve  
Louisiana*

• 8761899B Tidal

|            |                  |
|------------|------------------|
| Latitude:  | N29°40'02.04328" |
| Longitude: | W90°06'33.55653" |
| Height:    | -25.226          |

| AU2310  | *CURRENT SURVEY CONTROL |           |                   |                    |            |          |          |
|---------|-------------------------|-----------|-------------------|--------------------|------------|----------|----------|
| AU2310  |                         |           |                   |                    |            |          |          |
| AU2310* | NAD 83(2011)            | POSITION- | 29 40 02.04390(N) | 090 06 33.55595(W) |            |          | ADJUSTED |
| AU2310* | NAD 83(2011)            | ELLIP HT- | -25.189 (meters)  |                    | (06/27/12) | ADJUSTED |          |
| AU2310* | NAD 83(2011)            | EPOCH     | - 2010.00         |                    |            |          |          |





# Managing Position Accuracy



9/18/2018 11:06am EDT – 0.186m NAVD88

*Assateague Island National Seashore - Maryland*



9/18/2018 11:07am EDT – 0.189m NAVD88

# Managing Position Accuracy – Survey Control

## Shared Solution

**PID:** BFW34  
**Designation:** NCTC BM9  
**Stamping:** 9  
**Stability:** May hold, commonly subject to ground movement  
**Setting:** Object driven into ground  
**Description:** Mark is located on the USFWS National Conservation Training Center campus near Shepherdstown, WV. Mark location is in a field approximately 90m West of a parking lot, 130m North of NCTC BM1, and 3m Southeast of the nearest trail.  
**Observed:** 2018-01-11T17:12:00Z  
**Source:** OPUS - page5 1603.24



Close-up View

|                                   |                  |  |                |             |         |
|-----------------------------------|------------------|--|----------------|-------------|---------|
| REF_FRAME: NAD_83(2011)           | EPOCH: 2010.0000 | SOURCE: NAVD88 (Computed using GEOID12B) | UNITS: m       | SET PROFILE | DETAILS |
| LAT: 39° 29' 12.60146" ± 0.006 m  |                  |  |                |             |         |
| LON: -77° 48' 24.64960" ± 0.001 m |                  |  |                |             |         |
| ELL HT: 92.769 ± 0.014 m          |                  |  |                |             |         |
| X: 1041087.934 ± 0.004 m          |                  |  |                |             |         |
| Y: -4818009.881 ± 0.015 m         |                  |  |                |             |         |
| Z: 4034234.457 ± 0.006 m          |                  |  |                |             |         |
| ORTHO HT: 126.813 ± 0.027 m       |                  |  |                |             |         |
|                                   |                  | UTM 18                                   | SPC 4701(WV N) |             |         |
|                                   |                  | NORTHING: 4374564.923m                   | 110927.691m    |             |         |
|                                   |                  | EASTING: 258605.860m                     | 745644.515m    |             |         |
|                                   |                  | CONVERGENCE: -1.78573762°                | 1.07984716°    |             |         |
|                                   |                  | POINT SCALE: 1.00031750                  | 0.99994368     |             |         |
|                                   |                  | COMBINED FACTOR: 1.00030294              | 0.99992913     |             |         |

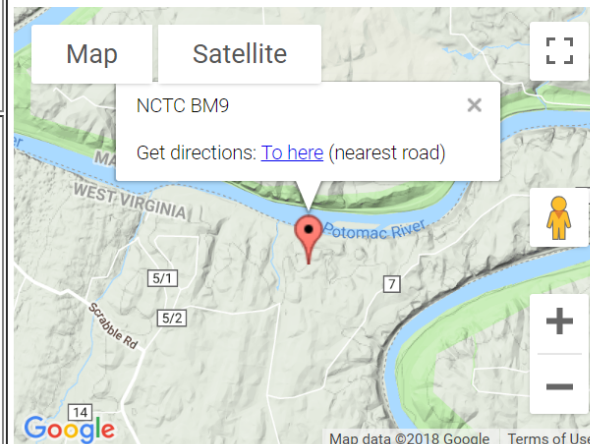
### CONTRIBUTED BY

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 [DOI National Park Service](#)



Horizon View



The background of the slide features a stylized, textured illustration of a landscape. It shows rolling hills or mountains in the distance, a range of jagged peaks in the middle ground, and a line of evergreen trees in the foreground. The entire illustration is rendered in a light tan or beige color against a darker tan background. A solid black horizontal bar is positioned at the top of the slide, above the text.

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