



# GPS on BMs Rocky Mountain Region (CO,WY, MT)



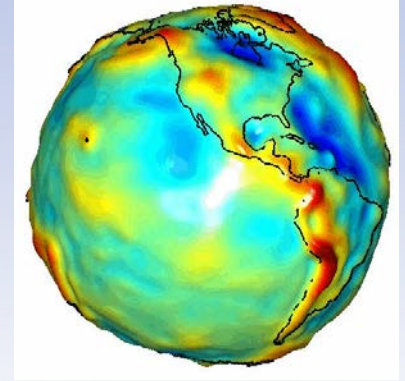
## Part III DS-World June 21, 2018

Pam Fromhertz  
Rocky Mountain Regional Advisor  
240-988-6363  
Pamela.Fromhertz@noaa.gov

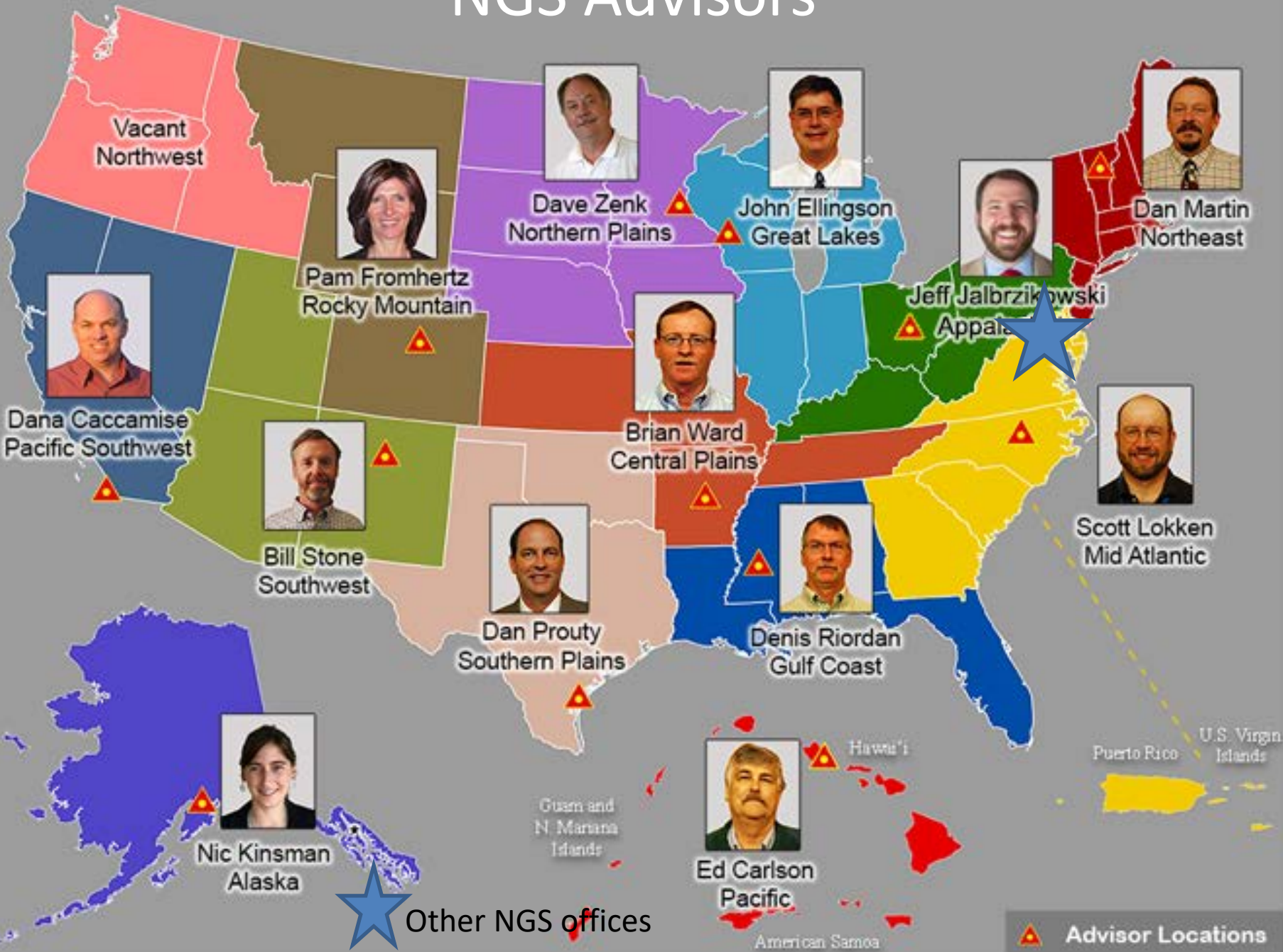
[geodesy.noaa.gov](http://geodesy.noaa.gov)

# Topics

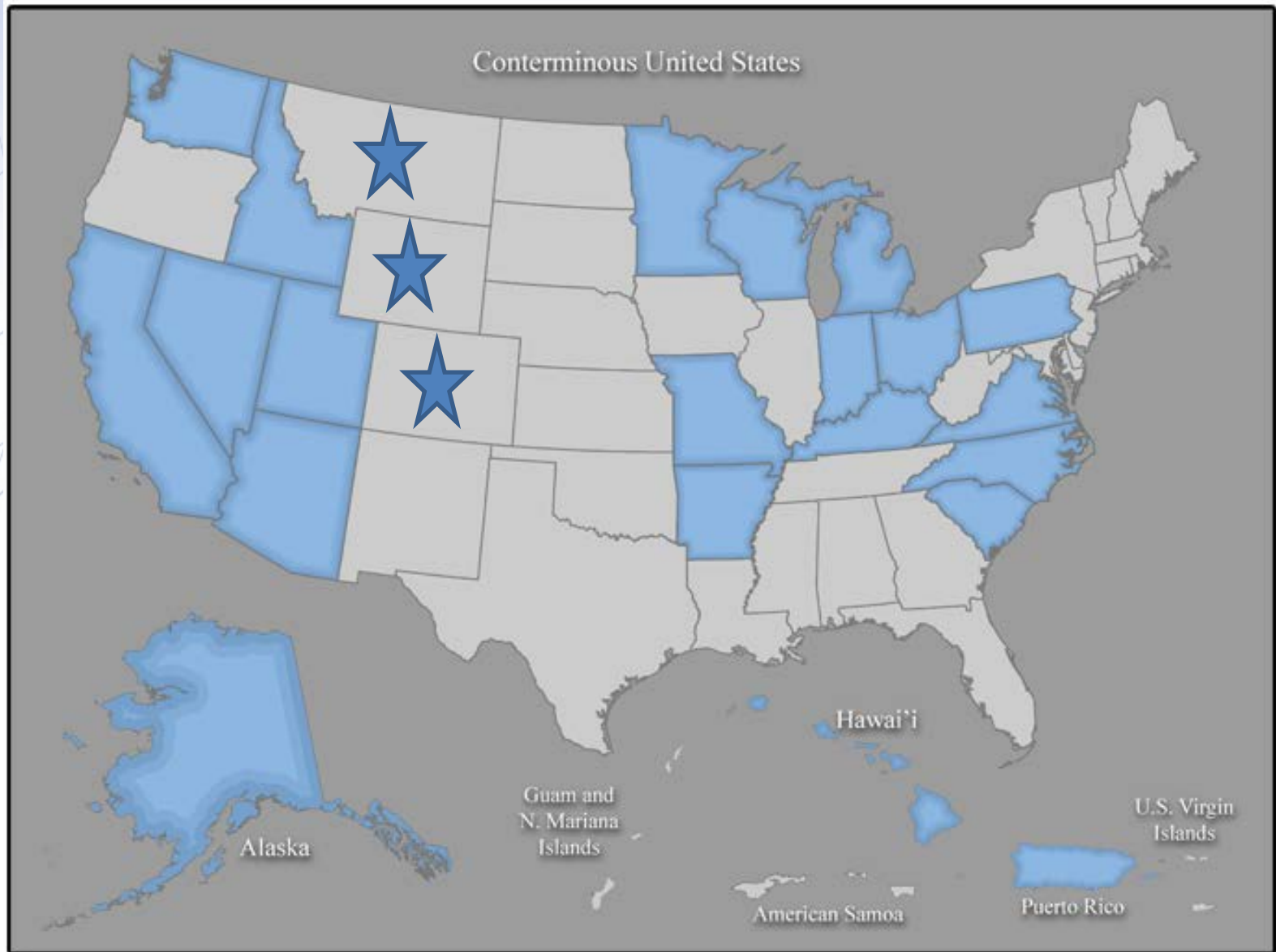
- Quick Review of Part I and II
- CO-WY-MT map and sign up sheet
- *OPUS share*
- Questions



# NGS Advisors



# Geodetic Coordinators



# State Contacts

- CO – [COCoordinator@plsc.net](mailto:COCoordinator@plsc.net)
  - John Hunter, PLSC (Joey Stone, Thomas Breitnauer)
- MT – Joshua Phillips, MARLS
  - Tyson Olinger, MDT
  - Erin Fashoway, MAGIP
  - Wally Gladstone, Tribal
- WY – Mark Corbridge, WYDOT, PLSW
  - Mike Londe, BLM Federal Partner
  - Karen Rodgers, WYGEO

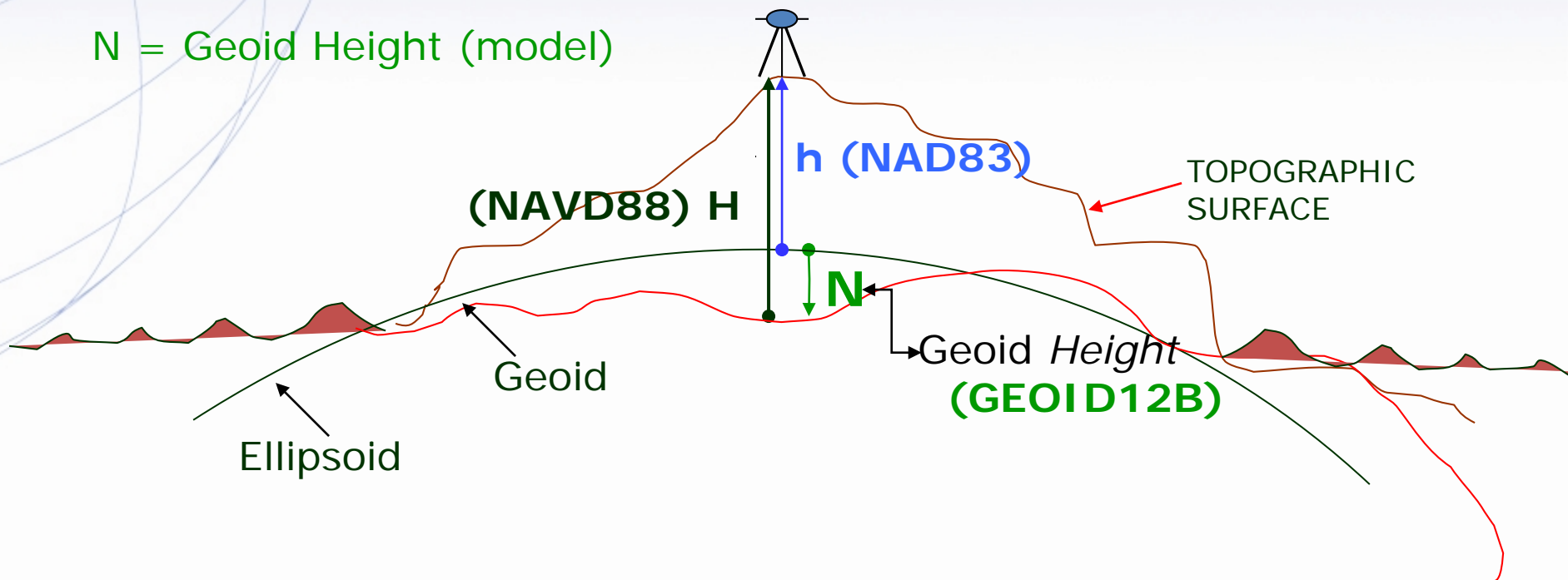
# Heights – why so important?

H = Orthometric Height (leveling)

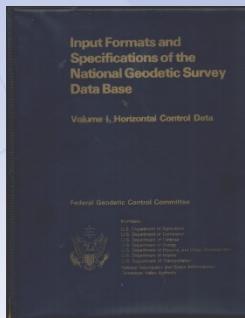
h = Ellipsoidal Height (GPS)

N = Geoid Height (model)

$$H = h - N$$



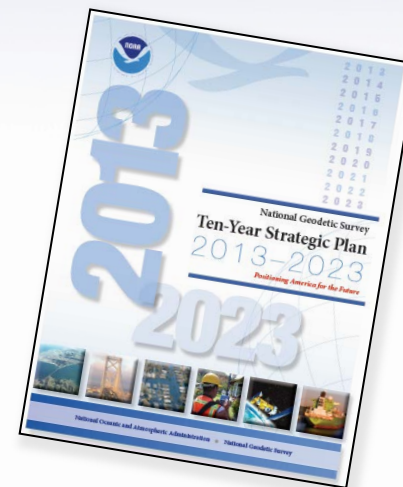
Ellipsoid, Geoid, and Orthometric Heights



# New Reference Frames Planned for 2022



- Replace NAD83 with a geocentric reference frame
- GNSS based
- Replace NAVD88 with a gravity based geoid



# GPS on BM

## Why?

- NGS will use data collected to develop **GEOID18**, increase access to NAVD 88, and enable conversions to **NAPGD2022**
- Obtain ellipsoid height where we have an orthometric height
- Redundant measurements ensures reliability of measurement
- Many of these marks are already destroyed, finding them can be a challenge



# Crowdsourcing GPS on Bench Marks

- Help with final hybrid Geoid Model
- Help with the transformation tools
- Find Bench Marks
  - Use our priority BM/tracking map
  - Use NGS Data Explorer
  - Use DS-World
- Provide a recovery note, coordinates, photos
  - Use DS-World
- Collect GPS data
  - 4 hours of data required with survey grade equipment
  - Share through OPUS



# OPUS: Online Positioning User Service

National Geodetic Survey

## Description entry successful! APPROVAL PENDING

You should soon receive a normal "solution report" email from OPUS. If successful, it and your mark description will be forwarded for approval:

- for option "share my solution" you are **ALMOST done**.  
-- You will receive a second email with final instructions.
- for option "contribute to a project" you are **done!**  
-- This second email will go to the manager for your project.

Thank you for using OPUS!

OPUS menu

Home / upload

About OPUS

Projects

Shared solutions

Support / feedback



# OPUS: Online Positioning User Service

National Geodetic Survey

- NGS Home
- About NGS
- Data & Imagery
- Tools
- Surveys
- Science & Education
- Search



**Hooray! You are done.**

**NGS review pending.**  
We will notify you, by email, after we manually review & share your solution.

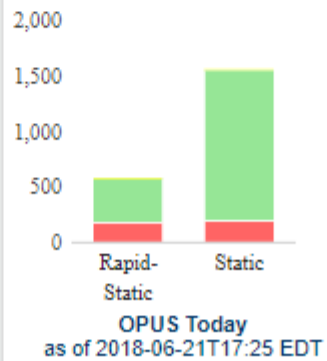
Thank you for using OPUS, and for contributing to the NGS geodetic control database!

RINEX FILE: de78169q.18o.gz  
DESIGNATION: RMCL 60

<https://geodesy.noaa.gov/OPUS/getFeedback.jsp?id=OP1529554054075>

### OPUS menu

- home / upload
- about OPUS
- projects
- shared solutions
- support / feedback





National Geodetic Survey



Review your solution carefully, then select an action below.

1. upload ✓

2. identify

3. describe

4. share

your solution

Shared Solution

PTID:	DE7819
Designation:	RMCL 60
Stamping:	RMCL 60 1988
Stability:	May hold commonly subject to ground movement.
Setting:	Set in top of concrete monument
Mark Condition:	G
Description:	
Observed:	2018-06-18 11:48:00Z
Source:	OPUS - page# 1803.24



Close-up View

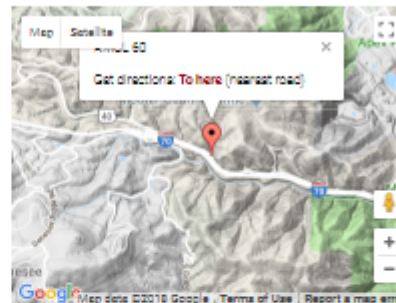
REF. FRAME:	EPOCH:	SOURCE:	UNITS:	SET PROFILE:	DETAILS
NAD 83(2011)	2010.0000	NAVD85 (Computed using GEOD125)	m		
<b>LAI:</b>	39° 42' 3.42475"	± 0.007 m			
<b>LOI:</b>	-105° 14' 22.14631"	± 0.010 m			
<b>ELL HI:</b>	2116.230	± 0.010 m			
<b>X:</b>	-1292088.989	± 0.009 m			
<b>Y:</b>	-4742757.759	± 0.008 m			
<b>Z:</b>	4053848.133	± 0.009 m			
<b>DIKING HI:</b>	2131.417	± 0.043 m			
			<b>UIM 13</b>	<b>SFC 502(CO C)</b>	
			<b>NORTHING:</b> 4394594.008m	512158.217m	
			<b>EASTING:</b> 479488.890m	938744.847m	
			<b>CONVERGENCE:</b> -0.15297778"	0.16430598"	
			<b>POINT SCALE:</b> 0.99985519	0.99985087	
			<b>COMBINED FACTOR:</b> 0.99927343	0.99985878	

CONTRIBUTED BY

panela.fromherz  
 National Geodetic Survey



Horizon View



The numerical values for this position solution have satisfied the quality control criteria of the National Geodetic Survey. The contributor has verified that the information submitted is accurate and complete.

Sharing release & quality statement: I consider these photos, notes, and solution to accurately represent a permanent mark of public interest, to be shared in the NGS geodetic control database.

SHARE

Add to NGS database

EDIT

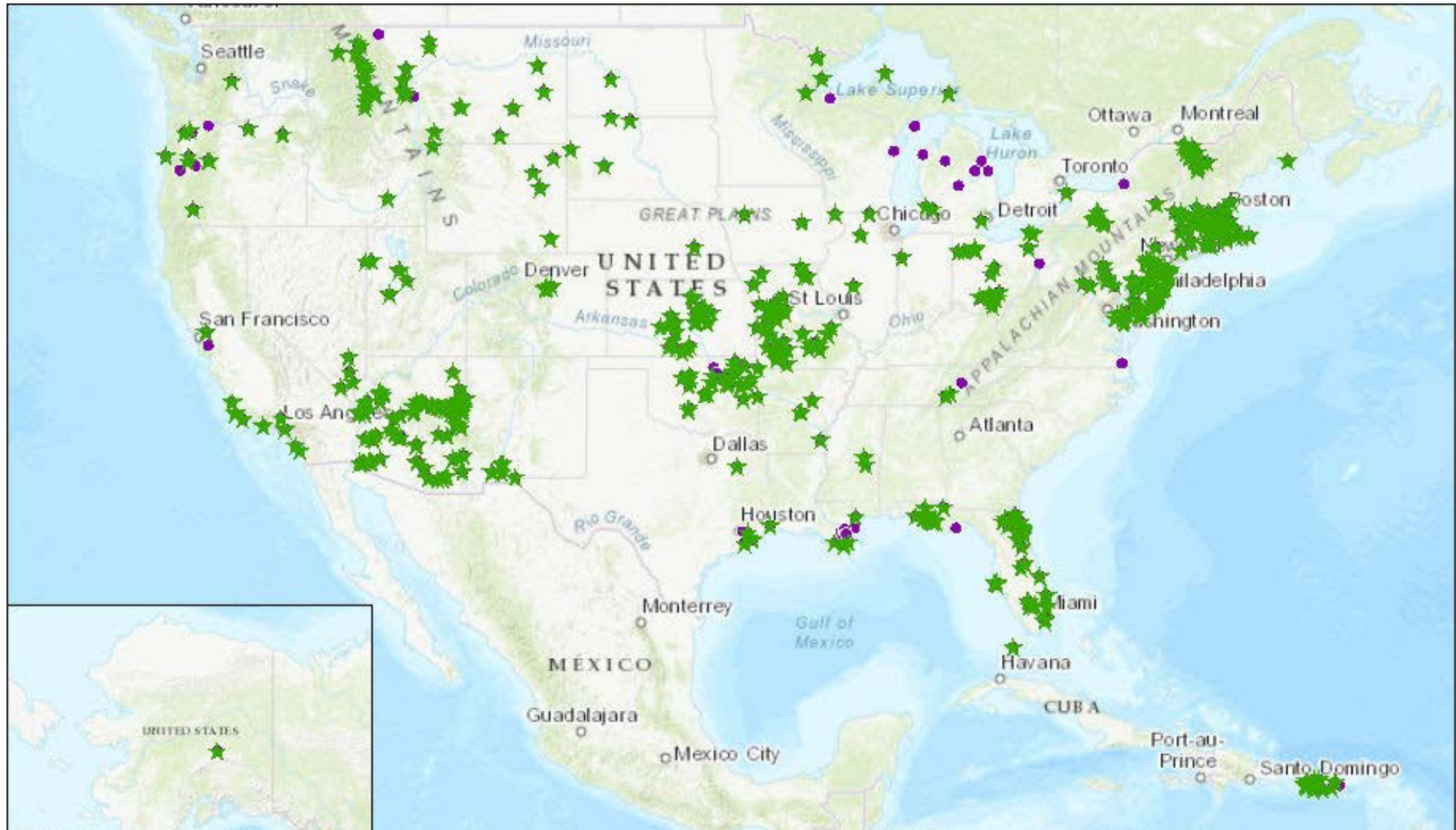
Change my description

DISCARD

Discard my solution

Website Owner: National Geodetic Survey / Last modified by NGS.OPUS V 2.3 Jun 11 2018

# Shared Solutions May 2018



<https://geodesy.noaa.gov/sitemsgs/OPUS/shared/overview-2018-May.h>

★ OPUS- IDB Shared Marks

● OPUS- IDB Shared Marks

COSTA RICA

Caracas

# Rocky Mountain Region Webinars

## GPS on BM

- May 21 2:00 Basics, why, how, when
  - Recorded <https://attendee.gotowebinar.com/recording/4100208993309956616>
- June 7 2:00 DS-World
  - Will be recorded
- June 14 2:00 Sharing through OPUS

## NOAA's National Geodetic Survey

# Thank you

Pam Fromhertz

[Pamela.fromhertz@noaa.gov](mailto:Pamela.fromhertz@noaa.gov)

240-988-6363

# Backup Slides





### Stay Informed

[New Datums](#)[Educational Videos](#)[Webinar Series](#)[What does NGS do?](#)[Activities in my area](#)[Regional Advisors](#)[Contact Us](#)

### NGS Subscription Services

#### NGS News

##### New Educational Video

The Importance of Accurate Coastal Elevation and Shoreline Data



This latest video explains the role of topo-bathy light detection and ranging (lidar) products in the National Geodetic Survey's (NGS) mapping and charting program, and how these products provide a critical dataset for coastal resilience, coastal intelligence, and place-based conservation.

The video is available for you to view both on COMET's YouTube channel, as well as on our video library page on our website.

NOAA's National Geodetic Survey  
geodetic.noaa.gov

**NGS News** - Receive emails about the latest NGS News. These notices will highlight:

- the release of new products
- updates to existing services
- progress reports for major projects
- information about upcoming NGS-sponsored events
- upcoming job opportunities at NGS

**Sign up** to receive these announcements automatically.

#### NGS Webinar Series

##### NADCON: your tool for easy, consistent coordinate transformations

Dr. Stu Smith and Dr. Andrea Blain, NGS

September 8, 2016; 2-3 pm eastern time

[Register](#)

As a reminder, the [NGS Webinar Series](#) hosts presentations on various topics related to NGS programs, projects, products and services to educate constituents about NGS activities.

- [View our upcoming schedule.](#)
- [View descriptions of previous webinars.](#)
- [Have a question? View our contact page.](#) ✉ email the NGS Info Center

NOAA's National Geodetic Survey  
geodetic.noaa.gov

**NGS Webinar Series** - Each month, a speaker will give a presentation on various topics related to NGS programs, projects, products and services to educate constituents about NGS activities.

**Sign up** to receive a monthly notice describing the upcoming presentation.

#### NGS Training

##### New Training Events Added

NGS training calendar has been updated with several new classes, such as an GPS-Project Managers' Training seminar in December and a Geodetic Digital Learning class next March. A follow up to the first GPS-Project Users Forum has been scheduled for November. Please visit the training calendar for more information about these and other classes.

Also, check out the newest addition to our Video Library, NOAA's VDatum Tool Transforming Heights Between Vertical Datums.

The NGS monthly webinar series will now be issuing certificates of attendance. Tune in to learn some great information about NGS products and tools.

Note: You are receiving this email because you requested to join the NGS training email list. The format of these emails has changed, but the content will be the same.

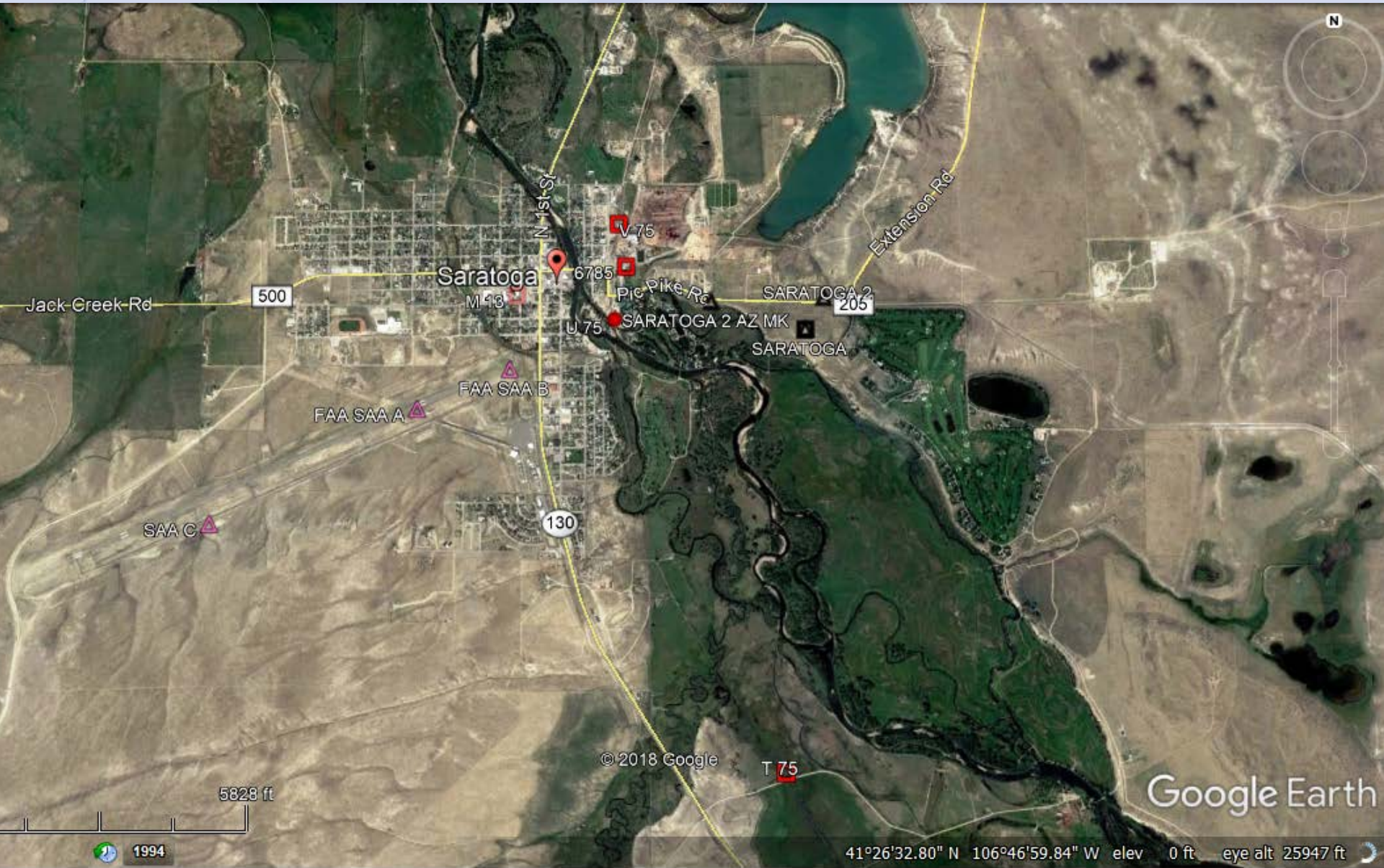
NOAA's National Geodetic Survey

**NGS Training** - Receive emails about online and classroom-based training opportunities when new classes are available.

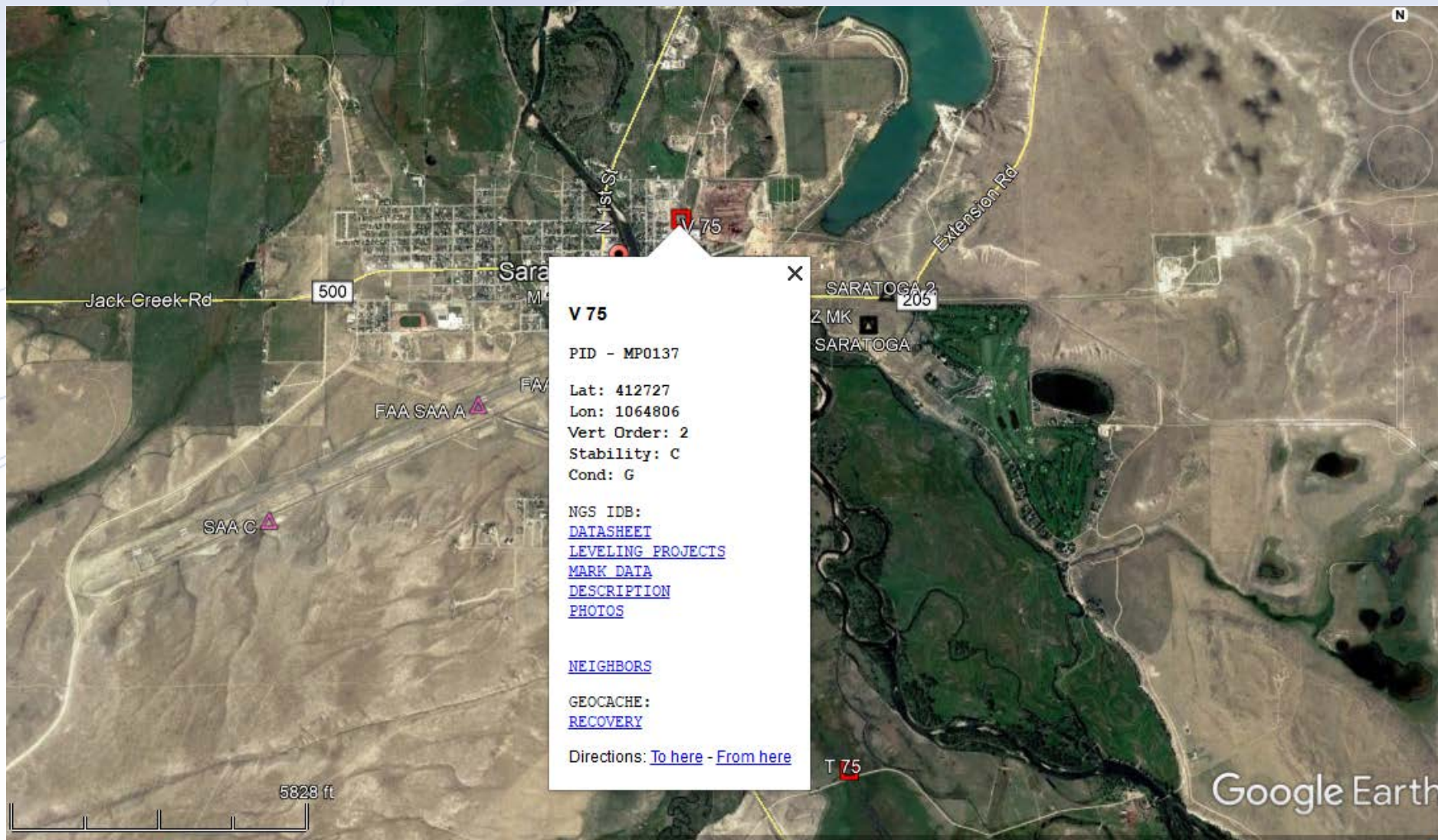
**Sign up** to receive these announcements.



# Geodetic Control in the area



# Geodetic Control in the area



MP0137

MP0137\_U.S. NATIONAL GRID SPATIAL ADDRESS: 13TCF495911(NAD 83)

MP0137

## STATION DESCRIPTION

' DESCRIBED BY US GEOLOGICAL SURVEY 1959

' IN SARATOGA.

' AT SARATOGA, ON THE SARATOGA AND ENCAMPMENT VALLEY RAILROAD, 630 FEET

' NORTH OF THE STATION, 90 FEET NORTHEAST OF THE POINT WHERE A ROAD

' CROSSES THE MAIN TRACK, 69 FEET EAST OF THE CENTERLINE OF THE MAIN

' TRACK, 10 FEET SOUTH OF THE FIFTH POLE NORTH OF THE STATION, AND IN

' LINE WITH A ROW OF POWER POLES. A STANDARD DISK, STAMPED V 75 1934

' AND SET IN THE TOP OF A CONCRETE POST. NOTE-- THE MARK IS 90 FEET

' NORTHWEST FROM THE POINT WHERE A ROAD CROSSES THE MAIN TRACK, AND 77

' FEET WEST OF THE MAIN TRACK.

MP0137

STATION DESCRIPTION

MP0137

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MP0137' LINE WITH A ROW OF POWER POLES. A STANDARD DISK, STAMPED V 75 1934

MP0137' AND SET IN THE TOP OF A CONCRETE POST. NOTE-- THE MARK IS 90 FEET

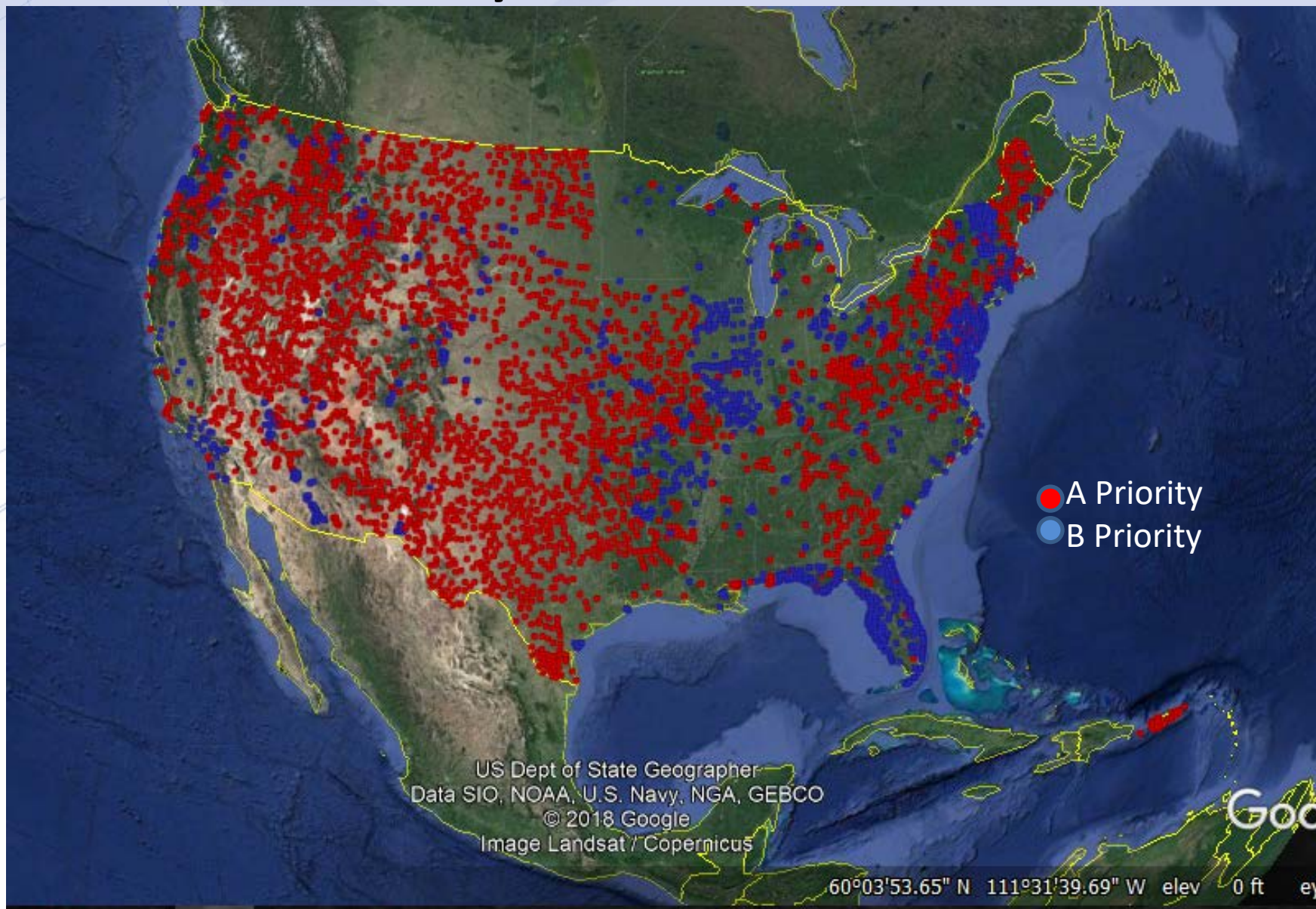
MP0137' NORTHWEST FROM THE POINT WHERE A ROAD CROSSES THE MAIN TRACK, AND 77

MP0137' FEET WEST OF THE MAIN TRACK.

\*\*\* retrieval complete.

Elapsed Time: 00:00:03

# Priority BMs Identified



# Priority Stations near Saratoga, WY

Apps GAO U.S. GAO - Geospatial NOAA Safety and Emergency OSHA Publications NOAA NGS GIS GPS Test Results from Research Interagency Security PJF Other bookmarks

**GPS on Bench Marks 2018**

[NGS Home](#)  
[GPS on Bench Marks](#)

Map Last Updated: April 27, 2018

728 of 5757 : Priority Marks Completed.

Welcome to the GPS on Bench Marks 2018 Web Map. This provides a view of the priority marks that have been selected to help improve GEOID18 and the Transformation Tool that will be created for NAPGD2022.

**Geographic Location Search**

Search by location or decimal coordinates (lat/lon). An X is placed at the top result with the specified km buffer. You can also place an X by right clicking at a location on the map.

Search ...

Click magnifying glass on the map to search by PID

**Symbology**

- Priority A Mark with n observation(s) requested
- Priority B Mark with n observation(s) requested
- Meets current criteria, no more observations needed
- Mark reported unfound or not GPSable.

**Priority A**

Name : Z 75  
 PID : MP0216  
 State : WY  
 County : CARBON  
 ObsCnt Requested : 2

[Datasheet](#)

41° 36' 04" N, 106° 30' 05" W  
Zoom : 10

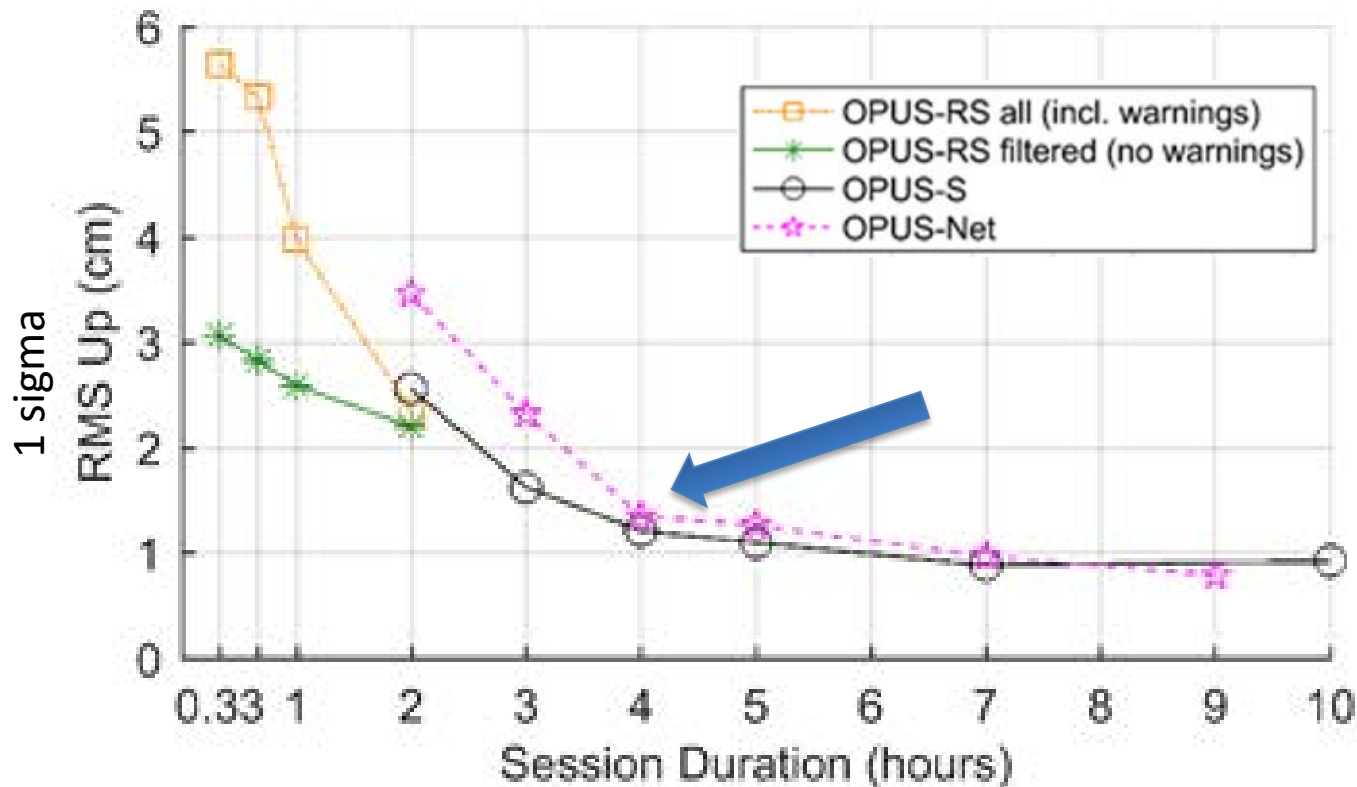
Leaflet | Sources

# Crowdsourcing

- Find Bench Marks (priority and others)
- Provide updated descriptions, Coordinates, photos (use DS-World)
- Collect 4 Hours of GPS grade data and create an OPUS Data sheet (share through OPUS)



# Why do we need 4 hours of data?



NGS is working on OPUS for RTK that will accept 3 minute observations, however the accuracy will NOT be as good as 4 hour observations.

Graph Courtesy of Dr. Daniel Gillins

# NGS Training Material

The screenshot shows the NOAA National Geodetic Survey website. The header includes the NOAA logo and the text "National Geodetic Survey Positioning America for the Future". A navigation bar contains links for "NGS Home", "About NGS", "Data & Imagery", "Tools", "Surveys", "Science & Education", and a search box. A dropdown menu is open under "Science & Education", listing various categories. "Educational Videos" and "GPS on Bench Marks" are circled in red. Below the menu, a "Video Library" section displays several video thumbnails with titles such as "What are Geodetic Datums?", "Precision and Accuracy in Geodetic Surveying", and "Two Right Feet? U.S. Survey Feet vs. International Survey Feet".

GPS on Bench  
Marks  
Webpages

This graphic features the text "Recover Observe Report" in large, bold, red letters at the top. Below it is a photograph of a surveying station with a tripod-mounted instrument and a satellite dish. At the bottom, the text "GPS on Bench Marks" is displayed in white over a dark background.

NGS Video  
Library

The thumbnail shows a person in a yellow safety vest and white hard hat operating a GNSS receiver on a tripod in a field. A large blue play button is overlaid on the image. Below the image, the text reads "Best Practices for Minimizing Errors during GNSS Data Collection".

NGS Online  
Lessons

The thumbnail features a landscape with a mountain and a body of water on the left, and a map with a red 'X' on the right. The text "Understanding Heights and Vertical Datums" is at the top. At the bottom, it says "Bruce Muller" and "Image credit: USGS ©The COMET Program".

# OPUS Share Data Sheet

**PID:** QX0259  
**Designation:** U 102  
**Stamping:** U 102 1934  
**Stability:** May hold commonly subject to ground movement  
**Setting:** Set in top of concrete monument  
**Mark Condition:** G  
**Description:**  
**Observed:** 2012-04-24T14:24:00Z [See Also 2006-03-06](#) [See Also Original](#)  
**Source:** OPUS - page5 1209.04



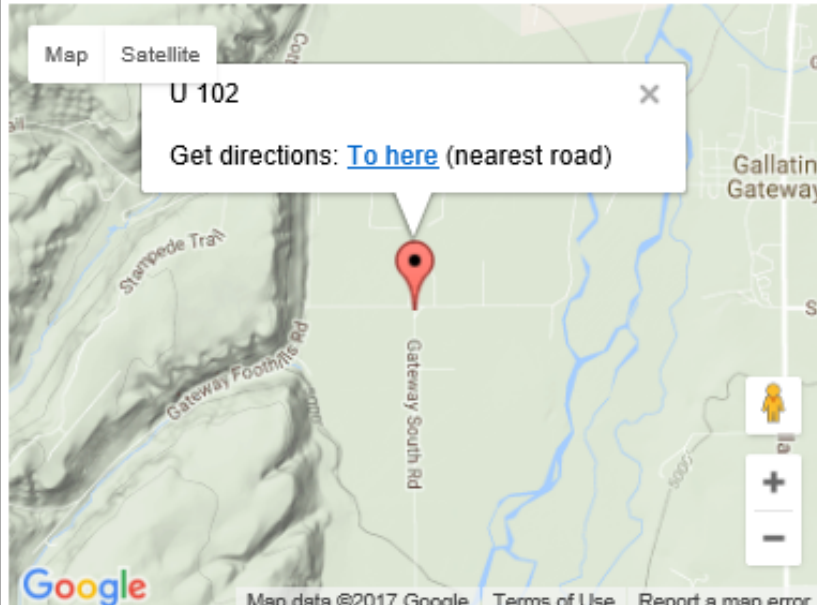
Close-up View

<b>REF_FRAME:</b> NAD_83(2011)	<b>EPOCH:</b> 2010.0000	<b>SOURCE:</b> NAVD88 (Computed using GEOID12B)	<b>UNITS:</b> m	<b>SET PROFILE</b>	<b>DETAILS</b>
<b>LAT:</b> 45° 35' 1.62881" ± 0.005 m					
<b>LON:</b> -111° 13' 41.40490" ± 0.005 m					
<b>ELL HT:</b> 1500.805 ± 0.006 m					
<b>X:</b> -1619426.862 ± 0.006 m					
<b>Y:</b> -4169051.346 ± 0.001 m					
<b>Z:</b> 4534063.306 ± 0.008 m					
<b>ORTHO HT:</b> 1511.363 ± 0.014 m					
		<b>UTM 12</b>	<b>SPC 2500(MT)</b>		
		<b>NORTHING:</b> 5047830.244m	149721.942m		
		<b>EASTING:</b> 482200.421m	465181.642m		
		<b>CONVERGENCE:</b> -0.16297506°	-1.26416218°		
		<b>POINT SCALE:</b> 0.99960390	0.99969977		
		<b>COMBINED FACTOR:</b> 0.99936876	0.99946461		

**CONTRIBUTED BY**  
[william.weber](#)  
[Northwestern Energy](#)



Horizon View



# DS-World

Secure | https://geodesy.noaa.gov/GPSonBM/webmap/

U.S. GAO - Geospatial | NOAA Safety and Environment | OSHA Publications | NOAA | NGS | GIS | GPS | Test Results from Recoveries | Interagency Security | PJF | Other bookmarks

### GPS on Bench Marks 2018

DSWorld 4.01.45

Plot Edit Download View Upload Tools NGS Tools Help Exit

- Digital Photograph(s) of Mark(s)
- .des File of Recoveries
- .gpx File of Hand Held Positions
- OpusDB Data
- Photo Trouble Report
- Project Proposal
- Recovery Report**
- Request for New Agency
- Single Hand Held Position(s)
- State/County Correction(s)
- Text Problem

Map Last Updated: [Redacted]

728 of 575

Welcome to the GPS on Bench Marks 2018 Web Map. This map provides a view of the priority marks that have been identified for recovery in the 2018-2022 period. The map also displays the geographic location of each mark and the status of the mark.

#### Geographic Location Search

Search by location or decimal coordinates (lat/lon). An 'X' is placed at the top result with the specified km buffer. You can also place an 'X' by right clicking at a location on the map.

Search...

#### Symbology

- Priority A Mark with n observation(s) requested
- Priority B Mark with n observation(s) requested
- Meets current criteria, no more observations needed
- Mark reported unfound or not GPSable.

41° 19' 59" N, 106° 54' 06" W  
Zoom: 11

UEUHGI.pdf | GPS on Benchma....docx | OnePagerGPSonB....pdf | UserGuidelinesFor....pdf | NGSGuidelinesFor....pdf | Show all

4:39 PM  
5/3/2018

# DS-World

**Mark Recovery Form**
\_ □ ×

PID:	<input type="text"/>	Desig:	<input type="text"/>	Lat:	<input type="text"/>
GPS:	<input type="text"/>	Alias:	<input type="text"/>	App:	<input type="text"/>
Country:	<input type="text"/>	State:	<input type="text"/>	County:	<input type="text"/>

**Recovery Information**

Rec. Agcy:	A <input type="text"/>	NGS <input type="text"/>	Date Rcvd:	<input type="text"/>	C.O.P.:	PJF	Cond:	<input type="text"/>
Name:	<input type="text" value="Pam Fromhertz"/>		email:	<input type="text" value="pamela.fromhertz@noaa.gov"/>				

**Surface Marker**

Cat	<input type="text"/>	Type:	<input type="text"/>	Mag	<input type="text"/>	Stability:	<input type="text"/>	FVProj/Rec.:	<input type="text"/>	<input type="text"/>
Setting	<input type="text"/>		Setting	<input type="text"/>						
Logo	<input type="text"/>		Stamping:	<input type="text"/>						



# NGS Coordinate Conversion and Transformation Tool (NCAT)

National Geodetic Survey

- NGS Home
- About NGS
- Data & Imagery
- Tools
- Surveys
- Science & Education

- Single Point Conversion
- Multipoint Conversion
- Web services
- Downloads
- About Conversion Tool

Convert from:

- LLh
- SPC
- UTM
- XYZ
- USNG

Enter lat-lon in decimal degrees

Lat:

Lon:

or degrees-minutes-seconds

Lat:

Lon:

or drag map marker to a location of interest



Ellipsoid Height (m)

Input datum:

Output datum:

Converted coordinates will be in output datum.

**Convert**

Export Results to



## NCAT

- LLh
- SPC
- UTM (m)
- XYZ (m)
- USNG

# NGS Coordinate Conversion and Transformation Tool



# National Geodetic Survey

Positioning America for the Future

[NGS Home](#)
[About NGS](#)
[Data & Imagery](#)
[Tools](#)
[Surveys](#)
[Science & Education](#)

[Search](#)

## Quick Links

- [OPUS](#)
- [CORS](#)
- [Survey Mark Datasheets](#)
- [NGS Data Explorer](#)
- [OPUS Projects](#)
- [Geodetic Tool Kit](#)
- [State Plane Coordinates](#)
- [Antenna Calibration](#)
- [UFCORS](#)
- [GEOID](#)
- [GPS on Bench Marks](#)
- [Geodetic Advisors](#)
- [Storm Imagery](#)
- [Publications](#)
- [2017 Geospatial Summit](#)
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Coming in 2022:  
**New Datums!**  
Learn more...

NOAA's National Geodetic Survey (NGS) provides the framework for all positioning activities in the Nation. The foundational elements of latitude, longitude, elevation, shoreline information impact a wide range of important activities.

Learn more about:

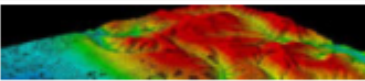
- [Data and tools we provide](#)
- [Activities in your area](#)
- [Applications of geodesy](#)



**GNSS & GPS Data**

Get coordinate information and the tools you need to work independently.


[Learn More](#)



**Remote Sensing**

Download data and critical information into nautical charts.

[Learn More](#)



**Land Surveying**

View guidelines and get tools to support land surveyors.

[Learn More](#)



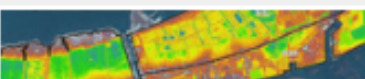
**Geodesy**

NGS works closely with the global researchers advancing geodetic science.

[Learn More](#)



**Training & Education**



**Datums & Transformations**

**Looking for Bench Marks?**

**Emergency Response**

Post Hurricane Aerial Imagery: Hurricane Nate

[Hurricane Maria](#)

[Hurricane Irma](#)

[Hurricane Harvey](#)

[Previous Storms](#)

**Notices**

**Beta Release: NADCON 5**

**Beta Release: CORS & OPUS Share Maps**

[Previous Notices](#)

**In the News**

geodesy.noaa.gov



### Stay Informed

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#### NGS News

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NOAA's National Geodetic Survey  
geodetic.noaa.gov

**NGS Webinar Series** - Each month, a speaker will give a presentation on various topics related to NGS programs, projects, products and services to educate constituents about NGS activities.

**Sign up** to receive a monthly notice describing the upcoming presentation.

#### NGS Training

##### New Training Events Added

NGS training calendar has been updated with several new classes, such as an GPS Project Managers' Training seminar in December and a Geodesy Digital Learning class next March. A follow up to the first GPS Project User Forum has been scheduled for November. Please visit the training calendar for more information about these and other classes.

Also, check out the newest addition to our Video Library, NOAA's VDatum Tool Transforming Heights Between Vertical Datums.

The NGS monthly webinar series will now be issuing certificates of attendance. Tune in to learn some great information about NGS products and tools.

Note: You are receiving this email because you requested to join the NGS training email list. The format of these emails has changed, but the content will be the same.

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**NGS Training** - Receive emails about online and classroom-based training opportunities when new classes are available.

**Sign up** to receive these announcements.



## NOAA's National Geodetic Survey

# Thank you

Pam Fromhertz

[Pamela.fromhertz@noaa.gov](mailto:Pamela.fromhertz@noaa.gov)

240-988-6363