



"Joy of Geodetics"



Part VI

Planning and Conducting Marker Recoveries, Recommended Equipment, Photo Requirements, and Visual Aids

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United States Power Squadrons / America's Boating Club
Sponsor: USPS Cooperative Charting Committee

Revision 5 - 2020

Part VI - Topics Outline

Planning / Conducting Marker Recoveries

1. National Geodetic Survey Data Explorer
2. Marker NGS Data Sheets
3. Coordinates and GPS Accuracy
4. Picture Requirements / Recommendations
5. Smartphone Apps for Locating Markers
6. Smartphone Apps for Picture Taking
7. Recommended Equipment
8. Visual Aids in the Field

National Geodetic Survey Data Explorer

There are several resources in the NOAA / NGS website to assist in Marker Recoveries

The most useful among these is
“National Geodetic Survey Data Explorer”
which shows the location of all markers in a given area on a zoomable map with search functions.

<https://www.ngs.noaa.gov/NGSDataExplorer/>

Pull up NGS Data Explorer – Shows map of NA & Marker Types

National Geodetic Survey Data Explorer

National Geodetic Survey

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

View Map View List

Help Map Layers Go To Location

Geographic Location County, City, Zip code etc
Cary, nc Go
Ex: Burke, VA 22015

Lat-Lon Location Dec Deg Location PID

Site Info Mouse over plotted marks to view information here.

Click "Go"

Enter a Location

Control Types

- CORS
- GPS Site
- Classic Horizontal
- Vertical Control
- Approx Height
- GPS and Vertical Control
- GPS and Approx Height
- Classic Horz and Vert Control
- Classic Horz and Approx Ht

Map Satellite

North Pacific Ocean

HI

48° 34' 29" N , 107° 55' 47" W

Map data ©2016 Google, INEGI Terms of Use

Website Owner: National Geodetic Survey / Last modified by ngs.infocenter Thursday, 11-Oct-2012 11:36:02 EST

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The screenshot shows the National Geodetic Survey Data Explorer interface. At the top, there's a navigation bar with links for NGS Home, About NGS, Data & Imagery, Tools, Surveys, Science & Education, and a search bar. Below the navigation is a map of North America. On the left side, there's a sidebar with options like 'View Map', 'View List', 'Help', 'Map Layers', and 'Go To Location'. Under 'Go To Location', there are fields for 'Geographic Location' (with 'Cary, nc' entered), 'Lat-Lon Location', 'Dec Deg Location', and 'PID'. A 'Site Info' box says 'Mouse over plotted marks to view information here.' Below the sidebar is a 'Control Types' legend with ten entries, each with a unique icon. A large callout box labeled 'Enter a Location' points to the 'Cary, nc' input field. Another callout box labeled 'Click "Go"' points to the 'Go' button. The map itself shows state/province boundaries and major cities. A coordinate overlay at the bottom right shows '48° 34' 29" N , 107° 55' 47" W'. The bottom of the page contains copyright information and links to other NGS services.

Brings up all Marks within a 5 mile Radius of Cary City Center

X Indicates Center of 5 Mile Radius Search

175 Marks in 5 Mile Radius!

Control Types

- CORS
- GPS Site
- Classic Horizontal
- Vertical Control
- Approx Height
- GPS and Vertical Control
- GPS and Approx Height
- Classic Horz and Vert Control
- Classic Horz and Approx Ht

Zoom In

1st Zoom shows more detailed distribution and smaller groupings

National Geodetic Survey Data Explorer

National Geodetic Survey

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

View Map View List Help Map Layers

Horizontal

- ★ CORS
- ▲ GPS Sites
- △ Classical Horizontal

Vertical

- Vertical Control
- Approximate Heights

Find Marks Clear Marks

Location radius 5 Miles

Mark Center Clear X

Go To Location

Site Info

Mouse over plotted marks to view information here.

Show/Hide Legend

Control Types

- ★ CORS
- ▲ GPS Site
- △ Classic Horizontal
- Vertical Control
- Approx Height
- △ GPS and Vertical Control
- ▲ GPS and Approx Height
- Classic Horz and Vert Control
- Classic Horz and Approx Ht

5 Mile Radius

Zoom In Again

Map Satellite

35° 52' 9" N , 78° 53' 4" W

Map data ©2016 Google Terms of Use Report a map error

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The map shows a 5-mile radius search results area centered on a location near Morrisville, NC. The results include numerous control points marked with green and orange squares containing numbers. The legend on the right side defines the symbols used for these control types. A callout box labeled "Zoom In Again" points to the zoom controls in the bottom right corner of the map.

2nd Zoom starts showing individual Marks

 National Geodetic Survey Data Explorer

National Geodetic Survey

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

[View Map](#) [View List](#)

[Help](#) [Map Layers](#)

Horizontal

- ★ CORS
- ▲ GPS Sites
- △ Classical Horizontal

Vertical

- Vertical Control
- Approximate Heights

[Find Marks](#) [Clear Marks](#)

Location radius Miles

[Mark Center](#) [Clear X](#)

Go To Location

PID : EZ6447

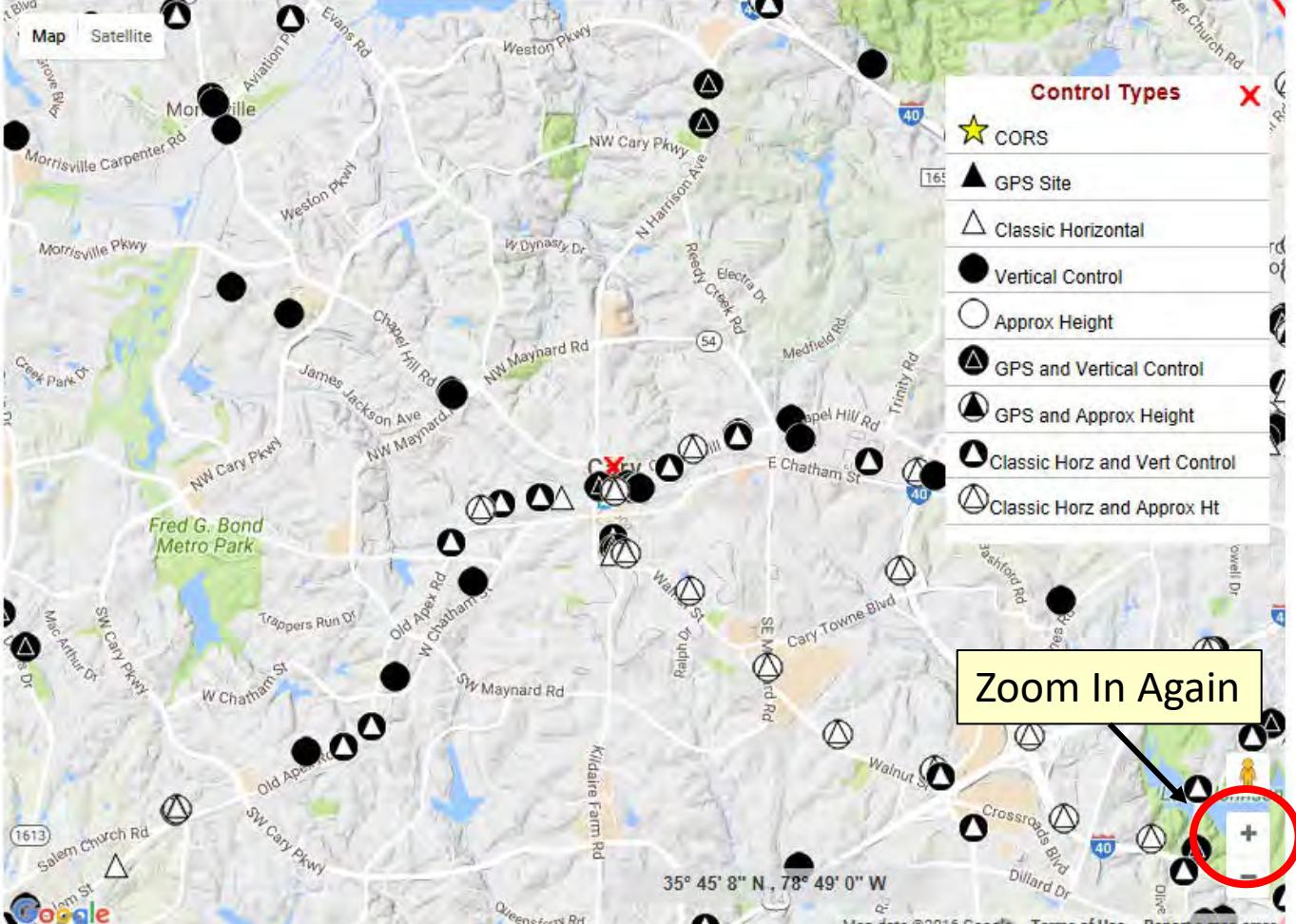
Name : LAJOHN
Elev Source : ADJUSTED
Elev Order : 2
Pos Source : ADJUSTED
Pos Order : None
Ortho Ht : 130.901
Ellip Ht : 98.265

[Datasheet](#)

[Show/Hide Legend](#)

Control Types

- ★ CORS
- ▲ GPS Site
- △ Classic Horizontal
- Vertical Control
- Approx Height
- △ GPS and Vertical Control
- △ GPS and Approx Height
- △ Classic Horz and Vert Control
- △ Classic Horz and Approx Ht



Zoom In Again

35° 45' 8" N, 78° 49' 0" W

Map data ©2016 Google Terms of Use Report a map error

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3rd Zoom shows about 28 individual Marks

National Geodetic Survey Data Explorer

National Geodetic Survey

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

View Map View List Help Map Layers

Horizontal

- CORS
- GPS Sites
- Classical Horizontal

Vertical

- Vertical Control
- Approximate Heights

Find Marks Clear Marks

Location radius 5 Miles

Mark Center Clear X

Go To Location

PID : EZ1892

Name : 50 DRD
Elev Source : ADJUSTED
Elev Order : 1
Pos Source : SCALED
Pos Order : None
Ortho Ht : 128.573
Ellip Ht : None

Datasheet

Show/Hide Legend

Map Satellite

Control Types

- CORS
- GPS Site
- Classic Horizontal
- Vertical Control
- Approx Height
- GPS and Vertical Control
- GPS and Approx Height
- Classic Horz and Vert Control
- Classic Horz and Approx Ht

Zoom In Again

35° 46' 15" N, 78° 48' 24" W

Map data ©2018 Google Terms of Use Report a map error

4rd Zoom shows about 20 individual Marks

National Geodetic Survey Data Explorer

National Geodetic Survey

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

View Map View List Help Map Layers

Horizontal

- ★ CORS
- ▲ GPS Sites
- △ Classical Horizontal

Vertical

- Vertical Control
- Approximate Heights

Find Marks Clear Marks

Location radius 5 Miles

Mark Center Clear X

Go To Location

PID : EZ1890

Name : CHATHAM
Elev Source : ADJUSTED
Elev Order : 1
Pos Source : ADJUSTED
Pos Order : 2
Ortho Ht : 147.380
Ellip Ht : None

Datasheet

Show/Hide Legend

Map Satellite

Control Types

- ★ CORS
- ▲ GPS Site
- △ Classic Horizontal
- Vertical Control
- Approx Height
- △ GPS and Vertical Control
- △ GPS and Approx Height
- △ Classic Horz and Vert Control
- △ Classic Horz and Approx Ht

35° 46' 53" N, 78° 47' 40" W

Website Owner: National Geodetic Survey / Last modified by ngs.infocenter Tuesday, 08-Aug-2017 09:08:06 EST

Map data ©2018 Google

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5th Zoom shows 9 individual Marks

National Geodetic Survey Data Explorer

National Geodetic Survey

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

View Map View List Help Map Layers

Horizontal

- ★ CORS
- ▲ GPS Sites
- △ Classical Horizontal

Vertical

- Vertical Control
- Approximate Heights

Find Marks Clear Marks

Location radius 5 Miles

Mark Center Clear X

Go To Location

PID : EZ1890

Name : CHATHAM
Elev Source : ADJUSTED
Elev Order : 1
Pos Source : ADJUSTED
Pos Order : 2
Ortho Ht : 147.380
Ellip Ht : None

Datasheet

Show/Hide Legend

Map Satellite

Control Types

- ★ CORS
- ▲ GPS Site
- △ Classic Horizontal
- Vertical Control
- Approx Height
- △ GPS and Vertical Control
- ▲ GPS and Approx Height
- Classic Horz and Vert Control
- Classic Horz and Approx Ht

Optional: Pan up and left to Center Marks of Interest

Page-Walker Arts & History Center

35° 47' 15" N, 78° 46' 44" W

Map data ©2018 Google Waldo St Terms of Use Report a map error

6th Zoom shows only 4 individual Marks – Select One

National Geodetic Survey Data Explorer

National Geodetic Survey

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

View Map View List

Help Map Layers

Map Satellite

Horizontal

★ CORS
 ▲ GPS Sites
 Δ Classical Horizontal

Vertical

● Vertical Control
 ○ Approximate Heights

Find Marks Clear Marks

Location radius 5 Miles

Mark Center

Go To Location

PID : EZ1842

Name : FETNER RM 2
Elev Source : ADJUSTED
Elev Order : 1
Pos Source : HD_HELD1
Pos Order : None
Ortho Ht : 152.579
Ellip Ht : None

Page-Walker Arts & History Center
Historic hotel turned cultural center

Ambassador Loop

Ambassador Loop

Jesucristo El Buen Pastor

E Cedar St

N Walker St

Selected Mark of Interest

Optional “Satellite View” Clearly Shows Mark’s Location

National Geodetic Survey Data Explorer

National Geodetic Survey

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

[View Map](#) [View List](#)

[Help](#) [Map Layers](#)

Horizontal

★ CORS
 ▲ GPS Sites
 △ Classical Horizontal

Vertical

● Vertical Control
 ○ Approximate Heights

[Find Marks](#) [Clear Marks](#)

Location radius Miles

[Mark Center](#)

[Go To Location](#)

PID : EZ1842

Name : FETNER RM 2
Elev Source : ADJUSTED
Elev Order : 1
Pos Source : HD_HELD1
Pos Order : None
Ortho Ht : 152.579
Ellip Ht : None

Map Satellite

Aerial view of a residential area and a cultural center. The map shows streets like Ambassador Loop, Cary St, and E Cedar St. A building labeled "Page-Walker Arts & History Center" is highlighted with a callout. A specific mark of interest is selected and highlighted with a yellow arrow.

Selected Mark of Interest



Click on Mark of Interest for PID# and Info Popup

National Geodetic Survey Data Explorer

National Geodetic Survey

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

View Map View List

Help Map Layers

Horizontal

★ CORS
 ▲ GPS Sites
 △ Classical Horizontal

Vertical

● Vertical Control
 ○ Approximate Heights

Find Marks Clear Marks

Location radius 5 Miles

Mark Center

Go To Location

PID : EZ1889

Name : FETNER RESET
Elev Source : ADJUSTED
Elev Order : 1
Pos Source : ADJUSTED
Pos Order : 2
Ortho Ht : 152.185
Ellip Ht : None

National Geodetic Survey Data Explorer

National Geodetic Survey

Map Satellite

Ambassador Loop Ambassador Loop

Page-Walker Arts & History Center Historic hotel turned cultural center

Datasheet

E Cedar St

Jesucristo El Buen Pastor

ar St

N Walker St

Click on Mark of Interest for Info Popup

PID : EZ1889

Name : FETNER RESET
Elev Source : ADJUSTED
Elev Order : 1
Pos Source : ADJUSTED
Pos Order : 2
Ortho Ht : 152.185
Ellip Ht : None

Click on Datasheet Link to Bring up Datasheet

National Geodetic Survey Data Explorer

National Geodetic Survey

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

View Map View List

Help Map Layers

Horizontal

- ★ CORS
- ▲ GPS Sites
- △ Classical Horizontal

Vertical

- Vertical Control
- Approximate Heights

Find Marks Clear Marks

Location radius 5 Miles

Mark Center

Go To Location

PID : EZ1889

Name : FETNER RESET
Elev Source : ADJUSTED
Elev Order : 1
Pos Source : ADJUSTED
Pos Order : 2
Ortho Ht : 152.185
Ellip Ht : None

National Geodetic Survey Data Explorer

National Geodetic Survey

Map Satellite

Ambassador Loop Ambassador Loop

Page-Walker Arts & History Center Historic hotel turned cultural center

Jesucristo El Buen Pastor

E Cedar St E Cedar St N Walker St

Click on Datasheet Link

Datasheet

The screenshot shows a map interface with various controls and data overlays. On the left, there's a sidebar with checkboxes for 'Horizontal' and 'Vertical' data layers, and buttons for 'Find Marks' and 'Clear Marks'. Below that is a location input with a '5 Miles' radius. At the bottom, there's a 'Go To Location' button and a detailed 'Datasheet' for a point labeled 'EZ1889'. The main map area shows a road network with labels like 'Ambassador Loop', 'Jesucristo El Buen Pastor', 'E Cedar St', and 'N Walker St'. A specific GPS site is highlighted with a red circle and a callout box containing the text 'Click on Datasheet Link'.

Mark DESIGNATION and PID are near top of Data Sheet

The NGS Data Sheet

See file [dsdata.txt](#) for more information about the datasheet.

```
PROGRAM = datasheet95, VERSION = 8.10
1      National Geodetic Survey,   Retrieval Date = OCTOBER 31, 2016
EZ1889 ****
EZ1889  DESIGNATION - FETNER RESET
EZ1889  PID        - EZ1889
EZ1889  STATE/COUNTY - NC/WAKE
EZ1889  COUNTRY    - US
EZ1889  USGS QUAD  - CARY (1993)
EZ1889
EZ1889          *CURRENT SURVEY CONTROL
EZ1889
EZ1889* NAD 83(2001) POSITION- 35 47 17.90507 (N) 078 46 42.71181 (W) ADJUSTED
EZ1889* NAVD 88 ORTHO HEIGHT - 152.185 (meters) 499.29 (feet) ADJUSTED
EZ1889
EZ1889  GEOID HEIGHT - -32.303 (meters)           GEOID12B
EZ1889  LAPLACE CORR - -6.30 (seconds)             DEFLEC12B
EZ1889  DYNAMIC HEIGHT - 152.056 (meters)         498.87 (feet) COMP
EZ1889  MODELED GRAVITY - 979,779.0 (mgal)        NAVD 88
EZ1889
EZ1889  HORIZ ORDER - SECOND
EZ1889  VERT ORDER  - FIRST     CLASS II
EZ1889
EZ1889.The horizontal coordinates were established by classical geodetic methods
EZ1889.and adjusted by the National Geodetic Survey in August 2005.
EZ1889.
EZ1889.The orthometric height was determined by differential leveling and
EZ1889.adjusted by the NATIONAL GEODETIC SURVEY
EZ1889.in June 1991.
EZ1889
EZ1889 Significant digits in the geoid height do not necessarily reflect accuracy
```

Mark COORDINATES and ELEVATION are between lines

The NGS Data Sheet

See file [dsdata.txt](#) for more information about the datasheet.

```
PROGRAM = datasheet95, VERSION = 8.10
1      National Geodetic Survey,   Retrieval Date = OCTOBER 31, 2016
EZ1889 ****
EZ1889 DESIGNATION - FETNER RESET
EZ1889 PID        - EZ1889
EZ1889 STATE/COUNTY- NC/WAKE
EZ1889 COUNTRY    - US
EZ1889 USGS QUAD  - CARY (1993)
EZ1889
EZ1889          *CURRENT SURVEY CONTROL
EZ1889
EZ1889* NAD 83(2001) POSITION- 35 47 17.90507 (N) 078 46 42.71181 (W) ADJUSTED
EZ1889* NAVD 88 ORTHO HEIGHT - 152.185 (meters)        499.29 (feet) ADJUSTED
EZ1889
EZ1889 GEOID HEIGHT - -32.303 (meters)                GEOID12B
EZ1889 LAPLACE CORR - -6.30 (seconds)                  DEFLEC12B
EZ1889 DYNAMIC HEIGHT - 152.056 (meters)        498.87 (feet) COMP
EZ1889 MODELED GRAVITY - 979,779.0 (mgal)            NAVD 88
EZ1889
EZ1889 HORZ ORDER - SECOND
EZ1889 VERT ORDER - FIRST     CLASS II
EZ1889
EZ1889.The horizontal coordinates were established by classical geodetic methods
EZ1889.and adjusted by the National Geodetic Survey in August 2005.
EZ1889.
EZ1889.The orthometric height was determined by differential leveling and
EZ1889.adjusted by the NATIONAL GEODETIC SURVEY
EZ1889.in June 1991.
EZ1889
EZ1889 Significant digits in the geoid height do not necessarily reflect accuracy
```

Coordinates Accuracy Displayed in NGS Datasheets - Examples

<u>LAT / LON (Seconds)</u>	<u>Accuracy Description</u>	<u>Position Accuracy (ft)</u>
44 .	SCALED	101
43 . 7	HD_HLD2	10
43 . 67	HD_HLD1	1
43 . 67435	ADJUSTED	0.001*

+/- 1 Sec of Latitude = +/- 101 ft

* Note: High precision surveying equipment that some surveyors use has accuracy capable of about 1/8 in. vertical (elevation) and about 5/8 in. horizontal. A handheld WASS GPS has accuracy to only about 15 ft.

Some Data Sheets have a **Photographs Link** just below the coordinates section.

Click on Link

AC7387
AC7387.The orthometric height was determined by differential leveling and
AC7387.adjusted by the NATIONAL GEODETIC SURVEY
AC7387.in April 1997.
AC7387
AC7387.Significant digits in the geoid height do not necessarily reflect accuracy.
AC7387.GEOID12B height accuracy estimate available [here](#).
AC7387
AC7387.Photographs are available for this station.
AC7387
AC7387.The X, Y, and Z were computed from the position and the ellipsoidal ht.
AC7387
AC7387.The Laplace correction was computed from DEFLEC12B derived deflections.
AC7387
AC7387.The ellipsoidal height was determined by GPS observations
AC7387.and is referenced to NAD 83.
AC7387
AC7387.The dynamic height is computed by dividing the NAVD 88
AC7387.geopotential number by the normal gravity value computed on the
AC7387.Satellite Reference System (GRS 80) ellipsoid. A 45

This can be very helpful in locating the mark!

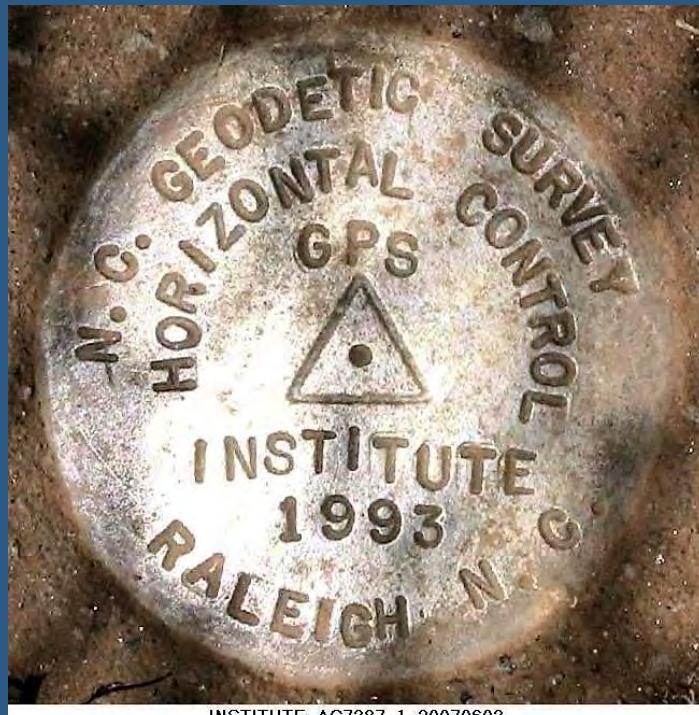
Images in data base for PID=AC7387



[AC7387-INSTITUTE-1-20070603.jpg](#) JPEG IMAGE FORMAT 84352 bytes



[AC7387-INSTITUTE-2-20070603.jpg](#) JPEG IMAGE FORMAT 170418 bytes



MARKER Type, SETTING, and STAMPING above HISTORY

EZ1889 MARKER: DS = TRIANGULATION STATION DISK
EZ1889_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
EZ1889 STAMPING: FETNER 1918 1980

EZ1889_MARK LOGO: NGS
EZ1889_PROJECTION: RECESSED 8 CENTIMETERS
EZ1889_MAGNETIC: O = OTHER; SEE DESCRIPTION
EZ1889_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY
EZ1889+STABILITY: SURFACE MOTION
EZ1889_SATELLITE: THE SITE LOCATION WAS REPORTED AS S
EZ1889+SATELLITE: SATELLITE OBSERVATIONS - May 20, 20
EZ1889
EZ1889 HISTORY - Date Condition Repor
EZ1889 HISTORY - 1980 MONUMENTED NGS
EZ1889 HISTORY - 1980 GOOD NGS
EZ1889 HISTORY - 1985 GOOD USPSQ
EZ1889 HISTORY - 1988 GOOD USPSQ
EZ1889 HISTORY - 1989 GOOD USPSQ
EZ1889 HISTORY - 20050609 GOOD GEOCA
EZ1889 HISTORY - 20060919 GOOD USPSQ
EZ1889 HISTORY - 20080520 GOOD NCGS

STATION DESCRIPTION

EZ1889

EZ1889'DESCRIBED BY NATIONAL GEODETIC SURVEY 1980

EZ1889'IN CARY.

EZ1889'0.05 MILE NORTH ALONG ACADEMY STREET FROM INTERSECTION WITH

EZ1889'CHATHAM STREET IN CARY, TO FIRE STATION, THENCE 0.15 MILE EAST

EZ1889'ALONG CEDAR STREET, AT INTERSECTION WITH NORTH WALKER STREET, 46.7

EZ1889'FEET WEST OF RM 2, 16.1 FEET SOUTHWEST OF TELEGRAPH POLE WITH

EZ1889'REFERENCE TAG, 24.0 FEET SOUTH OF SOUTH RAIL OF SOUTH TRACK, 38.2

EZ1889'FEET NORTH OF FIRE HYDRANT, 88.7 FEET EAST OF SOUTHEAST CORNER OF

EZ1889'BASE OF SEMAPHORE AND 8.9 FEET NORTH OF NORTH CURB OF CEDAR STREET.

EZ1889'THE MARK IS 1.5 FT W FROM A WITNESS POST.

EZ1889'THE MARK IS 1 FT ABOVE STREET.

EZ1889

Note: the “Stamping” on disk will be somewhat different than the “Designation”! The EZ1889 Stamping includes part of the designation (FETNER) plus the date of installation (1918) and the date of reset (1980).

Example of Designation vs. Stamping

DESIGNATION = BULLOCK RM 1

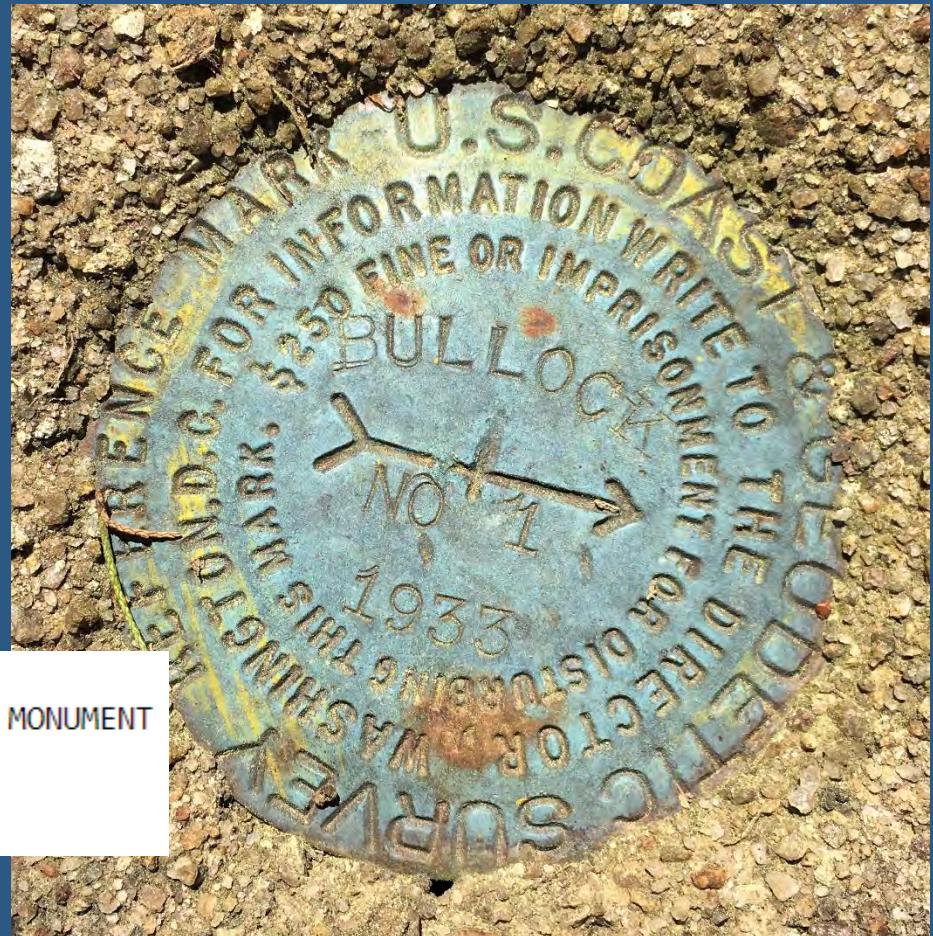
FY1763	*****
FY1763	DESIGNATION - BULLOCK RM 1
FY1763	PID - FY1763
FY1763	STATE/COUNTY- NC/GRAINVILLE
FY1763	COUNTRY - US
FY1763	USGS QUAD - STOVALL (2019)
FY1763	

Data Sheet

STAMPING = BULLOCK NO 1 1933

FY1763_MARKER: DR = REFERENCE MARK DISK
FY1763_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
FY1763_STAMPING: BULLOCK NO 1 1933
FY1763_MARK LOGO: CGS
FY1763_PROJECTION: FLUSH

Data Sheet



Note: Stamping on Disk should agree with Stamping description in Data Sheet

Recovery HISTORY is near middle of Data Sheet

EZ1889
EZ1889_MARKER: DS = TRIANGULATION STATION DISK
EZ1889_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
EZ1889_STAMPING: FETNER 1918 1980
EZ1889_MARK LOGO: NGS
EZ1889_PROJECTION: RECESSED 8 CENTIMETERS
EZ1889_MAGNETIC: O = OTHER; SEE DESCRIPTION
EZ1889_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
EZ1889+STABILITY: SURFACE MOTION
EZ1889_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
EZ1889+SATELLITE: SATELLITE OBSERVATIONS - May 20, 2008
EZ1889

EZ1889 HISTORY	- Date	Condition	Report By
EZ1889 HISTORY	- 1980	MONUMENTED	NGS
EZ1889 HISTORY	- 1980	GOOD	NGS
EZ1889 HISTORY	- 1985	GOOD	USPSQD
EZ1889 HISTORY	- 1988	GOOD	USPSQD
EZ1889 HISTORY	- 1989	GOOD	USPSQD
EZ1889 HISTORY	- 20050609	GOOD	GEOCAC
EZ1889 HISTORY	- 20060919	GOOD	USPSQD
EZ1889 HISTORY	- 20080520	GOOD	NCGS

EZ1889 STATION DESCRIPTION
EZ1889
EZ1889'DESCRIBED BY NATIONAL GEODETIC SURVEY 1980
EZ1889'IN CARY.
EZ1889'0.05 MILE NORTH ALONG ACADEMY STREET FROM INTERSECTION WITH
EZ1889'CHATHAM STREET IN CARY, TO FIRE STATION, THENCE 0.15 MILE EAST
EZ1889'ALONG CEDAR STREET, AT INTERSECTION WITH NORTH WALKER STREET, 46.7
EZ1889'FEET WEST OF RM 2, 16.1 FEET SOUTHWEST OF TELEGRAPH POLE WITH
EZ1889'REFERENCE TAG, 24.0 FEET SOUTH OF SOUTH RAIL OF SOUTH TRACK, 38.2
EZ1889'FEET NORTH OF FIRE HYDRANT, 88.7 FEET EAST OF SOUTHEAST CORNER OF
EZ1889'BASE OF SEMAPHORE AND 8.9 FEET NORTH OF NORTH CURB OF CEDAR STREET.
EZ1889'THE MARK IS 1.5 FT W FROM A WITNESS POST.
EZ1889'THE MARK IS 1 FT ABOVE STREET.
EZ1889

Location information is below the History section

```
EZ1889  
EZ1889_MARKER: DS = TRIANGULATION STATION DISK  
EZ1889_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT  
EZ1889_STAMPING: FETNER 1918 1980  
EZ1889_MARK LOGO: NGS  
EZ1889_PROJECTION: RECESSED 8 CENTIMETERS  
EZ1889_MAGNETIC: O = OTHER; SEE DESCRIPTION  
EZ1889_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO  
EZ1889+STABILITY: SURFACE MOTION  
EZ1889_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR  
EZ1889+SATELLITE: SATELLITE OBSERVATIONS - May 20, 2008
```

EZ1889

EZ1889 HISTORY	- Date	Condition	Report By
EZ1889 HISTORY	- 1980	MONUMENTED	NGS
EZ1889 HISTORY	- 1980	GOOD	NGS
EZ1889 HISTORY	- 1985	GOOD	USPSQD
EZ1889 HISTORY	- 1988	GOOD	USPSQD
EZ1889 HISTORY	- 1989	GOOD	USPSQD
EZ1889 HISTORY	- 20050609	GOOD	GEOCAC
EZ1889 HISTORY	- 20060919	GOOD	USPSQD
EZ1889 HISTORY	- 20080520	GOOD	NCGS

EZ1889

STATION DESCRIPTION

EZ1889

EZ1889'DESCRIBED BY NATIONAL GEODETIC SURVEY 1980
EZ1889'IN CARY.
EZ1889'0.05 MILE NORTH ALONG ACADEMY STREET FROM INTERSECTION WITH
EZ1889'CHATHAM STREET IN CARY, TO FIRE STATION, THENCE 0.15 MILE EAST
EZ1889'ALONG CEDAR STREET, AT INTERSECTION WITH NORTH WALKER STREET, 46.7
EZ1889'FEET WEST OF RM 2, 16.1 FEET SOUTHWEST OF TELEGRAPH POLE WITH
EZ1889'REFERENCE TAG, 24.0 FEET SOUTH OF SOUTH RAIL OF SOUTH TRACK, 38.2
EZ1889'FEET NORTH OF FIRE HYDRANT, 88.7 FEET EAST OF SOUTHEAST CORNER OF
EZ1889'BASE OF SEMAPHORE AND 8.9 FEET NORTH OF NORTH CURB OF CEDAR STREET.
EZ1889'THE MARK IS 1.5 FT W FROM A WITNESS POST.
EZ1889'THE MARK IS 1 FT ABOVE STREET.
EZ1889

Most Current Information is at end of Data Sheet

EZ1889'

EZ1889' REFERENCE MARK 2 RECOVERED IN GOOD CONDITION. PUBLISHED DESCRIPTION
EZ1889' ADEQUATE, WITH ADDITION THAT MARK IS 46.7 FEET EAST OF STATION,
EZ1889' RECESSED 2 CENTIMETERS.

EZ1889'

EZ1889' BENCHMARK F 189 1967 RECOVERED IN GOOD CONDITION SOUTHEAST OF THE
EZ1889' PAIGE-WALKER HOTEL, 8.7 FEET SOUTH OF A TELEPHONE POLE, AND 1.2 FEET
EZ1889' WEST OF A WITNESS POST. PUBLISHED DESCRIPTION ADEQUATE.

EZ1889'

EZ1889' BENCHMARK G 189 WAS RECOVERED BY GEOCAC IN JUNE 2002. THE MARK WAS
EZ1889' REPORTED TO BE IN GOOD CONDITION, ALTHOUGH IT WAS NOTED THAT THERE
EZ1889' WERE SCRATCHES ACROSS THE SURFACE. THE PUBLISHED DESCRIPTION IS
EZ1889' ADEQUATE.

EZ1889'

EZ1889

STATION RECOVERY (2006)

EZ1889

EZ1889' RECOVERY NOTE BY US POWER SQUADRON 2006

EZ1889' RECOVERED IN GOOD CONDITION.

EZ1889

EZ1889' STATION RECOVERY (2008)

EZ1889

EZ1889' RECOVERY NOTE BY NORTH CAROLINA GEODETIC SURVEY 2008 (WMK)

EZ1889' RECOVERED IN GOOD CONDITION WITH CHANGES.

EZ1889'

EZ1889' MARK IS 4 INCHES (10 CM) BELOW GROUND. LOCATED 1.5 FT (0.5 M)

EZ1889' SOUTHWEST OF METAL WITNESS POST. THE TELEPHONE POLE IS GONE.

*** retrieval complete.

Elapsed Time = 00:00:05

Handheld GPS Accuracy for Locating Marks



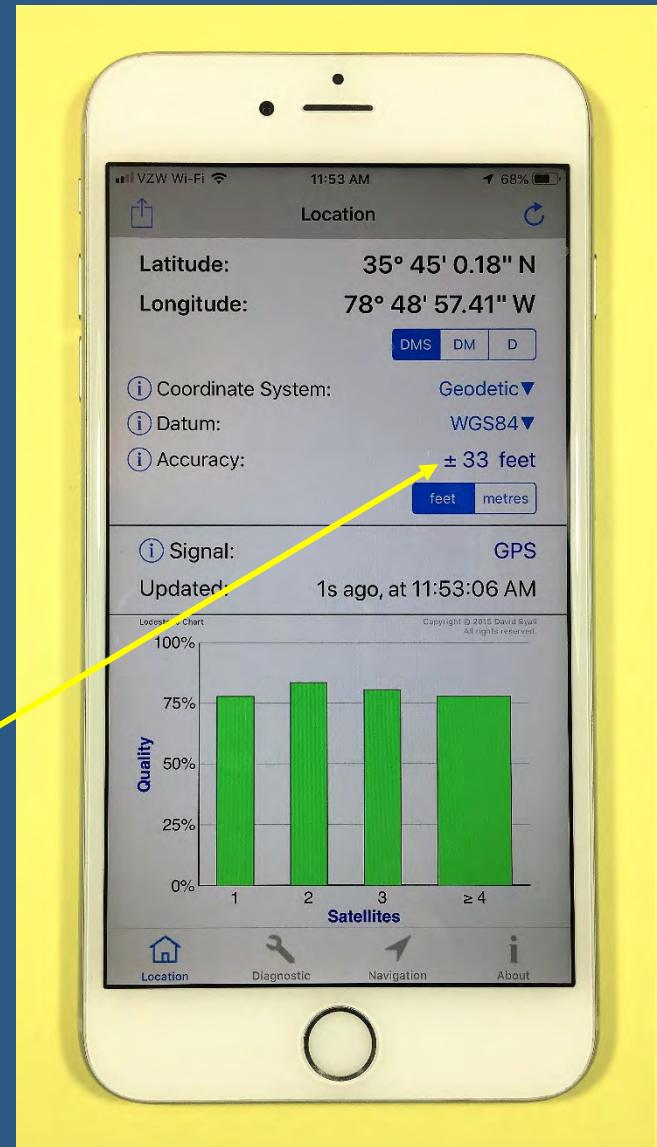
Commercial grade handheld GPS units are able to obtain coordinates with a horizontal accuracy of approximately 15 ft if the unit can receive a **Wide Area Augmentation System (WAAS)** signal; otherwise, the accuracy is approximately 30 ft similar to Smartphone GPS.

Smartphone GPS Accuracy

GPS apps in Android and iOS smartphones:

1. rely on the internet or cell towers for GPS location
2. have no direct communication with GPS satellites
3. are not WAAS enabled (have lower 30 ft accuracy)

33 ft Accuracy

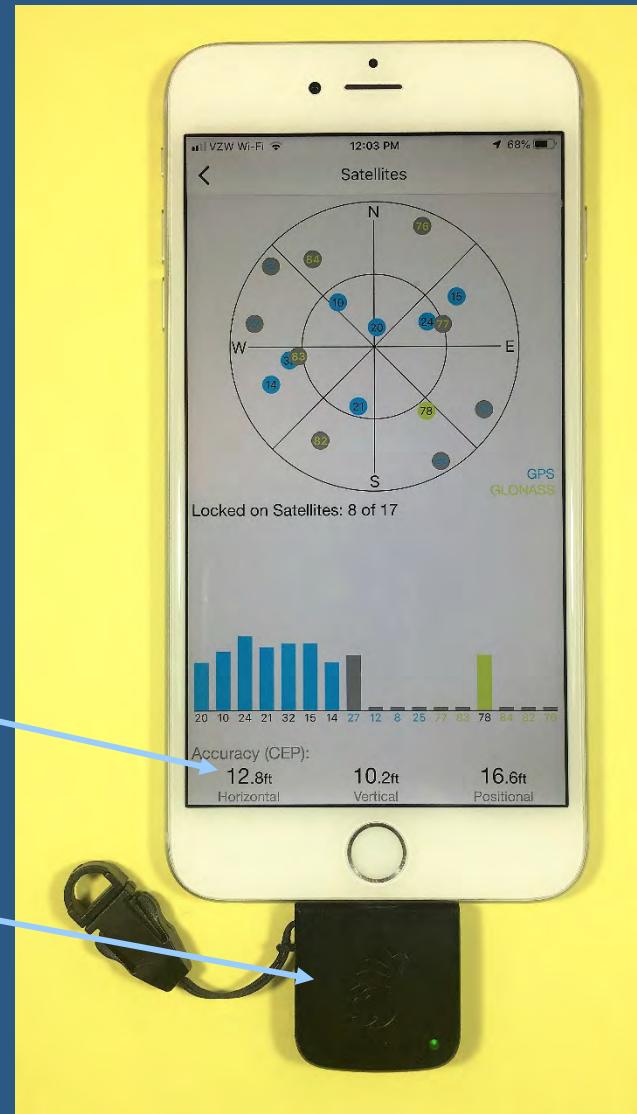


Smartphone WAAS Augmentation (for iOS)

1. Add GPS & GLONASS location support
2. High performance 66 channel WAAS enabled GPS for up to 9' accuracy
3. No internet or subscription required
4. Satellite lock without cell towers
5. Augments location accuracy for other navigation and GPS apps



12.8 ft



Bad Elf ® GPS “dongle”

Coordinates Search and Display Guidelines

- NGS Datasheets display coordinates in degrees / min / sec
Therefore: Set your handheld or smartphone GPS to match that format when searching for marks!
- Although NGS Datasheets may display coordinate seconds up to five decimal places (S.sssss sec), pictures taken with coordinates imprinted on the photos should display no more accuracy than S.s (i.e. 0.1 sec).
Therefore: Set picture-taking app (e.g. Solocator) or handheld GPS to display S.s (0.1 sec) when the picture of the mark is taken.

Photographic Requirement for Submission Report

Per the Cooperative Charting Geodetic SOP (Rev 03/2020), one of the requirements of the geodetic marker recovery program is to provide a **digital photograph** of the marker (closeup preferred), containing position coordinates as well as a date stamp.

Note 1: The coordinates and date stamp information can appear on the photo itself or within the digital properties of the photo.

Note 2: A marker location photo with date/coordinate stamp must be provided if the mark is reported “not found” or “destroyed”.

One method for showing the Mark, Coordinates and, Date in/on the photo:

Coordinates

Date

Mark



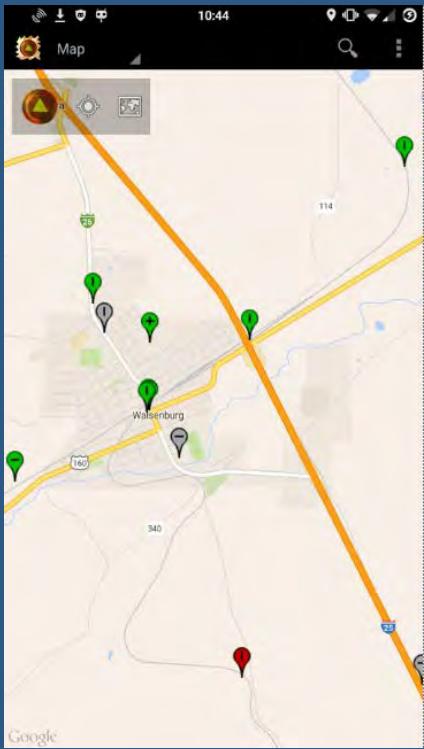
There are useful Smart Phone “Apps” that can help with finding and picture taking of Marks:

- Apps for locating marks and viewing the datasheets in the field
- Apps for taking pictures of marks that show the Mark, GPS coordinates and date of recovery in/on the photo

Disclaimer: Apps shown in this presentation should not be considered an endorsement by the creator of this presentation or the sponsoring organization.



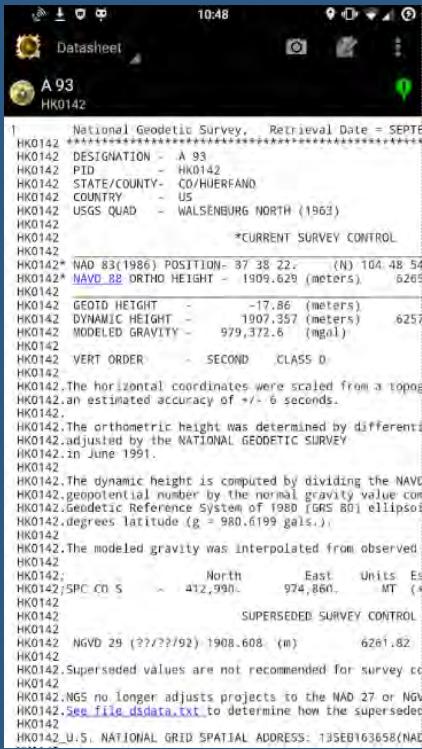
“BenchMap” – App for Locating and Navigating to Marks (Android only)



Standard
View



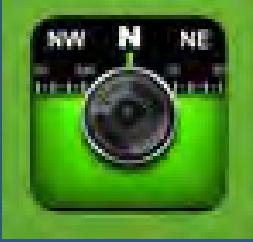
Topo or
Satellite
View



Datasheet
View



Station
Library



Solocator™ – App for Taking Pictures

Take a picture with this smart phone app, and the required recovery information shows in the photo:

- Mark
- Coordinates
- Date

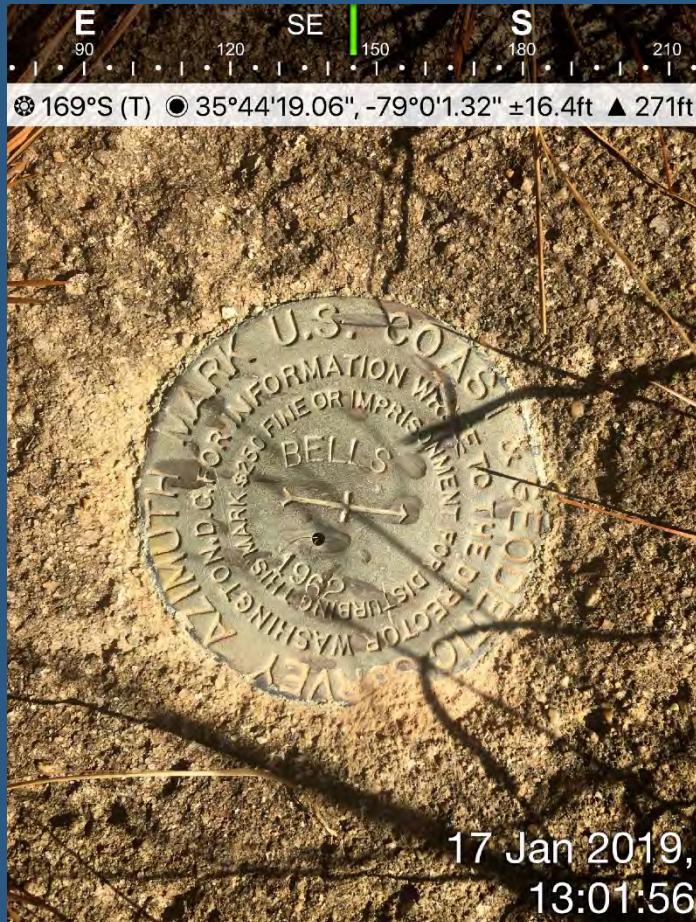
Also shown are:

- Position Accuracy
- Elevation
- Compass Direction
- Photog. Initials



Solocator™ Simultaneously Takes Two Pictures with each click of the shutter!

One With Data Showing



One Without Data Showing

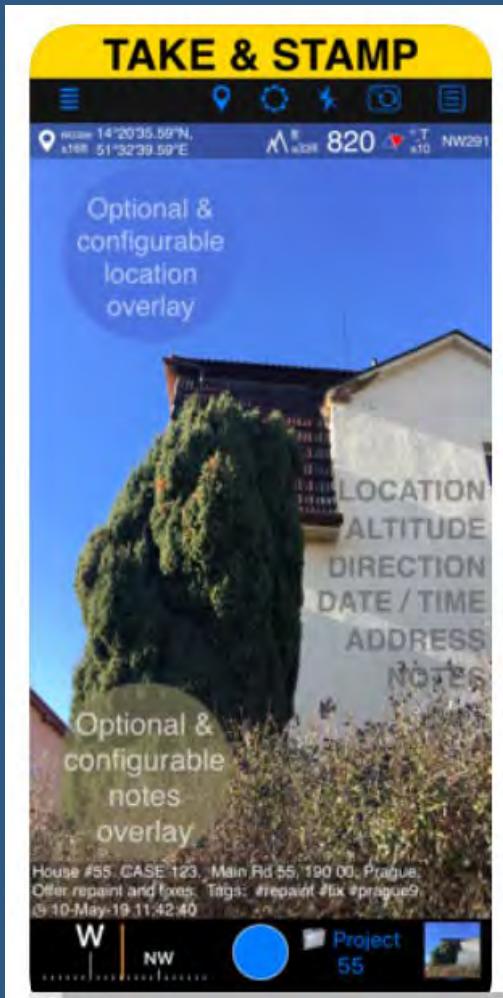


For USPS Reviewer

Optional for NGS

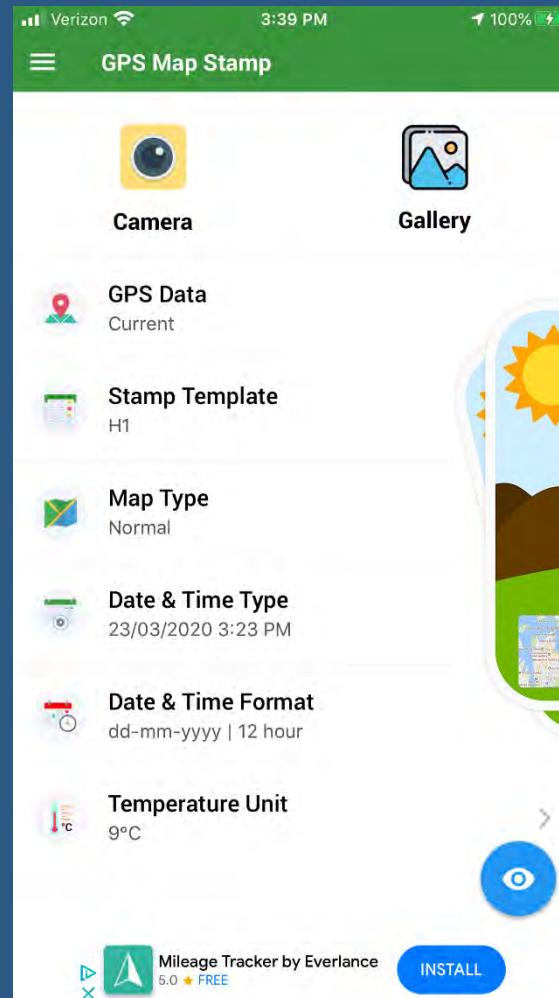
Other Phone Apps with Photo Date/GPS Stamping

GPS Camera 55.Field Survey



iOS

GPS Stamp (GPS Map Stamp)



iOS &
Android

Picture Option: Required Info in photo “Properties”

- Many **Stand-Alone Cameras** and **Smart Phone Cameras** have date and location data recorded in the photo’s “Properties”
- This also satisfies the Geodetic SOP photo requirement



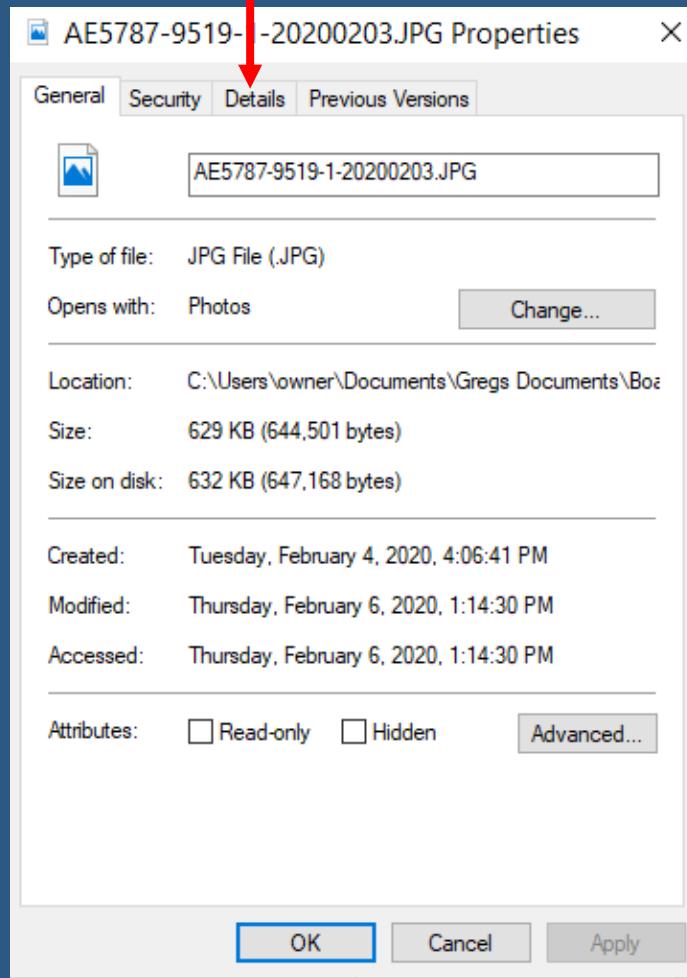
After download of photo to computer, right click on photo thumbnail to bring up a drop-down list of actions – then select “**Properties**”!

Camera filename: **IMG_1610.JPG**

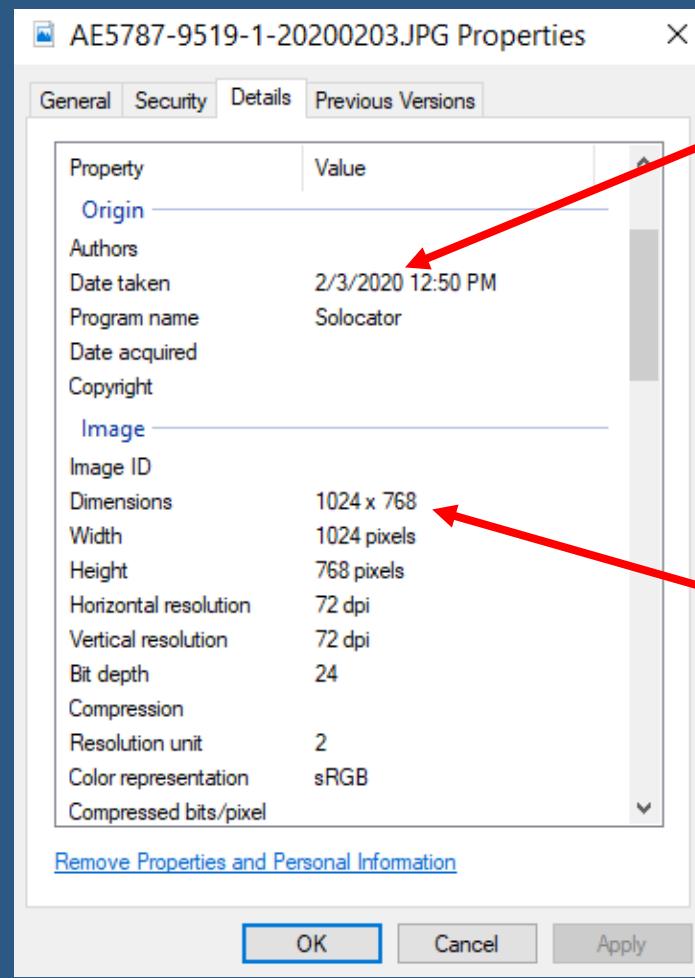
Renamed for NGS: **AE5787-9519-1-20200203**

I-Phone Example of Photo Properties Information

After Selecting Properties,
Select Details



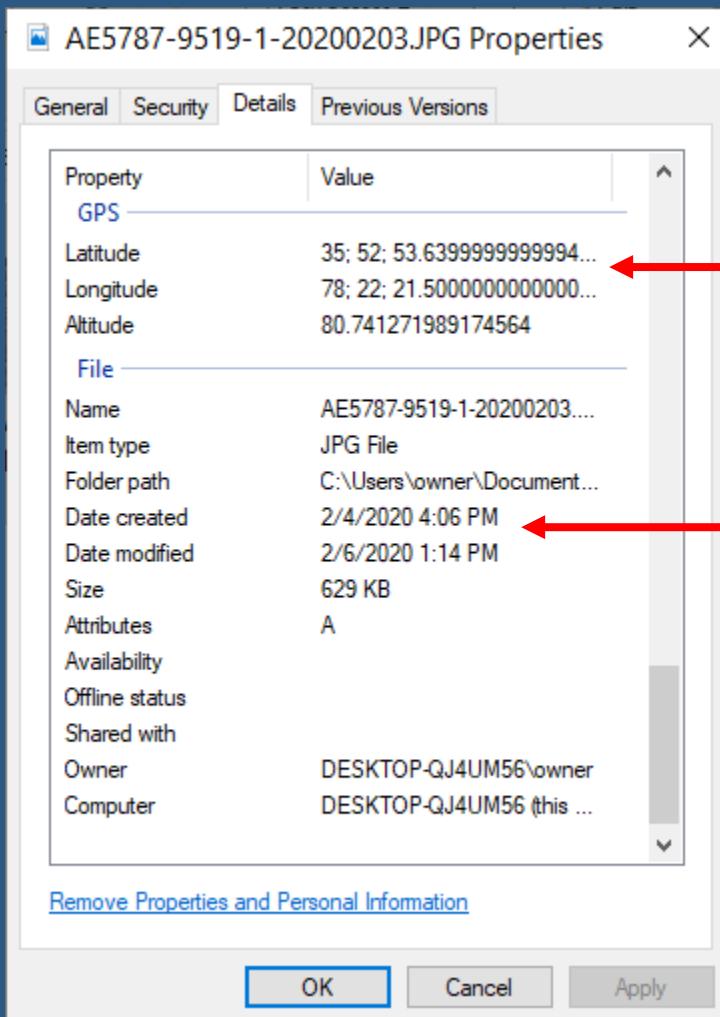
This section of Details shows Date Taken
(Date of Recovery) and Picture Size



Date
of
Rec

Pic
Size

I-Phone Ex. of Photo Properties Information – Cont.



Scroll further down in Details

Shows Coordinates Location where photo was taken

Note: These dates are “not the date photo was taken” (not the Date of Recovery) – for this photo, the 1st date here is when the photo was renamed to NGS standards, and 2nd date is when the photo was modified (resized for NGS standards).

Taking Pictures of a Mark Recovered – EX. 1

- *Only one picture (a close-up if the mark was found) is required for a recovery report*
- This picture must show the coordinates and date on the photo or in photo “Properties”
- If a mark is reported not found, the picture can be taken horizontally and/or vertically and should show coordinates, date and direction

Required for USPS
Reviewer Verification



0 - Close-Up
With Data Showing or Photo
Properties Option

Taking Pictures of Mark Recovered – EX. 1 Cont.

Additional Pictures are Optional “for NGS” in the Recovery Report



1 - Close-Up



2 - Eye Level



3 - Horizontal

It is preferable that these pictures do not show data on the photo! If Solocator™ was IS, select the duplicate photos without data showing for NGS.

Taking Pictures of a Mark Recovered – EX. 2

Required for USPS
Any Size < 4 MB



0 - Close-Up

Optional Photos for NGS
1024 X 768 Pixels Max



1 - Close-Up



2 - Eye Level
(from above)



3 - Horizontal
(From Side)

Note: the 1-Close-Up photo can be used for USPS if the required information is in the photo's “Properties”

What “Not” to Show in Recovery Pictures

Close-up, Eye Level, and Horizontal pictures taken for marker recovery reports should not have recovery equipment, people, feet, or hands etc. showing in the pictures – just the mark and its natural surroundings.



Recommended Equipment for Marker Recovery

Highly Recommended

- NGS Datasheet – or Smartphone Datasheet App
- Handheld GPS - (WAAS best) and/or GPS Smartphone App
- Tape Measure - 100 ft (pref.) - for locating mark from reference points in data sheet
- Compass - handheld or Smartphone compass for locating mark from direction information in datasheet
- Probe or Metal Detector (pref.) – for locating buried marks
- Digging Tool – spade or small shovel (pref.)
- Water / Towels – to clean mark for picture taking
- Camera – or optional Smartphone Camera App for combined picture of mark, coordinates, and date stamp

Recommended Equipment – Cont.

Recommended Nice to Have

- **Off Road Vehicle** – 4WD/AWD vehicle (nice to have) for parking along roadsides and off-road locations)
- **Gloves** - to protect hands from thorns, ants, and poison ivy etc.
- **Kneeling Pad** – easy on knees and keeps them dry
- **Machete** - clear weeds around mark
- **Marker Recovery Sign** – on vehicle to alert public of who you are and what you are doing
- **Reflective Vest** – for safety in traffic areas and public awareness
- **First Aid Kit** – just in case!

Where is that Mark? – if it is not showing on the surface, it should be under it somewhere!



Useful tools for locating marks



Compass



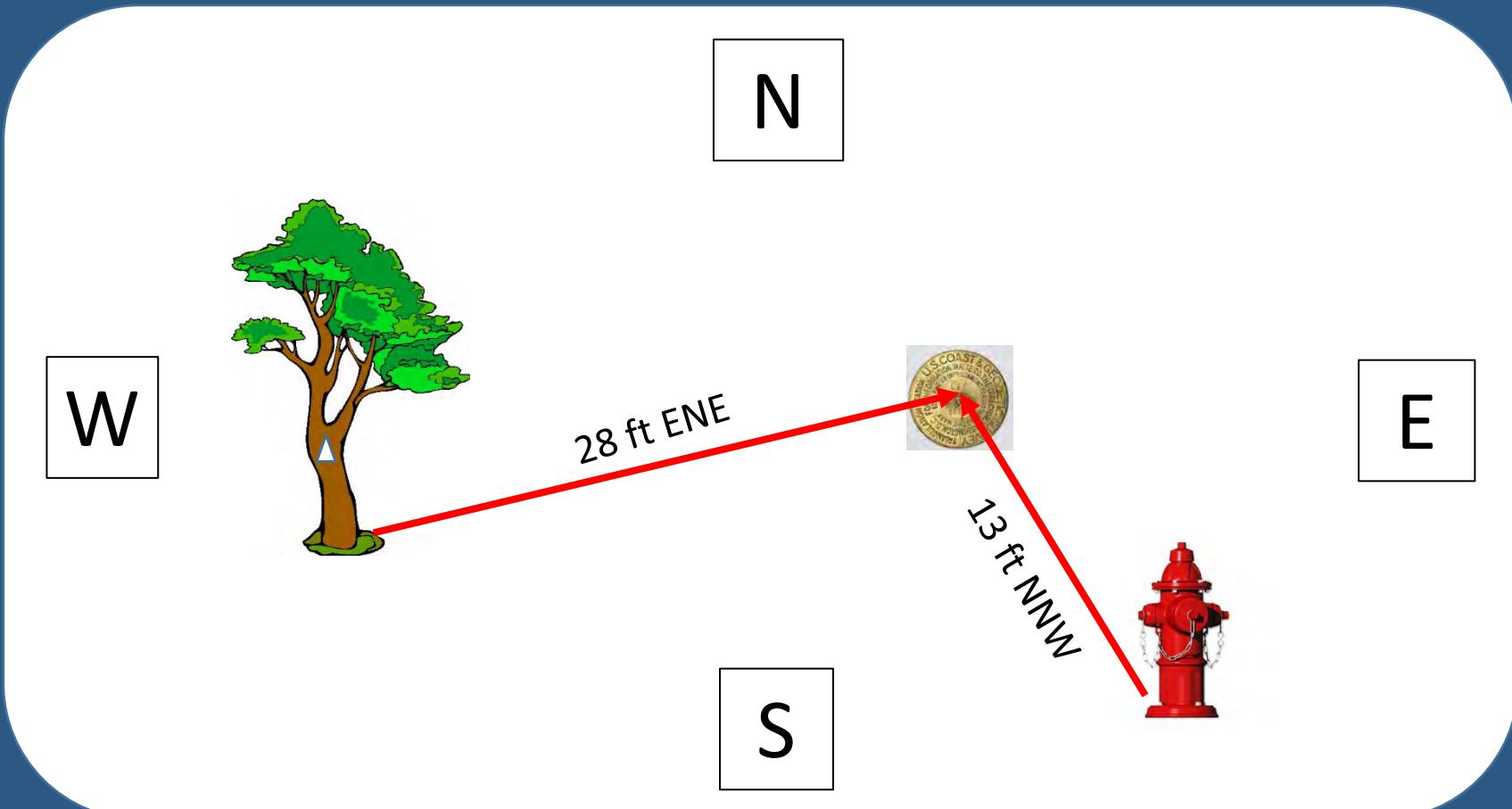
Tape Measure

Ref. 7

Example of Mark recovery with Tape Measure and Compass

mark location description in Datasheet:

....mark is located 28' ENE of a tree with metal witness tag, and 13' NNW of a fire hydrant



Useful tool if mark is not visible in ground



Metal Detector

Ref. 7

*Sign and/or Safety Vest to inform public
of who you are and what you are doing!*



Magnetic Car Sign



Safety Vest

Some things to look out for and avoid!



Poison Ivy

Poison
Sumac



Leaves of Three,
Leave it Be!!



Poison Oak

Some things to look out for and avoid!



Fire Ants



Bees and Wasps



Snakes

Ref. 7

Visual Aids – to Assist in Locating Marks

Some Marks have “Visual Aids” nearby to assist in locating them and to warn construction workers of their presence – these aids are referenced in the NGS Datasheets

- **Witness Posts** – near the mark
- **Witness Tags** – reference location
- **Vinyl Cloth (X or T)** - over mark
- **Painted Arrows** – point to mark loc.

“Witness Posts”

- Several Types
- Placed near a mark (often 1-2 ft or more)
- Lets public know a survey marker is nearby
- Datasheets give distance and direction to the Mark



Examples of “Sign” Witness Posts near Marks



FY0211 (WAKE=Q 9) - Youngsville, NC (GDS)



QW0066 (A 27) – Nibbe, MT (GDS)

Examples of “Sign” Witness Posts near Marks



FY1753 (F 201) – Lewis, NC (GDS)



DG6926 (27 MEA) – Louisburg, NC (GDS)

Examples of “Sign” Witness Posts near Marks



ET0763 (T 480) – La Paz County, AZ (WAJ)



RV0687 (X 537) – Broadview, MT (GDS)

Examples of Orange “Carsonite” Witness Posts near Marks



AE2728 (FEREBEEVILLE AZ) –
Switzerland, SC (GDS)



EX0274 (N 195) – Ocracoke, NC (GDS)

Carsonite Witness Posts near Marks



CK0605 (Y 72) – Hardeeville, SC (GDS)



DL8478 (BOST) - Jordan Lake, NC (GDS)

Carsonite Witness Posts near Marks



Witness Post
cemented
into rock!

ES0746 – T 496, Oxbow Estates, AZ (JKS)

“Wood Stake” Witness Posts near Marks



Near Tenth Legion, VA (GDS)



AI785 (BACCA) – Lewis, NC (GDS)

“Witness Tags”

- Placed on telephone poles, trees, fence posts etc.
- Location of Tag indicates **direction** to mark!
- Datasheet provides **distance** and **direction** to mark



Witness Tag
on Telephone
Poles





AI3787 (TOP) – Lewis, NC (GDS)

“Witness Tags”



Face
of Tag points
direction to Mark

“Witness Tags”

Direction
to Mark



“Witness Tags”



- One Witness Tag indicates direction to Mark
- Two Witness Tags can approximate the Mark's Location
- NGS Data Sheets - Reported distances from Tags to Mark can pinpoint the Mark's location

“Witness Tags”



Witness Tags on Fence Posts

“Witness Tags”



Witness Tags on Trees

“Witness Tags”



Witness Tag “*eaten by a tree*”



**“Vinyl Cloth” -
showing location of
Mark “T-Type”**

**DF5588 (WAY) - at end of Pine
Island Airport runway, NC (GDS)**

Placed over the Mark





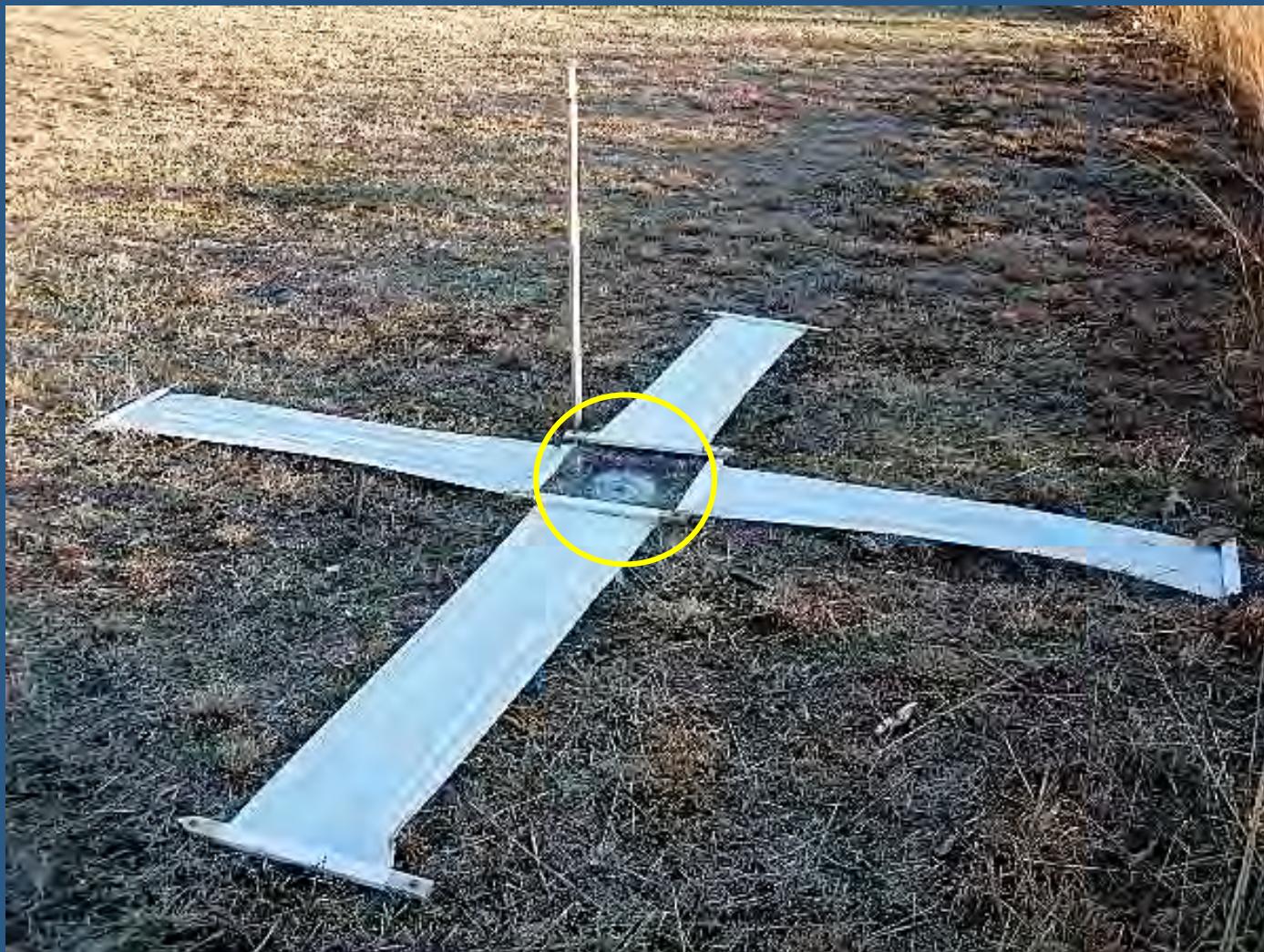
**“Vinyl Cloth” -
showing location of
Mark “T-Type”**

FW0050 (Y 167) - Kitty Hawk, NC (GDS)

Placed over the Mark



“Vinyl Cloth” - showing location of Mark “X-Type”



Placed around the Mark

Ref. 7

Helpful “Pointers” from NGS and Other Agencies



Painted arrows on pavement or concrete
point toward Mark's Location



Painted arrows on
pavement or concrete point
toward Mark's Location

Helpful “Pointers” from NGS and Other Agencies



DE6462 (HOOVER) – Duck, NC (GDS)



Helpful Data Sheet Geographic Pointers

NGS Data sheets providing direction and distance from a geographic object without a Tag can still be very helpful for locating a mark!

AI3786 (LEWIS) – Data sheet says “(14 FEET) SOUTHEAST OF A TWENETY-FOUR INCH TWIN CATALPA TREE” (GDS)

Did I find the right disk?

If the **Designation** name of the mark you are looking for is “**Acorn**”, you have ...



- found the correct disk if it is just stamped “**Acorn**”
- not found the correct disk if stamped “**Acorn Reset**”
- not found the correct disk if stamped “**Acorn RM 1**”
 - *this is a “Reference Mark” to Acorn instead*
- not found the correct disk if stamped “**Acorn AZ**”
 - *this is an “Azimuth” mark to Acorn instead*
- not found the correct disk if stamped “**Acorn 2**”
 - *this is a reset – the original disk is probably gone*

Disks that might appear to be the same but are Different in both PID and Designation

EZ0695



STATE COLLEGE

EZ0694



STATE COLLEGE
NO 4

EZ0697



STATE COLLEGE
NO 6