

**Minimum Technical Standards Report  
Control Survey &  
Specific Purpose Survey for LiDAR**



**PREPARED FOR:  
UNITED STATES GEOLOGICAL SURVEY  
& FEDERAL EMERGENCY MANAGEMENT AGENCY**



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2011 FEMA VI-DARDANELL RESERVOIR WATERSHED LIDAR  
DATE: 29 FEBUARY 2012

**Technical Standards Report  
Control Survey & Specific Purpose Survey for LiDAR**

2011 FEMA VI-Dardanell Reservoir Watershed

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## **Introduction & Specification**

The purpose of this project was to provide ground truth data which will be used to validate LiDAR data of the Dardanelle Reservoir Watershed LiDAR project located in North West Arkansas. The ground surveys were conducted utilizing the CORS network to collect checkpoints of 10% of the predominant vegetation within the AOI. The vertical accuracy requirements meet or exceed the required RMSEz of 12.5cm and the vertical accuracy of 24.5cm at the 95% confidence level as specified by the SOW using NSSDA accuracy standards.

## **Ground Truth Survey**

Ground Truth data was collected of the five major land cover classes representing 10% of the predominate vegetation dispersed within the area of interest. 20 points were collected in each of the five predominate vegetation classes, bare earth, tall weeds/ crops, brush lands, and forested/fully grown, all were collected with a Total Station. A pair of points was surveyed using the CORS network once completed the total station is used to collect the all vegetation ground classes. A Leica 1103 TCR+ total station was used to collect all the shots collected in all the classes surveyed, due to the limited GPS signal when working in and around tree canopy.

## **Datum & Coordinate Systems**

The survey data and coordinate values associated with this project are referenced to the Universal Transverse Mercator Coordinate System, Zone 15 units of Meters, North Americas Datum of 1983, in units of Meters. Geoid 09 was used to determine the NAVD88 heights.

## **Survey Area**

The project area is approximately 261 square miles and the AOI lies in a portion of Logan, Franklin and Johnson Counties in Arkansas.

## **Control Survey**

The GPS survey was tied into the CORS Network located in Arkansas, Missouri and Oklahoma. The CORS network is a network of continuously operating GPS reference stations. This allows post processing of the GPS points. Ten (10) CORS stations were used (ARBT, ARFY, ARHP, ARHR, ARLR, ARM3, CTA1, MOBR, MOCS, OKHV)

As a quality control measure differential levels using a Leica DNA 10 level were run between the pair of GPS points used to collect field data, also random points were collected to confirm that the project will meet the 5cm local network accuracy at the 95% confidence level.

Survey field work was performed on 2-06-12 thru 2-11-12 by Maptech Inc. field crews using Leica 1203 Global Positioning System with Leica ATX1230 and Leica ATX1230GG antennas.

## **Data Analysis**

Vertical accuracy requirements follow the NSSDA specifications based on RMSE of 12.5 cm in open terrain land cover category. This assessment verifies the vertical accuracy of the LiDAR derived DEM shall be calculated and reported in three ways. 1.FVA 2.SVA 3.CVA. Additionally the FVA points were assessed against the TIN derived from the LAS LiDAR point cloud controlled and calibrated swath data to ensure they met the required accuracy of 12.5cm RMSEz and 24.5cm at the 95% confidence interval. The results can be found within Appendix B.

## **Appendix A**

# The NGS Data Sheet

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

```

DATABASE = NGSIDB , PROGRAM = datasheet95, VERSION = 7.87.5
1      National Geodetic Survey,  Retrieval Date = FEBRUARY 10, 2012
DH8992 *****
DH8992 CORS          - This is a GPS Continuously Operating Reference Station.
DH8992 DESIGNATION - BATESVILLE CORS ARP
DH8992 CORS_ID      - ARBT
DH8992 PID          - DH8992
DH8992 STATE/COUNTY- AR/INDEPENDENCE
DH8992 USGS QUAD    - JAMESTOWN (1981)
DH8992
DH8992                      *CURRENT SURVEY CONTROL
DH8992
DH8992 * NAD 83(CORS)- 35 42 35.52897(N)    091 37 42.73873(W)    ADJUSTED
DH8992 * NAVD 88      -                      ** (meters)          ** (feet)
DH8992
DH8992 EPOCH DATE   -      2002.00
DH8992 X            -    -147,353.295 (meters)                      COMP
DH8992 Y            -    -5,182,836.019 (meters)                    COMP
DH8992 Z            -      3,702,154.503 (meters)                    COMP
DH8992 ELLIP HEIGHT-      93.161 (meters)                          (03/??/06) ADJUSTED
DH8992 GEOID HEIGHT-     -27.48 (meters)                            GEOID09
DH8992 HORZ ORDER  - SPECIAL (CORS)
DH8992 ELLP ORDER  - SPECIAL (CORS)
DH8992
DH8992. ITRF positions are available for this station.
DH8992
DH8992. The coordinates were established by GPS observations
DH8992. and adjusted by the National Geodetic Survey in March 2006.
DH8992
DH8992. The datum tag of NAD 83(CORS) is equivalent to NAD 83(CORS96).
DH8992
DH8992. The coordinates are valid at the epoch date displayed above
DH8992. which is a decimal equivalence of Year/Month/Day.
DH8992
DH8992. The PID for the CORS L1 Phase Center is DH8993.
DH8992
DH8992. The XYZ, and position/ellipsoidal ht. are equivalent.
DH8992
DH8992. The ellipsoidal height was determined by GPS observations
DH8992. and is referenced to NAD 83.
DH8992
DH8992. The geoid height was determined by GEOID09.
DH8992
DH8992;
DH8992;          North          East          Units Scale Factor Converg.
DH8992; SPC AR N  -    152,778.808    433,612.430    MT  0.99993833  +0 12 58.2
DH8992; SPC AR N  -    501,241.81    1,422,610.11    sFT 0.99993833  +0 12 58.2
DH8992
DH8992!
DH8992! SPC AR N  -    Elev Factor  x  Scale Factor =  Combined Factor
DH8992! SPC AR N  -    0.99998538  x  0.99993833 =  0.99992371
DH8992
DH8992                      SUPERSEDED SURVEY CONTROL

```

DH8992  
DH8992.No superseded survey control is available for this station.  
DH8992  
DH8992\_U.S. NATIONAL GRID SPATIAL ADDRESS: 15SXV2406152636(NAD 83)  
DH8992  
DH8992\_MARKER: STATION IS THE ANTENNA REFERENCE POINT OF THE GPS ANTENNA  
DH8992  
DH8992 STATION DESCRIPTION  
DH8992  
DH8992'DESCRIBED BY NATIONAL GEODETIC SURVEY 2006  
DH8992'STATION IS A GPS CORS. LATEST INFORMATION INCLUDING POSITIONS AND  
DH8992'VELOCITIES ARE AVAILABLE IN THE COORDINATE AND LOG FILES ACCESSIBLE  
DH8992'BY ANONYMOUS FTP OR THE WORLDWIDE WEB.  
DH8992' ftp://cors.ngs.noaa.gov/cors/README.txt  
DH8992' ftp://cors.ngs.noaa.gov/cors/coord/coord\_08  
DH8992' ftp://cors.ngs.noaa.gov/cors/station\_log  
DH8992' http://geodesy.noaa.gov/CORS

\*\*\* retrieval complete.  
Elapsed Time = 00:00:02



# The NGS Data Sheet

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

```

DATABASE = NGSIDB , PROGRAM = datasheet95, VERSION = 7.87.5
1      National Geodetic Survey,  Retrieval Date = FEBRUARY 10, 2012
DH7119 *****
DH7119 CORS          - This is a GPS Continuously Operating Reference Station.
DH7119 DESIGNATION - FAYETTEVILLE CORS ARP
DH7119 CORS_ID      - ARFY
DH7119 PID          - DH7119
DH7119 STATE/COUNTY- AR/WASHINGTON
DH7119 USGS QUAD    - FAYETTEVILLE (1995)
DH7119
DH7119                      *CURRENT SURVEY CONTROL
DH7119
DH7119 _____
DH7119* NAD 83(CORS)- 36 06 56.85173(N)    094 10 48.13582(W)    ADJUSTED
DH7119* NAVD 88      -                      *(meters)              *(feet)
DH7119 _____
DH7119 EPOCH DATE   -      2002.00
DH7119 X            -      -376,022.787 (meters)                COMP
DH7119 Y            -      -5,144,997.006 (meters)                COMP
DH7119 Z            -      3,738,785.247 (meters)                COMP
DH7119 ELLIP HEIGHT-      350.705 (meters)                    (11/??/05) ADJUSTED
DH7119 GEOID HEIGHT-      -28.05 (meters)                      GEOID09
DH7119 HORZ ORDER   - SPECIAL (CORS)
DH7119 ELLP ORDER   - SPECIAL (CORS)
DH7119
DH7119. ITRF positions are available for this station.
DH7119
DH7119.The coordinates were established by GPS observations
DH7119.and adjusted by the National Geodetic Survey in November 2005.
DH7119
DH7119.The datum tag of NAD 83(CORS) is equivalent to NAD 83(CORS96).
DH7119
DH7119.The coordinates are valid at the epoch date displayed above
DH7119.which is a decimal equivalence of Year/Month/Day.
DH7119
DH7119.The PID for the CORS L1 Phase Center is DH7120.
DH7119
DH7119.The XYZ, and position/ellipsoidal ht. are equivalent.
DH7119
DH7119.The ellipsoidal height was determined by GPS observations
DH7119.and is referenced to NAD 83.
DH7119
DH7119.The geoid height was determined by GEOID09.
DH7119
DH7119;
DH7119;          North          East          Units Scale Factor Converg.
DH7119;SPC AR N  - 199,926.166  203,747.686  MT  0.99997888  -1 16 06.8
DH7119;SPC AR N  - 655,924.43   668,462.20   sFT 0.99997888  -1 16 06.8
DH7119
DH7119!          - Elev Factor  x  Scale Factor =  Combined Factor
DH7119!SPC AR N  - 0.99994496  x  0.99997888 =  0.99992384
DH7119
DH7119                      SUPERSEDED SURVEY CONTROL

```

DH7119

DH7119.No superseded survey control is available for this station.

DH7119

DH7119\_U.S. NATIONAL GRID SPATIAL ADDRESS: 15SUV9379997436 (NAD 83)

DH7119

DH7119\_MARKER: STATION IS THE ANTENNA REFERENCE POINT OF THE GPS ANTENNA

DH7119

DH7119

STATION DESCRIPTION

DH7119

DH7119'DESCRIBED BY NATIONAL GEODETIC SURVEY 2005

DH7119'STATION IS A GPS CORS. LATEST INFORMATION INCLUDING POSITIONS AND

DH7119'VELOCITIES ARE AVAILABLE IN THE COORDINATE AND LOG FILES ACCESSIBLE

DH7119'BY ANONYMOUS FTP OR THE WORLDWIDE WEB.

DH7119' <ftp://cors.ngs.noaa.gov/cors/README.txt>

DH7119' [ftp://cors.ngs.noaa.gov/cors/coord/coord\\_08](ftp://cors.ngs.noaa.gov/cors/coord/coord_08)

DH7119' [ftp://cors.ngs.noaa.gov/cors/station\\_log](ftp://cors.ngs.noaa.gov/cors/station_log)

DH7119' <http://geodesy.noaa.gov/CORS>

\*\*\* retrieval complete.

Elapsed Time = 00:00:01



DH7103  
DH7103.No superseded survey control is available for this station.  
DH7103  
DH7103\_U.S. NATIONAL GRID SPATIAL ADDRESS: 15SVT4434328617(NAD 83)  
DH7103  
DH7103\_MARKER: STATION IS THE ANTENNA REFERENCE POINT OF THE GPS ANTENNA  
DH7103  
DH7103 STATION DESCRIPTION  
DH7103  
DH7103'DESCRIBED BY NATIONAL GEODETIC SURVEY 2005  
DH7103'STATION IS A GPS CORS. LATEST INFORMATION INCLUDING POSITIONS AND  
DH7103'VELOCITIES ARE AVAILABLE IN THE COORDINATE AND LOG FILES ACCESSIBLE  
DH7103'BY ANONYMOUS FTP OR THE WORLDWIDE WEB.  
DH7103' ftp://cors.ngs.noaa.gov/cors/README.txt  
DH7103' ftp://cors.ngs.noaa.gov/cors/coord/coord\_08  
DH7103' ftp://cors.ngs.noaa.gov/cors/station\_log  
DH7103' http://geodesy.noaa.gov/CORS

\*\*\* retrieval complete.  
Elapsed Time = 00:00:01

# The NGS Data Sheet

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

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DATABASE = NGSIDB , PROGRAM = datasheet95, VERSION = 7.87.6
1      National Geodetic Survey,  Retrieval Date = FEBRUARY 29, 2012
DH7105 *****
DH7105  CORS           -  This is a GPS Continuously Operating Reference Station.
DH7105  DESIGNATION   -  HARRISON CORS ARP
DH7105  CORS_ID       -  ARHR
DH7105  PID           -  DH7105
DH7105  STATE/COUNTY-  AR/BOONE
DH7105  USGS QUAD     -  HARRISON (1975)
DH7105
DH7105                      *CURRENT SURVEY CONTROL
DH7105
DH7105* NAD 83(CORS)-  36 11 03.23689(N)    093 01 48.72621(W)    ADJUSTED
DH7105* NAVD 88      -                      *(meters)              *(feet)
DH7105
DH7105 EPOCH DATE    -      2002.00
DH7105 X              -      -272,464.454 (meters)                COMP
DH7105 Y              -      -5,147,018.949 (meters)              COMP
DH7105 Z              -      3,744,907.602 (meters)                COMP
DH7105 ELLIP HEIGHT-      333.496 (meters)                      (11/??/05) ADJUSTED
DH7105 GEOID HEIGHT-      -28.26 (meters)                        GEOID09
DH7105 HORZ ORDER    -  SPECIAL (CORS)
DH7105 ELLP ORDER    -  SPECIAL (CORS)
DH7105
DH7105. ITRF positions are available for this station.
DH7105
DH7105.The coordinates were established by GPS observations
DH7105.and adjusted by the National Geodetic Survey in November 2005.
DH7105
DH7105.The datum tag of NAD 83(CORS) is equivalent to NAD 83(CORS96).
DH7105
DH7105.The coordinates are valid at the epoch date displayed above
DH7105.which is a decimal equivalence of Year/Month/Day.
DH7105
DH7105.The PID for the CORS L1 Phase Center is DI3469.
DH7105
DH7105.The XYZ, and position/ellipsoidal ht. are equivalent.
DH7105
DH7105.The ellipsoidal height was determined by GPS observations
DH7105.and is referenced to NAD 83.
DH7105
DH7105.The geoid height was determined by GEOID09.
DH7105
DH7105;
DH7105;          North          East          Units Scale Factor Converg.
DH7105;SPC AR N  -  205,832.436   307,332.297   MT  0.99999066  -0 35 58.1
DH7105;SPC AR N  -  675,301.92   1,008,306.04  sFT 0.99999066  -0 35 58.1
DH7105
DH7105!          -  Elev Factor  x  Scale Factor =  Combined Factor
DH7105!SPC AR N  -  0.99994766  x  0.99999066 =  0.99993832
DH7105
DH7105                      SUPERSEDED SURVEY CONTROL

```

DH7105  
DH7105.No superseded survey control is available for this station.  
DH7105  
DH7105\_U.S. NATIONAL GRID SPATIAL ADDRESS: 15SVA9728404383(NAD 83)  
DH7105  
DH7105\_MARKER: STATION IS THE ANTENNA REFERENCE POINT OF THE GPS ANTENNA  
DH7105  
DH7105 STATION DESCRIPTION  
DH7105  
DH7105'DESCRIBED BY NATIONAL GEODETIC SURVEY 2005  
DH7105'STATION IS A GPS CORS. LATEST INFORMATION INCLUDING POSITIONS AND  
DH7105'VELOCITIES ARE AVAILABLE IN THE COORDINATE AND LOG FILES ACCESSIBLE  
DH7105'BY ANONYMOUS FTP OR THE WORLDWIDE WEB.  
DH7105' ftp://cors.ngs.noaa.gov/cors/README.txt  
DH7105' ftp://cors.ngs.noaa.gov/cors/coord/coord\_08  
DH7105' ftp://cors.ngs.noaa.gov/cors/station\_log  
DH7105' http://geodesy.noaa.gov/CORS  
  
\*\*\* retrieval complete.  
Elapsed Time = 00:00:01

# The NGS Data Sheet

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

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DATABASE = NGSIDB , PROGRAM = datasheet95, VERSION = 7.87.5
1      National Geodetic Survey,  Retrieval Date = FEBRUARY 10, 2012
DH7107 *****
DH7107 CORS          - This is a GPS Continuously Operating Reference Station.
DH7107 DESIGNATION - LITTLE ROCK CORS ARP
DH7107 CORS_ID      - ARLR
DH7107 PID          - DH7107
DH7107 STATE/COUNTY- AR/PULASKI
DH7107 USGS QUAD    - ALEXANDER (1986)
DH7107
DH7107                      *CURRENT SURVEY CONTROL
DH7107
DH7107* NAD 83(CORS)- 34 40 21.44379(N)    092 22 57.18174(W)    ADJUSTED
DH7107* NAVD 88      -                      ** (meters)          ** (feet)
DH7107
DH7107 EPOCH DATE   -          2002.00
DH7107 X            -      -218,300.990 (meters)                COMP
DH7107 Y            -      -5,246,694.799 (meters)             COMP
DH7107 Z            -      3,608,099.611 (meters)             COMP
DH7107 ELLIP HEIGHT-          74.408 (meters)                (11/??/05) ADJUSTED
DH7107 GEOID HEIGHT-         -26.48 (meters)                GEOID09
DH7107 HORZ ORDER  - SPECIAL (CORS)
DH7107 ELLP ORDER  - SPECIAL (CORS)
DH7107
DH7107. ITRF positions are available for this station.
DH7107
DH7107. The coordinates were established by GPS observations
DH7107. and adjusted by the National Geodetic Survey in November 2005.
DH7107
DH7107. The datum tag of NAD 83(CORS) is equivalent to NAD 83(CORS96).
DH7107
DH7107. The coordinates are valid at the epoch date displayed above
DH7107. which is a decimal equivalence of Year/Month/Day.
DH7107
DH7107. The PID for the CORS L1 Phase Center is DH7108.
DH7107
DH7107. The XYZ, and position/ellipsoidal ht. are equivalent.
DH7107
DH7107. The ellipsoidal height was determined by GPS observations
DH7107. and is referenced to NAD 83.
DH7107
DH7107. The geoid height was determined by GEOID09.
DH7107
DH7107;
DH7107; SPC AR S      -      North      East      Units Scale Factor Converg.
DH7107; SPC AR S      -      622,556.754  364,939.918  MT  0.99998038  -0 12 50.8
DH7107; SPC AR S      -      2,042,504.95  1,197,307.05  sFT 0.99998038  -0 12 50.8
DH7107
DH7107!
DH7107! SPC AR S      -      Elev Factor x  Scale Factor =  Combined Factor
DH7107! SPC AR S      -      0.99998832 x  0.99998038 =  0.99996870
DH7107
DH7107                      SUPERSEDED SURVEY CONTROL

```

DH7107  
DH7107.No superseded survey control is available for this station.  
DH7107  
DH7107\_U.S. NATIONAL GRID SPATIAL ADDRESS: 15SWU5656736912(NAD 83)  
DH7107  
DH7107\_MARKER: STATION IS THE ANTENNA REFERENCE POINT OF THE GPS ANTENNA  
DH7107  
DH7107 STATION DESCRIPTION  
DH7107  
DH7107'DESCRIBED BY NATIONAL GEODETIC SURVEY 2005  
DH7107'STATION IS A GPS CORS. LATEST INFORMATION INCLUDING POSITIONS AND  
DH7107'VELOCITIES ARE AVAILABLE IN THE COORDINATE AND LOG FILES ACCESSIBLE  
DH7107'BY ANONYMOUS FTP OR THE WORLDWIDE WEB.  
DH7107' ftp://cors.ngs.noaa.gov/cors/README.txt  
DH7107' ftp://cors.ngs.noaa.gov/cors/coord/coord\_08  
DH7107' ftp://cors.ngs.noaa.gov/cors/station\_log  
DH7107' http://geodesy.noaa.gov/CORS

\*\*\* retrieval complete.  
Elapsed Time = 00:00:01



# The NGS Data Sheet

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

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DATABASE = NGSIDB , PROGRAM = datasheet95, VERSION = 7.87.6
1      National Geodetic Survey,  Retrieval Date = FEBRUARY 29, 2012
DM4627 *****
DM4627 CORS          - This is a GPS Continuously Operating Reference Station.
DM4627 DESIGNATION - MOUNTAIN HOME 3 CORS ARP
DM4627 CORS_ID      - ARM3
DM4627 PID          - DM4627
DM4627 STATE/COUNTY- AR/BAXTER
DM4627 USGS QUAD    - MOUNTAIN HOME EAST (1981)
DM4627
DM4627                      *CURRENT SURVEY CONTROL
DM4627
DM4627* NAD 83(CORS)- 36 22 09.24670(N)    092 22 23.29371(W)    ADJUSTED
DM4627* NAVD 88      -                      *(meters)          *(feet)
DM4627
DM4627 EPOCH DATE   -          2002.00
DM4627 X            -      -212,915.658 (meters)                COMP
DM4627 Y            -      -5,137,584.137 (meters)              COMP
DM4627 Z            -      3,761,395.995 (meters)              COMP
DM4627 ELLIP HEIGHT-          228.880 (meters)                (12/??/10) ADJUSTED
DM4627 GEOID HEIGHT-          -28.35 (meters)                GEOID09
DM4627 HORZ ORDER  - SPECIAL (CORS)
DM4627 ELLP ORDER  - SPECIAL (CORS)
DM4627
DM4627.ITRF positions are available for this station.
DM4627
DM4627.The coordinates were established by GPS observations
DM4627.and adjusted by the National Geodetic Survey in December 2010.
DM4627
DM4627.The datum tag of NAD 83(CORS) is equivalent to NAD 83(CORS96).
DM4627
DM4627.The coordinates are valid at the epoch date displayed above
DM4627.which is a decimal equivalence of Year/Month/Day.
DM4627
DM4627.The PID for the CORS L1 Phase Center is DM4628.
DM4627
DM4627.The XYZ, and position/ellipsoidal ht. are equivalent.
DM4627
DM4627.The ellipsoidal height was determined by GPS observations
DM4627.and is referenced to NAD 83.
DM4627
DM4627.The geoid height was determined by GEOID09.
DM4627
DM4627;              North      East      Units Scale Factor Converg.
DM4627;SPC AR N      -      225,939.960  366,513.195  MT  1.00002969  -0 13 01.7
DM4627;SPC AR N      -      741,271.35  1,202,468.71  sFT 1.00002969  -0 13 01.7
DM4627
DM4627!              - Elev Factor x Scale Factor = Combined Factor
DM4627!SPC AR N      -      0.99996408 x 1.00002969 = 0.99999377
DM4627
DM4627                      SUPERSEDED SURVEY CONTROL

```

DM4627  
DM4627.No superseded survey control is available for this station.  
DM4627  
DM4627\_U.S. NATIONAL GRID SPATIAL ADDRESS: 15SWA5623325085(NAD 83)  
DM4627  
DM4627\_MARKER: STATION IS THE ANTENNA REFERENCE POINT OF THE GPS ANTENNA  
DM4627  
DM4627 STATION DESCRIPTION  
DM4627  
DM4627'DESCRIBED BY NATIONAL GEODETIC SURVEY 2010  
DM4627'STATION IS A GPS CORS. LATEST INFORMATION INCLUDING POSITIONS AND  
DM4627'VELOCITIES ARE AVAILABLE IN THE COORDINATE AND LOG FILES ACCESSIBLE  
DM4627'BY ANONYMOUS FTP OR THE WORLDWIDE WEB.  
DM4627' ftp://cors.ngs.noaa.gov/cors/README.txt  
DM4627' ftp://cors.ngs.noaa.gov/cors/coord/coord\_08  
DM4627' ftp://cors.ngs.noaa.gov/cors/station\_log  
DM4627' http://geodesy.noaa.gov/CORS

\*\*\* retrieval complete.  
Elapsed Time = 00:00:01

# The NGS Data Sheet

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

```

DATABASE = NGSIDB , PROGRAM = datasheet95, VERSION = 7.87.6
1      National Geodetic Survey,  Retrieval Date = FEBRUARY 29, 2012
DG9661 *****
DG9661  CORS           -  This is a GPS Continuously Operating Reference Station.
DG9661  DESIGNATION  -  CRAFTON TULL COOP CORS ARP
DG9661  CORS_ID      -  CTA1
DG9661  PID          -  DG9661
DG9661  STATE/COUNTY-  AR/BENTON
DG9661  USGS QUAD    -  BENTONVILLE SOUTH (1982)
DG9661
DG9661                      *CURRENT SURVEY CONTROL
DG9661
DG9661 * NAD 83(CORS)-  36 20 37.34533(N)    094 10 48.00295(W)    ADJUSTED
DG9661 * NAVD 88      -                      ** (meters)          ** (feet)
DG9661
DG9661 EPOCH DATE   -          2002.00
DG9661 X            -          -374,931.940 (meters)                COMP
DG9661 Y            -          -5,130,116.767 (meters)                COMP
DG9661 Z            -           3,759,207.199 (meters)                COMP
DG9661 ELLIP HEIGHT-           385.173 (meters)                    (03/??/05) ADJUSTED
DG9661 GEOID HEIGHT-           -28.11 (meters)                      GEOID09
DG9661 HORZ ORDER  -  SPECIAL (CORS)
DG9661 ELLP ORDER  -  SPECIAL (CORS)
DG9661
DG9661. ITRF positions are available for this station.
DG9661
DG9661. The coordinates were established by GPS observations
DG9661. and adjusted by the National Geodetic Survey in March 2005.
DG9661
DG9661. The datum tag of NAD 83(CORS) is equivalent to NAD 83(CORS96).
DG9661
DG9661. The coordinates are valid at the epoch date displayed above
DG9661. which is a decimal equivalence of Year/Month/Day.
DG9661
DG9661. The PID for the CORS L1 Phase Center is DM5208.
DG9661
DG9661. The XYZ, and position/ellipsoidal ht. are equivalent.
DG9661
DG9661. The ellipsoidal height was determined by GPS observations
DG9661. and is referenced to NAD 83.
DG9661
DG9661. The geoid height was determined by GEOID09.
DG9661
DG9661;
DG9661; SPC AR N      -          North          East          Units Scale Factor Converg.
DG9661; SPC AR N      -          225,210.073    204,310.892    MT    1.00002368    -1 16 06.7
DG9661; SPC AR N      -          738,876.71     670,309.98     sFT   1.00002368    -1 16 06.7
DG9661
DG9661!
DG9661! SPC AR N      -          Elev Factor   x   Scale Factor =   Combined Factor
DG9661! SPC AR N      -          0.99993955   x   1.00002368 =   0.99996323
DG9661
DG9661                      SUPERSEDED SURVEY CONTROL

```

DG9661  
DG9661.No superseded survey control is available for this station.  
DG9661  
DG9661\_U.S. NATIONAL GRID SPATIAL ADDRESS: 15SUA9411022717(NAD 83)  
DG9661  
DG9661\_MARKER: STATION IS THE ANTENNA REFERENCE POINT OF THE GPS ANTENNA  
DG9661  
DG9661 STATION DESCRIPTION  
DG9661  
DG9661'DESCRIBED BY NATIONAL GEODETIC SURVEY 2005  
DG9661'STATION IS A GPS CORS. LATEST INFORMATION INCLUDING POSITIONS AND  
DG9661'VELOCITIES ARE AVAILABLE IN THE COORDINATE AND LOG FILES ACCESSIBLE  
DG9661'BY ANONYMOUS FTP OR THE WORLDWIDE WEB.  
DG9661' ftp://cors.ngs.noaa.gov/cors/README.txt  
DG9661' ftp://cors.ngs.noaa.gov/cors/coord/coord\_08  
DG9661' ftp://cors.ngs.noaa.gov/cors/station\_log  
DG9661' http://geodesy.noaa.gov/CORS

\*\*\* retrieval complete.  
Elapsed Time = 00:00:01

# The NGS Data Sheet

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

```

DATABASE = NGSIDB , PROGRAM = datasheet95, VERSION = 7.87.6
1      National Geodetic Survey,  Retrieval Date = FEBRUARY 29, 2012
DL6012 *****
DL6012  CORS           -   This is a GPS Continuously Operating Reference Station.
DL6012  DESIGNATION  -   MODOT BRANSON CORS ARP
DL6012  CORS_ID      -   MOBR
DL6012  PID          -   DL6012
DL6012  STATE/COUNTY-   MO/TANEY
DL6012  USGS QUAD    -   BRANSON (1989)
DL6012
DL6012                                     *CURRENT SURVEY CONTROL
DL6012
DL6012*  NAD 83(CORS)-  36 42 35.20135(N)    093 13 23.59299(W)    ADJUSTED
DL6012*  NAVD 88      -                    ** (meters)           ** (feet)
DL6012
DL6012  EPOCH DATE   -           2002.00
DL6012  X            -           -287,852.143 (meters)             COMP
DL6012  Y            -          -5,111,444.331 (meters)             COMP
DL6012  Z            -           3,791,795.527 (meters)             COMP
DL6012  ELLIP HEIGHT-           289.879 (meters)                 (12/??/09) ADJUSTED
DL6012  GEOID HEIGHT-           -28.80 (meters)                   GEOID09
DL6012  HORZ ORDER  -   SPECIAL (CORS)
DL6012  ELLP ORDER  -   SPECIAL (CORS)
DL6012
DL6012. ITRF positions are available for this station.
DL6012
DL6012. The coordinates were established by GPS observations
DL6012. and adjusted by the National Geodetic Survey in December 2009.
DL6012
DL6012. The datum tag of NAD 83(CORS) is equivalent to NAD 83(CORS96).
DL6012
DL6012. The coordinates are valid at the epoch date displayed above
DL6012. which is a decimal equivalence of Year/Month/Day.
DL6012
DL6012. The PID for the CORS L1 Phase Center is DL6013.
DL6012
DL6012. The XYZ, and position/ellipsoidal ht. are equivalent.
DL6012
DL6012. The ellipsoidal height was determined by GPS observations
DL6012. and is referenced to NAD 83.
DL6012
DL6012. The geoid height was determined by GEOID09.
DL6012
DL6012;
DL6012; SPC MO C      -           North           East           Units Scale Factor Converg.
DL6012; SPC MO C      -           97,491.160      435,384.929      MT  0.99998475  -0 25 56.4
DL6012
DL6012!
DL6012! SPC MO C      -           Elev Factor   x   Scale Factor =   Combined Factor
DL6012! SPC MO C      -           0.99995451   x   0.99998475 =   0.99993926
DL6012
DL6012                                     SUPERSEDED SURVEY CONTROL
DL6012

```

DL6012.No superseded survey control is available for this station.

DL6012

DL6012\_U.S. NATIONAL GRID SPATIAL ADDRESS: 15SVA8006362701(NAD 83)

DL6012

DL6012\_MARKER: STATION IS THE ANTENNA REFERENCE POINT OF THE GPS ANTENNA

DL6012

DL6012

STATION DESCRIPTION

DL6012

DL6012'DESCRIBED BY NATIONAL GEODETIC SURVEY 2009

DL6012'STATION IS A GPS CORS. LATEST INFORMATION INCLUDING POSITIONS AND

DL6012'VELOCITIES ARE AVAILABLE IN THE COORDINATE AND LOG FILES ACCESSIBLE

DL6012'BY ANONYMOUS FTP OR THE WORLDWIDE WEB.

DL6012' <ftp://cors.ngs.noaa.gov/cors/README.txt>

DL6012' [ftp://cors.ngs.noaa.gov/cors/coord/coord\\_08](ftp://cors.ngs.noaa.gov/cors/coord/coord_08)

DL6012' [ftp://cors.ngs.noaa.gov/cors/station\\_log](ftp://cors.ngs.noaa.gov/cors/station_log)

DL6012' <http://geodesy.noaa.gov/CORS>

\*\*\* retrieval complete.

Elapsed Time = 00:00:01

# The NGS Data Sheet

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

```

DATABASE = NGSIDB , PROGRAM = datasheet95, VERSION = 7.87.6
1      National Geodetic Survey,  Retrieval Date = FEBRUARY 29, 2012
DM3513 *****
DM3513 CORS          - This is a GPS Continuously Operating Reference Station.
DM3513 DESIGNATION - MODOT CASSVILLE CORS ARP
DM3513 CORS_ID      - MOCS
DM3513 PID          - DM3513
DM3513 STATE/COUNTY- MO/BARRY
DM3513 USGS QUAD    - EXETER (1974)
DM3513
DM3513                      *CURRENT SURVEY CONTROL
DM3513
DM3513 _____
DM3513* NAD 83(CORS)- 36 38 48.21009(N)    093 54 20.35652(W)    ADJUSTED
DM3513* NAVD 88      -                      ** (meters)          ** (feet)
DM3513 _____
DM3513 EPOCH DATE   -          2002.00
DM3513 X            -    -349,001.614 (meters)                      COMP
DM3513 Y            -    -5,111,905.656 (meters)                    COMP
DM3513 Z            -     3,786,244.968 (meters)                    COMP
DM3513 ELLIP HEIGHT-          392.737 (meters)                    (09/??/10) ADJUSTED
DM3513 GEOID HEIGHT-          -28.46 (meters)                      GEOID09
DM3513 HORZ ORDER  - SPECIAL (CORS)
DM3513 ELLP ORDER  - SPECIAL (CORS)
DM3513
DM3513. ITRF positions are available for this station.
DM3513
DM3513. The coordinates were established by GPS observations
DM3513. and adjusted by the National Geodetic Survey in September 2010.
DM3513
DM3513. The datum tag of NAD 83(CORS) is equivalent to NAD 83(CORS96).
DM3513
DM3513. The coordinates are valid at the epoch date displayed above
DM3513. which is a decimal equivalence of Year/Month/Day.
DM3513
DM3513. The PID for the CORS L1 Phase Center is DM3514.
DM3513
DM3513. The XYZ, and position/ellipsoidal ht. are equivalent.
DM3513
DM3513. The ellipsoidal height was determined by GPS observations
DM3513. and is referenced to NAD 83.
DM3513
DM3513. The geoid height was determined by GEOID09.
DM3513
DM3513;
DM3513; SPC MO W      -          North          East          Units Scale Factor Converg.
DM3513; SPC MO W      -          53,431.819    903,144.572    MT    0.99997596    +0 21 17.1
DM3513
DM3513!
DM3513! SPC MO W      -          Elev Factor x Scale Factor = Combined Factor
DM3513! SPC MO W      -          0.99993837 x 0.99997596 = 0.99991433
DM3513
DM3513                      SUPERSEDED SURVEY CONTROL
DM3513

```

DM3513.No superseded survey control is available for this station.

DM3513

DM3513\_U.S. NATIONAL GRID SPATIAL ADDRESS: 15SVA1904656065(NAD 83)

DM3513

DM3513\_MARKER: STATION IS THE ANTENNA REFERENCE POINT OF THE GPS ANTENNA

DM3513

DM3513

STATION DESCRIPTION

DM3513

DM3513'DESCRIBED BY NATIONAL GEODETIC SURVEY 2010

DM3513'STATION IS A GPS CORS. LATEST INFORMATION INCLUDING POSITIONS AND

DM3513'VELOCITIES ARE AVAILABLE IN THE COORDINATE AND LOG FILES ACCESSIBLE

DM3513'BY ANONYMOUS FTP OR THE WORLDWIDE WEB.

DM3513' ftp://cors.ngs.noaa.gov/cors/README.txt

DM3513' ftp://cors.ngs.noaa.gov/cors/coord/coord\_08

DM3513' ftp://cors.ngs.noaa.gov/cors/station\_log

DM3513' http://geodesy.noaa.gov/CORS

\*\*\* retrieval complete.

Elapsed Time = 00:00:01



# The NGS Data Sheet

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

```

DATABASE = NGSIDB , PROGRAM = datasheet95, VERSION = 7.87.5
1      National Geodetic Survey,  Retrieval Date = FEBRUARY 10, 2012
DF7475 *****
DF7475 CORS          - This is a GPS Continuously Operating Reference Station.
DF7475 DESIGNATION - HEAVENER CORS ARP
DF7475 CORS_ID      - OKHV
DF7475 PID          - DF7475
DF7475 STATE/COUNTY- OK/LE FLORE
DF7475 USGS QUAD    - HEAVENER (1981)
DF7475
DF7475                      *CURRENT SURVEY CONTROL
DF7475
DF7475* NAD 83(CORS)- 34 54 47.37873(N)    094 37 05.09292(W)    ADJUSTED
DF7475* NAVD 88      -                      ** (meters)          ** (feet)
DF7475
DF7475 EPOCH DATE   -          2002.00
DF7475 X            -      -421,573.977 (meters)                COMP
DF7475 Y            -      -5,219,068.024 (meters)              COMP
DF7475 Z            -      3,630,054.941 (meters)              COMP
DF7475 ELLIP HEIGHT-          146.534 (meters)                (08/??/03) ADJUSTED
DF7475 GEOID HEIGHT-          -31.56 (meters)                 GEOID09
DF7475 HORZ ORDER  - SPECIAL (CORS)
DF7475 ELLP ORDER  - SPECIAL (CORS)
DF7475
DF7475. ITRF positions are available for this station.
DF7475
DF7475. The coordinates were established by GPS observations
DF7475. and adjusted by the National Geodetic Survey in August 2003.
DF7475
DF7475. The datum tag of NAD 83(CORS) is equivalent to NAD 83(CORS96).
DF7475
DF7475. The coordinates are valid at the epoch date displayed above
DF7475. which is a decimal equivalence of Year/Month/Day.
DF7475
DF7475. The PID for the CORS L1 Phase Center is DF7476.
DF7475
DF7475. The XYZ, and position/ellipsoidal ht. are equivalent.
DF7475
DF7475. The ellipsoidal height was determined by GPS observations
DF7475. and is referenced to NAD 83.
DF7475
DF7475. The geoid height was determined by GEOID09.
DF7475
DF7475;
DF7475; SPC OK S      -      North      East      Units Scale Factor Converg.
DF7475; SPC OK S      -      180,418.240  908,982.439  MT  0.99995237  +1 55 10.7
DF7475; SPC OK S      -      591,922.18  2,982,219.89  sFT 0.99995237  +1 55 10.7
DF7475
DF7475!
DF7475! SPC OK S      -      Elev Factor x Scale Factor = Combined Factor
DF7475! SPC OK S      -      0.99997700 x 0.99995237 = 0.99992937
DF7475
DF7475                      SUPERSEDED SURVEY CONTROL

```

DF7475

DF7475.No superseded survey control is available for this station.

DF7475

DF7475\_U.S. NATIONAL GRID SPATIAL ADDRESS: 15SUU5218464607(NAD 83)

DF7475

DF7475\_MARKER: STATION IS THE ANTENNA REFERENCE POINT OF THE GPS ANTENNA

DF7475

DF7475

STATION DESCRIPTION

DF7475

DF7475'DESCRIBED BY NATIONAL GEODETIC SURVEY 2003

DF7475'STATION IS A GPS CORS. LATEST INFORMATION INCLUDING POSITIONS AND

DF7475'VELOCITIES ARE AVAILABLE IN THE COORDINATE AND LOG FILES ACCESSIBLE

DF7475'BY ANONYMOUS FTP OR THE WORLDWIDE WEB.

DF7475' <ftp://cors.ngs.noaa.gov/cors/README.txt>

DF7475' [ftp://cors.ngs.noaa.gov/cors/coord/coord\\_08](ftp://cors.ngs.noaa.gov/cors/coord/coord_08)

DF7475' [ftp://cors.ngs.noaa.gov/cors/station\\_log](ftp://cors.ngs.noaa.gov/cors/station_log)

DF7475' <http://geodesy.noaa.gov/CORS>

\*\*\* retrieval complete.

Elapsed Time = 00:00:01

## **Appendix B**

LiDAR Accuracy Assessment Summary

LC Type	# of Points	FVA	SVA	CVA
<b>LAS</b>				
ALL	81			
Bare Earth	21	0.159		
Brush Low Trees	20			
Fully Forested	20			
Tall Weeds Crops	20			
Total	81			
<b>DEM</b>				
ALL	81			0.320
Bare Earth	21	0.113		
Brush Low Trees	20		0.371	
Fully Forested	20		0.163	
Tall Weeds Crops	20		0.377	
Total	81			

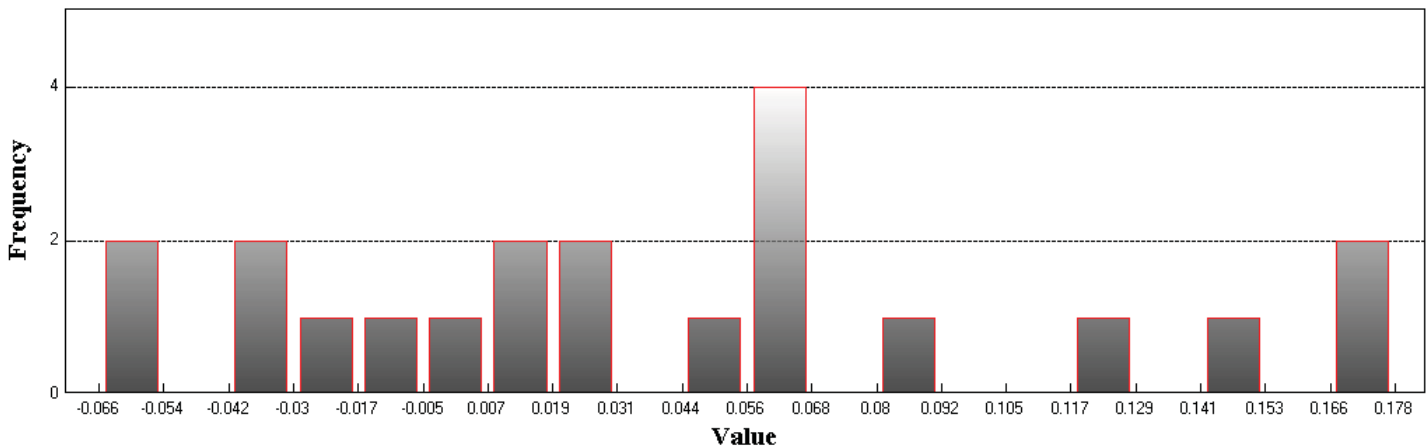
Units: Meters

# LAS

## Fundamental Vertical Accuracy

LandCover Type: Bare Earth  
Minimum DZ: -0.066  
Maximum DZ: 0.178  
Mean DZ: 0.041  
Mean Magnitude DZ: 0.253  
Number Observations: 21  
Standard Deviation DZ: 0.072  
RMSE Z: 0.081  
95% Confidence Level Z: 0.159  
Units: Meters

# Histogram



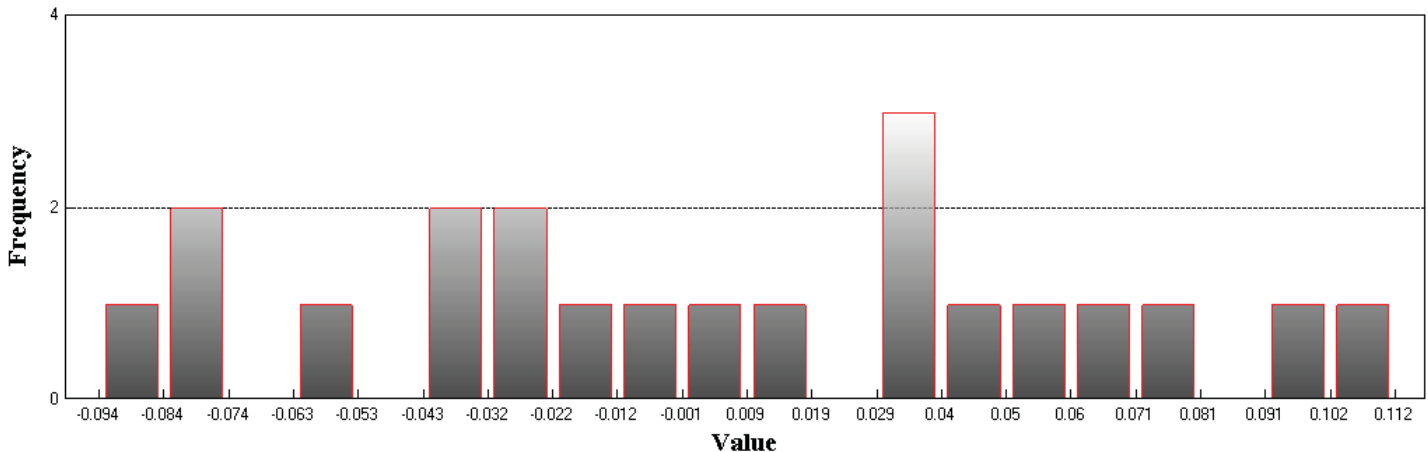
Min: -0.066  
Max: 0.178  
Number Of Bins: 20  
Bin Interval: 0.012

## DEM

### Fundamental Vertical Accuracy

LandCover Type: Bare Earth  
Minimum DZ: -0.094  
Maximum DZ: 0.112  
Mean DZ: 0.004  
Mean Magnitude DZ: 0.221  
Number Observations: 21  
Standard Deviation DZ: 0.059  
RMSE Z: 0.058  
95% Confidence Level Z: 0.113  
Units: Meters

## Histogram



Min: -0.094

Max: 0.112

Number Of Bins: 20

Bin Interval: 0.01

## DEM (Continued)

### Supplemental Vertical Accuracy

LandCover Type: Brush Low Trees

Minimum DZ: -0.064

Maximum DZ: 0.374

Mean DZ: 0.15

Mean Magnitude DZ: 0.395

Number Observations: 20

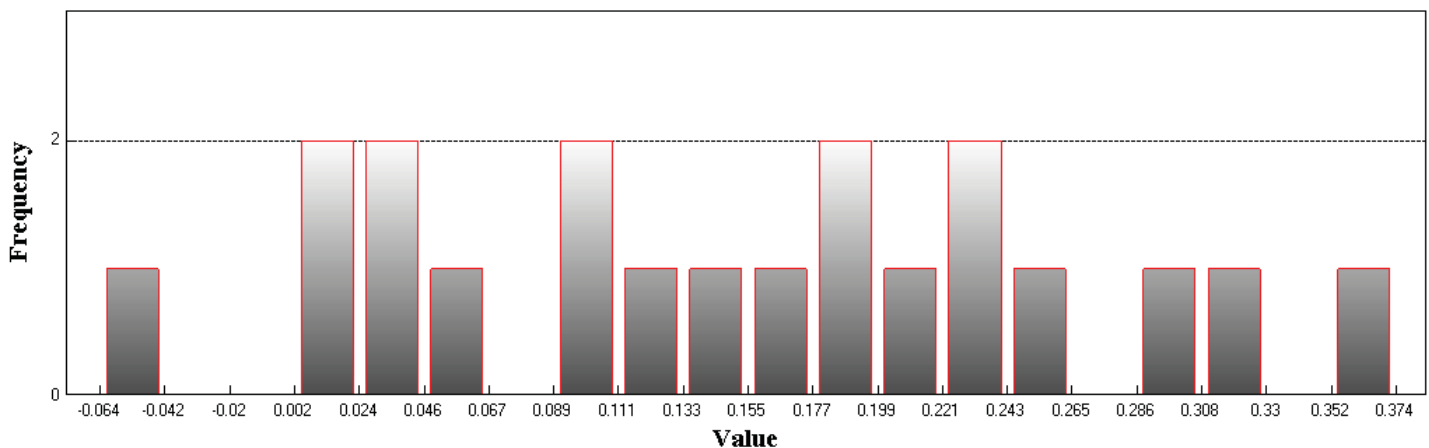
Standard Deviation DZ: 0.118

RMSE Z: 0.189

95th Percentile: 0.371

Units: Meters

## Histogram



Min: -0.064

Max: 0.374

Number Of Bins: 20

Bin Interval: 0.022

## DEM (Continued)

### Supplemental Vertical Accuracy

LandCover Type: Fully Forested

Minimum DZ: -0.041

Maximum DZ: 0.163

Mean DZ: 0.069

Mean Magnitude DZ: 0.276

Number Observations: 20

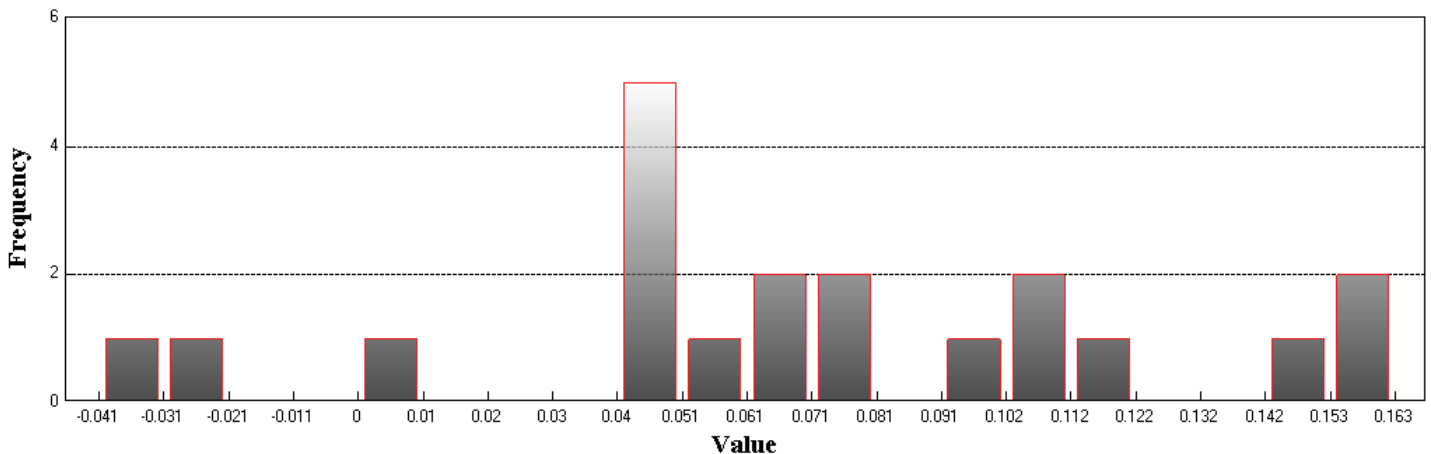
Standard Deviation DZ: 0.055

RMSE Z: 0.087

95th Percentile: 0.163

Units: Meters

## Histogram



Min: -0.041

Max: 0.163

Number Of Bins: 20

Bin Interval: 0.01



## DEM (Continued)

### Supplemental Vertical Accuracy

LandCover Type: Tall Weeds Crops

Minimum DZ: 0.004

Maximum DZ: 0.38

Mean DZ: 0.149

Mean Magnitude DZ: 0.385

Number Observations: 20

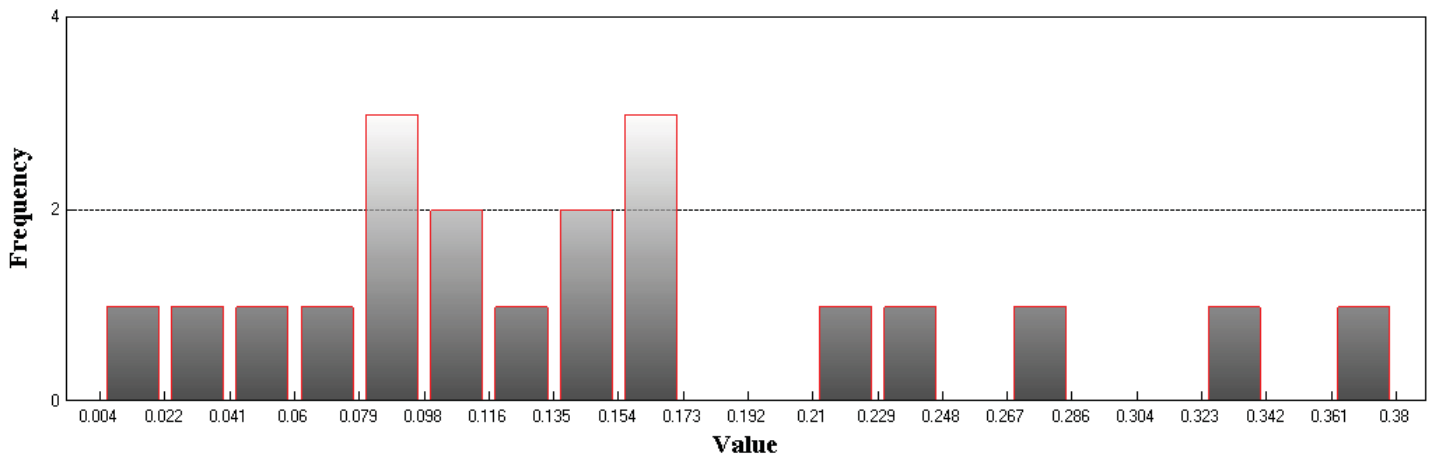
Standard Deviation DZ: 0.098

RMSE Z: 0.176

95th Percentile: 0.377

Units: Meters

## Histogram



Min: 0.004

Max: 0.38

Number Of Bins: 20

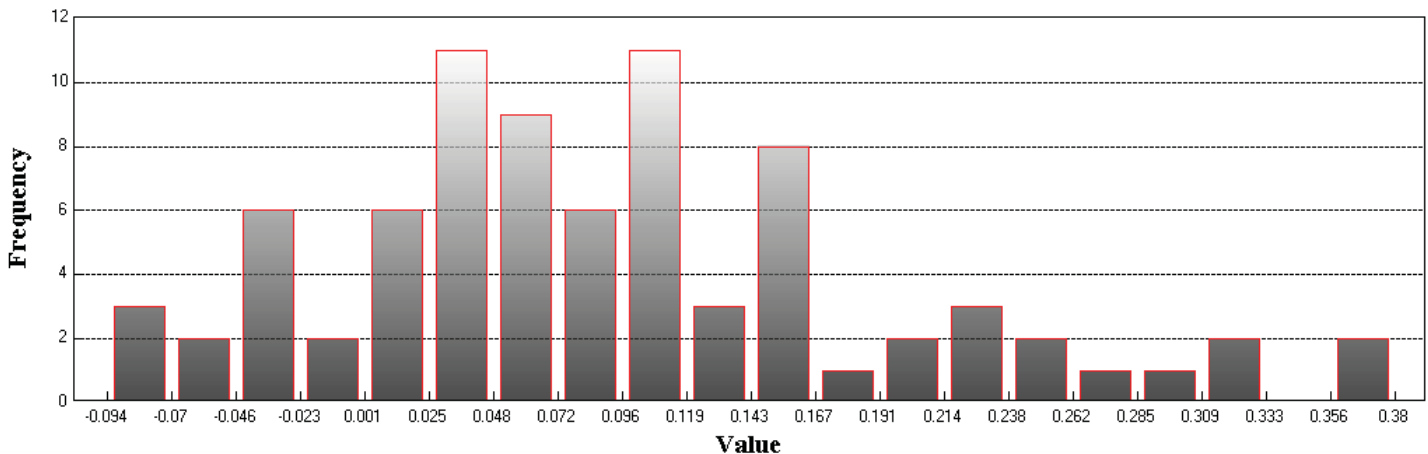
Bin Interval: 0.019

## DEM (Continued)

### Consolidated Vertical Accuracy

LandCover Type: ALL  
Minimum DZ: -0.094  
Maximum DZ: 0.38  
Mean DZ: 0.092  
Mean Magnitude DZ: 0.327  
Number Observations: 81  
Standard Deviation DZ: 0.105  
RMSE Z: 0.139  
95th Percentile: 0.32  
Units: Meters

## Histogram



Min: -0.094

Max: 0.38

Number Of Bins: 20

Bin Interval: 0.024

## Appendix C

Tiled-Data Area

