

OPUS-RS solution : 940123226S.14O OP1408550426991

opus <opus@ngs.noaa.gov>

Wed 8/20/2014 10:03 AM

To:Chad Mozol <Chad.Mozol@neciusa.com>;

FILE: 940123226S.14O OP1408550426991

NGS OPUS-RS SOLUTION REPORT =====

All computed coordinate accuracies are listed as 1-sigma RMS values.
For additional information: <http://www.ngs.noaa.gov/OPUS/about.jsp#accuracy>

USER: cmozol@neciusa.com DATE: August 20, 2014
RINEX FILE: 9401226s.14o TIME: 16:03:13 UTC

SOFTWARE: rsgps 1.37 RS51.prl 1.99.2 START: 2014/08/14 18:01:05
EPHEMERIS: igr18054.eph [rapid] STOP: 2014/08/14 19:08:20
NAV FILE: brdc2260.14n OBS USED: 3090 / 3975 : 78%
ANT NAME: CHCX91R NONE QUALITY IND. 24.39/ 52.63
ARP HEIGHT: 1.8 NORMALIZED RMS: 0.307

REF FRAME: NAD_83(2011)(EPOCH:2010.0000) IGS08 (EPOCH:2014.61856)

X:	-1386047.215(m)	0.005(m)	-1386048.091(m)	0.005(m)
Y:	-4031302.575(m)	0.007(m)	-4031301.352(m)	0.007(m)
Z:	4729710.855(m)	0.009(m)	4729710.847(m)	0.009(m)

LAT:	48 9 45.76290	0.006(m)	48 9 45.78375	0.006(m)
E LON:	251 1 33.40148	0.004(m)	251 1 33.34216	0.004(m)
W LON:	108 58 26.59852	0.004(m)	108 58 26.65784	0.004(m)
EL HGT:	1003.374(m)	0.010(m)	1002.786(m)	0.010(m)
ORTHO HGT:	1018.673(m)	0.013(m)	[NAVD88 (Computed using GEOID12A)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 12)	SPC (2500 MT)
Northing (Y) [meters]	5336369.971	434911.638
Easting (X) [meters]	650647.124	639109.098
Convergence [degrees]	1.50969656	0.38473087
Point Scale	0.99987886	0.99959485
Combined Factor	0.99972165	0.99943768

US NATIONAL GRID DESIGNATOR: 12UXU5064736369(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DG9749	MTMS MONTANA STATE UNI	CORS ARP	N483227.426 W1094111.858	67523.6
DL7731	P053 WHITEWATERMT2007	CORS ARP	N484333.865 W1074331.456	111628.2
DM7133	MTLW LEWISTOWN	CORS ARP	N470314.929 W1092633.764	128211.3
DI2257	P049 ARMINGTON_MT2006	CORS ARP	N472059.850 W1105422.382	170756.6
DI3425	P052 LRRNCHJRDNMT2006	CORS ARP	N472229.026 W1070107.185	170773.6

NEAREST NGS PUBLISHED CONTROL POINT

Information on nearest mark is not available due to database connectivity issues or has restrictions on when or how it can be published.

OPUS-RS Extended Output, Level 2

FINAL COORDINATES (ITRF at epoch of observations)

mtms	-1425435.576	-3984013.207	4757493.877
p053	-1283559.261	-4015770.323	4771131.603
mtlw	-1449333.480	-4105829.828	4646773.508
p049	-1545099.840	-4044895.871	4669084.567
p052	-1266648.338	-4138194.574	4670709.507
9401	-1386048.091	-4031301.352	4729710.847

Covariance matrix of the stations:

1	1.9410E-07	3.2710E-07	-3.4520E-07	5.8470E-09	-6.8630E-08	7.2930E-08	-8.8190E-10	-8.9960E-08	9.4410E-08
2	3.2710E-07	1.3570E-06	-1.3840E-06	-2.5290E-08	-2.2320E-07	3.6410E-07	-1.1710E-07	-3.2500E-07	3.3870E-07
3	-3.4520E-07	-1.3840E-06	1.7650E-06	8.3030E-08	3.4590E-07	-3.9880E-07	8.7900E-08	3.4410E-07	-3.8510E-07
4	5.8470E-09	-2.5290E-08	8.3030E-08	2.1510E-07	3.2360E-07	-2.8240E-07	-2.0870E-08	-1.1410E-07	6.9000E-08
5	-6.8630E-08	-2.2320E-07	3.4590E-07	3.2360E-07	1.3820E-06	-1.4270E-06	-9.8020E-08	-3.3070E-07	3.6090E-07
6	7.2930E-08	3.6410E-07	-3.9880E-07	-2.8240E-07	-1.4270E-06	1.8260E-06	6.6430E-08	3.4940E-07	-4.0770E-07
7	-8.8190E-10	-1.1710E-07	8.7900E-08	-2.0870E-08	-9.8020E-08	6.6430E-08	2.1940E-07	3.8660E-07	-3.5540E-07
8	-8.9960E-08	-3.2500E-07	3.4410E-07	-1.1410E-07	-3.3070E-07	3.4940E-07	3.8660E-07	1.4970E-06	-1.4610E-06
9	9.4410E-08	3.3870E-07	-3.8510E-07	6.9000E-08	3.6090E-07	-4.0770E-07	-3.5540E-07	-1.4610E-06	1.7400E-06
10	-3.8890E-09	-1.4110E-07	8.8220E-08	-4.6030E-08	-1.1610E-07	6.0410E-08	1.8800E-08	-6.8550E-08	1.1870E-07
11	-9.4550E-08	-2.4190E-07	3.2780E-07	-7.0240E-08	-2.6720E-07	3.5460E-07	-1.1460E-07	-3.1780E-07	3.4510E-07
12	1.0020E-07	2.9190E-07	-3.7350E-07	5.4910E-08	3.2470E-07	-4.0790E-07	1.2460E-07	3.7610E-07	-3.4630E-07
13	5.0020E-09	-4.2460E-08	8.4870E-08	4.5480E-08	-4.1230E-08	8.2800E-08	-1.6360E-08	-1.1420E-07	7.3580E-08

```

-3.7560E-08 -8.0900E-08 6.4580E-08 2.0280E-07 2.7980E-07 -3.0650E-07 5.9970E-08 6.2000E-08 -5.2950E-08
 14 -7.4090E-08 -3.6700E-07 3.6800E-07 -1.1310E-07 -3.5980E-07 3.5870E-07 -5.7410E-08 -3.2340E-07 4.1550E-07
-3.7080E-08 -3.5390E-07 4.2170E-07 2.7980E-07 1.6050E-06 -1.5630E-06 -1.9630E-08 -9.7590E-08 1.0900E-07
 15 7.7900E-08 3.8930E-07 -4.0790E-07 7.5050E-08 3.9560E-07 -4.1240E-07 7.6640E-08 3.9100E-07 -4.0090E-07
7.8610E-08 3.8520E-07 -3.9910E-07 -3.0650E-07 -1.5630E-06 1.8200E-06 -1.4120E-09 5.9050E-08 -1.6020E-09
 16 4.1880E-08 3.0340E-08 -3.4070E-09 6.4630E-08 2.4980E-08 1.8040E-09 2.3890E-08 -2.7460E-08 3.4740E-09
9.6140E-09 -7.9840E-09 -4.4190E-10 5.9970E-08 -1.9630E-08 -1.4120E-09 1.9490E-06 4.2870E-06 -4.4440E-06
 17 6.6290E-09 1.7450E-07 -3.4650E-08 8.3490E-08 9.7580E-08 4.8700E-08 -5.5600E-08 -4.4520E-08 -7.2950E-09
-9.6230E-08 7.0620E-08 -6.5920E-08 6.2000E-08 -9.7590E-08 5.9050E-08 4.2870E-06 1.7430E-05 -1.8810E-05
 18 -4.1540E-09 -1.0770E-07 6.5570E-08 -6.6150E-08 -3.1830E-08 -1.9820E-08 4.3700E-08 5.9970E-08 5.7530E-08
7.9260E-08 -2.9670E-08 9.8290E-08 -5.2950E-08 1.0900E-07 -1.6020E-09 -4.4440E-06 -1.8810E-05 2.2770E-05
    
```

Covariance Matrix for the xyz OPUS Rover Position (meters^2).

```

0.0000019490 0.0000042870 -0.0000044440
0.0000042870 0.0000174300 -0.0000188100
-0.0000044440 -0.0000188100 0.0000227700
    
```

Covariance Matrix for the enu OPUS Position (meters^2).

```

0.0000009493 0.0000002563 0.0000023448
0.0000002563 0.0000012456 0.0000001672
0.0000023448 0.0000001672 0.0000399541
    
```

Horizontal network accuracy = 0.00259 meters.

Vertical network accuracy = 0.01239 meters.

Vectors

To	From	X	Y	Z
mtms	9401	-39387.485	47288.145	27783.031
p053	9401	102488.830	15531.030	41420.756
mtlw	9401	-63285.389	-74528.475	-82937.339
p049	9401	-159051.749	-13594.519	-60626.280
p052	9401	119399.753	-106893.222	-59001.339

Covariance matrix of the 5 vectors

```

1 2.0593E-06 4.5771E-06 -4.7816E-06 1.8483E-06 4.1868E-06 -4.3687E-06 1.8823E-06 4.2179E-06 -4.3489E-06
1.8936E-06 4.1938E-06 -4.3392E-06 1.8522E-06 4.2259E-06 -4.3605E-06
2 4.5771E-06 1.8438E-05 -2.0052E-05 4.1479E-06 1.6935E-05 -1.8387E-05 4.1952E-06 1.6975E-05 -1.8356E-05
4.2118E-06 1.6943E-05 -1.8344E-05 4.1522E-06 1.6986E-05 -1.8372E-05
3 -4.7816E-06 -2.0052E-05 2.4404E-05 -4.2914E-06 -1.8398E-05 2.2325E-05 -4.3964E-06 -1.8491E-05 2.2262E-05
-4.4316E-06 -1.8418E-05 2.2233E-05 -4.3028E-06 -1.8516E-05 2.2298E-05
4 1.8483E-06 4.1479E-06 -4.2914E-06 2.0348E-06 4.5021E-06 -4.6621E-06 1.8396E-06 4.1169E-06 -4.3123E-06
1.8287E-06 4.1413E-06 -4.3225E-06 1.8699E-06 4.1100E-06 -4.3014E-06
5 4.1868E-06 1.6935E-05 -1.8398E-05 4.5021E-06 1.8617E-05 -2.0254E-05 4.2196E-06 1.7046E-05 -1.8410E-05
4.2421E-06 1.6995E-05 -1.8388E-05 4.1588E-06 1.7070E-05 -1.8442E-05
6 -4.3687E-06 -1.8387E-05 2.2325E-05 -4.6621E-06 -2.0254E-05 2.4636E-05 -4.4231E-06 -1.8569E-05 2.2325E-05
-4.4647E-06 -1.8474E-05 2.2284E-05 -4.3101E-06 -1.8609E-05 2.2379E-05
7 1.8823E-06 4.1952E-06 -4.3964E-06 1.8396E-06 4.2196E-06 -4.4231E-06 2.1206E-06 4.7567E-06 -4.8466E-06
1.9343E-06 4.2360E-06 -4.3627E-06 1.8488E-06 4.3048E-06 -4.4096E-06
8 4.2179E-06 1.6975E-05 -1.8491E-05 4.1169E-06 1.7046E-05 -1.8569E-05 4.7567E-06 1.9016E-05 -2.0324E-05
4.3421E-06 1.7086E-05 -1.8428E-05 4.1383E-06 1.7249E-05 -1.8538E-05
9 -4.3489E-06 -1.8356E-05 2.2262E-05 -4.3123E-06 -1.8410E-05 2.2325E-05 -4.8466E-06 -2.0324E-05 2.4395E-05
-4.4080E-06 -1.8428E-05 2.2268E-05 -4.3209E-06 -1.8496E-05 2.2313E-05
    
```

10 1.8936E-06 4.2118E-06 -4.4316E-06 1.8287E-06 4.2421E-06 -4.4647E-06 1.9343E-06 4.3421E-06 -4.4080E-06
2.1991E-06 4.7527E-06 -4.8681E-06 1.8419E-06 4.3658E-06 -4.4432E-06
11 4.1938E-06 1.6943E-05 -1.8418E-05 4.1413E-06 1.6995E-05 -1.8474E-05 4.2360E-06 1.7086E-05 -1.8428E-05
4.7527E-06 1.8669E-05 -2.0127E-05 4.1521E-06 1.7103E-05 -1.8454E-05
12 -4.3392E-06 -1.8344E-05 2.2233E-05 -4.3225E-06 -1.8388E-05 2.2284E-05 -4.3627E-06 -1.8428E-05 2.2268E-05
-4.8681E-06 -2.0127E-05 2.4301E-05 -4.3260E-06 -1.8431E-05 2.2274E-05
13 1.8522E-06 4.1522E-06 -4.3028E-06 1.8699E-06 4.1588E-06 -4.3101E-06 1.8488E-06 4.1383E-06 -4.3209E-06
1.8419E-06 4.1521E-06 -4.3260E-06 2.0319E-06 4.5244E-06 -4.6961E-06
14 4.2259E-06 1.6986E-05 -1.8516E-05 4.1100E-06 1.7070E-05 -1.8609E-05 4.3048E-06 1.7249E-05 -1.8496E-05
4.3658E-06 1.7103E-05 -1.8431E-05 4.5244E-06 1.9230E-05 -2.0541E-05
15 -4.3605E-06 -1.8372E-05 2.2298E-05 -4.3014E-06 -1.8442E-05 2.2379E-05 -4.4096E-06 -1.8538E-05 2.2313E-05
-4.4432E-06 -1.8454E-05 2.2274E-05 -4.6961E-06 -2.0541E-05 2.4593E-05

Correlation matrix of the 5 vectors

1 1.0000E+00 7.4280E-01 -6.7450E-01 9.0293E-01 6.7618E-01 -6.1335E-01 9.0075E-01 6.7401E-01 -6.1357E-01
8.8983E-01 6.7637E-01 -6.1338E-01 9.0545E-01 6.7153E-01 -6.1273E-01
2 7.4280E-01 1.0000E+00 -9.4529E-01 6.7718E-01 9.1405E-01 -8.6272E-01 6.7090E-01 9.0655E-01 -8.6552E-01
6.6144E-01 9.1322E-01 -8.6663E-01 6.7838E-01 9.0208E-01 -8.6277E-01
3 -6.7450E-01 -9.4529E-01 1.0000E+00 -6.0898E-01 -8.6314E-01 9.1052E-01 -6.1113E-01 -8.5837E-01 9.1239E-01
-6.0494E-01 -8.6288E-01 9.1295E-01 -6.1104E-01 -8.5474E-01 9.1019E-01
4 9.0293E-01 6.7718E-01 -6.0898E-01 1.0000E+00 7.3148E-01 -6.5846E-01 8.8558E-01 6.6182E-01 -6.1206E-01
8.6450E-01 6.7191E-01 -6.1469E-01 9.1961E-01 6.5704E-01 -6.0805E-01
5 6.7618E-01 9.1405E-01 -8.6314E-01 7.3148E-01 1.0000E+00 -9.4574E-01 6.7156E-01 9.0597E-01 -8.6387E-01
6.6300E-01 9.1159E-01 -8.6448E-01 6.7619E-01 9.0218E-01 -8.6186E-01
6 -6.1335E-01 -8.6272E-01 9.1052E-01 -6.5846E-01 -9.4574E-01 1.0000E+00 -6.1194E-01 -8.5793E-01 9.1065E-01
-6.0658E-01 -8.6145E-01 9.1073E-01 -6.0919E-01 -8.5497E-01 9.0918E-01
7 9.0075E-01 6.7090E-01 -6.1113E-01 8.8558E-01 6.7156E-01 -6.1194E-01 1.0000E+00 7.4905E-01 -6.7383E-01
8.9572E-01 6.7323E-01 -6.0772E-01 8.9065E-01 6.7411E-01 -6.1061E-01
8 6.7401E-01 9.0655E-01 -8.5837E-01 6.6182E-01 9.0597E-01 -8.5793E-01 7.4905E-01 1.0000E+00 -9.4361E-01
6.7147E-01 9.0683E-01 -8.5724E-01 6.6575E-01 9.0200E-01 -8.5723E-01
9 -6.1357E-01 -8.6552E-01 9.1239E-01 -6.1206E-01 -8.6387E-01 9.1065E-01 -6.7383E-01 -9.4361E-01 1.0000E+00
-6.0183E-01 -8.6351E-01 9.1456E-01 -6.1374E-01 -8.5397E-01 9.1097E-01
10 8.8983E-01 6.6144E-01 -6.0494E-01 8.6450E-01 6.6300E-01 -6.0658E-01 8.9572E-01 6.7147E-01 -6.0183E-01
1.0000E+00 7.4176E-01 -6.6593E-01 8.7134E-01 6.7135E-01 -6.0419E-01
11 6.7637E-01 9.1322E-01 -8.6288E-01 6.7191E-01 9.1159E-01 -8.6145E-01 6.7323E-01 9.0683E-01 -8.6351E-01
7.4176E-01 1.0000E+00 -9.4496E-01 6.7416E-01 9.0266E-01 -8.6125E-01
12 -6.1338E-01 -8.6663E-01 9.1295E-01 -6.1469E-01 -8.6448E-01 9.1073E-01 -6.0772E-01 -8.5724E-01 9.1456E-01
-6.6593E-01 -9.4496E-01 1.0000E+00 -6.1564E-01 -8.5261E-01 9.1113E-01
13 9.0545E-01 6.7838E-01 -6.1104E-01 9.1961E-01 6.7619E-01 -6.0919E-01 8.9065E-01 6.6575E-01 -6.1374E-01
8.7134E-01 6.7416E-01 -6.1564E-01 1.0000E+00 7.2381E-01 -6.6433E-01
14 6.7153E-01 9.0208E-01 -8.5474E-01 6.5704E-01 9.0218E-01 -8.5497E-01 6.7411E-01 9.0200E-01 -8.5397E-01
6.7135E-01 9.0266E-01 -8.5261E-01 7.2381E-01 1.0000E+00 -9.4455E-01
15 -6.1273E-01 -8.6277E-01 9.1019E-01 -6.0805E-01 -8.6186E-01 9.0918E-01 -6.1061E-01 -8.5723E-01 9.1097E-01
-6.0419E-01 -8.6125E-01 9.1113E-01 -6.6433E-01 -9.4455E-01 1.0000E+00

G-FILE for the vectors

Axx2014 8142014 814
B201408141800201408141900 5 rsgps 1.37IGS
lant_info.003 NGS
C00060001 -393874853 14 472881454 42 277830305 49
C00060002 1024888303 14 155310298 43 414207560 49

C00060003 -632853887 14 -745284753 43 -829373388 49
 C00060004 -1590517489 14 -135945186 43 -606262796 49
 C00060005 1193997530 14 -1068932218 43 -590013392 49
 D 1 2 7428008 1 3 -6745023 1 4 9029256 1 5 6761781 1 6 -6133498
 D 1 7 9007504 1 8 6740144 1 9 -6135733 1 10 8898327 1 11 6763733
 D 1 12 -6133808 1 13 9054525 1 14 6715288 1 15 -6127285 2 3 -9452875
 D 2 4 6771800 2 5 9140461 2 6 -8627196 2 7 6709037 2 8 9065533
 D 2 9 -8655227 2 10 6614394 2 11 9132194 2 12 -8666279 2 13 6783822
 D 2 14 9020795 2 15 -8627662 3 4 -6089840 3 5 -8631363 3 6 9105190
 D 3 7 -6111331 3 8 -8583734 3 9 9123913 3 10 -6049434 3 11 -8628844
 D 3 12 9129478 3 13 -6110437 3 14 -8547408 3 15 9101891 4 5 7314757
 D 4 6 -6584612 4 7 8855828 4 8 6618231 4 9 -6120633 4 10 8644975
 D 4 11 6719067 4 12 -6146867 4 13 9196058 4 14 6570361 4 15 -6080452
 D 5 6 -9457429 5 7 6715631 5 8 9059736 5 9 -8638738 5 10 6629996
 D 5 11 9115914 5 12 -8644802 5 13 6761874 5 14 9021820 5 15 -8618635
 D 6 7 -6119428 6 8 -8579319 6 9 9106504 6 10 -6065773 6 11 -8614526
 D 6 12 9107269 6 13 -6091915 6 14 -8549671 6 15 9091836 7 8 7490497
 D 7 9 -6738349 7 10 8957189 7 11 6732326 7 12 -6077205 7 13 8906496
 D 7 14 6741117 7 15 -6106114 8 9 -9436095 8 10 6714660 8 11 9068285
 D 8 12 -8572374 8 13 6657494 8 14 9019966 8 15 -8572268 9 10 -6018320
 D 9 11 -8635133 9 12 9145620 9 13 -6137363 9 14 -8539669 9 15 9109695
 D 10 11 7417613 10 12 -6659253 10 13 8713428 10 14 6713522 10 15 -6041882
 D 11 12 -9449619 11 13 6741577 11 14 9026609 11 15 -8612504 12 13 -6156397
 D 12 14 -8526098 12 15 9111271 13 14 7238112 13 15 -6643338 14 15 -9445466

ITRF position of 9401 as determined by individual baselines

	X	Y	Z
mtms	-1386048.092	-4031301.350	4729710.840
p053	-1386048.086	-4031301.355	4729710.857
mtlw	-1386048.086	-4031301.342	4729710.842
p049	-1386048.083	-4031301.346	4729710.847
p052	-1386048.092	-4031301.348	4729710.835

Residuals of position determined by individual baselines from the final position

	X	Y	Z	East	North	Up
mtms	-0.001	0.003	-0.006	-0.002	-0.002	-0.006
p053	0.005	-0.003	0.010	0.005	0.006	0.008
mtlw	0.005	0.010	-0.005	0.001	0.005	-0.011
p049	0.008	0.006	0.000	0.006	0.006	-0.006
p052	-0.001	0.005	-0.011	-0.002	-0.005	-0.011

STATE PLANE COORDINATES - International Foot

SPC (2500 MT)	
Northing (Y) [feet]	1426875.453
Easting (X) [feet]	2096814.626
Convergence [degrees]	0.38473087
Point Scale	0.99959485
Combined Factor	0.99943768

** Orthometric Heights Above Future Geopotential Datum.

Prototype orthometric heights are now being made available as a precursor to the completion of GRAV-D and the replacement of NAVD 88 with a new geopotential reference system. The following height reflects the current best estimate of the true orthometric height, based on the existing gravimetric geoid model. This height is subject to change as data and modeling for the gravimetric geoid change throughout the lifetime of the GRAV-D project, or as new realizations of the ITRF are adopted. However, at the completion of GRAV-D, these heights will supersede the NAVD 88 heights

APPROX ORTHO HGT: 1017.673 (m) [PROTOTYPE (Computed using USGG2012,GRS80,IGS08)]

dop from interpolation is 0.504
scatter (mean square distance from rover) is 18353.832
average edop for rover is 0.750
average ndop for rover is 0.790
average hdop for rover is 1.089
average vdop for rover is 1.860
average gdop for rover is 2.470

This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.