



DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

NDGPS Site: Moriches DGPS Site (803)

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REFERENCES:

- (1) DGPS Concept of Operations, COMDTINST 16577.2 (AUG 1995)
- (2) 2010 Federal Radio Navigation Plan
- (3) Broadcast Standard for the USCG DGPS Navigation Service, CIM 16577.1 (APR 1993).
- (4) RTCM Recommend Standards for Differential GNSS Service, Version 2.3.

PURPOSE:

- Validate advertised DGPS coverage of the Moriches DGPS site.
- Validate required RTCM message scheduling and delivery.
- Test differential correction accuracy versus a predetermined survey monument.

EQUIPMENT:

Trimble SPS 461 Receiver

Trimble GA 530 Antenna

MORICHES DGPS SITE PARAMETERS:

Frequency	293 KHz
Forward Output Power	900 W
Transmission Rate	100 baud
Field Strength/Range	75 μ V/m (37.5 dB μ V/m) at 241 km

SUMMARY:

The Operational Assessment of the Moriches DGPS site revealed that the provided coverage is consistent with the predicted coverage area except as noted below. Far-Field (FF) signal strength readings taken on the north side of the coverage area did not meet the required 75 μ V/m. FF readings taken on the southern range ring exceeded system requirements. Additionally a review of the output/reflected power and near-field signal strength levels was conducted and found to be satisfactory. All RTCM messages were verified and evaluated and are consistent with the requirements set forth by reference (3) and (4) except as noted below in the Type-7 RTCM message. Finally, accuracy measurements taken at a range of 92.8 km from the DGPS site revealed 0.4 to 0.5 meter horizontal accuracy which exceeds accuracy requirements set forth by Reference (1) and (2).

RESULTS:

Signal Strength:

Verification of the Moriches DGPS coverage area was conducted from Corson's Inlet New Jersey to Rockport, MA and then from Glen Falls, NY south to Maryland. Figure 1 below shows that the DGPS coverage is consistent with the predicted coverage plot and does not meet the advertised 241 km range to the north of the coverage area. Green points represent areas of satisfactory signal strength. Areas of unsatisfactory signal strength are represented with red points. Far-Field signal strength measurements were taken at northern and southern points of the advertised range from both sides of the site (Table 1 to 4). The southern FF readings were well above the required 37.5 dB μ V/m while the northern readings taken did not meet system requirements.

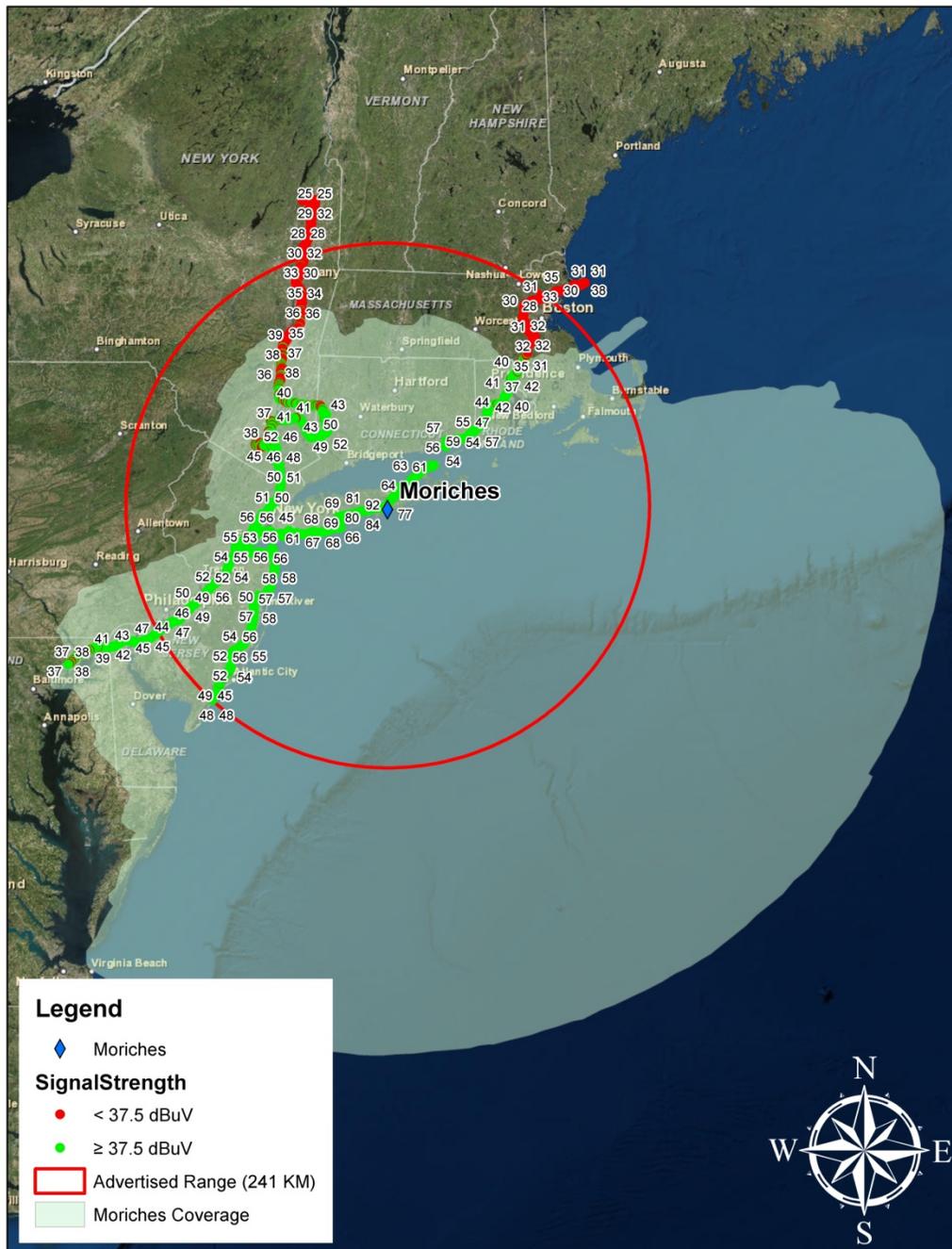


Figure 1: DNAV Signal Strength Results

Signal Strength	Signal to Noise ratio	Position
50 dB μ V/m	30 dB μ V/m	39° 11.713180' N, 074° 39.427520' W

Table 1: South East (NJ) - Far-Field Signal Strength Reading

Signal Strength	Signal to Noise ratio	Position
30 dB μ V/m	9 dB μ V/m	42° 31.045723' N, 071° 59.799259' W

Table 2: North East (MA) - Far-Field Signal Strength

Signal Strength	Signal to Noise ratio	Position
30 dB μ V/m	3 dB μ V/m	42° 50.469900' N, 073° 40.528171' W

Table 3: North West (NY) - Far-Field Signal Strength

Signal Strength	Signal to Noise ratio	Position
45 dB μ V/m	19 dB μ V/m	39° 46.051069' N, 075° 15.207791' W

Table 4: South West (NJ) - Far-Field Signal Strength

RTCM Message Verification:

RTCM message scheduling, receipt, and content were checked during the assessment (Table 5 and 6). Receipt of all RTCM messages was validated utilizing a Remote Desktop session whereby the assessment team witnessed the on-time receipt of all messages on the Moriches side A Integrity Monitor. All message content was verified and is in accordance with Reference (4) with the exception of the location information provided in the Type-7 message for the Moriches DGPS site which places the site position 1.6 km to the north and 1.0 km to the west. RTCM message scheduling on both Side A and Side B was validated with the DGPS watch and is in accordance with the Reference (3).

Message Type	Received	Scheduled	Content Verified/Accurate
<i>Type 3</i>	Y	Y	Y
<i>Type 5 (ensure message is not being transmitted)</i>	N	N	N/A
<i>Type 7</i>	Y	Y	N
<i>Type 9</i>	Y	Y	Y
<i>Type 16</i>	Y	Y	Y

Table 5: Side A RTCM Message Validation

Message Type	Received	Scheduled	Content Verified/Accurate
<i>Type 3</i>	Y	Y	Y
<i>Type 5 (ensure message is not being transmitted)</i>	N	N	N/A
<i>Type 7</i>	Y	Y	N
<i>Type 9</i>	Y	Y	Y
<i>Type 16</i>	Y	Y	Y

Table 6: Side B RTCM Message Validation

Accuracy Validation:

The OA team placed a Trimble GA 530 antennae atop of a National Geodetic Survey (NGS) marker and collected positional data for 10 minutes per side. Next, they post processed and compared the data to the published survey marker position in order to verify the horizontal accuracy of the broadcast correction (Table 7 and 8). Side A broadcasted a correction that was calculated to be 0.4247 meters away from the monument, bearing 297.8°. Side B’s correction was calculated to be 0.5110 meters away from the monument, bearing 318.6°. As per Reference (1) and (2), both respective distances were well within advertised accuracy requirements.

The OA team conducted a comparison (Table 7) between the GPS satellites in view at the Moriches DGPS site and at the NGS monument location to identify any differences in the GPS satellite geometry used at the respective locations; any differences in geometry could lead to accuracy discrepancies. The Trimble SPS 461 received corrections for nine GPS satellites during the accuracy check performed on side A and side B.

A two dimension radial review of the same time period was completed for the integrity monitors. Side A’s average deviation was 0.24659 meters; Side B’s average deviation was 0.24858 meters. Both findings were consistent with the findings observed in the field and are well within system parameters.

NGS Monument ID:	BBDD33
Monument LAT:	40° 37.054’ N
Monument LON:	073° 49.481685’ W
Distance from DGPS Site	92.8 km

Averaged LAT:	40 ° 37.054107’ N
Averaged LON:	073° 49.481952 ’ W
Antenna Distance from Monument:	0.4247 meters (1.39ft)
Antenna Bearing from Monument:	297.8°

Table 7: Side A Accuracy Check Results

Averaged LAT:	40 ° 37.054207 ’N
Averaged LON:	073 ° 49.481925 ’ W
Distance from Monument:	0.5110 meters (1.68 ft)
Bearing from Monument:	318.6°

Table 8: Side B Accuracy Check Results

Antenna Location	GPS Satellites Tracked (PRN)											
Reference Station A	1	4	6	7	11	17	20	28	30	32		
Integrity Monitor A	1	4	6	7	11	17	20	28	30	32		
Reference Station B	1	4	6	7	11	17	20	28	30	32		
Integrity Monitor B	1	4	6	7	11	17	20	28	30	32		
NGS Monument Location, Side A	1	4	6	11	17	20	28	30	32			
NGS Monument Location, Side B	1	4	6	11	17	20	28	30	32			

Table 9: GPS Satellite Comparison