



DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

NDGPS Site: Albuquerque, NM DGPS Site (875)
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REFERENCES

- (1) Broadcast Standard for the USCG DGPS Navigation Service, CIM 16577.1 (APR 1993).
- (2) Radio Technical Commission for Maritime Services (RTCM) Recommended Standards for Differential Global Navigation Satellite System (GNSS) Service, Version 2.3.
- (3) Differential Global Positioning System (DGPS) Concept of Operations, COMDTINST 16577.2 (AUG 1995).
- (4) 2014 Federal Radio Navigation Plan.

PURPOSE

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

EQUIPMENT

Trimble SPS461 Receiver
Trimble GA 530 Antenna
Dell Latitude E6320 Laptop

ALBUQUERQUE DGPS SITE PARAMETERS

Frequency	291 KHz
Forward Output Power	600 W
Transmission Rate	100 baud
Field Strength/Range	75 μ V/m (37.5 dB μ V/m) at 400 km

SUMMARY

The Operational Assessment of the Albuquerque DGPS site revealed that the provided coverage is consistent with the advertised range. Both eastern and western far-field signal strength readings were within the required signal strength. The signal strength measurements, were satisfactory, and in some cases, better than the advertised range. 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, evaluated and are consistent with the requirements set forth by reference (1) and (2). Finally, accuracy measurements and analysis proved that at a distance of approximately 216 km from the broadcast site, the horizontal accuracy is sub-meter and within the 10 meter accuracy requirement as set forth by Reference (3) and (4).

RESULTS

Signal Strength

A verification of the Albuquerque DGPS coverage area was conducted from Lubbock, TX to the site and to Flagstaff, AZ. The advertised signal strength range is 400 km. Figure 1 below displays adequate signal strength, beyond the advertised range of 400 km from the site and throughout the planned route in the coverage area. Green points represent areas of satisfactory signal strength, whereas areas of unsatisfactory signal strength are represented with red points. As seen in Table 1 and Table 2, far-field signal strength readings were taken at eastern and western points of the advertised range from both sides of the site. Both eastern and western far-field readings were above the required 37.5 dB μ V/m signal strength on both sides.

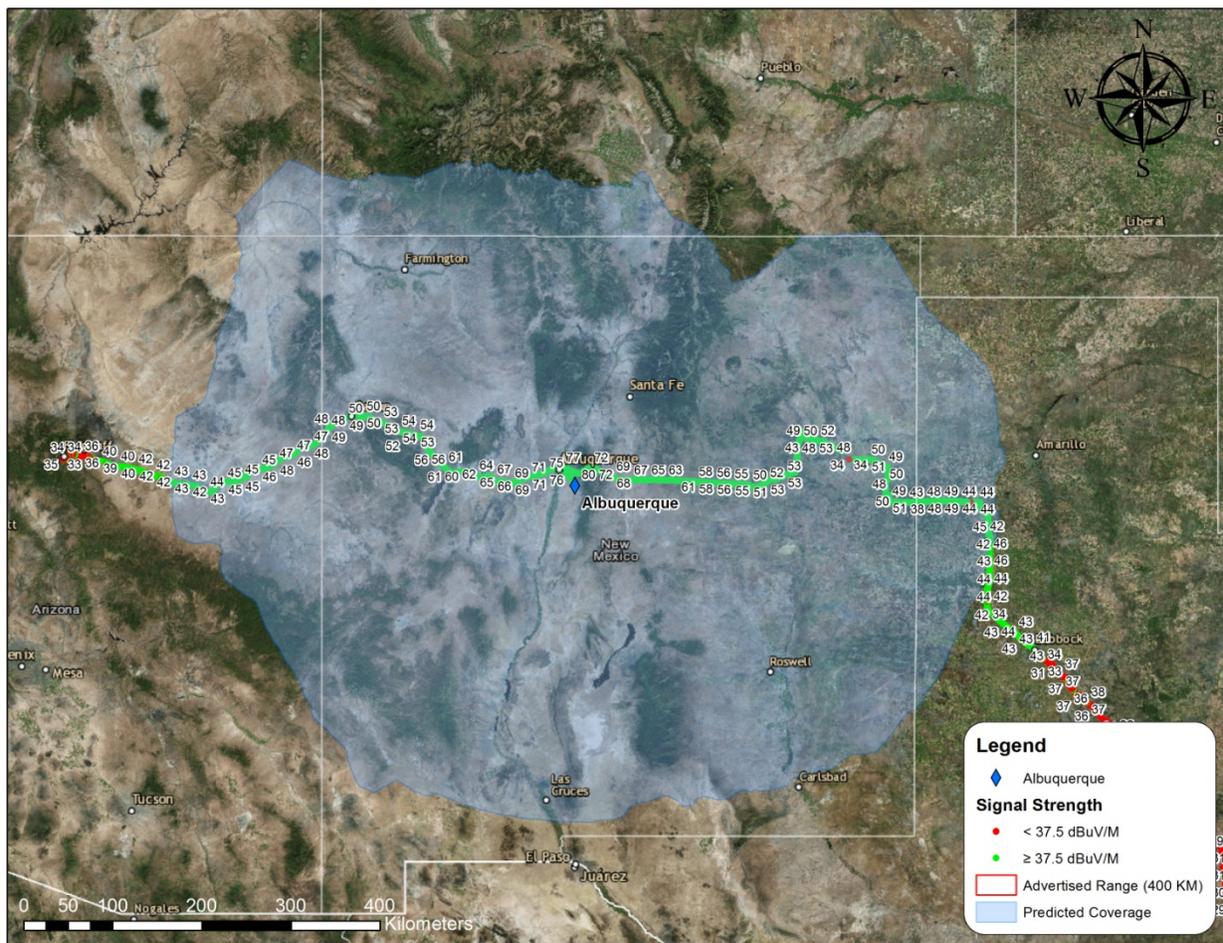


Figure 1: Signal Strength Results

Side	Signal Strength	Signal to Noise ratio	Position
A	44 dB μ V/m	27 dB μ V/m	33° 55' 31.57" N, 102° 19' 36.73" W
B	44 dB μ V/m	28 dB μ V/m	

Table 1: East Far-Field Signal Strength Reading

Side	Signal Strength	Signal to Noise ratio	Position
A	42 dB μ V/m	26 dB μ V/m	35° 5' 42.57" N, 110° 56' 8.84"W
B	42 dB μ V/m	26 dB μ V/m	

Table 2: West Far-Field Signal Strength Reading

RTCM Message Verification

Table 3 and Table 4 shows RTCM message scheduling, receipt, and content collected during the assessment. RTCM message scheduling on both Side A and Side B was validated with the DGPS watch and is in accordance with the Reference (1). 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 active and standby Integrity Monitor computers. All message content was verified and is in accordance with Reference (2).

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	Y
<i>Type 9</i>	Y	Y	Y
<i>Type 16</i>	Y	Y	Y

Table 3: 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	Y
<i>Type 9</i>	Y	Y	Y
<i>Type 16</i>	Y	Y	Y

Table 4: Side B RTCM Message Validation

Accuracy Validation

Positional data was collected for 10 minutes per side using the Trimble SPS461. The data was then post processed and compared to a National Geodetic Survey (NGS) marker (Table 5) to verify the horizontal accuracy of the broadcast correction (Table 6 and 7). Side A was 0.5006 meters, bearing 312.6247° from the monument, while Side B was 0.3739 meters, bearing

312.6839° from the monument. As per Reference (3) and (4), both respective distances were within advertised accuracy requirements. A comparison between the GPS satellites in view at the Albuquerque DGPS site and at the NGS monument location was conducted (Table 8) to identify any differences in the GPS satellite geometry used at the respective locations; any differences in geometry could lead to accuracy discrepancies. In this case, the satellites being tracked by the Reference Station and Integrity Monitor GPS receivers at the site were almost identical to those tracked at the NGS monument location. A two dimension radial review of the same time period was completed for the integrity monitors. Side A’s average deviation was 0.18233 meters; Side B’s average deviation was 0.18760 meters. Both findings were consistent with the findings observed in the field and are within system parameters.

NGS Monument ID:	FN0455
Monument LAT:	35° 23' 40.44501" N
Monument LON:	104° 10' 47.94805" W
Distance from DGPS Site	216 km

Table 5: NGS Monument ID

Averaged LAT:	35° 23' 40.45599" N
Averaged LON:	104° 10' 47.96268" W
Distance from Monument:	0.5006 m (1.642389 ft)
Bearing from Monument:	312.6247°

Table 6: Side A Accuracy Check Results

Averaged LAT:	35° 23' 40.45155" N
Averaged LON:	104° 10' 47.96055" W
Distance from Monument:	0.3739 m (1.226706 ft)
Bearing from Monument:	312.6839°

Table 7: Side B Accuracy Check Results

<i>Antenna Location</i>	<i>GPS Satellites Tracked (PRN)</i>										
Reference Station A	2	5	13	15	18	20	21	25	26	29	
Integrity Monitor A	2	5	13	15	18	20	21	25	26	29	
Reference Station B	2	5	12	13	15	16	18	20	21	25	26
Integrity Monitor B	2	5	16	15	18	20	21	25	26	29	
NGS Monument Location, Side A	2	5	6	12	20	25	29				
NGS Monument Location, Side B	2	5	6	12	20	25	29				

Table 8: GPS Satellite Comparison

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Discrepancies

No discrepancies noted

RECOMMENDATION

No changes recommended. The predicted coverage is less than the advertised range. However, data supports measured coverage just beyond the advertised range ring.

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