



DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

NDGPS Site: Essex, CA DGPS Site (875)

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REFERENCES

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

PURPOSE

- Validate advertised DGPS coverage of the Essex, CA 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

ESSEX DGPS SITE PARAMETERS

Frequency	298 KHz
Forward Output Power	1000 W
Transmission Rate	100 baud
Field Strength/Range	75 μ V/m (37.5 dB μ V/m) at 325 km

SUMMARY

An Operational Assessment of the Essex, CA DGPS site revealed that the provided coverage is consistent with the predicted coverage plot and advertised range. The signal strength measurements, throughout the predicted coverage area within the advertised range, were largely satisfactory. Exceptions were observed in short segments North of San Diego as well as Northeast of Los Angeles and may be due to terrestrial masking. All RTCM messages were verified, evaluated, and are consistent with the requirements set forth by reference (3) and (4). Accuracy check results of .86 meters for Side A and 1.51 meters for Side B were within the 10 meter requirement as set forth by Reference (1) and (2).

RESULTS

Signal Strength

A verification of the Essex, CA DGPS coverage area was conducted from San Diego, CA, along the coast to Bakersfield, CA then east to Phoenix, AZ, and finally north to Las Vegas, NV. The advertised signal strength range is 325 km. Figure 1 displays adequate signal strength within the advertised range and throughout the predicted 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 the northwestern and southeastern points of the advertised range from Side A of the site. Both northern and southern far-field readings were well above the required 37.5 dB μ V/m signal strength on both sides.

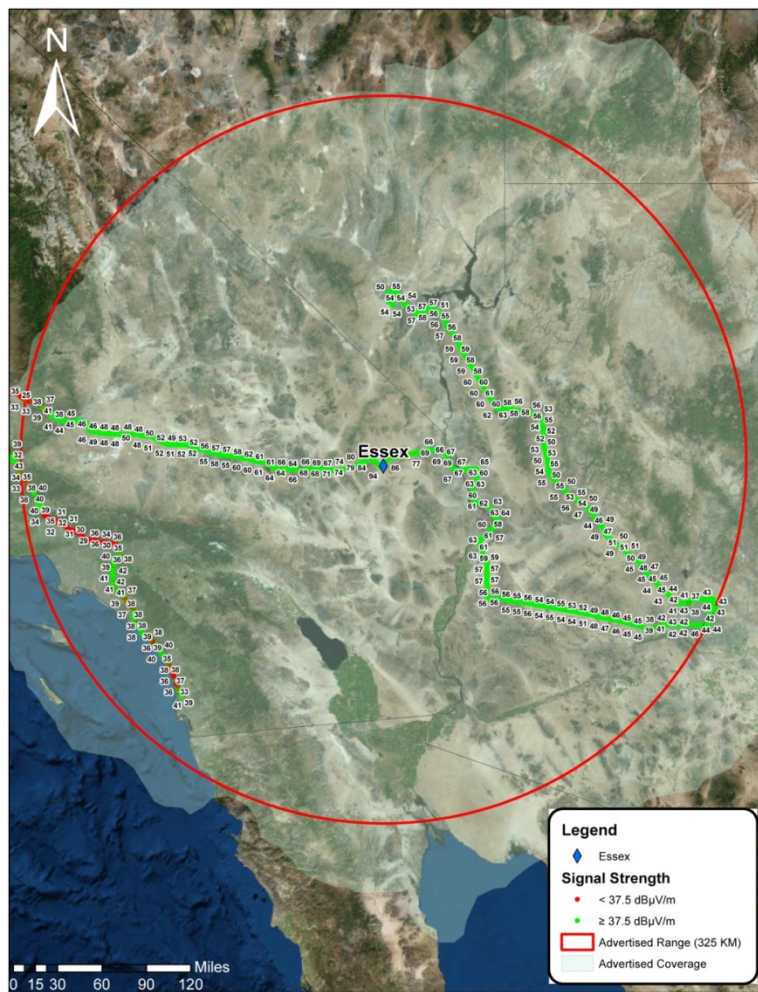


Figure 1: Signal Strength Results

Side	Signal Strength	Signal to Noise ratio	Position
A	39 dB μ V/m	24 dB μ V/m	35° 17' 4.58" N, 118° 44' 0.08" W
B	N/A	N/A	

Table 1: Northwestern Far-Field Signal Strength Reading

Side	Signal Strength	Signal to Noise ratio	Position
A	64 dB μ V/m	36 dB μ V/m	34° 43' 34.71" N, 116° 8' 20.03" W
B	N/A	N/A	

Table 2: Southeastern Far-Field Signal Strength Reading

RTCM Message Verification

Table 3 and Table 4 show 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 Reference (3). 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 (4).

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 to verify the horizontal accuracy of the broadcast correction (See Table 5 through Table 7). Side A was 0.8699 meters, bearing 349.6275° from the monument, while Side B was 1.5110 meters, bearing 257.6381° from the monument. Per Reference (1) and (2), both respective distances were well within advertised accuracy requirements. As seen in Table 8, a comparison between the GPS satellites in view at the Essex DGPS site and those at the NGS monument location was conducted 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 different from 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 0.32011meters; Side B's average deviation was 0.31736 meters. Both findings were consistent with the findings observed in the field and are well within system parameters.

NGS Monument ID:	BBCR82
Monument LAT:	33° 12' 31.67560"N
Monument LON:	33° 12' 31.67560"N
Distance from DGPS Site	263 km

Table 5: NGS Monument ID

Averaged LAT:	33° 12' 31.7033" N
Averaged LON:	117° 23' 40.10267"W
Antenna Distance from Monument:	0.8699 m (2.87067 ft)
Antenna Bearing from Monument:	349.6275°

Table 6: Side A Accuracy Check Results

Averaged LAT:	33° 12' 31.66513" N
Averaged LON:	117° 23' 40.15371" W
Distance from Monument:	1.511 m (4.9863 ft)
Bearing from Monument:	257.6381°

Table 7: Side B Accuracy Check Results

<i>Antenna Location</i>	<i>GPS Satellites Tracked (PRN)</i>										
Reference Station A	1	6	13	15	17	24	28	30			
Integrity Monitor A	1	6	13	15	17	24	28	30			
Reference Station B	2	5	10	12	21	25	26	31			
Integrity Monitor B	2	5	10	12	21	25	26	31			
NGS Monument Location, Side A	1	3	4	11	23	31	32				
NGS Monument Location, Side B	1	3	4	11	16	23	31	32			

Table 8: GPS Satellite Comparison

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