



DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

NDGPS Site:	Point Loma DGPS Site (881)
Inspector(s):	LT Hermie Mendoza, CWO Louie Baytan
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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 Point Loma DGPS site.
- Validate required RTCM message scheduling and delivery.
- Test differential correction accuracy versus a predetermined survey monument.

EQUIPMENT:

DNAV 212 Receiver
MBA-2 Receive Antenna
Trimble SPS461 Receiver
Trimble GA 530 Antenna

POINT LOMA DGPS SITE PARAMETERS:

Frequency	302 KHz
Forward Output Power	500 W
Transmission Rate	100 baud
Field Strength/Range	75 μ V/m (37.5 dB μ V/m) at 333 km

RESULTS:

Signal Strength:

A verification of the Point Loma DGPS coverage area was conducted from Santa Maria, CA along the Pacific Coast to San Ysidro, CA. The advertised signal strength range is 333 km. Figure 1 displays inadequate signal strength to the advertised range of 333 km from the site. Green points represent areas of satisfactory signal strength. Areas of unsatisfactory signal strength are represented with red points. Far-field (FF) signal strength readings were taken at northern point of the advertised range from both sides of the site (Table 1 and Table 2). The northern FF readings were below the required 37.5 dB μ V/m signal strength.



Figure 1: DNAV Signal Strength Results

Table 1: North Far-Field Signal Strength Reading

	POSITION	Trimble SPS461
Side A SS	34° 29' 18.2"N 120° 13' 35.2"W	35 dB μ V/m, 22 SNR

Table 2: Northeast Far-Field Signal Strength Reading

	POSITION	Trimble SPS461
Side A SS	35° 23' 54.5"N 115° 48' 24.2"W	21 dB μ V/m, 6 SNR

RTCM Message Verification:

RTCM message scheduling, receipt, and content were checked during the assessment (Table 3 and 4). RTCM message scheduling on both Side A and Side B was validated with the DGPS watch and is in accordance with the 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).

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

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

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 (Table 5 and 6). Side A was 1.396 meters, bearing 316.754°, away from the monument while Side B was 1.412 meters, bearing 317.860°, away from the monument. As per Reference (1) and (2), both respective distances were well within advertised accuracy requirements. A comparison between the GPS satellites in view at the Point Loma DGPS site and at the NGS monument location was conducted (Table 7) 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 RS and IM 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 0.1996 meters; Side B's average deviation was 0.2292 meters. Both findings were consistent with the findings observed in the field and are well within system parameters.

NGS Monument ID:	EW6804
Monument LAT:	34° 21' 20.41928" N
Monument LON:	-119° 26' 30.82084" W

Table 5: Side A Accuracy Check Results

Averaged LAT:	34° 21' 20.452212" N
Averaged LON:	119° 26' 30.85836" W
Distance from DGPS Site:	277.2 km
Antenna Distance from Monument:	1.396 m (4.5800 ft)
Antenna Bearing from Monument:	316.754°

Table 6: Side B Accuracy Check Results

Averaged LAT:	43° 24' 54.8969472" N
Averaged LON:	089° 32' 17.6012634" W
Distance from DGPS Site:	277.2 km
Distance from Monument:	1.412 m (4.632546 ft)
Bearing from Monument:	317.860°

Table 7: GPS Satellite Comparison

<i>Antenna Location</i>	<i>GPS Satellites Tracked (PRN)</i>										
Reference Station A	1	4	8	9	15	17	24	26	28		
Integrity Monitor A	1	4	7	8	9	15	17	24	26	28	
Reference Station B	1	2	4	8	9	15	17	24	26	28	
Integrity Monitor B	1	2	4	8	9	15	17	24	26	28	
NGS Monument Location, Side A	1	4	8	9	15	17	24	26	28		
NGS Monument Location, Side B	1	4	8	9	15	17	24	26	28		

SUMMARY:

The Operational Assessment of the Point Loma DGPS site revealed that the provided coverage is not consistent with the predicted coverage plot and advertised range. Both northern and northeastern Far-Field signal strength readings were below the required signal strength. The signal strength measurements, throughout most of the predicted coverage area within the advertised range, were satisfactory. However, signal strengths north of Santa Barbara and east of Rancho Cucamonga, CA were inadequate, possibly due to signal masking from mountainous and/or forested terrain as the site is located near sea level. 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). Finally, accuracy measurements and analysis proved that at a distance of approximately 277 km from the broadcast site, the horizontal accuracy is less than 1.5 meters and within the accuracy requirements set forth by Reference (1) and (2).