



## DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

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<b>NDGPS Site:</b>	Lompoc DGPS Site (882)
<b>Inspector(s):</b>	LT Hermie Mendoza, CWO3 Louie Baytan
<b>Date:</b>	28 JUL 2013

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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 Lompoc DGPS site.
- Validate required RTCM message scheduling and delivery.
- Test differential correction accuracy versus a predetermined survey monument.

### **EQUIPMENT:**

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

### **LOMPOC DGPS SITE PARAMETERS:**

Frequency	321 KHz
Forward Output Power	900 W
Transmission Rate	100 baud
Field Strength/Range	75 $\mu$ V/m (37.5 dB $\mu$ V/m) at 333 km

### **RESULTS:**

#### ***Signal Strength:***

A verification of the Lompoc DGPS coverage area was conducted from San Francisco, CA, along the California Coast to Point Loma then northeast towards Nevada. The advertised signal range is 333 km. Figure 1 displays the route taken with green points representing areas of satisfactory signal strength. Areas of unsatisfactory signal strength are represented with red points. Signal strength in the north between San Francisco and Salinas, CA were inadequate possibly due to masking from the mountainous terrain. Signal strengths to the south of the site

extend beyond the advertised range of 333 Km and predicted coverage area before decreasing again in the northeasterly route.

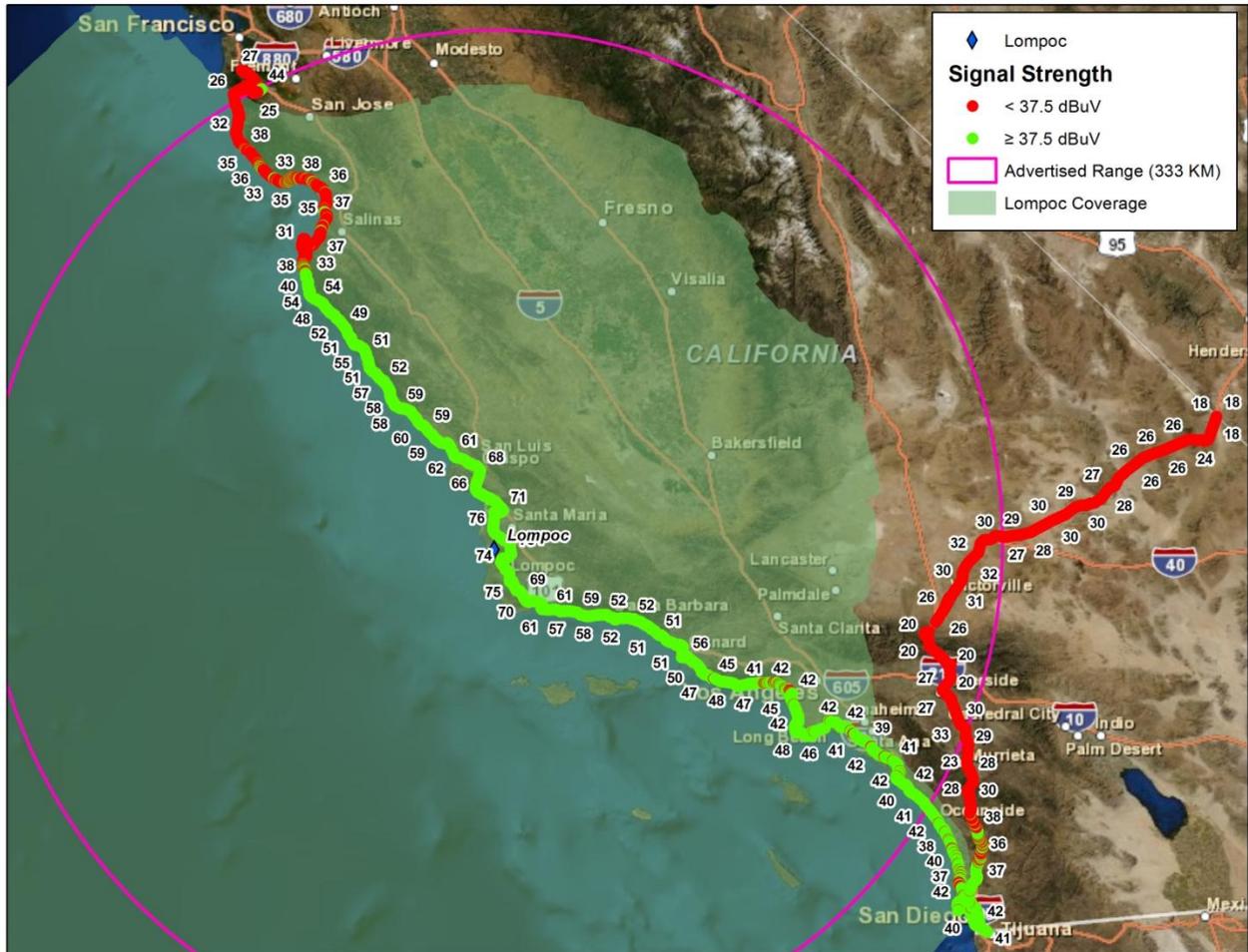


Figure 1: DNAV Signal Strength Results

Table 1: North Far-Field Signal Strength Reading

	POSITION	Trimble SPS461
Side A SS	37° 30' 42.9"N 122° 20' 58.4"W	25 dB $\mu$ V/m, 10 SNR

Table 2: South Far-Field Signal Strength Reading

	POSITION	Trimble SPS461
Side A SS	33° 21' 07.9"N 117° 31' 19.4"W	42 dB $\mu$ V/m, 28 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 0.2371 meters, bearing 106.405°, away from the monument while Side B was 0.4985 meters, bearing 113.563°, 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 Lompoc 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 0.2186 meters; Side B’s average deviation was 0.4251 meters. Both findings were consistent with the findings observed in the field and are well within system parameters. Furthermore, a comparison between the uncorrected GPS position and the NGS Monument was conducted to see how effective the DGPS corrections were.

<b>NGS Monument ID:</b>	<b>EW6804</b>
Monument LAT:	34° 21' 20.41928" N
Monument LON:	119° 26' 30.82084" W

Table 5: Side A Accuracy Check Results

<b>Averaged LAT:</b>	34° 21' 20.417112" N
<b>Averaged LON:</b>	119° 26' 30.81192" W
<b>Distance from DGPS Site:</b>	115 km
<b>Antenna Distance from Monument:</b>	0.2371 m (0.77789 ft)
<b>Antenna Bearing from Monument:</b>	106.405°

Table 6: Side B Accuracy Check Results

<b>Averaged LAT:</b>	34° 21' 20.412828" N
<b>Averaged LON:</b>	119° 26' 30.80292" W
<b>Distance from DGPS Site:</b>	115 km
<b>Distance from Monument:</b>	0.4985 m (1.63550 ft)
<b>Bearing from Monument:</b>	113.563°

Table 7: GPS Satellite Comparison

<i>Antenna Location</i>	<i>GPS Satellites Tracked (PRN)</i>											
Reference Station A	1	2	4	8	9	12	15	17	24	26	28	
Integrity Monitor A	2	4	9	12	15	17	24	26	28			
Reference Station B	1	2	4	8	9	12	15	17	24	26	28	
Integrity Monitor B	1	2	4	8	9	12	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 Lompoc DGPS site revealed that the provided coverage is consistent with the predicted coverage plot and advertised range. The northern Far Field signal strength was below the required signal strength while the southern Far-Field signal strength readings were well within it. The signal strength measurements, throughout most of the predicted coverage area within the advertised range, were satisfactory. **However, signal strengths north of Salinas and east of Oceanside, CA were inadequate, possibly due to signal masking from mountainous and/or forested terrain.** 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 115 km from the broadcast site, the horizontal accuracy is sub-meter and within the accuracy requirements set forth by Reference (1) and (2).