



## DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

**NDGPS Site:** Lincoln, CA DGPS Site (764)  
**Inspector(s):** LCDR Marlon Heron & CWO2 Marin Kaczmar  
**Date:** September 2016

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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 Lincoln 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 E3620 Laptop

### LINCOLN DGPS SITE PARAMETERS

Frequency	314 KHz
Forward Output Power	700 W
Transmission Rate	200 BPS
Field Strength/Range	100 $\mu$ V/m (40 dB $\mu$ V/m) at 225 km

### SUMMARY

The Operational Assessment of the Lincoln Differential Global Positioning System (DGPS) site revealed that the provided coverage is consistent with the advertised range. The signal strength measurements within the advertised range were satisfactory. Both northern and southern far-field signal strength readings were within the required signal strength. 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 references (1) and (2). A far field accuracy evaluation was not conducted due to a software malfunction on the laptop used for the assessment.

**RESULTS**

***Signal Strength***

A verification of the Lincoln DGPS coverage area was conducted from Oakland, CA to Eugene OR, and south along the coast to Santa Barbara, CA. A waterborne assessment of the San Francisco Bay was performed to verify coverage in high vessel traffic areas including the Port of San Francisco and Port of Oakland. The advertised signal strength range is 225 km. Figure 1 below displays adequate signal strength between the East and West mountain ranges throughout the predicted coverage area. Green points represent areas of signal strength above 40 dB $\mu$ V/m, whereas areas below 40 dB $\mu$ V/m are represented in yellow. Areas where a DGPS fix was unable to be obtained are represented in red. As seen in Table 1 and Table 2, far-field signal strength readings were taken at northern and southern points of the advertised range from both sides of the site. Both northern and southern far-field readings were above the required 40 dB $\mu$ V/m signal strength on both sides.

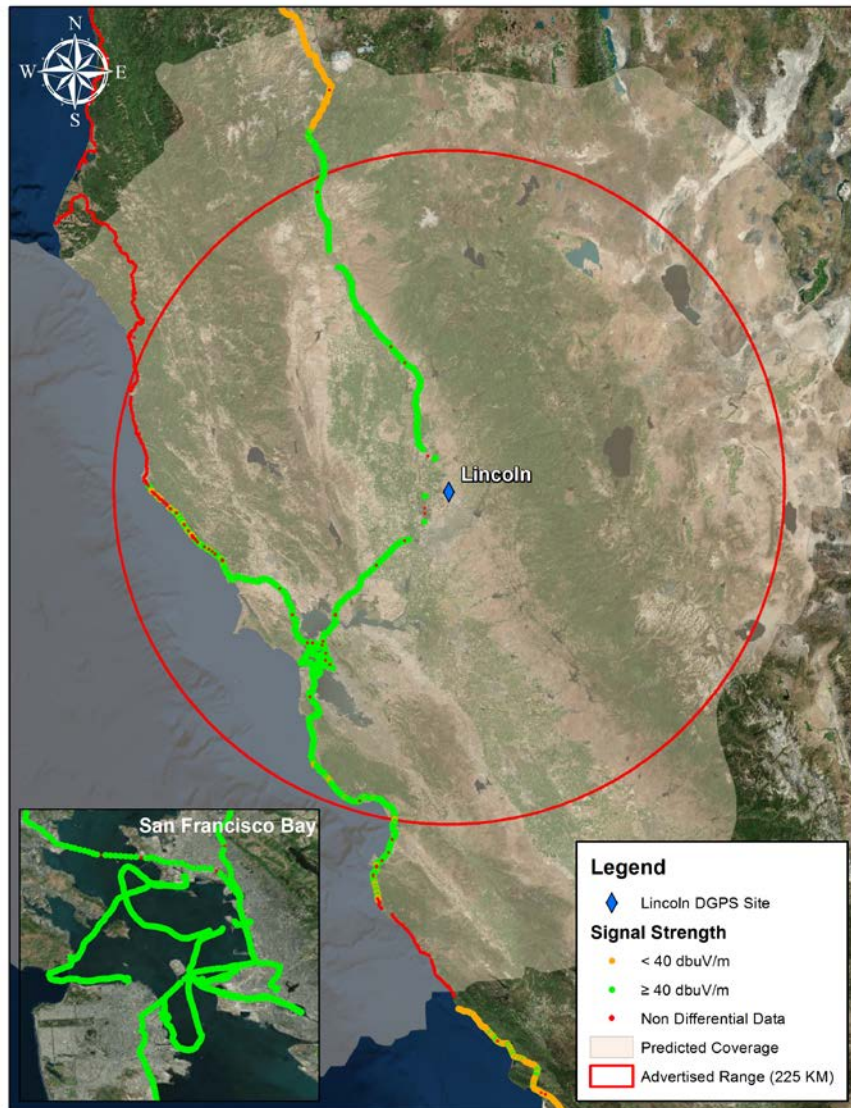


Figure 1: Signal Strength Results

Side	Signal Strength	Signal to Noise ratio	Position
A	43 dB $\mu$ V/m	23 dB $\mu$ V/m	14° 00' 09.75"N, 122° 24' 36.82" W

Table 1: North Far-Field Signal Strength Reading

Side	Signal Strength	Signal to Noise ratio	Position
A	47 dB $\mu$ V/m	18 dB $\mu$ V/m	36° 57' 45.15"N, 122° 02' 37.93"W

Table 1: South Far-Field Signal Strength Reading

**Accuracy Validation**

Due to a problem with the software, the monument’s accuracy positional data was not collected for 10 minutes per side. However, the rest of the required data was collected for the Lincoln DGPS site. A comparison between the GPS satellites in view at the Lincoln DGPS site and at the NGS monument location was conducted (Table 6) 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 using archived data from the DGPS Nationwide Control Station (NCS). Side A’s average deviation was 0.07327 meters; Side B’s average deviation was 0.06477 meters. Both findings were consistent with the findings observed in the field and are within system parameters.

<b>NGS Monument ID:</b>	<b>BBCP23</b>
Monument LAT:	38° 54' 50.84224" N
Monument LON:	123° 42' 31.36884" W
Distance from DGPS Site	204km

Table 3: NGS Monument ID

<i>Antenna Location</i>	<i>GPS Satellites Tracked (PRN)</i>										
Reference Station A	8	10	14	18	21	24	27	32			
Integrity Monitor A	8	10	14	18	21	24	27	32			
Reference Station B	8	10	11	14	18	21	24	27	32		
Integrity Monitor B	8	10	11	14	18	21	27	32			
NGS Monument Location, Side A	8	10	14	18	21	27	32				
NGS Monument Location, Side B	8	10	11	14	18	21	27	32			

Table 6: GPS Satellite Comparison

***Discrepancies***

There was limited data collected from the Lincoln DGPS site during the Lincoln accuracy check due to a software problem. For some reason, the Hydro Pro accuracy file was not loaded with the Lincoln frequency. It was locked onto Cape Mendocino. All of the accuracy data at the monument was from Cape Mendocino. The rest of the required data was collected while at the monument for the Lincoln DGPS site. The only data not collected was the accuracy positional data of the monument.

**RECOMMENDATION**

No changes recommended

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