



DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

NDGPS Site: Cape Mendocino, CA DGPS Site (885)
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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 Cape Mendocino 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

CAPE MENDOCINO DGPS SITE PARAMETERS

Frequency	292 KHz
Forward Output Power	900 Watts
Transmission Rate	100 BPS
Field Strength/Range	75 μ V/m (37.5 dB μ V/m) at 333 km

SUMMARY

The Operational Assessment of the Cape Mendocino Differential Global Positioning System (DGPS) site revealed that the provided coverage is consistent with the advertised range. The signal strength verification within the advertised range was satisfactory. Both northern and southern far-field signal strength readings were within the required signal strength, with the exception of portions of San Francisco Bay. The signal in the majority of the area, being beyond the advertised usable range, was too weak to receive a differential lock. 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). Finally, accuracy measurements and analysis proved that at a distance of approximately 255 km from the broadcast site, the horizontal accuracy is sub-meter and within the 10 meter accuracy requirement as set forth by references (3) and (4).

RESULTS

Signal Strength

A verification of the Cape Mendocino 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 333 km. Figure 1 below displays adequate signal strength along the California coastline, which is the intended service area for this site. The areas to the east and throughout the bay area did not receive adequate signal strength due to terrestrial masking; however, these areas received a very strong signal and reliable coverage from the Lincoln DGPS site. Green points represent areas of signal strength above 37.5 dB μ V/m, whereas areas below 37.5 dB μ V/m are represented in yellow. Areas where a DGPS fix was unable to be obtained are represented in red. As seen in figure 1 below, far-field signal strength readings were taken at a northern point of the advertised range from both sides of the site. The northern far-field readings were above the required 37.5 dB μ V/m signal strength on both sides.

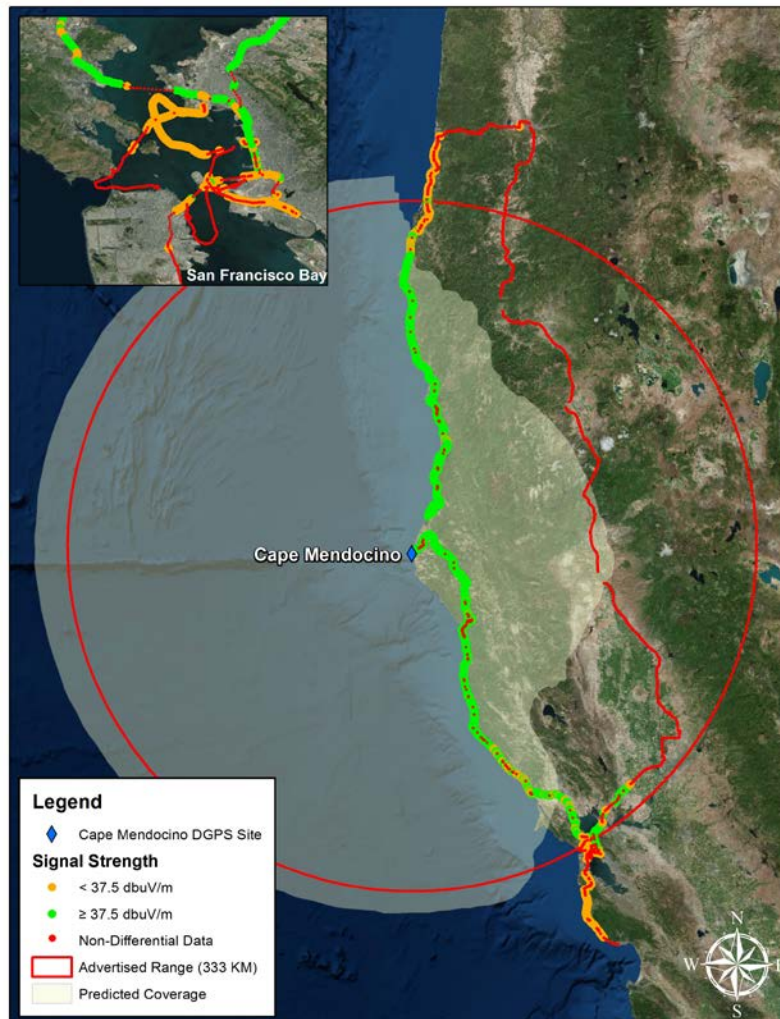


Figure 1: Signal Strength Results

Side	Signal Strength	Signal to Noise ratio	Position
A	45 dB μ V/m	32.72 dB μ V/m	42° 44' 20.23"N, 124° 29' 57.22"W
B	46 dB μ V/m	32 dB μ V/m	42° 44' 20.22"N, 124° 29' 57.25"W

Table 1: North Far-Field Signal Strength Reading

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 4 and 5). Side A was 0.8493 meters, bearing 40.798611° from the monument while Side B was 0.4346 meters, bearing 359.419722° from the monument. As per references (3) and (4), both respective distances were within advertised accuracy requirements. A comparison between the GPS satellites in view at the Cape Mendocino 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 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 0.24559 meters; Side B's average deviation was 0.51658 meters. Both findings were consistent with the findings observed in the field and are within system parameters.

NGS Monument ID:	OA0790
Monument LAT:	42° 44' 20.21520" N
Monument LON:	124° 29' 57.25319" W
Distance from DGPS Site	255 km

Table 3: NGS Monument ID

Averaged LAT:	42° 44' 20.2360" N
Averaged LON:	124° 29' 57.2287" W
Distance from Monument:	0.8493 m (2.7864 ft)
Bearing from Monument:	40.798611°

Table 4: Side A Accuracy Check Results

Averaged LAT:	42° 44' 20.2292" N
Averaged LON:	124° 29' 57.2533" W
Distance from Monument:	0.4346 m (1.425 ft)
Bearing from Monument:	359.4197°

Table 5: Side B Accuracy Check Results

<i>Antenna Location</i>	<i>GPS Satellites Tracked (PRN)</i>										
Reference Station A	2	5	12	20	21	25	29	31			
Integrity Monitor A	2	5	12	20	21	25	29	31			
Reference Station B	2	5	12	20	21	25	29	31			
Integrity Monitor B	2	5	12	20	21	25	29	31			
NGS Monument Location, Side A	2	5	12	20	21	25	29	31			
NGS Monument Location, Side B	2	5	12	20	21	25	29	31			

Table 6: GPS Satellite Comparison

Discrepancies

None

RECOMMENDATION

No changes recommended.

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