



## **DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT**

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**NDGPS Site:** Card Sound DGPS Site (808)  
**Inspector(s):** LT Michael Brashier, CWO3 William Iozzino  
**Date:** 26JUN13

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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 Card Sound 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

### **CARD SOUND DGPS SITE PARAMETERS:**

Frequency	314 KHz
Forward Output Power	900 W
Transmission Rate	200 baud
Field Strength/Range	100 $\mu$ V/m (40.0 dB $\mu$ V/m) at 261 km

### **RESULTS:**

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

A verification of the Card Sound DGPS coverage area was conducted from the Cape Canaveral, FL to Key West, FL. The minimum service range for the Card Sound site is 261 km. Figure 1 below displays adequate signal strength, beyond the advertised and predicted coverage area. 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 the northern part of the advertised range ring from both sides of the site (Table 1). All readings were above the required 40.0 dB $\mu$ V/m for signal strength.

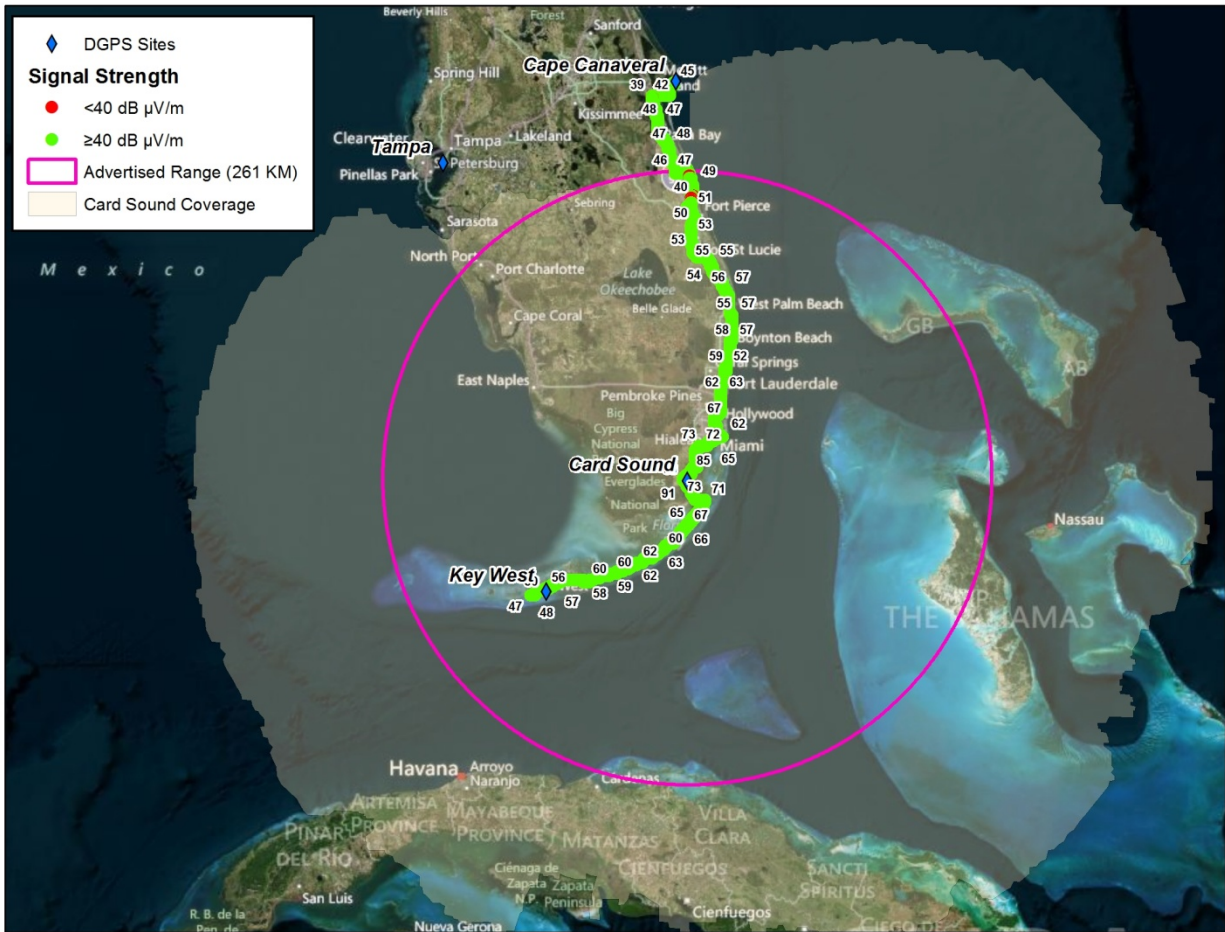


Figure 1: Signal Strength Results

Side	Signal Strength	Signal to Noise ratio	Position
A	47 dBμV/m	15 dBμV/m	27 46.5381059 N, 080 26.844806
B	Side B was NMC at the time of the verification		

Table 1: North Far-Field Signal Strength Reading (measured w/ a Trimble SPS461)

***RTCM Message Verification:***

RTCM message scheduling, receipt, and content were checked during the assessment (Table 2 and 3). 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 Side B Integrity Monitor. All message content was verified and is in accordance with reference (4) with the exception of the Card Sound road location in the Type 7 message. **The position provided is 1.6 km to the east, which is 1.0 km greater then allowed.**

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	N
<i>Type 9</i>	Y	Y	Y
<i>Type 16</i>	Y	Y	Y

Table 2: 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	N
<i>Type 9</i>	Y	Y	Y
<i>Type 16</i>	Y	Y	Y

Table 3: Side B RTCM Message Validation

***Accuracy Validation:***

Positional data was collected for 10 minutes per side using the Trimble SPS 461 DGPS receiver. 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 0.3664 meters bearing 068.3°, from the monument. While side B was 0.5097 meters, bearing 047.7°, from the monument. As per reference (1) and (2), both distances are well within advertised accuracy requirements. A comparison between the GPS satellites in view at the Card Sound site and the NGS monument was conducted (Table 6) to identify any differences in the GPS satellite geometry; significant differences in satellite geometry could lead to greater position error. In this case, there were seven satellites in view by both the RS/IM and Trimble receiver located at the NGS monument. A minimum of four satellites are required to generate a two dimension correction. Furthermore a two dimension radial review of the same time period was conducted for the integrity monitors. Side A's average deviation was 0.09421 meters; Side B's average deviation was 0.09892 meters. Both findings were consistent with the findings observed in the field.

<b>NGS Monument ID:</b>	<b>BBCB90</b>
Monument LAT:	25° 46' 16.83617" N
Monument LON:	080° 08' 40.02387" W

<b>Averaged LAT:</b>	25° 46' 16.840560" N
<b>Averaged LON:</b>	-80° 08' 40.011634" W
<b>Distance from DGPS Site:</b>	49.8 km
<b>Antenna Distance from Monument:</b>	0.3664 m/1.20'
<b>Antenna Bearing from Monument:</b>	068.33°

Table 4: Side A Accuracy Check Results

<b>Averaged LAT:</b>	25° 46' 16.847285"
<b>Averaged LON:</b>	-80° 08' 40.010348"
<b>Distance from DGPS Site:</b>	49.8 km
<b>Distance from Monument:</b>	0.5097 m/1.67'
<b>Bearing from Monument:</b>	47.73 °

Table 5: Side B Accuracy Check Results

<i>Antenna Location</i>	<i>GPS Satellites Tracked (PRN)</i>											
Reference Station <b>A</b>	1	14	16	18	20	22	25	29	31	32		
Integrity Monitor A	1	14	16	18	20	22	25	29	31	32		
Reference Station <b>B</b>	1	14	16	20	22	25	31	32				
Integrity Monitor B	1	14	16	18	20	22	25	29	31	32		
NGS Monument Location, Side <b>A</b>	14	16	20	22	25	31	32					
NGS Monument Location, Side <b>B</b>	14	16	20	22	25	31	32					

Table 6: GPS Satellite Comparison

**SUMMARY:**

The Operational Assessment of the Cape Canaveral DGPS site revealed that the provided coverage is consistent with the predicted coverage area and advertised range. Far-Field signal strength readings exceeded minimum service requirements. Additionally the site performed as expected throughout the predicted coverage area. Overall site performance was exceptional with only one discrepancy noted in the RTCM Type 7 message.