DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

NDGPS Site:	Isabela, Puerto Rico DGPS Site (817)
Inspector(s):	LT Hermie Mendoza
Date:	20-23 Apr 2015

REFERENCES

(1) Differential Global Positioning System (DGPS) DGPS Concept of Operations, COMDTINST 16577.2 (AUG 1995).
(2) 2012 Federal Radio Navigation Plan.
(3) Broadcast Standard for the USCG DGPS Navigation Service, CIM 16577.1 (APR 1993).
(4) Radio Technical Commission for Maritime Services (RTCM) Recommended Standards for Differential Global Navigational Satellite System (GNSS) Service, Version 2.3.

PURPOSE

- Validate advertised DGPS coverage of the Isabela 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

ISABELA DGPS SITE PARAMETERS

Frequency	295 KHz
Forward Output Power	900 W
Transmission Rate	100 baud
Field Strength/Range	75µV/m at 125 km

SUMMARY

The Operational Assessment of the Isabela, PR DGPS site demonstrated that the site continued to provide adequate beacon coverage within the advertised range since having the NAVEX tower replaced in 2014. Furthermore, the far-field signal strength readings, output power, reflected power, and near-field signal strength levels were satisfactory. All RTCM messages were verified, checked, but the adjacent site information for Isabela was offset by 1.6 km. The U.S. Coast Guard (USCG) Navigation Center (NAVCEN) will re-engage USCG DGPS Product Line to verify the status of the software trouble report submitted in late 2014 to update all beacon locations. Lastly, an accuracy assessment was conducted and found to be well within published requirements of 10 m accuracy with 0.60 m on side A and 0.45 m on side B.

RESULTS

Signal Strength

NAVCEN conducted a verification of the Isabela, PR DGPS coverage area by circumnavigating the main island of Puerto Rico via highway. Figure 1 displays adequate signal strength throughout most of the advertised coverage area with the exception of the southeast portion of the island. Although COAST, the beacon coverage prediction software, indicates adequate coverage in this area, signal strength is unsatisfactory because of the placement of road infrastructure along the mountainous terrain. Green points represent areas of satisfactory signal strength, whereas areas of unsatisfactory signal strength are represented with red points. As seen in Table 1, far-field signal strength readings were taken of the Isabela DGPS site. These measurements were collected at the northeast point of its 125 km advertised range ring and were satisfactory.

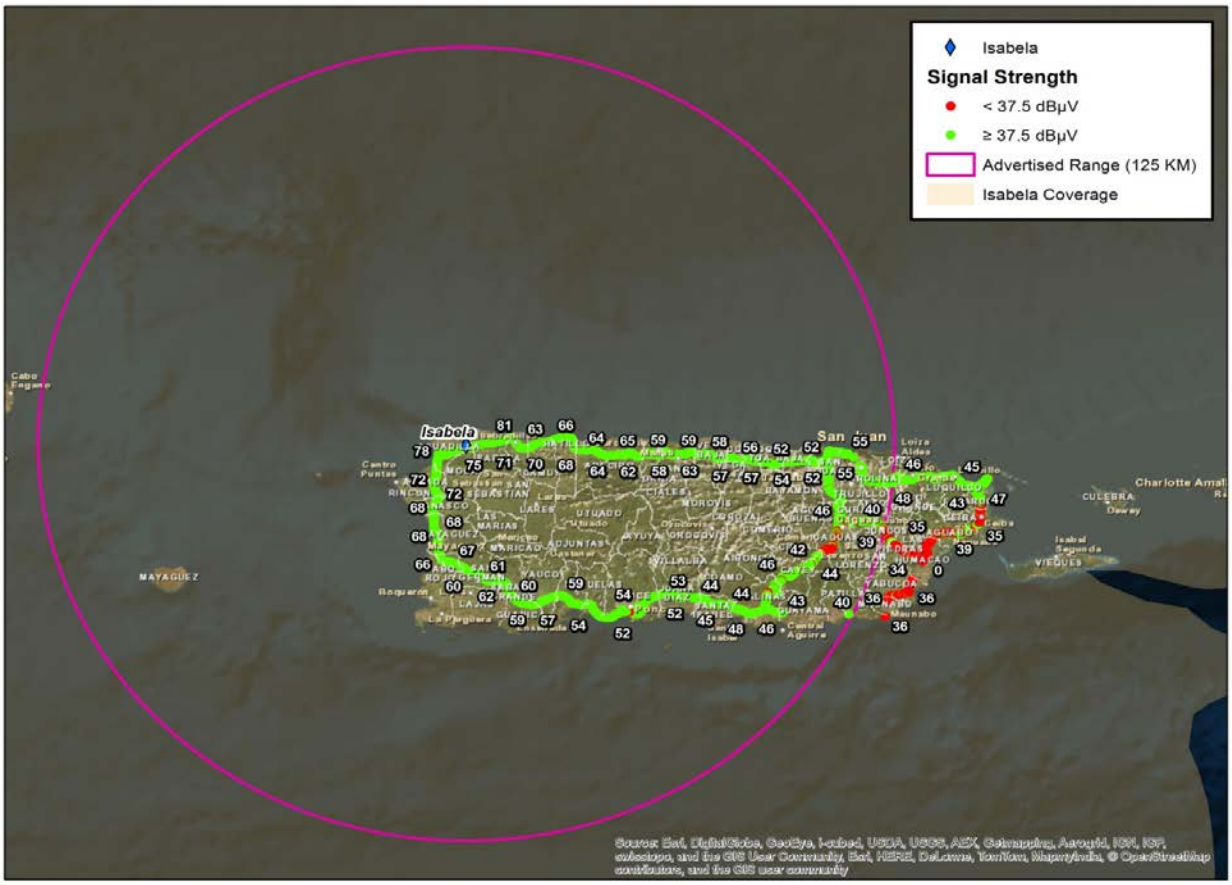

Figure 1: Signal Strength Results

Side	Signal Strength	Signal to Noise ratio	Position
A	50 dBµV/m	33 dBµV/m	18° 21.609496’ N 65° 53.6415’ W
B	50 dBµV/m	33 dBµV/m	

Table 1: Far-Field Signal Strength Reading

RTCM Message Verification

Table 2 and Table 3 show RTCM message scheduling, receipt, and content collected during the assessment. 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 the Nationwide Control Station (NCS) system whereby the assessment team witnessed the on-time receipt of all messages on the active and standby integrity monitor computers. All message content was observed and validated for accuracy in accordance with Reference (4).

For both side A and side B, the position information for the Card Sound DGPS site in the RTCM Type 7 was offset by 1.6 km from the site's known position.

Message Type	Received	Scheduled	Content Verified/Accurate
Type 3	Y	Y	Y
Type 5 (ensure message is not being transmitted)	N	N	N/A
Type 7	Y	Y	Y - Card Sound position offset by 1.6 km
Type 9	Y	Y	Y
Type 16	N	Y	Y

Table 2: Side A RTCM Message Validation

Message Type	Received	Scheduled	Content Verified/Accurate
Type 3	Y	Y	Y
Type 5 (ensure message is not being transmitted)	N	N	Y - Card Sound position offset by 1.6 km
Type 7	Y	Y	Y
Type 9	Y	Y	Y
Type 16	N	Y	Y

Table 3: Side B RTCM Message Validation

Accuracy Validation

Table 4 provides site reference detail from the U.S. Army Corps of Engineers Antilles Area Office on a monument BBDR62. Table 5 and Table 6 provide positional data that was collected for 15 minutes per side and checked against NGS monument. The results are within the advertised 10 m accuracy with 0.60 m on side A and 0.45 m on side B.

NGS Monument ID:	**BBDR62**
Monument LAT:	18° 27’ 42.92041” N
Monument LON:	066° 5’ 38.31850” W
Distance from DGPS Site	99.41 km

Table 4: NGS Monument ID

Averaged LAT:	18° 27’ 42.9114” N
Averaged LON:	66° 5’ 38.2986” W
Antenna Distance from Monument:	0.60 m (1.98 ft)
Antenna Bearing from Monument:	242.56°

Table 5: Side A Accuracy Check Results

Averaged LAT:	18° 27’ 42.9258” N
Averaged LON:	66° 5’ 38.3028” W
Distance from Monument:	0.45 m (1.49 ft)
Bearing from Monument:	291.49°

Table 6: Side B Accuracy Check Results

Antenna Location	***GPS Satellites Tracked (PRN)***								
Reference Station A	3	14	16	19	23	27	29	31	32
Integrity Monitor A	3	14	16	19	23	27	29	31	32
Reference Station B	3	14	16	19	23	27	29	31	32
Integrity Monitor B	3	14	16	19	23	27	29	31	32
NGS Monument Location, Side A	3	14	16	19	23	27		31	32
NGS Monument Location, Side B	3	14	16	19	23	27		31	32

Table 7: GPS Satellite Comparison

#