DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

NDGPS Site: Whidbey Island DGPS Site (848)
Inspector(s): CWO3 William Iozzino
Date: 24 SEP 2013

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 Whidbey Island 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

WHIDBEY ISLAND DGPS SITE PARAMETERS:

Frequency	302 KHz
Forward Output Power	250 watts
Transmission Rate	100 baud
Field Strength/Range	75µV/m (37.5 dBµV/m) at 166 km

RESULTS:

Signal Strength:

A verification of the Whidbey Island DGPS coverage area was conducted from the southeast portion of the coverage area north to the Canadian border then west to Neah Bay, then through the Olympic mountains south to Astoria, OR. The advertised signal range is 166 km. Figure 1 below displays satisfactory signal strength around Puget Sound, the Salish Sea and the Strait of Juan de Fuca. Unsatisfactory signal strength was observed in and around the Olympic Mountains as well as the mountain ranges to the south east. 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 south west and south east range ring, see Table 1 and 2 below. These FF measurements did not meet minimum system requirements.

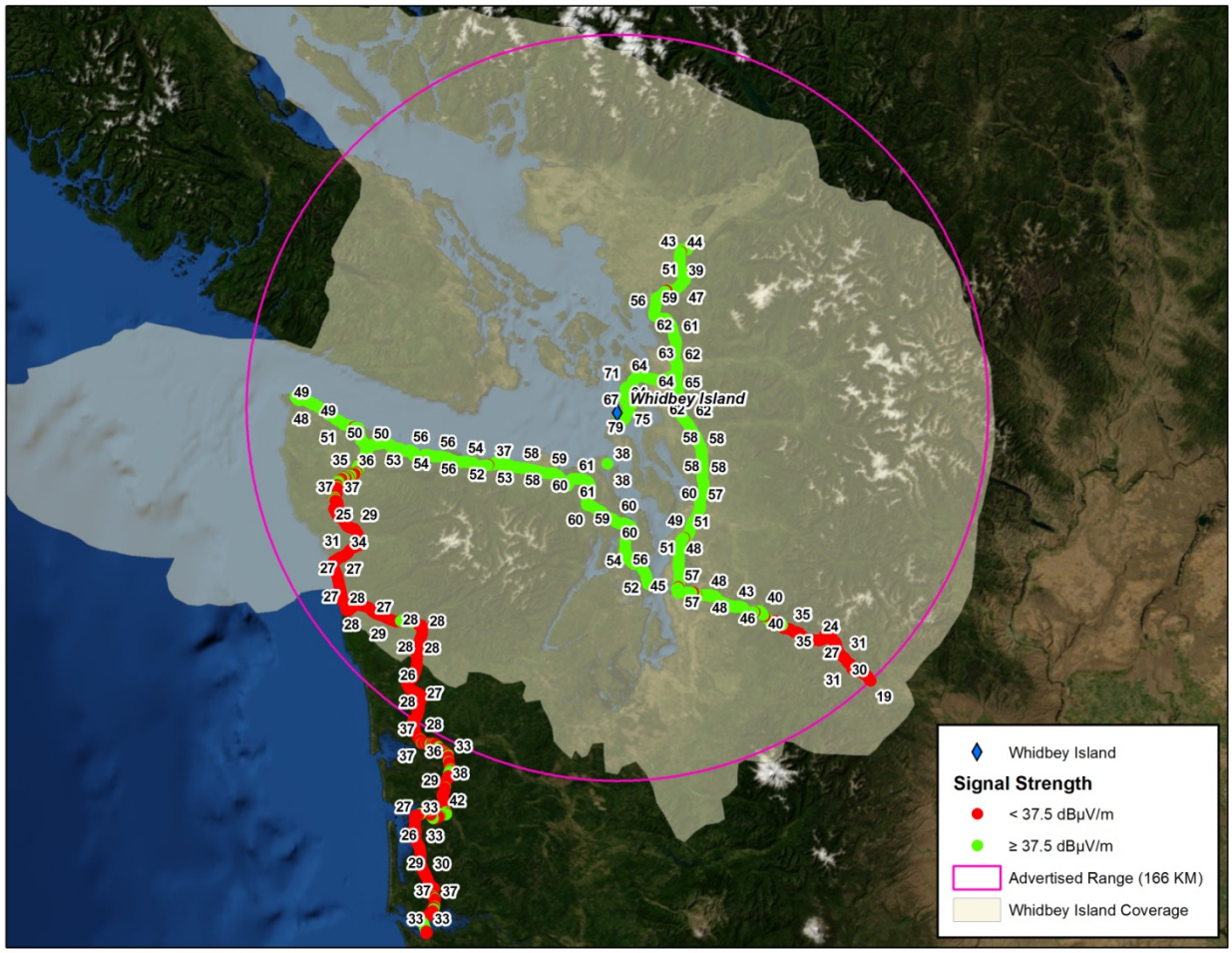

Figure 1: Signal Strength Results

Side	Signal Strength	Signal to Noise ratio	Position
A	29 dBµV/m	14 dBµV/m	47º 04.189694', -123º 55.760630'
B	25 dBµV/m	7 dBµV/m	

Table 1: Southwest Far Field Signal Strength Readings measured w/ a Trimble SPS461)

Side	Signal Strength	Signal to Noise ratio	Position
A	31 dBµV/m	18 dBµV/m	47º 13.855950', -121º 10.125899'
B	30 dBµV/m	17 dBµV/m	

Table 2: Southeast Far Field Signal Strength Readings measured w/ a Trimble SPS461

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 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).

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
Type 9	Y	Y	Y
Type 16	Y	Y	Y

Table 3: 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	N/A
Type 7	Y	Y	Y
Type 9	Y	Y	Y
Type 16	Y	Y	Y

Table 4: Side B RTCM Message Validation

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 0.1383 meters away from the monument bearing 134.2º. Side B was 0.04947 meters away from the monument bearing 339.5º. As per reference (1) and (2) both distances were well within advertised accuracy requirements. A comparison between the GPS satellites in view at the Whidbey Island site and the NGS monument was conducted (Table 7) to identify any differences in the GPS satellite geometry; significant differences in satellite geometry could lead to greater position error. There were seven common satellites in view at the Whidbey Island site and 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 0.07683 meters; Side B's average deviation was 0.09551 meters. Both findings were consistent with the findings observed in the field.

NGS Monument ID:	**BBBG10**
Monument LAT:	48º 1.361922’
Monument LON:	-122º 43.757946’

Averaged LAT:	48º 1.361870’
Averaged LON:	-122º 43.757866’
Distance from DGPS Site:	32.34 km
Antenna Distance from Monument:	0.1383 m
Antenna Bearing from Monument:	134.2º

Table 5: Side A Accuracy Check Results

Averaged LAT:	48º 1.361947’
Averaged LON:	-122º 43.757960’
Distance from DGPS Site:	32.34 km
Distance from Monument:	0.04947 m
Bearing from Monument:	339.5º

Table 6: Side B Accuracy Check Results

Antenna Location	***GPS Satellites Tracked (PRN)***											
Reference Station A	1	2	4	8	12	15	17	24	26	28		
Integrity Monitor A	1	2	4	8	12	15	17	24	26	28		
Reference Station B	1	2	4	8	12	15	17	24	26	28		
Integrity Monitor B	1	2	4	8	12	15	17	24	26	28		
NGS Monument Location, Side A	1	4	12	15	17	24	28					
NGS Monument Location, Side B	1	4	12	15	17	24	28					

Table 7: GPS Satellite Comparison

SUMMARY:

The Operational Assessment of the Whidbey Island DGPS site revealed consistent coverage throughout Puget Sound, the Salish Sea, and the Strait of Juan de Fuca. Overall the site performed well with the exception of areas blocked by mountain ranges. All RTCM messages were verified and evaluated and are consistent with the requirements set forth in reference (3) and (4). Finally, the horizontal accuracy was found to be within 0.14 meters from the monument and well within the accuracy requirements set forth in reference (1) and (2).