



DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

NDGPS Site: Robinson Point DGPS Site (887)
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 Robinson Pt 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

ROBINSON PT DGPS SITE PARAMETERS:

Frequency	323 KHz
Forward Output Power	250 W
Transmission Rate	200 baud
Field Strength/Range	100 μ V/m (40.0 dB μ V/m) at 111 km

RESULTS:

Signal Strength:

A verification of the Robinson Pt DGPS coverage area was conducted from the east range ring to the northern edge of the predicted coverage area, then west to Port Angeles Harbor, WA. The advertised signal strength range is 111 km. Figure 1 below displays inadequate signal strength throughout the advertised and predicted coverage areas. Green points represent areas of satisfactory signal strength. Red dots represent areas of unsatisfactory signal strength. Far-Field signal strength readings were taken at two points on the northern advertised range ring and one from the eastern range ring (Table 1, 2 and 3). Of the three measurements taken only the northern most one met the required 100 μ V/m (40.0 dB μ V/m) signal strength.

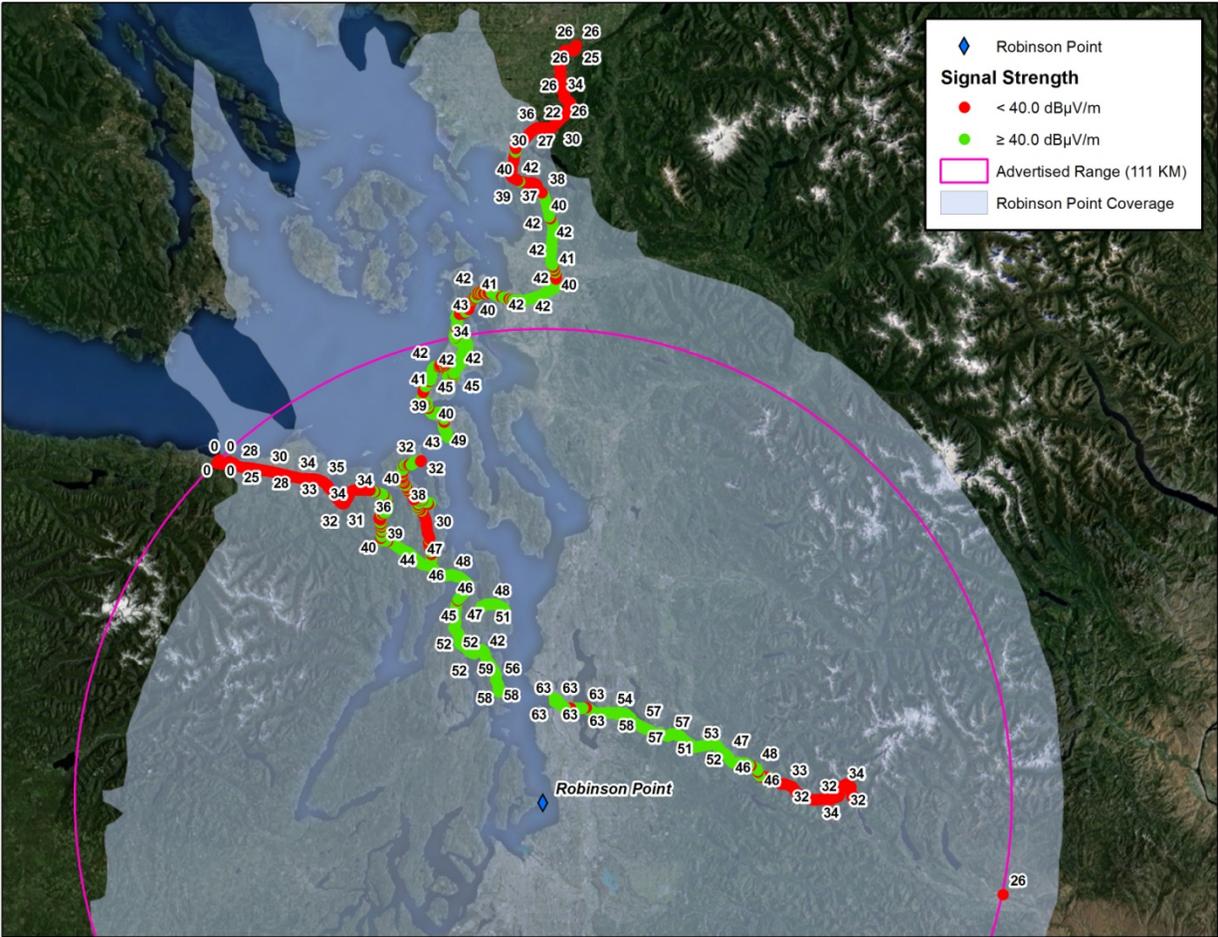


Figure 1: DNAV Signal Strength Results

Side	Signal Strength	Signal to Noise ratio	Position
A	26 dB μ V/m	9dB μ V/m	47° 11.643753', -120° 55.946880'
B	26 dB μ V/m	7 dB μ V/m	

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

Side	Signal Strength	Signal to Noise ratio	Position
A	45 dB μ V/m	26 dB μ V/m	48° 22.156866, -122° 39.251402'
B	45 dB μ V/m	26 dB μ V/m	

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

Side	Signal Strength	Signal to Noise ratio	Position
A	24 dB μ V/m	2 dB μ V/m	48° 06.724591', -123° 23.585420'
B	24 dB μ V/m	1 dB μ V/m	

Table 3: Northwest 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 4 and 5). 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 using the Side B Integrity Monitor. All message content was certified and is in accordance with reference (4) with the exception of the Appleton site location in the Type 7 message. **The position provided is .93 km to the south, which is .63 km greater than 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 4: 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 5: 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 6 and 7). Side A was 0.6249 m bearing 001.9° from the monument while Side B was 0.6961 m bearing 341.4°. As per reference (1) and (2), both distances are well within system accuracy requirements. A comparison between the GPS satellites in view at the Robinson Pt DGPS site and the NGS monument location was conducted (Table 8) to identify any differences in the GPS satellite geometry used at the two locations. Differences in the GPS satellite geometry could lead to accuracy discrepancies. In this case satellites being tracked by the RS and IM GPS receivers at the site were almost identical to those tracked at the NGS monument. A two dimensional radial review of the same time period was completed for the integrity monitors. Side A's average deviation was 0.09610 meters, Side B's average deviation was 0.10500 meters. Both findings are consistent with findings observed in the field and well with system parameters.

NGS Monument ID:	BBBG10
Monument LAT:	48° 1.361922'
Monument LON:	-122° 43.757946'
Distance from DGPS Site:	75.3 km

Averaged LAT:	48° 1.362259'
Averaged LON:	-122° 43.757929'
Antenna Distance from Monument:	0.6249 m
Antenna Bearing from Monument:	001.9°

Table 6: Side A Accuracy Check Results

Averaged LAT:	48 1.362278
Averaged LON:	-122 43.758125
Antenna Distance from Monument:	0.6961 m
Antenna Bearing from Monument:	341.4°

Table 7: Side B Accuracy Check Results

<i>Antenna Location</i>	<i>GPS Satellites Tracked (PRN)</i>											
Reference Station A	1	4	8	9	12	15	17	24	26	28		
Integrity Monitor A	1	4	8	9	15	17	24	26	28			
Reference Station B	1	4	8	9	12	15	17	24	26	28		
Integrity Monitor B	1	4	8	9	15	17	24	26	28			
NGS Monument Location, Side A	1	4	12	15	17	24	26	28				
NGS Monument Location, Side B	1	4	8	9	12	14	17	24	26	28		

Table 8: GPS Satellite Comparison

SUMMARY:

The Operational Assessment of the Robinson Pt DGPS site revealed a significant portion of the coverage area does not meet minimum system requirements. Signal strength readings taken on the northwest and eastern range rings did not meet system requirements while the north range reading was acceptable. Additionally, a review of the output and reflected power and the near field signal strength levels was conducted and found to be satisfactory. All RTCM messages were verified and evaluated and are consistent with the requirements set forth by reference (3) and (4), with the exception of the Type 7 message as noted above. Finally the accuracy measurements and analysis proved that at a distance of 75 km from the broadcast site, the horizontal accuracy is sub-meter and within the accuracy requirements set forth by reference (1) and (2).