DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

NDGPS Site: Robinson Point, WA DGPS Site (887)
Inspector(s): LTJG Joe Kliman and CWO Wayne Horn
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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 Robinson Point 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

ROBINSON POINT DGPS SITE PARAMETERS

Frequency	323 KHz
Forward Output Power	250 W
Transmission Rate	200 BPS
Field Strength/Range	100µV/m (40 dBµV/m) at 111 km

SUMMARY

The Operational Assessment of the Robinson Point Differential Global Positioning System (DGPS) site revealed that the site is well placed to provide service for the Puget Sound, but due to terrestrial masking from the nearby mountain ranges does not provide coverage consistent with the advertised range. The signal strength measurements, within the advertised range were predominantly satisfactory, but some areas to the west were below the required threshold. Both northern and western far-field signal strength readings were below the required signal strength. 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 reference (1) and (2). Finally, accuracy measurements and analysis proved that at a distance of approximately 48 km from the broadcast site, the horizontal accuracy is sub-meter and within the 10 meter accuracy requirement as set forth by Reference (3) and (4).

RESULTS

Signal Strength

A verification of the Robinson Point DGPS coverage area was conducted via a circuitous route around Puget Sound. The advertised signal strength range is 111 km. Figure 1 below displays adequate signal strength on and around Puget Sound, with terrestrial masking limiting the signal strength to the west around the Strait of Juan de Fuca and to the north around the Strait of Georgia. Green points represent areas of signal strength above 40 dBµV/m, whereas areas below 40 dBµV/m are represented in yellow. Areas where a DGPS fix was unable to be obtained are represented in red. As seen in Table 1 and Table 2, far-field signal strength readings were taken at northern and western points of the advertised range from both sides of the site. Both northern and western far-field readings were below the required 40 dBµV/m signal strength on both sides.

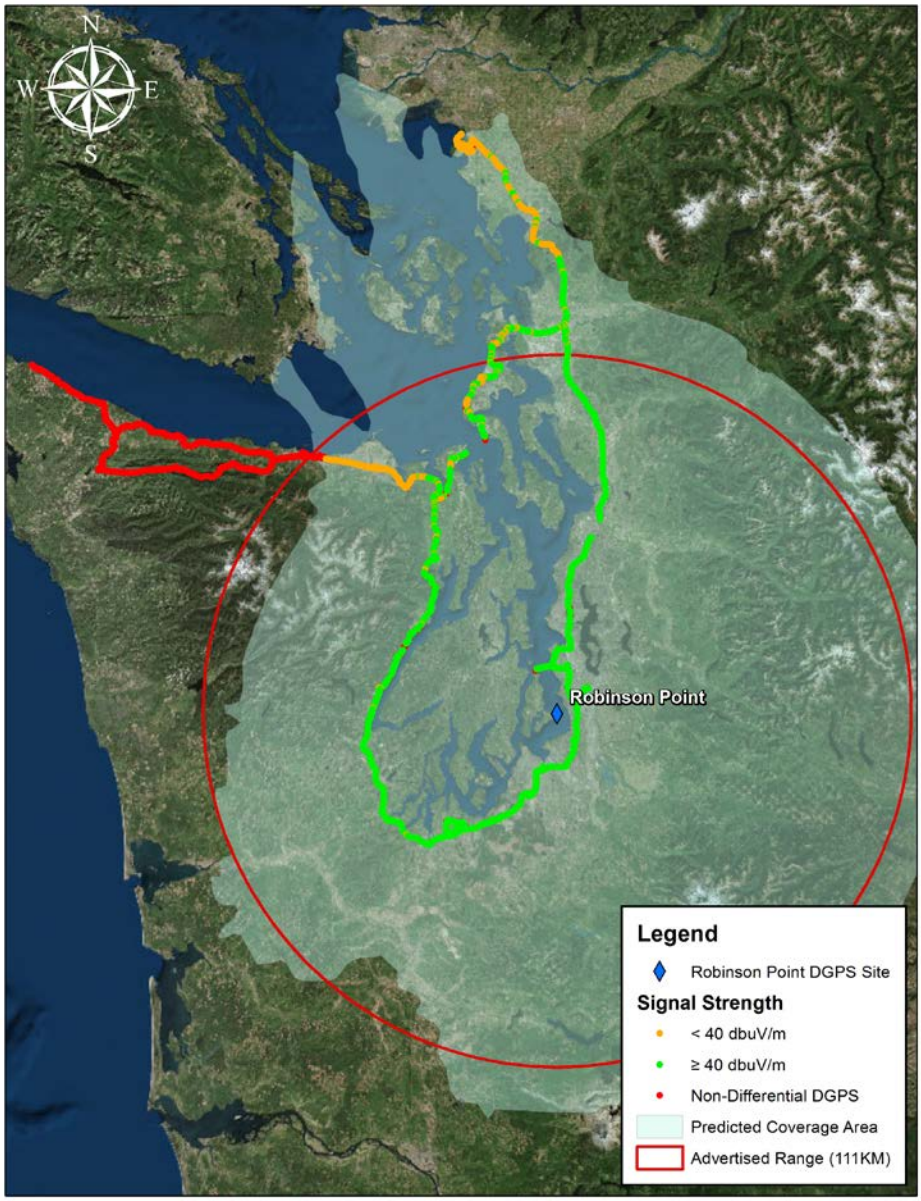

Figure 1: Signal Strength Results

Side	Signal Strength	Signal to Noise ratio	Position
A	32 dBµV/m	12 dBµV/m	48° 59’ 26.62”N, 122° 46’ 21.02”W
B	32 dBµV/m	12 dBµV/m	

Table 1: North Far-Field Signal Strength Reading

Side	Signal Strength	Signal to Noise ratio	Position
A	32 dBµV/m	10 dBµV/m	48° 04’ 38.99”N, 123° 07’ 46.78”W
B	32 dBµV/m	10 dBµV/m	

Table 2: West Far-Field Signal Strength Reading

Accuracy Validation

Positional data was collected for 12 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 0.0758 meters, bearing 035.8389º from the monument while Side B was 0.1867 meters, bearing 037.5727º 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 Robinson Point 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 almost 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 0.09844 meters; Side B’s average deviation was 0.10078 meters. Both findings were consistent with the findings observed in the field and are within system parameters.

NGS Monument ID:	**BBCG94**
Monument LAT:	47º 03’ 50.77519” N
Monument LON:	122º 47’ 05.73649” W
Distance from DGPS Site	48 km

Table 3: NGS Monument ID

Averaged LAT:	47º 03’ 50.7732” N
Averaged LON:	122º 47’ 05.7386” W
Distance from Monument:	0.0758 m (0.2488 ft)
Bearing from Monument:	035.8389º

Table 4: Side A Accuracy Check Results

Averaged LAT:	47º 03’ 50.7704” N
Averaged LON:	122º 47’ 05.7419” W
Distance from Monument:	0.1867 m (0.6125 ft)
Bearing from Monument:	037.5727º

Table 5: Side B Accuracy Check Results

Antenna Location	***GPS Satellites Tracked (PRN)***										
Reference Station A	2	3	6	12	17	19	24	28			
Integrity Monitor A	2	3	6	12	17	19	24	28			
Reference Station B	2	3	6	12	17	19	24	28			
Integrity Monitor B	2	3	6	12	17	19	24	28			
NGS Monument Location, Side A	2	6	12	17	19	24	28				
NGS Monument Location, Side B	2	6	12	17	19	24	28				

Table 6: GPS Satellite Comparison

RECOMMENDATION

No changes recommended. If the future brings a further reduction in the number of DGPS broadcast stations, Robinson Point would be a good selection for decommission. Both Robinson Point and Whidbey Island provide similar coverage throughout Puget Sound, while Whidbey Island also provides coverage to the Strait of Juan de Fuca and the Strait of Georgia.

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