



DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

NDGPS Site: Polson DGPS Site (849)
Inspector(s): LT Hermie Mendoza
Date: 07AUG14

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 Polson DGPS site.
- Validate required RTCM message scheduling and delivery.
- Test differential correction accuracy versus a predetermined survey monument.

EQUIPMENT:

Hemisphere GNSS Eclipse VS330 Receiver
Hemisphere GNSS A43 Antenna
Trimble SPS461 Receiver
Trimble GA 530 Antenna

POLSON DGPS SITE PARAMETERS:

| | |
|----------------------|--|
| Frequency | 3287 kHz |
| Forward Output Power | 600 W |
| Transmission Rate | 100 baud |
| Field Strength/Range | 75 μ V/m (37.5 dB μ V/m) at 300 km |

RESULTS:

Signal Strength:

A verification of the Polson DGPS coverage area was conducted from Helena, MT. The advertised signal strength range is 300 km. Figure 1 below displays inadequate signal strength throughout the predicted coverage area because of the terrain features. Green points represent areas of satisfactory signal strength. Areas of unsatisfactory signal strength are represented with red points, which occurred most frequently along portions of the Rocky Mountains.

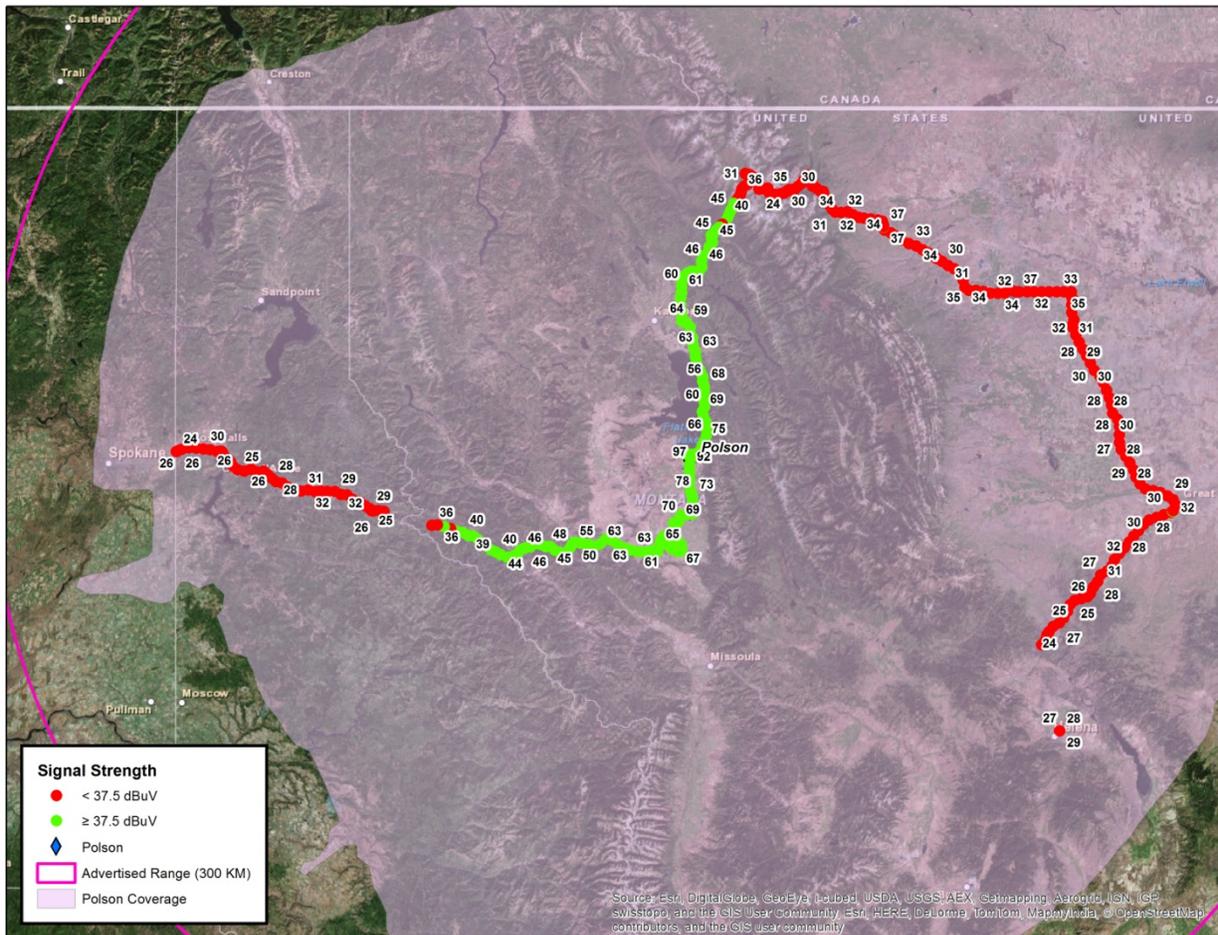


Figure 1: DNAV Signal Strength Results

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 the 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 active and standby Integrity Monitor computers. All message content was verified and is in accordance with Reference (4).

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 | N/A |
| Type 7 | Y | Y | Y |
| Type 9 | Y | Y | Y |
| Type 16 | Y | Y | Y |

Table 3: Side B 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 | Y |
| <i>Type 9</i> | Y | Y | Y |
| <i>Type 16</i> | Y | Y | Y |

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 0.70 meters, bearing 351.37°, away from the monument while Side B was 0.38 meters, bearing 3.84°, away from the monument. As per Reference (1) and (2), both respective distances were well within advertised accuracy requirements. A comparison between the GPS satellites in view at the Polson DGPS site and at the NGS monument location was conducted (Table 7) 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 RS and IM 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 0.29201 meters; Side B’s average deviation was 0.25942 meters. Both findings were consistent with the findings observed in the field and are well within system parameters.

Table 4: Monument ID

| | |
|-------------------------|---------------------|
| NGS Monument ID: | BBCV38 |
| Monument LAT: | 48° 44' 31.55865" N |
| Monument LON: | 113° 26' 6.45169" W |
| Distance from DGPS Site | 154.80 km |

Table 5: Side A Accuracy Check Results

| | |
|--|-----------------------|
| Averaged LAT: | 48° 44' 31.5810888" N |
| Averaged LON: | 113° 26' 6.4465242" W |
| Antenna Distance from Monument: | 0.70 m (2.29659 ft) |
| Antenna Bearing from Monument: | 351.37° |

Table 6: Side B Accuracy Check Results

| | |
|--------------------------------|-----------------------|
| Averaged LAT: | 48° 44' 31.5709503" N |
| Averaged LON: | 113° 26' 6.4529412" W |
| Distance from Monument: | 0.38 m (1.24672 ft) |
| Bearing from Monument: | 3.84° |

Table 7: GPS Satellite Comparison

| <i>Antenna Location</i> | <i>GPS Satellites Tracked (PRN)</i> | | | | | | | | | | | | |
|-------------------------------|-------------------------------------|---|----|----|----|----|----|----|----|----|----|----|----|
| Reference Station A | 1 | 4 | 6 | 11 | 12 | 15 | 17 | 20 | 24 | 26 | 28 | 30 | |
| Integrity Monitor A | 1 | 4 | 6 | 11 | 12 | 15 | 17 | 20 | 24 | 26 | 28 | 30 | |
| Reference Station B | 1 | 4 | 6 | 8 | 11 | 12 | 15 | 17 | 20 | 24 | 26 | 28 | 30 |
| Integrity Monitor B | 1 | 4 | 6 | 8 | 11 | 12 | 15 | 17 | 20 | 24 | 26 | 28 | 30 |
| NGS Monument Location, Side A | 1 | 4 | 11 | 15 | 17 | 24 | 26 | 28 | 30 | | | | |
| NGS Monument Location, Side B | 1 | 4 | 11 | 15 | 17 | 24 | 26 | 28 | 30 | | | | |

SUMMARY:

The Operational Assessment of the Polson DGPS site revealed that the provided coverage is inconsistent with the predicted coverage plot and advertised range. The signal strength measurements, throughout the predicted coverage area within the advertised range, were severely attenuated due to terrain. Moreover, 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 and evaluated and are consistent with the requirements set forth by reference (3) and (4). Finally, accuracy measurements and analysis proved that at a distance of approximately 154.80 km from the broadcast site, the horizontal accuracy is sub-meter and within the accuracy requirements set forth by Reference (1) and (2).