



DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

NDGPS Site: Sallisaw DGPS Site (866)
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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 Sallisaw 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

SALLISAW DGPS SITE PARAMETERS:

Frequency	299 KHz
Forward Output Power	900 W
Transmission Rate	200 baud
Field Strength/Range	100 μ V/m (40.0 dB μ V/m) at 161 km

RESULTS:

Signal Strength:

A verification of the Sallisaw DGPS coverage area was conducted from Carlisle, AR to the Sallisaw site and then onto Oklahoma City, OK. The advertised signal strength range is 161 km. Figure 1 below displays adequate signal strength, throughout the advertised and predicted coverage area. Green points represent areas of satisfactory signal strength. Areas of unsatisfactory signal strength are represented with red points. Far-field (FF) signal strength readings taken at points on the eastern and western advertised range ring (Table 1 and Table 2) were above the required 40.0 dB μ V/m signal strength on both side A and B.

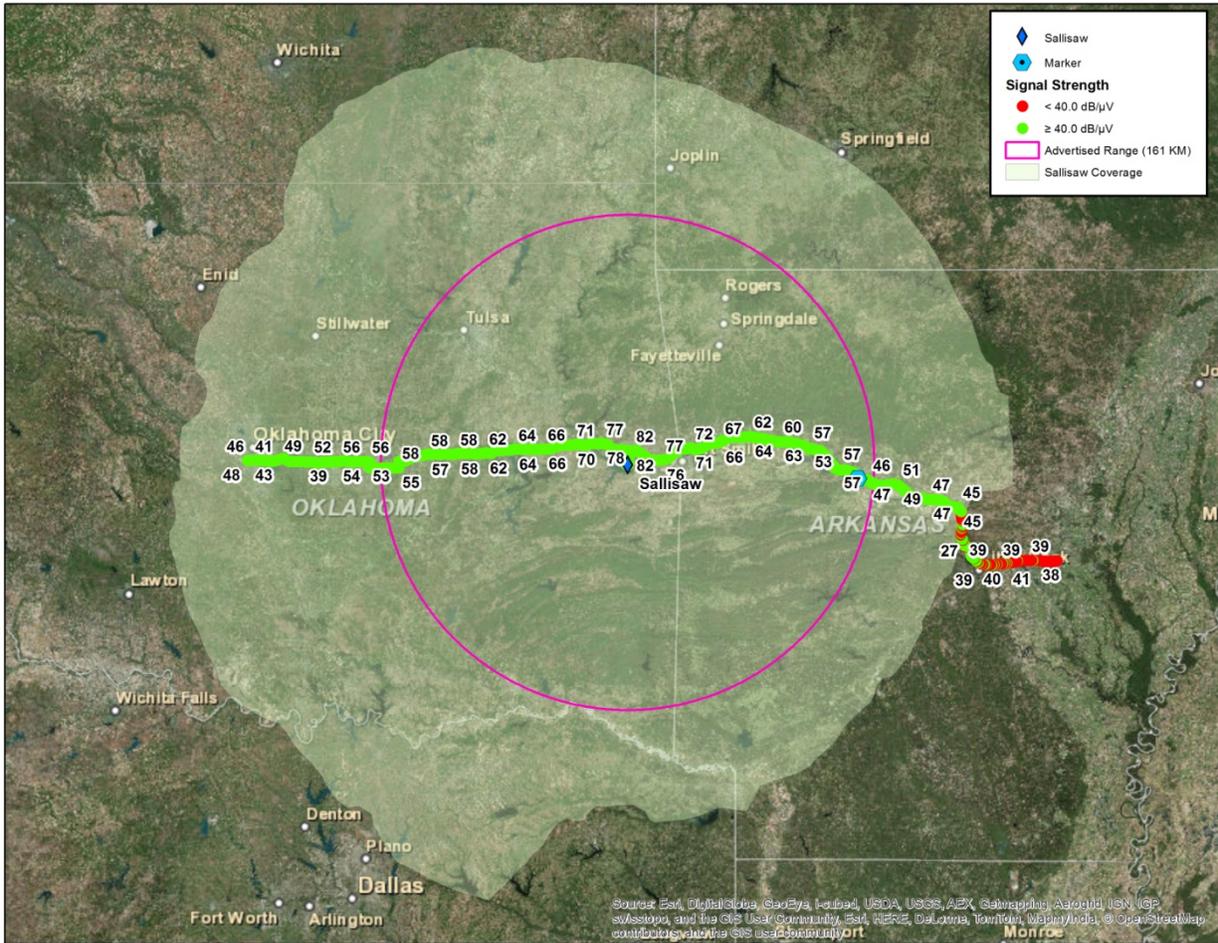


Figure 1: DNAV Signal Strength Results

Side	Signal Strength	Signal to Noise ratio	Position
A	50 dB μ V/m	22 dB μ V/m	35° 15.235687' N, 093° 02895932' W
B	51 dB μ V/m	23 dB μ V/m	

Table 1: East Far-Field Signal Strength Reading

Side	Signal Strength	Signal to Noise ratio	Position
A	56 dB μ V/m	25 dB μ V/m	35° 20.886612' N, 096° 35.494116' W
B	55 dB μ V/m	25 dB μ V/m	

Table 2: West Far-Field Signal Strength Reading

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 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 side B Integrity Monitor. All message content was verified and is in accordance with Reference (4).

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

Table 3: 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	Y
<i>Type 9</i>	Y	Y	Y
<i>Type 16</i>	Y	Y	Y

Table 4: Side B RTCM Message Validation

Accuracy Validation:

The OA team placed a Trimble GA 530 antennae atop of a National Geodetic Survey (NGS) marker and collected positional data for 10 minutes per side. Next, they post processed and compared the data to the published survey marker position in order to verify the horizontal accuracy of the broadcast correction (Table 5 and 6). Side A broadcasted a correction that was calculated to be 0.4037 meters away from the monument, bearing 080.2°. Side B’s correction was calculated to be 0.3829 meters away from the monument, bearing 091.9°. As per Reference (1) and (2), both respective distances were well within advertised accuracy requirements.

The OA team conducted a comparison (Table 7) between the GPS satellites in view at the Sallisaw DGPS site and at the NGS monument location to identify any differences in the GPS satellite geometry used at the respective locations; any differences in geometry could lead to accuracy discrepancies. The satellites tracked by the RS and IM GPS receivers were almost all identical at both locations.

A two dimension radial review of the same time period was completed for the integrity monitors. Side A’s average deviation was 0.10920 meters; Side B’s average deviation was 0.09234 meters. Both findings were consistent with the findings observed in the field and are well within system parameters.

NGS Monument ID:	FG1591
Monument LAT:	35 ° 17.191842' N
Monument LON:	093° 9.691625' W
Distance from DGPS Site	150.4 km

Averaged LAT:	35 17.191879
Averaged LON:	-93 9.691362
Antenna Distance from Monument:	0.4037 meters (1.324472 ft)
Antenna Bearing from Monument:	080.2°

Table 5: Side A Accuracy Check Results

Averaged LAT:	35° 17.191835'
Averaged LON:	-093° 9.691372'
Distance from Monument:	0.3829 meters (1.256231 ft)
Bearing from Monument:	091.9°

Table 6: Side B Accuracy Check Results

<i>Antenna Location</i>	<i>GPS Satellites Tracked (PRN)</i>											
Reference Station A	1	3	7	8	11	13	17	19	26	27	28	30
Integrity Monitor A	1	3	7	8	11	13	17	19	26	27	28	30
Reference Station B	1	3	7	8	11	13	17	19	26	27	28	30
Integrity Monitor B	1	3	7	8	11	13	17	19	26	27	28	30
NGS Monument Location, Side A	1	3	7	8	11	13		19	26	27	28	30
NGS Monument Location, Side B	1	3	7	8	11	13		19	23	27	28	30

Table 7: GPS Satellite Comparison

SUMMARY:

The Operational Assessment of the Sallisaw DGPS site revealed that the provided coverage is consistent with the predicted coverage plot and advertised range. Far-Field signal strength readings taken at both the east and west range rings and exceeded minimum system requirements. 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 and evaluated and are consistent with the requirements set forth by reference (3) and (4). Finally, accuracy measurements taken at distance of 150.4 km from the broadcast site displayed sub-meter horizontal accuracy and exceed accuracy requirements set forth by Reference (1) and (2).