



## DGPS SITE OPERATIONAL ASSESSMENT

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**NDGPS Site:** *St. Louis DGPS Site (862)*

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**Date:** 19APR12

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### **PURPOSE:**

- Validate advertised DGPS coverage of the St. Louis DGPS site.
- Validate required RTCM message scheduling and delivery.
- Test differential correction accuracy versus a predetermined survey monument.

**REFERENCE:** (1) DGPS Concept of Operations, COMDTINST 16577.2 (AUG 1995).  
(2) Broadcast Standard for the USCG DGPS Navigation Service, COMDTINST M16577.1 (APR 1993).  
(3) RTCM Recommend Standards for Differential GNSS Service, Version 2.3.

**EQUIPMENT:** STARLINK DNAV-212 DGPS Receiver  
Hemisphere R110 USB DGPS Receiver  
Trimble MBA-2 Receive Antenna  
Potomac Instruments 4100 FIM meter

### **PARAMETERS:**

Frequency	322 KHz
Forward Output Power	900W
Transmission Rate	200 baud
Field Strength/Range	100 $\mu$ V/m (40.0 dB $\mu$ V/m) at 184 km

## **RESULTS**

### **Signal Strength:**

A verification of the St. Louis Differential GPS (DGPS) coverage area was conducted from Lock and Dam #18 on the Mississippi River, along the Mississippi River, to Sikeston, MO. The advertised signal strength range is 184 km. Figure 1 below displays adequate signal strength at the advertised range of 184 km from the site and throughout the 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 were taken at northern and southern points along the DNAV route from both sides of the site (Table 1 and Table 2). Both northern and southern FF readings were well above the required 40 dB $\mu$ V/m signal strength on both sides.

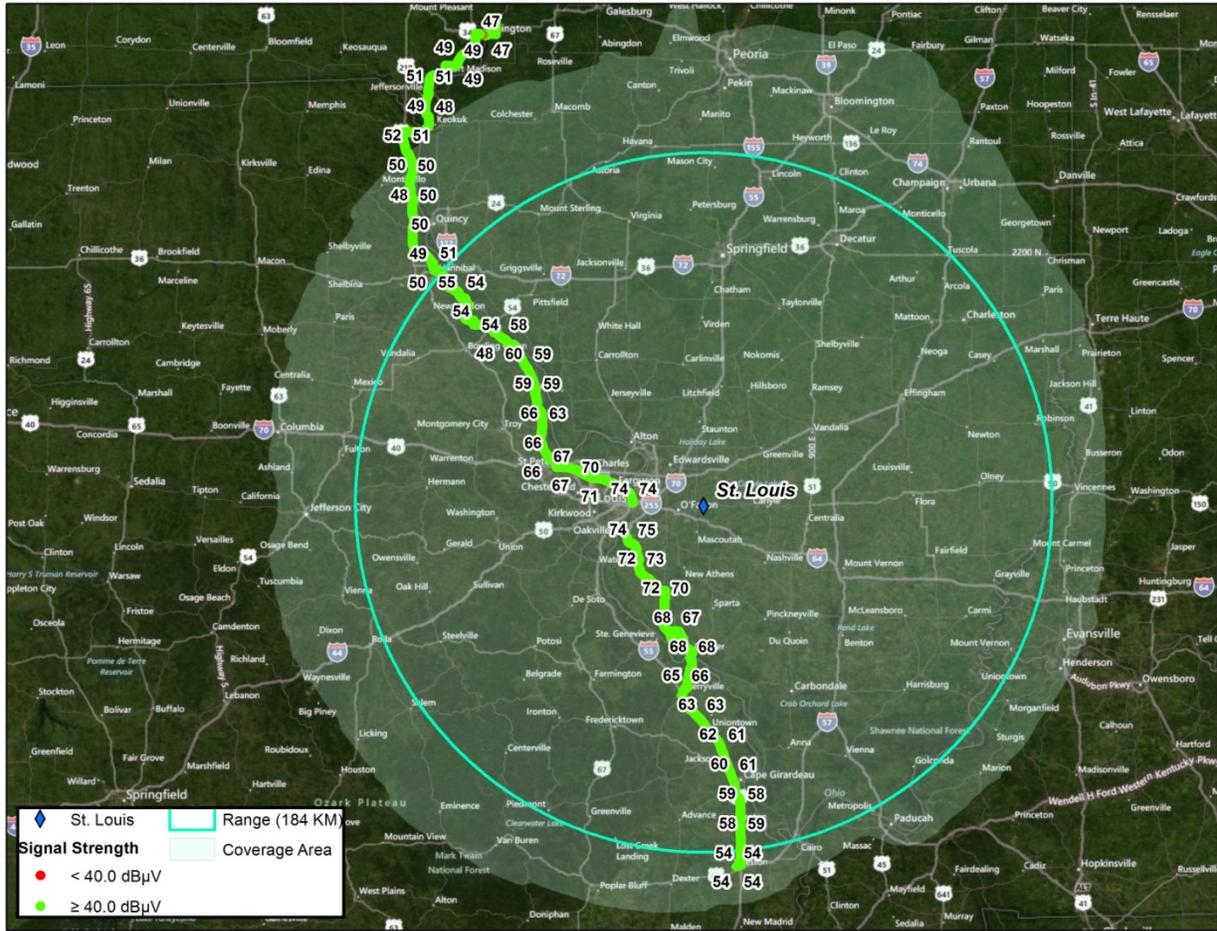


Figure 1: DNAV Signal Strength Results

	POSITION	Starlink DNAV 212, MBA 2 Antenna	4100 FIM Meter
Side A SS	40° 02.8233'N 091° 30.938'W	48 dB $\mu$ V/m, 17 SNR	48.2 dB $\mu$ V/m
Side B SS	40° 02.8233'N 091° 30.938'W	48 dB $\mu$ V/m, 18 SNR	48.4 dB $\mu$ V/m

Table 1: North Far-Field Signal Strength Reading

	POSITION	Starlink DNAV 212, MBA 2 Antenna	4100 FIM Meter
Side A SS	36° 53.1198'N 089° 33.464'W	54 dB $\mu$ V/m, 15 SNR	51.6 dB $\mu$ V/m
Side B SS	36° 53.1198'N 089° 33.464'W	54 dB $\mu$ V/m, 15 SNR	51.2 dB $\mu$ V/m

Table 2: South 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 were validated with the DGPS watch and is in accordance with the Reference (2). 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 (3). With the exception of the beacon position for the Rock Island site listed in the Type 7 message as noted in the Rock Island operational Assessment.

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 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	N
<i>Type 9</i>	Y	Y	Y
<i>Type 16</i>	Y	Y	Y

Table 4: Side B RTCM Message Validation

**Accuracy Validation:**

Positional data was collected for 10 minutes per side using a Hemisphere RPR 210 DGPS receiver with a Trimble MBA-2 DGPS Receive antenna. 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 0.22 meters, bearing 228.45°, away from the monument while Side B was 0.20 meters, bearing 238.49°, away from the monument. Both respective distances were well within advertised accuracy requirements. A comparison between the GPS satellites in view at the St. Louis 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 identical to those tracked at the NGS monument location. At the NGS monument location, the GPS receiver was able to pick up one additional satellite (PRN 12). Furthermore, a two dimension radial review for the same time period was completed for the integrity monitors. Side A’s average deviation was 0.13571 meters; Side B’s average deviation was 0.24175 meters. Both findings were consistent with the finding observed in the field and are well within system parameters.

<b>NGS Monument ID:</b>	<b>BBCP65</b>
Monument LAT:	37° 58' 54.88482" N
Monument LON:	089° 56' 41.49050W

<b>Averaged LAT:</b>	37° 58' 54.88000045" N
<b>Averaged LON:</b>	089° 56' 41.49739978" W
<b>Distance from DGPS Site:</b>	71.84 km
<b>Antenna Distance from Monument:</b>	0.22 m (0.74 ft)
<b>Antenna Bearing from Monument:</b>	228.45°

Table 5: Side A Accuracy Check Results

<b>Averaged LAT:</b>	37° 58' 54.88145937" N
<b>Averaged LON:</b>	089° 56' 41.49745424" W
<b>Distance from DGPS Site:</b>	71.84 km
<b>Distance from Monument:</b>	0.20 m (0.65 ft)
<b>Bearing from Monument:</b>	238.49°

Table 6: Side B Accuracy Check Results

<i>Antenna Location</i>	<i>GPS Satellites Tracked (PRN)</i>										
Reference Station A	3	6	9	14	15	18	19	21	22	27	
Integrity Monitor A	3	6	9	14	15	18	19	21	22	27	
Reference Station B	3	6	9	14	15	18	19	21	22	27	
Integrity Monitor B	3	6	9	14	15	18	19	21	22	27	
NGS Monument Location	3	6	9	12	14	15	18	19	21	22	27

Table 7: GPS Satellite Comparison

**SUMMARY:**

The Operational Assessment of the St. Louis DGPS site revealed that the provided coverage is consistent with the predicted coverage plot and advertised range. Both northern and southern Far-Field signal strength readings were well within the required signal strength. Additionally, the signal strength measurements throughout the predicted coverage area was satisfactory. All RTCM messages verified and evaluated and are consistent with the requirements set forth by Reference (2) and (3). Finally, accuracy measurements and analysis proved that at a distance of approximately 72 km from the broadcast site, the horizontal accuracy is sub-meter and within the accuracy requirements set forth by Reference (1) and (2).