



DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

NDGPS Site: Macon DGPS Site (822)
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Date: 07 MAR 13

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

EQUIPMENT:

DNAV 212 Receiver
Raven INVICTA Receiver
MBA-2 Receive Antenna
Trimble SPS461 Receiver
Trimble GA 530 Antenna
Potomac Instruments 4100 FIM meter

<u>Macon DGPS SITE PARAMETERS:</u>	301 KHz
Frequency	
Forward Output Power	1000 W
Transmission Rate	200 baud
Field Strength/Range	75 μ V/m (37.5 dB μ V/m) at 300 km

RESULTS:

Signal Strength:

A verification of the Macon DGPS coverage area was conducted from Charleston, SC along the coast, to Savannah, GA; to Macon and back to Savannah via Hwy 16; then south along the coast to Jacksonville, FL. The advertised signal strength range is 300 km. Figure 1 below displays inadequate signal strength, within the advertised range of 300 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 the Southern point of the advertised range and attempted from the North advertised range. (Table 1 and Table 2). Both Northern and Southern FF readings were well below the required 37.5 dB μ V/m signal strength on both sides.

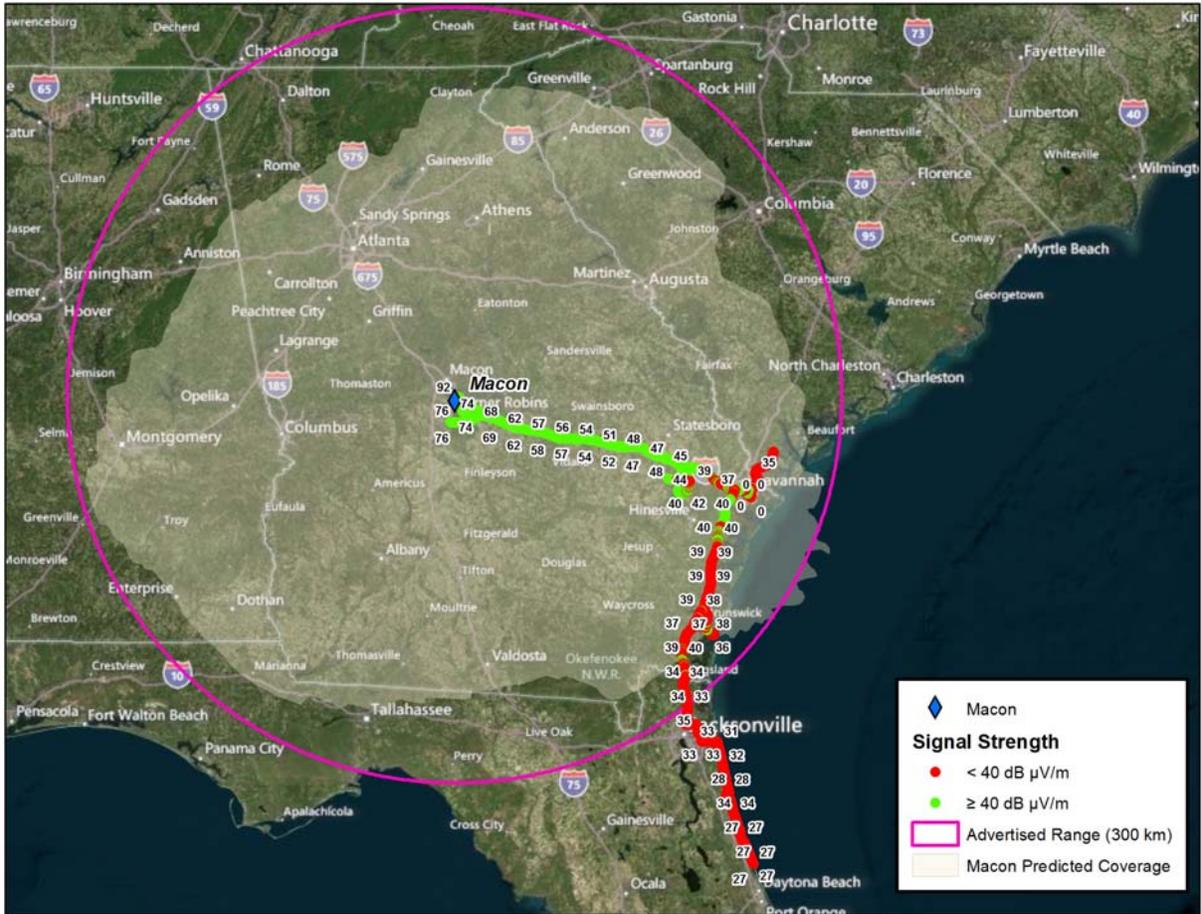


Figure 1: DNAV Signal Strength Results

	POSITION	Trimble SPS461	4100 FIM Meter
Side A SS	32° 20' 21.4" N 80° 55' 46.9" W	33 dB μ V/m, 7 SNR	No Data
Side B SS	32° 20' 21.4" N 80° 55' 46.9" W	33 dB μ V/m, 7 SNR	No Data

Table 1: North Far-Field Signal Strength Reading

	POSITION	Trimble SPS461	4100 FIM Meter
Side A SS	31° 03' 28.1"N 81° 25' 22.6"W	36 dB μ V/m, 15 SNR	40.2 dB μ V/m
Side B SS	31° 03' 28.1"N 81° 25' 22.6"W	36 dB μ V/m, 15 SNR	39.0 dB μ 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 was coordinated with the DGPS watch and is in accordance with the Reference (3). Receipt of all RTCM messages was validated utilizing a Raven INVICTA receiver, whereby the assessment team witnessed the on-time receipt of all messages. 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:

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 and B were 0.9954 meters, bearing 136.38°. 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 Macon 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 0.20093 meters; Side B’s average deviation was 0.16184 meters. Both findings were consistent with the findings observed in the field and are well within system parameters

NGS Monument ID:	BBCD02
Monument LAT:	31° 3' 28.04512" N
Monument LON:	81° 25' 23.35994" W

Averaged LAT:	31° 03' 28.021788" N
Averaged LON:	081° 25' 23.333988" W
Distance from DGPS Site:	271.1 km
Antenna Distance from Monument:	0.9954 m (3.265742 ft)
Antenna Bearing from Monument:	136.38°

Table 5: Side A Accuracy Check Results

Averaged LAT:	31° 03' 28.037988" N
Averaged LON:	081° 25' 23.329812" W
Distance from DGPS Site:	271.1 km
Distance from Monument:	0.9954 m (3.265742 ft)
Bearing from Monument:	136.38°

Table 6: Side B Accuracy Check Results

<i>Antenna Location</i>	<i>GPS Satellites Tracked (PRN)</i>											
Reference Station A	3	6	16	20	23	30	31					
Integrity Monitor A	1	16	19	20	23	28	30	31	32			
Reference Station B	3	16	20	23	29	30	31	32				
Integrity Monitor B	1	14	16	20	22	23	25	29	30	31	32	
NGS Monument Location, Side A	6	14	16	20	23	29	30	31	32			
NGS Monument Location, Side B	14	16	20	30	31	32						

Table 7: GPS Satellite Comparison

SUMMARY:

The Operational Assessment of the Macon DGPS site revealed that the provided coverage is not consistent with the predicted coverage plot and advertised range. The Northern Far-Field signal strength readings were insufficient throughout the predicted coverage area within the advertised range. The DNAV data in (Figure 1) represents the same. 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 (2) and (3). However, an accuracy measurement and analysis proved that at a distance of approximately 271.1 km from the broadcast site, the horizontal accuracy is sub-meter and within the accuracy requirements set forth by Reference (1) and (2).