



DGPS SITE OPERATIONAL ASSESSMENT

NDGPS Site: *Mequon DGPS Site (777)*

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PURPOSE:

- Validate advertised DGPS coverage of the Mequon 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 GPS Receiver
Raven MBA-2 Antenna
Hemisphere Crescent GPS Receiver
Potomac Instruments 4100 FIM meter

PARAMETERS:

Frequency	304 KHz
Forward Output Power	800 W
Transmission Rate	200 bps
Field Strength/Range	100 μ V/m (40.0 dB μ V/m) at 230 KM

RESULTS:

Signal Strength

A verification of the Mequon Differential GPS (DGPS)) coverage area was conducted in conjunction with the Sturgeon Bay DGPS coverage area. The advertised signal strength range is 230 KM. Figure 1 displays the signal strength measurements found 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 along the northern and southern points the DNAV route of the site (refer to Table 1 and Table 2). Note that the extremis FF signal strength measurements were taken before Mequon's approved two hour off-air time on 14 Aug 2012. All other FF readings were satisfactory IAW COMDTINST 16577.2, despite not switching sides.

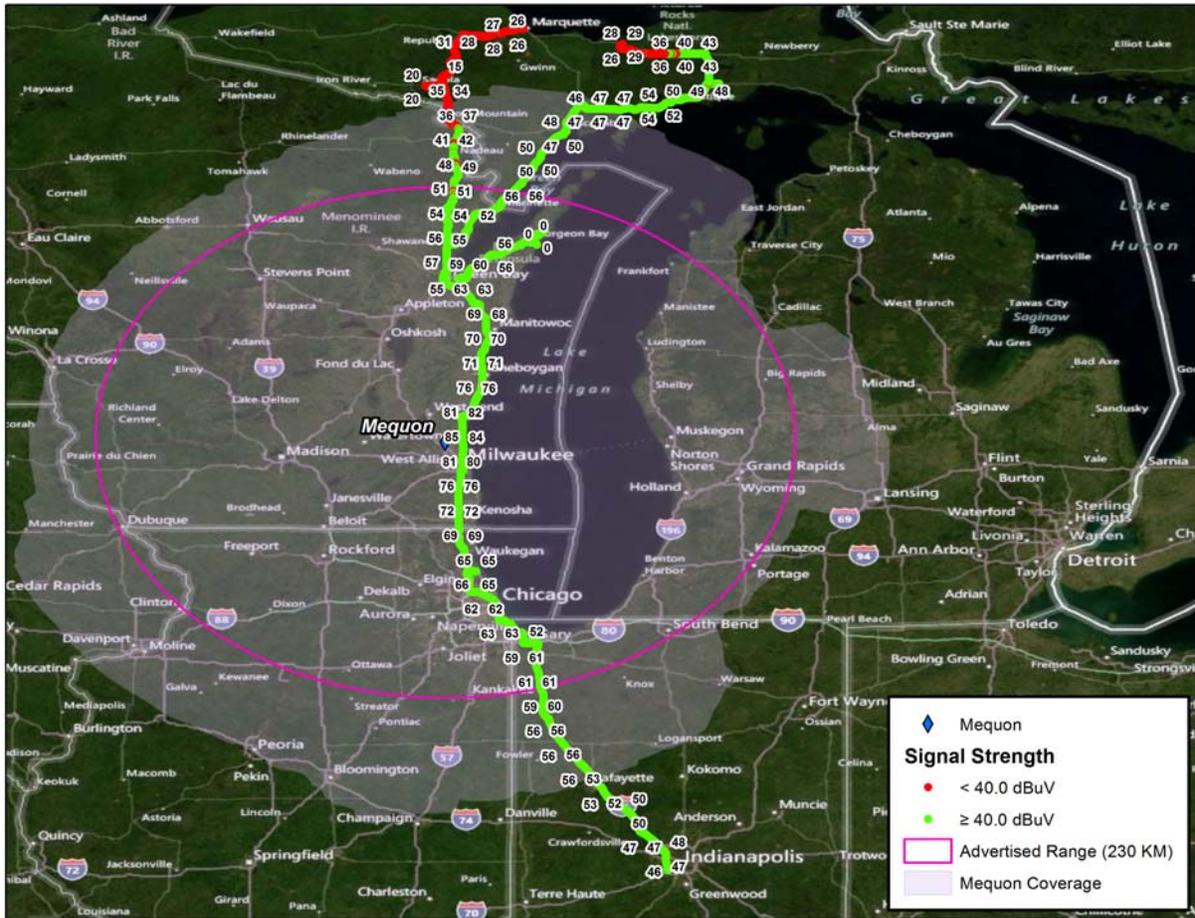


Figure 1: DNAV Signal Strength/FIM Results

Table 1: North Far-Field Signal Strength Reading (extremis)

	POSITION	SS (DNAV-212 and MBA-2 Antenna)
Side A	46° 15.24570' N 087° 58.76280' W	30 dB μ V/m, SNR = 11
Side B	46° 15.24570' N 087° 58.76280' W	30 dB μ V/m, SNR = 11

Table 2: North Far-Field Signal Strength Reading (on range ring)

	POSITION	SS (DNAV-212 and MBA-2 Antenna)
Side A	45° 15.8484' N 087° 59.4339' W	43 dB μ V/m, SNR = 15

Table 3: South Far-Field Signal Strength Reading

	POSITION	SS (DNAV-212 and MBA-2 Antenna)
Side A	44° 12.3402' N 087° 17.17638' W	60 dB μ V/m, SNR = 17
Side B	44° 12.3402' N 087° 17.17638' W	60 dB μ V/m, SNR = 17

RTCM Message Verification

RTCM message scheduling, receipt, and content were checked during the assessment (refer to Table 4 and 5). 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. A review of the RTCM traffic scheduling in NCS showed that the site was broadcasting Type 5 messages. This discrepancy was immediately corrected and verified remotely that no additional Type 5 messages were sent. Type 7 message positions are within .3 KM of latitude and .6 KM of longitude away from the referenced broadcast antenna with the exception of Rock Island. All other message content was verified and accurate.

Table 4: Side A RTCM Message Validation

Message Type	Received	Scheduled	Content Verified/Accurate
<i>Type 3</i>	Y	Y	Y
<i>Type 5</i>	Y	Y	N/A
<i>Type 7</i>	Y	Y	N
<i>Type 9</i>	Y	Y	Y
<i>Type 16</i>	Y	Y	Y

Table 5: Side B RTCM Message Validation

Message Type	Received	Scheduled	Content Verified/Accurate
<i>Type 3</i>	Y	Y	Y
<i>Type 5</i>	N	Y	N/A
<i>Type 7</i>	Y	Y	N
<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 Hemisphere Crescent GPS receiver with a Raven MBA-2 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 (refer to Table 7). Side A was 0.34 ms, bearing 180°, away from the monument. Side A’s respective distance was well within advertised accuracy requirements. A comparison between the GPS satellites in view at the Mequon DGPS site and at the NGS monument location was conducted (Table 8) to identify any differences in the GPS satellite geometry used at the respective locations.

Table 6: Monument Information

NGS Monument PID:	BBBC23 (BLA-17)
Monument LAT:	42° 8' 53.71918" N
Monument LON:	087° 48' 55.82205" W

Table 7: Side A Accuracy Check Results

Averaged LAT:	42° 8' 53.7081" N
Averaged LON:	087° 48' 55.812" W
Distance from DGPS Site:	163.41 KM
Antenna Distance from Monument:	0.34 m (1.1549 ft.)
Antenna Bearing from Monument:	180°

Table 8: GPS Satellite Comparison

<i>Antenna Location</i>	<i>GPS Satellites Tracked (PRN)</i>											
Reference Station A	1	2	4	8	9	17	20	27	28	32		
Integrity Monitor A	1	2	4	8	9	17	20	27	28	32		
NGS Monument Location	1	2	4	8	9	11	17	20	27	28	49	57

SUMMARY:

The Operational Assessment of the Mequon DGPS site meets the advertised range of 230 km and exceeds its predicted coverage in the south. The Far-field signal strength measurements conducted at the extremis of the predicted coverage were not satisfactory; however, single side readings at the edge of the advertised range were satisfactory. All RTCM messages were verified, evaluated, and are consistent with the requirements set forth in Reference (2) and (3).