DGPS SITE OPERATIONAL ASSESSMENT

NDGPS Site: *Topeka DGPS Site (765)*

Inspector(s): LT Mike Brashier, CWO Greg Sandness

Date: 14MAY12

PURPOSE:

- Validate advertised DGPS coverage of the Topeka 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: Trimble SPS461 DGPS Receiver
Raven Invicta Receiver
Trimble GA-520 Antenna
Potomac Instruments 4100 FIM meter

PARAMETERS:

Frequency	289 KHz
Forward Output Power	900W
Transmission Rate	200 baud
Field Strength/Range	100µV/m (40.0 dBµV/m) at 375 km

RESULTS

Signal Strength:

A verification of the Topeka Differential GPS (DGPS) coverage area was conducted from 72 miles north of Sioux Falls, SD to the Topeka, KS DGPS site, in conjunction with a signal verification of the Omaha DGPS site. The advertised signal strength range is 375 km. Figure 1 below displays adequate signal strength at the advertised range of 375 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 a point 232 miles north of the site (Table 1). Northern FF readings were well above the required 40 dBµV/m signal strength on both sides.

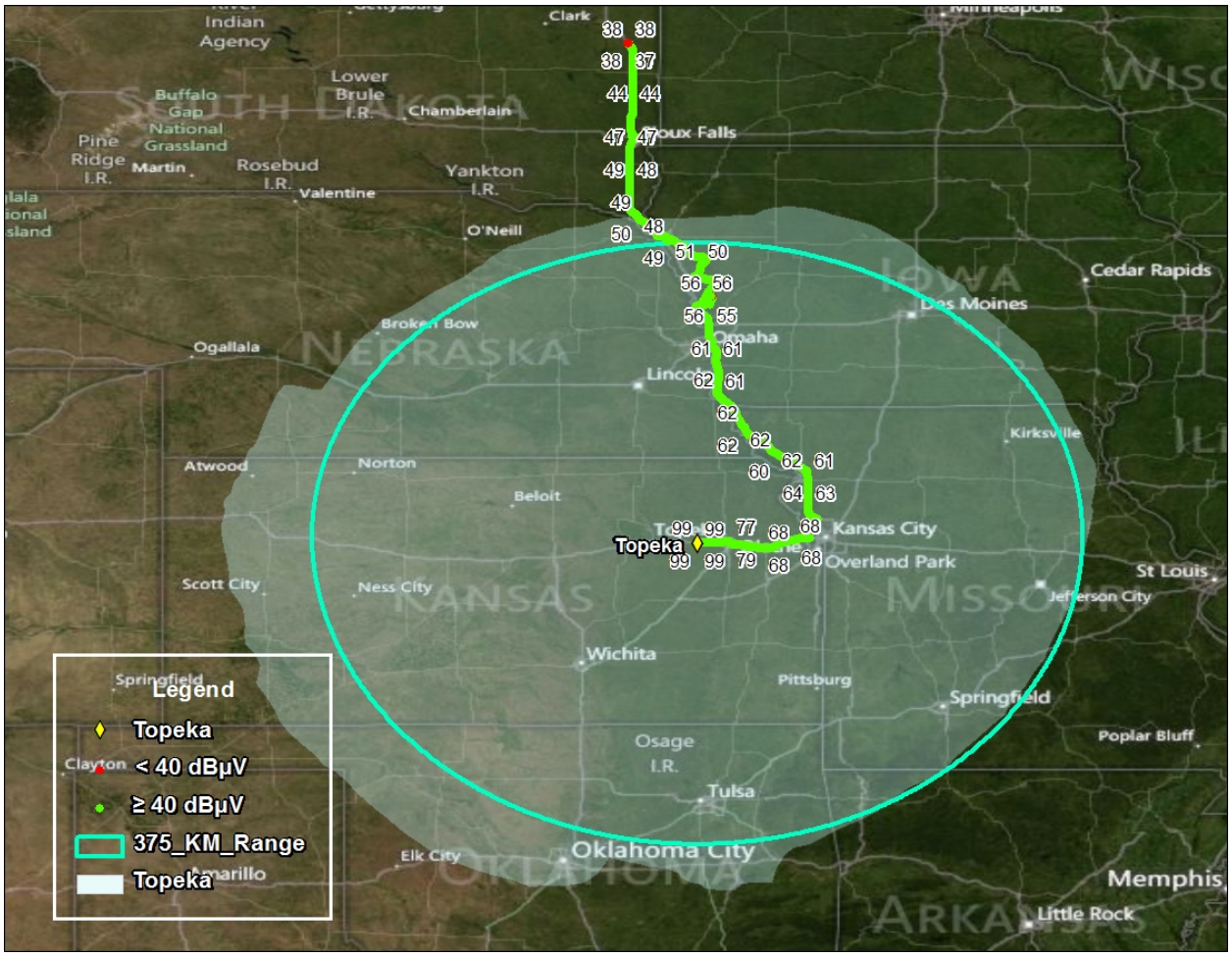

Figure 1: DNAV Signal Strength Results

Distance from Antenna:232M	POSITION	Trimble SPS461, Trimble GA 530 Antenna	4100 FIM Meter
Side A SS	42° 23.829'N 096° 14.018'W	50 dBµV/m, 23 SNR	51.7 dBµV/m
Side B SS	42° 23.829'N 096° 14.018'W	50 dBµV/m, 23 SNR	51.4 dBµV/m

Table 1: North 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 Raven Invicta DGPS Receiver with a Trimble GA 530 antenna, whereby the assessment team witnessed and recorded the receipt of all messages on both sides of the DGPS site. A review of the RTCM message content found inaccurate Type 7 messages for all sites used. In addition all were deemed unusable. Further testing may be required at the manufacturer level or C3Cen.

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	N
Type 9	Y	Y	Y
Type 16	Y	Y	Y

Table 3: 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	N
Type 9	Y	Y	Y
Type 16	Y	Y	Y

Table 4: Side B RTCM Message Validation

Accuracy Validation:

Positional data was collected for 10 minutes per side using a Trimble SPS461 DGPS receiver with a Trimble GA 530 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 3.41 meters, bearing 324.40º, away from the monument while Side B was 3.27 meters, bearing 324.09º, away from the monument. Both respective distances were well within advertised accuracy requirements. A comparison between the GPS satellites in view at the Topeka 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.

NGS Monument ID:	**TT 14**
Monument LAT:	39º 06’ 56.91” N
Monument LON:	096º 29’ 09.83”W

Averaged LAT:	39º 06’ 56.999898” N
Averaged LON:	096º 29‘ 09.7439424” W
Distance from DGPS Site:	38.00 km
Antenna Distance from Monument:	3.41 m (11.2 ft)
Antenna Bearing from Monument:	324.40º

Table 5: Side A Accuracy Check Results

Averaged LAT:	39º 06’ 56.99565” N
Averaged LON:	096º 29’ 09.747048” W
Distance from DGPS Site:	38.00 km
Distance from Monument:	3.27 m (10.72 ft)
Bearing from Monument:	324.09º

Table 6: Side B Accuracy Check Results

Antenna Location	***GPS Satellites Tracked (PRN)***										
Reference Station A	3	6	9	14	15	18	19	21	22	24	32
Integrity Monitor A	1	11	14	16	20	22	23	25	30	31	32
Reference Station B	1	11	14	16	20	22	23	25	30	31	32
Integrity Monitor B	1	11	14	16	20	22	23	25	30	31	32
NGS Monument Location	1	11	14	20	22	25	30	31	32		

Table 7: GPS Satellite Comparison

SUMMARY:

The Operational Assessment of the Topeka DGPS site revealed that the provided coverage exceeds 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 were satisfactory. All RTCM messages were received and all met the requirements set forth by reference (2) and (3) with the exception of type 7 messages. Finally, accuracy measurements and analysis proved that at a distance of approximately 38 km from the broadcast site, the horizontal accuracy is within the accuracy requirements set forth by reference (1) and (2).