



DIFFERENTIAL GPS (DGPS) SITE OPERATIONAL ASSESSMENT

NDGPS Site: Cape Hinchinbrook DGPS Site (894)
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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 Cape Hinchinbrook DGPS site.
- Validate required RTCM message scheduling and delivery.
- Test differential correction accuracy versus a predetermined survey monument.

EQUIPMENT:

Hemisphere VS330 Receiver
Hemisphere R330 Receiver
Hemisphere R110 Receiver
Hemisphere A43 Antenna
Hemisphere A42 Antenna
MBA-2 Receive Antenna

CAPE HINCHINBROOK DGPS SITE PARAMETERS:

Frequency	292 KHz
Forward Output Power	500 Watts
Transmission Rate	100 baud
Field Strength/Range	75 μ V/m (37.5 dB μ V/m) at 222 km

SUMMARY:

The Operational Assessment of the Cape Hinchinbrook DGPS site revealed that the provided coverage is *not* consistent with the predicted coverage plot and advertised range. There were myriad pockets of inadequate signal strength throughout the coverage area particularly inside Prince William Sound. Additionally, a review of the output/reflected power and near-field signal strength levels was conducted and found to be unsatisfactory. All RTCM messages were verified and evaluated and are consistent with the requirements set forth by reference (3) and (4). Finally, accuracy measurements and analysis proved that at a distance of approximately 126 km from the broadcast site, the horizontal accuracy is within the accuracy requirements set forth by Reference (1) and (2).

RESULTS:

Signal Strength:

A verification of the Cape Hinchinbrook DGPS coverage area was conducted from M/V Kennicott as she transited the Gulf of Alaska from Juneau to Whittier and on to Kodiak and Homer. The advertised signal strength range is 222 km. Figure 1 below displays adequate signal strength, beyond the advertised range of 222 km from the site however there are numerous areas throughout the advertised coverage area that do not have adequate signal levels particularly in the western portions of Prince William Sound. Furthermore, the eastern portion of the Gulf of Alaska and the western portion on the approach to Kodiak have many sporadic areas of low signal strength. Green points represent areas of satisfactory signal strength. Areas of unsatisfactory signal strength are represented with red points.

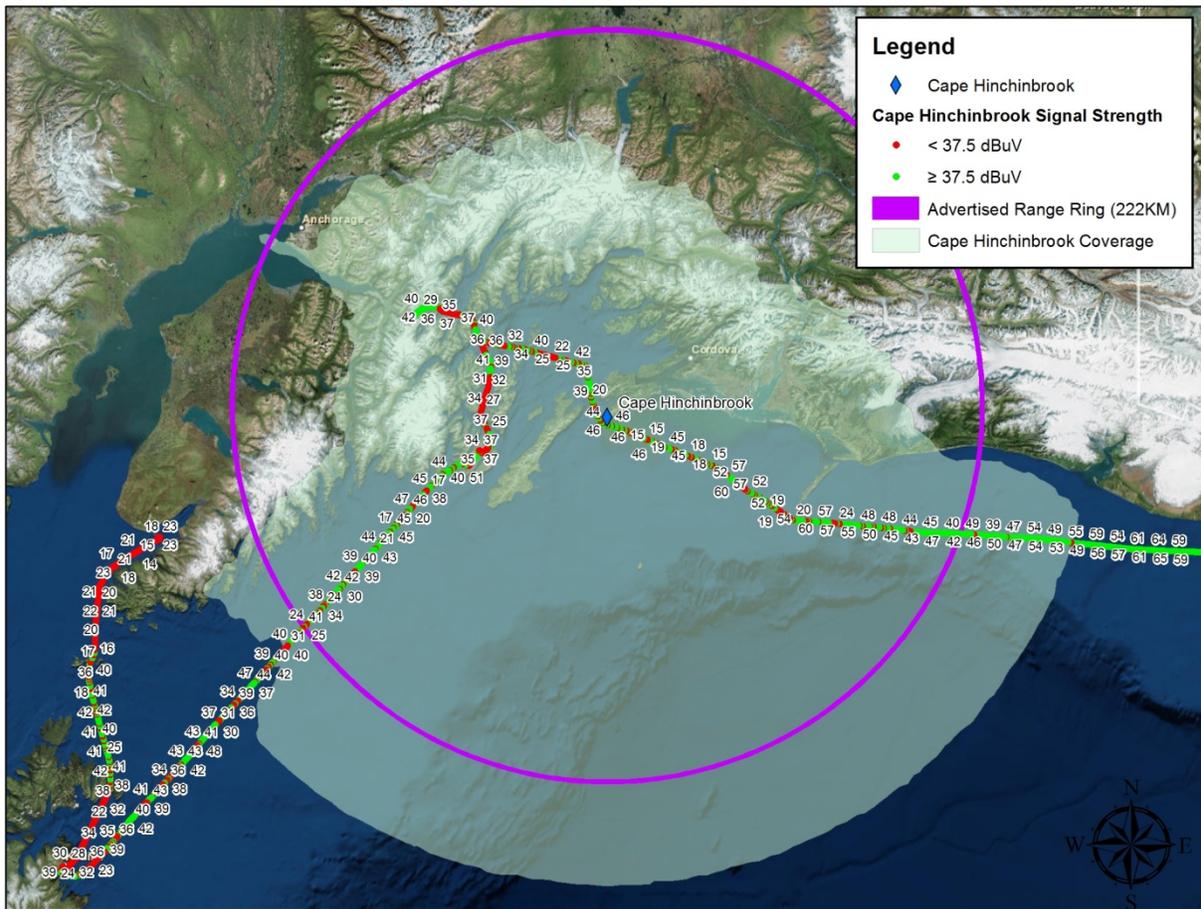


Figure 1: DNAV Signal Strength Results

Signal Strength	Signal to Noise ratio	Position
39 dB μ V/m	12 dB μ V/m	59° 5' 29.9616", -149° 54' 29.1054"

Table 1: Southeast Far-Field Signal Strength Reading

Signal Strength	Signal to Noise ratio	Position
46 dB μ V/m	30 dB μ V/m	59° 37' 10.113", -142° 56' 8.775"

Table 2: Southwest 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 active and standby Integrity Monitor computers. 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 Hemisphere R110. 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 6 and 7). Side A was 1.645 meters away from the monument bearing 257°. Side B was 1.552 meters away bearing 269°. 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 Cape Hinchinbrook 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; 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 0.38514 meters; Side B's average deviation was 0.19635 meters. Both are well within system parameters.

NGS Monument ID:	BBCV98
Monument LAT:	60° 46' 34.26603" N
Monument LON:	148° 40' 52.63108" W
Distance from DGPS Site	126.4 km

Table 5: Monument ID

Averaged LAT:	60° 46' 34.2546" N
Averaged LON:	148° 40' 52.7376" W
Antenna Distance from Monument:	1.645 m (5.396 ft)
Antenna Bearing from Monument:	257°

Table 6: Side A Accuracy Check Results

Averaged LAT:	60° 46' 34.2654" N
Averaged LON:	148° 40' 52.734" W
Distance from Monument:	1.552 m (5.091 ft)
Bearing from Monument:	269°

Table 7: Side B Accuracy Check Results

<i>Antenna Location</i>	<i>GPS Satellites Tracked (PRN)</i>											
Reference Station A	3	5	7	8	10	13	16	23	26	27	28	30
Integrity Monitor A	3	5	7	8	10	13	16	23	26	27	28	30
Reference Station B	3	5	7	8	10	13	16	23	26	27	28	30
Integrity Monitor B	2	3	5	7	8	10	13	16	23	26	27	30
NGS Monument Location, Side A	2	3	5	7	8	10	13	16	23	26	27	30
NGS Monument Location, Side B	2	3	5	7	8	10	13	16	23	26	27	30

Table 8: GPS Satellite Comparison