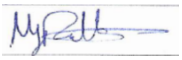
GLOBAL POSITIONING SYSTEM (GPS) PERFORMANCE

QUARTERLY REPORT 2 (APRIL TO JUNE 2026)

Prepared by: M Copple

Approved by: M Pattinson

Authorized by: M Pattinson



Code: GMV_CAA-GPS-SPS-Q2-26

Version: 1.0

Date: 27/07/2026

Internal code: GMV 25351/26 V1/26

DOCUMENT STATUS SHEET

Version	Date	Pages	Changes
1.0	27/07/2026	33	First version delivered to CAA

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

1. INTRODUCTION

1.1. PURPOSE

This document presents the results of the GPS SPS performance assessment for the period from April to June 2026. The objectives of the study are to compare the measured performance against US DoD SPS Performance Standard [RD.1], covering the following parameters [AD.1]:

- SPS SIS Accuracy,
- SPS SIS Integrity,
- SPS SIS Continuity,
- SPS SIS Availability,
- PDOP Availability,
- SPS Position Service Availability and
- SPS Position Service Accuracy.

The report also includes an analysis of NANUs and geomagnetic activity. The performance is analysed using raw data recorded at the GMV Nottingham site (NOTT).

1.2. DOCUMENT OVERVIEW

This document is arranged in the following sections:

- **Section 1**, the current section, describes the purpose, scope and structure of the document and lists the reference documents;
- **Section 2** introduces the activity, including the performance specification, assessment methodology and assumptions;
- **Section 3** contains an assessment of performance against GPS SPS performance standards;
- **Section 4** provides an analysis of NANUs;
- **Section 5** contains the conclusions;
- **Annex A** provides the geomagnetic activity data.

1.3. REFERENCES

1.3.1. APPLICABLE DOCUMENTS

The following documents, of the exact issue shown, form part of this document to the extent specified herein. Applicable documents are those referenced in the Contract or approved by the Approval Authority. They are referenced in this document in the form [AD.x]:

Table 1-1 Applicable Documents

Ref.	Title	Code	Version	Date
[AD.1]	THE PROVISION OF MONITORING AND ANALYSIS OF GPS SIGNALS IN SPACE –	CONTRACT NO. 1762 (AMENDMENT NO. 15)	-	16/01/26

1.3.2. REFERENCE DOCUMENTS

The following documents, although not part of this document, amplify or clarify its contents. Reference documents are those not applicable and referenced within this document. They are referenced in this document in the form [RD.x]:

Table 1-2 Reference Documents

Ref.	Title	Code	Version	Date
[RD.1]	Global Positioning System Standard Positioning Service Performance Standard	GPS SPS	5th Edition	Apr 2020
[RD.2]	Global Positioning System (GPS) Civil Monitoring Performance Specification	DOT-VNTSC-FAA-09-08	-	April 30th 2009
[RD.3]	Reference Set of Parameters for RAIM Availability Simulations', EUROCAE WG-62	-	-	8-9 July 2003
[RD.4]	The International GNSS Service in a changing landscape of Global Navigation Satellite Systems	Journal of Geodesy 83: 191-198		2009

1.4. ACRONYMS

Acronyms used in this document and needing a definition are included in the following table:

Table 1-3 Acronyms

Acronym	Definition
AOD	Age Of Data
CAA	Civil Aviation Authority
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HDOP	Horizontal Dilution Of Precision
IGS	International GNSS Service
NANU	Notice Advisory to Navstar Users
NOTAM	Notice To Airmen
PDOP	Position Dilution Of Precision
RAIM	Receiver Autonomous Integrity Monitoring
SIS	Signal In Space
SPS	Standard Positioning Service
TTA	Time To Alarm
UERE	User Equivalent Range Error
URA	User Range Accuracy
URE	User Range Error
VDOP	Vertical Dilution Of Precision

2. PERFORMANCE REQUIREMENTS AND METHODOLOGY

2.1. PURPOSE

The purpose of the performance monitoring activity is to collect and analyse data on the performance of the GPS Signal-in-Space (SIS) [AD.1]. For this report, the applicable requirements are defined in the Global Positioning System Standard Positioning Service Performance Standard (GPS SPS PS), approved by the US Department of Defense [RD.1].

2.2. PERFORMANCE SPECIFICATION AND DEFINITIONS

The applicable performance specifications for the Standard Positioning Service [RD.1] are as follows, with changes to the previous version of the GPS Performance standard (prior to April 2020) noted:

Criteria	Specifications
SPS SIS Accuracy	**The User Range Error (URE) for any healthy satellite for Single-Frequency C/A-Code**: • ≤7.0 m 95% Global Average URE during Normal Operations over all age of data (AODs) ***[previous value was 7.8m]*** • ≤3.8m 95% Global Average URE during Normal Operations at Zero AOD ***[previous value was 6.0m]*** • ≤9.7 m 95% Global Average URE during Normal Operations at Any AOD ***[previous value was 12.8m]*** • ≤30 m 99.94% Global Average URE during Normal Operations over a one-year period • ≤30 m 99.79% Worst Case Single-Point Average URE during Normal Operations over one-year period • ≤388 m 95% Global Average URE during Extended Operations after 14 Days without upload. **The User Range Error (URE) for all healthy satellites for Single-Frequency C/A-Code**: • ≤2.0 m 95% Global Average URE during Normal Operations over all age of data (AODs) ***[New specification – did not appear previously]*** **The User Range Rate Error (URRE) for Single-Frequency C/A-Code:** ≤0.006 m/sec 95% Global Average URRE over any 3-second interval during Normal Operations at Any AOD **The User Range Acceleration Error (URAE) for Single-Frequency C/A-Code:** ≤0.002 m/sec/sec 95% Global Average URAE over any 3-second interval during Normal Operations at Any AOD **The UTC Offset Error for Single-Frequency C/A-Code:** ≤30 nsec 95% Global Average UTCOE during Normal Operations at Any AOD ***[previous value was 40nsec]***

Criteria	Specifications
SPS SIS Integrity	**The SIS Instantaneous URE Integrity for Single-Frequency C/A-Code:** • ≤1x10^{-5} Probability Over Any Hour of the SPS SIS Instantaneous URE Exceeding the NTE Tolerance Without a Timely Alert during Normal Operations **The SIS Instantaneous UTCOE Integrity for Single-Frequency C/A-Code:** • ≤1x10^{-5} Probability Over Any Hour of the SPS SIS Instantaneous UTCOE Exceeding the NTE Tolerance Without a Timely Alert during Normal Operations **The SIS Instantaneous Psat and Pconst for Single-Frequency C/A-Code:** • ≤1x10^{-5} Fraction of Time when the SPS SIS Instantaneous URE Exceeds the NTE Tolerance Without a Timely Alert (Psat) ***[New specification – did not appear previously]*** • ≤1x10^{-8} Fraction of Time when the SPS SIS Instantaneous URE from two or more satellites Exceeds the NTE Tolerance due to a common cause Without a Timely Alert (Pconst) ***[New specification – did not appear previously]***
SPS SIS Continuity	**SPS SIS Unscheduled Failure Interruption Continuity** • ≥ 0.9998 Probability Over Any Hour of Not Losing the SPS SIS Availability from a Slot Due to Unscheduled Interruption • Given that the SPS SIS is available from the slot at the start of the hour
Status and Problem reporting	**Scheduled Event Affecting Service** • Appropriate NANU issued to the Coast Guard and the FAA at least 48 hours prior to the event for 95% of the events ***[previously did not specify a %]***
SPS SIS Availability	**SPS SIS Per-Slot Availability** • ≥ 0.957 Probability that a Slot in the Baseline 24-Slot Configuration will be Occupied by a Satellite Broadcasting a Healthy SPS SIS • ≥ 0.957 Probability that a Slot in the Expanded Configuration will be Occupied by a Pair of Satellites Each Broadcasting a Healthy SPS SIS **SPS SIS Constellation Availability** • ≥ 0.98 Probability that at least 21 Slots out of the 24 Slots will be Occupied Either by a Satellite Broadcasting a Healthy SPS SIS in the Baseline 24-Slot Configuration or by a Pair of Satellites Each Broadcasting a Healthy SPS SIS in the Expanded Slot Configuration • ≥ 0.99999 Probability that at least 20 Slots out of the 24 Slots will be occupied either by a Satellite Broadcasting a Healthy SPS SIS in the Baseline 24-Slot Configuration or by a Pair of Satellites Each Broadcasting a Healthy SPS SIS in the Expanded Slot Configuration. • ≥ 0.95 Probability that the Constellation will have at least 24 Operational Satellites regardless of Whether Those Operational Satellites are Located in Slots or Not.
PDOP Availability	• ≥ 98% global Position Dilution of Precision (PDOP) of 6 or less • ≥ 88% worst site PDOP of 6 or less

Criteria	Specifications
SPS Position Service Availability	• ≥ 99% Horizontal Service Availability average location • ≥ 90%Horizontal Service Availability worst-case location • ≥ 99% Vertical Service Availability average location • ≥ 90% Vertical Service Availability worst-case location **With 15 m horizontal and 33 m vertical (SIS only) 95% threshold over 24hours** ***[previous values were 17m and 37m]***
Positioning Accuracy	• ≤ 8 meters 95% Global Average Horizontal Error ***[previous value was 9m]*** • ≤ 15 meters 95% worst site Horizontal Error ***[previous value was 17m]*** • ≤ 13 meters 95% Global Average Vertical Error ***[previous value was 15m]*** • ≤ 33 meters 95% worst site Vertical Error ***[previous value was 37m]*** • Global Average Velocity Accuracy • ≤ 0.2 m/sec 95% velocity error, any axis ***[New specification – did not appear previously]*** • ≤ 30 nanoseconds time transfer error 95% of time for Time Transfer Domain Accuracy ***[previous value was 40nsec]***

Table 2-1: SPS Criteria and Specifications

The definitions for each of the criteria and the methodology used for assessment are given below. As well as the GPS SPS [RD.1], the GPS civil monitoring performance specification [RD.2] has also been used to help define the methodology for the assessment.

SPS SIS Accuracy

The SPS SIS accuracy is described in two statistical ways; one way is as the 95th percentile (95%) SPS SIS user range error (URE) at a specified age of data (AOD), the other as the 95% SPS SIS URE over all AODs. With either statistical expression, the SPS SIS accuracy is also known as the SPS SIS pseudorange accuracy. In this context, "pseudorange" means the full pseudorange data set (i.e. the matched combination of a corrected pseudorange measurement and a pseudorange origin, or equivalently the matched combination of a raw pseudorange measurement and the associated NAV data).

Other accuracy-related SPS SIS performance parameters include the SPS SIS pseudorange rate (velocity) accuracy defined as the 95% SPS SIS pseudorange rate error over all AODs and the SPS SIS pseudorange acceleration (rate-of-change) accuracy defined as the 95% SPS SIS pseudorange acceleration error over all AODs. These values are not monitored as part of this performance monitoring contract.

SPS SIS Integrity

The SPS SIS integrity is defined as the trust which can be placed in the correctness of the information provided by the SPS SIS. SPS SIS integrity includes the ability of the SPS SIS to provide timely alerts to receivers when the SPS SIS should not be used for positioning or timing. The SPS SIS should not be used when it is providing misleading signal-in-space information (MSI), where the threshold for "misleading" is a not-to-exceed (NTE) tolerance on the SIS URE. For this SPS PS, the four components of integrity are the probability of a major service failure, the time to alert, the SIS URE NTE tolerance, and the alert (either one or the other of two types of alerts).

- Probability of a Major Service Failure. The probability of a major service failure for the SPS SIS is defined as the probability that the SPS SIS instantaneous URE exceeds the SIS URE NTE tolerance

(i.e., MSI) without a timely alert being issued (i.e., unalerted MSI [UMSI]). Alerts generically include both alarms and warnings.

- Time to Alert. The time to alert (TTA) for the SPS SIS is defined to be the time from the onset of MSI until an alert (alarm or warning) indication arrives at the receiver's antenna. Real-time alert information broadcast as part of the NAV message data is defined to arrive at the receiver's antenna at the end of the NAV message subframe which contains that particular piece of real-time alert information.
- SIS URE NTE Tolerance. The SPS SIS URE NTE tolerance for a healthy SPS SIS is defined to be 4.42 times the upper bound on the URA value corresponding to the URA index "N" currently broadcast by the satellite. The SIS URE NTE tolerance for a marginal SPS SIS is not defined and there is no SIS URE NTE tolerance for an unhealthy SPS SIS.

SPS SIS Continuity

The SPS SIS continuity for a healthy SPS SIS is the probability that the SPS SIS will continue to be healthy without unscheduled interruption over a specified time interval. Scheduled interruptions which are announced at least 48 hours in advance do not contribute to a loss of continuity. Scheduled SPS SIS interruptions are announced by way of the Control Segment issuing a "Notice Advisory to Navstar Users" (NANU). NANUs are similar to the "Notices to Airmen" (NOTAMs) issued regarding scheduled interruptions of ground-based air navigation aids. OCS internal procedures are to issue NANUs for scheduled interruptions at least 96 hours in advance.

SPS SIS Availability

The SPS SIS availability is the probability that the slots in the GPS constellation will be occupied by satellites transmitting a trackable and healthy SPS SIS. For this SPS Performance Standard, there are two components of availability as follows:

- Per-Slot Availability. The fraction of time that a slot in the GPS constellation will be occupied by a satellite that is transmitting a trackable and healthy SPS SIS.
- Constellation Availability. The fraction of time that a specified number of slots in the GPS constellation

PDOP Availability

PDOP availability is defined as the percentage of time over a specified time interval that the predicted PDOP is less than a specified value for any point within the service volume [RD.1].

Position Service Availability

Position service availability is defined as the percentage of time over a specified time interval that the position accuracy is less than a specified value for any point within the service volume [RD.1].

Positioning Service Accuracy

Position service accuracy is defined as the statistical difference between position measurements and a surveyed benchmark for any point within the service volume over a specified time interval [RD.1].

2.3. METHODOLOGY

For the performance analysis in this report, raw GPS measurement data from reference stations have been analysed. The primary source of data is continuously operating receivers, installed by GMV at its Nottingham and Harwell offices, which provide a log of 1Hz GNSS measurement data. These are shown in the map below.

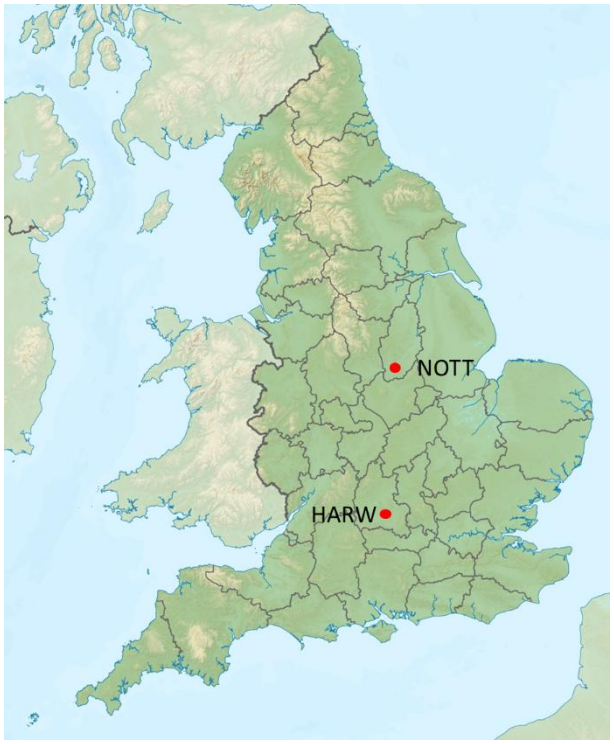


Figure 2-1: Location of GMV Monitoring Receivers

As an alternative, data from the EUREF permanent GPS network can be used (as shown in the next figure). The EUREF receivers provide high-rate (1Hz), multi-constellation, multi-frequency GNSS measurements. The data files are accessed via ftp and can be downloaded at GMV NSL before processing with GISMO software. The daily navigation message files are also downloaded from the IGS ftp site and used to provide the navigation data [RD.4].

Figure 2-2: Location of EUREF Sites
(http://www.epncb.oma.be/_networkdata/stationmaps.php)

In this quarter, data from the GMV Nottingham site (NOTT) is used for most of the monitoring period. There was an issue with the NOTT antennas between 14th and 19th May so data from the EUREF site DARE has been used for these days.

The methods for assessing each of the requirements are described below.

SPS SIS Accuracy

SIS accuracy is assessed through processing and analysis of the raw measurement data. In order to compute the SIS accuracy, the measurements recorded at the GPS receiver are used to compute the instantaneous SIS errors. This is done by computing the difference between computed ranges (based on known receiver location and satellite position) and the corrected measurement, which has satellite and receiver clock biases, group delay, ionospheric and tropospheric errors removed. Once the SIS range errors for every satellite measurement on every epoch have been computed, the per-satellite and all-satellite statistics across the whole period, as well as daily statistics for all satellites combined, are generated.

SPS SIS Integrity

SIS integrity is assessed through processing and analysis of the raw measurement data. The SIS integrity is assessed by comparing each instantaneous computed SIS error value with a threshold value of 4.42 x the broadcast URA. The number of occasions where the instantaneous URE exceeds the threshold are counted and checked against the expected number of failures.

SPS SIS Continuity

SIS continuity is assessed through analysis of the broadcast navigation messages and the NANU archive. First, the daily broadcast navigation messages are scanned to find the time periods for any satellites that do not have healthy navigation messages. These satellites and time periods are then matched against NANU information to see if the outages are scheduled or unscheduled.

The SIS continuity is computed for the baseline 24-slot constellation and is an average value over all slots. The total time that any satellites in the baseline constellation were unhealthy due to an unscheduled outage is divided by the total time in the analysis period and expressed as a percentage. Results are presented for the reporting period and, when available, for the previous year.

SPS SIS Availability

SIS availability is assessed through analysis of the broadcast navigation messages and the NANU archive. Firstly, the daily broadcast navigation messages are scanned to find the time periods for any satellites that do not have healthy navigation messages. These satellites and time periods are then matched against NANU information to see if the outages are scheduled or unscheduled.

The SIS availability is computed for the baseline 24-slot constellation as well as for the whole constellation and is an average value over all slots. At each epoch, the number of healthy satellites (both in the baseline 24-slot constellation and in total) is counted. Then the following parameters are computed:

- Total time that there are less than 21 healthy satellites in the baseline constellation;
- Total time that there are less than 20 healthy satellites in the baseline constellation;
- Total time that there are less than 24 healthy satellites in the whole constellation.

These parameters are then divided by total analysis time and expressed as percentage values. Results are presented for the reporting period and, when available, for the previous year.

It should be noted that if the baseline 24-slot constellation does not meet requirements, the analysis will be expanded to include pairs of satellites in the expanded slot constellation.

PDOP Availability

PDOP availability is assessed through processing and analysis of the raw measurement data. The PDOP availability is assessed by computing the PDOP for all satellites in view above 5 degrees elevation mask at the GPS receiver at every epoch at a rate of 1Hz. Each PDOP value is checked against the threshold value of 6 and any failures are counted. The numbers of failures on each day are then used to generate the daily availability value. A separate availability value for each day is computed.

Position Service Availability

Position service availability is assessed through processing and analysis of the raw measurement data. The derivation of the position service availability requirements of 15m (95% horizontal accuracy) and 33m (95% vertical accuracy) for 99% of the time are explained in more detail in section B.3.2 of the GPS SPS [RD.1]. The requirement is based on fulfilling a 1-sigma UERE of 3.6m, HDOP of 2.1 and VDOP of 4.53. To check this requirement, the following approach is used:

- For each day, compute daily RMS SIS error for all satellites combined. This is equivalent to the 1-sigma UERE in the description above;
- On each epoch, multiply daily RMS SIS error by HDOP value to compute estimated horizontal accuracy due to SIS error;
- For each epoch, multiply daily RMS SIS error by VDOP value to compute estimated vertical accuracy due to SIS error;
- Compute daily availability (%) of estimated horizontal accuracy < 7.5m (1-sigma);
- Compute daily availability (%) of estimated vertical accuracy < 16.5m (1-sigma).
- If daily availability of horizontal accuracy is greater than the required threshold, the requirement for horizontal service accuracy is met;
- If daily availability of vertical accuracy greater than the required threshold, the requirement for vertical service accuracy is met.

Positioning Service Accuracy

In order to check the position service accuracy, the raw measurements recorded at the GPS receiver are used to compute a user position solution at every epoch (1Hz). The computed positions are then compared against the known position of the receiver in order to generate horizontal and vertical position errors. Statistics for 95% error value, 99.99% error value etc. are then computed separately for each day and checked against the thresholds.

2.4. ASSUMPTIONS

For processing the raw data and generating the results, the following assumptions are made:

- Single frequency (L1) processing with C/A code;
- 5-degree elevation mask used;
- Broadcast ionospheric model (Klobuchar) used to remove ionospheric errors;
- RTCA tropospheric model used to remove tropospheric errors;
- Weighted least squares RAIM algorithm used for RAIM prediction (protection level computation) and Fault Detection;
- Probability of missed detection = 0.001 and Probability of false alarm = 1x10-5 for RAIM computations;
- UERE budget (non-SIS components) used in position solution and for RAIM predictions based on the values given below [RD.3]:

Elevation, degrees	Error, metres
5	7.48
10	6.64
15	5.92
20	5.31
30	4.31
40	3.57
50	3.06
60	2.73
90	2.44

- The URA value from the broadcast navigation message is combined with the values in the table to form the total UERE for the observations.

As the actual monitoring is based on the measurements from a single receiver, the following points should be noted:

- Performance monitoring is local to the monitoring station with a coverage area defined by the correlation of the major error sources and the configuration of the constellation.
- The range-domain errors contain the residuals of other error sources other than the SIS range errors, hence the performance statistics generated are conservative.

3. SPS PERFORMANCE

3.1. BASELINE 24-SLOT CONSTELLATION

The SPS SIS performance standard is largely based on the GPS baseline 24-slot constellation, which consists of 24 slots in six orbital planes with four slots per plane. Some of these slots are e expanded, such that two satellites occupy fore and aft positions within that slot, in which case the slot is considered occupied provided that at least one of the two expanded positions contains an operational satellite. It is important to identify the baseline constellation (and expanded slots) to provide a reference for subsequent data processing and analysis. The following tables show the satellite PRN assigned to each slot for the baseline constellation for the period from April to June 2026[1].

Table 3-1: Baseline constellation for the Period 1 April to 20 April 2026

Slot	A1	A2A/A2F	A3	A4	B1A/B1F	B2	B3	B4	C1	C2	C3	C4A/C4F
PRN	24	31/28	30	7	16/26	25	14	12	29	27	8	19/17
Slot	D1	D2A/D2	D3	D4	E1	E2	E3A/E3F	E4	F1	F2A/F2F	F3	F4
PRN	11	1/2	18	6	3	10	5/20	23	32	15/13	9	4

Table 3-2: Baseline constellation for the Period 20 April to 10 June 2026

Slot	A1	A2A/A2F	A3	A4	B1A/B1F	B2	B3	B4	C1	C2	C3	C4A/C4F
PRN	24	31/28	30	7	16/26	25	14	12	29	27	8	19/17
Slot	D1	D2A/D2	D3	D4	E1	E2	E3A/E3F	E4	F1	F2A/F2F	F3	F4
PRN	11	1/2	18	6	3	10	5/21	23	32	15/13	9	4

Table 3-3: Baseline constellation for the Period 10 June to 30 June 2026

Slot	A1	A2A/A2F	A3	A4	B1A/B1F	B2	B3	B4	C1	C2	C3	C4A/C4F
PRN	24	31/28	30	7	16/26	25	14	12	29	27	8	19/17
Slot	D1	D2A/D2	D3	D4	E1	E2	E3A/E3F	E4	F1	F2A/F2F	F3	F4
PRN	11	1/2	18	6	3	10	5/21	23	32	15/20	9	4

It is also noted that SVN44 was re-activated to broadcast PRN22 from 18th August 2024 but no information is available regarding the orbital plane and slot occupied by that satellite.

3.2. SPS SIS ACCURACY

In addition to the specifications in Table 2-1, the conditions and constraints for SPS SIS URE Accuracy specification [RD.1] are:

[1] The information on slots is taken from the figure at https://www.navcen.uscg.gov/sites/default/files/pdf/gps/current.pdf. It is noted that there is some inconsistency between this figure and the slot numbers in the ops advisory messages. The figures were from 1st January 2025, then updated on 20th Jan 2026 and updated again on 10th March 2026.

- For any healthy SPS SIS;
- Neglecting single-frequency ionospheric delay model errors;
- Including group delay time correction (TGD) errors at L1;
- Including inter-signal bias (P(Y)-code to C/A-code) errors at L1.

The statistics presented here use the same sampling rate as the positioning analysis (1Hz). It should be noted that the computed range errors (in addition to SIS errors) contain residual errors local to the monitoring antenna (multipath, tropospheric and ionospheric). The URE accuracy (95th percentile) values of each satellite for the period April to June 2026 are shown in the next figure.

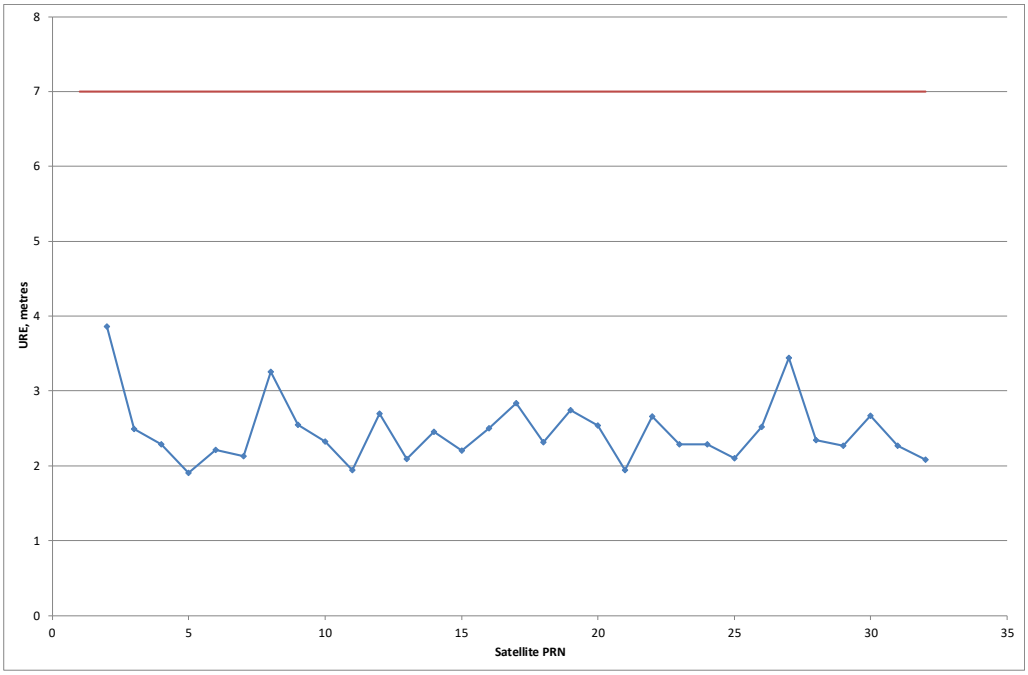


Figure 3-1: Constellation URE (95%) for Reporting Period

It can be seen that the URE (95%) for all satellites is below the 7m threshold.

The daily constellation RMS URE results for the period April to June 2026 and the 3.6m threshold are shown in the next figure. Note that ≤ 7 m 95% SPS SIS URE performance standard is equivalent to a ≤ 3.6 m RMS SPS SIS URE performance standard [RD.1]. This is also important for the position service availability assessment.

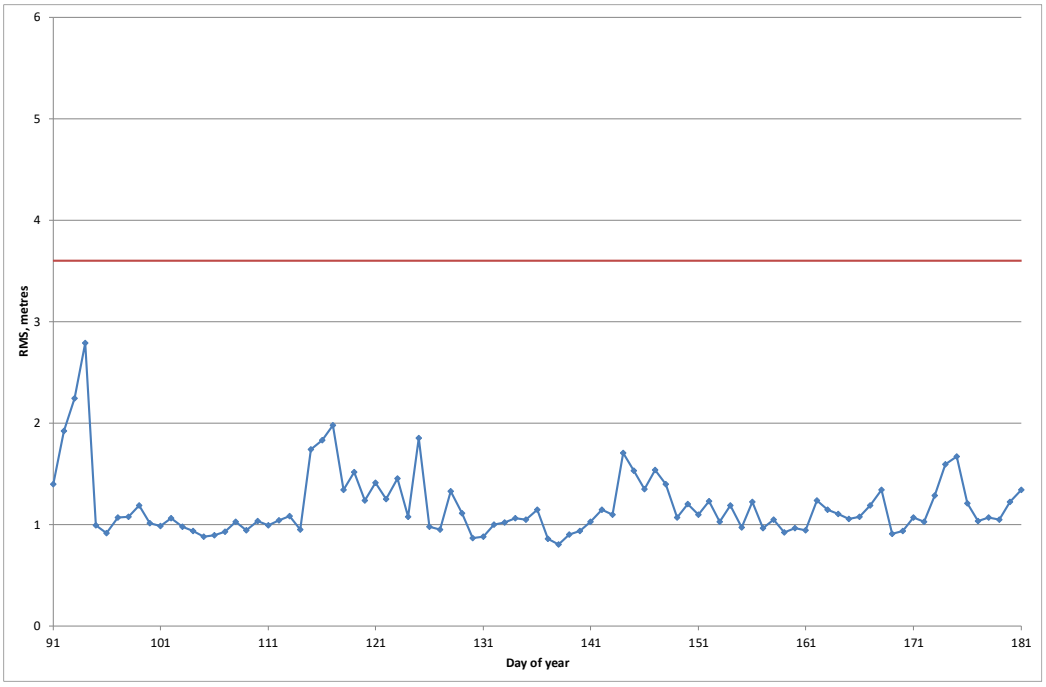


Figure 3-2: Constellation RMS URE for Reporting Period

This combined statistic considers all satellites and can therefore help identify if the apparent poor satellite performance (from Figure 3-1) affects the whole reporting period (in which case we would expect to see a general increase in the metric) or whether it is limited to particular dates. It can be seen that the RMS values are below the threshold (3.6 metres) on all dates.

As well as the 95% and rms URE statistics, additional URE statistics are computed, including mean, 1-sigma and maximum values. Although not strictly required for the performance specification, these values can be useful for anomaly investigation. The range error statistics (in metres) for the period April to June 2026 are given in the table below.

Table 3-4: Range Error Statistics for Reporting Period Using L1 Only

PRN	Range Error (mean)	Range Error (RMS)	1-sigma	Range Error (95%)	Range Error (max)	Number of Samples
1	-0.06	1.51	1.51	3.02	7.15	2132728
2	0.69	1.70	1.56	3.86	7.97	2177050
3	-0.22	1.29	1.28	2.49	8.70	2445950
4	-0.22	1.19	1.17	2.29	5.62	2663331
5	-0.05	0.97	0.97	1.90	5.64	2753126
6	0.33	1.11	1.06	2.22	5.05	2769020
7	0.06	1.05	1.05	2.13	5.43	2815462
8	0.44	1.54	1.48	3.26	7.65	2420456
9	0.29	1.24	1.21	2.55	6.38	2453293
10	0.00	1.16	1.16	2.32	7.05	2863421
11	0.08	0.97	0.97	1.94	4.78	2829614

PRN	Range Error (mean)	Range Error (RMS)	1-sigma	Range Error (95%)	Range Error (max)	Number of Samples
12	0.30	1.26	1.23	2.70	7.70	2349035
13	0.71	1.06	0.78	2.09	4.40	596646
14	-0.23	1.26	1.24	2.46	6.10	2830199
15	-0.13	1.11	1.11	2.20	4.32	2516703
16	0.02	1.22	1.22	2.50	6.86	2568473
17	-0.13	1.39	1.39	2.84	6.60	2619475
18	-0.50	1.15	1.04	2.32	5.67	2744828
19	0.83	1.36	1.08	2.74	6.53	2836960
20	-0.11	1.24	1.23	2.53	4.97	2422889
21	0.02	0.97	0.97	1.94	4.75	2616127
22	0.20	1.27	1.26	2.66	6.77	2837218
23	-0.38	1.13	1.07	2.29	5.24	2860546
24	-0.30	1.17	1.13	2.29	5.02	2098717
25	0.47	1.11	1.00	2.10	6.44	2109638
26	-0.17	1.27	1.26	2.52	6.40	2451586
27	0.43	1.70	1.64	3.44	7.81	1829710
28	-0.56	1.20	1.07	2.35	5.95	2679614
29	0.08	1.16	1.16	2.27	5.85	2557824
30	0.25	1.29	1.27	2.67	5.86	2593554
31	-0.39	1.15	1.08	2.27	4.64	2770699
32	-0.12	1.03	1.03	2.08	5.25	2883679
Total	0.02	1.08	1.08	2.46	8.70	80097571

3.3. SPS SIS INTEGRITY

In addition to the specifications in Table 2-1, the Conditions and Constraints for SPS SIS Integrity performance [RD.1] are:

- For any healthy SPS SIS;
- SPS SIS URE NTE tolerance defined to be ±4.42 times the upper bound on the URA value corresponding to the URA index "N" currently broadcast by the satellite;
- Given that the maximum SPS SIS instantaneous URE did not exceed the NTE tolerance at the start of the hour;
- The worst case for a delayed alert is 6 hours;
- Neglecting single-frequency ionospheric delay model errors.

Based on the requirement of $1x10^{-5}$/hr probability for misleading information, a 92-day period and a 31-satellite constellation, the maximum number of events expected is 0.66.

At every epoch throughout the monitoring period, the instantaneous measured URE for each satellite has been compared against a threshold of 4.42 times the upper-bound value corresponding to the URA index. The number of URE values above the threshold has been recorded and is checked against the expected number.

From the analysis, no SIS faults were identified and the requirement was therefore met.

3.4. SPS SIS CONTINUITY

In addition to the specifications in Table 2-1, the Conditions and Constraints for SPS SIS Continuity performance [RD.1] are:

- Calculated as an average over all slots in the 24-slot constellation, normalised annually;
- Given that the SPS SIS is available from the slot at the start of the hour.

During this reporting period, there were two unscheduled events affecting the baseline constellation lasting a total of 55.22 hours. Therefore, this resulted in a continuity value of 99.893% in this period, which did not meet the requirement of 99.98% for the reporting period.

During the previous rolling year, there have been thirteen unscheduled outages on the baseline constellation lasting for 490.42 hrs in total. This gives a continuity value for the year of 99.766%, which does not meet the performance standard.

3.5. SPS SIS AVAILABILITY

In addition to the specifications in Table 2-1, the Conditions and Constraints for SPS SIS Availability performance [RD.1] are:

- Calculated as an average over all slots in the 24-slot constellation, normalised annually;
- Applies to satellites broadcasting a healthy SPS SIS which also satisfy the other performance standards in this SPS Performance Standard.

The total period (in this monitoring period) in which satellites from the baseline 24-satellite constellation broadcast an unhealthy SIS was 541.97 hours. This is equivalent to an average of 0.99966 over all slots in the 24-slot constellation and satisfies SPS SIS per-slot availability standard (≥ 0.957).

The minimum number of the baseline-constellation satellites broadcasting healthy SPS SIS was 22, greater than the specified thresholds of 20 and 21. Hence, performance during the monitoring period was measured at the 100% level, satisfying the Performance Standard as specified below.

- ≥0.98 Probability that at least 21 Slots out of the 24 Slots will be Occupied Either by a Satellite Broadcasting a Healthy SPS SIS in the Baseline 24-Slot Configuration or by a Pair of Satellites Each Broadcasting a Healthy SPS SIS in the Expanded Slot Configuration;
- ≥ 0.99999 Probability that at least 20 Slots out of the 24 Slots will be occupied either by a Satellite Broadcasting a Healthy SPS SIS in the Baseline 24-Slot Configuration or by a Pair of Satellites Each Broadcasting a Healthy SPS SIS in the Expanded Slot Configuration.

The minimum number of operational satellites broadcasting healthy navigation messages in this reporting period was 29. This represents performance at the 100% level, satisfying the Performance Standard as specified below.

- ≥ 0.95 Probability that the Constellation has at least 24 operational satellites regardless of whether the operational satellites are in the baseline slots.

For the previous rolling year, the total period in which satellites from the baseline 24-satellite constellation did not broadcast a healthy SIS was 1067.80 hours. This is equivalent to an average of 99.492% over all slots in the 24-slot constellation and satisfies SPS SIS Per-slot Availability (≥ 0.957).

The minimum number of the baseline constellation satellites broadcasting healthy SPS SIS was 22, greater than the specifications of 20 and 21, and the minimum number of operational satellites broadcasting healthy messages was 29. This means that all constellation-availability requirements in the Performance Standard were met for the previous year.

3.6. PDOP AVAILABILITY

In addition to the specifications in Table 2-1, the Conditions and Constraints for PDOP performance [RD.1] are:

- Defined for a position solution meeting the representative user conditions and operating within the service volume over any 24-hour interval;
- Based on using only satellites transmitting standard code and indicating "healthy" in the broadcast navigation message.

The following plot shows the daily PDOP availability (PDOP < 6) calculated at the site for all healthy satellites above 5-degree elevation mask during the period April to June 2026.

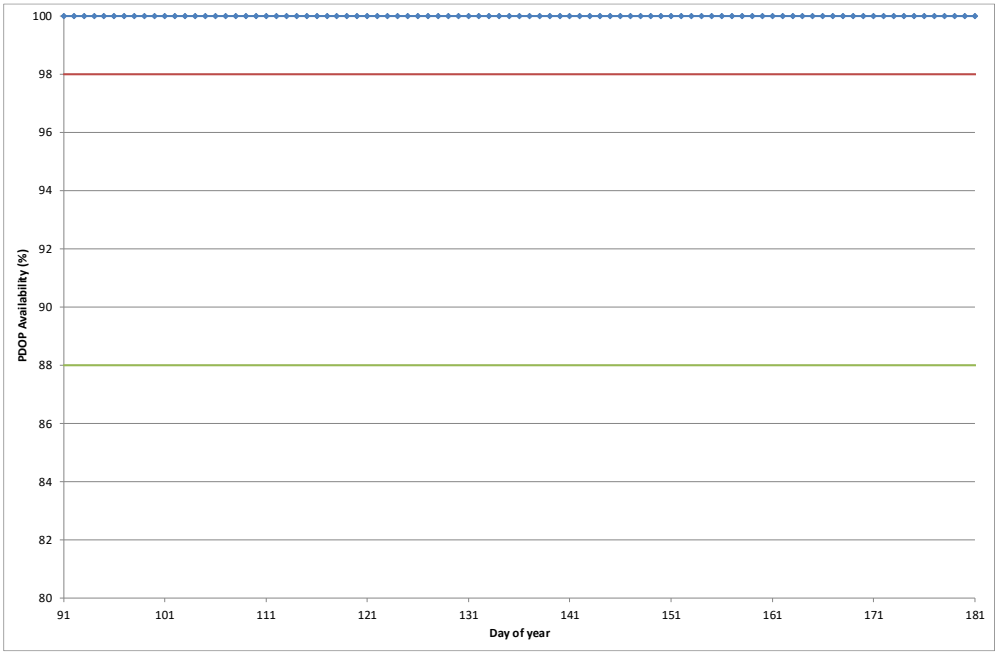


Figure 3-3: Daily PDOP Availability in the Reporting Period

The daily PDOP availability values are all above the thresholds of 98% (global average) and 88% (worst site). Therefore, the PDOP availability requirements were met.

In addition, the daily mean and maximum PDOP values are shown for the same period.

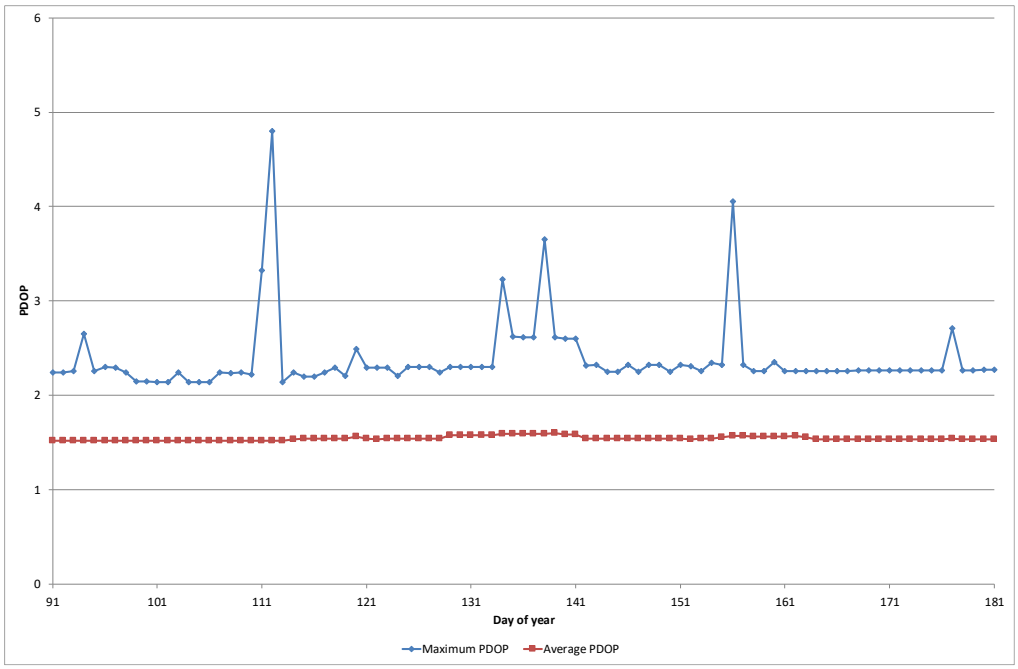


Figure 3-4: Daily Maximum PDOP Value in the Reporting Period

The daily PDOP values PDOP can be used to identify specific days that have different performance from the others. The maximum PDOP remained below the threshold of 6.

3.7. POSITION SERVICE AVAILABILITY

In addition to the specifications in Table 2-1, the Conditions and Constraints for Service Availability performance [RD.1] are:

- 15 meters horizontal (SIS only) 95% threshold;
- 33 meters vertical (SIS only) 95% threshold;
- Defined for position solution meeting representative user conditions and operating within the service volume over any 24-hour interval;
- Based on using only satellites transmitting standard code and indicating “healthy” in the broadcast navigation message.

The computation of these values is detailed in Section 2.3.

The daily horizontal and vertical service availabilities for the period April to June 2026 are shown in the following figures.

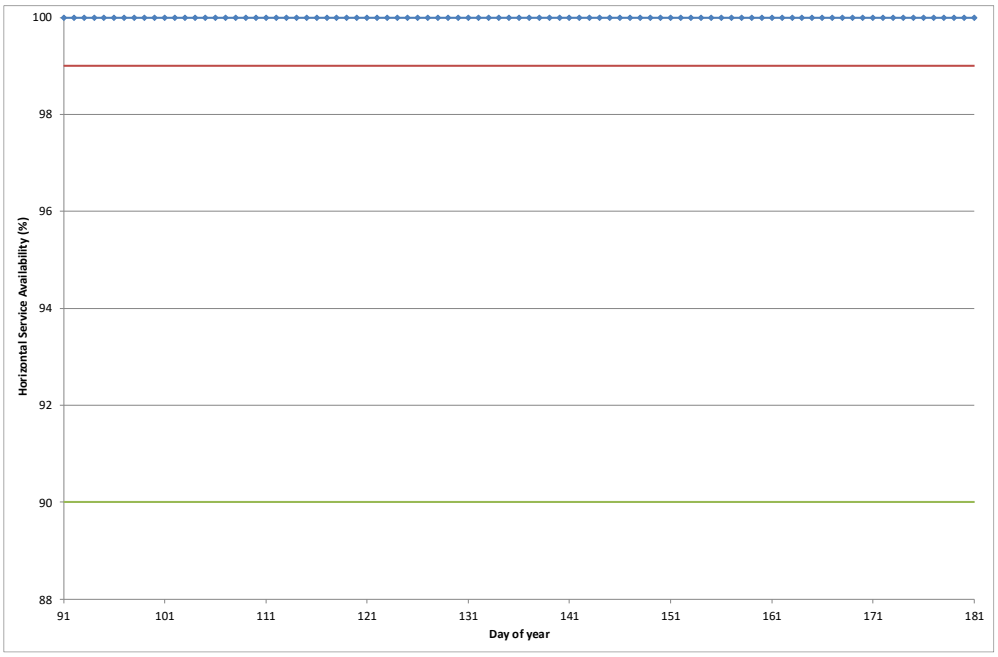


Figure 3-5: Daily Horizontal Service Availability Values for Reporting Period

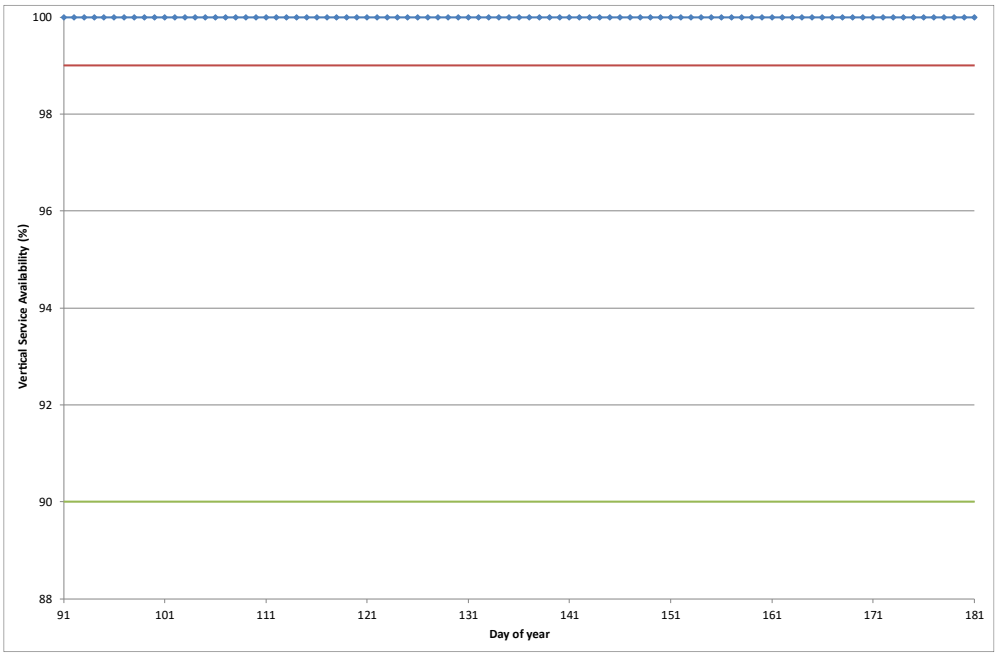


Figure 3-6: Daily Vertical Service Availability Values for Reporting Period

These plots show that the horizontal and vertical availability values are well above the thresholds of 99% (global average) and 90% (worst site) for the reporting period. Therefore, the position service availability met the requirements.

3.8. POSITIONING ACCURACY

In addition to the specifications in Table 2-1, the Conditions and Constraints for Positioning Accuracy performance [RD.1] are:

- Defined for position solution meeting the representative user conditions;

- Standard based on a measurement interval of 24 hours averaged over all points within the service volume.

For this monitoring activity, it should be noted that the position accuracy is assessed through the analysis of measured data at a single point, rather than through service volume analysis.

The daily horizontal and vertical accuracy values (95%) for the period April to June 2026 are shown in the following figures.

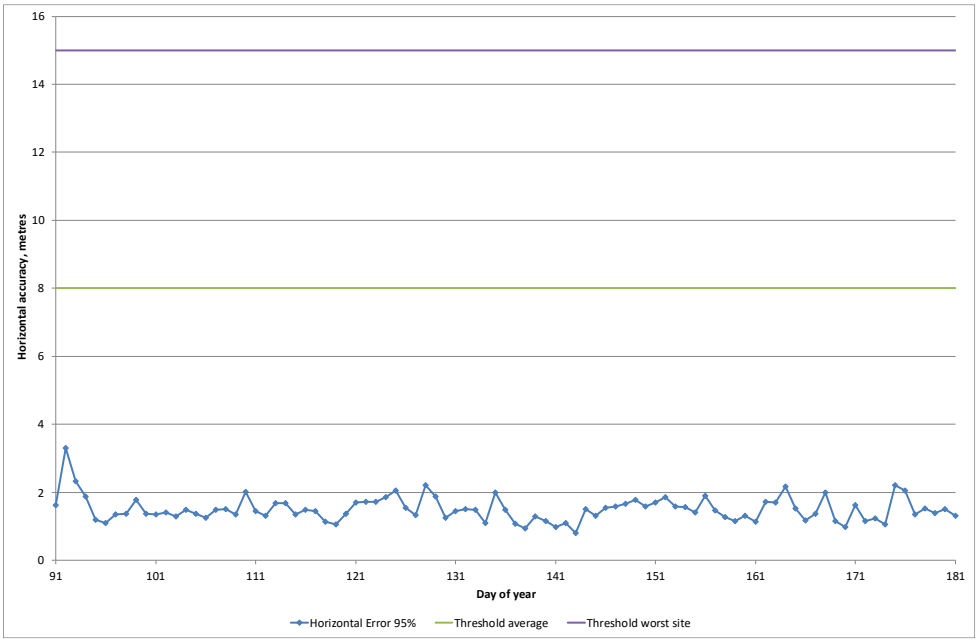


Figure 3-7: Daily Horizontal Position Accuracy (95%) for Reporting Period L1 Only

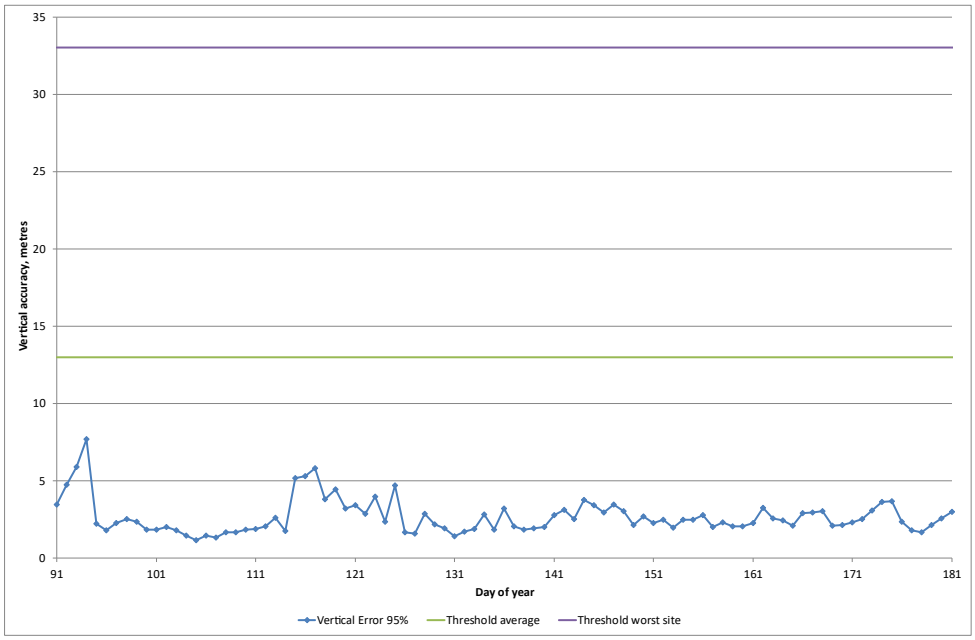


Figure 3-8: Daily Vertical Position Accuracy (95%) for Reporting Period L1 Only

The daily horizontal accuracy values are all below the thresholds of 8m (global average) and 15m (worst site).

The daily vertical accuracy values are below the thresholds of 13m (global average) and 33m (worst site).

In addition, the daily position accuracy values at the 99.99% level are shown for the same period.

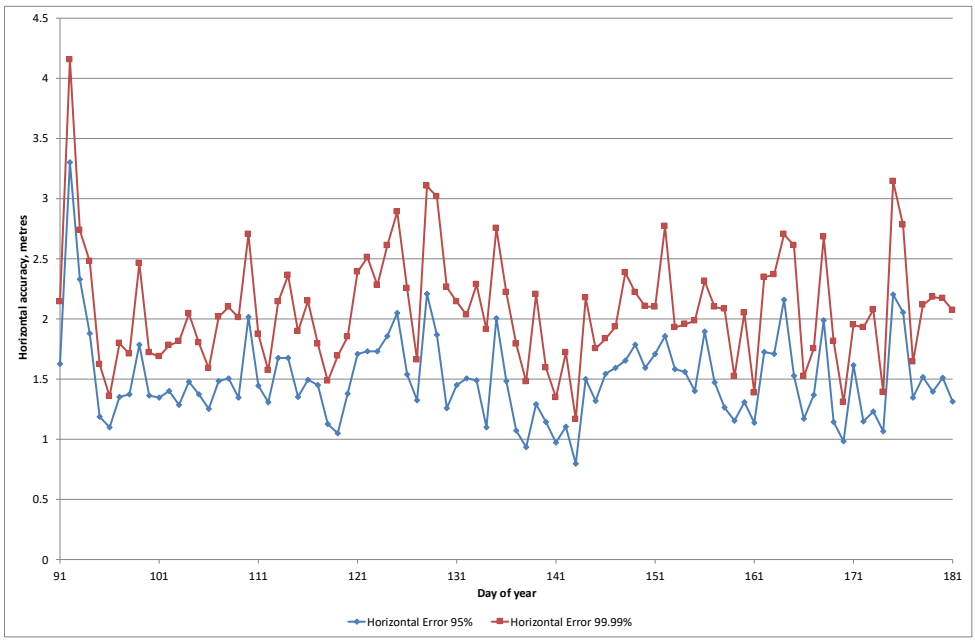


Figure 3-9: Daily Horizontal Position Accuracy (99.99%) for Reporting Period L1 Only

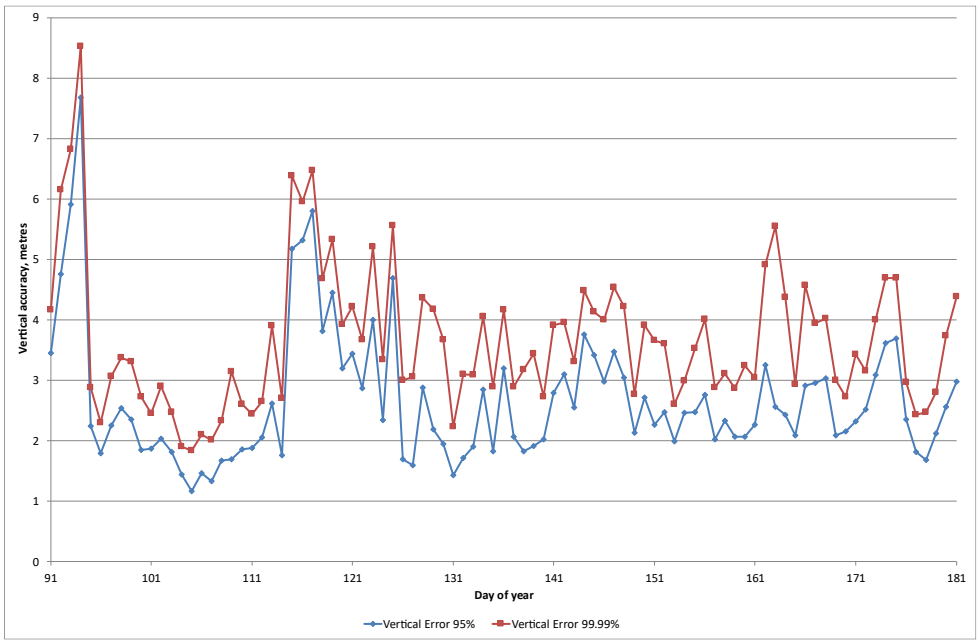


Figure 3-10: Daily Vertical Position Accuracy (99.99%) for Reporting Period L1 Only

On most days the 99.99% values generally follow the same pattern as the 95% values and are not significantly larger.

4. NANU ANALYSIS

(http://www.navcen.uscg.gov/?pageName=gpsNanuInfo). Summaries of the forecast and actual outages associated with scheduled and unscheduled events are provided below. NANUs affecting an entire slot in the baseline constellation are highlighted in green. NANUs that affect one satellite within an expanded slot in the baseline constellation are highlighted in blue, tan, orange, red or purple.

Table 4-1: Summary of Forecast Scheduled Outages

NANU	PRN	Type	Start Date / DOY	Start Time	Stop Date / DOY	Stop Time	Outage (Hours)	Ref
2026030	2	FCSTDV	99	2245	100	1045	12	D2F
2026032	20	FCSTDV	107	215	107	1415	12	F2F
2026034	22	FCSTDV	114	200	114	1400	12	??
2026035	13	FCSTUUFN	114	1600	NA	NA	NA	??
2026037	21	FCSTDV	120	1545	121	345	12	E3F
2026041	27	FCSTUUFN	128	1800	NA	NA	NA	C2
2026045	17	FCSTMX	155	600	163	1800	204	C4F

Table 4-2: Summary of Actual Scheduled Outages

NANU	PRN	Type	Start Date / DOY	Start Time	Stop Date / DOY	Stop Time	Outage (Hours)	Ref
2026031	2	FCSTSUMM	99	2249	100	420	5.51667	2026030
2026033	20	FCSTSUMM	107	225	107	834	6.15000	2026032
2026036	22	FCSTSUMM	114	207	114	729	5.36667	2026034
2026038	13	DECOM	114	1923	114	2200	2.61667	2026035
2026040	21	FCSTSUMM	120	1601	120	2151	5.83333	2026037
2026043	27	FCSTSUMM	128	1800	139	2124	267.40000	2026041
2026046	17	FCSTSUMM	155	600	163	1551	201.85000	2026045

Table 4-3: Summary of Forecast Unscheduled Outages

NANU	PRN	Type	Start Date / DOY	Start Time	Stop Date / DOY	Stop Time	Outage (Hours)	Ref
2026042	28	UNUSUFN	139	1415	NA	NA	NA	A2F
2026048	11	UNUSUFN	177	1612	NA	NA	NA	D1

Table 4-4: Summary of Actual Unscheduled Outages

NANU	PRN	Type	Start Date / DOY	Start Time	Stop Date / DOY	Stop Time	Outage (Hours)	Ref
2026044	28	UNUSABLE	139	1359	141	1816	52.28333333	2026042
2026049	11	UNUSABLE	177	1612	177	1908	2.933333333	2026048

The constellation availability and continuity figures for the baseline constellation and for all satellites, based on the NANU information, are shown in the following table. Note that, for continuity and availability, the baseline constellation is affected if at least one satellite in an expanded slot is

unhealthy, i.e., an outage on one of the satellites in an expanded slot is still included in the statistics for the baseline constellation.

Table 4-5: Summary of NANU Statistics for Monitoring Period

	Q2 2026
Hours	2184
Total Forecast Downtime (all)	252.00
Total Forecast Downtime (baseline)	240.00
Total Actual Scheduled Downtime (all)	494.73
Total Actual Scheduled Downtime (baseline)	486.75
Scheduled Satellite Outage Events (all)	7
Scheduled Satellite Outage Events (baseline)	5
Unscheduled Satellite Outage Events (all)	2
Unscheduled Satellite Outage Events (baseline)	2
Total Actual Unscheduled Downtime (all)	55.22
Total Actual Unscheduled Downtime (baseline)	55.22
Total Actual Downtime (all)	549.95
Total actual downtime (baseline)	541.97
Availability (all)	99.188
Availability (baseline)	98.966
Continuity (baseline)	99.893

5. CONCLUSIONS

The following table summarises the measured performance against the specification.

Table 5-1: Summary of Performance

Criteria	Specifications	Measured Performance	Requirement Met
SPS SIS Accuracy	The User Range Error (URE) ≤7 m 95% for any satellite	All SV < 7m	Yes.
	The User Range Error (URE) ≤2 m 95% for all satellites	2.46m	No. Likely still affected by residual ionospheric errors.
SPS SIS rms	≤3.6 m	All days < 3.6m	Yes.
SPS SIS Integrity	The SIS Integrity ≤$1x10^{-5}$ Probability Over Any Hour (<0.7 events per quarter)	No SIS events	Yes.
SPS SIS Continuity	≥ 0.9998 Probability Over Any Hour	99.893% 99.766% for rolling year	No for both monitoring period and rolling year.
SPS SIS Availability	SPS SIS Per-Slot Availability • ≥ 0.957 SPS SIS Constellation Availability • ≥ 0.98 Probability that at least 21 Slots out of the 24 Slots will be healthy • ≥ 0.99999 Probability that at least 20 Slots out of the 24 Slots will be healthy • ≥ 0.95 Probability that the Constellation will have at least 24 Operational Satellites	1) 99.966% per-Slot Availability 2) 100% Constellation Availability 3) 100% probability that the number of operational satellites is larger than 24.	Yes, for both monitoring period and rolling year.
PDOP Availability	• ≥ 98% global PDOP of 6 or less • ≥ 88% worst site PDOP of 6 or less	>99.8% availability on all days	Yes

Criteria	Specifications	Measured Performance	Requirement Met
SPS Position Service Availability	• ≥ 99% Horizontal Service Availability average location • ≥ 90%Horizontal Service Availability worst-case location • ≥ 99% Vertical Service Availability average location • ≥ 90% Vertical Service Availability worst-case location	100% availability on all days	Yes
Positioning Accuracy	• ≤ 8 meters 95% All-in-View Global Average Horizontal Error (SIS Only) • ≤ 15 meters 95% All-in-View worst site Horizontal Error (SIS Only) • ≤ 13 meters 95% All-in-View Global Average Vertical Error (SIS Only) • ≤ 33 meters 95% All-in-View worst site Vertical Error (SIS Only)	1) <5m metres 95% Horizontal error at the site. 2) <12 metres 95% Vertical Error at the site	Yes for Horizontal and Vertical.

From the table, it can be seen that most of the applicable requirements are met. The exceptions are the SIS accuracy for all satellites because the processing results still include contributions from residual ionospheric errors, and the SPS SIS continuity for this period and the rolling year, because of several unscheduled outages.

ANNEX A. GEOMAGNETIC DATA

Geomagnetic activity during a particular period can be assessed using K-index data provided by the British Geological Survey (BGS) in the UK. These data are available from http://www.geomag.bgs.ac.uk/data_service/data/magnetic_indices/k_indices.html. The K index at each observatory summarises the geomagnetic activity by assigning an index value (in the range 0 – 9) to each 3-hour interval. The index values are determined from the maximum range in H or D with allowance made for the normal (undisturbed) diurnal variation. The conversion from range to index value is made using a quasi-logarithmic scale, with the scale values dependent on the geomagnetic latitude of the observatory. In general, the higher the K index, the more active the Earth's magnetic field. K-index values of 5 or higher indicate geomagnetic storm level activity and index values of 7 or higher indicate a severe geomagnetic storm. The geomagnetic activity is important to consider for GPS signals as geomagnetic storms may affect GPS performance, either by increasing the residual ionospheric delay errors in the position solution or by causing problems with tracking the satellite signals. The following figures show the K-index values at three sites in the UK during the monitoring period. The figures are reproduced with the permission of the British Geological Survey, © NERC. All rights reserved.

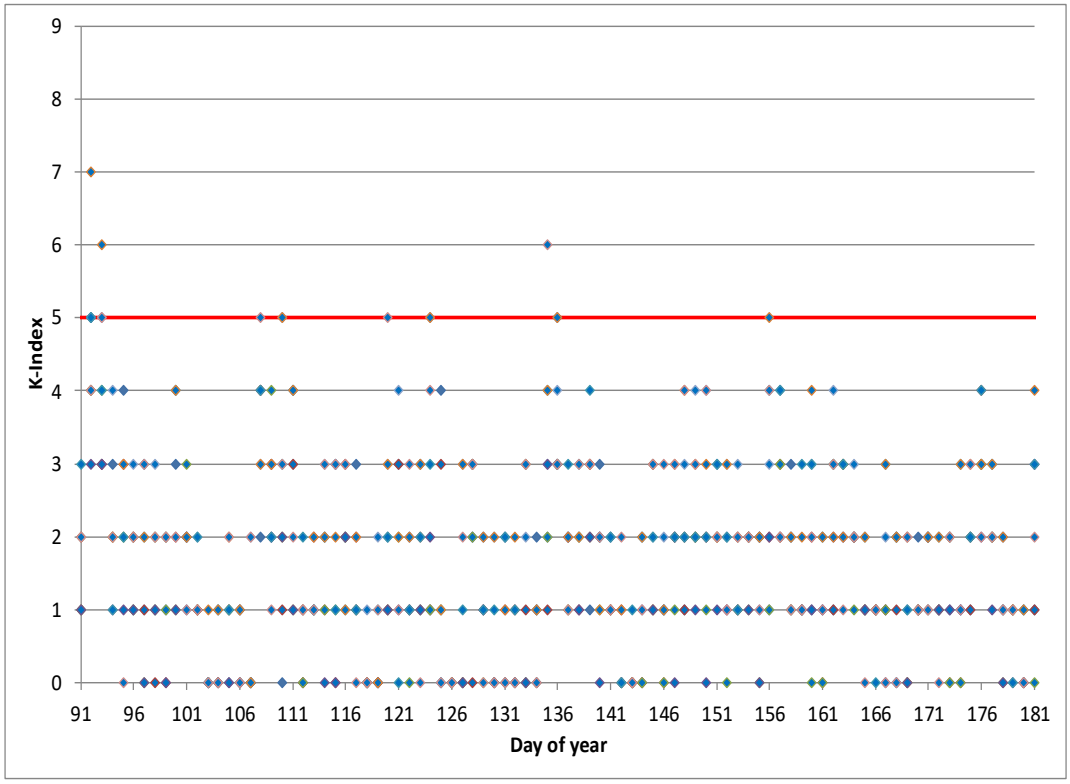


Figure 5-1: K-Index Values at Lerwick during Reporting Period

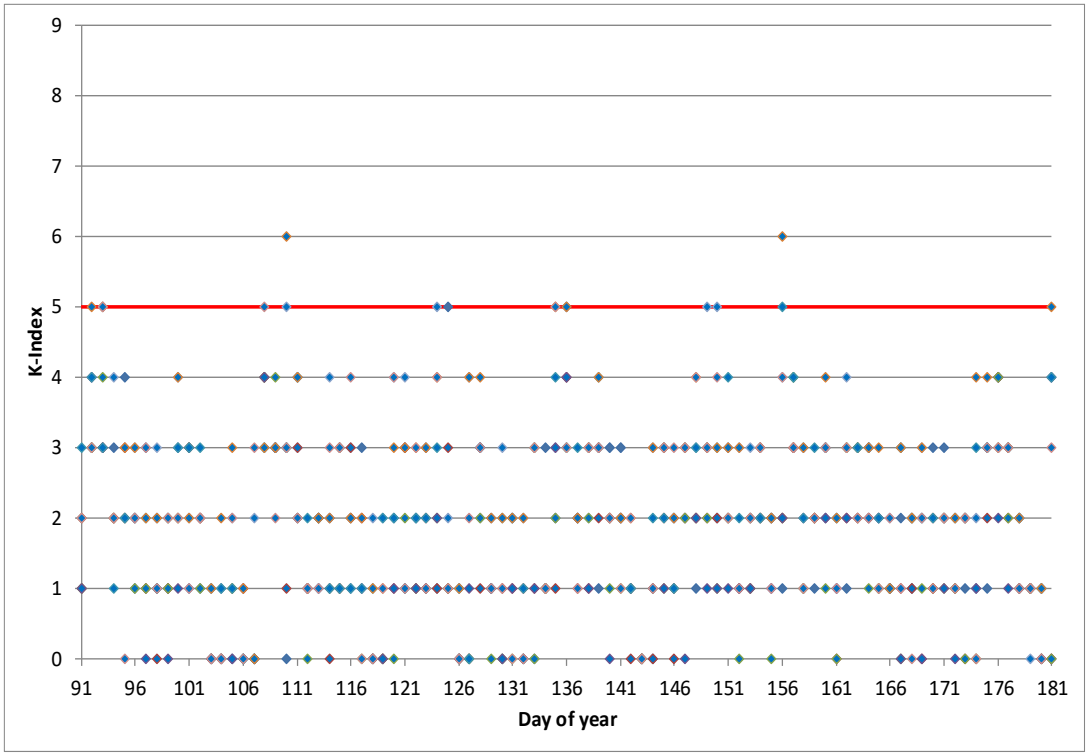


Figure 5-2: K-Index Values at Eskdalemuir during Reporting Period

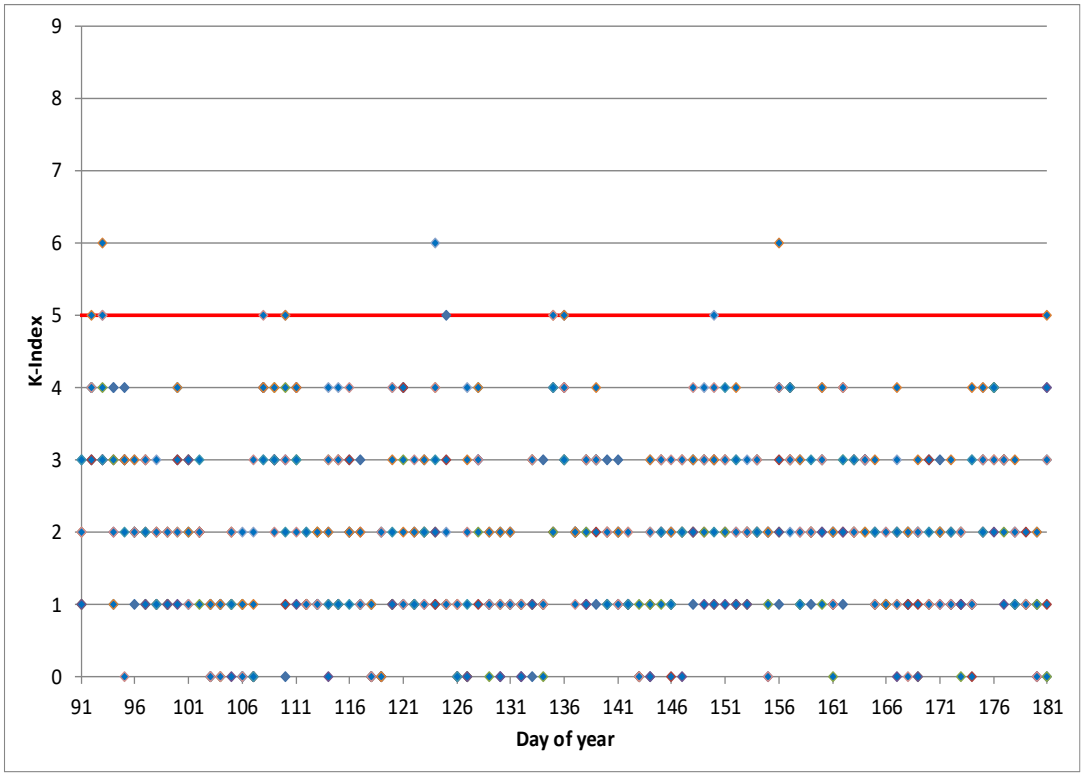


Figure 5-3: K-Index Values at Hartland during Reporting Period

During the monitoring period, there were several occasions with high activity and Kp index values of 6, 7 or 8. These occurrences are spread over six days which are: 2nd, 3rd, 20th April, 4th, 15th May and 5th June.

END OF DOCUMENT