WIDE-AREA AUGMENTATION SYSTEM PERFORMANCE ANALYSIS REPORT

Report #20

Reporting Period: January 1 to March 31, 2007

April 2007

FAA/William J. Hughes Technical Center
NSTB/WAAS T&E Team
Atlantic City International Airport, NJ 08405

Executive Summary

Since 1999 the WAAS Group at the William J. Hughes Technical Center has reported GPS performance as measured against the GPS Standard Positioning Service (SPS) Signal Specification. These quarterly reports are known as the PAN (Performance Analysis Network) Report. In addition to that report, the WAAS/NSTB Team reports on the performance of the Wide-Area Augmentation System (WAAS). This report is the twentieth such WAAS quarterly report. This report covers WAAS performance during the period from January 1, 2007 to March 31 2007.

The following table shows observations for accuracy and availability made during the reporting period. See the body of the report for additional results in accuracy, availability, safety index, range accuracy, WAAS broadcast message rates and GEO ranging availability. Please note that the results in the below table are valid when the Localizer Approach with Vertical Guidance (LPV) service is available. LPV service is available when the calculated Horizontal Protection Level (HPL) is less than 40 meters and the Vertical Protection Level (VPL) is less than 50 meters.

Parameter	**CONUS Site/Maximum**	**CONUS Site/Minimum**	**All Sites Site/Maximum**	**All Sites Site/Minimum**
95% Horizontal Accuracy	Miami 0.982 meters	Albuquerque 0.597 meters	Miami .982 meters	Bethel 0.530 meters
95% Vertical Accuracy	Miami 1.592 meters	Albuquerque 0.800 meters	Barrow 1.807 meters	Albuquerque 0.8 meters
LPV Availability (HPL < 40 meters & VPL < 50 meters)	Denver 100%	Boston 96.33%	Denver 100%	Barrow 61.17%
95% HPL	Boston 28.615 meters	Memphis 15.971 meters	Barrow 49.90 meters	Memphis 15.971 meters
95% VPL	Boston 46.743 meters	Kansas City 26.596 meters	Barrow 93.816 meters	Kansas City 26.596 meters

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1.0 INTRODUCTION

The FAA began monitoring GPS SPS performance in order to ensure the safe and effective use of the satellite navigation system in the National Airspace System (NAS). The Wide Area Augmentation System (WAAS) adds more timely integrity monitoring of GPS and improves position accuracy and availability of GPS within the WAAS coverage area.

Objectives of this report are:

a. To evaluate and monitor the ability of WAAS to augment GPS by characterizing important performance parameters.
b. To analyze the effects of GPS satellite operation and maintenance, and ionospheric activity on the WAAS performance.
c. To investigate any GPS and WAAS anomalies and determine their impact on potential users.
d. To archive performance of GPS and WAAS for future evaluations.

The WAAS data transmitted from GEO satellite PRN#122 (AORW), PRN#134 (POR), and PRN#135 (CRW) were used in the evaluation. GEO CRW was added to the WAAS system and was placed operational on November 9, 2006. Currently the CRW GEO provides only the data link capability, i.e. there is no ranging service available from this GEO.

Table 1.1 and Table 1.2 list NSTB and WAAS reference station receivers used in Precision Approach (PA) and Non-Precision Approach (NPA) evaluation process, respectively. This report presents results from three months of data, collected from January 1, 2007 to March 31, 2007.

Table 1-1 PA Sites

WAAS Performance Analysis Report April 2007

	Number of Days Evaluated	Number of Samples
NSTB:		
Atlantic City	87	7501267
Greenwood	90	7772943
San Angelo	83	7134772
WAAS:		
Albuquerque	90	7743898
Anchorage	89	7653707
Atlanta	90	7758815
Barrow	85	7380401
Bethel	86	7463634
Billings	74	6419311
Boston	89	7720260
Chicago	90	7740032
Cleveland	90	7750912
Cold Bay	88	7607239
Dallas	84	7287200
Denver	90	7751251
Fairbanks	85	7376089
Houston	90	7749811
Jacksonville	90	7751663
Juneau	83	7165781
Kansas City	90	7754494
Kotzebue	86	7439829
Los Angeles	90	7732970
Memphis	90	7753954
Miami	90	7749802
Minneapolis	90	7744297
New York	90	7753453
Oakland	90	7747860
Salt Lake City	89	7653848
Seattle	90	7753503
Washington DC	90	7749137

Table 1-2 NPA Sites

Location	Number of Days Evaluated	Number of Samples
Albuquerque	89	7762009
Anchorage	89	7774158
Atlanta	89	7770530
Bethel	86	7474859
Billings	74	6455907
Boston	89	7730906
Cleveland	89	7759965
Cold Bay	89	7771652
Fairbanks	86	7474229
Honolulu	89	7737997
Houston	89	7769670
Juneau	87	7598409
Kansas City	82	7160162
Kotzebue	86	7461627
Los Angeles	89	7767062
Miami	89	7766566
Minneapolis	89	7759131
Oakland	89	7765452
Salt Lake City	89	7741278
San Juan	89	7728123
Seattle	89	7768120
Washington DC	89	7767501

The report is divided in the performance categories listed below. This report also includes WAAS LPV Service Availability at Selected Airports, and WAAS Deterministic Code Noise and Multipath (CNMP) Bounding Analysis.

1. WAAS Position Accuracy
2. WAAS Operational Service Availability
3. Coverage
4. Integrity
5. WAAS Range Domain Accuracy
6. GEO Ranging Performance

Table 1.3 lists the performance parameters evaluated for the WAAS in this report. Please note that these are the performance parameters associated with the WAAS IOC system. These requirements are extracted from the FAA Specification FAA-E-2892B Change 1 and FAA Specification FAA-E-2976, as applicable.

Table 1-3 WAAS Performance Parameters

Performance Parameter	Expected WAAS Performance
PA Accuracy Horizontal	≤ 7.6m error 95% of the time
PA Accuracy Vertical	≤ 7.6m error 95% of the time
NPA Accuracy Horizontal	≤ 100m error 95% of the time ≤ 556m error 99.999% of the time
Availability LPV*	Not Defined for Current WAAS phase
Availability LNAV/VNAV*	Not Defined for Current WAAS phase
LPV and LNAV/VNAV Outages and outage rate	Not Defined for Current WAAS phase
LNAV Outages and outage rates	Not Defined for Current WAAS phase
Coverage LPV	Not Defined for Current WAAS phase For this report - 95% availability of 75% of CONUS
Coverage LNAV/VNAV	95% availability of 75% of CONUS
Coverage NPA	99.9% availability of 75% of service volume
LPV Availability	≥ 95% of the time within the service volume
LNAV/VNAV Availability	≥ 95% of the time within the service volume
Integrity	≤ 4 X 10e-8 HMI's per approach

* Instantaneous availability (i.e. Availability is calculated every second.)

1.1 Event Summary

Table 1.4 lists test events that occurred during the reporting period that affected WAAS performance or the ability to determine the WAAS performance. These events include GPS or WAAS anomalies, relevant receiver malfunctions, and receiver maintenance conducted. Detailed analyses of particular events are documented in the Discrepancy Reports (DR). The DRs are posted on the website http://www.nstb.tc.faa.gov under 'WAAS Technical Reports' and can also be accessed via hyperlink from Table 1.4 below.

Table 1-4 Test Events

GPS Week	Date	Sites	Events
1408 day 3	1/3/07	North-Western CONUS Sites	See DR# 50, "WAAS Service Outage Due to Three Satellites Set to Not Monitored."
1408 day 4 to 1410 day 4	1/4/07 to 1/18/07	Billings	Billings outage.
1410 day 3 to 1410 day 4	1/17/07 to 1/18/07	Legacy (Non-G2) WAAS Sites	Legacy WRS's did not track SV PRN's 25, 26 the day following their respective NANU's.
1412 day 5	2/2/07	CRW-only sites	See DR# 48, "Abnormal CRW Switchover and Extended SIS (Signal in Space) Outage."
1412 day 6	2/3/07	ZAU TCS Comm Node Sites	ZAU TCS Communications Node outage.
1413 day 3	2/7/07	All WAAS Sites	WEI outages.

GPS Week	Date	Sites	Events
1414 day 4	2/15/07	All Sites	WAAS mask updated to include PRN 12 as of 0600 Zulu.
1416 day 3	2/28/07	CRW-only Sites	See DR# 49, "CRW Switchover Caused By Comm Glitch."
1416 day 3	2/28/07	Barrow	Ionospheric scintillation observed at Barrow WRS. All 3 threads dropped several SVs from the solution.
1416 day 4	3/1/07	Jacksonville	Jacksonville antenna upgrade.
1417 day 1 to 1417 day 3	3/5/07 to 3/7/07	Dallas	Dallas outage.
1417 day 2	3/6/07	Several Alaska Sites	GIVE value of IGP set to 15 caused loss of Alaska LPV coverage.
1418 day 0	3/11/07	ZLA TCS Comm Node Sites	ZLA TCS Communications Node outage.
1418 day 0	3/11/07	Several Alaska Sites	GIVE value of IGP set to 15 caused loss of Alaska LPV coverage.
1418 day 5	3/16/07	All WAAS Sites	WEI outage.
1418 day 6	3/17/07	All WAAS Sites	WEI outages.
1419 day 3	3/21/07	Kansas City	Kansas City WRS antenna upgrade.
1419 day 4	3/22/07	All WAAS Sites	WEI outages.
1419 day 4	3/22/07	Albuquerque	Albuquerque WRS antenna upgrade.
1419 day 6	3/24/07	Several Alaska Sites	See DR# 51, "Loss of LPV Service in Alaska Due To IGP GIVE Set To 15."
1419 day 6	3/24/07	Juneau	See DR# 53, "Ionospheric scintillation at Juneau."
1419 day 6 to 1420 day 1	3/24/07 to 3/26/07	Atlantic City	Atlantic City outage.
1420 day 0 to 1420 day 1	3/25/07 to 3/26/07	Dallas	Dallas outage.
1420 day 4	3/29/07	DC	DC WRS antenna upgrade.
1420 day 5	3/30/07	Fairbanks	See DR# 52, "Ionospheric Scintillation Caused High Position Errors At Fairbanks."

1.2 Report Overview

Section 2 provides the vertical and horizontal position accuracies from data collected, on a daily basis, at one-second intervals. The 95% accuracy index and the maximum accuracy for the reporting period are tabulated. The daily 95% accuracy index is plotted graphically for each receiver. Histograms of the vertical and horizontal error distribution are provided for three receivers within the WAAS service area.

Section 3 summarizes the WAAS instantaneous availability performance, at each receiver, for three operational service levels during the reporting period. Daily availability is also plotted for each receiver evaluated. The number of outages and outage rate for each site is reported.

Section 4 provides the percent of coverage provided by WAAS on a daily basis. Monthly roll-up graphs presented indicate the portions of service volume covered, and the percentage of time that WAAS was available.

Section 5 summarizes the number of HMI's detected during the reporting period and presents a safety margin index for each receiver. The safety index reflects the amount of over bounding of position error by WAAS protection levels. This section also includes update rates of WAAS messages transmitted from AORW, POR and CRW.

Section 6 provides the UDRE and GIVE bounding percentage and the 95% index of the range and ionospheric accuracy for each satellite tracked by the WAAS receiver in Houston.

Section 7 provides the GEO ranging performance for AORW, POR and CRW.

Section 8 summarizes WAAS anomalies and problems identified during the reporting period, which adversely affect WAAS performance described in Table 1.3.

Section 9 provides WAAS LPV availability and outages at selected airports.

Section 10 provides the assessment of WAAS CNMP bounding for 75 WAAS receivers.

2.0 WAAS POSITION ACCURACY

Navigation error data, collected from WAAS and NSTB reference stations, was processed to determine position accuracy at each location. This was accomplished by utilizing the GPS/WAAS position solution tool to compute a MOPS-weighted least squares user navigation solution, and WAAS horizontal and vertical protection levels (HPL & VPL), once every second. The user position calculated for each receiver was compared to the surveyed position of the antenna to assess position error associated with the WAAS SIS over time. The position errors were analyzed and statistics were generated for two operational service levels: WAAS LPV, and WAAS LNAV/VNAV, as shown in Table 2.1. For this evaluation, the WAAS operational service level is considered available at a given time and location, if the computed WAAS HPL and VPL are within the horizontal and vertical alarm limits (HAL & VAL) specified in Table 2.1.

Table 2-1 Operational Service Levels

WAAS Operational Service Levels	Horizontal Alert Limit HAL (meters)	Vertical Alert Limit VAL (meters)
LPV (LOC/VNAV)	40	50
LNAV/VNAV	556	50

Table 2.2 shows PA horizontal and vertical position accuracy maintained for 95% of the time at LPV and LNAV/VNAV operational service levels for the quarter. The table also includes 95% SPS accuracy for certain locations. Figures 2.1 to 2.4 show the daily horizontal and vertical 95% accuracy for LNAV/VNAV operational service level for the period. Note that WAAS accuracy statistics presented are compiled only when all WAAS corrections (fast, long term, and ionospheric) for at least 4 satellites are available. This is referred to as PA navigation mode. The percentage of time that PA navigation mode was supported by WAAS at each receiver is also shown in Table 2.2. A user is considered to be in NPA navigation mode if only WAAS fast and long term corrections are available to a user (i.e. no ionospheric corrections). Table 2.3 shows NPA horizontal position accuracy for 95% and 99.999% of the time. This table also shows the maximum NPA horizontal position error for the quarter. Figures 2.5 shows the daily horizontal 95% accuracy for NPA.

During the evaluated period, the 95% horizontal and vertical accuracy at all evaluated sites were less than 2 meters for both WAAS operational service levels. The maximum 95% horizontal and vertical LPV errors are .982 meters at Miami and 1.807 at Barrow, respectively. The minimum 95% horizontal and vertical LPV errors are 0.530 meters at Bethel and 0.80 meters at Albuquerque, respectively. The maximum 95% and 99.999% NPA horizontal errors are 2.715 meters at Honolulu and 9.162 meters at Bethel. The minimum 95% and 99.999% horizontal errors are 1.042 meters at Fairbanks and 2.453 meters at Washington DC.

The AOR-W GEO is no longer available for PA ranging. Currently the CRW GEO provides only the data link capability, i.e. there is no ranging service available from this GEO.

Table 2.4 shows the maximum horizontal and vertical position errors while the calculated HPL and VPL met the LPV service levels. The column marked ‘Horizontal (or Vertical) Error/HPL (or VPL)’ is the ratio of position error to protection level at the time the maximum error occurred. The column marked ‘Horizontal (or Vertical) Maximum Ratio’ is the maximum position error to protection level ratio for the quarter.

Figures 2.6 to 2.15 show the distributions of the vertical and horizontal errors in triangle charts and 2-D histogram plots for the quarter at three locations, Kansas City, Washington DC and Seattle. The triangle charts show the distributions of vertical position errors (VPE) versus vertical protection levels (VPL) and horizontal position errors (HPE) versus horizontal protection levels (HPL). The horizontal axis is the position error and the vertical axis is the WAAS protection levels. Lower protection levels equate to better availability. The diagonal line shows the point where error equals protection level. Above and to the left of the diagonal line in the chart, errors are bounded (WAAS is providing integrity in the position domain); below and to the right, errors are not bounded (HMI could be present). The horizontal lines at various protection levels represent the various operational service levels as defined in Table 2.1. The 2-D histogram plots contain four histograms showing the distributions of vertical and horizontal position errors and normalized position errors. The left top and bottom histograms show the distributions of the actual vertical and horizontal errors. The horizontal axis is the position errors and the vertical axis is the total count of data samples (log scale) in each 0.1-meter bin. The right top and bottom histograms show the distributions of the actual vertical and horizontal errors normalized by one-sigma value of the protection level; vertical - (VPL/5.33) and horizontal - (HPL/6.0). The horizontal axis is the standard units and vertical axis is the observed distribution of normalized errors data samples in each 0.1-sigma bin. Narrowness of the normalized error distributions shows very good observed safety performance.

Table 2-2 PA 95% Horizontal and Vertical Accuracy

Location	Horizontal GLS/APV2/LPV (HAL=40m) (Meters)	Horizontal APV-1(LNAV) (HAL=556m) (Meters)	Vertical LPV/VNAV (VAL=50m) (Meters)	Percentage in PA mode (%)	SPS Accuracy	
					95% Horizontal (Meters)	95% Vertical (Meters)
Atlantic City	0.867	0.867	1.204	99.99998	*	*
Greenwood	0.712	0.712	1.111	100.00	*	*
San Angelo	0.692	0.693	1.167	100.00	*	*
Albuquerque	0.597	0.598	0.800	100.00	2.264	4.209
Anchorage	0.560	0.560	0.975	100.00	*	*
Atlanta	0.730	0.730	1.038	100.00	2.610	4.769
Barrow	0.666	0.784	1.807	99.73771	*	*
Bethel	0.529	0.530	0.945	99.99998	2.021	4.885
Billings	0.691	0.691	0.947	100.00	2.299	4.129
Boston	0.828	0.829	1.046	100.00	2.695	4.708
Chicago	0.722	0.722	0.872	100.00	*	*
Cleveland	0.865	0.865	0.899	100.00	2.760	4.632
Cold Bay	0.894	0.924	1.065	99.99326	*	*
Dallas	0.792	0.792	1.184	100.00	*	*
Denver	0.602	0.602	0.852	100.00	*	*
Fairbanks	0.541	0.542	1.062	99.99969	1.796	4.496
Houston	0.700	0.701	1.245	100.00	2.333	4.613
Jacksonville	0.771	0.771	1.271	100.00	*	*
Juneau	0.683	0.683	1.046	100.00	*	*
Kansas City	0.666	0.666	0.929	100.00	2.634	4.827
Kotzebue	0.632	0.645	1.162	99.98472	1.862	5.079
Los Angeles	0.690	0.690	1.091	100.00	2.168	4.824
Memphis	0.638	0.638	0.924	100.00	*	*
Miami	0.982	0.982	1.592	100.00	2.509	5.232
Minneapolis	0.731	0.731	1.012	100.00	2.557	4.416
New York	0.821	0.821	0.999	100.00	*	*
Oakland	0.665	0.665	0.917	100.00	2.163	4.745
Salt Lake City	0.649	0.649	0.821	100.00	2.294	4.433
Seattle	0.926	0.926	0.886	100.00	2.357	4.652
Washington DC	0.743	0.744	0.970	100.00	2.729	4.988

* SPS accuracy not computed for this location.

Table 2-3 NPA 95% and 99.999% Horizontal Accuracy

Location	95% Horizontal (meters)	99.999% Horizontal (meters)	Percentage in NPA mode (%)	Maximum Horizontal Error
Albuquerque	1.073	2.673	100.00	2.760
Anchorage	1.218	2.731	100.00	3.738
Atlanta	1.390	3.552	100.00	4.171
Bethel	1.361	9.162	100.00	3.807
Billings	1.397	3.663	100.00	4.778
Boston	1.617	3.660	100.00	4.187
Cleveland	1.593	3.033	100.00	3.462
Cold Bay	1.659	4.207	100.00	4.473
Fairbanks	1.042	4.641	100.00	4.944
Honolulu	2.715	7.300	100.00	7.534
Houston	1.181	2.982	100.00	3.253
Juneau	1.077	3.734	100.00	3.180
Kansas City	1.424	2.816	100.00	3.218
Kotzebue	1.079	4.792	100.00	5.872
Los Angeles	1.099	2.775	100.00	3.091
Miami	1.311	3.264	100.00	3.421
Minneapolis	1.385	2.933	100.00	3.318
Oakland	1.076	2.728	100.00	3.658
Salt Lake City	1.215	2.670	100.00	3.096
San Juan	1.410	4.241	99.99	6.318
Seattle	1.241	2.595	100.00	2.917
Washington DC	1.525	2.453	100.00	2.634

Table 2-4 Maximum Position Errors and Position Error/Protection Level Ratio

Location	Horizontal Error (m)	Horizontal Error/HPL	Horizontal Maximum Ratio	Vertical Error (m)	Vertical Error/VPL	Vertical Maximum Ratio
Atlantic City	2.088	0.076	0.120	4.029	0.107	0.143
Greenwood	2.648	0.105	0.127	4.860	0.105	0.198
San Angelo	2.034	0.053	0.104	3.666	0.094	0.106
Albuquerque	1.808	0.061	0.094	2.982	0.090	0.103
Anchorage	3.037	0.115	0.115	4.995	0.113	0.113
Atlanta	1.631	0.101	0.132	2.501	0.123	0.123
Barrow	11.175	0.448	0.448	8.123	0.236	0.236
Bethel	1.494	0.067	0.082	3.467	0.096	0.105
Billings	3.628	0.102	0.113	4.155	0.118	0.118
Boston	3.284	0.171	0.171	4.199	0.136	0.136
Chicago	1.758	0.078	0.118	2.597	0.093	0.113
Cleveland	3.000	0.081	0.111	3.257	0.084	0.112
Cold Bay	4.292	0.119	0.119	3.897	0.133	0.133
Dallas	3.364	0.144	0.170	6.040	0.201	0.201
Denver	1.932	0.084	0.094	3.371	0.113	0.113
Fairbanks	1.879	0.103	0.103	22.492	0.669	0.669
Houston	2.356	0.069	0.125	3.826	0.141	0.141
Jacksonville	1.895	0.090	0.139	4.167	0.146	0.165
Juneau	3.127	0.136	0.136	7.541	0.257	0.257
Kansas City	2.514	0.140	0.140	4.467	0.138	0.138
Kotzebue	3.916	0.215	0.215	4.559	0.092	0.103
Los Angeles	2.534	0.088	0.082	3.321	0.089	0.114
Memphis	1.944	0.069	0.123	2.670	0.056	0.116
Miami	2.406	0.077	0.143	5.125	0.147	0.172
Minneapolis	1.885	0.112	0.112	3.079	0.106	0.122
New York	1.987	0.054	0.100	3.726	0.080	0.113
Oakland	2.464	0.114	0.125	4.377	0.094	0.099
Salt Lake City	1.695	0.098	0.104	3.898	0.135	0.135
Seattle	3.089	0.089	0.164	5.858	0.258	0.258
Washington DC	1.743	0.103	0.108	2.947	0.074	0.110

Figure 2-1 95% Horizontal Accuracy at LNAV/VNAV

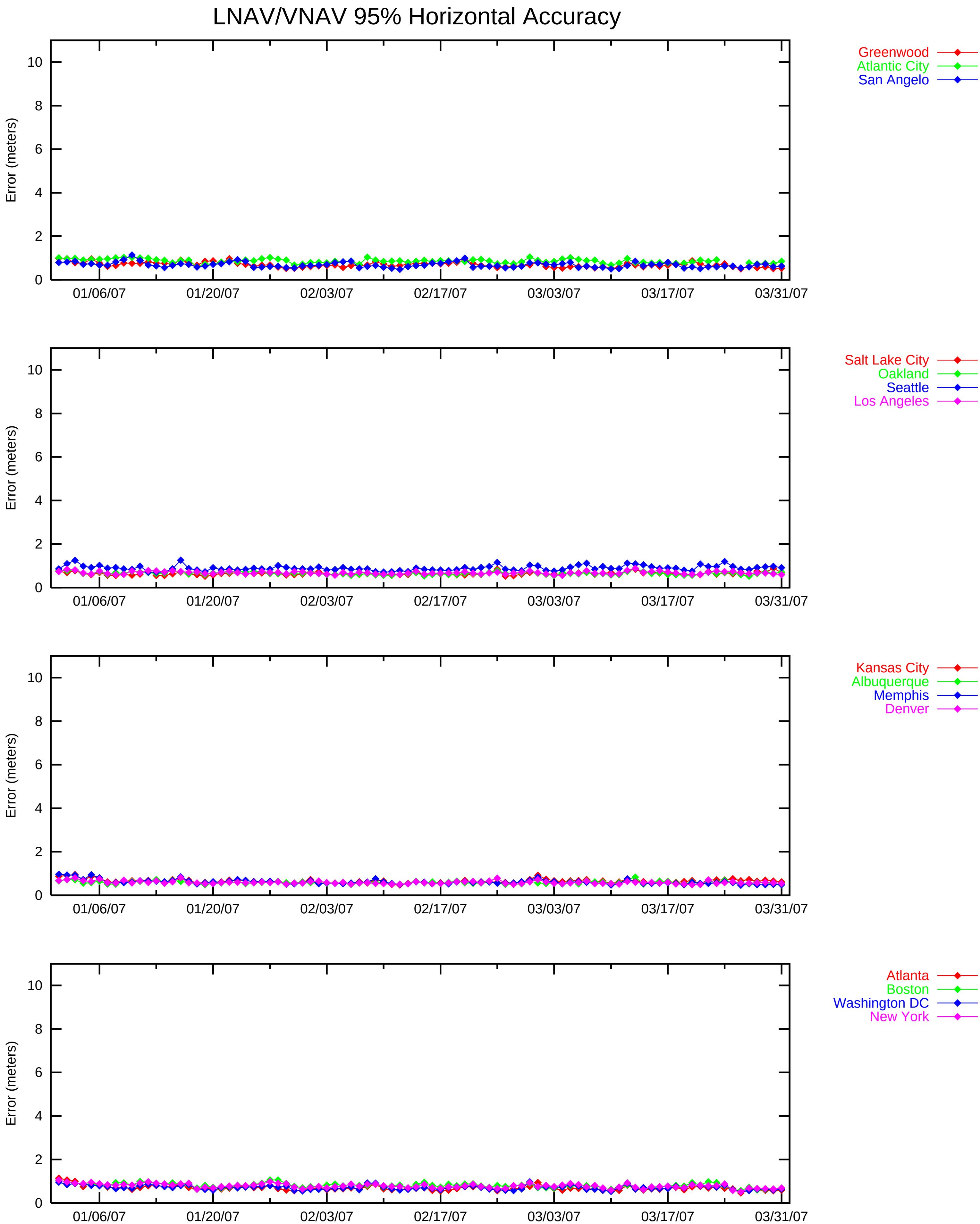


Figure 2-2 95% Horizontal Accuracy at LNAV/VNAV

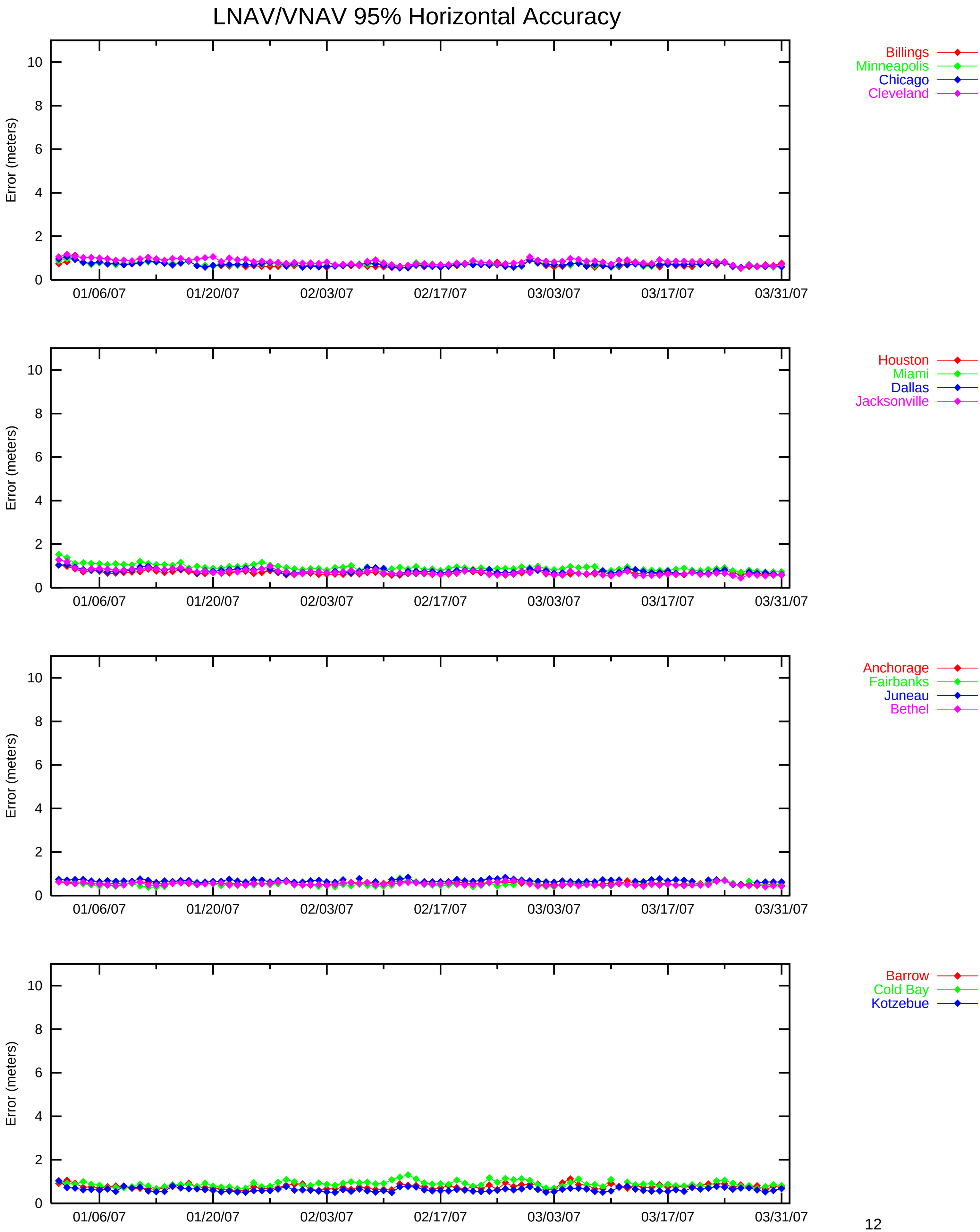


Figure 2-3 95% Vertical Accuracy at LNAV/VNAV

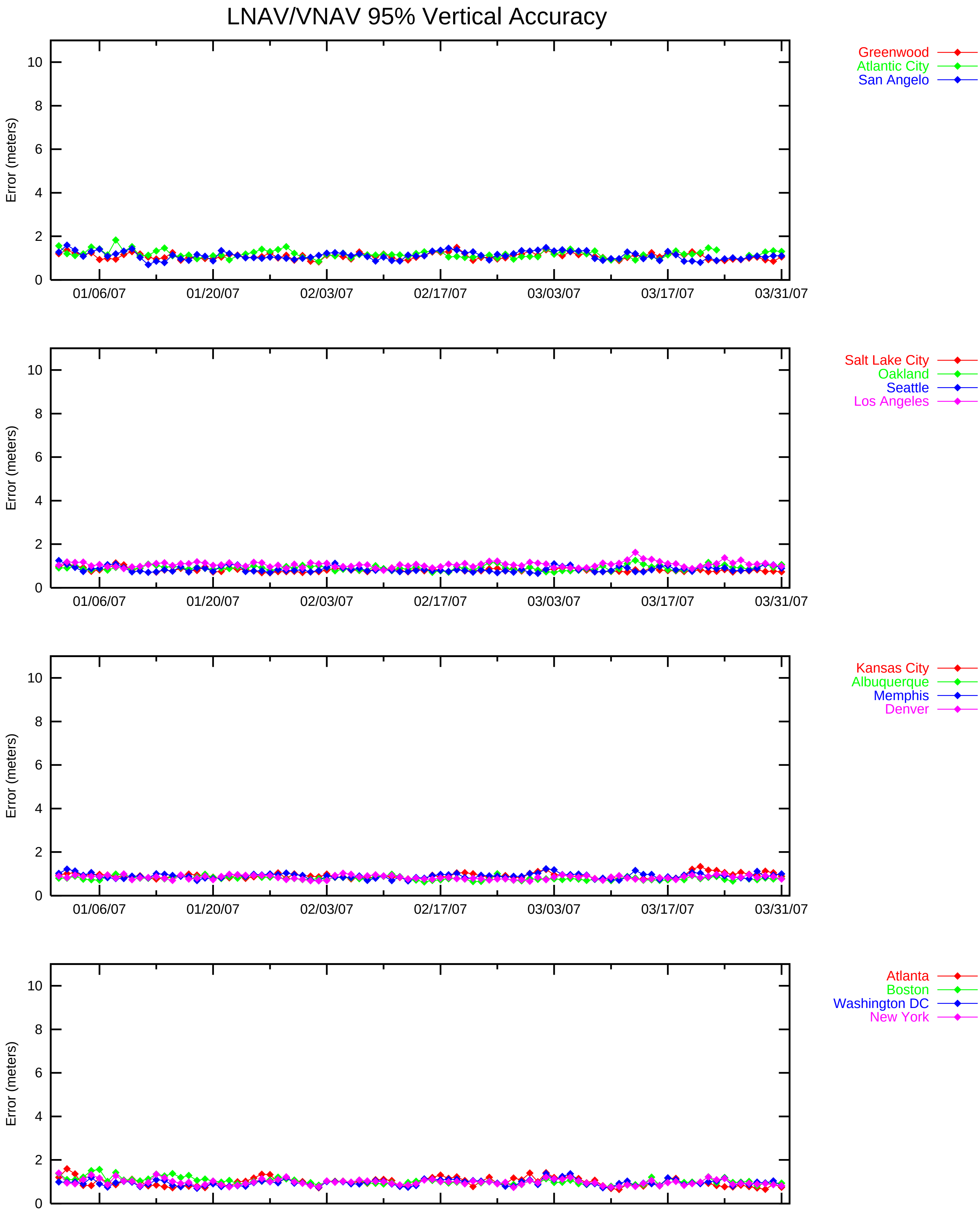


Figure 2-4 95% Vertical Accuracy at LNAV/VNAV

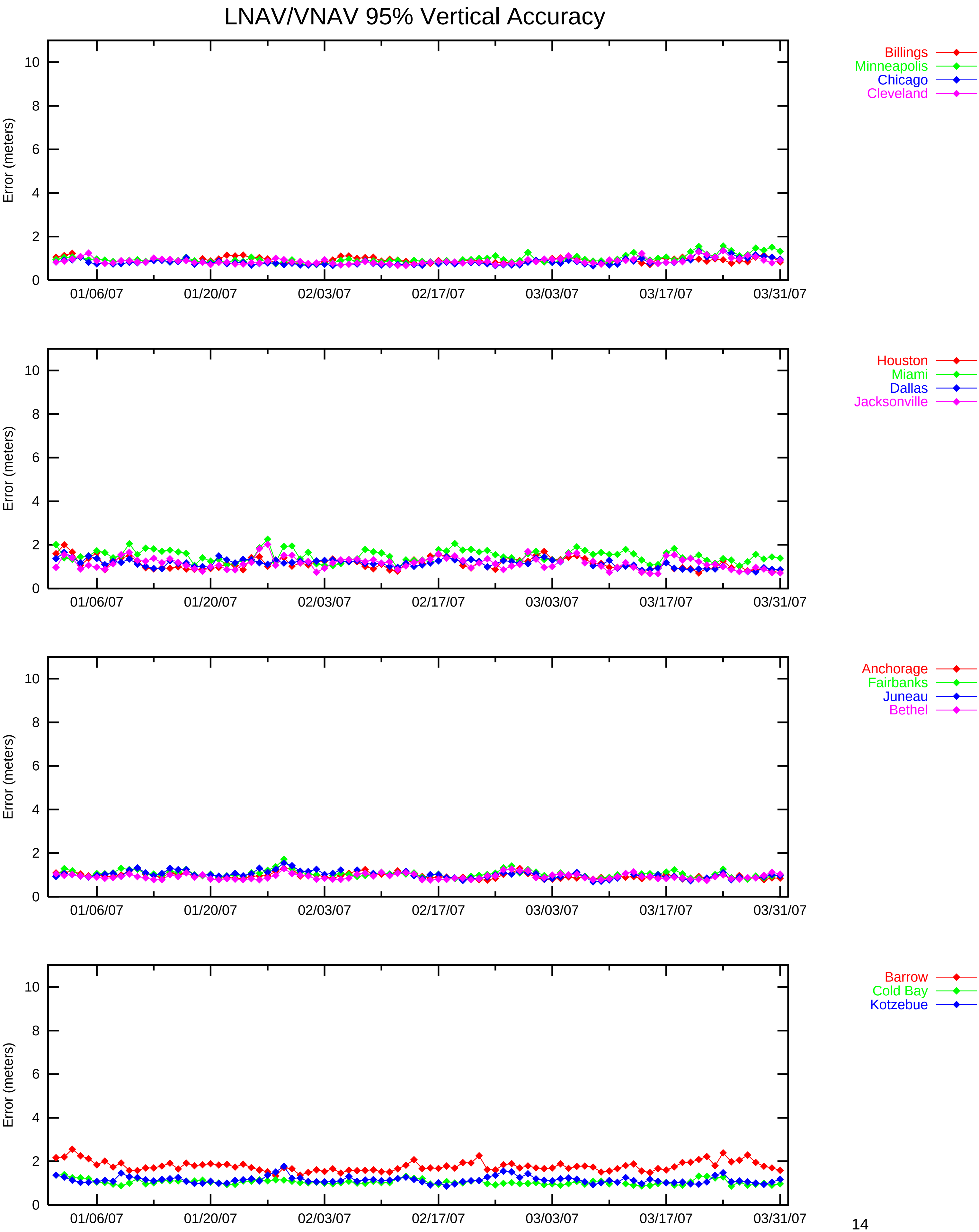


Figure 2-5 NPA 95% Horizontal Accuracy

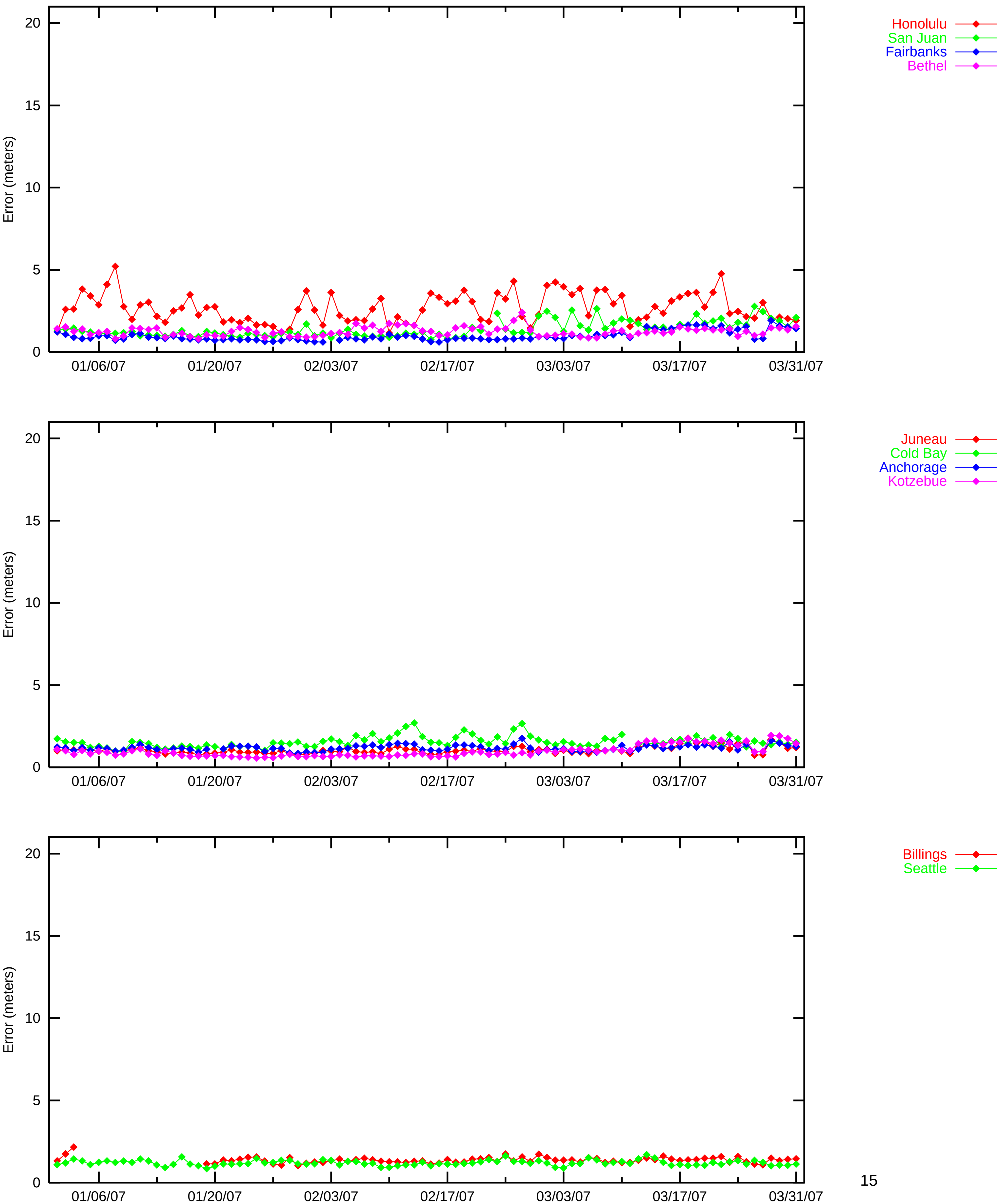


Figure 2-6 NPA 95% Horizontal Accuracy

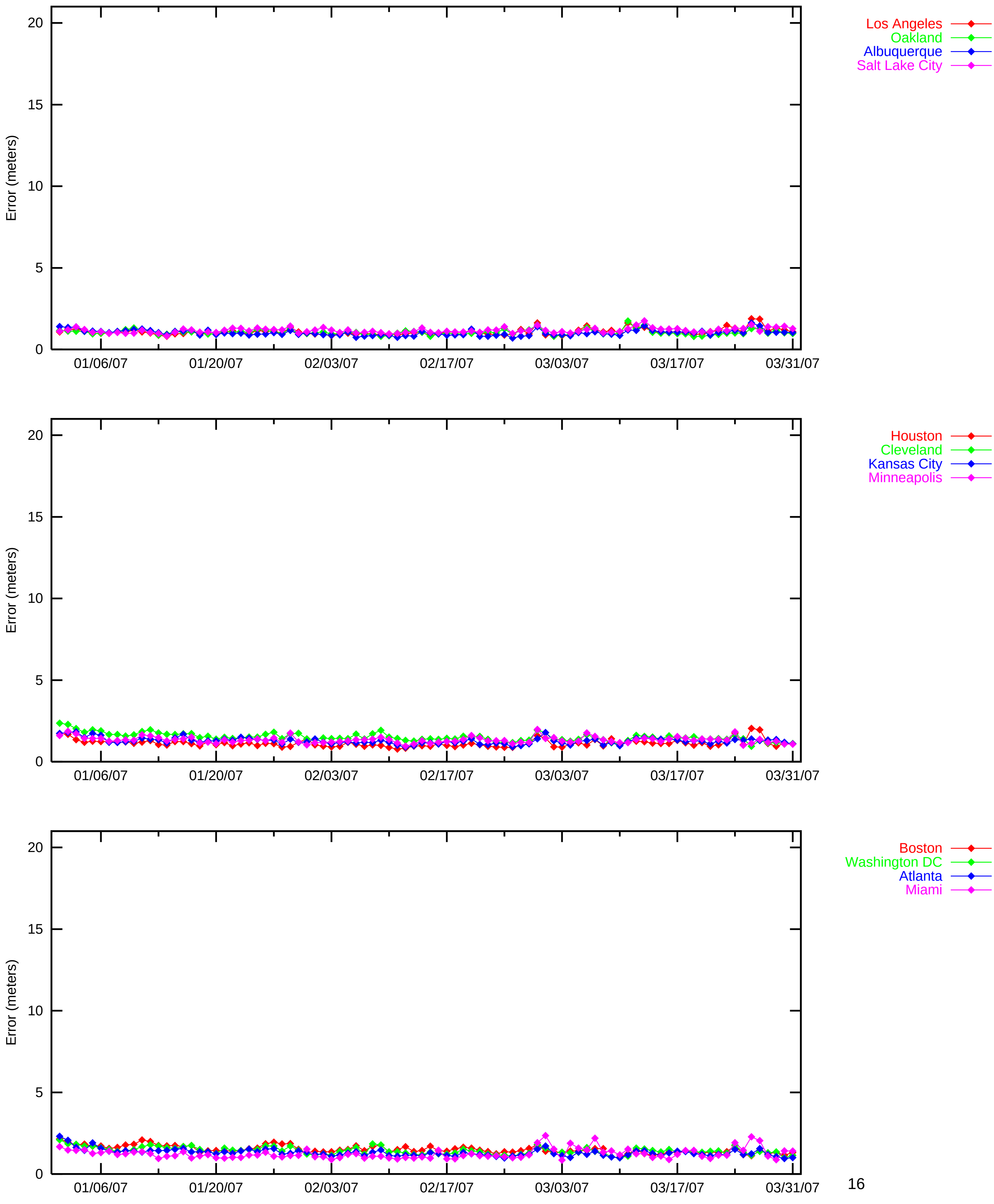
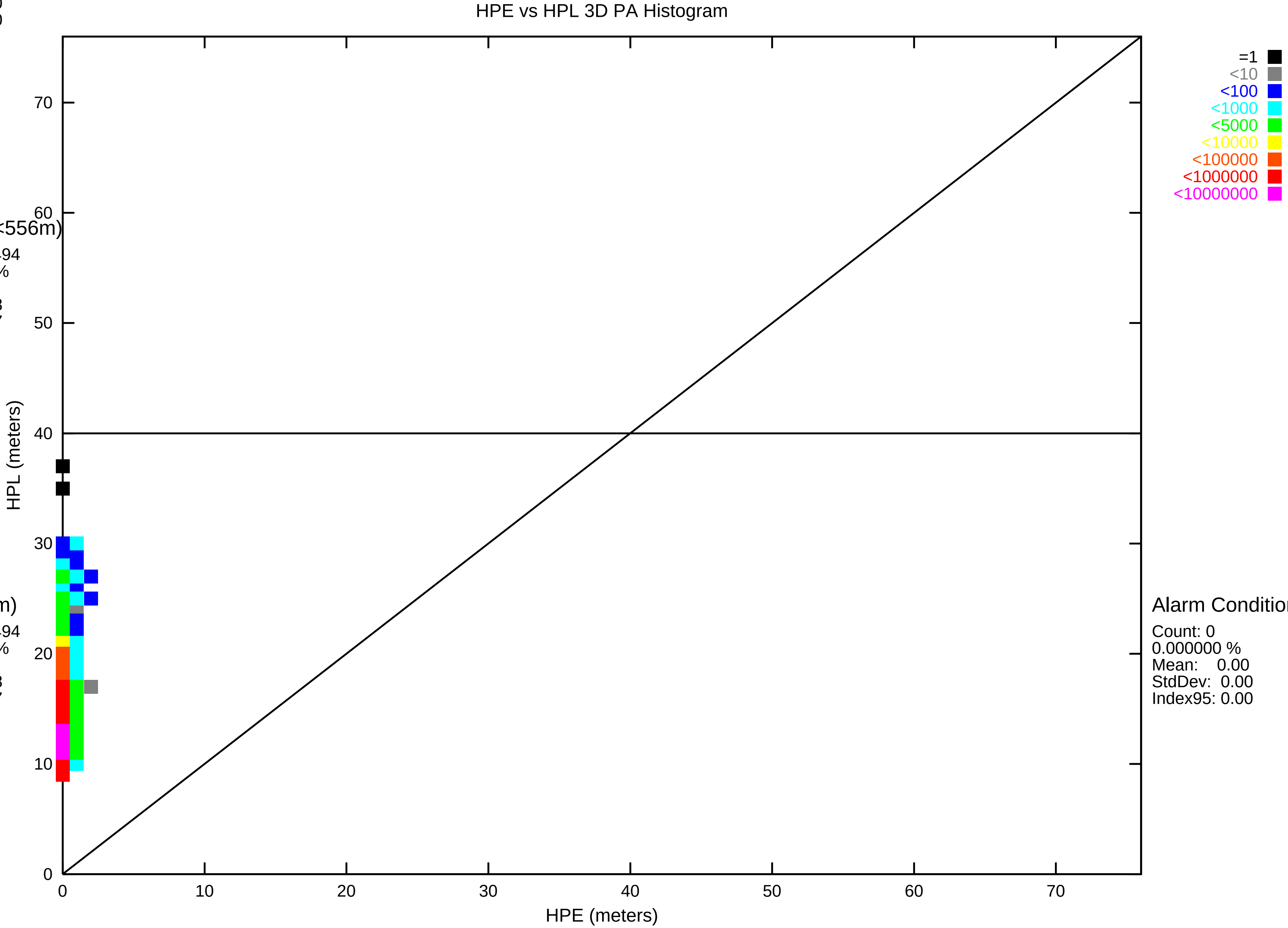


Figure 2-7 Horizontal Triangle Chart forKansas City

Site: Kansas_City Date: 01/01/07-03/31/07

PA mode Unavailable(>556m)
Count: 0
0.000000 %
Mean: 0.00
StdDev: 0.00
Index95: 0.00



All Modes
L/VNAV(=<556m)
Count: 7754494
100.000000 %
Mean: 0.34
StdDev: 0.18
Index95: 0.67

LPV(=<40m)
Count: 7754494
100.000000 %
Mean: 0.34
StdDev: 0.18
Index95: 0.67

Alarm Condition
Count: 0
0.000000 %
Mean: 0.00
StdDev: 0.00
Index95: 0.00

Samples: 7754494
Mean: 0.34
StdDev: 0.18
Index95: 0.67

PA Samples: 7754494
Mean: 0.34
StdDev: 0.18
Index95: 0.67

Not PA Samples: 0
Mean: 0.00
StdDev: 0.00
Index95: 0.00

Figure 2-8 Vertical Triangle Chart for Kansas City

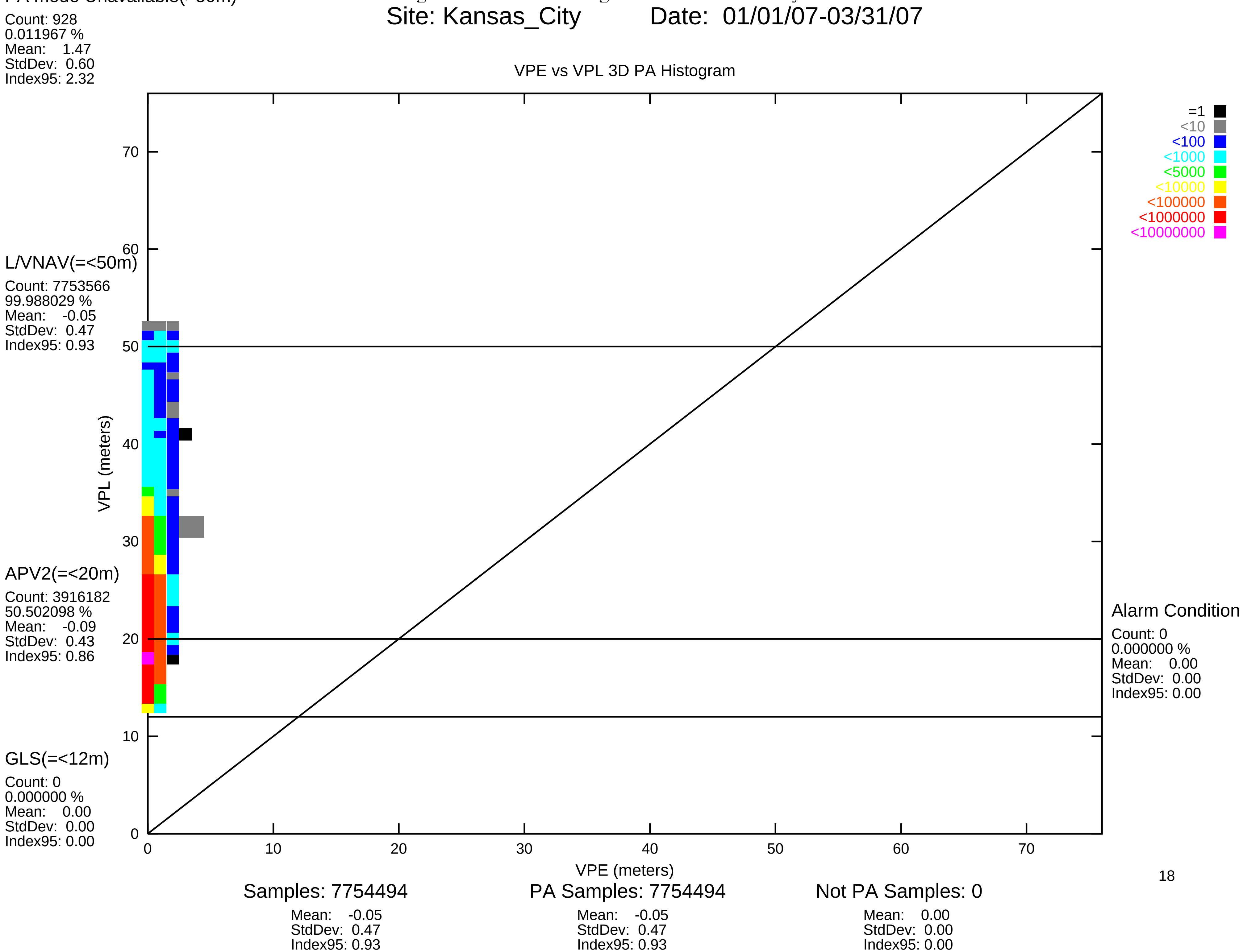


Figure 2-9 2-D Histogram for Kansas City

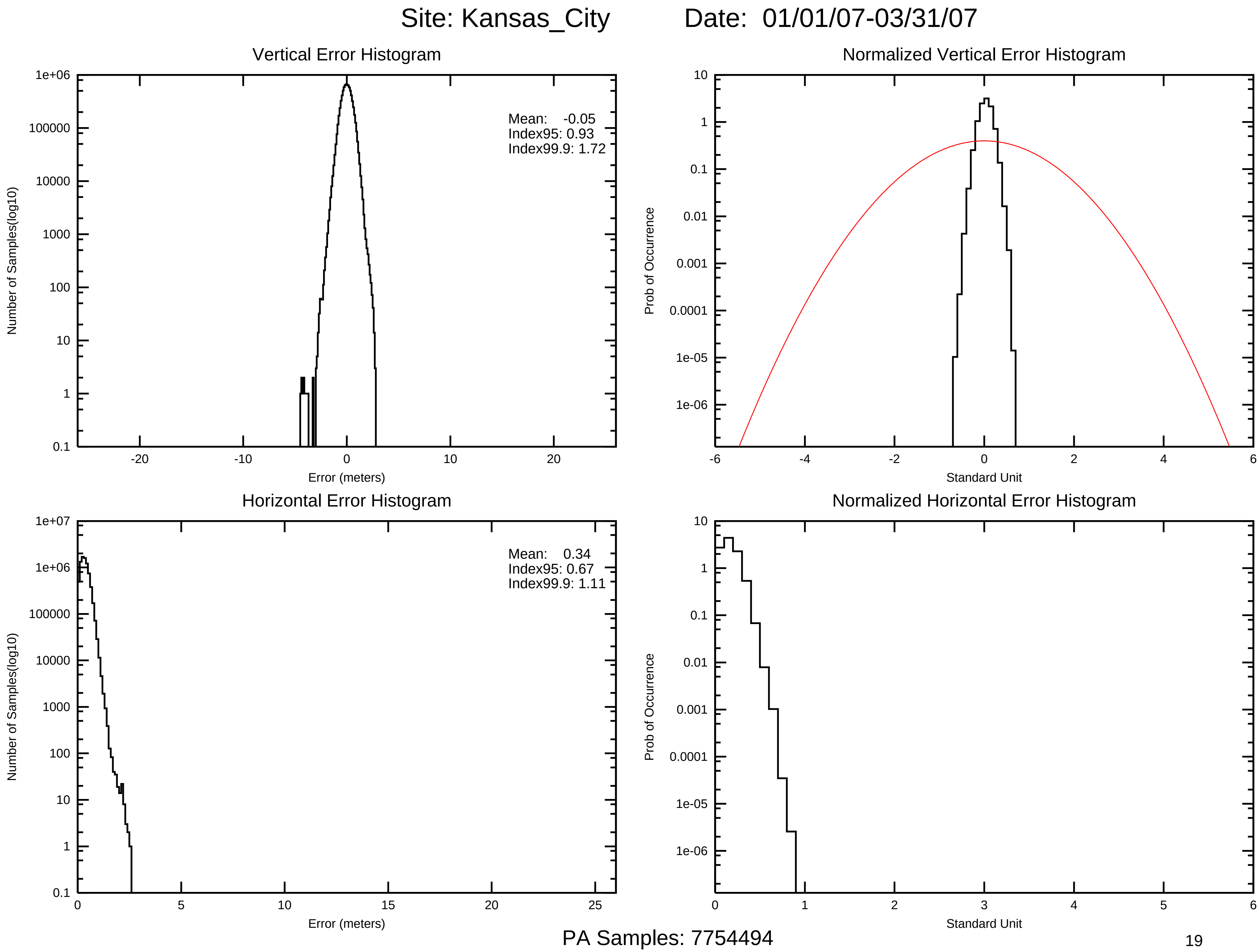


Figure 2-10 Horizontal Triangle Chart for Washington, DC

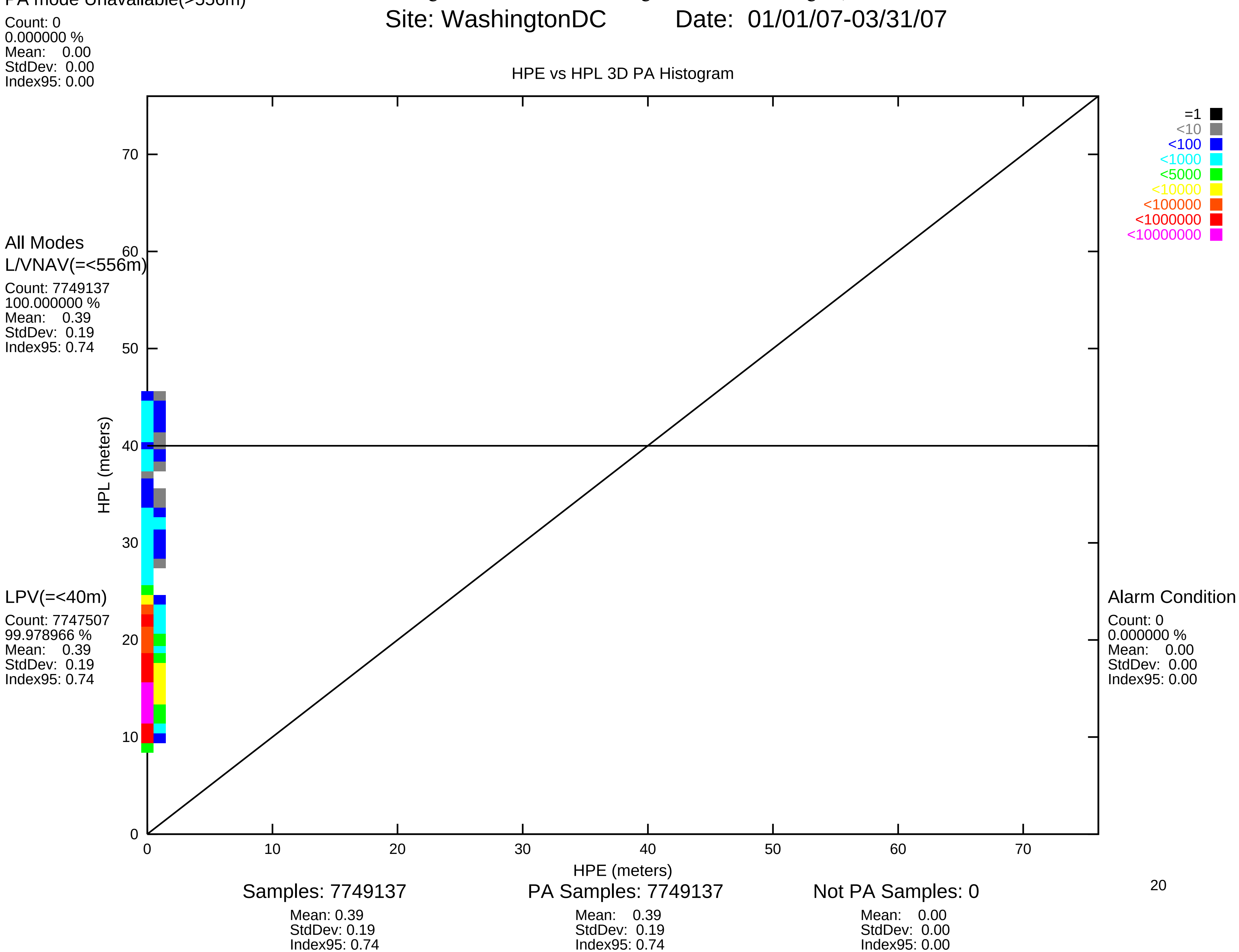


Figure 2-11 Vertical Triangle Chart for Washington, DC

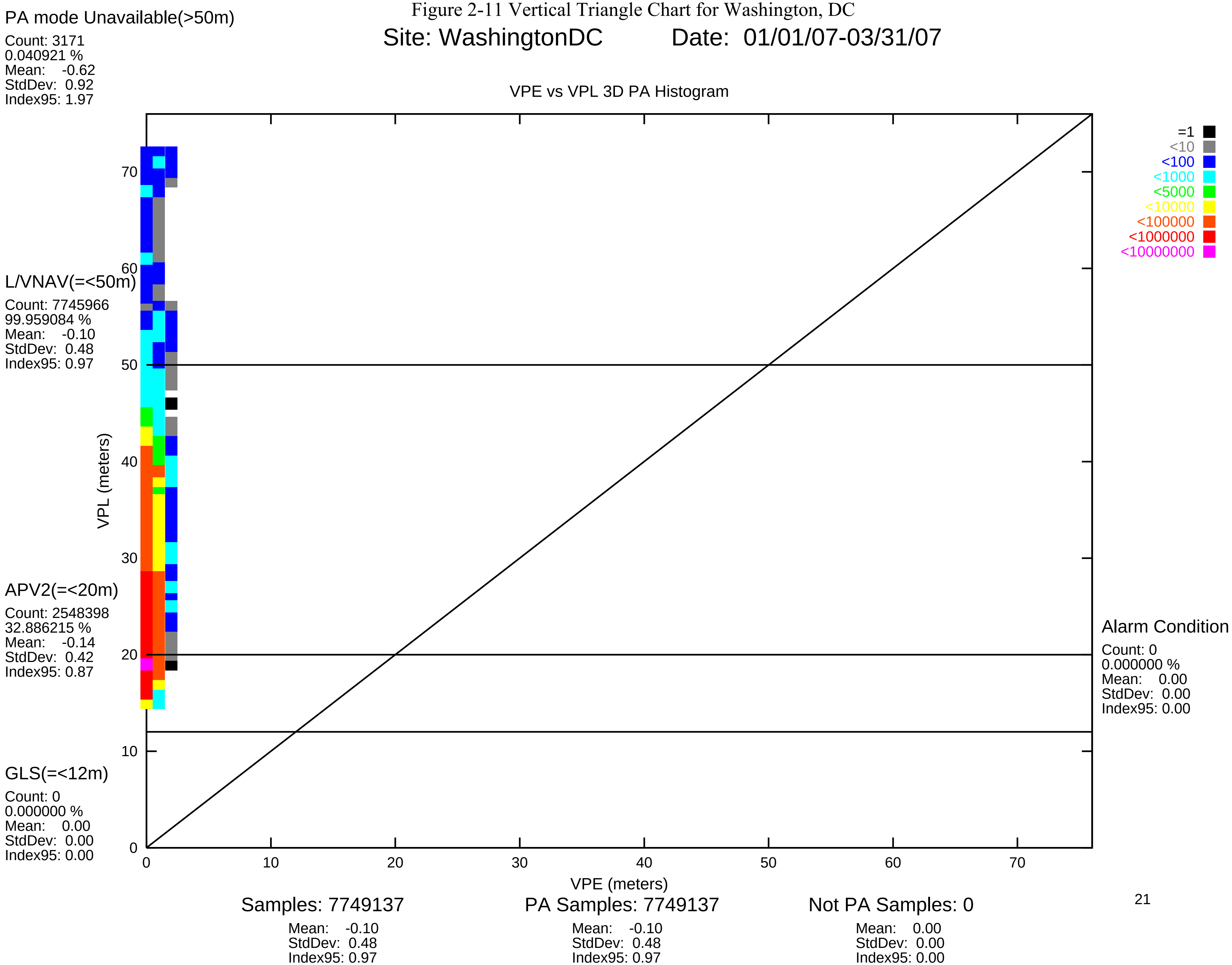


Figure 2-12 2-D Histogram for Washington, DC

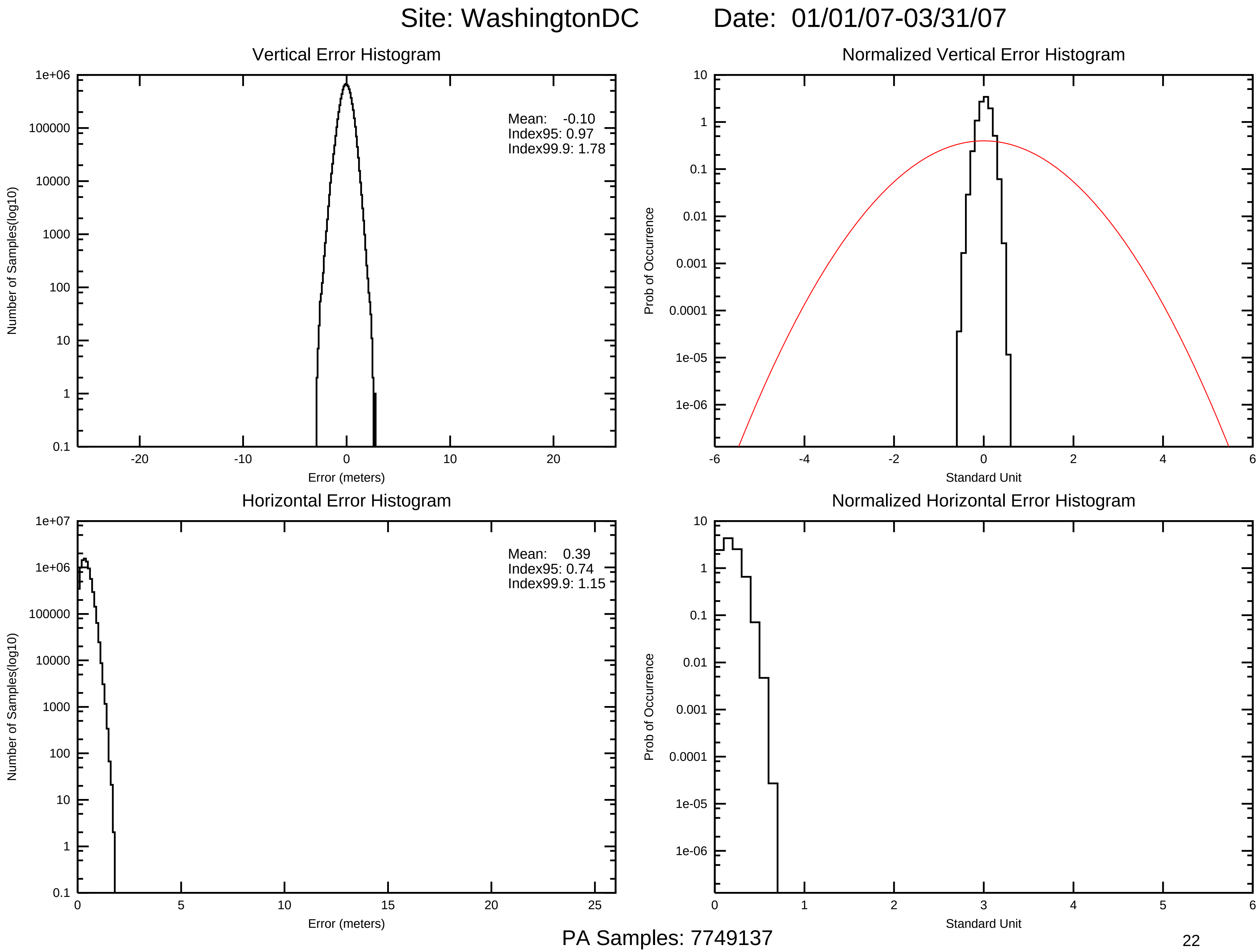


Figure 2-13 Horizontal Triangle Chart for Seattle

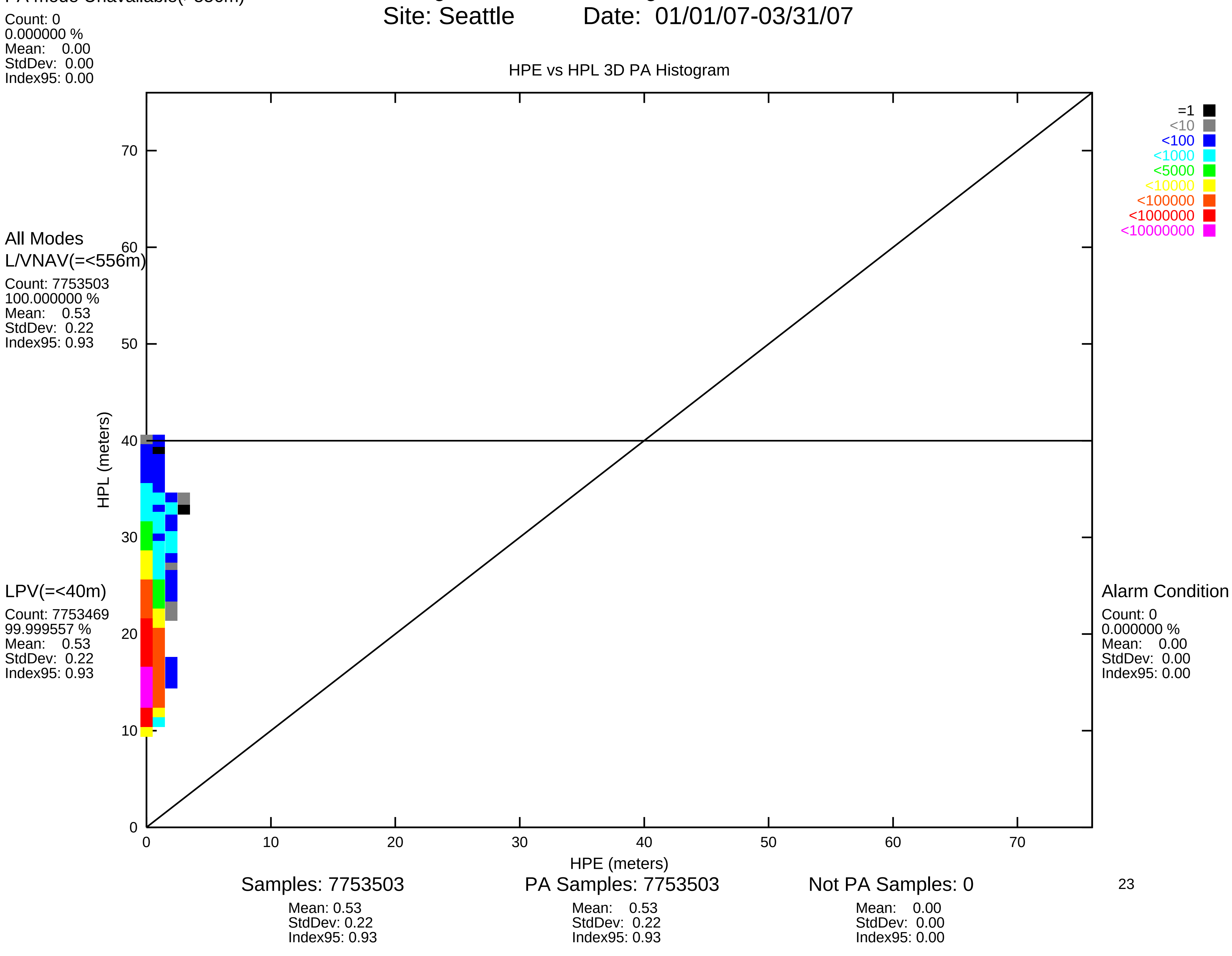


Figure 2-14 Vertical Triangle Chart for Seattle

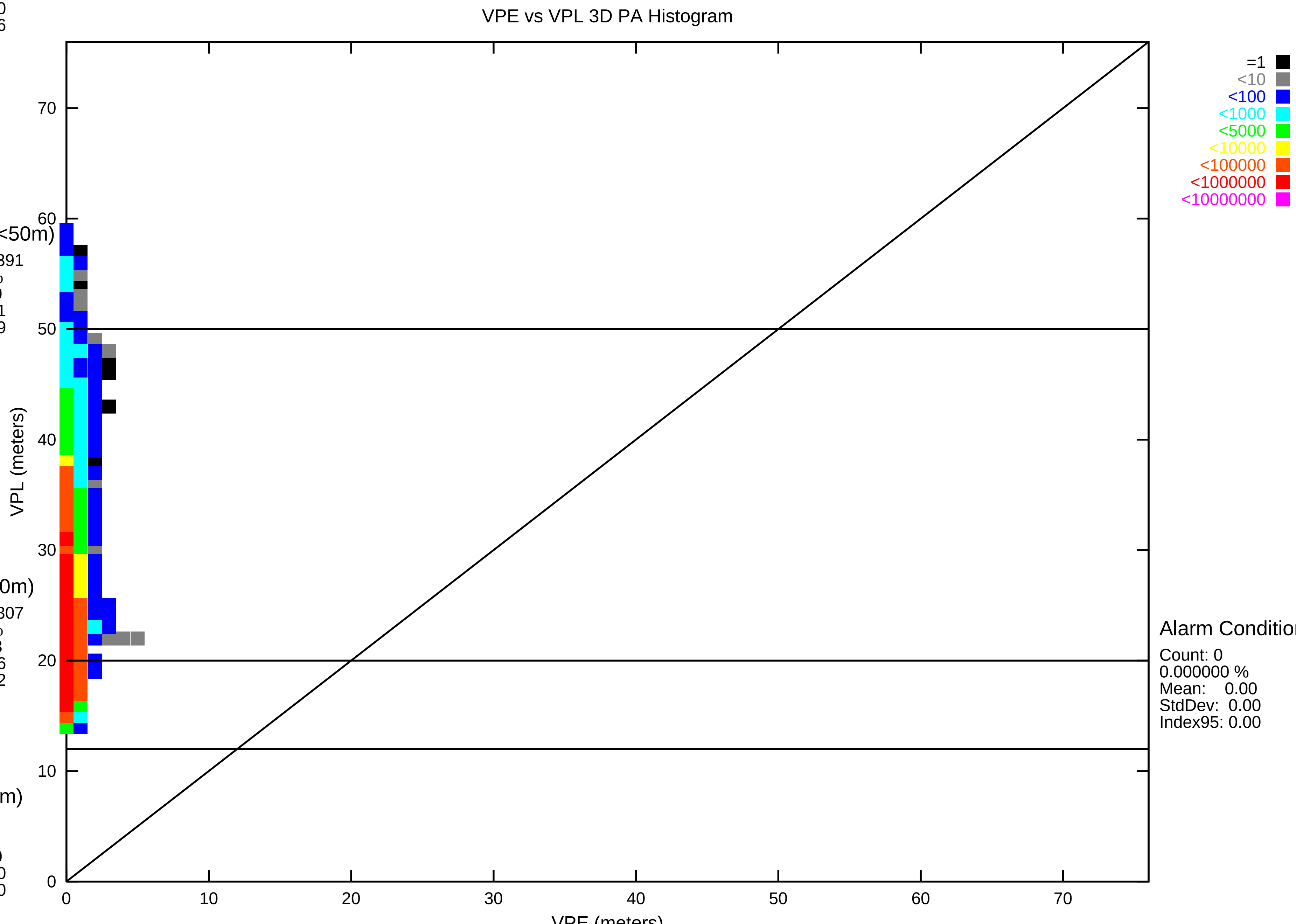
Site: Seattle Date: 01/01/07-03/31/07

PA mode Unavailable(>50m)
Count: 2112
0.027239 %
Mean: -0.04
StdDev: 0.50
Index95: 0.96

L/VNAV(=<50m)
Count: 7751391
99.972763 %
Mean: 0.19
StdDev: 0.41
Index95: 0.89

APV2(=<20m)
Count: 2601307
33.550087 %
Mean: 0.23
StdDev: 0.36
Index95: 0.82

GLS(=<12m)
Count: 0
0.000000 %
Mean: 0.00
StdDev: 0.00
Index95: 0.00



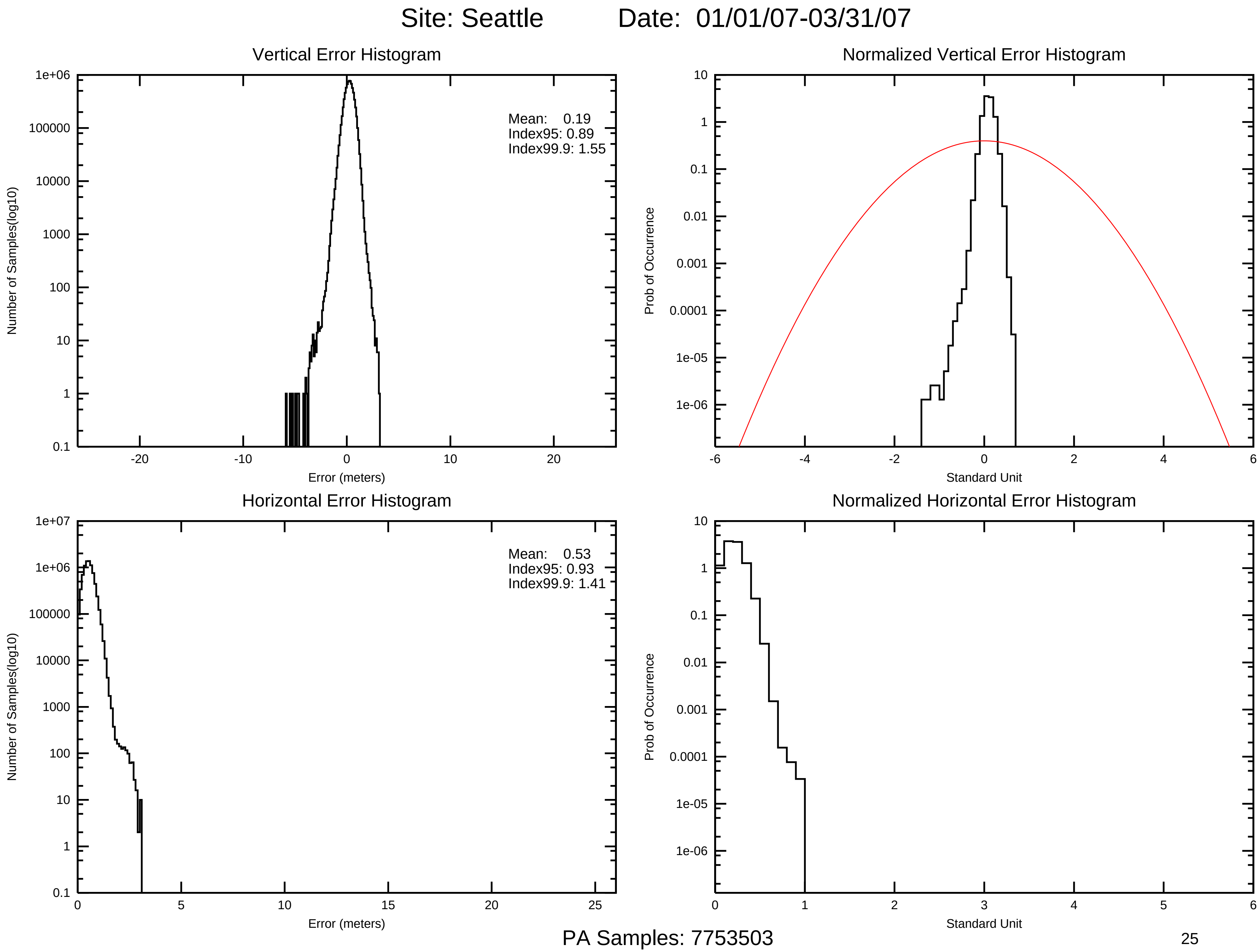
Alarm Condition
Count: 0
0.000000 %
Mean: 0.00
StdDev: 0.00
Index95: 0.00

Samples: 7753503
Mean: 0.19
StdDev: 0.41
Index95: 0.89

PA Samples: 7753503
Mean: 0.19
StdDev: 0.41
Index95: 0.89

Not PA Samples: 0
Mean: 0.00
StdDev: 0.00
Index95: 0.00

Figure 2-15 2-D Histogram for Seattle



3.0 AVAILABILITY

WAAS availability evaluation estimates the probability that the WAAS can provide service for the operational service levels (LPV and LNAV/VNAV) defined in Table 2.1. At each receiver, the WAAS message, along with the GPS/GEO satellites tracked, were used to produce WAAS protection levels in accordance with the WAAS MOPS. Table 3.1 shows the protection levels that were maintained for 95% of the time for each receiver location for the quarter. The table also included the percentage in PA mode as described in section 2.0. The first two columns of Table 3.2 presents the average portion of time that WAAS operational service levels are available at each receiver location.

Availability of LPV and LNVA/VNAV service is evaluated by monitoring the WAAS protection levels at receiver locations throughout the test period. If both the vertical and horizontal protection levels are not greater than their respective alert limits (VAL and HAL) then the service is available. If either of the protection levels exceeds the required alert level then the operational service at that location is considered unavailable and an outage in service is recorded with its duration. The operational service is not considered available again until the protection levels are both within the alert limits for at least 15 minutes. Although this will reduce operational service availability minimally, it substantially reduces the number of service outages and prevents excessive switching in and out of service availability. The percent of time that LPV and LNVA/VNAV service is available using the fifteen-minute window criteria is presented in the last two columns in Table 3.2. The LPV and LNVA/VNAV service outages and associated outage rate for the test period is presented in Table 3.4. The outage rate is the percent of approaches that theoretically would be interrupted by a loss of operational service once the approach had started. Figures 3.1 through 3.4 show the daily availability of LNAV/VNAV and LPV service levels for the evaluated period. Figures 3.5 through 3.8 show the daily interruptions of LNAV/VNAV and LPV service levels for the evaluated period.

The following table shows the maximum and minimum 95% HPL and VPL observed for this evaluated period.

Parameter	CONUS Maximum	CONUS Minimum	All Sites Maximum	All Sites Minimum
95% HPL	Boston 28.615 meters	Memphis 15.971 meters	Barrow 49.90 meters	Memphis 15.971 meters
95% VPL	Boston 46.743 meters	Memphis 26.623 meters	Barrow 93.816 meters	Kansas City 26.596 meters

Availability of NPA service is evaluated by monitoring the WAAS horizontal protection level at receiver locations throughout the test period. If the horizontal protection level is not greater than the horizontal alert limit (HAL = 556m) then the service is available. If the horizontal protection level exceeds the required alert level or if WAAS navigation message is not received then the NPA service at that location is considered unavailable and an outage in service is recorded with its duration. The NPA service is not considered available again until the horizontal protection level is within the alert limit for at least 15 minutes. The percent of time that NPA service is available using the fifteen-minute window criteria is presented in Table 3.3. The NPA service outages and associated outage rate for the test period is presented in Table 3.5. The outage rate is the percent of NPA approaches that theoretically would be interrupted by a loss of operational service once the approach had started. During this period, Puerto Rico had 16 NPA outages, all due to CRW GUS switchovers.

Table 3-1 95% Protection Level

Location	95% HPL (meters)	95% VPL (meters)	Percentage in PA mode
Atlantic City	22.521	39.544	99.999977
Greenwood	17.178	28.746	100.00
San Angelo	22.654	34.548	100.00
Albuquerque	19.245	31.999	100.00
Anchorage	21.916	37.312	100.00
Atlanta	16.768	27.570	100.00
Barrow	49.909	93.816	99.737709
Bethel	26.940	50.455	99.999977
Billings	18.218	28.413	100.00
Boston	28.615	46.743	100.00
Chicago	16.860	27.782	100.00
Cleveland	17.417	28.875	100.00
Cold Bay	44.864	66.502	99.993256
Dallas	18.946	30.979	100.00
Denver	17.236	27.915	100.00
Fairbanks	22.731	43.306	99.999687
Houston	21.701	33.729	100.00
Jacksonville	18.323	32.096	100.00
Juneau	21.900	34.857	100.00
Kansas City	16.192	26.596	100.00
Kotzebue	31.791	60.683	99.984718
Los Angeles	27.880	43.013	100.00
Memphis	15.971	26.623	100.00
Miami	22.870	40.601	100.00
Minneapolis	20.111	28.985	100.00
New York	24.295	41.816	100.00
Oakland	28.056	43.015	100.00
Salt Lake City	18.437	29.686	100.00
Seattle	20.881	30.695	100.00
Washington DC	18.683	33.112	100.00

Table 3-2 Quarterly Availability Statistics

Location	LPV *Average Availability Percentage of time*	LNAV/VNAV *Average Availability Percentage of time*	LPV WAAS *With 15 minute window*	LNAV/VNAV *With 15 minute window*
Atlantic City	0.99789619	0.99794251	0.99705627	0.99706497
Greenwood	0.99997854	0.99998635	0.99997875	0.99998651
San Angelo	0.99880600	0.99927872	0.99849814	0.99899081
Albuquerque	0.99987268	0.99990004	0.99985771	0.99988223
Anchorage	0.99280268	0.99283797	0.99159638	0.99163105
Atlanta	0.99993104	0.99993104	0.99988373	0.99988373
Barrow	0.61178601	0.65563387	0.56148244	0.60661829
Bethel	0.94791025	0.94803602	0.94297080	0.94309977
Billings	0.99990624	0.99996775	0.99974618	0.99984906
Boston	0.96332961	0.96354383	0.94950548	0.95011075
Chicago	0.99996889	0.99996889	0.99994300	0.99994300
Cleveland	0.99984753	0.99987870	0.99984456	0.99987162
Cold Bay	0.82084501	0.85672057	0.78040858	0.82245478
Dallas	0.99963129	0.99993318	0.99939463	0.99989094
Denver	100.00	100.00	100.00	100.00
Fairbanks	0.98334497	0.98346943	0.97993827	0.98068119
Houston	0.99911135	0.99940073	0.99904057	0.99913004
Jacksonville	0.99928236	0.99928236	0.99916929	0.99916929
Juneau	0.99458623	0.99468154	0.99260033	0.99278393
Kansas City	0.99988031	0.99988031	0.99982486	0.99982486
Kotzebue	0.87591273	0.88342446	0.84941202	0.86447383
Los Angeles	0.98956186	0.99042815	0.98772494	0.98872405
Memphis	0.99999213	0.99999213	0.99999222	0.99999222
Miami	0.99577188	0.99577188	0.99415328	0.99415328
Minneapolis	0.99990380	0.99993455	0.99988965	0.99992004
New York	0.99473655	0.99477535	0.99233013	0.99245477
Oakland	0.98239785	0.98350966	0.97903425	0.98047842
Salt Lake City	0.99994671	0.99998409	0.99993268	0.99998424
Seattle	0.99972320	0.99972761	0.99958270	0.99967889
Washington DC	0.99951881	0.99959081	0.99940641	0.99947533

Table 3-3 NPA Availability

Location	NPA Availability (Excluding RAIM/FDE)
Albuquerque	100.00
Anchorage	100.00
Atlanta	100.00
Bethel	100.00
Billings	100.00
Boston	100.00
Cleveland	100.00
Cold Bay	100.00
Fairbanks	100.00
Honolulu	100.00
Houston	100.00
Juneau	100.00
Kansas City	100.00
Kotzebue	100.00
Los Angeles	100.00
Miami	100.00
Minneapolis	100.00
Oakland	100.00
Puerto Rico	0.99969010
Salt Lake City	100.00
Seattle	100.00
Washington DC	100.00

Table 3-4 LPV and LNAV/VNAV Outage Rate

Location	LPV Outages	LPV Outage Rates	LNAV/VNAV Outages	LNAV/VNAV Outage Rates
Atlantic City	57	0.001130	56	0.001111
Greenwood	3	0.000057	2	0.000038
San Angelo	30	0.000625	15	0.000312
Albuquerque	8	0.000153	8	0.000153
Anchorage	143	0.002778	141	0.002739
Atlanta	4	0.000077	4	0.000077
Barrow	1199	0.043409	1295	0.043320
Bethel	421	0.008877	411	0.008665
Billings	7	0.000161	4	0.000092
Boston	311	0.006295	310	0.006271
Chicago	2	0.000038	2	0.000038
Cleveland	5	0.000096	5	0.000096
Cold Bay	1054	0.026371	810	0.019226
Dallas	11	0.000224	6	0.000122
Denver	0	0.000000	0	0.000000
Fairbanks	318	0.007079	299	0.006653
Houston	7	0.000134	7	0.000134
Jacksonville	14	0.000268	14	0.000268
Juneau	130	0.002710	123	0.002564
Kansas City	9	0.000172	9	0.000172
Kotzebue	1066	0.025045	1040	0.024008
Los Angeles	189	0.003671	181	0.003512
Memphis	1	0.000019	1	0.000019
Miami	115	0.002215	115	0.002215
Minneapolis	7	0.000134	3	0.000057
New York	139	0.002681	138	0.002661
Oakland	167	0.003267	158	0.003086
Salt Lake City	4	0.000078	2	0.000039
Seattle	14	0.000268	13	0.000249
Washington DC	10	0.000194	10	0.000194

Table 3-5 NPA Outage Rates

Location	NPA Outages	NPA Outage Rate
Albuquerque	0	0
Anchorage	0	0
Anchorage	0	0
Atlanta	0	0
Bethel	0	0
Billings	0	0
Boston	0	0
Cleveland	0	0
Cold Bay	0	0
Cold Bay	0	0
Fairbanks	0	0
Fairbanks	0	0
Honolulu	0	0
Houston	0	0
Juneau	0	0
Kansas City	0	0
Kotzebue	0	0
Los Angeles	0	0
Miami	0	0
Minneapolis	0	0
Oakland	0	0
Puerto Rico	16	0.000310587
Salt Lake City	0	0
Seattle	0	0
Washington DC	0	0

Figure 3-1 LPV Instantaneous Availability

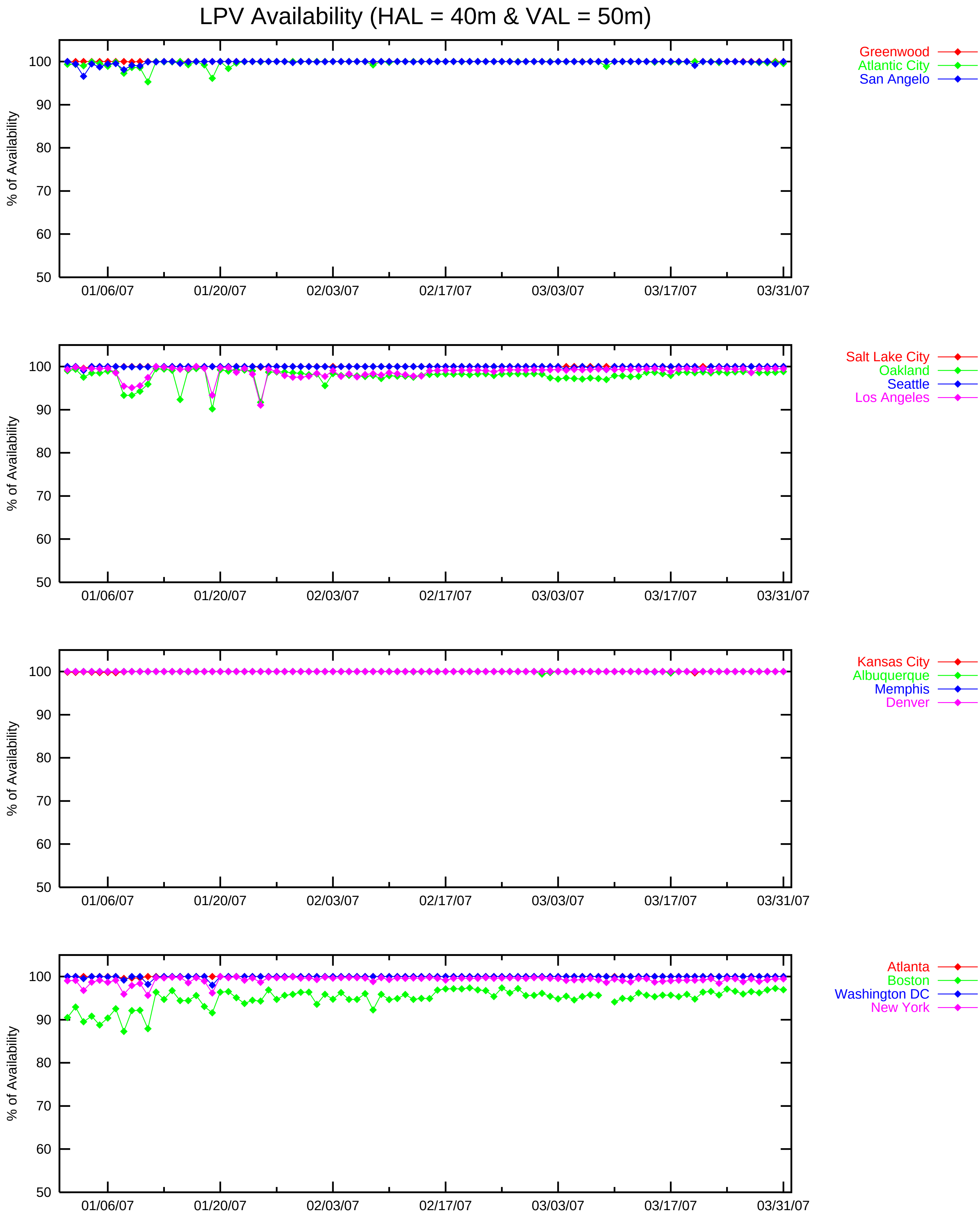


Figure 3-2 LPV Instantaneous Availability

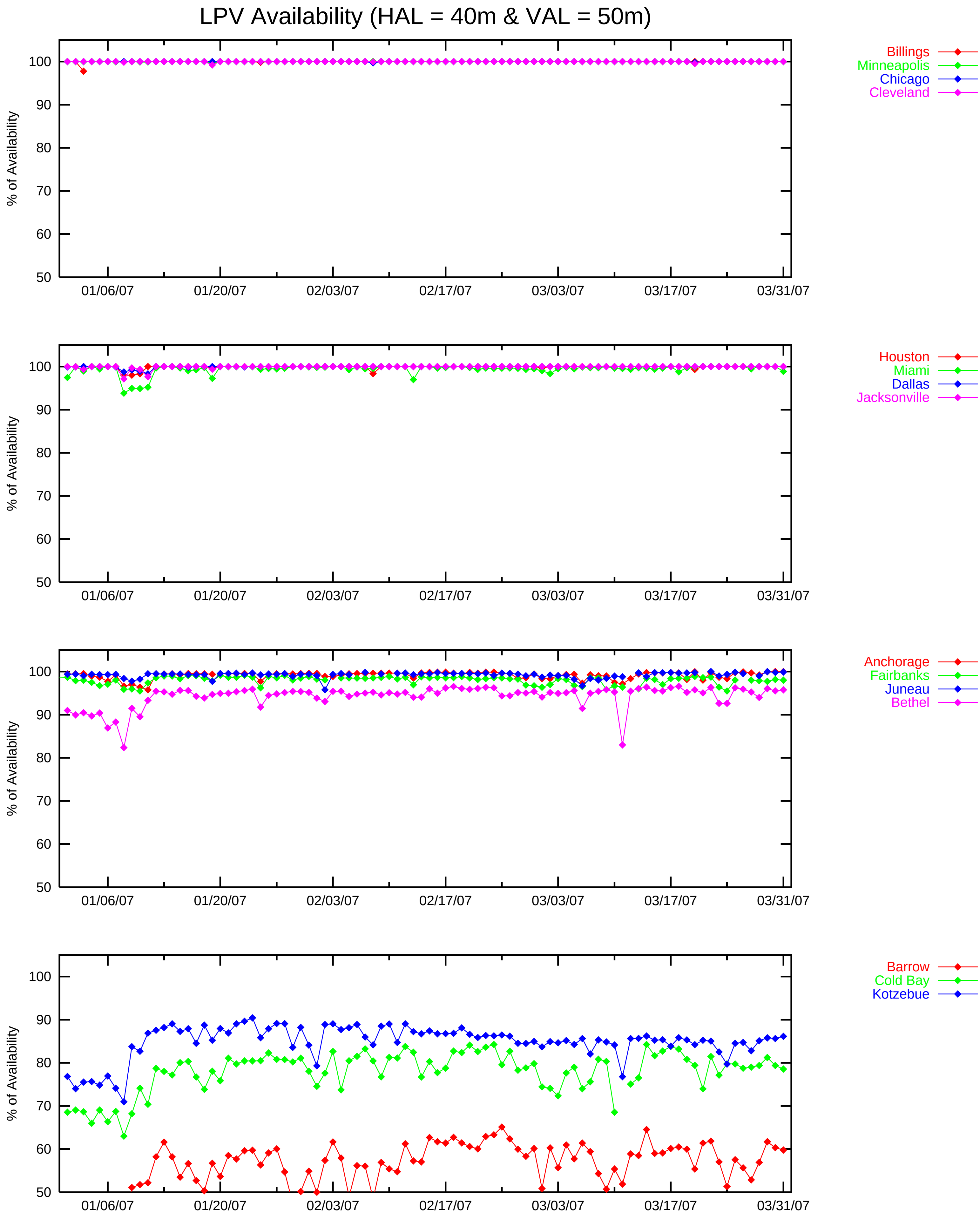


Figure 3-3 LNAV/VNAV Instantaneous Availability

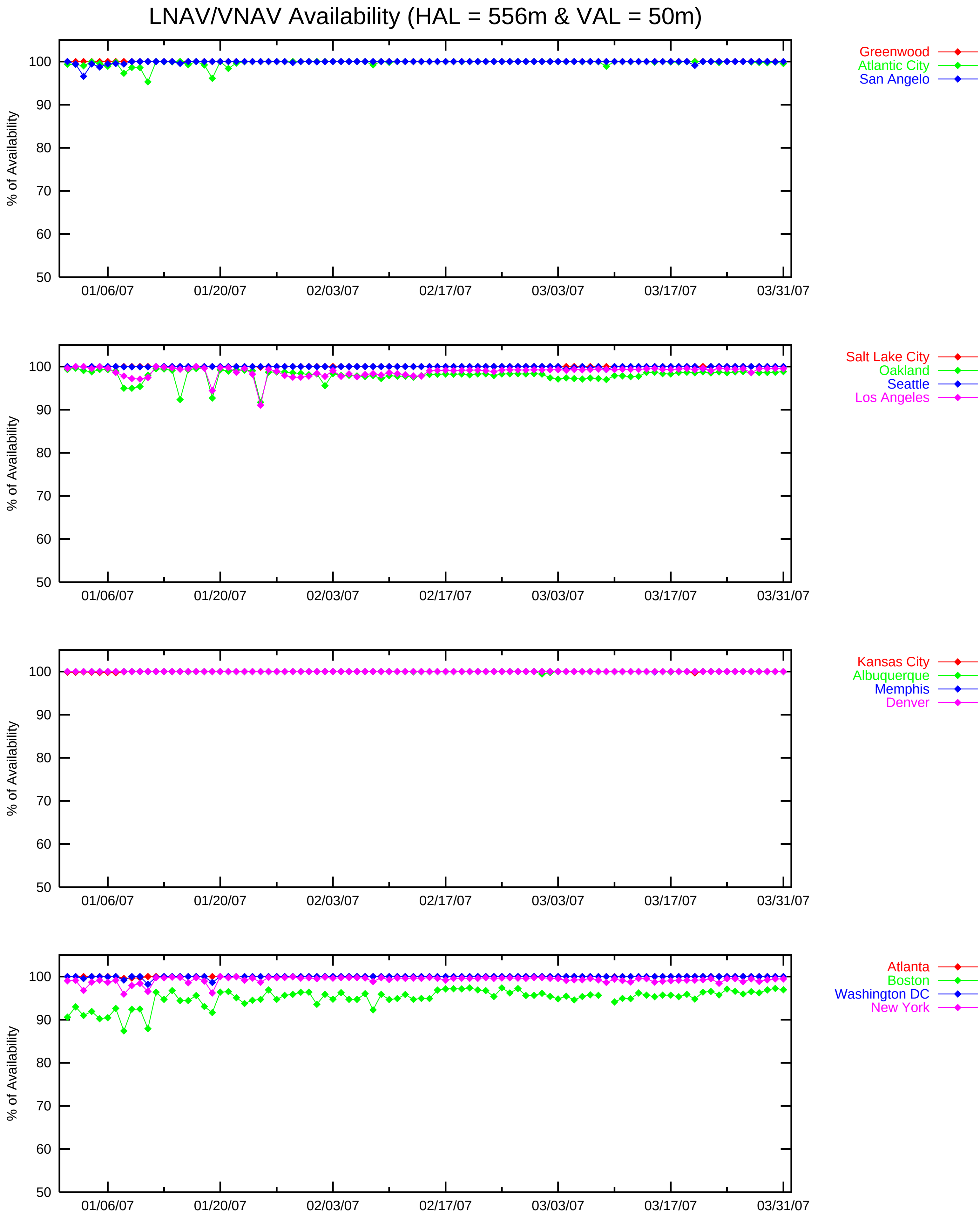


Figure 3-4 LNAV/VNAV Instantaneous Availability

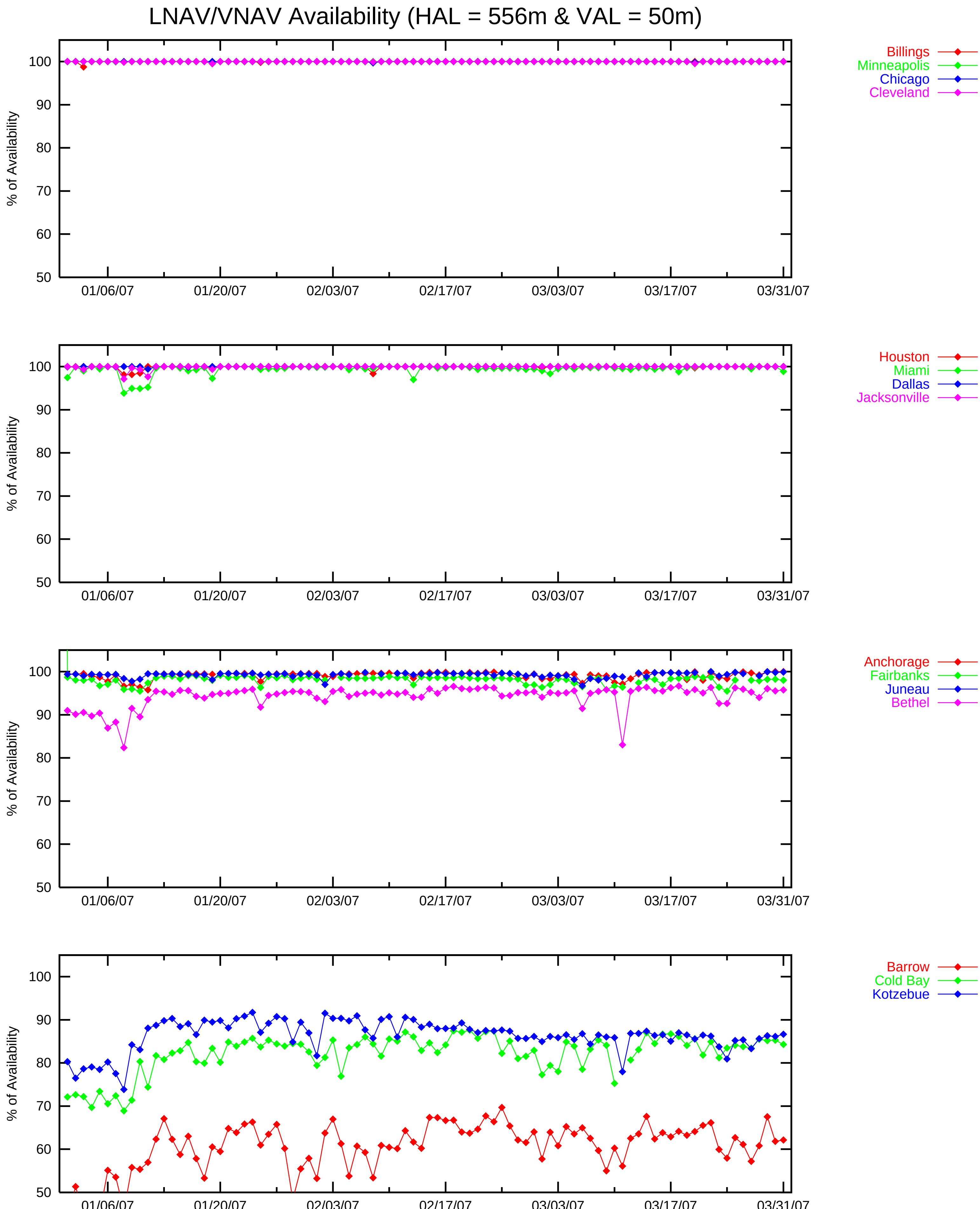


Figure 3-5 LPV Outages

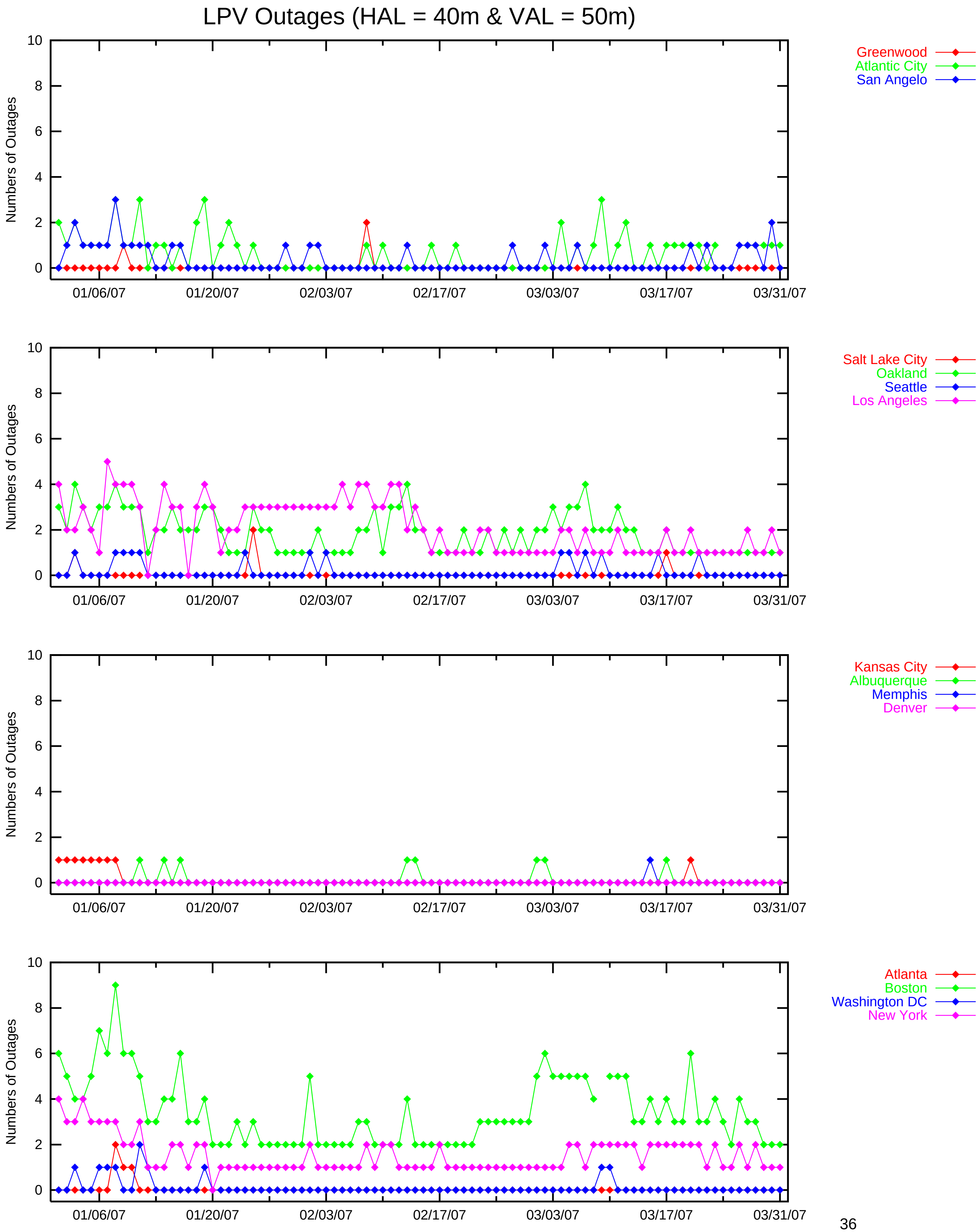


Figure 3-6 LPV Outages

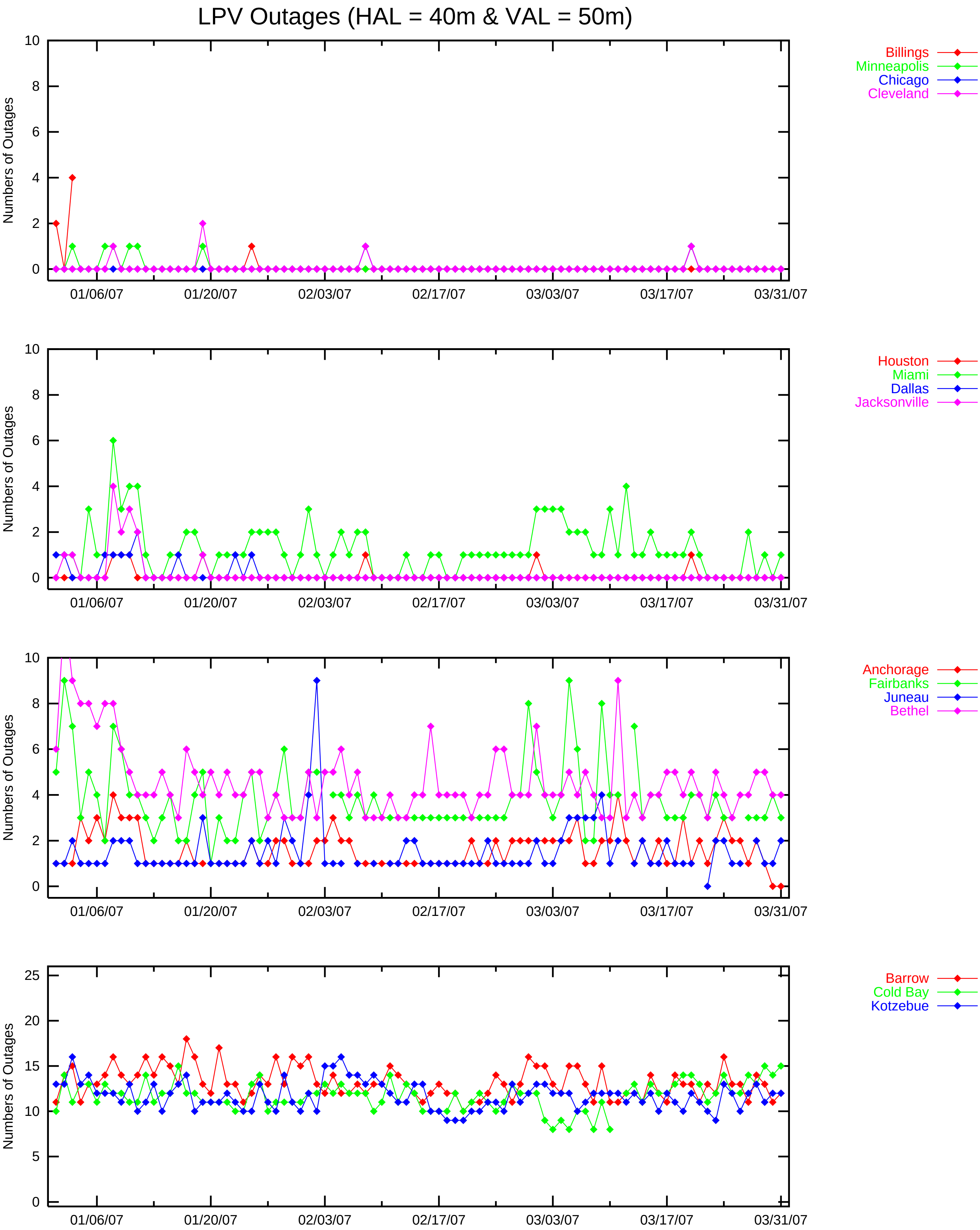


Figure 3-7 LNAV/VNAV Outages

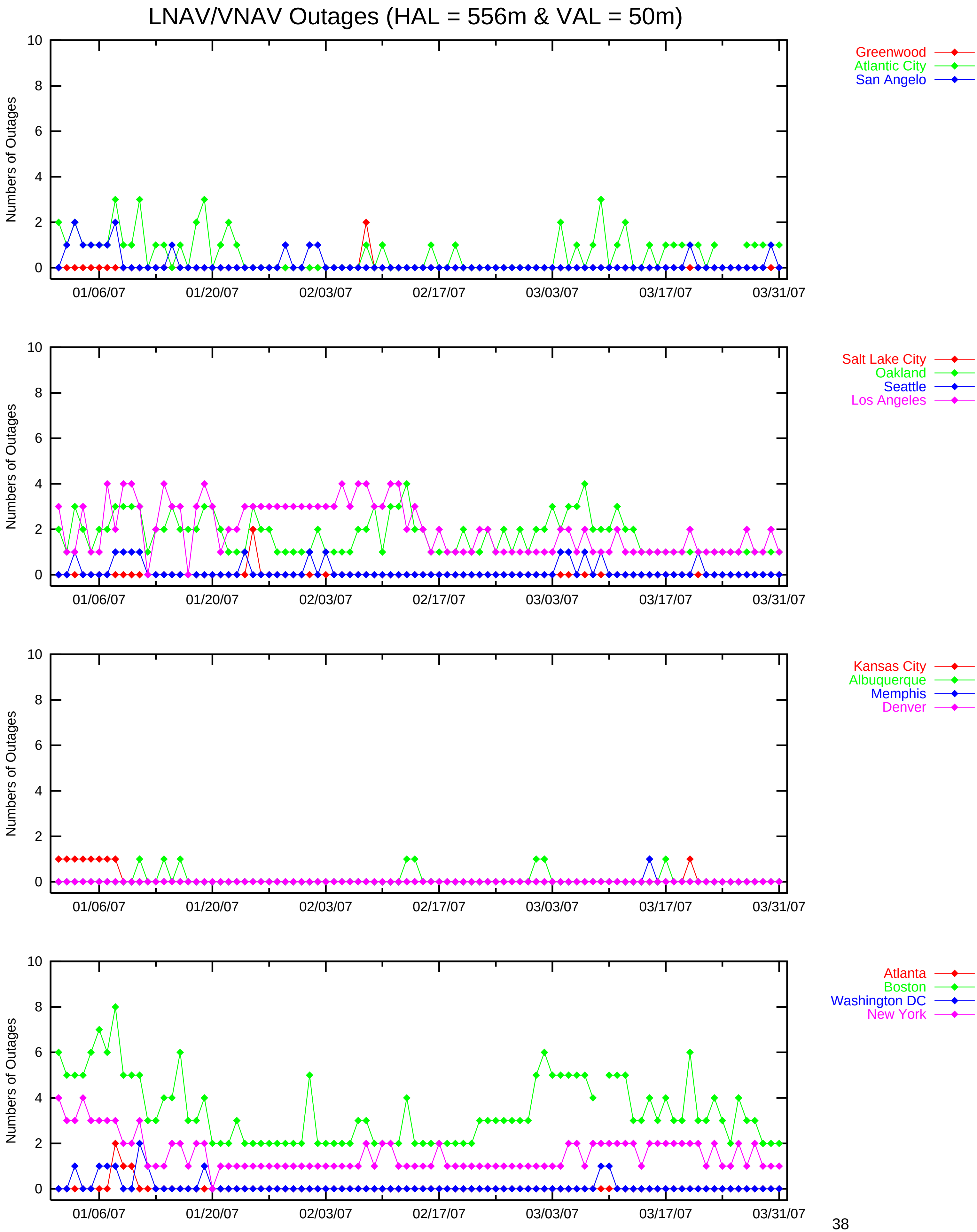
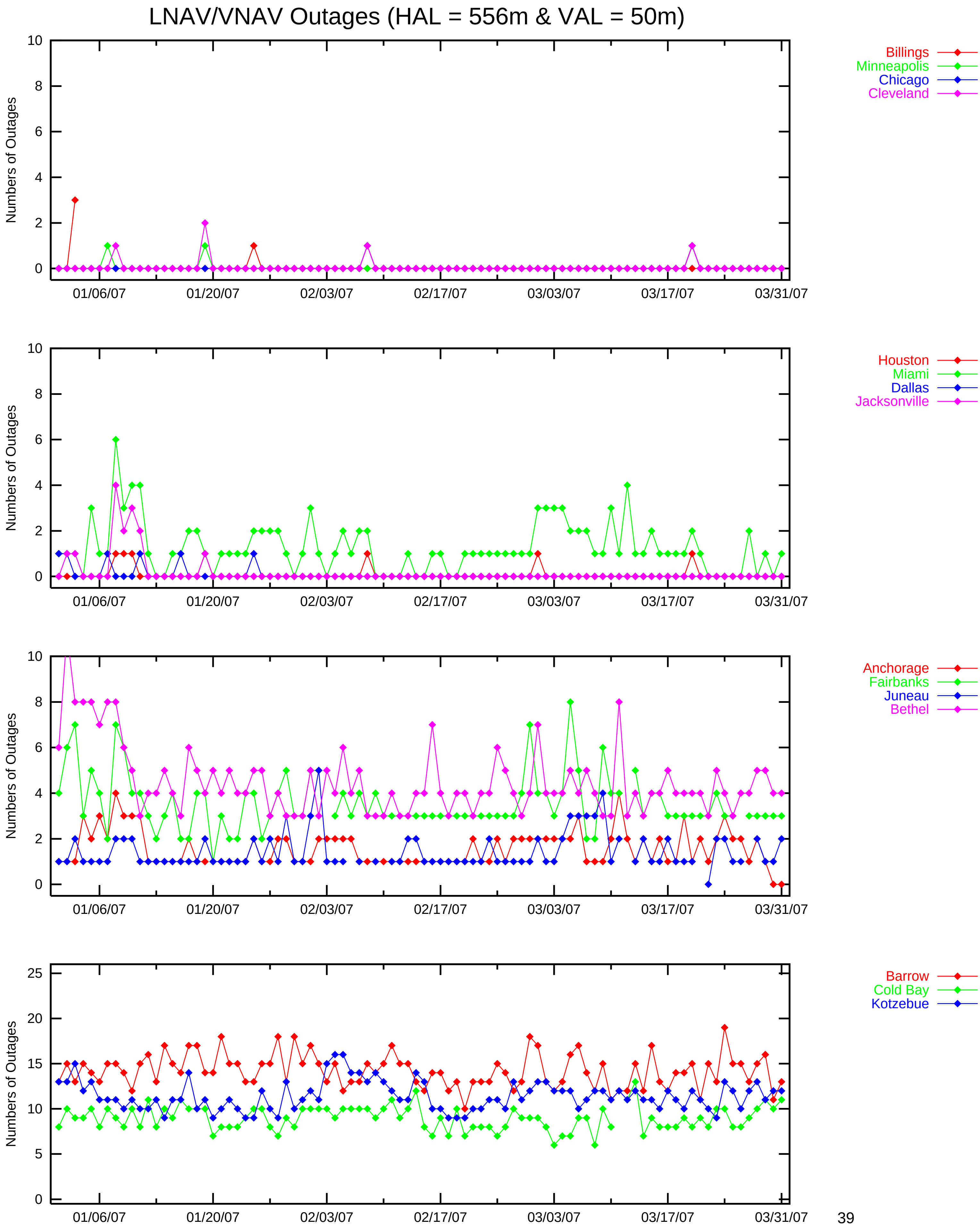


Figure 3-8 LNAV/VNAV Outages



4.0 COVERAGE

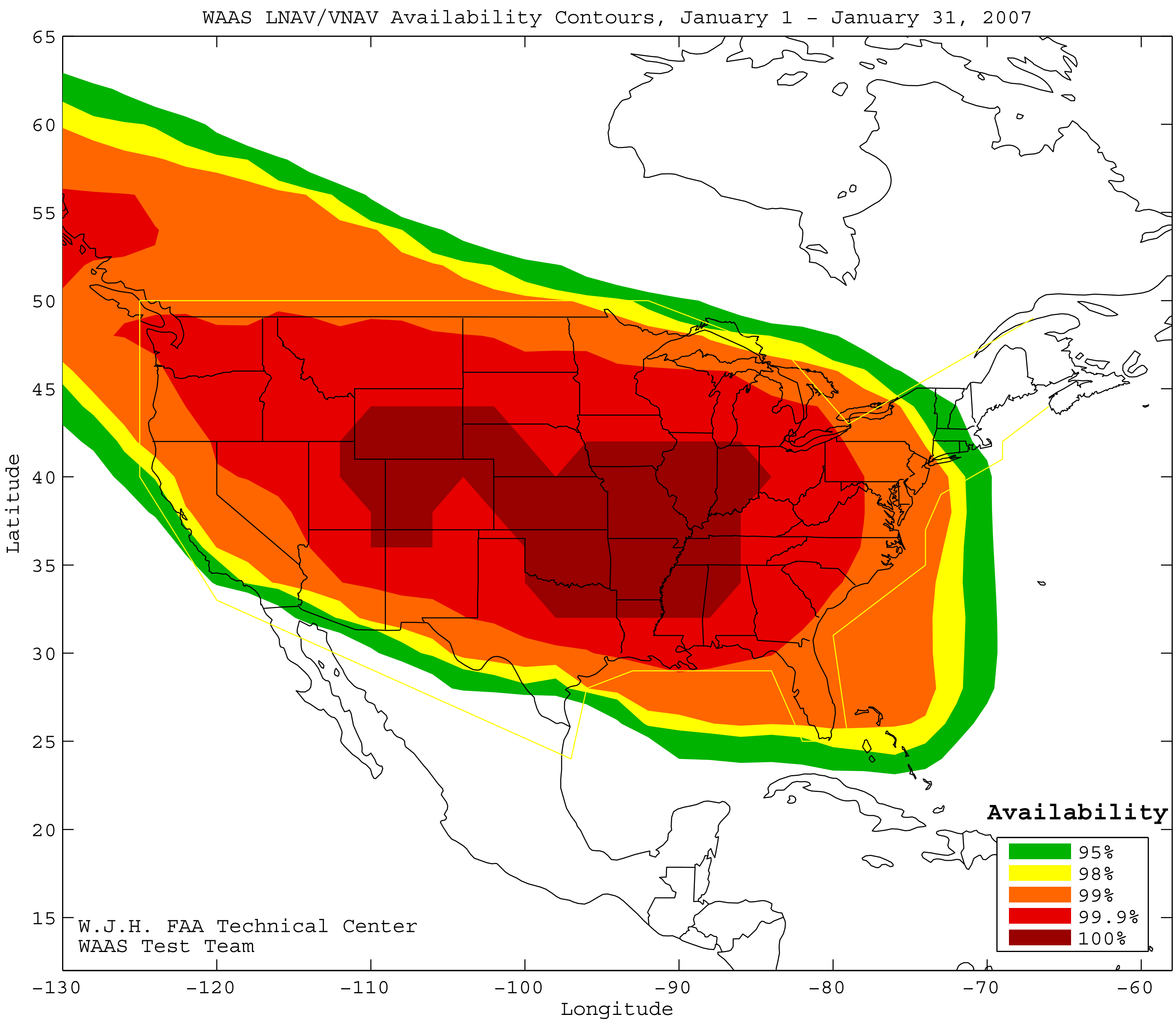
WAAS coverage area evaluation estimates the percent of service volume where WAAS is providing LPV, LNAV/VNAV and NPA services. The WAAS message and the GPS/GEO satellite status are used to determine WAAS availability across North America. For PA coverage, protection levels were calculated at two-minute intervals and at two degree spacing over the PA service volume, while NPA coverage was calculated at two-minute intervals and five degree spacing over the NPA service volume.

Daily analysis for PA was conducted for both LPV and LNAV/VNAV service levels. The coverage plots provide 100, 99, 95, 90 and 80% availability contours. Figures 4.1 to 4.3 and 4.5 to 4.7 show the LNAV/VNAV and LPV CONUS coverage area for each month for this quarter, respectively. Figures 4.19 to 4.21 show the LPV Alaska coverage area for each month for this quarter, respectively. Figures 4.4, 4.8 and 4.22 show the rollup LNAV/VNAV and LPV coverage for the quarter. Figure 4.14 shows the daily LNAV/VNAV and LPV CONUS coverage at 99% availability and ionosphere KP index values for this quarter. Figure 4.23 shows the daily LPV Alaska coverage for this quarter. Figure 4.9 shows the rollup LPV CONUS coverage at 200 feet for the quarter.

Daily analysis for NPA was based on a 99.9% availability requirement. The NPA coverage plots provide 100, 99.9 and 99% availability contours. Figure 4.10 to 4.12 show the NPA coverage area of each month and Figure 4.13 shows the rollup NPA coverage for the quarter. Figure 4.15 shows the daily NPA coverage at 99.9% availability and ionosphere Kp index values for this quarter.

Figures 4.16 to 4.18 show the rollup LNAV/VNAV, LPV and NPA CONUS coverage since WAAS commissioning (July 2003). Figure 4.24 shows the rollup LPV Alaska coverage since added to the WAAS (Oct 2006).

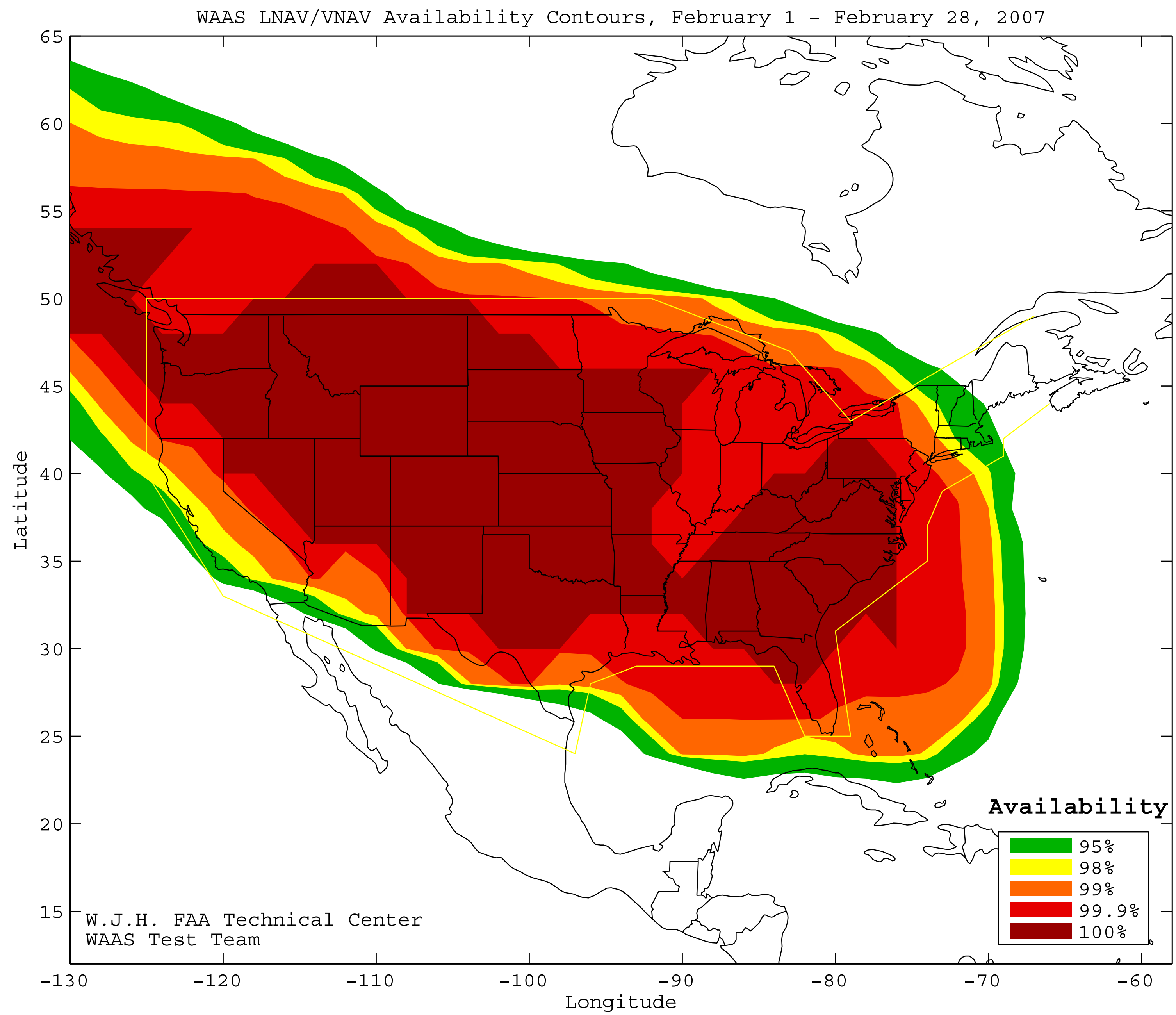
Figure 4-1 WAAS LNAV/VNAV Coverage - January



CONUS Coverage at 95% Availability = 94.33%
CONUS Coverage at 99% Availability = 86.23%
CONUS Coverage at 100% Availability = 28.34%

SL = LNAV/VNAV

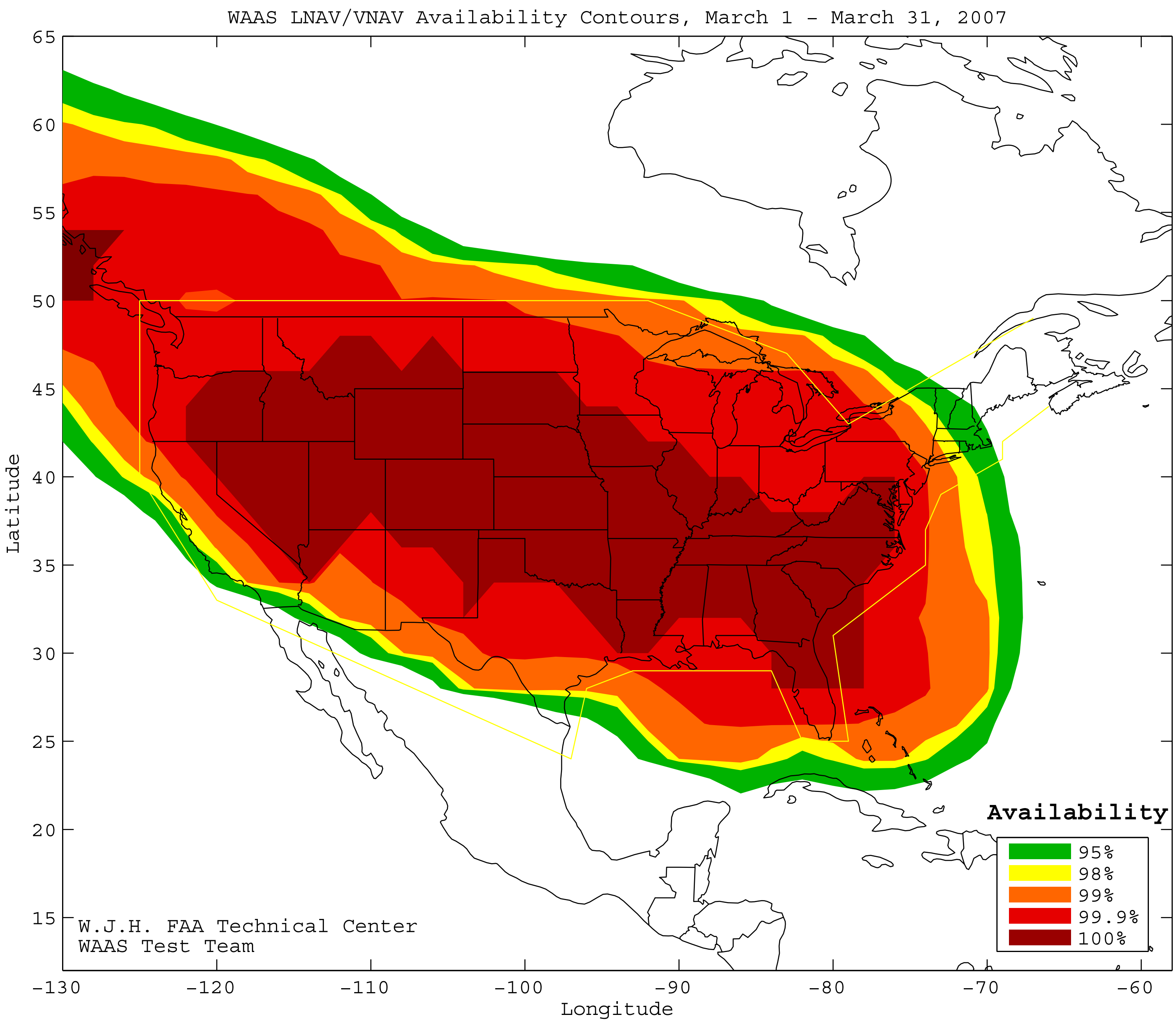
Figure 4-2 WAAS LNAV/VNAV Coverage - February



CONUS Coverage at 95% Availability = 95.14%
CONUS Coverage at 99% Availability = 89.47%
CONUS Coverage at 100% Availability = 68.02%

SL = LNAV/VNAV

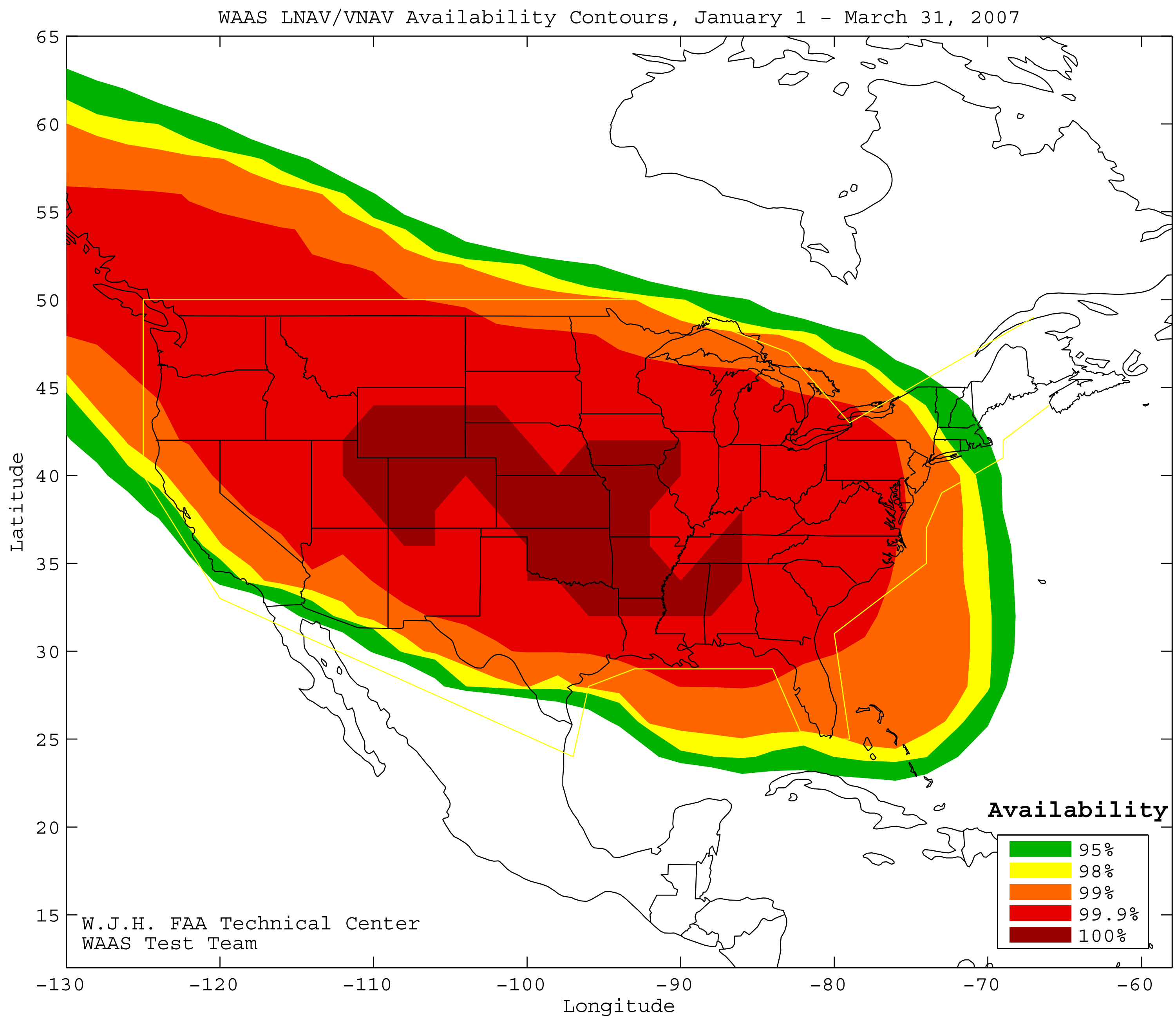
Figure 4-3 WAAS LNAV/VNAV Coverage - March



CONUS Coverage at 95% Availability = 95.14%
CONUS Coverage at 99% Availability = 90.69%
CONUS Coverage at 100% Availability = 57.09%

SL = LNAV/VNAV

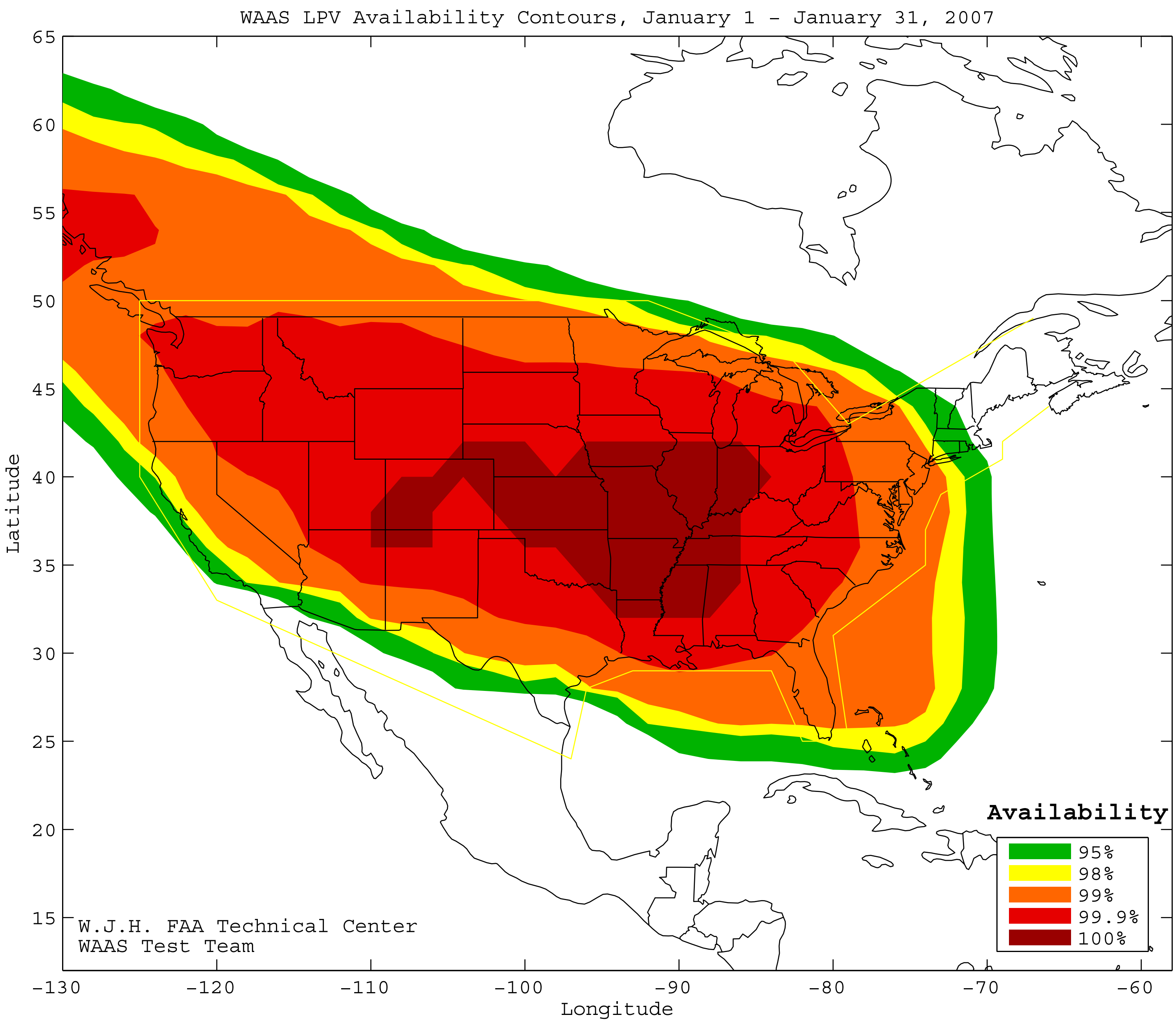
Figure 4-4 WAAS LNAV/VNAV Coverage for the Quarter



CONUS Coverage at 95% Availability = 95.14%
CONUS Coverage at 99% Availability = 88.26%
CONUS Coverage at 100% Availability = 24.29%

SL = LNAV/VNAV

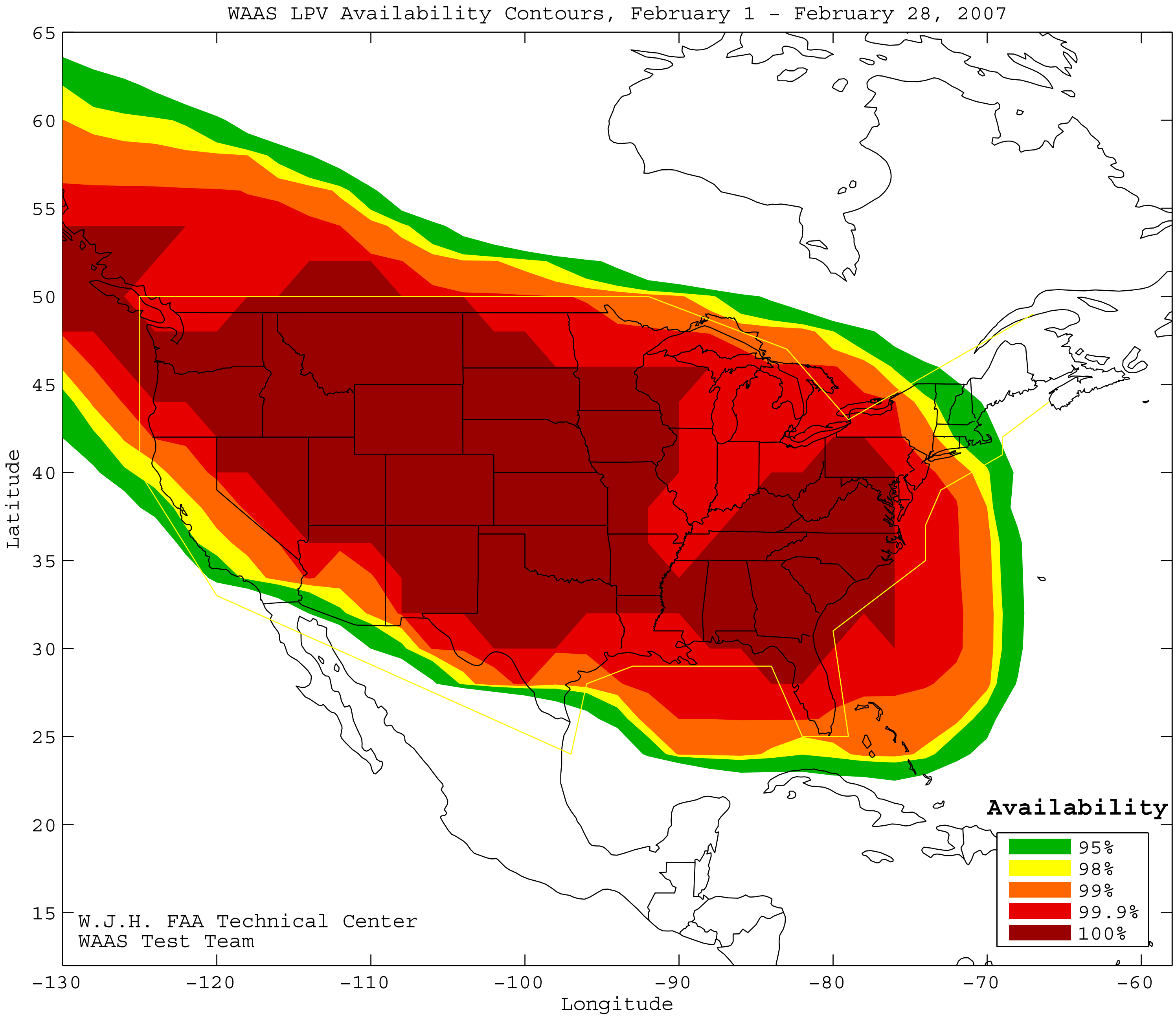
Figure 4-5 WAAS LPV Coverage - January



CONUS Coverage at 95% Availability = 93.93%
CONUS Coverage at 99% Availability = 85.02%
CONUS Coverage at 100% Availability = 22.27%

SL = LPV

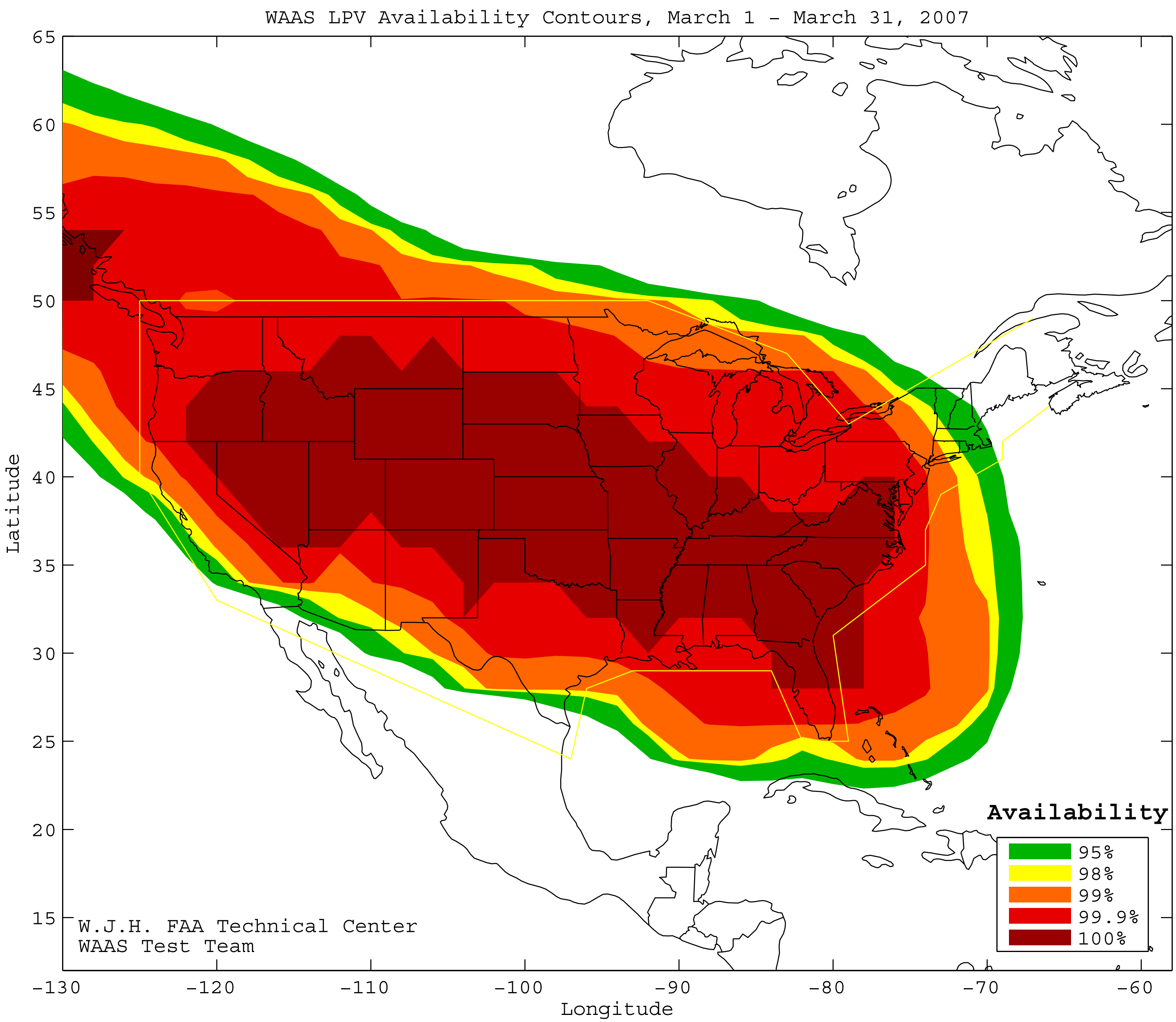
Figure 4-6 WAAS LPV Coverage - February



CONUS Coverage at 95% Availability = 95.14%
CONUS Coverage at 99% Availability = 89.07%
CONUS Coverage at 100% Availability = 68.02%

SL = LPV

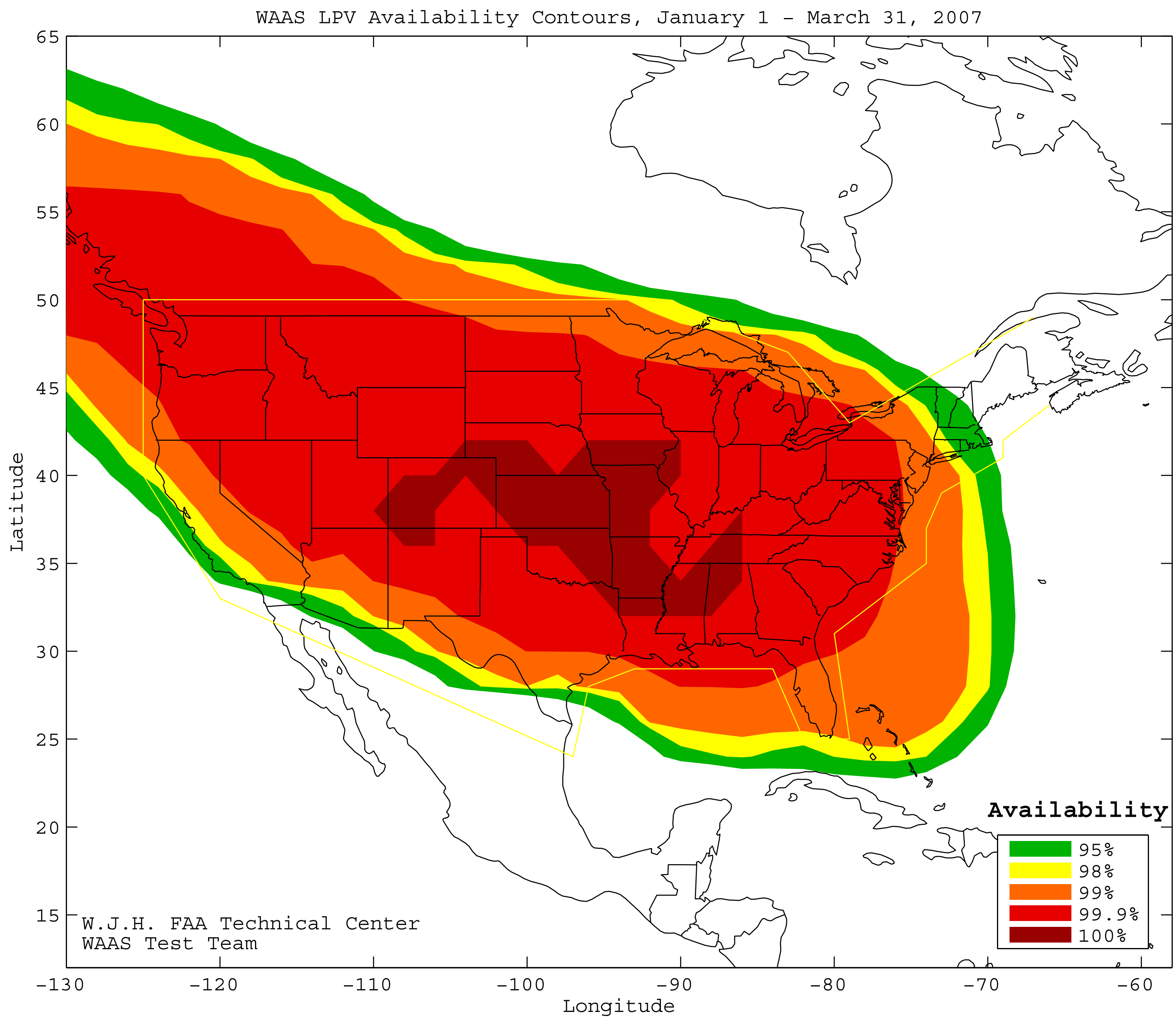
Figure 4-7 WAAS LPV Coverage - March



CONUS Coverage at 95% Availability = 95.14%
CONUS Coverage at 99% Availability = 89.07%
CONUS Coverage at 100% Availability = 56.28%

SL = LPV

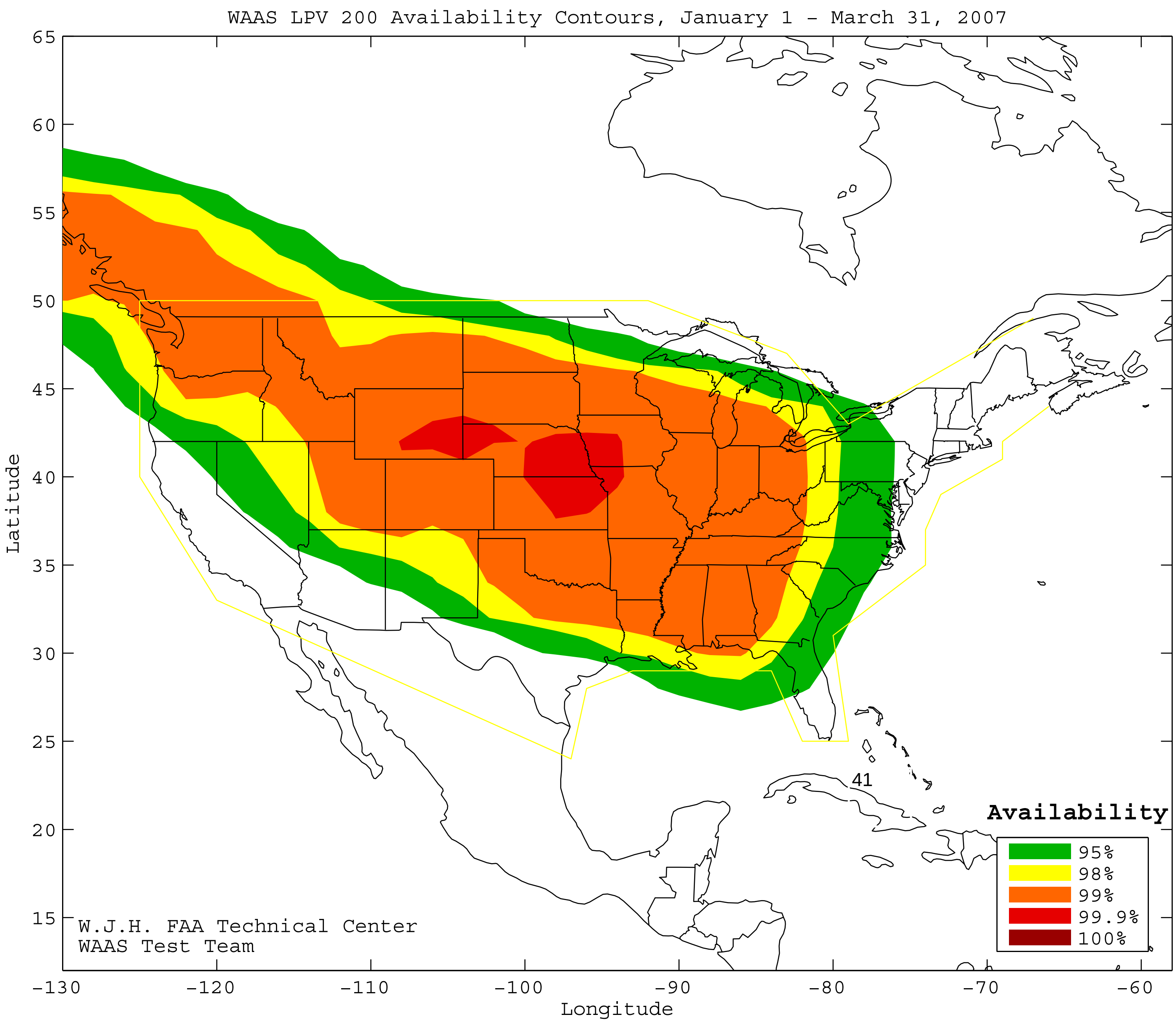
Figure 4-8 WAAS LPV Coverage for the Quarter



CONUS Coverage at 95% Availability = 94.74%
CONUS Coverage at 99% Availability = 87.45%
CONUS Coverage at 100% Availability = 18.62%

SL = LPV

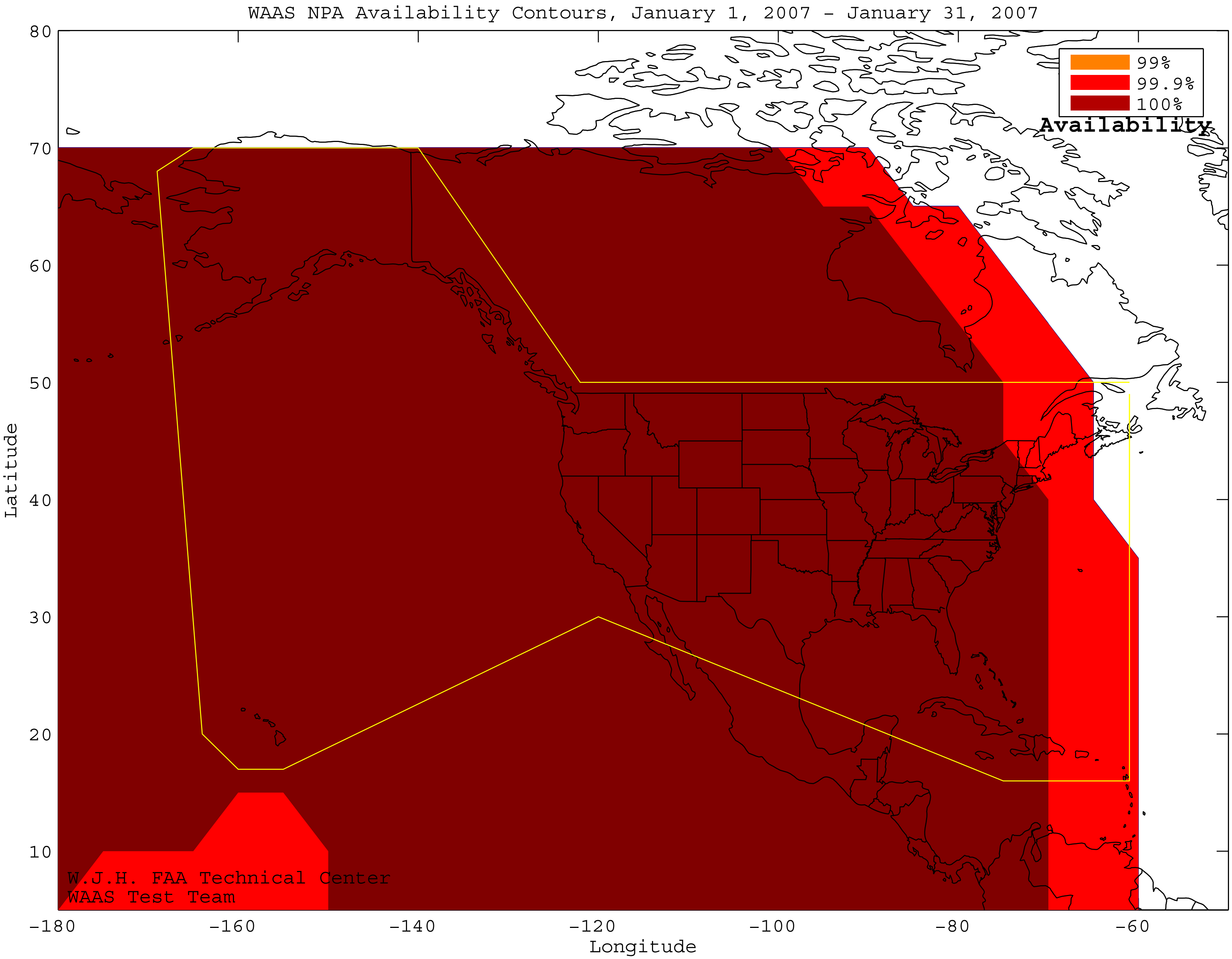
Figure 4-9 WAAS LPV 200 CONUS Coverage - Quarter



CONUS Coverage at 95% Availability = 75.3%
CONUS Coverage at 99% Availability = 48.18%
CONUS Coverage at 100% Availability = 0%

SL = LPV 200

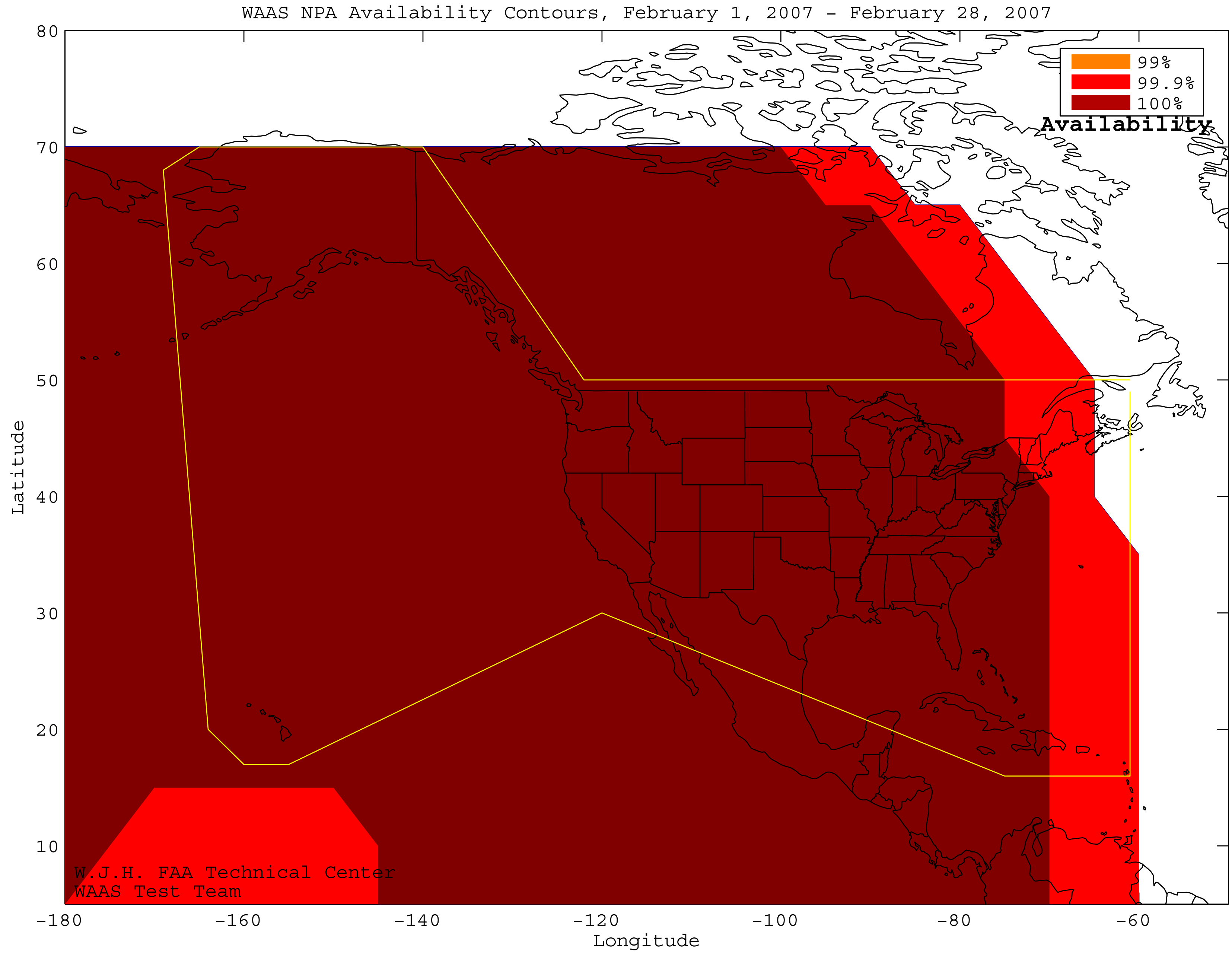
Figure 4-10 WAAS NPA Coverage - January



WAAS Coverage at 99% Availability = 100%
WAAS Coverage at 99.9% Availability = 100%
WAAS Coverage at 100% Availability = 94.85%

SL = NPA

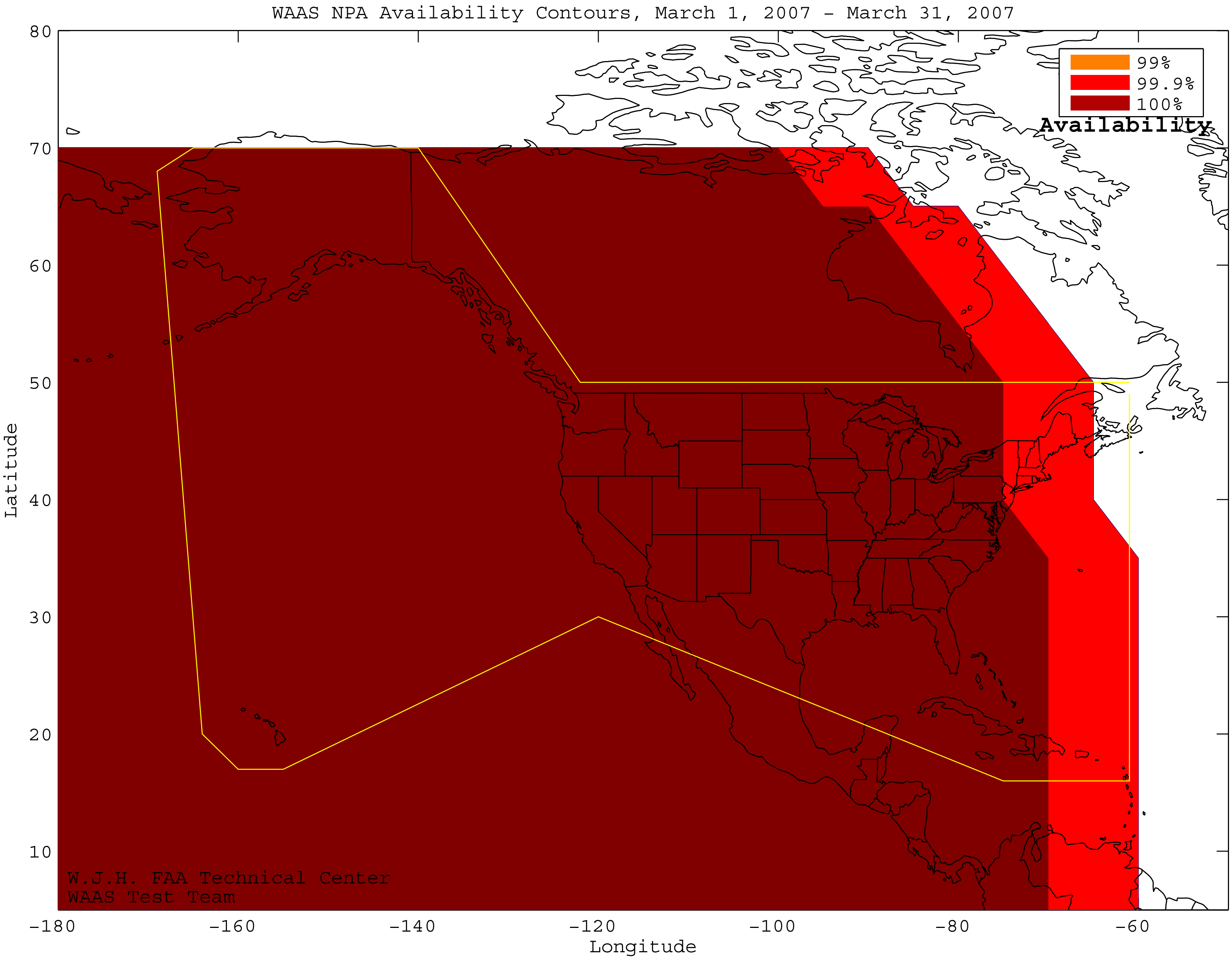
Figure 4-11 WAAS NPA Coverage - February



WAAS Coverage at 99% Availability = 100%
WAAS Coverage at 99.9% Availability = 100%
WAAS Coverage at 100% Availability = 94.85%

SL = NPA

Figure 4-12 WAAS NPA Coverage - March



WAAS Coverage at 99% Availability = 100%
WAAS Coverage at 99.9% Availability = 100%
WAAS Coverage at 100% Availability = 94.12%

SL = NPA

Figure 4-13 WAAS NPA Coverage for the Quarter

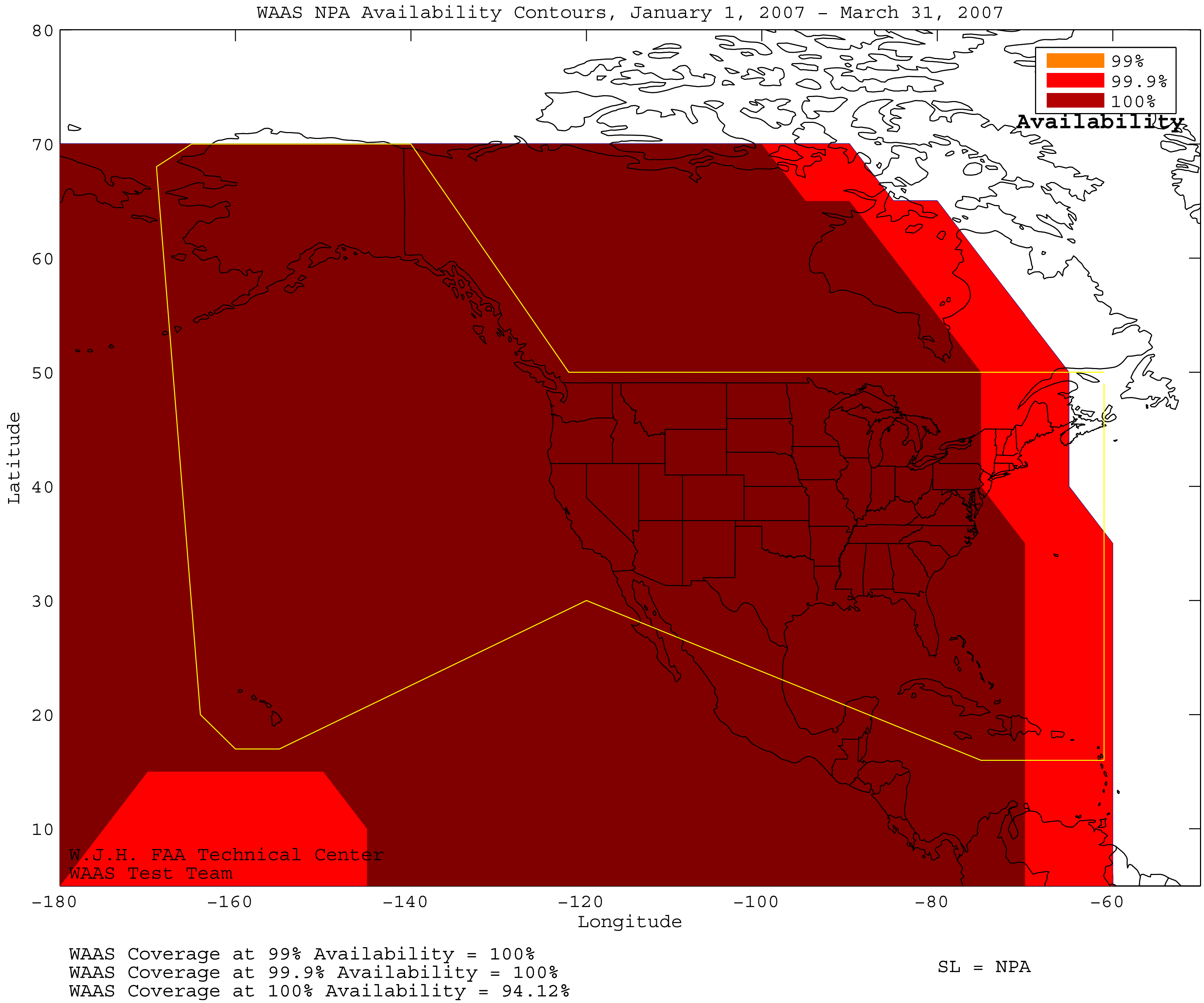


Figure 4-14 Daily LNAV/VNAV and LPV Coverage

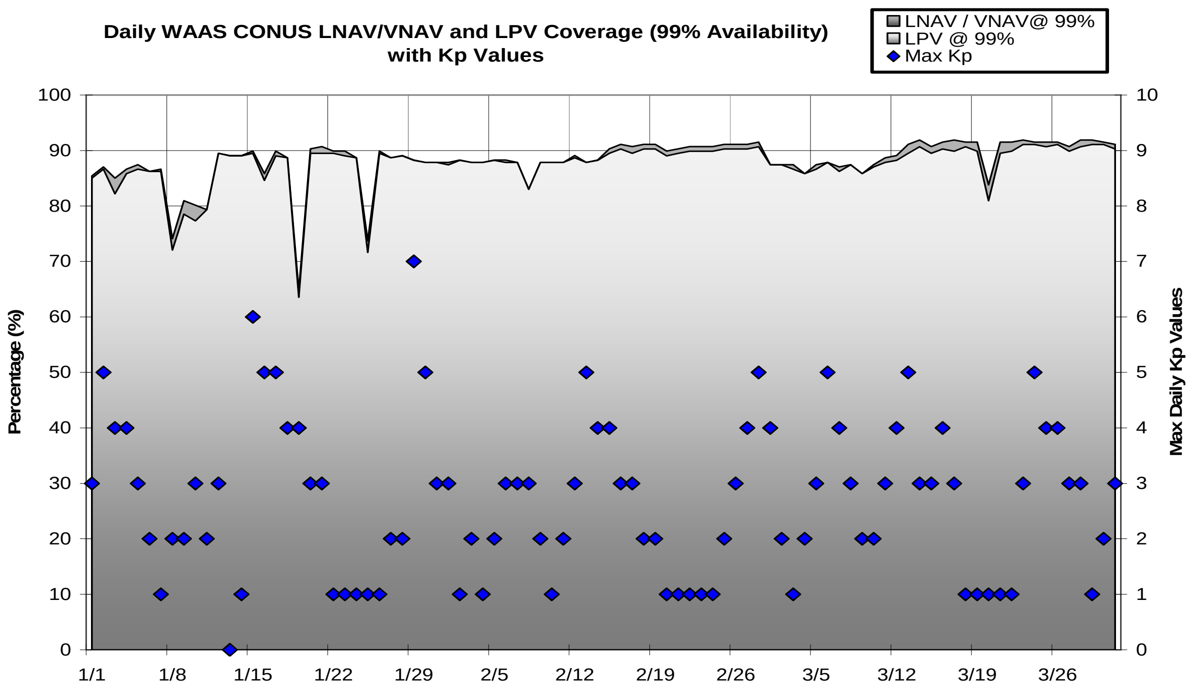


Figure 4-15 Daily NPA Coverage

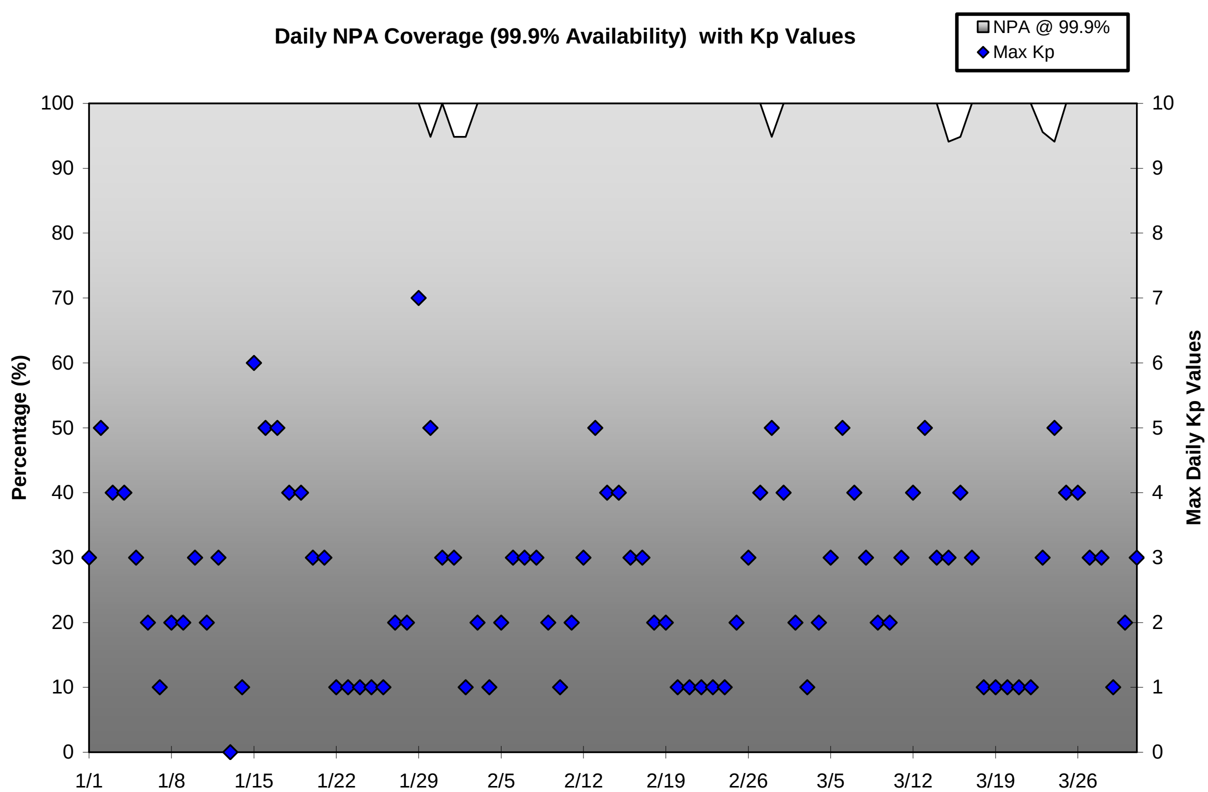
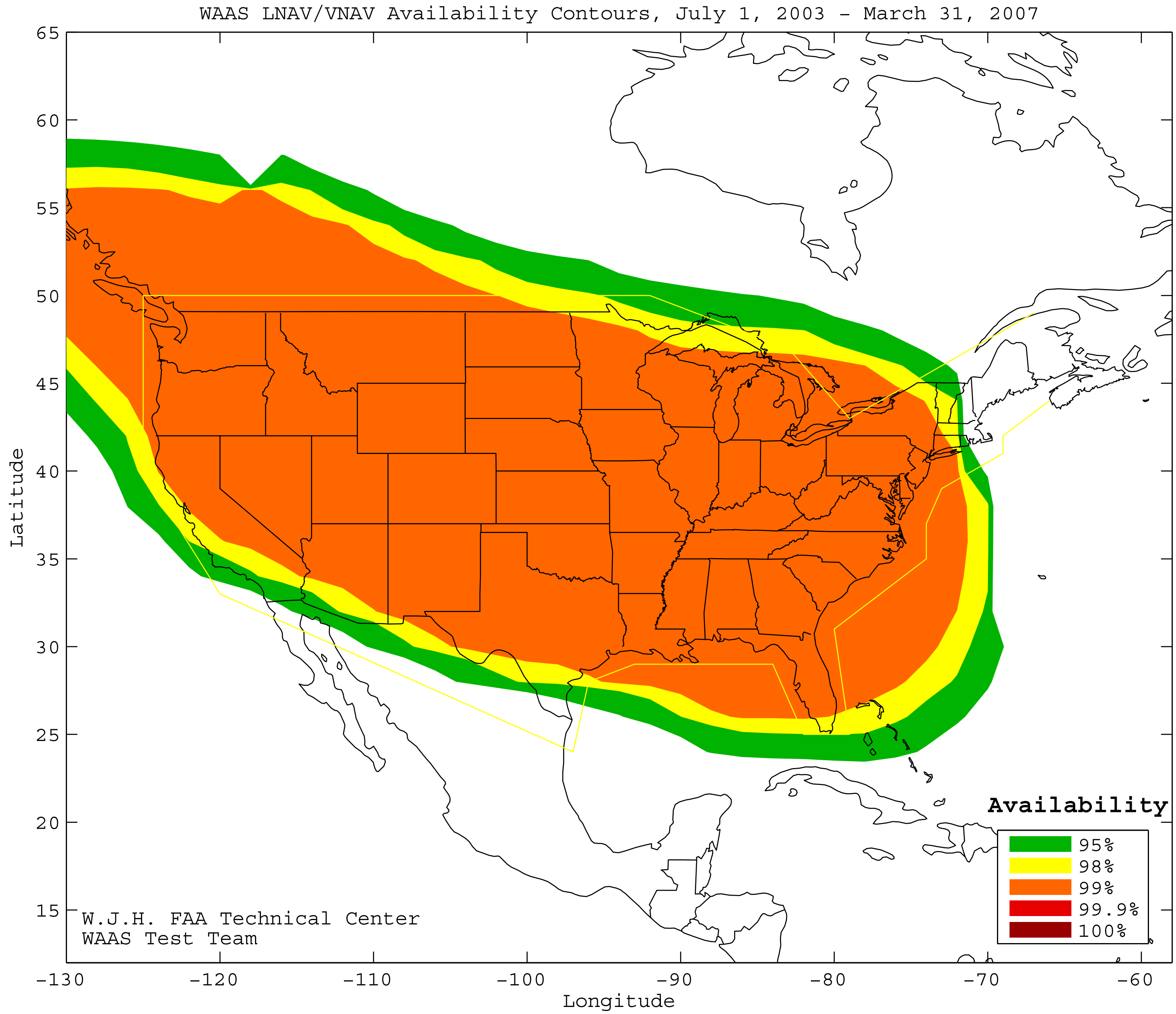


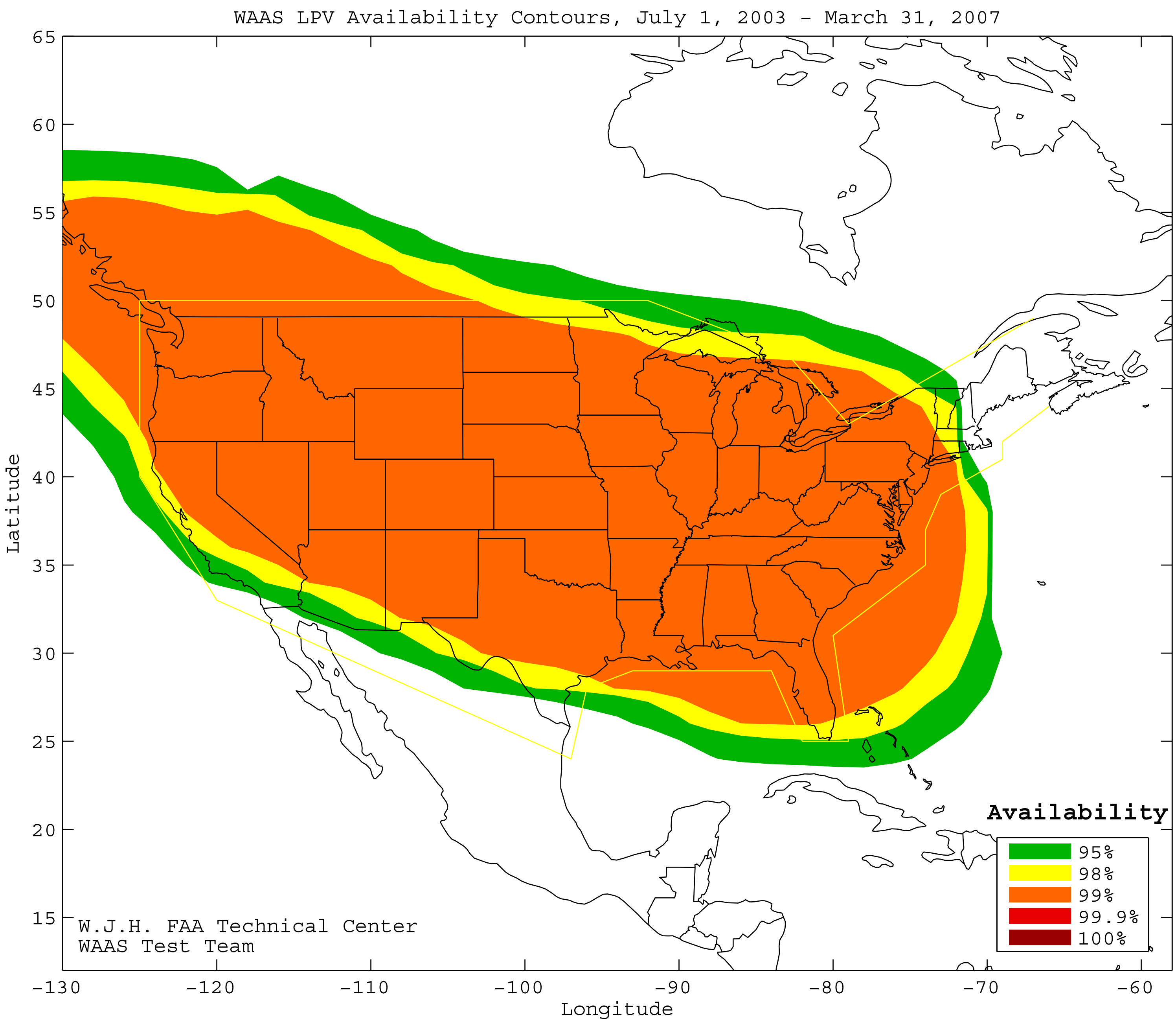
Figure 4-16 WAAS LNAV/VNAV Coverage Since Commissioning



CONUS Coverage at 95% Availability = 94.74%
CONUS Coverage at 99% Availability = 85.43%
CONUS Coverage at 100% Availability = 0%

SL = LNAV/VNAV

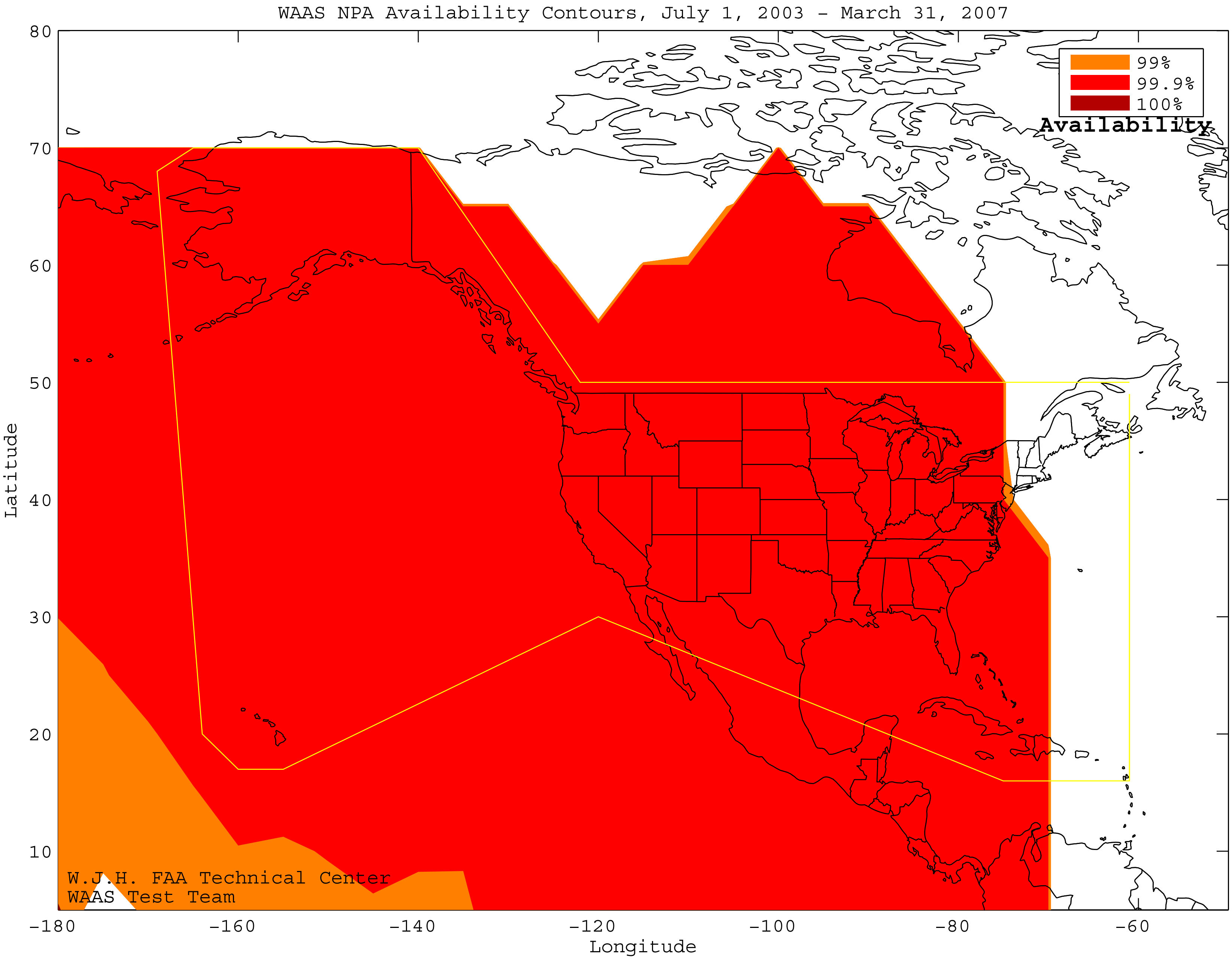
Figure 4-17 WAAS LPV Coverage Since Commissioning



CONUS Coverage at 95% Availability = 93.93%
CONUS Coverage at 99% Availability = 84.62%
CONUS Coverage at 100% Availability = 0%

SL = LPV

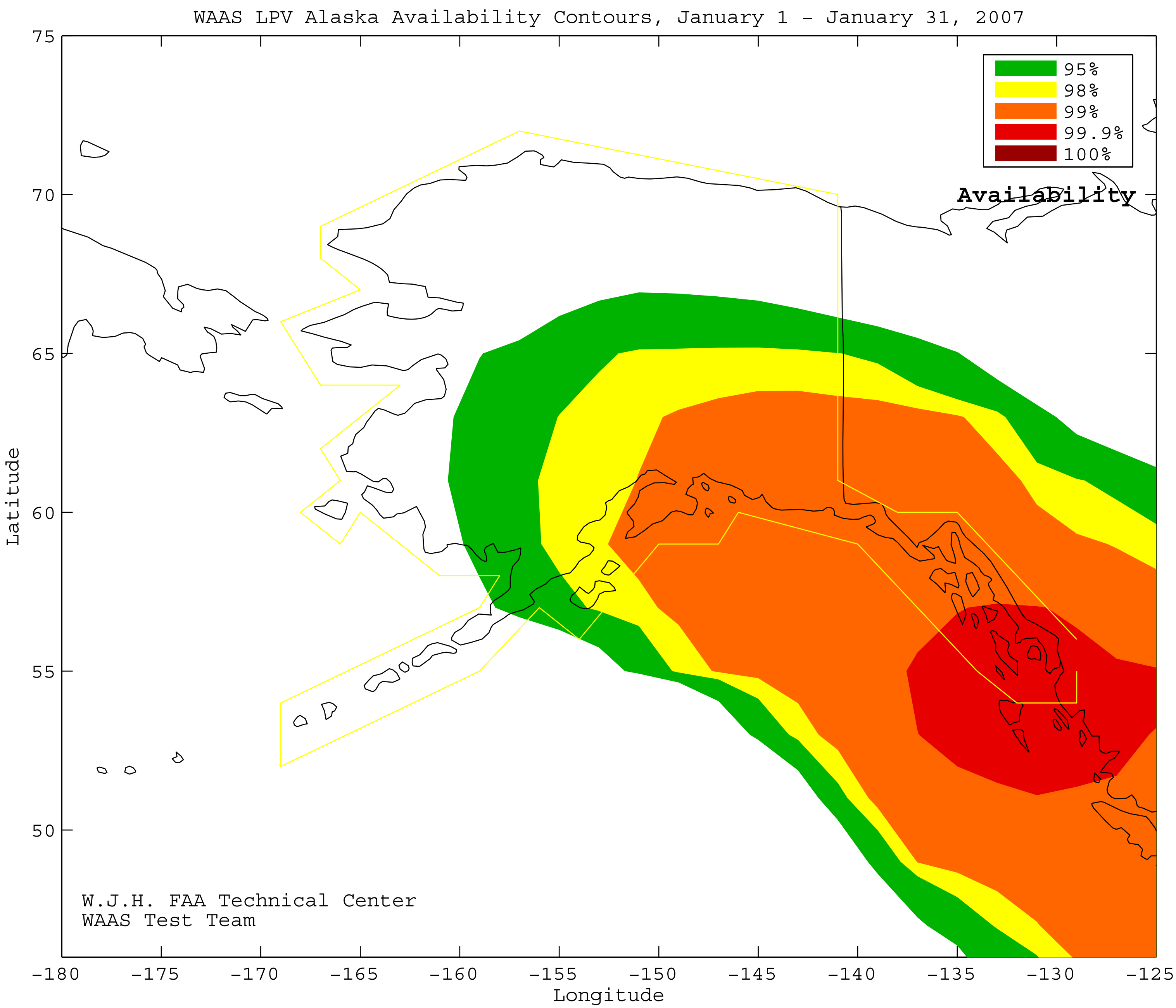
Figure 4-18 NPA Coverage Since Commissioning



WAAS Coverage at 99% Availability = 94.12%
WAAS Coverage at 99.9% Availability = 94.12%
WAAS Coverage at 100% Availability = 0%

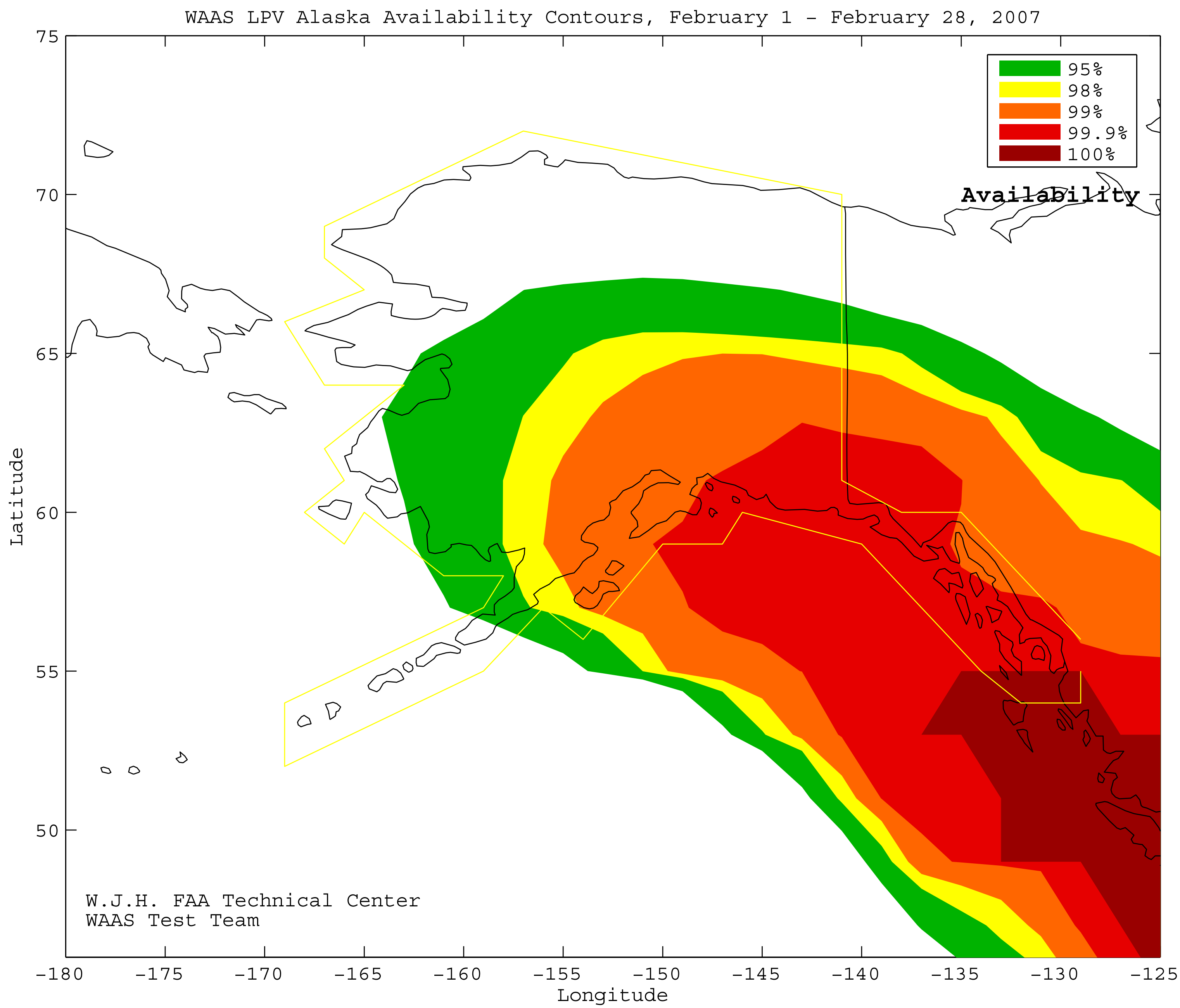
SL = NPA

Figure 4-19 LPV Alaska Coverage - January



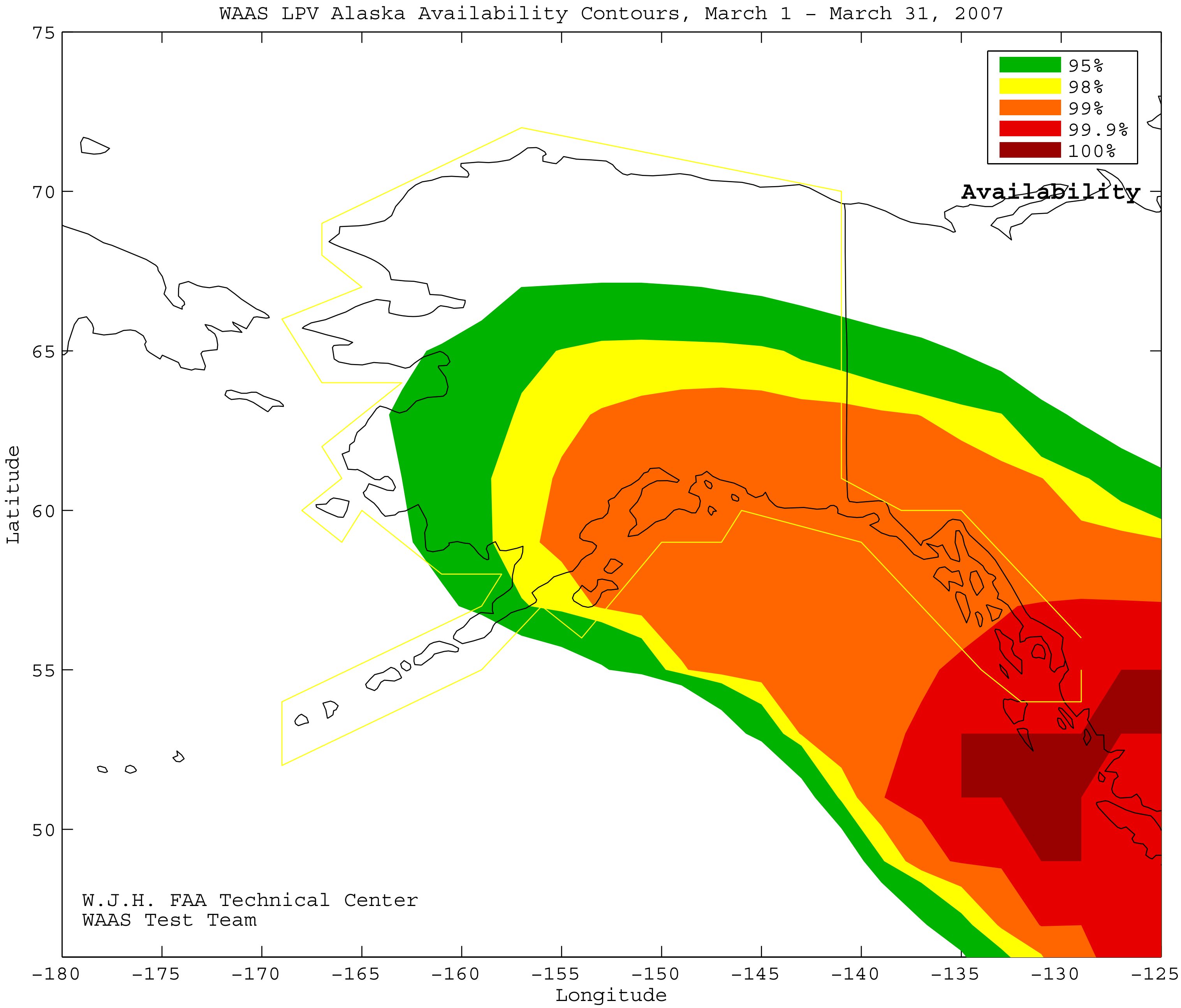
Alaska Coverage at 95% Availability = 48.91%
Alaska Coverage at 99% Availability = 22.83%
Alaska Coverage at 100% Availability = 0%

Figure 4-20 LPV Alaska Coverage - February



Alaska Coverage at 95% Availability = 63.04%
Alaska Coverage at 99% Availability = 30.43%
Alaska Coverage at 100% Availability = 2.174%

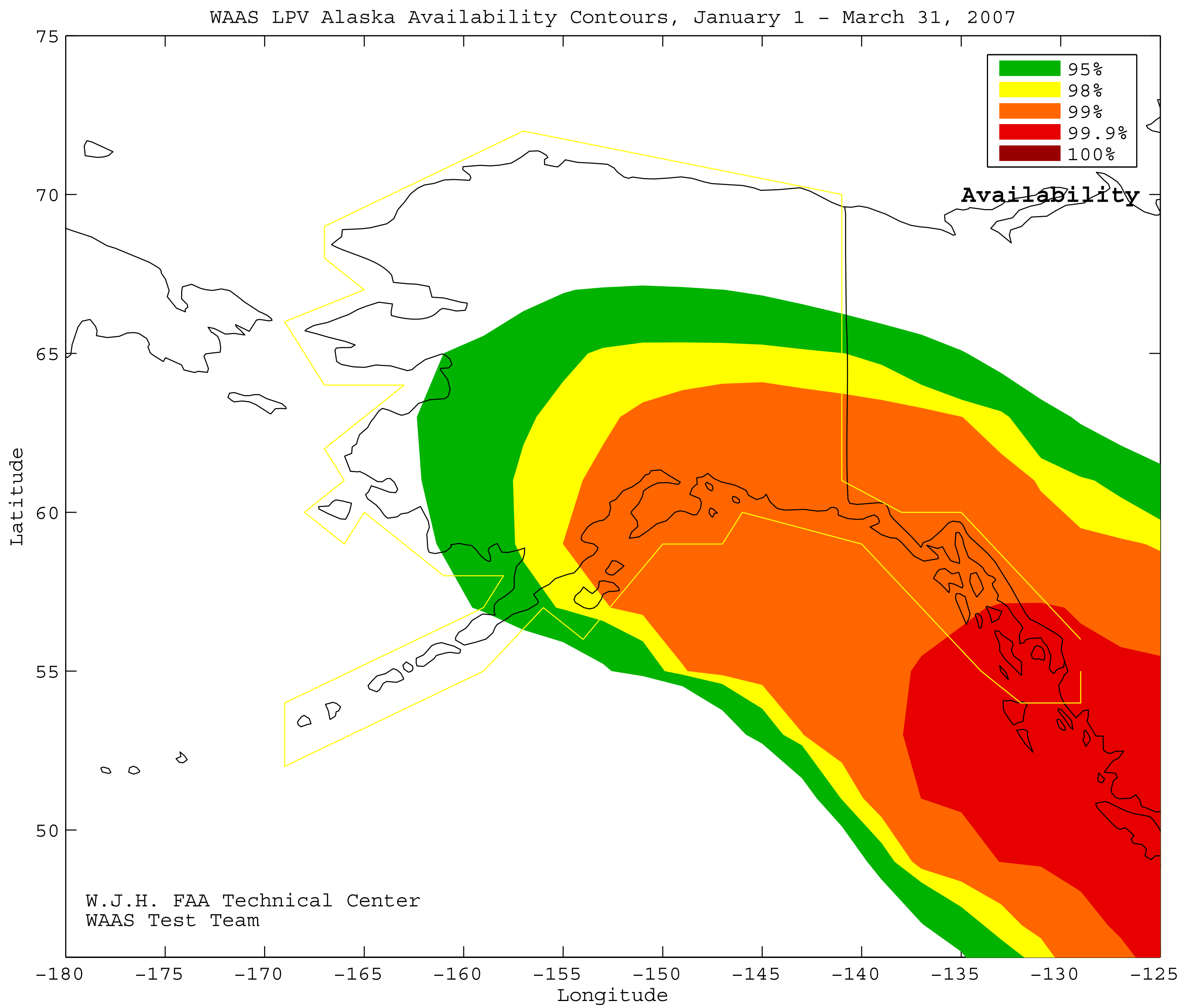
Figure 4-21 LPV Alaska Coverage - March



Alaska Coverage at 95% Availability = 60.87%
Alaska Coverage at 99% Availability = 30.43%
Alaska Coverage at 100% Availability = 0%

SL = LPV

Figure 4-22 LPV Alaska Coverage - Quarter



Alaska Coverage at 95% Availability = 58.7%
Alaska Coverage at 99% Availability = 27.17%
Alaska Coverage at 100% Availability = 0%

Figure 4-23 Daily LPV Alaska Coverage)

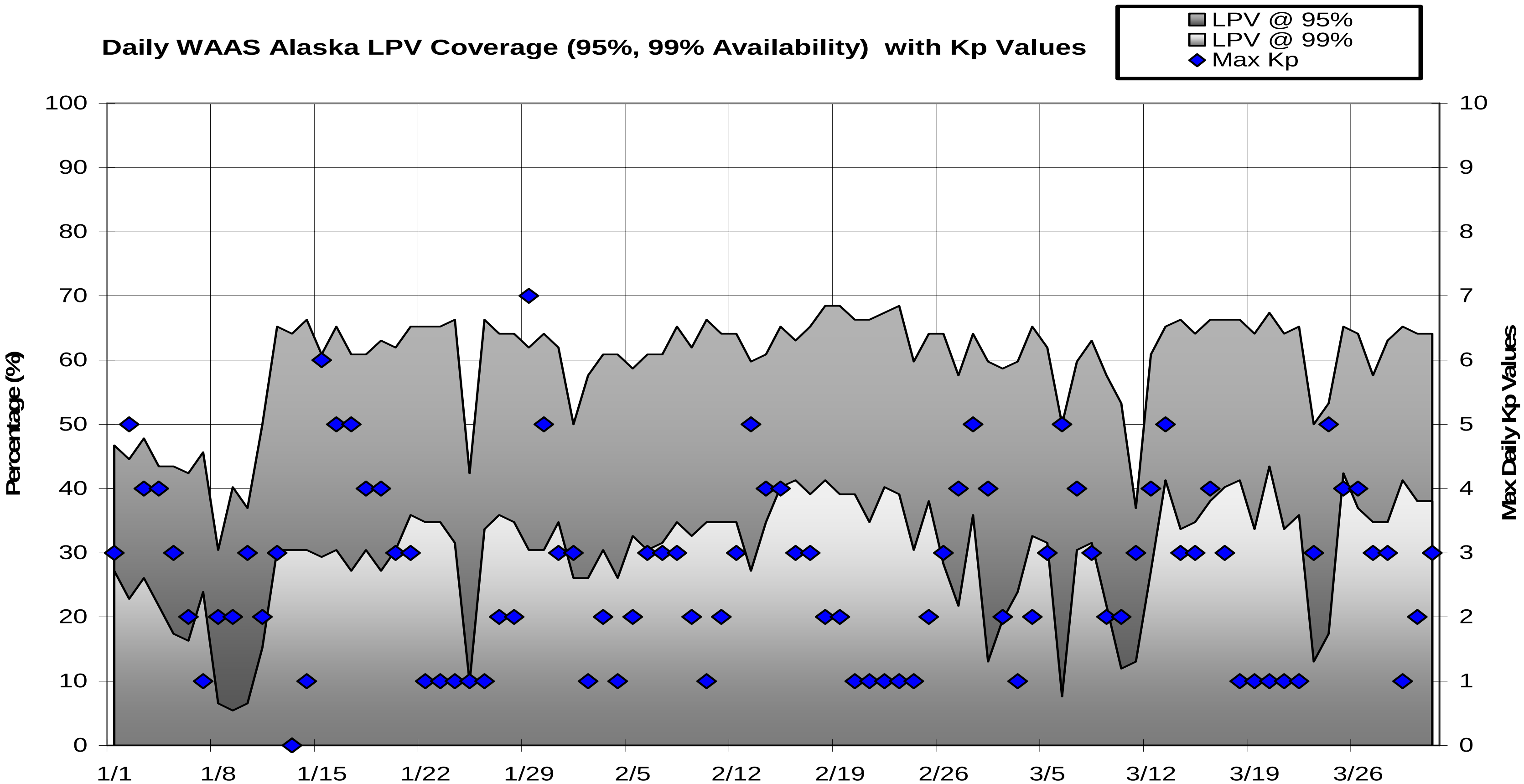
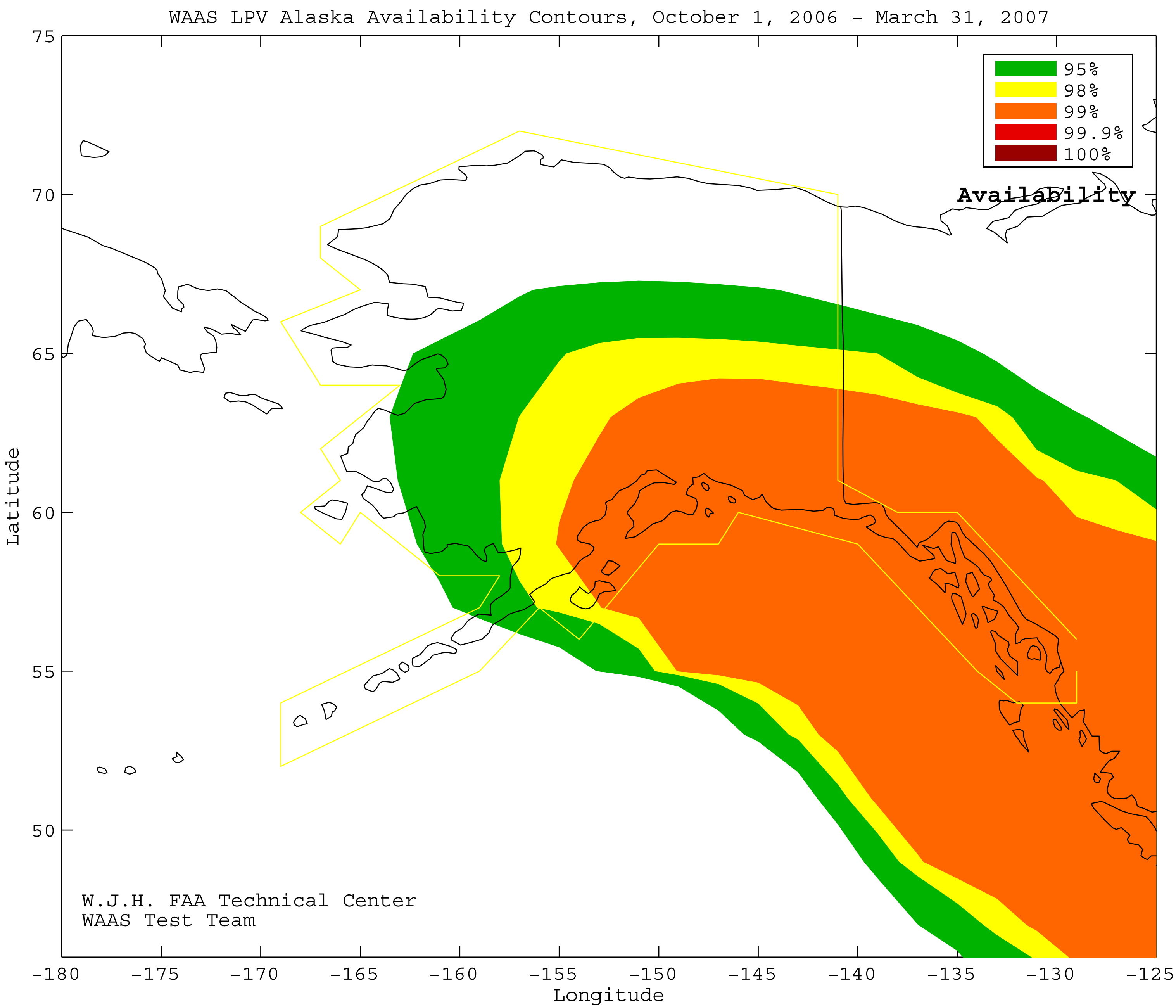


Figure 4-24 LPV Alaska Coverage - Since Added to WAAS (Oct 2006)



Alaska Coverage at 95% Availability = 63.04%
Alaska Coverage at 99% Availability = 27.17%
Alaska Coverage at 100% Availability = 0%

5.0 INTEGRITY

5.1 HMI Analysis

Analysis of integrity includes the identification and evaluation of HMI (hazardously misleading information), as well as the generation of a safety index to illustrate the margin of safety that WAAS protection levels are providing. The safety margin index (shown in Table 5.1) is a metric that shows how well the protection levels are bounding the maximum observed error. The process for determining this index involves normalizing the largest error observed at a site. This is accomplished by dividing this maximum observed error by the WAAS estimated standard deviation of the error. The safety margin requirement, 5.33 standard units for vertical and 6 standard units for horizontal, is then divided by this maximum normalized error.

Table 5-1 Safety Margin Index and HMI Statistics

Location	Safety Index		Number of HMIs
	Horizontal	Vertical	
Atlantic City	8.57	6.66	0
Greenwood	8.57	4.85	0
San_Angelo	10.00	8.88	0
Albuquerque	12.00	10.66	0
Anchorage	10.00	8.88	0
Atlanta	5.00	3.81	0
Barrow	2.31	2.13	0
Bethel	15.00	8.88	0
Billings	10.00	8.88	0
Boston	6.00	7.61	0
Chicago	8.57	8.88	0
Cleveland	10.00	8.88	0
Cold Bay	8.57	7.61	0
Dallas	6.00	4.85	0
Denver	12.00	8.88	0
Fairbanks	6.00	1.48	0
Houston	8.57	7.61	0
Jacksonville	7.50	5.92	0
Juneau	7.50	3.81	0
Kansas City	7.50	7.61	0
Kotzebue	3.75	8.88	0
Los Angeles	15.00	8.88	0
Memphis	8.57	8.88	0
Miami	7.50	5.92	0
Minneapolis	10.00	7.61	0
New York	10.00	8.88	0
Oakland	8.57	10.66	0
Salt Lake City	10.00	7.61	0
Seattle	6.67	3.81	0
Washington DC	10.00	8.88	0

An observed safety margin index of greater than one indicates safe bounding of the greatest observed error, less than one indicates that the maximum error was not bounded, and a result equal to one means that the error was equal to the protection level. As evidenced by the statistics in the above table, the lowest safety margin index is 1.48 at Fairbanks. Table 5.1 also shows the number of HMIs that occurred during the quarter, of which there were none. An HMI occurs if the position error exceeds the protection level in the vertical or horizontal dimensions at any time and 6.2 seconds or more passes before this event is corrected by WAAS. Since WAAS was made available to the public in August 2000 there has not been an HMI event. Note that the FAA commissioned WAAS for safety of life services in July 2003.

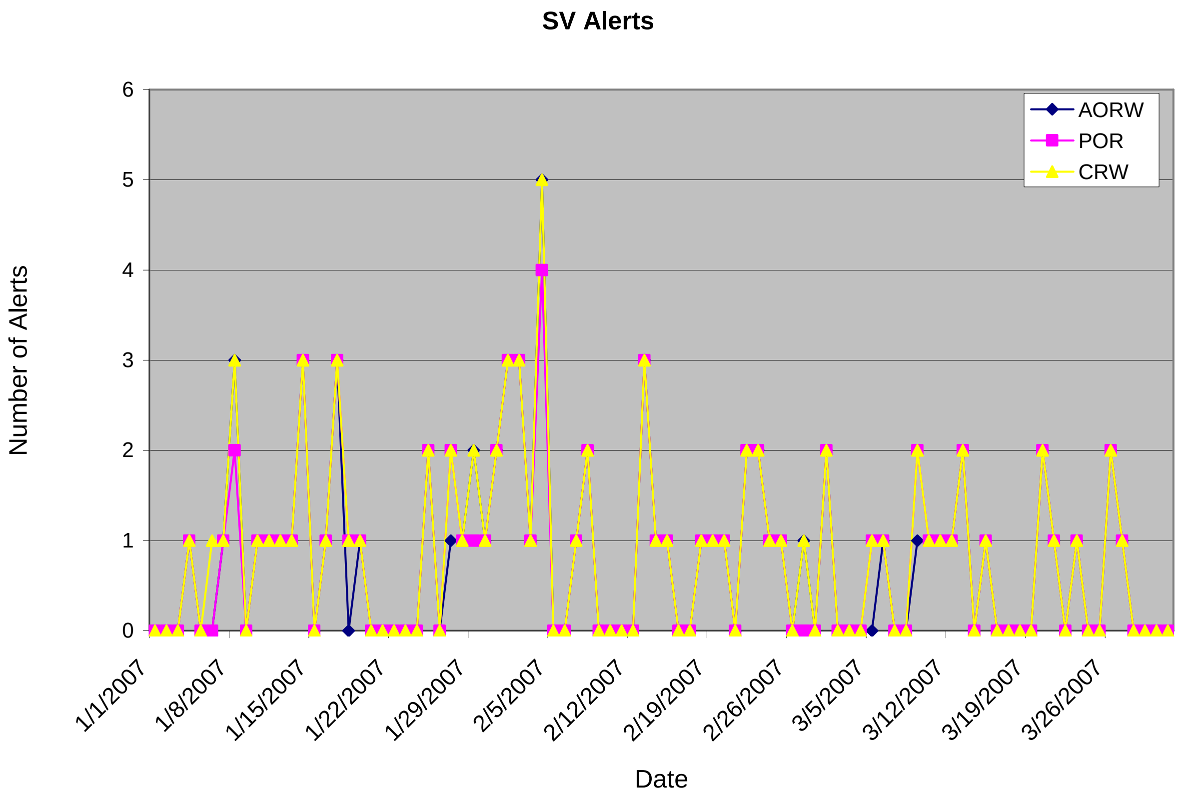
5.2 Broadcast Alerts

The WAAS transmits alert messages to protect the users from satellite degradation or severe ionospheric activity, both of which can cause unsafe conditions for a user. Space Vehicle (SV) alerts increase the User Differential Range Error (UDRE) of satellites, which can reduce the weighting of the satellite in the navigation solution, or completely exclude it from the navigation solution. An increase in UDRE's after an alert effectively increases the user protection levels (HPL and VPL), which affect the availability. Additionally, if an alert message sequence lasts for more than 12 seconds, WAAS fast corrections can time out, causing a loss of continuity. Table 5.2 shows the total number of alerts and the average number of alerts per day. Figure 5.1 shows the number of SV alerts that occurred daily during the reporting period. Often the number of alerts on one GEO is the same as the number of alerts on the other GEO. Therefore, lines tend to overlap in most points on this plot.

Table 5-2 WAAS SV Alert

	Number of Alerts			Average Alerts Per Day		
Message Type	**AORW**	**POR**	**CRW**	**AORW**	**POR**	**CRW**
2	28	28	29	0.3111	0.3111	0.3222
3	20	20	20	0.2222	0.2222	0.2222
4	25	25	29	0.2777	0.2777	.03222
5	0	0	0	0	0	0
6	0	0	0	0	0	0
24	0	0	0	0	0	0
26	0	0	0	0	0	0
Total Alerts	73	73	78	0.8111	0.8000	0.8666

Figure 5-1 SV Daily Alert Trends



5.3 Availability of WAAS Messages (AOR-W, POR and CRW)

For an accurate and current user position to be calculated, the content of the WAAS message must be broadcast and received within precise time specifications. This aspect of the WAAS is critical to maintaining integrity requirements. Each message type in the WAAS SIS has a specific amount of time for which it must be received anew. Although the content of every message is relevant to the functionality of the system, the importance of different messages varies along with the frequency with which they must be received. Table 5.3 lists the maximum intervals at which each message must broadcast to meet system requirements.

GUS switchovers or broadcast WAAS alerts can interrupt the normal broadcast message stream. If these events occur at a time when the maximum interval of a specific message is approaching, that message may be delayed, resulting in its late transmittal.

All late messages statistics reported during the quarter were caused by GEO SIS outages, GUS switchovers and SV alerts except message type 7 and 10. Occasionally, message type 7 and 10 were late and they were not caused by GEO SIS outages, GUS switchovers or SV alerts. The lateness of type 7 and type 10 messages has little or no impact on user performance and safety.

Tables 5.4 to 5.8 show fast correction, long correction, ephemeris covariance, ionosphere correction, and ionospheric mask message rates statistics broadcasted on AORW. Table 5.9 to 5.13 show message rates statistics broadcasted on POR. Table 5.14 to 5.18 show messages rates statistics broadcasted on CRW.

Table 5-3 Update Rates for WAAS Messages

Data	**Associated Message Types**	**Maximum Update Interval** (seconds)	**En Route, Terminal, NPA Timeout** (seconds)	**Precision Approach Timeout** (seconds)
WAAS in Test Mode	0	6	N/A	N/A
PRN Mask	1	60	None	None
UDREI	2-6, 24	6	18	12
Fast Corrections	2-5, 24	See Table A-8 in RTCA DO-229C	See Table A-8 in RTCA DO-229C	See Table A-8 in RTCA DO-229C
Long Term Corrections	24, 25	120	360	240
GEO Nav. Data	9	120	360	240
Fast Correction Degradation	7	120	360	240
Weighting Factors	8	120	240	240
Degradation Parameters	10	120	360	240
Ionospheric Grid Mask	18	300	None	None
Ionospheric Corrections	26	300	600	600
UTC Timing Data	12	300	None	None
Almanac Data	17	300	None	None

Table 5-4 WAAS Fast Correction and Degradation Message Rates - AORW

Message Type	**On Time**	**Late**	**Max Late Length (seconds)**
1	96291	2	130
2	1295997	48	34
3	1295969	52	31
4	1296010	42	29
7	88910	5	192
9	91109	5	355
10	88881	9	191
17	30222	3	326

Table 5-5 WAAS Long Correction Message Rates (Type 24 and 25) - AORW

SV	On Time	Late	Max Late Length (seconds)
1	46192	0	0
2	46563	0	0
3	43299	0	0
4	47304	0	0
5	45783	1	124
6	46688	1	157
7	47272	0	0
8	46174	0	0
9	47289	0	0
10	47196	0	0
11	48309	0	0
12	24024	0	0
13	46851	0	0
14	46972	0	0
16	47492	0	0
17	46901	0	0
18	45200	0	0
19	47690	0	0
20	48034	1	157
21	43349	0	0
22	44947	0	0
23	46375	0	0
24	45406	0	0
25	47376	0	0
26	46051	0	0
27	44377	0	0
28	45139	0	0
29	41144	0	0
30	48248	2	179
31	47956	0	0

Table 5-6 WAAS Ephemeris Covariance Message Rates (Type 28) - AORW

SV	On Time	Late	Max Late Length (seconds)
1	43285	0	0
2	43596	1	159
3	40787	1	184
4	44175	1	184
5	42959	0	0
6	43629	0	0
7	44207	0	0
8	43302	0	0
9	44454	0	0
10	44098	0	0
11	45512	1	184
12	22359	0	0
13	43771	1	123
14	44036	0	0
16	44256	0	0
17	43410	0	0
18	42359	0	0
19	43752	0	0
20	43588	1	189
21	39641	0	0
22	40657	0	0
23	41808	0	0
24	40986	1	128
25	42756	1	191
26	41561	0	0
27	39882	0	0
28	40876	0	0
29	37267	0	0
30	43709	0	0
31	43332	0	0
122	81974	1	140
134	80851	1	139

Table 5-7 WAAS Ionospheric Correction Message Rates (Type 26) - AORW

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	27023	8	406
1	0	27013	10	352
1	1	27014	9	352
1	2	27036	2	316
1	3	27011	8	310
1	4	27013	9	576
2	0	27045	5	313
2	1	26997	9	316
2	2	27000	10	346
2	3	27001	11	576
2	4	27006	10	579
2	5	26998	7	383
3	0	27014	8	392

Table 5-8 WAAS Ionospheric Mask Message Rates (Type 18) - AORW

Band	On Time	Late	Max Late Length (seconds)
0	71540	0	0
1	71514	0	0
2	71547	0	0
3	71509	0	0

Table 5-9 WAAS Fast Correction and Degradation Message Rates - POR

Message Type	On Time	Late	Max Late Length (seconds)
1	93617	2	127
2	1296000	43	33
3	1295968	53	26
4	1296006	43	29
7	86595	3	144
9	91115	3	351
10	86572	6	144
17	29969	1	338

Table 5-10 WAAS Long Correction Message Rates (Type 24 and 25) - POR

SV	On Time	Late	Max Late Length (seconds)
1	46189	0	0
2	46581	0	0
3	43288	0	0
4	47294	1	169
5	45785	1	165
6	46693	0	0
7	47273	0	0
8	46183	1	151
9	47276	2	174
10	47195	1	180
11	48305	0	0
12	24023	0	0
13	46853	0	0
14	46968	0	0
16	47484	0	0
17	46916	0	0
18	45174	0	0
19	47707	0	0
20	48029	1	165
21	43350	0	0
22	44956	0	0
23	46376	0	0
24	45413	1	174
25	47379	0	0
26	46053	0	0
27	44381	0	0
28	45144	1	171
29	41143	1	167
30	48244	1	166
31	47941	0	0

Table 5-11 WAAS Ephemeris Covariance Message Rates (Type 28) – POR

SV	On Time	Late	Max Late Length (seconds)
1	43284	1	186
2	43596	1	159
3	40794	0	0
4	44179	0	0
5	42962	1	181
6	43628	1	192
7	44199	0	0
8	43299	1	194
9	44441	1	178
10	44097	1	192
11	45515	0	0
12	22361	0	0
13	43771	2	192
14	44037	0	0
16	44258	0	0
17	43412	0	0
18	42371	0	0
19	43757	0	0
20	43590	0	0
21	39641	0	0
22	40658	1	192
23	41804	1	121
24	40994	1	190
25	42770	0	0
26	41565	0	0
27	39879	1	192
28	40881	1	194
29	37272	1	192
30	43709	1	140
31	43327	0	0
122	81972	1	140
134	80856	0	0

Table 5-12 WAAS Ionospheric Correction Message Rates (Type 26) – POR

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	27005	3	306
0	1	27045	7	576
0	2	27033	2	306
1	0	27019	4	576
1	1	27036	3	344
1	2	27032	4	311
1	3	27010	6	306
1	4	27022	6	306
2	0	27010	2	304
2	1	27006	6	432
2	2	27006	5	387
2	3	27025	6	376

Table 5-13 WAAS Ionospheric Mask Message Rates (Type 18) - POR

Band	On Time	Late	Max Late Length (seconds)
0	70044	0	0
1	70044	0	0
2	70015	0	0

Table 5-14 WAAS Fast Correction and Degradation Message Rates – CRW

Message Type	On Time	Late	Max Late Length (seconds)
1	98609	7	157
2	1295873	55	30
3	1295850	62	26
4	1295890	55	26
7	90894	8	140
9	91117	0	0
10	90958	10	176
17	30407	4	404

Table 5-15 WAAS Long Correction Message Rates (Type 24 and 25) – CRW

SV	On Time	Late	Max Late Length (seconds)
1	46179	1	167
2	46574	0	0
3	43297	0	0
4	47292	0	0
5	45787	0	0
6	46688	0	0
7	47264	1	182
8	46167	1	182
9	47279	0	0
10	47186	0	0
11	48307	0	0
12	24025	0	0
13	46835	1	164
14	46975	0	0
16	47479	1	167
17	46916	0	0
18	45186	0	0
19	47689	0	0
20	48028	0	0
21	43346	0	0
22	44957	0	0
23	46362	0	0
24	45407	0	0
25	47361	0	0
26	46052	0	0
27	44365	0	0
28	45140	0	0

29	41150	1	164
30	48275	1	172
31	47942	1	182

Table 5-16 WAAS Ephemeris Covariance Message Rates (Type 28) – CRW

SV	On Time	Late	Max Late Length (seconds)
1	43273	0	0
2	43588	2	183
3	40775	0	0
4	44166	0	0
5	42954	3	182
6	43620	0	0
7	44194	2	189
8	43293	0	0
9	44450	0	0
10	44085	1	192
11	45511	0	0
12	22359	1	176
13	43768	0	0
14	44047	0	0
16	44249	0	0
17	43405	2	187
18	42367	0	0
19	43742	0	0
20	43582	0	0
21	39648	0	0
22	40649	1	192
23	41798	2	193
24	40989	0	0
25	42755	0	0
26	41572	0	0
27	39880	0	0
28	40883	0	0
29	37275	1	133
30	43702	2	189
31	43321	1	192
122	81967	1	158
134	80839	2	193

Table 5-17 WAAS Ionospheric Correction Message Rates (Type 26) – CRW

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	27010	6	504
0	1	26991	16	488
0	2	27007	9	311
1	0	27004	12	331
1	1	26996	11	550
1	2	26992	14	576

1	3	27006	10	319
1	4	26996	12	576
2	0	27005	11	576
2	1	27005	11	533
2	2	27000	12	409
2	3	26985	12	410
2	4	27013	16	392
2	5	26998	10	380
3	0	26987	17	398

Table 5-18 WAAS Ionospheric Mask Message Rates (Type 18) - CRW

Band	On Time	Late	Max Late Length (seconds)
0	72945	0	0
1	72923	0	0
2	72930	0	0
3	72963	0	0

6.0 SV RANGE ACCURACY

Range accuracy evaluation computes the probability that the WAAS User Differential Range Error (UDRE) and Grid Ionospheric Vertical Error (GIVE) statistically bound 99.9% of the range residuals for each satellite tracked by the receiver. A UDRE is broadcast by the WAAS for each satellite that is monitored by the system and the 99.9% bound (3.29 sigma) of the residual error on a pseudorange after application of fast and long-term corrections is checked. The pseudorange residual error is determined by taking the difference between the raw pseudorange and a calculated reference range. The reference range is equal to the true range between the corrected satellite position and surveyed user antenna plus all corrections (WAAS Fast Clock, WAAS Long-Term Clock, WAAS Ionospheric delay, Tropospheric delay, Receiver Clock Bias, and Multipath). Since the true ionospheric delay and multipath error are not precisely known, the estimated variance in these error sources are added to the UDRE before the comparing it to the residual error.

GPS satellite range residual errors were calculated for twelve WAAS receivers during the quarter. Table 6.1 and 6.2 show the range error 95% index and 99.9% (3.29 sigma) bounding statistics for each SV at the selected locations. Figures 6.1 and 6.2 show the range error for each SV as measured by the WAAS receivers at the Washington DC reference station.

A GIVE is broadcast by the WAAS for each IGP that is monitored by the system and the 99.9% (3.29 sigma) bound of the ionospheric error is checked. The WAAS broadcasts the ionospheric model using IGP's at predefined geographic locations. Each IGP contains the vertical ionospheric delay and the error in that delay in the form of the GIVE. The ionospheric error is determined by taking the difference between the WAAS vertical ionospheric delay interpolated from the IGP's and GPS dual frequency measurement at that GPS satellite.

GPS satellite ionospheric errors were calculated for twelve WAAS receivers during the quarter. Table 6.3 and 6.4 show the ionospheric error 95% index and 99.9% (3.29 sigma) bounding statistics for each SV at the selected locations. Figures 6.3 and 6.4 show the ionospheric error for each SV as measured by the WAAS receiver at the Washington DC reference station.

Table 6-1 Range Error 95% index and 3.29 Sigma Bounding

Site →	Billings		Albuquerque		Boston		Washington DC		Houston		Kansas City	
SV ↓	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding
1	1.326	100.00	1.261	100.00	1.040	100.00	0.694	100.00	1.075	100.00	1.146	100.00
2	1.090	100.00	2.013	100.00	1.670	100.00	1.847	100.00	2.169	100.00	1.993	100.00
3	1.566	100.00	1.189	100.00	1.390	100.00	1.066	100.00	1.347	100.00	1.381	100.00
4	1.841	100.00	1.657	100.00	1.479	100.00	1.342	100.00	1.440	100.00	1.842	100.00
5	1.438	100.00	1.506	100.00	1.058	100.00	1.004	100.00	1.291	100.00	1.314	100.00
6	1.952	100.00	1.570	100.00	1.646	100.00	1.245	100.00	1.064	100.00	2.009	100.00
7	1.552	100.00	0.962	100.00	1.187	100.00	0.963	100.00	1.160	100.00	1.702	100.00
8	1.082	100.00	1.121	100.00	1.107	100.00	1.141	100.00	1.209	100.00	1.198	100.00
9	1.522	100.00	1.478	100.00	1.287	100.00	1.053	100.00	1.072	100.00	1.445	100.00
10	0.882	100.00	2.605	100.00	1.054	100.00	1.610	100.00	1.260	100.00	1.282	100.00
11	1.146	100.00	1.467	100.00	1.085	100.00	1.230	100.00	2.011	100.00	1.631	100.00
12	1.691	100.00	1.682	100.00	1.143	100.00	0.845	100.00	0.995	100.00	1.741	100.00
13	1.459	100.00	1.285	100.00	1.136	100.00	0.988	100.00	1.242	100.00	1.476	100.00
14	1.165	100.00	1.299	100.00	1.318	100.00	1.613	100.00	1.447	100.00	1.440	100.00
15	-	-	-	-	-	-	-	-	-	-	-	-
16	0.815	100.00	1.587	100.00	1.101	100.00	1.165	100.00	1.618	100.00	1.414	100.00
17	1.716	100.00	1.147	100.00	0.951	100.00	0.775	100.00	1.262	100.00	1.243	100.00
18	1.053	100.00	1.446	100.00	1.392	100.00	2.016	100.00	1.839	100.00	1.968	100.00
19	1.809	100.00	2.842	100.00	2.129	100.00	2.651	100.00	2.228	100.00	2.428	100.00
20	1.027	100.00	1.790	100.00	1.248	100.00	1.073	100.00	1.823	100.00	1.374	100.00
21	0.917	100.00	1.731	100.00	1.258	100.00	1.818	100.00	1.693	100.00	1.705	100.00
22	0.755	100.00	1.557	100.00	1.544	100.00	1.515	100.00	1.552	100.00	1.540	100.00
23	1.606	100.00	2.468	100.00	2.296	100.00	2.883	100.00	2.887	100.00	3.026	100.00
24	1.839	100.00	1.563	100.00	1.468	100.00	1.385	100.00	1.191	100.00	1.801	100.00
25	1.925	100.00	1.381	100.00	1.081	100.00	0.872	100.00	1.315	100.00	1.324	100.00
26	1.598	100.00	1.409	100.00	1.657	100.00	1.578	100.00	1.313	100.00	1.765	100.00
27	1.197	100.00	1.276	100.00	1.554	100.00	1.097	100.00	0.909	100.00	1.317	100.00
28	0.824	100.00	1.601	100.00	1.005	100.00	1.012	100.00	1.504	100.00	1.365	100.00
29	1.731	100.00	1.328	100.00	1.681	100.00	1.443	100.00	1.423	100.00	1.761	100.00
30	2.005	100.00	1.595	100.00	1.286	100.00	0.961	100.00	1.592	100.00	1.525	100.00
31	2.015	100.00	1.265	100.00	0.928	100.00	0.889	100.00	1.203	100.00	1.394	100.00
122	-	-	-	-	-	-	-	-	-	-	-	-
134	-	-	-	-	-	-	-	-	-	-	-	-

Table 6-2 Range Error 95% index and 3.29 Sigma Bounding

Site →	Los Angeles		Salt Lake City		Miami		Minneapolis		Atlanta		Juneau	
SV ↓	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding
1	1.156	100.00	1.456	100.00	1.396	100.00	1.040	100.00	1.111	100.00	1.062	100.00
2	1.975	100.00	2.104	100.00	1.699	100.00	1.663	100.00	1.566	100.00	1.264	100.00
3	1.295	100.00	1.587	100.00	1.117	100.00	1.561	100.00	1.582	100.00	1.158	100.00
4	1.667	100.00	2.283	100.00	1.793	100.00	1.728	100.00	1.821	100.00	1.418	100.00
5	1.300	100.00	2.191	100.00	1.379	100.00	1.209	100.00	1.463	100.00	0.816	100.00
6	1.213	100.00	1.770	100.00	1.445	100.00	1.871	100.00	1.650	100.00	1.418	100.00
7	1.583	100.00	1.733	100.00	1.443	100.00	1.533	100.00	1.580	100.00	1.351	100.00
8	1.308	100.00	1.441	100.00	1.238	100.00	1.441	100.00	1.166	100.00	1.130	100.00
9	1.610	100.00	1.866	100.00	1.241	100.00	1.317	100.00	1.577	100.00	1.263	100.00
10	1.679	100.00	1.379	100.00	1.049	100.00	0.988	100.00	1.240	100.00	0.752	100.00
11	1.650	100.00	1.349	100.00	2.818	100.00	1.055	100.00	1.196	100.00	0.870	100.00
12	1.313	100.00	1.488	100.00	1.265	100.00	1.469	100.00	2.118	100.00	0.881	100.00
13	1.231	100.00	1.320	100.00	1.642	100.00	1.331	100.00	1.544	100.00	1.299	100.00
14	1.760	100.00	1.659	100.00	1.439	100.00	1.254	100.00	1.463	100.00	0.854	100.00
15	-	-	-	-	-	-	-	-	-	-	-	-
16	1.722	100.00	1.387	100.00	1.489	100.00	1.010	100.00	1.414	100.00	0.800	100.00
17	1.172	100.00	1.406	100.00	1.294	100.00	1.037	100.00	1.188	100.00	1.040	100.00
18	1.798	100.00	1.746	100.00	1.629	100.00	1.325	100.00	1.542	100.00	1.118	100.00
19	2.833	100.00	2.542	100.00	2.713	100.00	2.217	100.00	2.634	100.00	2.029	100.00
20	1.961	100.00	1.441	100.00	1.326	100.00	1.197	100.00	1.382	100.00	0.825	100.00
21	1.985	100.00	1.544	100.00	1.775	100.00	1.350	100.00	1.479	100.00	1.083	100.00
22	2.261	100.00	1.614	100.00	2.207	100.00	1.267	100.00	1.633	100.00	1.055	100.00
23	2.786	100.00	2.686	100.00	2.155	100.00	2.748	100.00	2.277	100.00	1.854	100.00
24	1.489	100.00	2.242	100.00	1.323	100.00	1.995	100.00	1.709	100.00	1.686	100.00
25	1.253	100.00	1.508	100.00	1.218	100.00	1.393	100.00	1.391	100.00	1.110	100.00
26	1.133	100.00	2.135	100.00	1.301	100.00	2.019	100.00	2.048	100.00	1.549	100.00
27	1.290	100.00	1.754	100.00	1.177	100.00	1.476	100.00	1.407	100.00	1.303	100.00
28	1.487	100.00	1.348	100.00	1.494	100.00	1.143	100.00	1.272	100.00	1.001	100.00
29	1.334	100.00	1.738	100.00	1.597	100.00	1.809	100.00	1.939	100.00	1.335	100.00
30	1.591	100.00	1.711	100.00	1.711	100.00	1.319	100.00	1.683	100.00	1.476	100.00
31	1.433	100.00	1.682	100.00	1.387	100.00	0.964	100.00	1.424	100.00	0.944	100.00
122	-	-	-	-	-	-	-	-	-	-	-	-
134	-	-	-	-	-	-	-	-	-	-	-	-

Table 6-3 Ionospheric Error 95% index and 3.29 Sigma Bounding

Site →	Billings		Albuquerque		Boston		Washington DC		Houston		Kansas City	
SV ↓	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding
1	0.806	100.00	0.721	100.00	0.538	100.00	0.396	100.00	0.428	100.00	0.517	100.00
2	0.791	100.00	1.610	100.00	1.078	100.00	1.184	100.00	1.189	100.00	1.370	100.00
3	0.823	100.00	0.555	100.00	0.519	100.00	0.630	100.00	0.768	100.00	0.637	100.00
4	1.149	100.00	1.081	100.00	0.825	100.00	0.964	100.00	1.207	100.00	1.033	100.00
5	0.545	100.00	0.810	100.00	0.456	100.00	0.387	100.00	0.579	100.00	0.559	100.00
6	1.110	100.00	0.721	100.00	0.564	100.00	0.645	100.00	0.596	100.00	0.796	100.00
7	0.878	100.00	0.545	100.00	0.430	100.00	0.424	100.00	0.471	100.00	0.671	100.00
8	0.542	100.00	0.674	100.00	0.383	100.00	0.629	100.00	0.646	100.00	0.568	100.00
9	0.758	100.00	0.703	100.00	0.585	100.00	0.499	100.00	0.527	100.00	0.741	100.00
10	0.475	100.00	1.338	100.00	0.444	100.00	0.950	100.00	0.769	100.00	0.627	100.00
11	0.592	100.00	0.821	100.00	0.355	100.00	0.639	100.00	1.088	100.00	0.694	100.00
12	0.758	100.00	0.838	100.00	0.426	100.00	0.343	100.00	0.403	100.00	0.713	100.00
13	0.946	100.00	0.697	100.00	0.468	100.00	0.504	100.00	0.715	100.00	0.613	100.00
14	0.695	100.00	0.878	100.00	0.507	100.00	0.872	100.00	0.780	100.00	0.880	100.00
15	-	-	-	-	-	-	-	-	-	-	-	-
16	0.404	100.00	1.075	100.00	0.514	100.00	0.764	100.00	0.804	100.00	0.666	100.00
17	1.295	100.00	0.851	100.00	0.433	100.00	0.377	100.00	0.849	100.00	0.562	100.00
18	0.645	100.00	1.054	100.00	0.665	100.00	1.074	100.00	0.961	100.00	1.180	100.00
19	1.374	100.00	2.020	100.00	1.479	100.00	1.752	100.00	1.622	100.00	1.496	100.00
20	0.411	100.00	0.930	100.00	0.683	100.00	0.594	100.00	0.904	100.00	0.596	100.00
21	0.672	100.00	1.159	100.00	0.636	100.00	1.048	100.00	1.050	100.00	1.095	100.00
22	0.444	100.00	1.115	100.00	0.810	100.00	0.949	100.00	0.903	100.00	1.077	100.00
23	1.345	100.00	2.097	100.00	1.553	100.00	2.188	100.00	2.079	100.00	2.172	100.00
24	1.238	100.00	1.010	100.00	0.828	100.00	0.971	100.00	0.838	100.00	0.985	100.00
25	1.174	100.00	0.850	100.00	0.493	100.00	0.457	100.00	0.781	100.00	0.703	100.00
26	0.981	100.00	0.731	100.00	0.761	100.00	0.924	100.00	0.987	100.00	1.010	100.00
27	0.769	100.00	0.841	100.00	0.525	100.00	0.568	100.00	0.487	100.00	0.643	100.00
28	0.506	100.00	1.124	100.00	0.583	100.00	0.552	100.00	0.875	100.00	1.014	100.00
29	0.878	100.00	0.666	100.00	0.428	100.00	0.816	100.00	0.777	100.00	0.833	100.00
30	0.942	100.00	0.720	100.00	0.544	100.00	0.586	100.00	0.679	100.00	0.592	100.00
31	1.621	100.00	0.777	100.00	0.294	100.00	0.373	100.00	0.875	100.00	0.524	100.00

Table 6-4 Ionospheric Error 95% index and 3.29 Sigma Bounding

Site →	Los Angeles		Salt Lake City		Miami		Minneapolis		Atlanta		Juneau	
SV ↓	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding
1	0.448	100.00	0.976	100.00	0.997	100.00	0.571	100.00	0.720	100.00	0.494	100.00
2	1.114	100.00	1.410	100.00	0.837	100.00	1.112	100.00	0.927	100.00	1.007	100.00
3	0.568	100.00	0.914	100.00	0.869	100.00	0.819	100.00	0.695	100.00	0.522	100.00
4	0.974	100.00	1.481	100.00	1.178	100.00	1.087	100.00	1.067	100.00	0.803	100.00
5	0.432	100.00	0.849	100.00	0.538	100.00	0.522	100.00	0.569	100.00	0.435	100.00
6	0.549	100.00	1.166	100.00	1.058	100.00	0.882	100.00	0.757	100.00	0.725	100.00
7	0.679	100.00	0.910	100.00	0.834	100.00	0.637	100.00	0.684	100.00	0.625	100.00
8	0.523	100.00	1.043	100.00	1.027	100.00	0.694	100.00	0.639	100.00	0.490	100.00
9	0.558	100.00	0.934	100.00	0.725	100.00	0.565	100.00	0.802	100.00	0.615	100.00
10	0.780	100.00	0.759	100.00	0.545	100.00	0.455	100.00	0.552	100.00	0.493	100.00
11	0.708	100.00	0.651	100.00	1.282	100.00	0.481	100.00	0.700	100.00	0.506	100.00
12	0.431	100.00	0.928	100.00	0.793	100.00	0.500	100.00	0.932	100.00	0.464	100.00
13	0.547	100.00	0.869	100.00	1.232	100.00	0.642	100.00	0.780	100.00	0.582	100.00
14	0.758	100.00	1.122	100.00	0.690	100.00	0.681	100.00	0.785	100.00	0.651	100.00
15	-	-	-	-	-	-	-	-	-	-	-	-
16	0.885	100.00	0.814	100.00	0.578	100.00	0.503	100.00	0.748	100.00	0.625	100.00
17	0.610	100.00	0.907	100.00	0.966	100.00	0.419	100.00	0.667	100.00	0.476	100.00
18	0.953	100.00	1.256	100.00	1.085	100.00	0.797	100.00	0.931	100.00	0.794	100.00
19	1.626	100.00	1.641	100.00	1.149	100.00	1.508	100.00	1.612	100.00	1.544	100.00
20	0.848	100.00	0.822	100.00	0.608	100.00	0.573	100.00	0.725	100.00	0.563	100.00
21	1.122	100.00	1.191	100.00	1.304	100.00	1.097	100.00	0.824	100.00	0.754	100.00
22	1.240	100.00	1.185	100.00	1.657	100.00	0.835	100.00	1.016	100.00	0.725	100.00
23	1.951	100.00	2.139	100.00	1.627	100.00	2.213	100.00	1.762	100.00	1.618	100.00
24	0.950	100.00	1.546	100.00	1.135	100.00	1.153	100.00	1.048	100.00	1.024	100.00
25	0.702	100.00	0.932	100.00	0.998	100.00	0.656	100.00	0.730	100.00	0.487	100.00
26	0.607	100.00	1.207	100.00	0.995	100.00	0.994	100.00	1.046	100.00	0.797	100.00
27	0.628	100.00	1.241	100.00	1.161	100.00	0.661	100.00	0.767	100.00	0.655	100.00
28	0.696	100.00	0.893	100.00	0.904	100.00	0.773	100.00	0.791	100.00	0.765	100.00
29	0.520	100.00	0.973	100.00	1.099	100.00	0.836	100.00	0.815	100.00	0.603	100.00
30	0.737	100.00	1.001	100.00	0.979	100.00	0.653	100.00	0.816	100.00	0.755	100.00
31	0.475	100.00	0.954	100.00	0.898	100.00	0.421	100.00	0.783	100.00	0.367	100.00

Figure 6-1 95% Range Error (SV 1 --SV 16) - Washington, DC

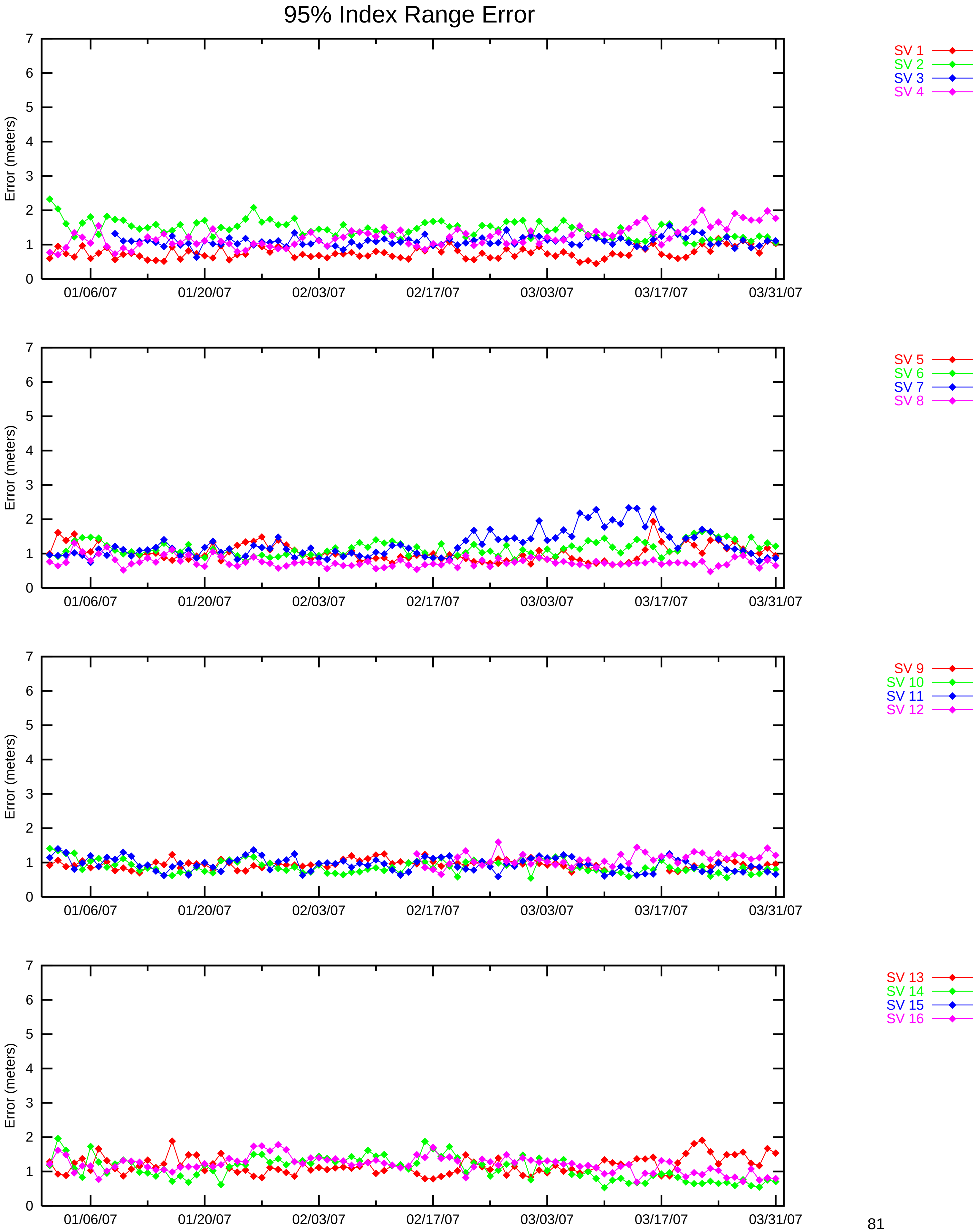
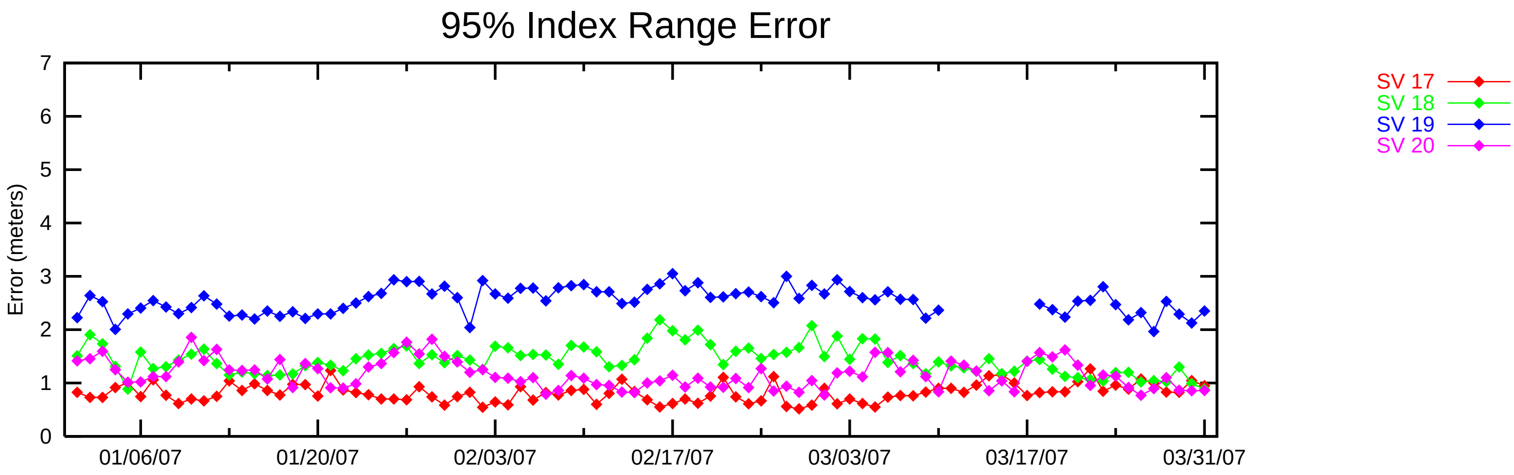
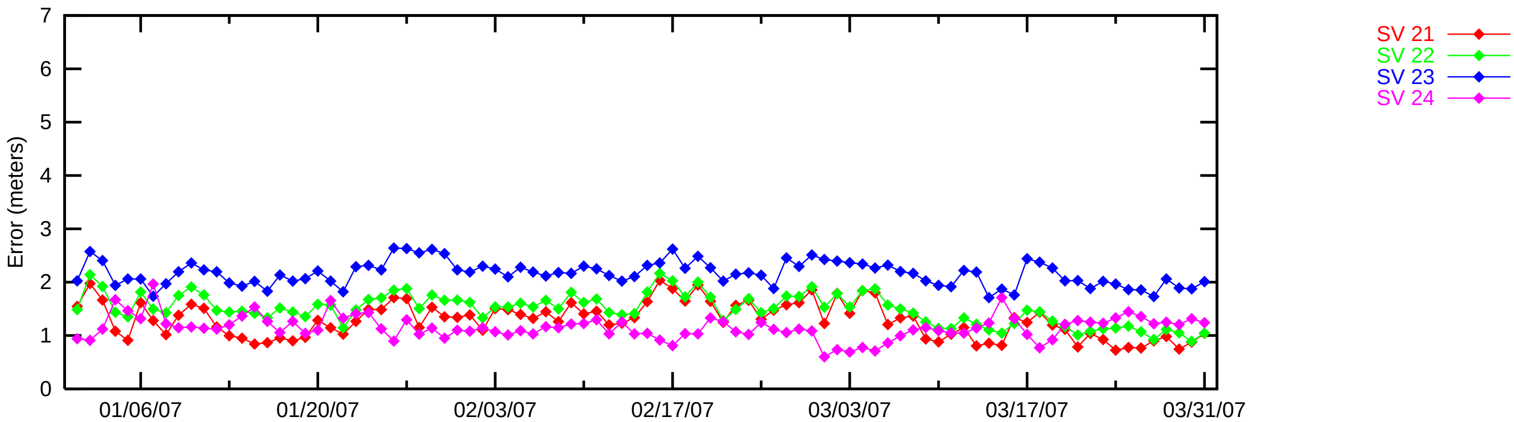
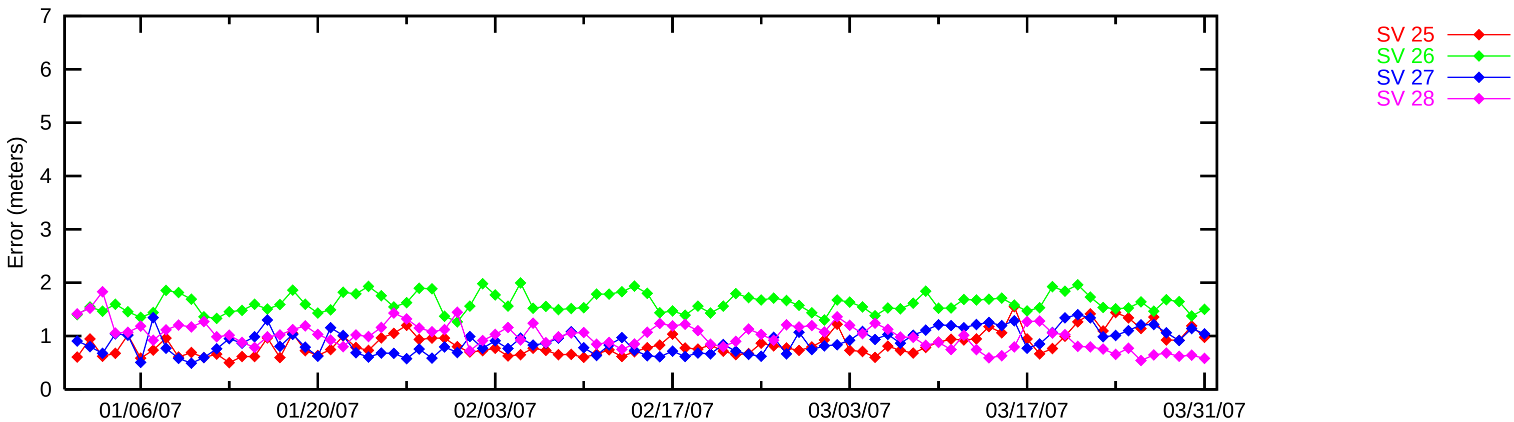


Figure 6-2 95% Range Error (SV 17 --SV 31 and SV 122) - Washington, DC







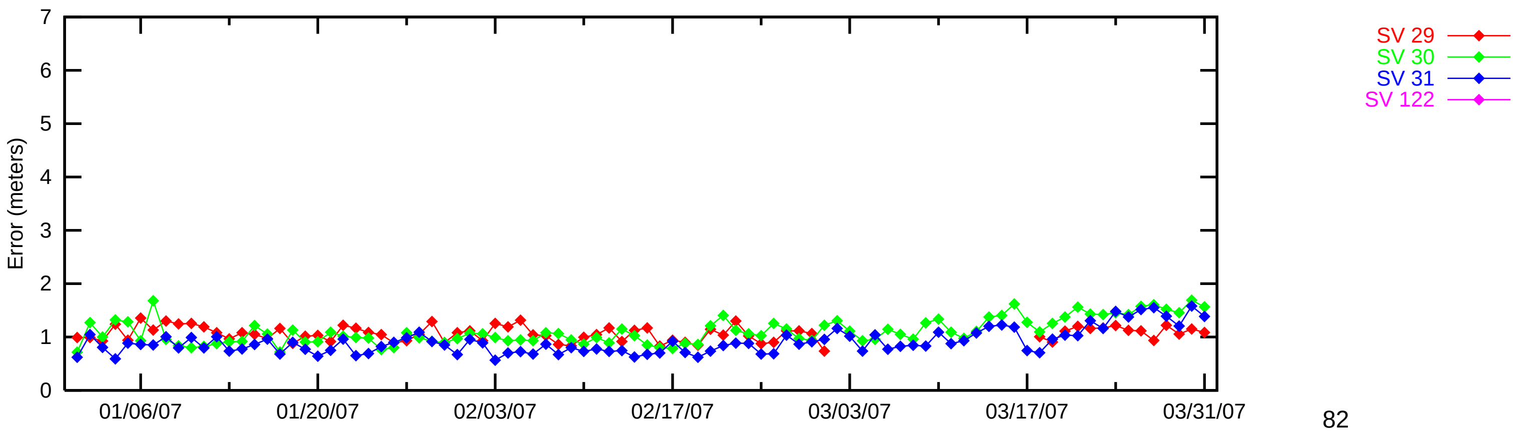


Figure 6-3 95% Ionospheric Error (SV 1 --SV 16) - Washington, DC

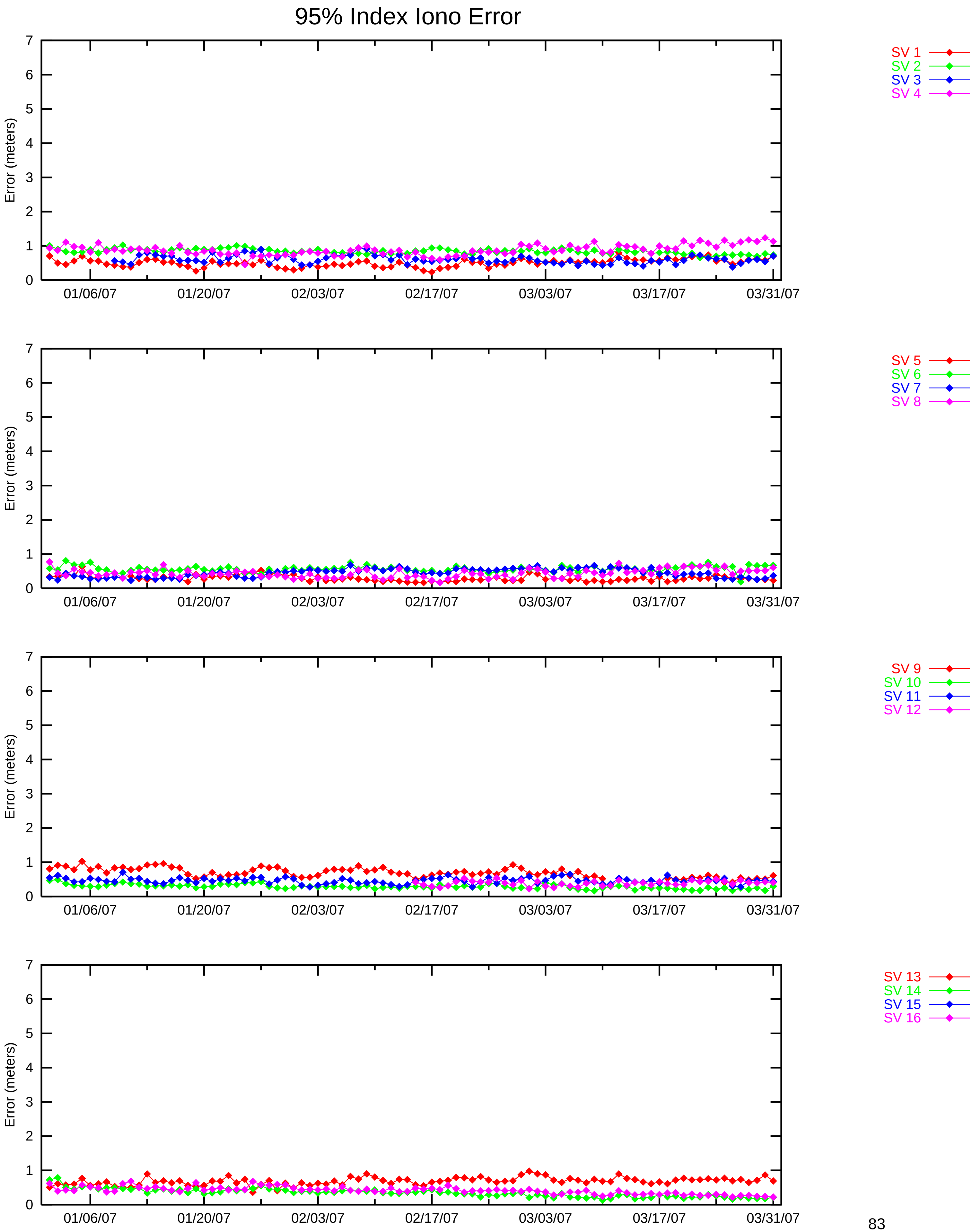
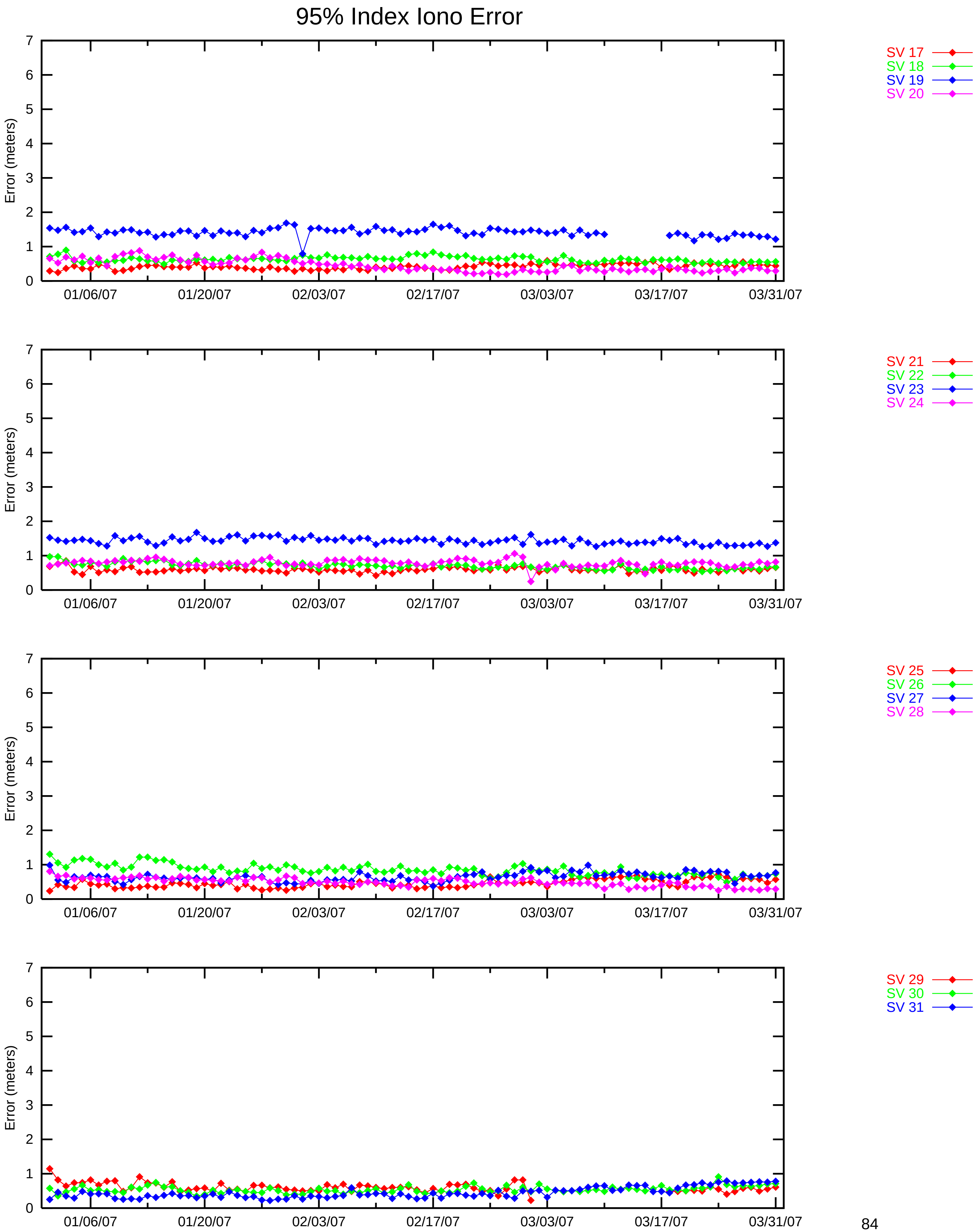


Figure 6-4 95% Ionospheric Error (SV 17 --SV 31) - Washington, DC



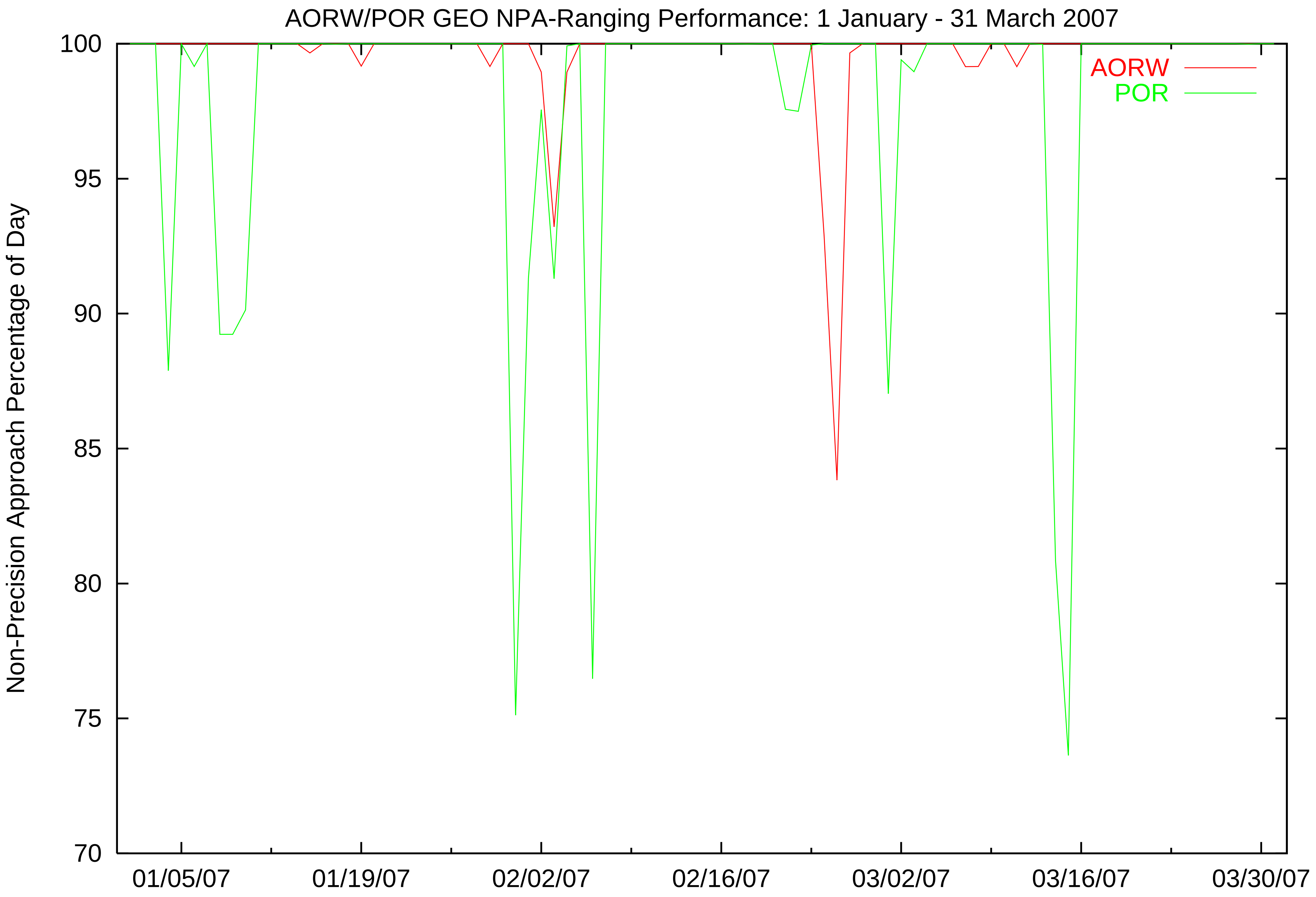
7.0 GEO RANGING PERFORMANCE

For the evaluated period, AOR-W GEO no longer provides PA ranging capability. Currently, the CRW GEO provides only the data link capability, i.e. there is no ranging service available from this GEO. As in the past, the POR satellite as a ranging source has very low PA availability. Table 7.1 shows the GEO-Ranging performance for AORW, POR, and CRW satellites throughout the evaluated period. Figure 7.1 shows the trend of NPA Ranging Availability for the AORW and POR satellite.

Table 7-1 GEO Ranging Availability

GEO	PA (%)	NPA (%)	Not Monitored (%)	Do Not Use (%)
AORW	0	99.578	0.108	0.304
POR	0	98.134	1.647	0.209
CRW	0	0	99.909	0.081

Figure 7-1 Daily NPA GEO Ranging Availability Trend



8.0 WAAS PROBLEM SUMMARY

During this evaluated period, there are several events that affected the WAAS service. High vertical errors were observed due to localized ionospheric scintillation, but did not exceed the protection levels. Details of each of the events are documented in the WAAS Dscrepancy Report (DR). The DRs are available on the website http://www.nstb.tc.faa.gov under 'WAAS Technical Reports', and can also be accessed via hyperlink below.

January 1, 2007 – WAAS CONUS coverage experienced a drop in availability in the Northwest area due to three satellites being set to Not Monitor. See DR# 50, "WAAS Service Outage Due to Three Satellites Set to Not Monitored."

February 2, 2007 – An Abnormal CRW GUS switchover caused SIS outage of 580 seconds. See DR# 48, "Abnormal CRW Switchover and Extended SIS (Signal in Space) Outage."

February 28, 2007 – A serial port communication failure caused a GUS switchover for CRW, but it did not cause a SIS outage. See DR# 49, "CRW Switchover Caused By Comm Glitch."

March 24, 2007 – The IGP GIVE values in Alaska area were set to 15 that caused a loss of LPV service in Alaska. There were no other significant events recorded on that day that would have affected the LPV service in Alaska area. See DR# 51, "Loss of LPV Service in Alaska Due To IGP GIVE Set To 15." Similar event occurred on March 6, 2007 and March 11, 2007.

March 24, 2007 – Localized ionospheric scinitillation caused a loss of GPS satellite tracking at Juneau WRS. Though the vertical error did briefly exceed the one-sigma protection levels, at no point did they exceed the actual protection levels. See DR# 53, "Ionospheric scintillation at Juneau."

March 30, 2007 – High vertical errors were observed at Fairbanks due to localized ionospheric scintillation. Though the vertical error was briefly as high as 22.492 meters, it did not exceed the protection levels. See DR# 52, "Ionospheric Scintillation Caused High Position Errors At Fairbanks."

9.0 WAAS AIRPORT AVAILABILITY

The WAAS airport availability evaluation determines the number and length LVP service outages at selected airports from the transmitted WAAS navigation message. The navigation messages transmitted from both AORW and POR GEO satellites are processed simultaneously, and WAAS protection levels (VPL and HPL) are computed at each airport once a second in accordance with the WAAS MOPS. Once the protection levels have been produced at each airport an LPV service evaluation is conducted to identify outages in service (i.e. when protection levels exceed alert limits). WAAS LPV service is available for a user when the vertical protection level (VPL) is less than or equal to vertical alert limit (VAL) of 50 meters and the horizontal protection level (HPL) is less than or equal to horizontal alert limit (HAL) of 40 meters. If both conditions are met at a specified airport location then WAAS LPV service is available at that airport. If either one of the conditions are not met at a specified airport location then WAAS LPV service at that airport is unavailable and an outage in LPV service is recorded with its duration. When the LPV service becomes unavailable it is not considered available again until protection levels are below or equal to alert limits for at least 15 minutes. Although this will reduce LPV service availability minimally, it substantially reduces the number of service outages and prevents excessive switching in and out of service availability. When computing LPV service availability an extra two minutes of outage time was prefixed to each outage. The number of WAAS LPV service outages and the availability at selected airports for the period from January 1, 2007 to March 31, 2007 of WAAS operation is presented in Table 9.1. Figures 9.1 and 9.2 provide a graphical representation of WAAS LPV service availability and outage counts for the same period, respectively.

Table 9-1 WAAS LPV Outages and Availability

Airport Id	Airport Name	State	Outages	Availability
79J	ANDALUSIA-OPP	AL	6	0.99970050
BHM	BIRMINGHAM INTL	AL	2	0.99995220
DHN	DOTHAN REGIONAL	AL	7	0.99959720
HSV	HUNTSVILLE INTL-CARL T JONES F	AL	2	0.99995230
JKA	JACK EDWARDS	AL	6	0.99956477
MDQ	MADISON COUNTY EXECUTIVE	AL	2	0.99995230
BFM	MOBILE DOWNTOWN	AL	6	0.99972160
MOB	MOBILE REGIONAL	AL	6	0.99975556
MGM	MONTGOMERY REGIONAL (DANNELLY FIELD)	AL	4	0.99984354
MSL	NORTHWEST ALABAMA REGIONAL	AL	2	0.99995220
DCU	PRYOR FIELD REGIONAL	AL	2	0.99995230
LIT	ADAMS FIELD	AR	2	0.99993020
M73	ALMYRA MUNICIPAL	AR	2	0.99993020
BYH	ARKANSAS INTL	AR	3	0.99991935
VBT	BENTONVILLE MUNICIPAL/LOUISE M THAD	AR	2	0.99993120
HRO	BOONE COUNTY	AR	2	0.99993120
FSM	FORT SMITH REGIONAL	AR	2	0.99993120
PBF	GRIDER FIELD	AR	2	0.99993020
XNA	NORTHWEST ARKANSAS REGIONAL	AR	2	0.99993120
BPK	OZARK REGIONAL	AR	2	0.99993020
ROG	ROGERS MUNICIPAL-CARTER FIELD	AR	2	0.99993120
SRC	SEARCY MUNICIPAL	AR	2	0.99993020
ELD	SOUTH ARKANSAS REGIONAL	AR	2	0.99993020
ASG	SPRINGDALE MUNICIPAL	AR	2	0.99993120
SGT	STUTTGART MUNICIPAL	AR	2	0.99993020
ARG	WALNUT RIDGE REGIONAL	AR	3	0.99991786
PRC	ERNEST A. LOVE FIELD	AZ	63	0.99545850
GCN	GRAND CANYON NATIONAL PARK	AZ	5	0.99976140

IFP	LAUGHLIN/BULLHEAD INTL	AZ	22	0.99802120
DVT	PHOENIX DEER VALLEY	AZ	88	0.99255040
PHX	PHOENIX SKY HARBOR INTL	AZ	107	0.99111870
TUS	TUCSON INTL	AZ	201	0.97991323
APV	APPLE VALLEY	CA	113	0.99102160
ACV	ARCATA	CA	107	0.98950636
DAG	BARSTOW-DAGGETT	CA	88	0.99348545
C83	BYRON	CA	129	0.98356840
CNO	CHINO	CA	222	0.97832800
FAT	FRESNO YOSEMITE INTL	CA	93	0.98895310
WJF	GENERAL WM J FOX AIRFIELD	CA	162	0.98637730
HAF	HALF MOON BAY	CA	194	0.97376920
LGB	LONG BEACH /DAUGHERTY FIELD/	CA	297	0.96263236
LAX	LOS ANGELES INTL	CA	294	0.96358580
CRQ	MC CLELLAN-PALOMAR	CA	320	0.94801220
BFL	MEADOWS FIELD	CA	138	0.98556125
OAK	METROPOLITAN OAKLAND INTL	CA	142	0.97884345
MRY	MONTEREY PENINSULA	CA	228	0.97137374
APC	NAPA COUNTY	CA	132	0.98161906
O02	NERVINO	CA	28	0.99830640
SJC	NORMAN Y. MINETA SAN JOSE INTL	CA	158	0.97843660
VCB	NUT TREE	CA	127	0.98448694
ONT	ONTARIO INTL	CA	209	0.98125520
PSP	PALM SPRINGS INTL	CA	171	0.98418990
PMD	PALMDALE REGIONAL/USAF PLANT 4	CA	167	0.98637605
RAL	RIVERSIDE MUNICIPAL	CA	210	0.97936416
MHR	SACRAMENTO MATHER	CA	78	0.99163526
SFO	SAN FRANCISCO INTL	CA	168	0.97651350
TCY	TRACY MUNICIPAL	CA	124	0.98382470
COS	CITY OF COLORADO SPRINGS MUNICIPAL	CO	3	0.99991363
AKO	COLORADO PLAINS REGIONAL	CO	2	0.99993426
CEZ	CORTEZ MUNICIPAL	CO	2	0.99993630
DEN	DENVER INTL	CO	2	0.99993426
GXY	GREELEY-WELD COUNTY	CO	2	0.99993426
ITR	KIT CARSON COUNTY	CO	2	0.99993426
LAA	LAMAR MUNICIPAL	CO	2	0.99993426
ALS	SAN LUIS VALLEY REGIONAL/BERGM	CO	2	0.99993630
HDN	YAMPA VALLEY	CO	2	0.99993630
BDL	BRADLEY INTL	CT	217	0.96689594
GON	GROTON-NEW LONDON	CT	217	0.96679260
HVN	TWEED-NEW HAVEN	CT	193	0.98430570
DCA	RONALD REAGAN WASHINGTON NATIONAL	DC	7	0.99928220
GED	SUSSEX COUNTY	DE	16	0.99849564
CEW	BOB SIKES	FL	6	0.99960650
BCT	BOCA RATON	FL	38	0.99653006
DAB	DAYTONA BEACH INTL	FL	13	0.99876320
DED	DELAND MUNI-SIDNEY H TAYLOR FIELD	FL	12	0.99875190
FLL	FORT LAUDERDALE/HOLLYWOOD INTL	FL	66	0.99477804
GNV	GAINESVILLE REGIONAL	FL	13	0.99890440
JAX	JACKSONVILLE INTL	FL	12	0.99904263
TMB	KENDALL-TAMIAMI EXECUTIVE	FL	109	0.99238133
EYW	KEY WEST INTL	FL	227	0.97462910
ISM	KISSIMMEE GATEWAY	FL	14	0.99849296

MLB	MELBOURNE INTL	FL	14	0.99839020
COI	MERRITT ISLAND	FL	14	0.99847937
OCF	OCALA INTL-JIM TAYLOR FIELD	FL	14	0.99877630
MCO	ORLANDO INTL	FL	14	0.99853490
PBI	PALM BEACH INTL	FL	25	0.99724233
PFN	PANAMA CITY-BAY CO INTL	FL	7	0.99952585
PNS	PENSACOLA REGIONAL	FL	6	0.99954313
PMP	POMPANO BEACH AIRPARK	FL	49	0.99588650
SRQ	SARASOTA/BRADENTON INTL	FL	20	0.99793680
RSW	SOUTHWEST FLORIDA INTL	FL	30	0.99713993
PIE	ST PETERSBURG-CLEARWATER INTL	FL	16	0.99823260
TLH	TALLAHASSEE REGIONAL	FL	8	0.99956300
TPA	TAMPA INTL	FL	15	0.99826133
VDF	VANDENBERG	FL	15	0.99820960
AGS	AUGUSTA RGNL AT BUSH FIELD	GA	5	0.99980070
BQK	BRUNSWICK GOLDEN ISLES	GA	9	0.99918990
CSG	COLUMBUS METROPOLITAN	GA	7	0.99969400
ATL	HARTSFIELD - JACKSON ATLANTA INTL	GA	7	0.99976190
MCN	MIDDLE GEORGIA REGIONAL	GA	7	0.99974570
CCO	NEWNAN COWETA COUNTY	GA	6	0.99976510
SAV	SAVANNAH/HILTON HEAD INTL	GA	8	0.99947244
ACJ	SOUTHER FIELD	GA	8	0.99964240
TBR	STATESBORO-BULLOCH COUNTY	GA	5	0.99976760
AYS	WAYCROSS-WARE COUNTY	GA	10	0.99965260
CTJ	WEST GEORGIA REGIONAL - O V GRAY F	GA	6	0.99976560
IKV	ANKENY REGIONAL	IA	2	0.99993120
DVN	DAVENPORT MUNICIPAL	IA	2	0.99995220
DSM	DES MOINES INTL	IA	2	0.99993120
DBQ	DUBUQUE REGIONAL	IA	2	0.99995220
EOK	KEOKUK MUNICIPAL	IA	2	0.99994930
MCW	MASON CITY MUNICIPAL	IA	2	0.99993120
MXO	MONTICELLO REGIONAL	IA	2	0.99994930
MUT	MUSCATINE MUNICIPAL	IA	2	0.99994930
OTM	OTTUMWA INDUSTRIAL	IA	2	0.99994930
SDA	SHENANDOAH MUNICIPAL	IA	2	0.99993120
SLB	STORM LAKE MUNICIPAL	IA	2	0.99993120
CID	THE EASTERN IOWA	IA	2	0.99994930
ALO	WATERLOO REGIONAL	IA	2	0.99993120
BOI	BOISE AIR TERMINAL/GOWEN FIELD	ID	5	0.99979330
IDA	IDAHO FALLS REGIONAL	ID	4	0.99984090
LWS	LEWISTON-NEZ PERCE COUNTY	ID	4	0.99963960
PIH	POCATELLO REGIONAL	ID	4	0.99983543
SPI	ABRAHAM LINCOLN CAPITAL	IL	2	0.99995220
ARR	AURORA MUNICIPAL	IL	4	0.99989110
BMI	CENTRAL IL REGIONAL ARPT	IL	3	0.99991655
ENL	CENTRALIA MUNICIPAL	IL	3	0.99987510
MDW	CHICAGO MIDWAY INTL	IL	4	0.99983120
ORD	CHICAGO O'HARE INTL	IL	4	0.99984443
RFD	CHICAGO/ROCKFORD INTL	IL	3	0.99992750
DEC	DECATUR	IL	3	0.99988780
FOA	FLORA MUNICIPAL	IL	3	0.99987674
PIA	GREATER PEORIA REGIONAL	IL	2	0.99995220
PPQ	PITTSFIELD PENSTONE MUNICIPAL	IL	2	0.99995220

MLI	QUAD CITY INTL	IL	2	0.99995220
TIP	RANTOUL NATL AVN CNTR-FRANK EL	IL	3	0.99992620
SLO	SALEM-LECKRONE	IL	3	0.99987245
ALN	ST LOUIS REGIONAL	IL	2	0.99995220
UGN	WAUKEGAN REGIONAL	IL	5	0.99981110
BAK	COLUMBUS MUNICIPAL	IN	3	0.99991950
GWB	DE KALB COUNTY	IN	4	0.99980550
EKM	ELKHART MUNICIPAL	IN	4	0.99977297
FWA	FORT WAYNE INTL	IN	4	0.99981785
IND	INDIANAPOLIS INTL	IN	3	0.99990550
MZZ	MARION MUNICIPAL	IN	4	0.99983174
CEV	METTEL FIELD	IN	4	0.99989770
BMG	MONROE COUNTY	IN	3	0.99990624
SBN	SOUTH BEND REGIONAL	IN	4	0.99976850
ANQ	TRI-STATE STEUBEN COUNTY	IN	4	0.99978644
PTS	ATKINSON MUNICIPAL	KS	2	0.99993120
AAO	COLONEL JAMES JABARA	KS	2	0.99993120
DDC	DODGE CITY REGIONAL	KS	2	0.99993120
FOE	FORBES FIELD	KS	2	0.99993120
HYS	HAYS REGIONAL	KS	2	0.99993120
OJC	JOHNSON COUNTY EXECUTIVE	KS	2	0.99993120
LWC	LAWRENCE MUNICIPAL	KS	2	0.99993120
MHK	MANHATTAN REGIONAL	KS	2	0.99993120
IXD	NEW CENTURY AIRCENTER	KS	2	0.99993120
EWK	NEWTON-CITY-COUNTY	KS	2	0.99993120
OEL	OAKLEY MUNICIPAL	KS	2	0.99993120
TOP	PHILIP BILLARD MUNICIPAL	KS	2	0.99993120
GLD	RENNER FLD /GOODLAND MUNICIPAL	KS	2	0.99993120
SLN	SALINA MUNICIPAL	KS	2	0.99993120
TQK	SCOTT CITY MUNICIPAL	KS	2	0.99993120
CBK	SHALZ FIELD	KS	2	0.99993120
WLD	STROTHER FIELD	KS	2	0.99993120
ULS	ULYSSES	KS	2	0.99993426
ICT	WICHITA MID-CONTINENT	KS	2	0.99993120
EKX	ADDINGTON FIELD	KY	2	0.99995230
PAH	BARKLEY REGIONAL	KY	6	0.99985450
K22	BIG SANDY REGIONAL	KY	5	0.99979140
LEX	BLUE GRASS	KY	2	0.99995230
FFT	CAPITAL CITY	KY	3	0.99993540
CVG	CINCINNATI/NORTHERN KENTUCKY INTL	KY	3	0.99992764
LOZ	LONDON-CORBIN ARPT-MAGEE FIELD	KY	5	0.99987686
SDF	LOUISVILLE INTL-STANDIFORD FIELD	KY	2	0.99995230
OWB	OWENSBORO-DAVIESS COUNTY	KY	3	0.99993370
ARA	ACADIANA REGIONAL	LA	7	0.99928190
AEX	ALEXANDRIA INTL	LA	4	0.99989680
BTR	BATON ROUGE METROPOLITAN RYAN	LA	7	0.99965584
DRI	BEAUREGARD REGIONAL	LA	7	0.99969566
CWF	CHENNAULT INTL	LA	7	0.99929476
PTN	HARRY P WILLIAMS MEMORIAL	LA	8	0.99918190
LCH	LAKE CHARLES REGIONAL	LA	7	0.99923600
MSY	LOUIS ARMSTRONG NEW ORLEANS IN	LA	9	0.99932283
DTN	SHREVEPORT DOWNTOWN	LA	2	0.99993020
SHV	SHREVEPORT REGIONAL	LA	2	0.99993170

TVR	VICKSBURG TALLULAH REGIONAL	LA	2	0.99993020
HYA	BARNSTABLE MUNICIPAL - BOARDMAN/POLAN	MA	335	0.94020295
OWD	NORWOOD MEMORIAL	MA	286	0.94867426
ORH	WORCESTER REGIONAL	MA	251	0.95482380
BWI	BALTIMORE/WASHINGTON INTL THUR	MD	9	0.99920930
DMW	CARROLL COUNTY REGIONAL/JACK B	MD	8	0.99921600
FDK	FREDERICK MUNICIPAL	MD	9	0.99937830
GAI	MONTGOMERY COUNTY AIRPARK	MD	7	0.99928490
LEW	AUBURN/LEWISTON MUNICIPAL	ME	511	0.91249484
AUG	AUGUSTA STATE	ME	610	0.89257830
BHB	HANCOCK COUNTY-BAR HARBOR	ME	796	0.82850915
PWM	PORTLAND INTL JETPORT	ME	464	0.91809076
ARB	ANN ARBOR MUNICIPAL	MI	5	0.99973280
ACB	ANTRIM COUNTY	MI	9	0.99929667
FNT	BISHOP INTL	MI	5	0.99966764
DTW	DETROIT METROPOLITAN WAYNE COUNTY	MI	5	0.99973810
GRR	GERALD R. FORD INTL	MI	5	0.99965876
CMX	HOUGHTON COUNTY MEMORIAL	MI	44	0.99555707
OZW	LIVINGSTON COUNTY SPENCER J. H	MI	5	0.99968980
MBS	MBS INTL	MI	6	0.99958520
MKG	MUSKEGON COUNTY	MI	5	0.99965954
HYX	SAGINAW COUNTY H.W. BROWNE	MI	6	0.99960390
BIV	TULIP CITY	MI	5	0.99967176
YIP	WILLOW RUN	MI	5	0.99973200
BRD	BRAINERD LAKES REGIONAL	MN	9	0.99919110
AXN	CHANDLER FIELD	MN	8	0.99955880
HIB	CHISHOLM-HIBBING	MN	23	0.99798065
DLH	DULUTH INTL	MN	14	0.99882060
MSP	MINNEAPOLIS-ST PAUL INTL	MN	5	0.99981135
RGK	RED WING REGIONAL	MN	4	0.99983275
RST	ROCHESTER INTL	MN	4	0.99986720
STC	ST CLOUD REGIONAL	MN	8	0.99967750
JYG	ST JAMES MUNICIPAL	MN	3	0.99989890
STP	ST PAUL DOWNTOWN HOLMAN FIELD	MN	5	0.99980720
CGI	CAPE GIRARDEAU REGIONAL	MO	6	0.99983150
MKC	CHARLES B. WHEELER DOWNTOWN	MO	2	0.99993120
GPH	CLAY COUNTY REGIONAL	MO	2	0.99993120
COU	COLUMBIA REGIONAL	MO	2	0.99994930
LBO	FLOYD W. JONES LEBANON	MO	2	0.99993145
HIG	HIGGINSVILLE INDUSTRIAL MUNICIPAL	MO	2	0.99993120
JLN	JOPLIN REGIONAL	MO	2	0.99993120
MCI	KANSAS CITY INTL	MO	2	0.99993120
TKX	KENNETT MEMORIAL	MO	3	0.99991477
IRK	KIRKSVILLE REGIONAL	MO	2	0.99994930
STL	LAMBERT-ST LOUIS INTL	MO	2	0.99995220
AIZ	LEE C FINE MEMORIAL	MO	2	0.99994930
6M6	LEWIS COUNTY REGIONAL	MO	2	0.99994930
MYJ	MEXICO MEMORIAL	MO	2	0.99994930
STJ	ROSECRANS MEMORIAL	MO	2	0.99993120
DMO	SEDALIA MEMORIAL	MO	2	0.99993134
SIK	SIKESTON MEML MUNICIPAL	MO	4	0.99988693
SGF	SPRINGFIELD-BRANSON NATIONAL	MO	2	0.99993120
TBN	WAYNESVILLE REGIONAL ARPT	MO	2	0.99994930

UNO	WEST PLAINS MUNICIPAL	MO	2	0.99994930
GWO	GREENWOOD-LEFLORE	MS	2	0.99993020
GNF	GRENADA MUNICIPAL	MS	2	0.99994930
GPT	GULFPORT-BILOXI INTL	MS	9	0.99959654
JAN	JACKSON-EVERS INTL	MS	2	0.99993020
MEI	KEY FIELD	MS	2	0.99994930
OLV	OLIVE BRANCH	MS	2	0.99994930
CRX	ROSCOE TURNER	MS	2	0.99994930
UTA	TUNICA MUNICIPAL	MS	2	0.99994930
BTM	BERT MOONEY	MT	5	0.99970317
BIL	BILLINGS LOGAN INTL	MT	4	0.99980235
MLS	FRANK WILEY FIELD	MT	4	0.99979640
GPI	GLACIER PARK INTL	MT	10	0.99919784
HLN	HELENA REGIONAL	MT	6	0.99963090
LWT	LEWISTOWN MUNICIPAL	MT	5	0.99974020
HBI	ASHEBORO REGIONAL	NC	6	0.99968370
AVL	ASHEVILLE REGIONAL	NC	5	0.99979216
CLT	CHARLOTTE/DOUGLAS INTL	NC	6	0.99976340
JQF	CONCORD REGIONAL	NC	6	0.99975490
FAY	FAYETTEVILLE REGIONAL/GRANNIS	NC	7	0.99951440
LHZ	FRANKLIN COUNTY	NC	7	0.99950117
GWW	GOLDSBORO-WAYNE MUNICIPAL	NC	11	0.99901380
ISO	KINSTON REGIONAL JETPORT	NC	11	0.99887960
EQY	MONROE REGIONAL	NC	6	0.99976087
GSO	PIEDMONT TRIAD INTL	NC	6	0.99965507
PGV	PITT-GREENVILLE	NC	11	0.99887590
RDU	RALEIGH-DURHAM INTL	NC	8	0.99952840
RWI	ROCKY MOUNT-WILSON REGIONAL	NC	11	0.99917510
RUQ	ROWAN COUNTY	NC	6	0.99969130
TTA	SANFORD-LEE COUNTY REGIONAL	NC	8	0.99956500
SVH	STATESVILLE REGIONAL	NC	6	0.99970330
ILM	WILMINGTON INTL	NC	11	0.99892765
BIS	BISMARCK MUNICIPAL	ND	8	0.99946620
DIK	DICKINSON - THEODORE ROOSEVELT	ND	9	0.99959630
GFK	GRAND FORKS INTL	ND	14	0.99876270
FAR	HECTOR INTL	ND	10	0.99911720
MOT	MINOT INTL	ND	15	0.99855960
ANW	AINSWORTH MUNICIPAL	NE	2	0.99993120
BIE	BEATRICE MUNICIPAL	NE	2	0.99993120
FNB	BRENNER FIELD	NE	2	0.99993120
GRI	CENTRAL NEBRASKA REGIONAL	NE	3	0.99990726
CDR	CHADRON MUNICIPAL	NE	3	0.99991226
OLU	COLUMBUS MUNICIPAL	NE	2	0.99993120
OMA	EPPLEY AIRFIELD	NE	2	0.99993120
HSI	HASTINGS MUNICIPAL	NE	3	0.99990666
OFK	KARL STEFAN MEMORIAL	NE	2	0.99993120
EAR	KEARNEY MUNICIPAL	NE	3	0.99989600
LNK	LINCOLN	NE	2	0.99993120
MCK	MC COOK REGIONAL	NE	2	0.99993120
VTN	MILLER FIELD	NE	2	0.99993120
LBF	NORTH PLATTE RGNL AIRPORT LEE	NE	2	0.99993120
PMV	PLATTSMOUTH MUNICIPAL	NE	2	0.99993120
SCB	SCRIBNER STATE	NE	2	0.99993120

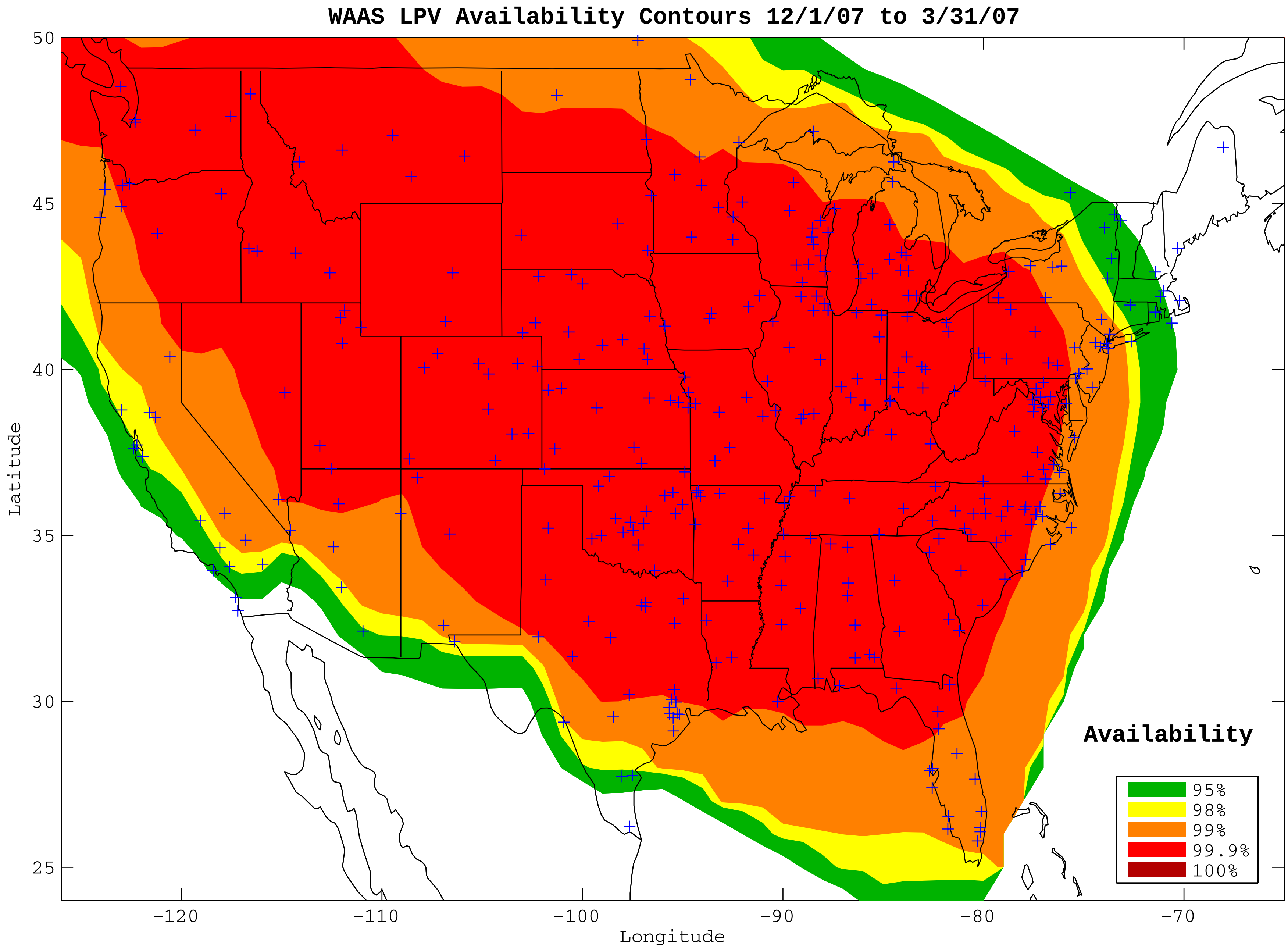
LCG	WAYNE MUNICIPAL	NE	2	0.99993120
BFF	WESTERN NEB. REGIONAL/WILLIAM B. H	NE	2	0.99993120
JYR	YORK MUNICIPAL	NE	2	0.99993120
CON	CONCORD MUNICIPAL	NH	315	0.94634193
ACY	ATLANTIC CITY INTL	NJ	30	0.99801904
WWD	CAPE MAY COUNTY	NJ	18	0.99827087
MIV	MILLVILLE MUNICIPAL	NJ	19	0.99843967
EWR	NEWARK LIBERTY INTL	NJ	75	0.99569390
ABQ	ALBUQUERQUE INTL SUNPORT	NM	3	0.99991250
CVN	CLOVIS MUNICIPAL	NM	3	0.99983734
AEG	DOUBLE EAGLE II	NM	3	0.99990994
FMN	FOUR CORNERS REGIONAL	NM	2	0.99993630
SVC	GRANT COUNTY	NM	41	0.99721150
LRU	LAS CRUCES INTL	NM	52	0.99660534
ROW	ROSWELL INTL AIR CENT	NM	8	0.99972630
LAS	MC CARRAN INTL	NV	27	0.99865013
4SD	RENO/STEAD	NV	20	0.99874884
WMC	WINNEMUCCA MUNICIPAL	NV	8	0.99941660
9G3	AKRON	NY	13	0.99916230
BUF	BUFFALO NIAGARA INTL	NY	13	0.99920330
OLE	CATTARAUGUS COUNTY-OLEAN	NY	11	0.99928635
JHW	CHAUTAUQUA COUNTY/JAMESTOWN	NY	9	0.99942500
ELM	ELMIRA/CORNING REGIONAL	NY	19	0.99878880
FOK	FRANCIS S GABRESKI	NY	165	0.98771720
BGM	GREATER BINGHAMTON	NY	36	0.99776226
ROC	GREATER ROCHESTER INTL	NY	15	0.99886715
JFK	JOHN F KENNEDY INTL	NY	92	0.99471050
LGA	LA GUARDIA	NY	92	0.99463230
MSS	MASSENA INTL-RICHARDS FIELD	NY	255	0.96717894
PBG	PLATTSBURGH INTL	NY	321	0.94940627
SWF	STEWART INTL	NY	111	0.99325055
SYR	SYRACUSE HANCOCK INTL	NY	59	0.99658996
HPN	WESTCHESTER COUNTY	NY	117	0.99321020
CXY	CAPITAL CITY	OH	10	0.99916510
CLE	CLEVELAND-HOPKINS INTL	OH	9	0.99976190
MGY	DAYTON-WRIGHT BROTHERS	OH	3	0.99992190
FDY	FINDLAY	OH	4	0.99985090
DAY	JAMES M COX DAYTON INTL	OH	4	0.99989736
1G3	KENT STATE UNIVERSITY	OH	8	0.99974310
I68	LEBANON-WARREN COUNTY	OH	3	0.99992340
OSU	OHIO STATE UNIVERSITY	OH	3	0.99991786
UNI	OHIO UNIVERSITY SNYDER FIELD	OH	4	0.99982830
CMH	PORT COLUMBUS INTL	OH	4	0.99990030
RZT	ROSS COUNTY	OH	5	0.99988200
TOL	TOLEDO EXPRESS	OH	5	0.99979040
AVK	ALVA REGIONAL	OK	2	0.99993120
CQB	CHANDLER REGIONAL	OK	2	0.99993120
CHK	CHICKASHA MUNICIPAL	OK	3	0.99991316
GCM	CLAREMORE REGIONAL	OK	2	0.99993120
F29	CLARENCE E PAGE MUNICIPAL	OK	3	0.99991566
1K4	DAVID JAY PERRY	OK	3	0.99991680
MKO	DAVIS FIELD	OK	2	0.99993120
DUA	EAKER FIELD	OK	2	0.99993426

2O8	HINTON MUNICIPAL	OK	2	0.99993426
HBR	HOBART MUNICIPAL	OK	4	0.99989610
MLC	MC ALESTER REGIONAL	OK	2	0.99993120
MIO	MIAMI MUNICIPAL	OK	2	0.99993120
MDF	MOORELAND MUNICIPAL	OK	2	0.99993180
OKM	OKMULGEE REGIONAL	OK	2	0.99993120
PVJ	PAULS VALLEY MUNICIPAL	OK	3	0.99991730
PNC	PONCA CITY REGIONAL	OK	3	0.99991580
RVS	RICHARD LLOYD JONES JR	OK	2	0.99993120
2K4	SCOTT FIELD	OK	4	0.99989110
SNL	SHAWNEE REGIONAL	OK	2	0.99993120
SWO	STILLWATER REGIONAL	OK	2	0.99993120
TQH	TAHLEQUAH MUNICIPAL	OK	2	0.99993120
TUL	TULSA INTL	OK	2	0.99993120
OKC	WILL ROGERS WORLD	OK	3	0.99991506
UAO	AURORA STATE	OR	14	0.99892706
LMT	KLAMATH FALLS	OR	21	0.99873490
LGD	LA GRANDE/UNION COUNTY	OR	4	0.99971700
EUG	MAHLON SWEET FIELD	OR	16	0.99838740
SLE	MCNARY FLD	OR	14	0.99877036
ONP	NEWPORT MUNICIPAL	OR	18	0.99834200
PDX	PORTLAND INTL	OR	13	0.99912610
AGC	ALLEGHENY COUNTY	PA	9	0.99961360
AOO	ALTOONA-BLAIR COUNTY	PA	9	0.99945500
HZL	HAZLETON MUNICIPAL	PA	19	0.99882310
JST	JOHN MURTHA JOHNSTOWN-CAMBRIA	PA	9	0.99950780
LNS	LANCASTER	PA	13	0.99907243
ABE	LEHIGH VALLEY INTL	PA	22	0.99842820
PNE	NORTHEAST PHILADELPHIA	PA	26	0.99832326
PHL	PHILADELPHIA INTL	PA	22	0.99856824
PIT	PITTSBURGH INTL	PA	8	0.99965190
FWQ	ROSTRAVER	PA	8	0.99962140
OYM	ST MARYS MUNICIPAL	PA	9	0.99941120
UNV	UNIVERSITY PARK	PA	9	0.99925540
FKL	VENANGO REGIONAL	PA	9	0.99955076
PVD	THEODORE FRANCIS GREEN STATE	RI	263	0.95440660
AIK	AIKEN MUNICIPAL	SC	5	0.99979230
AND	ANDERSON REGIONAL	SC	5	0.99979980
CHS	CHARLESTON AFB/INTL	SC	10	0.99913514
CAE	COLUMBIA METROPOLITAN	SC	5	0.99977410
GSP	GREENVILLE SPARTANBURG INTL	SC	5	0.99977905
MYR	MYRTLE BEACH INTL	SC	11	0.99901783
ABR	ABERDEEN REGIONAL	SD	6	0.99970263
BKX	BROOKINGS REGIONAL	SD	4	0.99988085
HON	HURON REGIONAL	SD	5	0.99983150
FSD	JOE FOSS FIELD	SD	2	0.99993120
PIR	PIERRE REGIONAL	SD	6	0.99982560
RAP	RAPID CITY REGIONAL	SD	3	0.99989230
PVE	BEECH RIVER REGIONAL	TN	2	0.99995220
UCY	EVERETT-STEWART	TN	3	0.99993220
CHA	LOVELL FIELD	TN	4	0.99991390
TYS	MC GHEE TYSON	TN	8	0.99981034
MEM	MEMPHIS INTL	TN	2	0.99994930

NQA	MILLINGTON REGIONAL JETPORT	TN	3	0.99993044
BNA	NASHVILLE INTL	TN	2	0.99995220
TRI	TRI-CITIES REGIONAL TN/VA	TN	5	0.99976330
ABI	ABILENE REGIONAL	TX	6	0.99964410
ADS	ADDISON	TX	5	0.99983220
ALI	ALICE INTL	TX	143	0.97753200
LFK	ANGELINA COUNTY	TX	7	0.99951990
GKY	ARLINGTON MUNICIPAL	TX	5	0.99974155
AUS	AUSTIN-BERGSTROM INTL	TX	11	0.99899370
LBX	BRAZORIA COUNTY	TX	27	0.99727780
BWD	BROWNWOOD REGIONAL	TX	6	0.99959180
E30	BRUCE FIELD	TX	9	0.99945440
TKI	COLLIN COUNTY REGIONAL AT MC K	TX	5	0.99987510
CRP	CORPUS CHRISTI INTL	TX	147	0.97807896
RBD	DALLAS EXECUTIVE	TX	5	0.99976060
DAL	DALLAS LOVE FIELD	TX	5	0.99979370
DFW	DALLAS/FORT WORTH INTL	TX	5	0.99978620
DWH	DAVID WAYNE HOOKS MEMORIAL	TX	9	0.99892414
DRT	DEL RIO INTL	TX	43	0.99602294
TPL	DRAUGHON-MILLER CENTRAL TEXAS	TX	5	0.99950624
CLL	EASTERWOOD FIELD	TX	6	0.99935570
EBG	EDINBURG INTL	TX	538	0.90096617
ELP	EL PASO INTL	TX	59	0.99558710
AFW	FORT WORTH ALLIANCE	TX	5	0.99978083
FWS	FORT WORTH SPINKS	TX	6	0.99971270
IAH	GEORGE BUSH INTERCONTINENTAL	TX	9	0.99887186
PVW	HALE COUNTY	TX	6	0.99981153
AXH	HOUSTON-SOUTHWEST	TX	21	0.99806356
ERV	KERRVILLE MUNI/LOUIS SCHREINER	TX	12	0.99888760
LNC	LANCASTER	TX	5	0.99976060
LRD	LAREDO INTL	TX	196	0.97555950
CXO	LONE STAR EXECUTIVE	TX	7	0.99915120
LBB	LUBBOCK PRESTON SMITH INTL	TX	7	0.99976915
GVT	MAJORS	TX	2	0.99993426
MFE	MC ALLEN MILLER INTL	TX	632	0.87605630
HQZ	MESQUITE METRO	TX	5	0.99980070
MAF	MIDLAND INTL	TX	15	0.99903923
OSA	MOUNT PLEASANT REGIONAL	TX	2	0.99993426
RAS	MUSTANG BEACH	TX	147	0.98095036
BAZ	NEW BRAUNFELS MUNICIPAL	TX	24	0.99829160
AMA	RICK HUSBAND AMARILLO INTL	TX	3	0.99985236
SJT	SAN ANGELO REGIONAL/MATHIS FIELD	TX	10	0.99929905
SAT	SAN ANTONIO INTL	TX	24	0.99821050
GLS	SCHOLES INTL AT GALVESTON	TX	24	0.99797110
SPS	SHEPPARD AFB/WICHITA FALLS	TX	5	0.99983150
SGR	SUGAR LAND REGIONAL	TX	21	0.99816720
T43	T P MC CAMPBELL	TX	138	0.98213380
TRL	TERRELL MUNICIPAL	TX	5	0.99985460
TYR	TYLER POUNDS REGIONAL	TX	3	0.99990890
IWS	WEST HOUSTON	TX	21	0.99848150
HOU	WILLIAM P HOBBY	TX	21	0.99834680
CDC	CEDAR CITY REGIONAL	UT	6	0.99972606
KNB	KANAB MUNICIPAL	UT	4	0.99983275

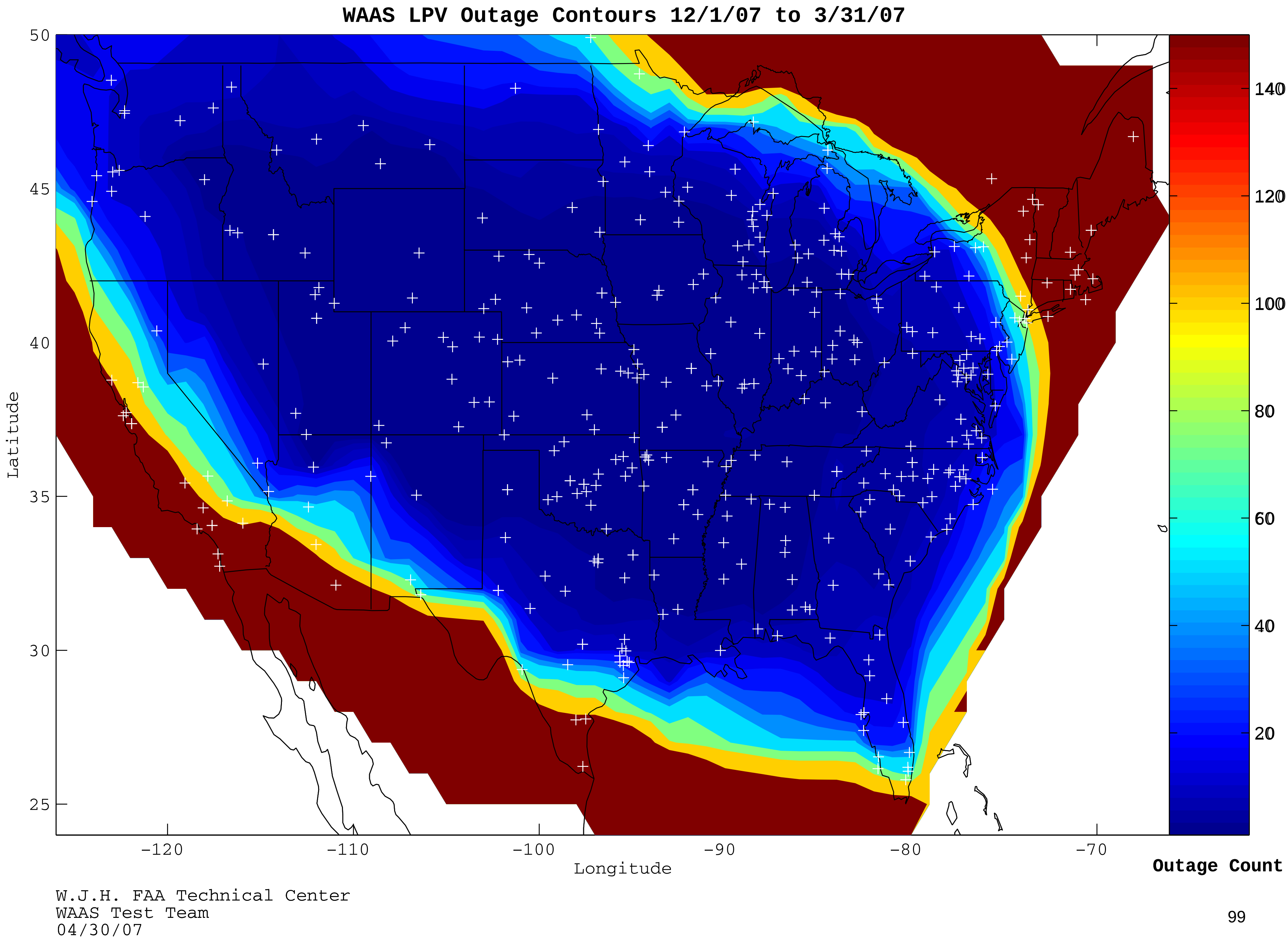
LGU	LOGAN-CACHE	UT	3	0.99987596
OGD	OGDEN-HINCKLEY	UT	3	0.99988410
PVU	PROVO MUNICIPAL	UT	3	0.99990195
SLC	SALT LAKE CITY INTL	UT	3	0.99989086
SGU	ST GEORGE MUNICIPAL	UT	6	0.99963397
CHO	CHARLOTTESVILLE-ALBEMARLE	VA	7	0.99954000
FCI	CHESTERFIELD COUNTY	VA	7	0.99942610
JYO	LEESBURG EXECUTIVE	VA	8	0.99942344
HEF	MANASSAS REGIONAL	VA	7	0.99942523
PSK	NEW RIVER VALLEY	VA	6	0.99965470
PHF	NEWPORT NEWS/WILLIAMSBURG INTL	VA	10	0.99891550
ORF	NORFOLK INTL	VA	12	0.99864876
RIC	RICHMOND INTL	VA	7	0.99940896
RMN	STAFFORD REGIONAL	VA	7	0.99944150
BCB	VIRGINIATECH/MONTGOMERY EXECUT	VA	6	0.99964260
IAD	WASHINGTON DULLES INTL	VA	8	0.99941190
FSO	FRANKLIN COUNTY STATE	VT	352	0.94134800
BLI	BELLINGHAM INTL	WA	15	0.99914515
FHR	FRIDAY HARBOR	WA	15	0.99911770
MWH	GRANT CO INTL	WA	9	0.99937016
PUW	PULLMAN/MOSCOW REGIONAL	WA	5	0.99953080
RLD	RICHLAND	WA	4	0.99964790
SEA	SEATTLE-TACOMA INTL	WA	12	0.99934600
BVS	SKAGIT REGIONAL	WA	14	0.99917465
PAE	SNOHOMISH COUNTY (PAINE FIELD)	WA	10	0.99941290
GEG	SPOKANE INTL	WA	10	0.99925560
ALW	WALLA WALLA REGIONAL	WA	4	0.99964490
GRB	AUSTIN STRAUBEL INTL	WI	9	0.99954367
CWA	CENTRAL WISCONSIN	WI	6	0.99964530
MSN	DANE COUNTY REGIONAL-TRUAX FIELD	WI	4	0.99986100
EGV	EAGLE RIVER UNION	WI	11	0.99920714
FLD	FOND DU LAC COUNTY	WI	5	0.99978215
MKE	GENERAL MITCHELL INTL	WI	6	0.99978260
MTW	MANITOWOC COUNTY	WI	7	0.99956375
MFI	MARSHFIELD MUNICIPAL	WI	5	0.99974030
ATW	OUTAGAMIE COUNTY REGIONAL	WI	7	0.99959797
RHI	RHINELANDER-ONEIDA COUNTY	WI	11	0.99932986
RPD	RICE LAKE REGIONAL	WI	7	0.99961257
SBM	SHEBOYGAN COUNTY MEMORIAL	WI	6	0.99971970
OSH	WITTMAN REGIONAL	WI	5	0.99976970
PKB	MID-OHIO VALLEY REGIONAL	WV	5	0.99975604
MGW	MORGANTOWN MUNICIPAL -WALTER L. BILL	WV	6	0.99966350
HTS	TRI-STATE/MILTON J. FERGUSON	WV	5	0.99980503
CYS	CHEYENNE REGIONAL/JERRY OLSON	WY	2	0.99993426
GCC	GILLETTE-CAMPBELL COUNTY	WY	3	0.99987775
JAC	JACKSON HOLE	WY	3	0.99986530
LAR	LARAMIE REGIONAL	WY	2	0.99993616
CPR	NATRONA COUNTY INTL	WY	3	0.99989724
RIW	RIVERTON REGIONAL	WY	3	0.99988010
RKS	ROCK SPRINGS-SWEETWATER COUNTY	WY	3	0.99989960
COD	YELLOWSTONE REGIONAL	WY	3	0.99986520

Figure 9-1 WAAS LPV Availability



W.J.H. FAA Technical Center
WAAS Test Team
04/30/07

Figure 9-2 WAAS LPV Outage



10.0 WAAS DETERMINISTIC CODE NOISE AND MULTIPATH BOUNDING ANALYSIS

WAAS utilizes a deterministic model to estimate the residual CNMP noise after the application of standard dual frequency carrier smoothing techniques to minimize the effects of multipath and code noise. This analysis performs an assessment of how well that deterministic model bounds the actual errors. This analysis is periodically performed as part of the WAAS Test Team's off-line monitoring to ensure that there are no drastic detrimental changes to the multipath environment at the WAAS Reference Stations (WRSs). This analysis also ensures that WAAS system is not indefinitely exposed to conspiring receiver failure symptoms that would invalidate the CNMP bounding estimate in a manner that would exceed the assumption that no more than one receiver is conspiring to deceive the WAAS monitors at any time by underestimating the residual measurement noise the safety monitors. Although some failures mechanisms that cause CNMP bounding issues are occasionally seen, no "conspiring" errors have ever been detected. That is, data has caused the safety monitors to trip unnecessarily versus missing a necessary trip.

The analysis post processes measurement data to estimate the pseudorange code to carrier ambiguity for each entire arc of measurements for each satellite pass. The ambiguity estimate is then used to level the carrier measurement. The leveled carrier is then used as a multipath free truth estimate. The WAAS real time deterministic CNMP smoothing algorithm is then applied to the original measurements. The difference between the smoothed measurements and the leveled truth measurements is compared to the deterministic noise estimates. Only arcs with continuous carrier phase greater in length than 7200 seconds are utilized for this analysis to minimize the impacts of non-zero mean multipath biasing the truth estimates. The WAAS dual frequency cycle slip detector algorithm is used to detect any discontinuities in the carrier phase.

Statistics are calculated on how well the 0.1 multiples of the deterministically estimated standard deviation bounds the difference between the leveled truth and the real time smoothed measurements. Those statistics are then compared to a theoretical gaussian distribution and an extensive set of plots are generated and manually reviewed. Table 10.1 recaps the results of that manual analysis.

Table 10-1 CNMP Bounding Statistics

WAAS Site	WRE	Apr 06	May 06	Jun 06	Jul 06	Aug 06	Sep 06	Oct 06	Nov 06	Dec 06	Jan 07	Feb 07	Mar 07
Albuquerque	A	green	blue	green	red	green	yellow	blue	green	green	blue	blue	blue
	B	green	green	blue	red	green	blue	blue	green	blue	blue	green	blue
	C	yellow	blue	yellow	blue	yellow	red	blue	blue	blue	blue	yellow	blue
Anchorage	A	green	red	red	green	red	red	red	green	green	red	green	yellow
	B	green	yellow	yellow	red	red	red	yellow	red	red	green	green	red
	C	yellow	red	red	red	yellow	red	red	red	yellow	red	red	red
Atlanta	A	blue	blue	yellow	yellow	blue	blue	green	green	blue	blue	blue	blue
	B	blue	blue	blue	yellow	blue	blue	yellow	blue	blue	blue	blue	blue
	C	blue	blue	green	green	yellow	blue	yellow	blue	blue	blue	blue	blue
Billings	A	blue	green	yellow	red	green	blue	blue	blue	blue	green	blue	green
	B	blue	yellow	green	yellow	green	blue	blue	blue	green	green	blue	blue
	C	blue	yellow	green	green	blue	blue	blue	blue	blue	green	blue	green
Boston	A	blue	yellow	yellow	yellow	blue	blue	blue	blue	green	blue	blue	blue
	B	green	yellow	blue	blue	blue	yellow	green	green	yellow	blue	yellow	yellow
	C	blue	blue	blue	blue	yellow	blue	blue	green	blue	blue	blue	blue
Chicago	A	yellow	green	blue	green	yellow	blue	green	blue	blue	green	blue	green
	B	green	green	green	blue	green	blue	blue	blue	yellow	green	blue	blue
	C	green	yellow	green	blue	blue	red	blue	green	blue	blue	yellow	blue
Cleveland	A	blue	blue	red	yellow	blue	blue	blue	green	yellow	green	green	yellow
	B	blue	yellow	green	blue	blue	green	green	blue	blue	blue	green	red
	C	green	green	blue	blue	green	yellow	green	yellow	yellow	green	blue	yellow
Cold Bay	A	green	red	yellow	yellow	yellow	red	red	yellow	green	green	yellow	red
	B	blue	red	red	red	red	yellow	yellow	red	red	red	red	red
	C	blue	yellow	red	yellow	yellow	red	yellow	red	yellow	red	yellow	green
Dallas	A	green	red	red	yellow	yellow	red	red	yellow	red	red	red	red
	B	yellow	red	red	red	red	red	red	red	red	yellow	red	red
	C	green	red	yellow	red	red	red	yellow	red	red	red	red	red
Denver	A	yellow	green	blue	blue	blue	blue	yellow	green	blue	blue	yellow	yellow
	B	blue	green	blue	blue	blue	green	blue	blue	blue	blue	blue	yellow
	C	green	green	red	yellow	yellow	green	blue	blue	yellow	blue	blue	green
Honolulu	A	yellow	green	green	blue	blue	yellow	green	red	green	yellow	green	green
	B	blue	blue	blue	blue	blue	blue	blue	green	blue	blue	blue	blue
	C	green	yellow	red	blue	blue	green	blue	red	green	yellow	green	green
Houston	A	red	red	red	green	green	yellow	yellow	red	green	green	yellow	yellow
	B	red	green	blue	yellow	green	green	yellow	yellow	yellow	red	green	yellow
	C	blue	yellow	blue	blue	green	yellow	yellow	yellow	red	green	red	red
Jacksonville	A	blue	green	blue	blue	yellow	blue	blue	green	blue	green	blue	blue
	B	green	blue	blue	blue	green	blue	green	blue	green	green	green	blue
	C	yellow	yellow	yellow	blue	blue	blue	green	blue	blue	green	blue	blue
Juneau	A	blue	green	yellow	yellow	green	blue	red	green	green	yellow	yellow	red
	B	green	yellow	blue	blue	green	green	blue	blue	blue	blue	blue	yellow
	C	blue	yellow	blue	yellow	green	green	blue	green	blue	blue	blue	yellow
Kansas City	A	yellow	yellow	yellow	yellow	yellow	red	red	red	red	red	red	red
	B	yellow	red	red	red	red	red	red	yellow	green	yellow	red	red
	C	green	red	yellow	green	green	blue	red	red	red	green	blue	yellow
Los Angeles	A	blue	blue	yellow	blue	green	yellow	green	blue	green	blue	blue	yellow
	B	blue	blue	blue	green	blue	blue	blue	blue	blue	blue	blue	blue
	C	blue	blue	blue	yellow	blue	yellow	blue	blue	blue	blue	blue	green
Memphis	A	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
	B	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
	C	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	green	blue
Miami	A	yellow	yellow	yellow	green	green	yellow	yellow	red	yellow	yellow	yellow	yellow
	B	blue	blue	blue	blue	blue	red	blue	blue	blue	green	green	blue
	C	blue	yellow	blue	yellow	yellow	red	green	blue	blue	yellow	blue	blue
Minneapolis	A	blue	green	red	red	red	red	red	red	red	green	yellow	red
	B	blue	green	red	red	red	red	yellow	red	red	yellow	red	green
	C	yellow	red	red	yellow	yellow	green	blue	yellow	yellow	red	red	yellow
New York	A	blue	blue	blue	yellow	yellow	blue	blue	blue	green	blue	blue	blue
	B	green	green	yellow	blue	blue	blue	blue	blue	yellow	yellow	green	blue
	C	green	blue	blue	red	red	green	blue	blue	red	red	red	red
Oakland	A	yellow	red	blue	yellow	red	yellow	red	red	green	yellow	red	red
	B	green	green	red	red	red	red	red	red	red	red	red	red
	C	yellow	yellow	red	red	yellow	red	red	red	red	red	green	red
Salt Lake City	A	red	yellow	red	yellow	red	red	green	yellow	yellow	red	red	red
	B	green	green	red	yellow	blue	red	yellow	green	yellow	green	yellow	yellow
	C	blue	green	green	yellow	red	red	yellow	green	yellow	red	yellow	green
San Juan	A	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
	B	blue	blue	yellow	blue	yellow	blue	blue	blue	blue	blue	blue	blue
	C	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	green	blue

Seattle	A	green	yellow	red	red	red	red	red	green	red	green	green	red
	B	blue	yellow	yellow	red	green	red	yellow	red	yellow	red	red	blue
	C	blue	yellow	red	red	green	green	blue	yellow	blue	blue	red	green
Washington, DC	A	blue	yellow	green	green	red	red	blue	blue	green	blue	green	yellow
	B	blue	green	green	red	yellow	blue	yellow	yellow	blue	yellow	yellow	blue
	C	blue	yellow	yellow	red	yellow	blue	yellow	red	yellow	green	green	yellow

- **Excellent** - 3.29σ bounded 100%
- **Good** - 4σ bounded 100%
- **Fair** - 4σ bounded 100% with one worst satellite excluded (Requires manual review if symptoms repeat from month to month)
- **Poor** – Requires manual review

Shaded receivers represent legacy receivers (non-G2). These receivers are predominantly the trouble receivers, with over 95% of their failures occurring on the L2 frequency.

Appendix A: Glossary

General Terms and Definitions

Alert. An alert is an indication provided by the GPS/WAAS equipment to inform the user when the positioning performance achieved by the equipment does not meet the integrity requirements.

APV-ILNAV/VNAV. APV-I is a WAAS operational service level with an HAL equal to 556 meters and a VAL equal to 50 meters.

Availability. The availability of a navigation system is the ability of the system to provide the required function and performance at the initiation of the intended operation. Availability is an indication of the ability of the system to provide usable service within the specified coverage area.

AVP-II. APV-II is a WAAS operational service level with an HAL equal to 40 meters and a VAL equal to 20 meters.

CONUS. Continental United States.

Continuity. The continuity of a system is the ability of the total system (comprising all elements necessary to maintain aircraft position within the defined airspace) to perform its function without interruption during the intended operation. More specifically, continuity is the probability that the specified system performance will be maintained for the duration of a phase of operation, presuming that the system was available at the beginning of that phase of operation.

Coverage. The coverage provided by a radio navigation system is that surface area or space volume in which the signals are adequate to permit the user to determine position to a specified level of accuracy. Coverage is influenced by system geometry, signal power levels, receiver sensitivity, atmospheric noise conditions, and other factors that affect signal availability.

Dilution of Precision (DOP). The magnifying effect on GPS position error induced by mapping GPS ranging errors into position through the position solution. The DOP may be represented in any user local coordinate desired. Examples are HDOP for local horizontal, VDOP for local vertical, PDOP for all three coordinates, and TDOP for time.

DR. Discrepancy Report

Fault Detection and Exclusion (FDE). Fault detection and exclusion is a receiver processing scheme that autonomously provides integrity monitoring for the position solution, using redundant range measurements. The FDE consists of two distinct parts: fault detection and fault exclusion. The fault detection part detects the presence of an unacceptably large position error for a given mode of flight. Upon the detection, fault exclusion follows and excludes the source of the unacceptably large position error, thereby allowing navigation to return to normal performance without an interruption in service.

GEO. Geostationary Satellite.

Global Positioning System (GPS). A space-based positioning, velocity, and time system composed of space, control, and user segments. The space segment, when fully operational, will be composed of 24 satellites in six orbital planes. The control segment consists of five monitor stations, three ground antennas, and a master control station. The user segment consists of antennas and receiver-processors that provide positioning, velocity, and precise timing to the user.

GLS. GLS is a WAAS operational service level with HAL equal to 40 meters and VAL equal to 12 meters.

Grid Ionospheric Vertical Error (GIVE). GIVEs indicate the accuracy of ionospheric vertical delay correction at a geographically defined ionospheric grid point (IGP). WAAS transmits one GIVE for each IGP in the mask.

Hazardous Misleading Information (HMI). Hazardous misleading information is any position data, that is output, that has an error larger than the current protection level (HPL/VPL), without any indication of the error (e.g., alert message sequence).

Horizontal Alert Limit (HAL). The Horizontal Alert Limit (HAL) is the radius of a circle in the horizontal plane (the local plane tangent to the WGS-84 ellipsoid), with its center being at the true position, which describes the region that is required to contain the indicated horizontal position with a probability of $1\text{-}10^{-7}$ per flight hour, for a particular navigation mode, assuming the probability of a GPS satellite integrity failure being included in the position solution is less than or equal to 10^{-4} per hour.

Horizontal Protection Level (HPL). The Horizontal Protection Level is the radius of a circle in the horizontal plane (the plane tangent to the WGS-84 ellipsoid), with its center being at the true position, which describes the region that is assured to contain the indicated horizontal position. It is based upon the error estimates provided by WAAS.

Ionospheric Grid Point (IGP). IGP is a geographically defined point for which the WAAS provides the vertical ionospheric delay.

LNAV. Lateral Navigation.

MOPS. Minimum Operational Performance Standards.

Navigation Message. Message structure designed to carry navigation data.

Non-Precision Approach (NPA) Navigation Mode. The Non-Precision Approach navigation mode refers to the navigation solution operating with a minimum of four satellites with fast and long term WAAS corrections (no WAAS ionospheric corrections) available.

Position Solution. The use of ranging signal measurements and navigation data from at least four satellites to solve for three position coordinates and a time offset.

Precision Approach (PA) Navigation Mode. The Precision Approach navigation mode refers to the navigation solution operating with a minimum of four satellites with all WAAS corrections (fast, long term, and ionospheric) available.

Selective Availability. Protection technique employed by the DOD to deny full system accuracy to unauthorized users.

Standard Positioning Service (SPS). Three-dimensional position and time determination capability provided to a user equipped with a minimum capability GPS SPS receiver in accordance with GPS national policy and the performance specifications.

SV. Satellite Vehicle.

User Differential Range Error (UDRE). UDRE's indicate the accuracy of combined fast and slow error corrections. WAAS transmits one UDRE for each satellite in the mask.

Vertical Alert Limit (VAL). The Vertical Alert Limit is half the length of a segment on the vertical axis (perpendicular to the horizontal plane of WGS-84 ellipsoid), with its center being at the true position, which describes the region that is required to contain the indicated vertical position with a probability of $1\text{-}10^{-7}$ per flight hour, for a particular navigation mode, assuming the probability of a GPS satellite integrity failure being included in the position solution is less than or equal to 10^{-4} per hour.

Vertical Protection Level (VPL). The Vertical Protection Level is half the length of a segment on the vertical axis (perpendicular to the horizontal plane of WGS-84 ellipsoid), with its center being at the true position, which describes the region that is assured to contain the indicated vertical position. It is based upon the error estimates provided by WAAS.

VNAV. Vertical Navigation.

Wide Area Augmentation System (WAAS). The WAAS is made up of an integrity reference monitoring network, processing facilities, geostationary satellites, and control facilities. Wide area reference stations and integrity monitors are widely dispersed data collection sites that contain GPS/WAAS ranging receivers that monitor all signals from the GPS, as well as the WAAS geostationary satellites. The reference stations collect measurements from the GPS and WAAS satellites so that differential corrections, ionospheric delay information, GPS/WAAS accuracy, WAAS network time, GPS time, and UTC can be determined. The wide area reference station and integrity monitor data are forwarded to the central data processing sites. These sites process the data in order to determine differential corrections, ionospheric delay information, and GPS/WAAS accuracy, as well as verify residual error bounds for each monitored satellite. The central data processing sites also generate navigation messages for the geostationary satellites and WAAS messages. This information is modulated on the GPS-like signal and broadcast to the users from geostationary satellites.