WIDE-AREA AUGMENTATION SYSTEM PERFORMANCE ANALYSIS REPORT

Report #9

Reporting Period: April 1 to June 30, 2004

August 2004

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 ninth such WAAS quarterly report. This report covers WAAS performance during the period from April 1, 2004 to June 30, 2004. This period is the 4th quarter in which the WAAS is a fully commissioned system in the National Airspace System (NAS).

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, continuity, 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	Site/Maximum	Site/Minimum
95% Horizontal Accuracy	Elko 3.466 meters	Minneapolis 0.614 meters
95% Vertical Accuracy	Elko 3.208	Kansas City 1.071 meters
LPV Instantaneous Availability (HPL < 40 meters & VPL < 50 meters)	Salt Lake City 99.9%	San Angelo 98.5%
95% HPL	San Angelo 28.230 meters	Kansas City 16.25
95% VPL	San Angelo 44.234 meters	Kansas City 27.663 meters

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDIX

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) and PRN#134 (POR) were used in the evaluation. 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 April 1, 2004 to June 30, 2004.

Table 1-1 PA Sites

	Number of Days Evaluated	Number of Samples
NSTB:		
Anderson	85	7339057
Atlantic City	83	7157027
Elko	86	7423837
Grand Forks	91	7854603
Great Falls	90	7806850
Oklahoma City	90	7787544
San Angelo	88	7596445
WAAS:		
Albuquerque	91	7851117
Atlanta	91	7852291
Billings	87	7497124
Boston	91	7826509
Chicago	91	7826108
Cleveland	91	7850690
Dallas	91	7835484
Denver	91	7855542
Houston	91	7839835
Jacksonville	91	7855351
Kansas City	91	7856008
Los Angeles	91	7849756
Memphis	91	7851161
Miami	91	7844365
Minneapolis	91	7846823
New York	91	7852445
Oakland	91	7853177
Salt Lake City	91	7853376
Seattle	91	7853110
Washington DC	91	7856804

Table 1-2 NPA Sites

Location	Number of Days Evaluated	Number of Samples
Albuquerque	91	7854672
Anchorage	90	7809955
Atlanta	91	7855348
Bethel	89	7708360
Billings	87	7557235
Boston	91	7841952
Cleveland	91	7856188
Cold Bay	90	7801491
Fairbanks	83	7199462
Honolulu	91	7858334
Houston	91	7842828
Juneau	90	7794749
Kansas City	91	7859244
Kotzebue	89	7716451
Los Angeles	91	7853428
Mauna Loa	82	7104782
Miami	91	7847781
Minneapolis	91	7858956
Oakland	91	7858504
Puerto Rico	91	7858073
Salt Lake City	91	7857839
Seattle	91	7857840
Washington DC	91	7859935

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

1. WAAS Position Accuracy
2. WAAS Operational Service Availability
3. Coverage
4. Continuity
5. Integrity
6. WAAS Range Domain Accuracy
7. 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. In future reports the performance parameters will be derived from 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
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
NPA Continuity of Navigation	≥ 99.999% of the time
NPA Continuity of Fault Detection	≥ 99.999% of the time
PA Continuity of Function (LNAV/VNAV and LPV)	1-5.5 x 10^{-5} per approach
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.

Table 1-4 Test Events

Date	Site	Events
2/4/04 to 5/20/04	Bangor	Bangor outage.
4/22/04	All	SV PRN 8 anomaly. (48 sec outage, all receivers lost track. Position and range errors increased on reacquiring.)
4/24/04 to 4/27/04	Prescott	Prescott outage.
5/6/04	All WAAS Sites	WEI outage. (2 outages, 155 & 152 sec.)
5/7/04 to 5/12/04	Anderson	Anderson outage.
5/15/04 to 5/21/04	Atlantic City	Atlantic City outage.
5/21/04 to end of qtr.	Bangor	Bangor not evaluated. Many bad / filtered samples from receiver. Problem persists beyond end of quarter.
6/24/04	All	All site outage, 489+ sec.
6/25/04 to 6/30/04	Elko	Elko outage.

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.

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 provides the percentage of time continuity requirements were met during the reporting period for each receiver. Please note that these continuity requirements are from the WAAS Specification FAA-E-2892B Change 1. The definition for continuity is being evaluated from an operational perspective. The continuity analysis will be reported to reflect this new definition in future reports.

Section 6 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 and POR.

Section 7 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 8 provides the GEO ranging performance for AORW and POR.

Section 9 summarizes WAAS anomalies and problems identified during the reporting period, which adversely affect WAAS performance described in Table 1.3.

Section 10 provides WAAS LPV availability and outages at selected airports.

Section 11 provides the assessment of WAAS CNMP bounding for 75 WAAS receivers.

Section 12 summarizes WAAS equipment outages and GUS switchovers.

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 (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 7.6 meters for both WAAS operational service levels. The maximum 95% horizontal and vertical LPV errors are 3.466 and 3.208 meters respectively, both at the Elko NSTB site. Both of these maximum errors are not in line the other locations indicating a possible issue with the Elko site. The minimum 95% horizontal and vertical LPV errors are 0.614 meters at Atlanta and 1.071 meters at Oklahoma City and Kansas City, respectively. The maximum 95% and 99.999% NPA horizontal errors are 5.517 meters and 17.995 meters both at Mauna Loa. The minimum 95% and 99.999% horizontal errors are1.825 meters at Fairbanks and 3.935 meters at Juneau.

Table 2.4 shows the maximum horizontal and vertical position errors while the caluculated HPL and VPL met the LPV service levels. Also shown is the ratio of the maximum position error divided by the calculated protection level for that second. In future reports the maximum of the quantity position error divided by protection level will be reported.

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, Oklahoma 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)
Anderson	0.745	0.746	1.424	99.99296	*	*
Atlantic City	0.858	0.862	1.380	99.99419	*	*
Elko	3.466	3.467	3.208	100.00	4.709	6.504
Grand Forks	0.860	0.868	1.523	99.99329	*	*
Great Falls	0.904	0.908	1.318	99.99413	*	*
Oklahoma City	0.794	0.795	1.071	99.99327	*	*
San Angelo	0.876	0.880	1.402	99.99302	*	*
Albuquerque	0.758	0.758	1.103	99.99336	4.121	5.649
Atlanta	0.614	0.614	1.193	99.99345	3.863	5.612
Billings	0.794	0.794	1.294	99.99468	3.623	5.044
Boston	0.814	0.816	1.339	99.99339	3.505	4.971
Chicago	0.643	0.647	1.146	99.99342	*	*
Cleveland	0.724	0.729	1.272	99.99336	3.628	5.445
Dallas	0.871	0.872	1.442	99.99349	*	*
Denver	0.741	0.742	1.476	99.99331	*	*
Houston	0.807	0.807	1.181	99.99343	4.394	5.751
Jacksonville	0.843	0.843	1.340	99.99343	*	*
Kansas City	0.649	0.651	1.071	99.99345	3.804	5.596
Los Angeles	1.250	1.253	1.752	99.99992	4.474	6.021
Memphis	0.718	0.719	1.241	99.99348	*	*
Miami	0.927	0.927	1.594	99.99329	4.488	5.622
Minneapolis	1.013	1.018	1.695	99.99323	3.679	5.315
New York	0.826	0.831	1.227	99.9934	*	*
Oakland	0.921	0.924	2.054	99.99992	4.129	5.748
Salt Lake City	0.728	0.729	1.213	100.00	3.892	5.520
Seattle	0.961	0.962	1.514	99.99992	3.657	4.832
Washington DC	0.850	0.853	1.151	99.99342	3.573	5.397

* 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	2.903	8.782	99.991179	19.716
Anchorage	1.914	4.060	99.987549	6.639
Atlanta	2.459	7.710	99.991244	7.847
Bethel	3.044	7.362	99.988592	9.398
Billings	2.522	8.122	99.992365	8.444
Boston	1.831	9.087	99.991369	9.288
Cleveland	2.072	7.491	99.991167	7.841
Cold Bay	2.360	5.447	99.986899	6.914
Fairbanks	1.825	4.127	99.986309	6.986
Honolulu	4.564	12.290	99.985528	13.938
Houston	3.196	9.251	99.991238	9.379
Juneau	1.852	3.935	99.987400	6.185
Kansas City	2.340	6.116	99.991274	8.357
Kotzebue	2.637	4.727	99.987191	8.589
Los Angeles	3.566	9.959	99.997735	10.262
Mauna Loa	5.517	17.995	99.986947	19.140
Miami	2.935	6.782	99.991095	9.830
Minneapolis	2.785	8.811	99.991065	9.831
Oakland	3.014	10.121	99.997723	10.322
Puerto Rico	3.082	7.264	99.990517	7.818
Salt Lake City	2.621	8.887	99.997735	9.118
Seattle	2.371	7.298	99.997544	7.568
Washington DC	2.435	6.368	99.998599	7.523

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	3.804	0.178	0.182	5.910	0.176	0.176
Anderson	3.518	0.089	0.240	4.569	0.093	0.146
Grand Forks	5.762	0.149	0.230	6.879	0.221	0.253
Great Falls	3.805	0.183	0.206	7.317	0.157	0.168
Oklahoma City	3.021	0.231	0.231	3.385	0.111	0.122
San Angelo	2.863	0.183	0.183	5.648	0.116	0.158
Albuquerque	2.916	0.228	0.228	4.060	0.106	0.136
Atlanta	3.185	0.259	0.259	4.551	0.095	0.135
Billings	3.663	0.099	0.225	5.678	0.114	0.150
Boston	3.191	0.183	0.183	6.235	0.155	0.155
Chicago	3.935	0.154	0.228	4.696	0.114	0.177
Cleveland	3.881	0.097	0.195	5.601	0.112	0.185
Dallas	5.233	0.322	0.322	8.191	0.205	0.229
Denver	2.881	0.237	0.237	6.551	0.223	0.264
Houston	2.713	0.196	0.196	4.135	0.129	0.169
Jacksonville	4.015	0.119	0.214	4.921	0.099	0.133
Kansas City	2.914	0.237	0.237	6.177	0.125	0.154
Los Angeles	4.526	0.126	0.193	7.074	0.150	0.170
Memphis	2.810	0.228	0.228	4.557	0.103	0.195
Miami	2.907	0.165	0.165	4.651	0.100	0.166
Minneapolis	4.385	0.151	0.199	7.794	0.191	0.202
New York City	3.124	0.103	0.179	6.152	0.209	0.209
Oakland	4.579	0.127	0.164	6.031	0.147	0.183
Salt Lake City	2.866	0.233	0.233	4.547	0.113	0.166
Seattle	3.535	0.094	0.197	4.680	0.142	0.149
Washington DC	4.149	0.150	0.195	5.919	0.141	0.151

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

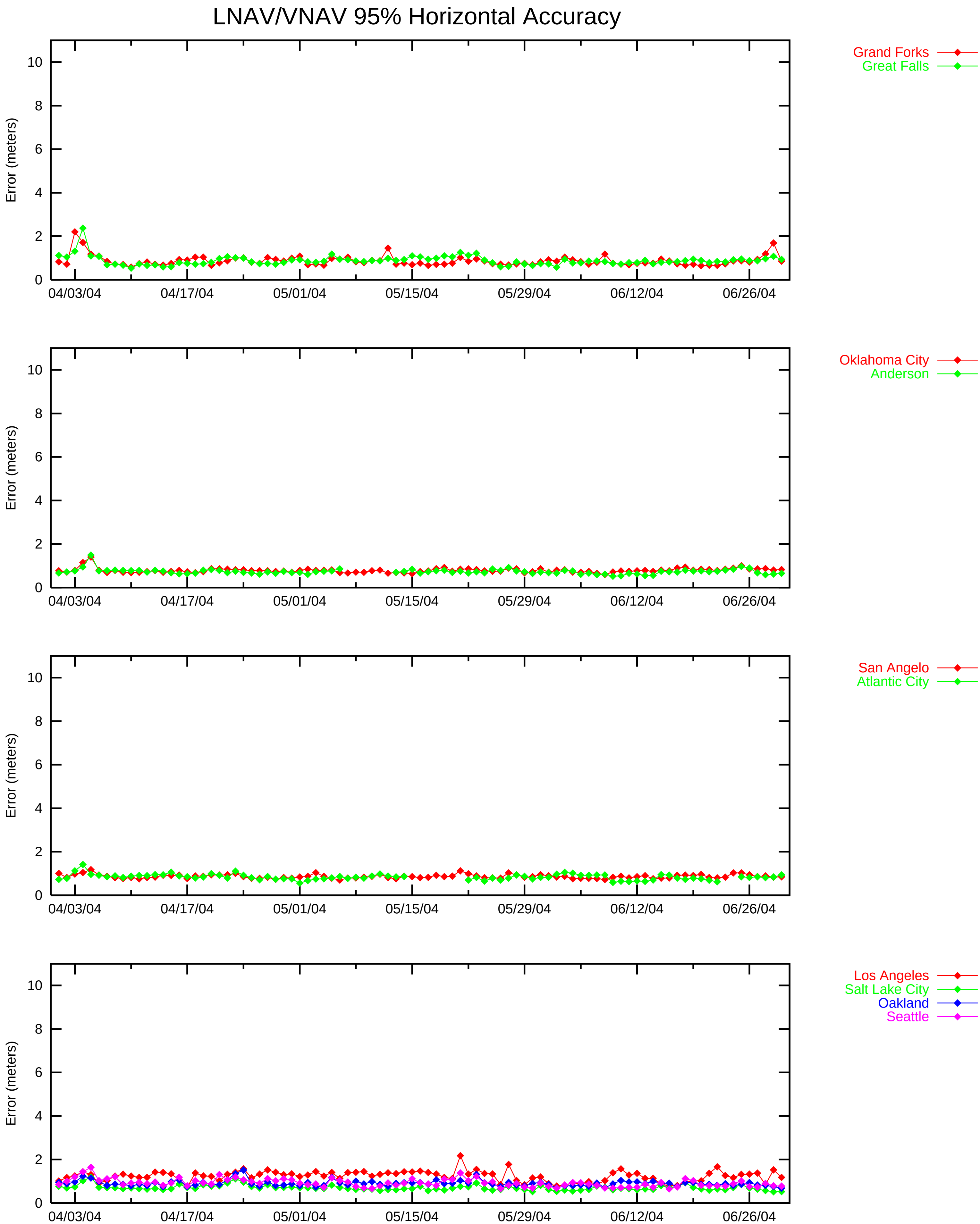


Figure 2•2 95% Horizontal Accuracy at LNAV/VNAV

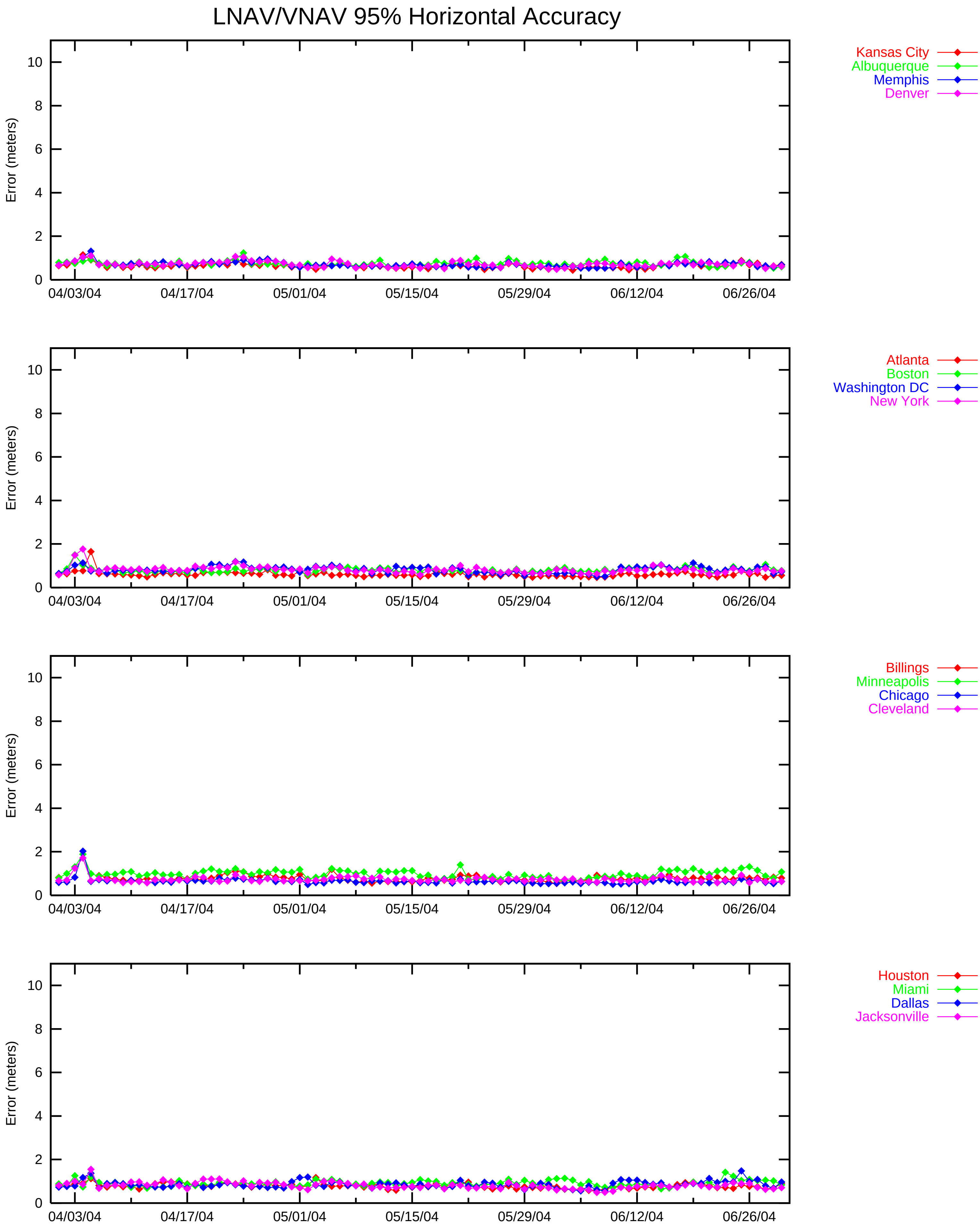


Figure 2•3 95% Vertical Accuracy at LNAV/VNAV

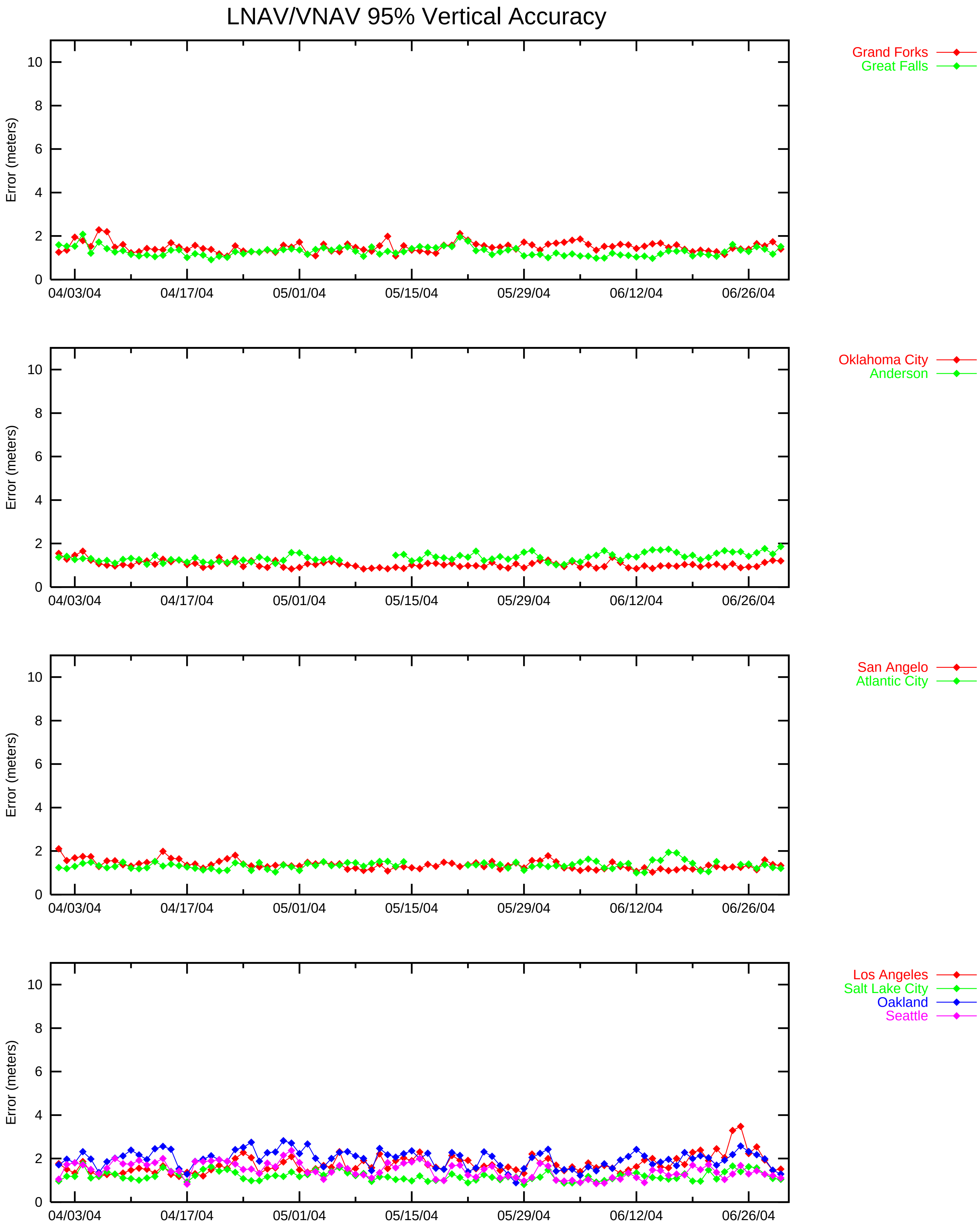


Figure 2•4 95% Vertical Accuracy at LNAV/VNAV

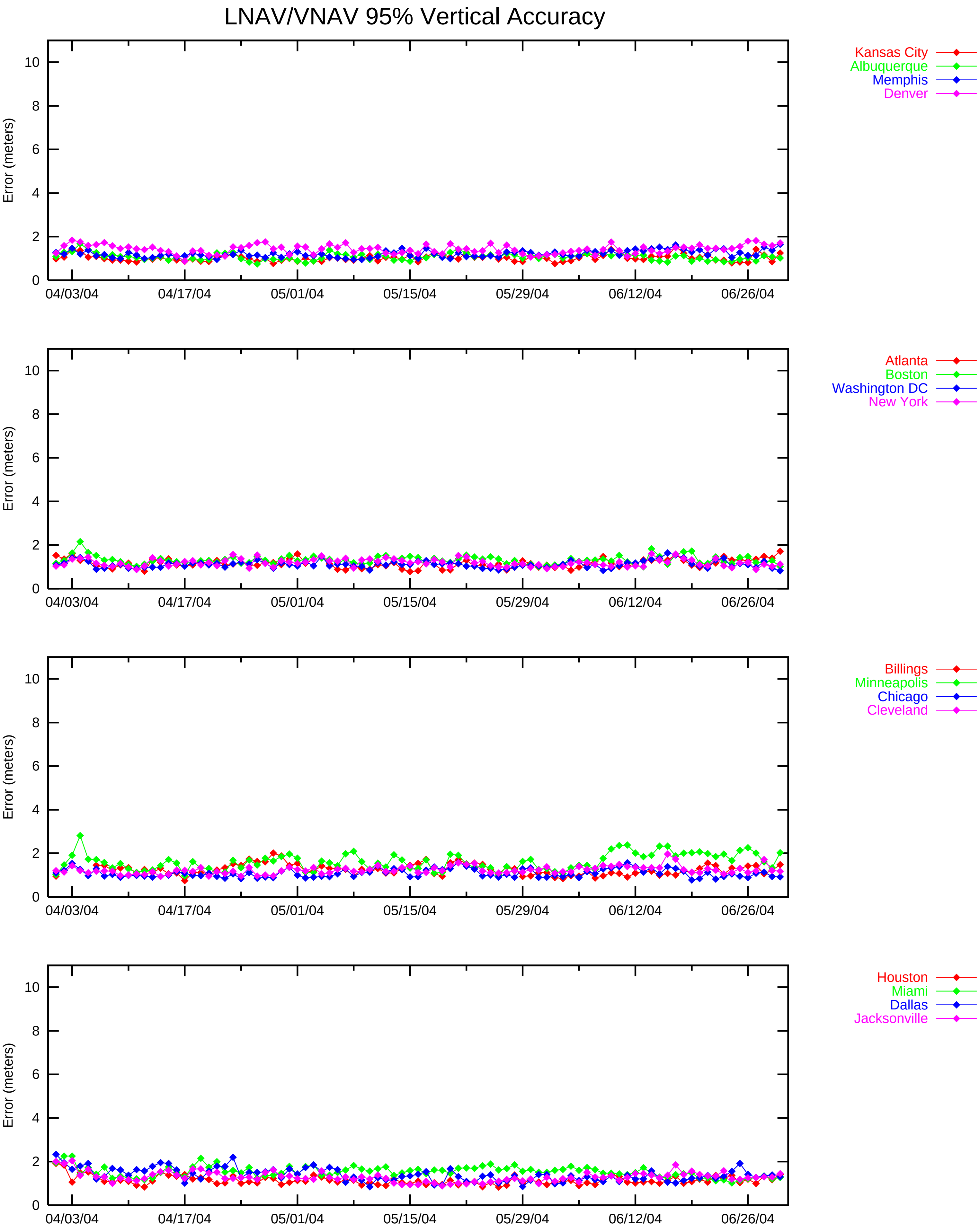
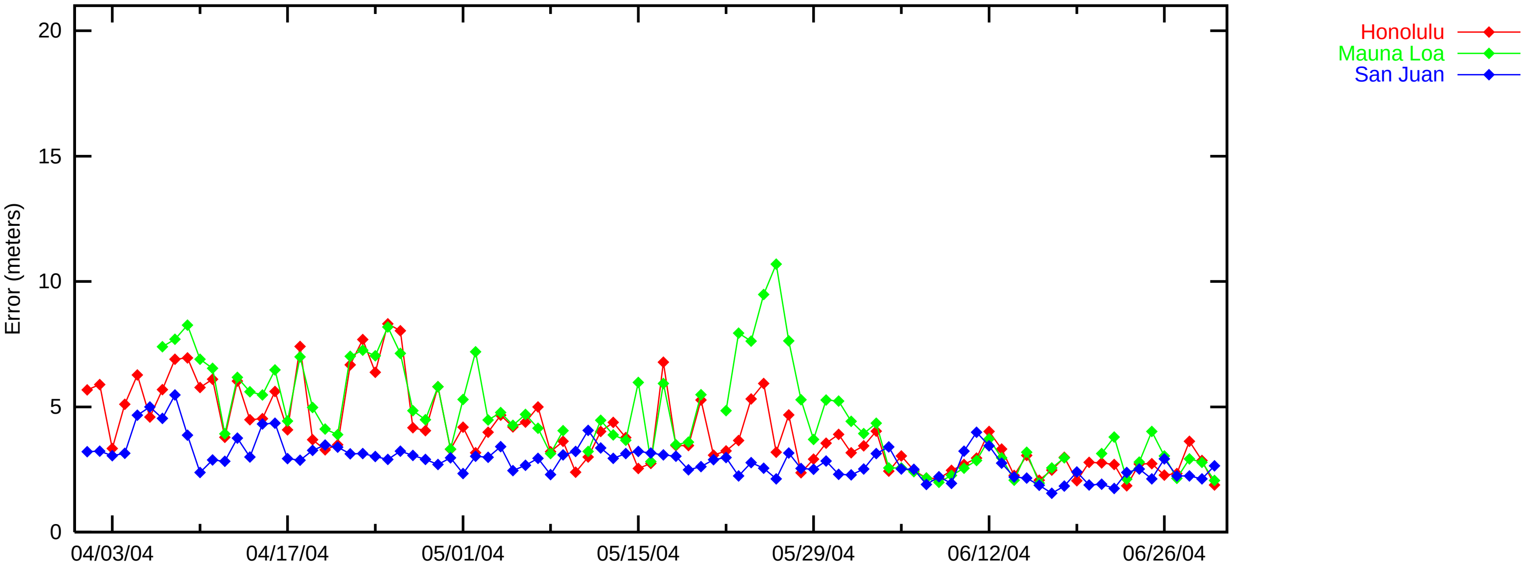
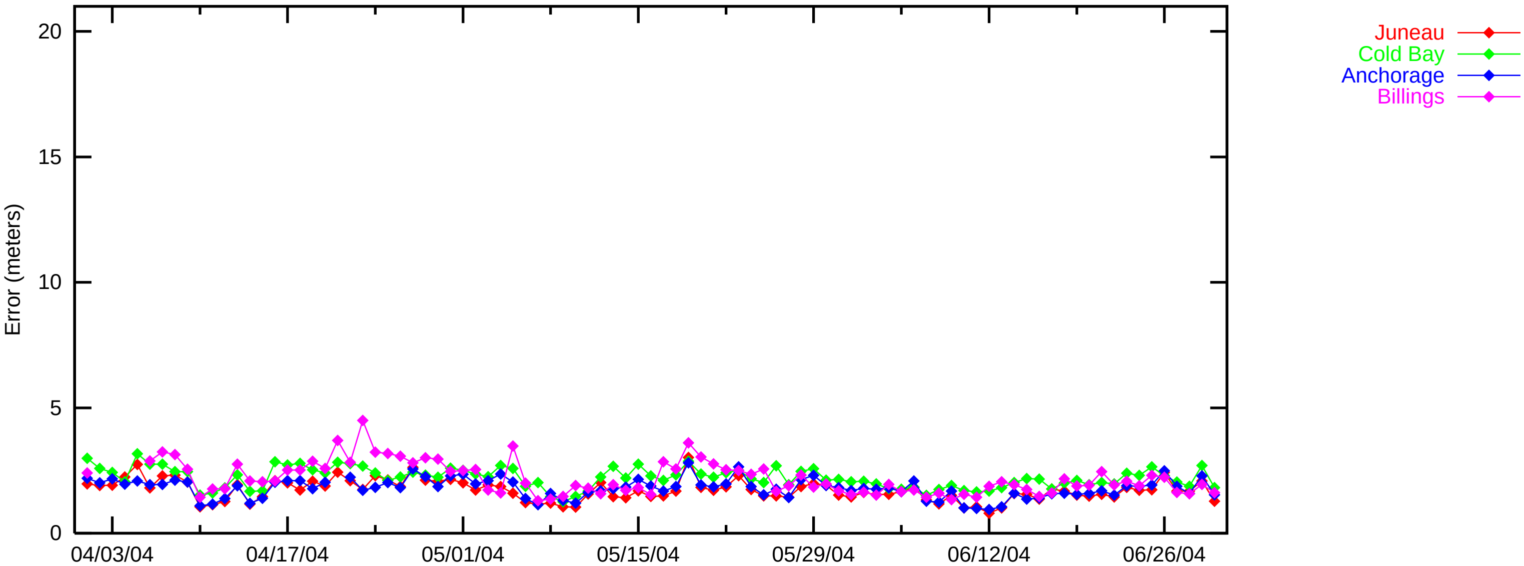


Figure 2•5 NPA 95% Horizontal Accuracy





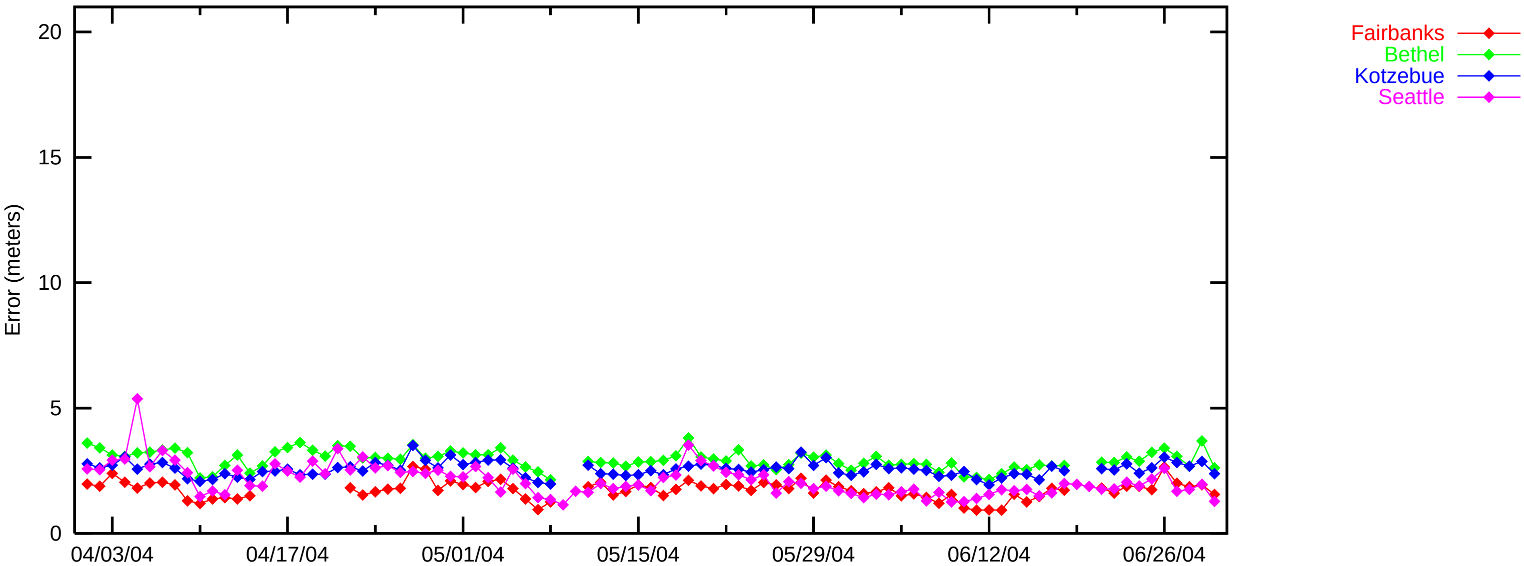


Figure 2•6 NPA 95% Horizontal Accuracy

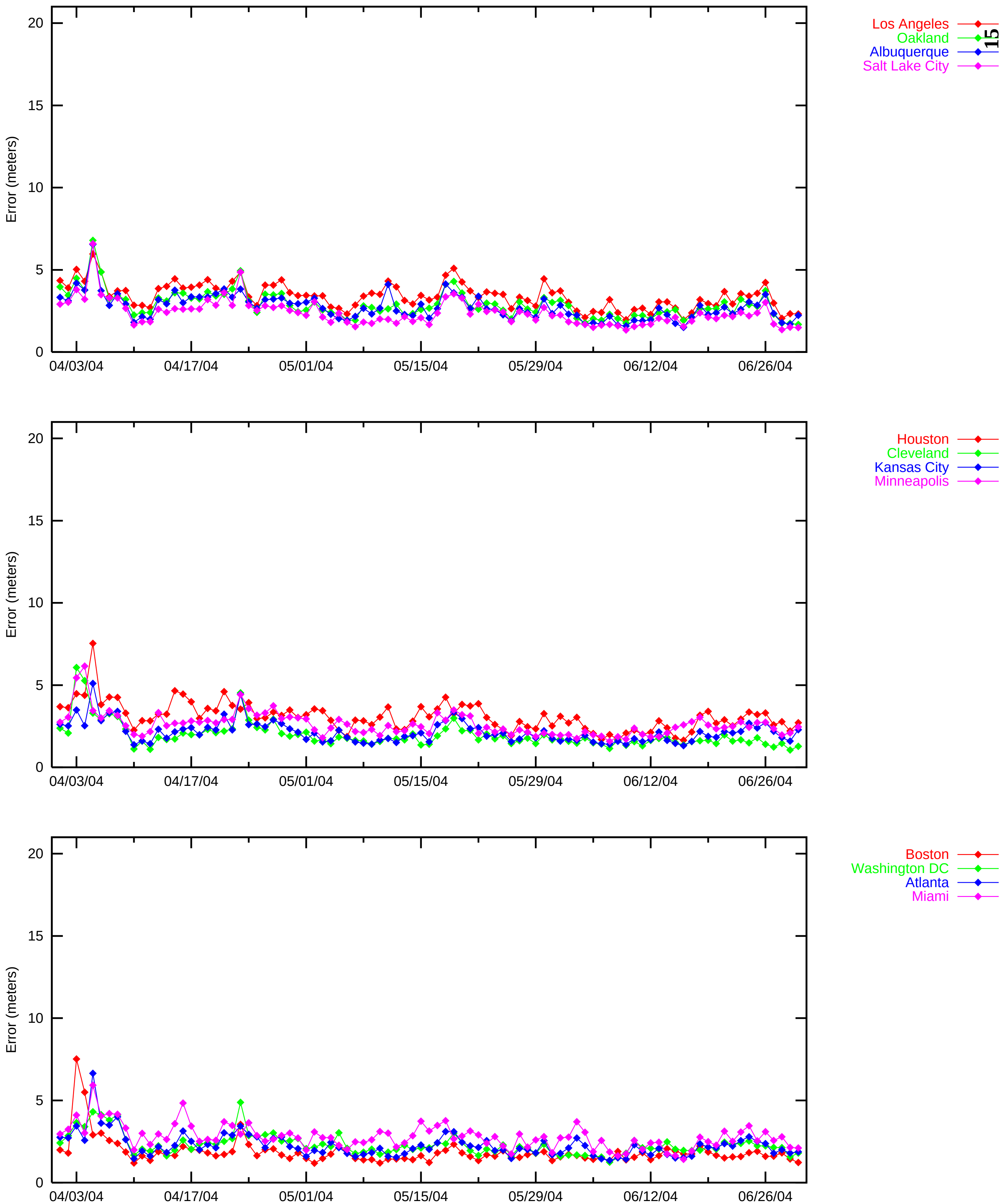


Figure 2•6 NPA 95% Horizontal Accuracy

15

Figure 2•7 Horizontal Triangle Chart for Oklahoma City

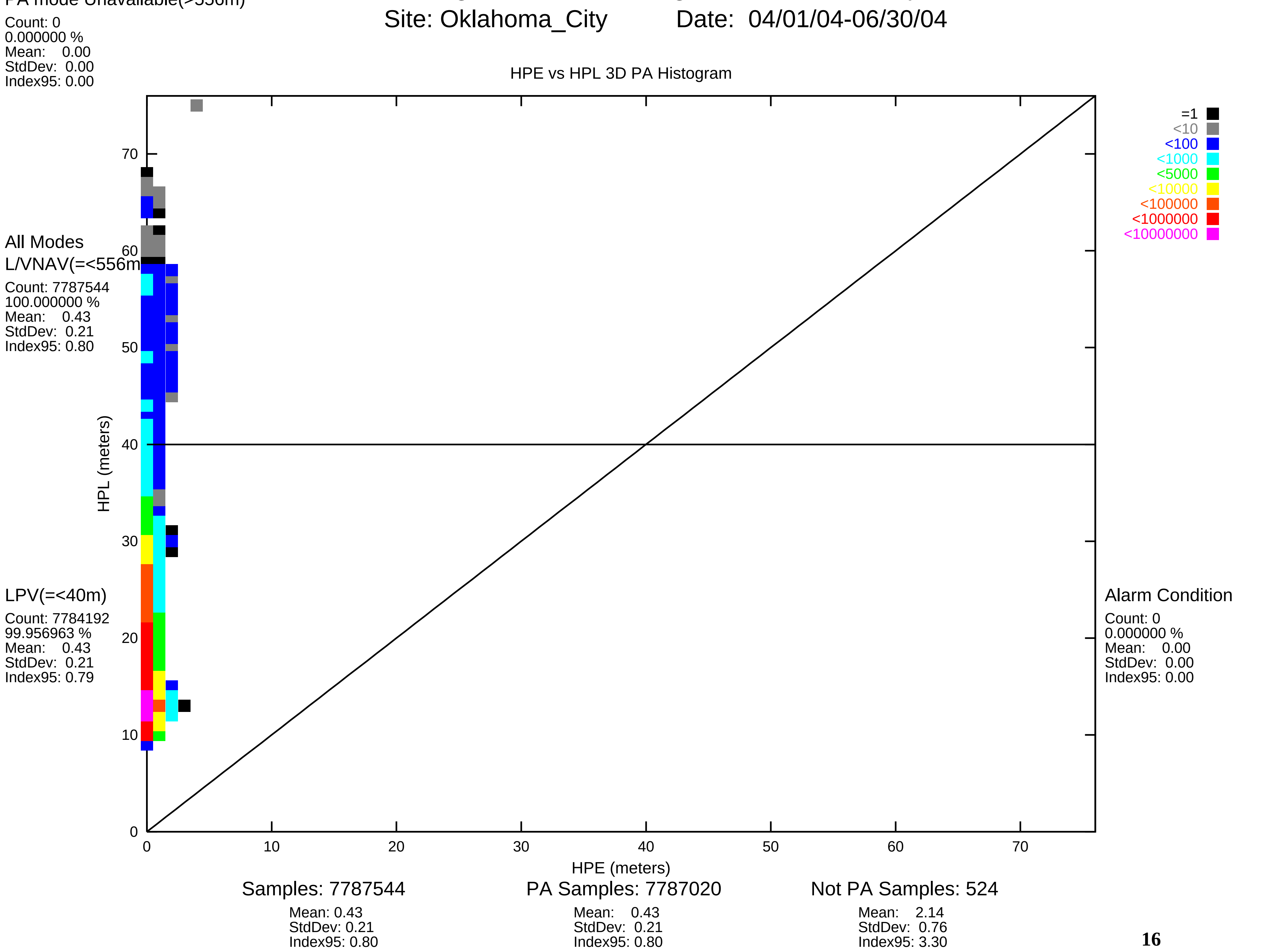
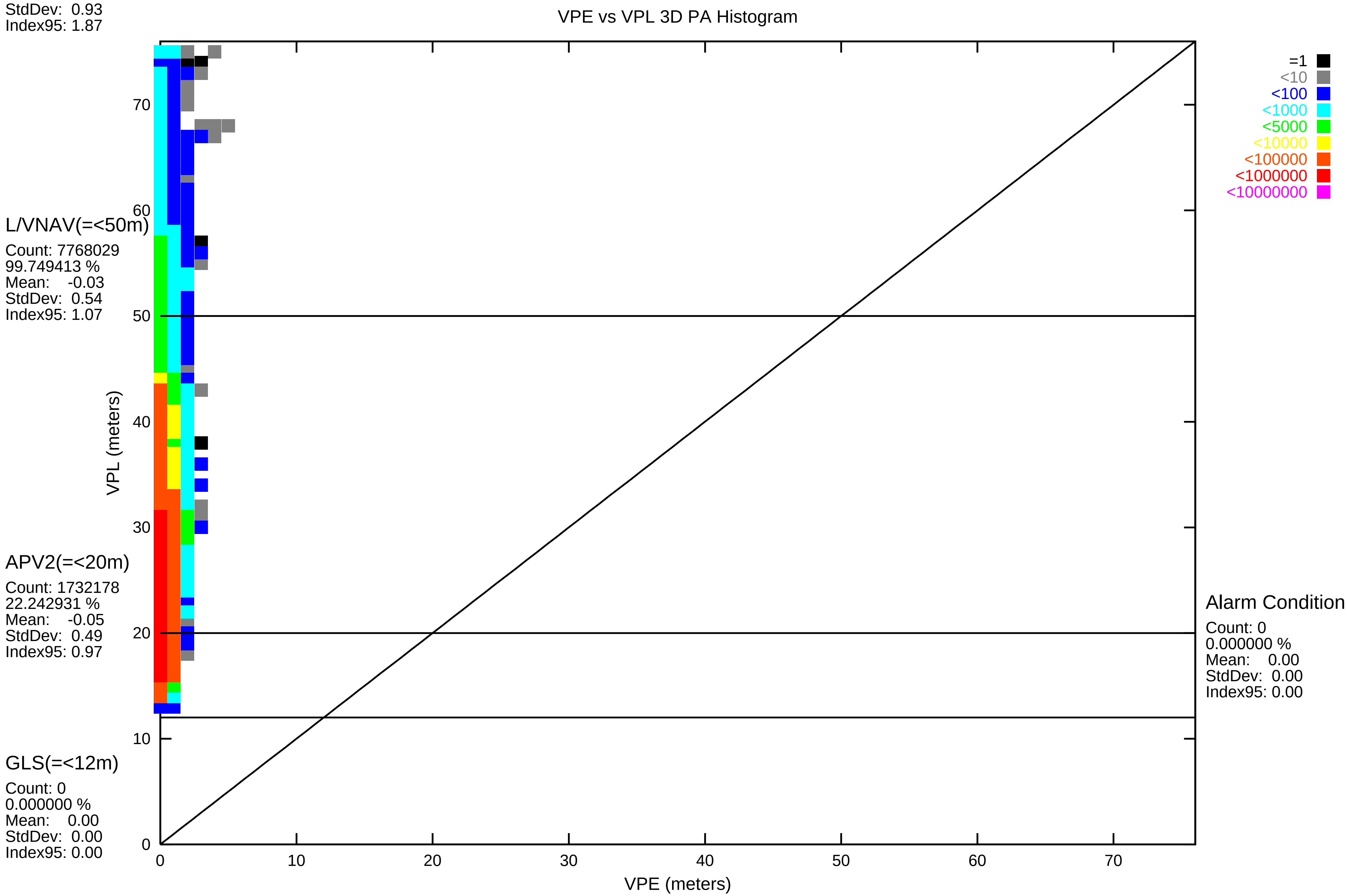


Figure 2•8 Vertical Triangle Chart for Oklahoma City

Site: Oklahoma_City Date: 04/01/04-06/30/04



Samples: 7787544
Mean: -0.03
StdDev: 0.54
Index95: 1.07

PA Samples: 7787020
Mean: -0.03
StdDev: 0.54
Index95: 1.07

Not PA Samples: 524
Mean: 1.07
StdDev: 3.01
Index95: 5.76

Figure 2•9 2-D Histogram for Oklahoma City

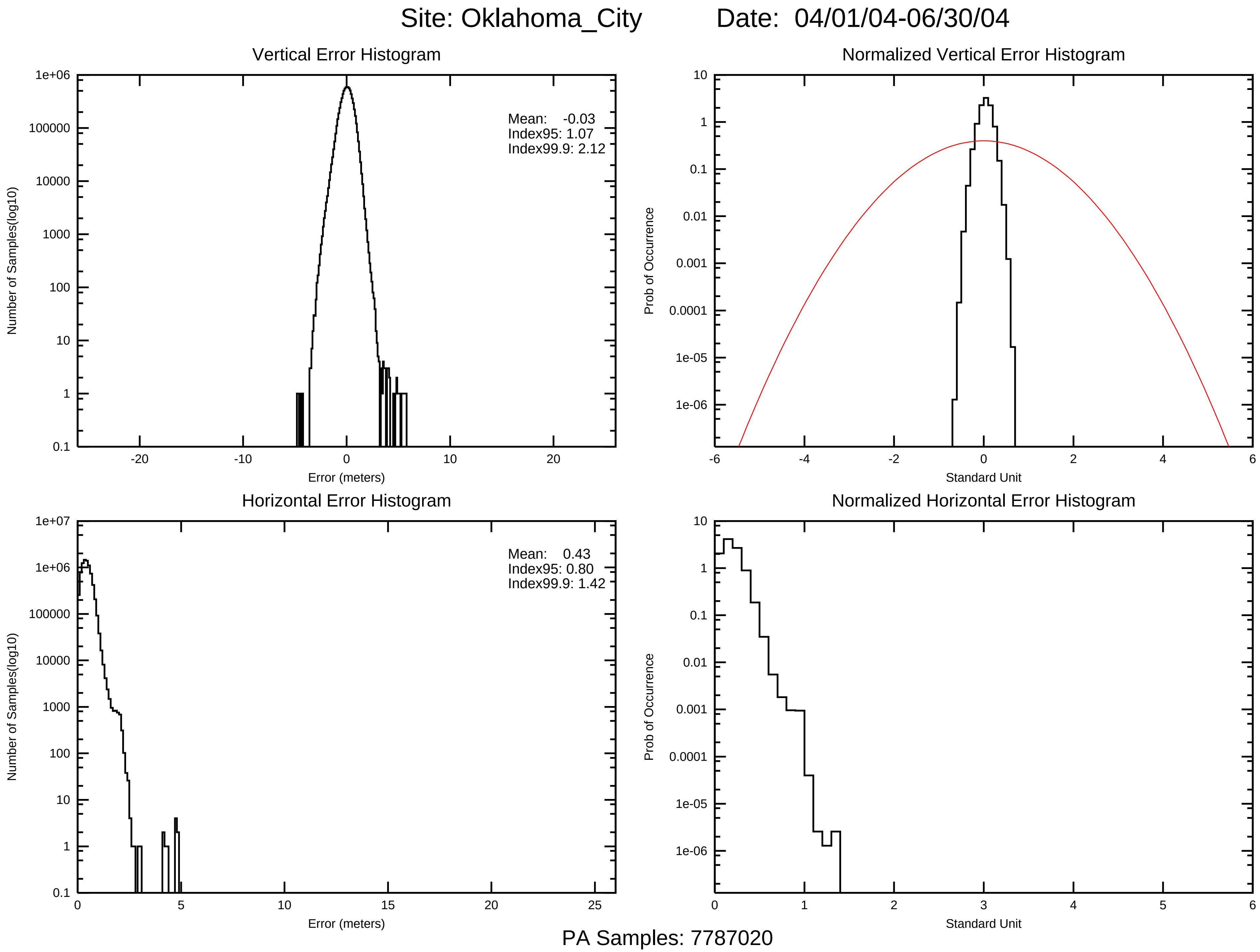


Figure 2•10 Horizontal Triangle Chart for Washington, DC

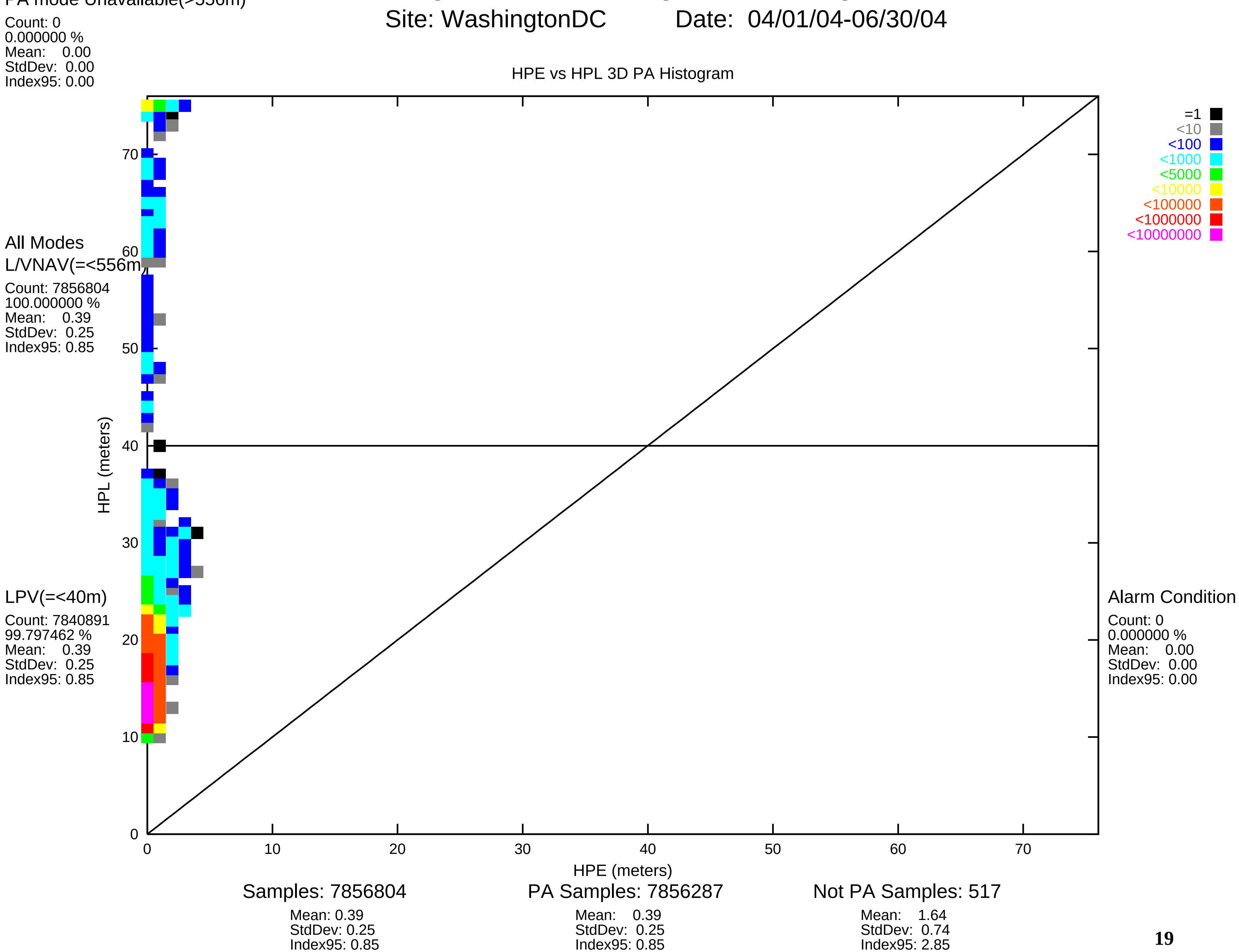


Figure 2•11 Vertical Triangle Chart for Washington, DC

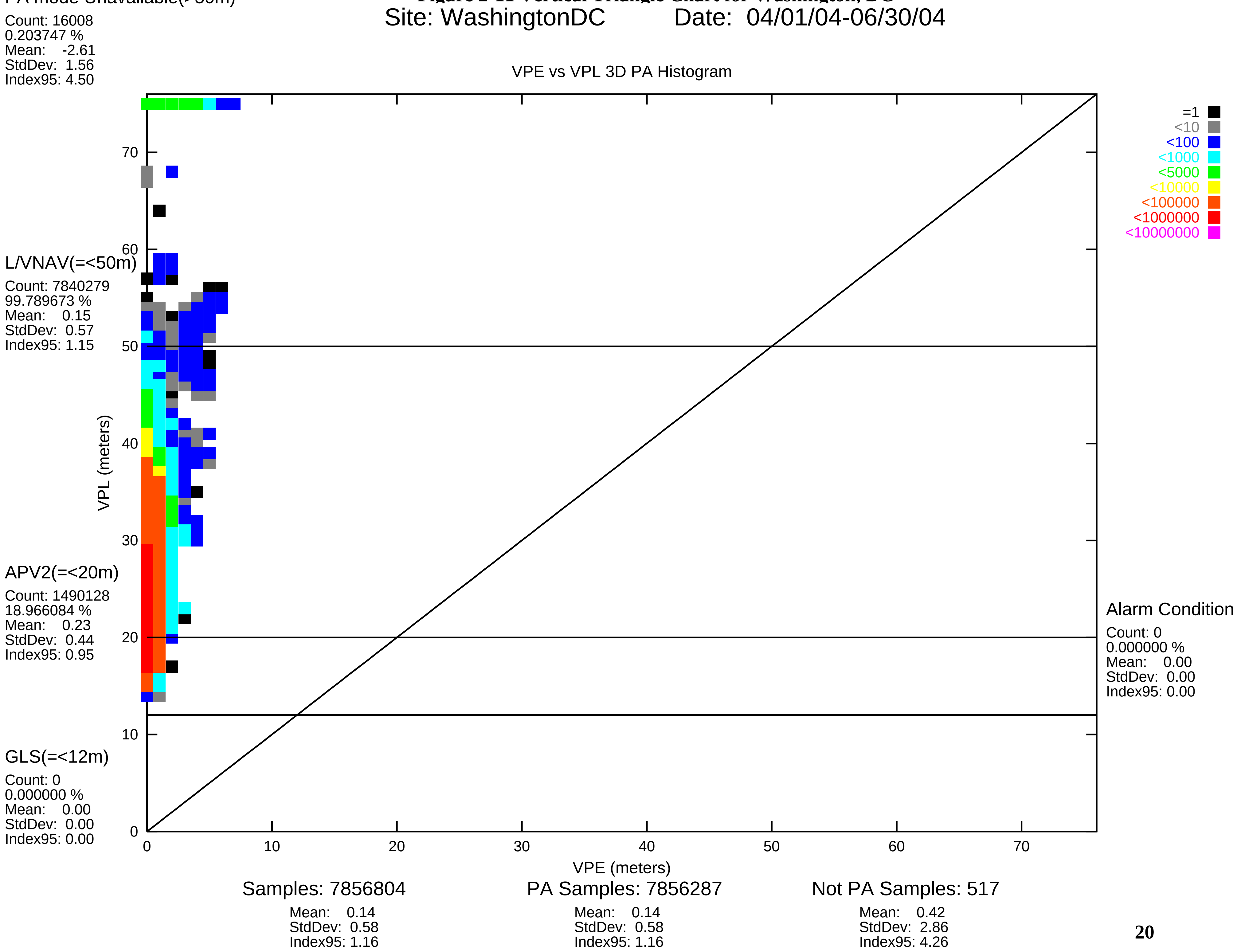


Figure 2•12 2-D Histogram for Washington, DC

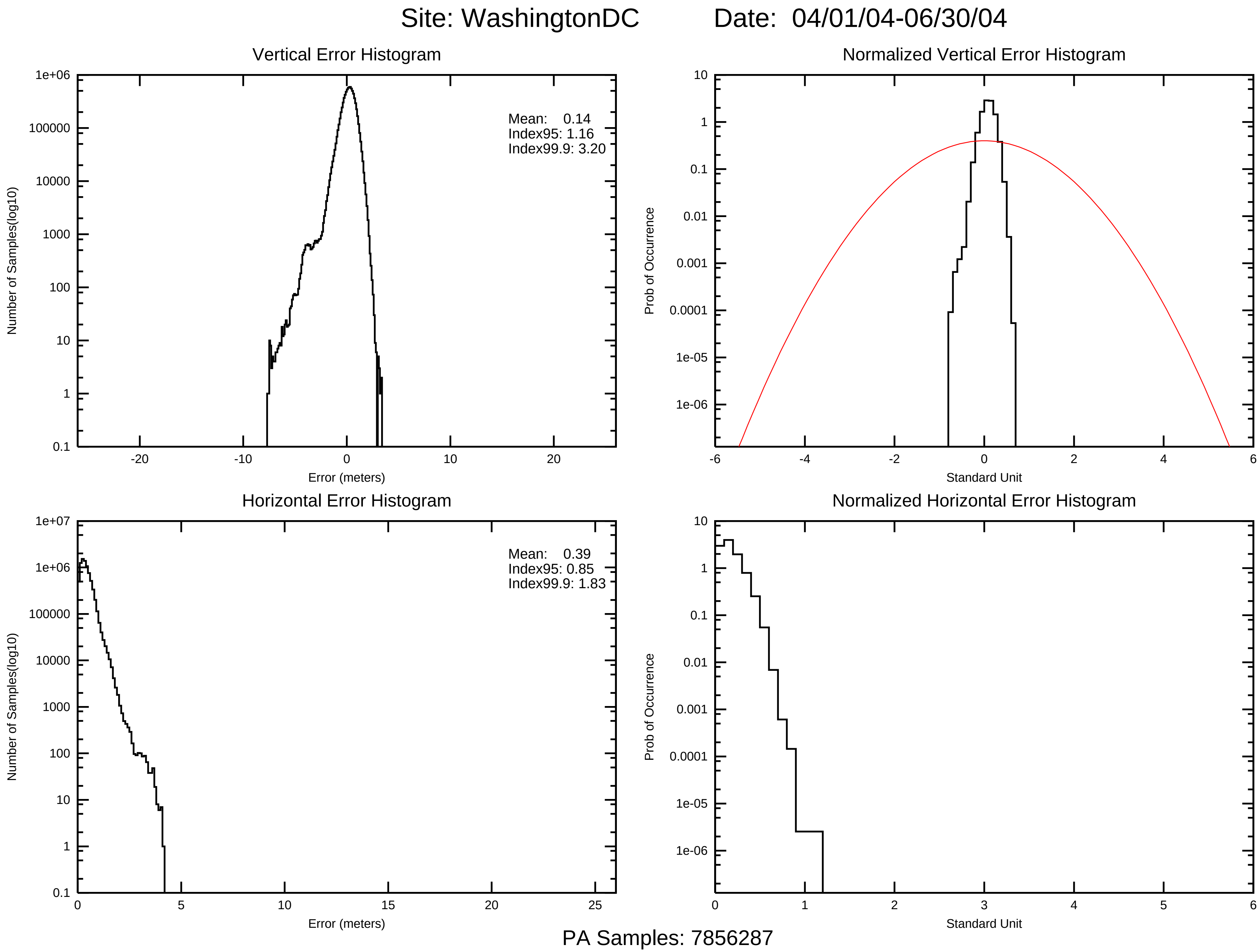


Figure 2•13 Horizontal Triangle Chart for Seattle

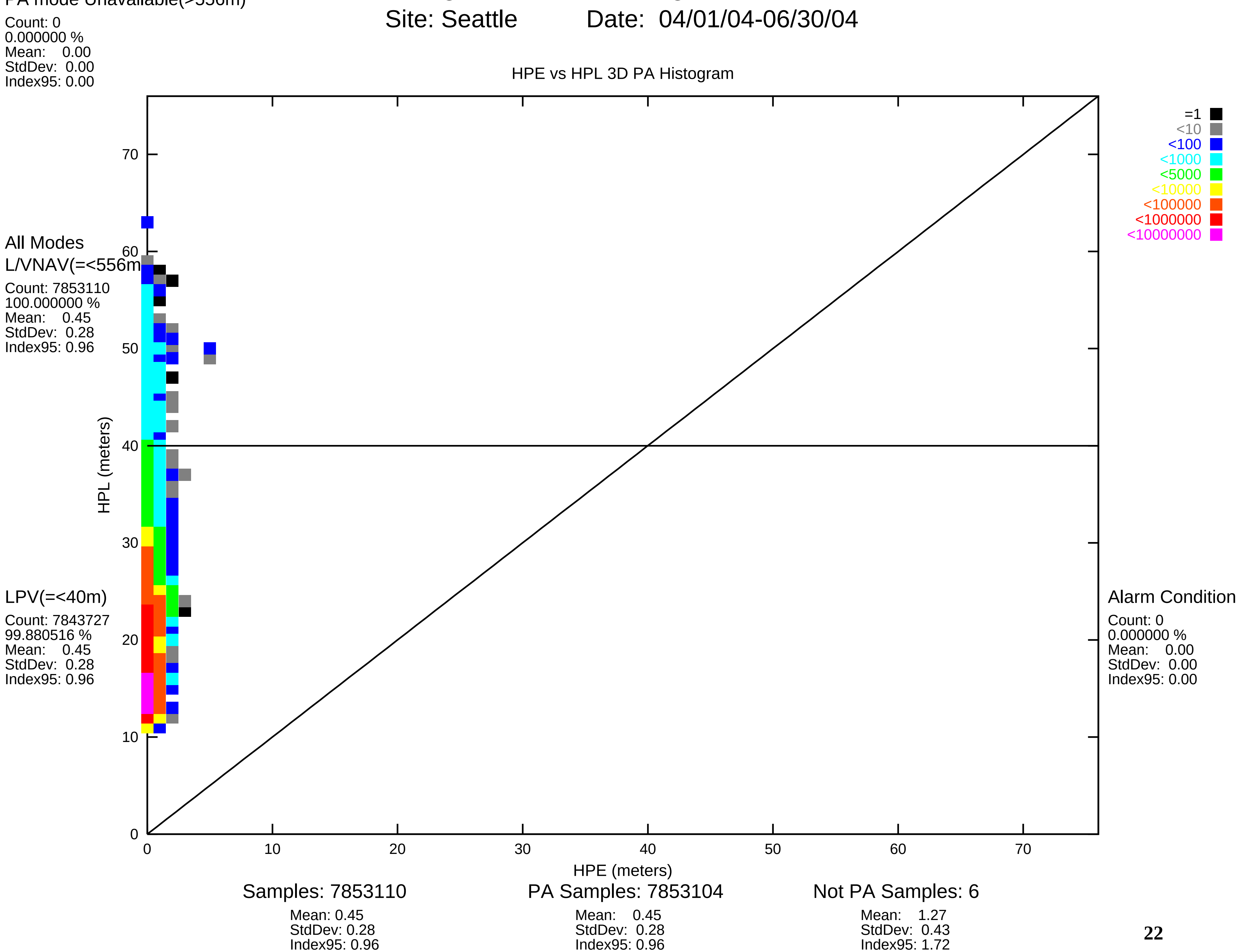


Figure 2•14 Vertical Triangle Chart for Seattle

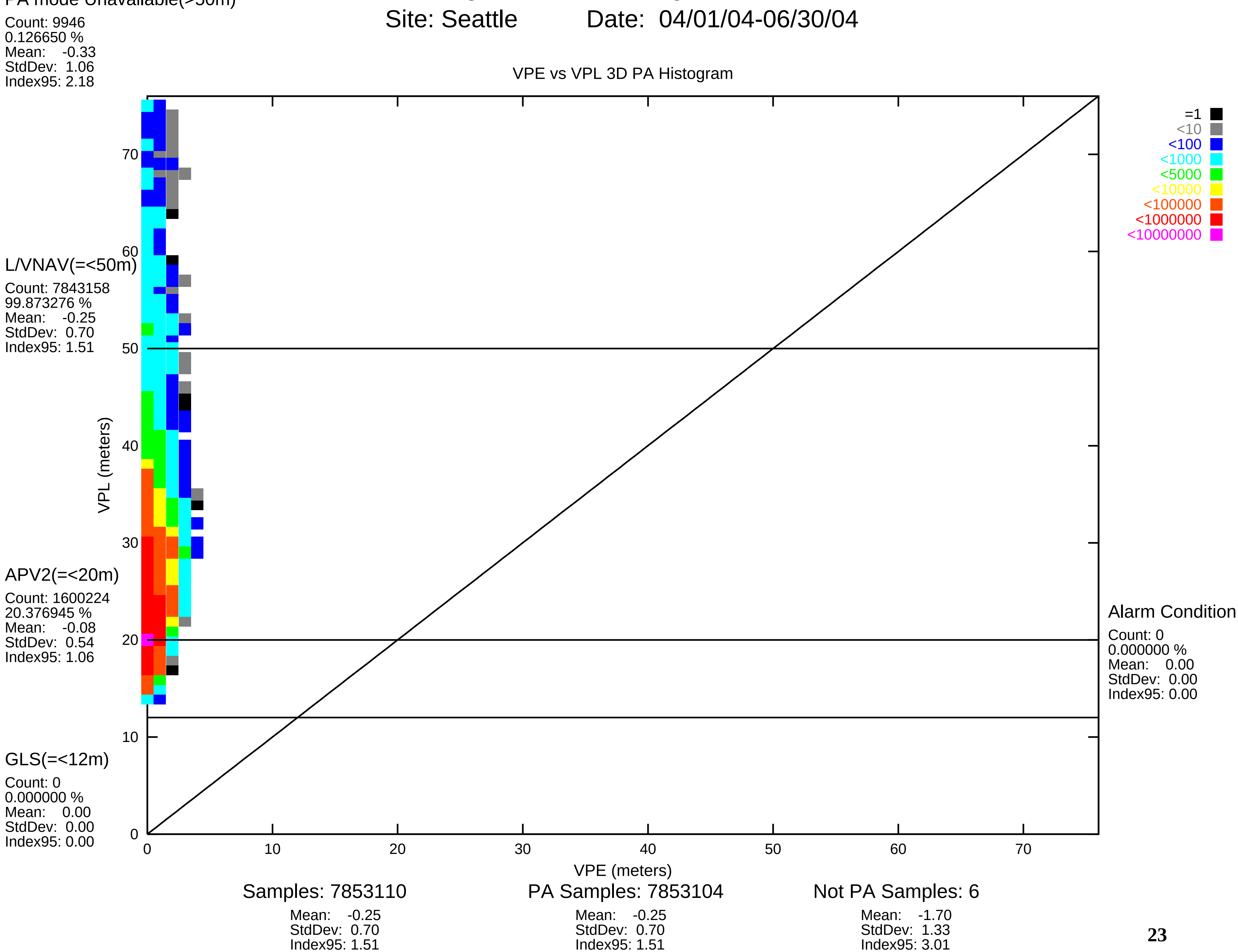
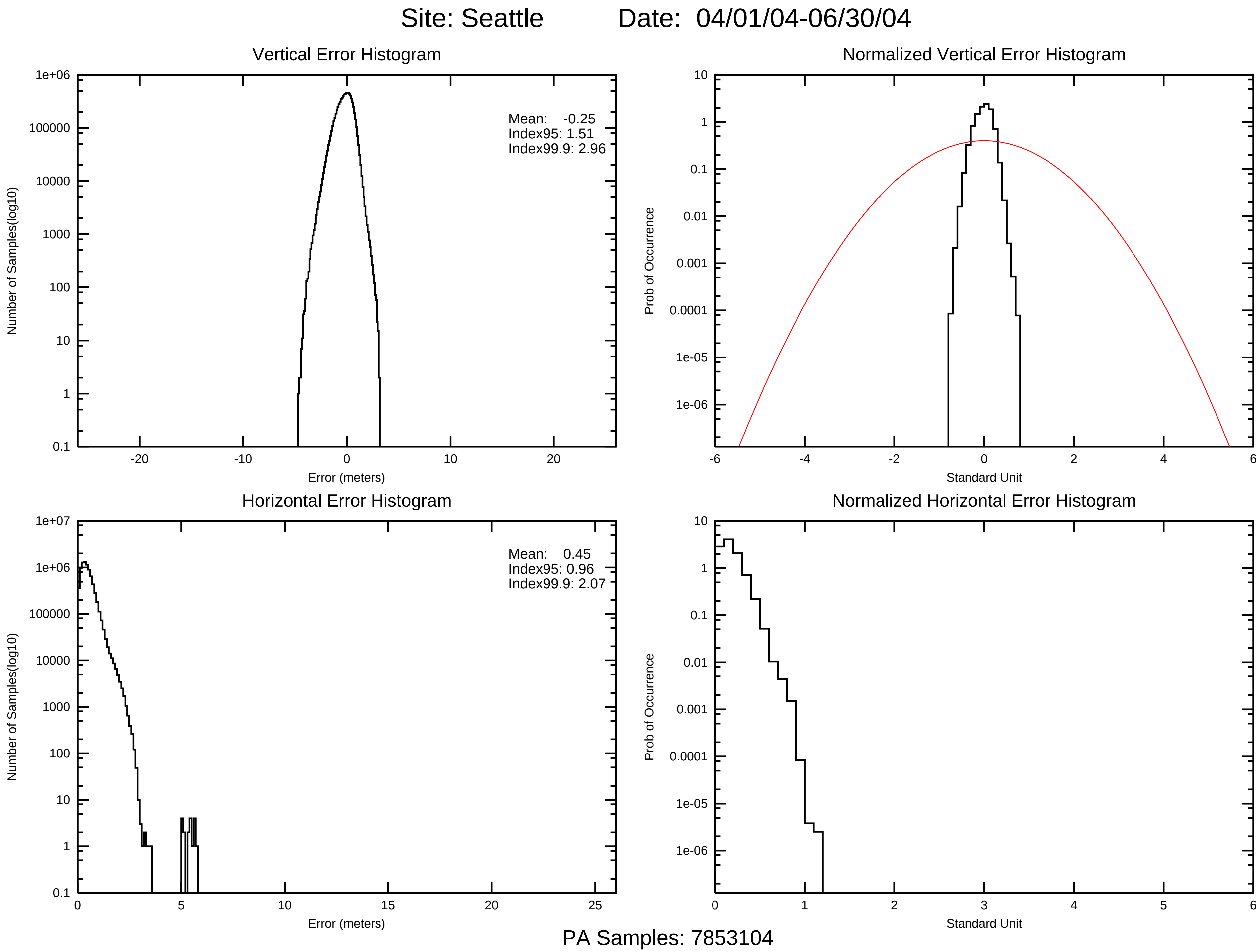


Figure 2•15 2-D Histogram for Seattle



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. Table 3.2 presents the percentage of time that WAAS operational service levels were available at each receiver location. Figures 3.1 through 3.4 show the daily instantaneous availability of LNAV/VNAV and LPV service levels for the evaluated period.

The geographic location of each receiver evaluated is depicted in Figure 3.5 and 3.6, along with the 95% VPL value, the WAAS LPV and the LNAV/VNAV instantaneous availability percentage at each location for the quarter.

Table 3-1 95% Protection Level

Location	95% HPL (meters)	95% VPL (meters)	Percentage in PA mode
Anderson	17.871	31.021	99.98667
Atlantic City	21.224	36.590	99.98361
Elko	22.276	33.101	99.99937
Grand Forks	25.622	35.405	99.97800
Great Falls	25.045	35.887	99.98994
Oklahoma City	20.703	34.622	99.98587
Prescott	27.041	43.271	99.99943
San Angelo	28.230	44.234	99.98603
Albuquerque	20.059	32.434	99.98669
Atlanta	17.284	30.109	99.98691
Billings	19.590	27.989	99.98615
Boston	24.289	41.234	99.98659
Chicago	17.132	28.742	99.97962
Cleveland	18.498	31.127	99.98261
Dallas	18.666	32.060	99.98671
Denver	17.958	28.581	99.97910
Houston	21.688	36.109	99.98644
Jacksonville	17.985	34.179	99.98672
Kansas City	16.250	27.633	99.97816
Los Angeles	27.815	41.470	99.99905
Memphis	16.610	30.298	99.98272
Miami	21.694	40.847	99.98671
Minneapolis	18.892	29.366	99.97955
New York	21.177	37.512	99.98663
Oakland	27.836	40.608	99.99896
Salt Lake City	19.489	28.568	99.99913
Seattle	22.693	30.928	99.99899
Washington DC	18.047	32.076	99.98709

Table 3-2 Average Quarterly Availability Statistics

Location	LPV (HAL = 40m VAL = 50m) Percentage of time	LNAV/VNAV (HAL= 556m VAL = 50m) Percentage of time
Anderson	0.99964	0.99972
Atlantic City	0.99674	0.99738
Elko	0.99773	0.99797
Grand Forks	0.98908	0.98913
Great Falls	0.99869	0.99907
Oklahoma City	0.99804	0.99805
Prescott	0.99083	0.99247
San Angelo	0.98498	0.98567
Albuquerque	0.99961	0.99967
Atlanta	0.99955	0.99955
Billings	0.99937	0.99949
Boston	0.99275	0.99335
Chicago	0.99825	0.99833
Cleveland	0.99839	0.99852
Dallas	0.99977	0.99977
Denver	0.99976	0.99977
Houston	0.99939	0.99939
Jacksonville	0.99966	0.99966
Kansas City	0.99932	0.99933
Los Angeles	0.98927	0.99022
Memphis	0.99948	0.99949
Miami	0.99242	0.99255
Minneapolis	0.99848	0.99860
New York	0.99637	0.99664
Oakland	0.99275	0.99365
Salt Lake City	0.99982	0.99983
Seattle	0.99876	0.99898
Washington DC	0.99878	0.99888

During the evaluated period, the maximum 95% HPL and VPL are 28.230 meters and 44.234 meters, both at San Angelo. The minimum 95% HPL and VPL are 16.250 meters in Kansas City and 27.633 meters, both at Kansas City. LNAV/VNAV instantaneous availability ranges between 98.6% and 100%. LPV instantaneous availability ranges between 98.5% and 99.9%. Note that there were no major ionospheric storms during this quarter that would lower the availability of WAAS.

Figure 3•1 LNAV/VNAV Instantaneous Availability

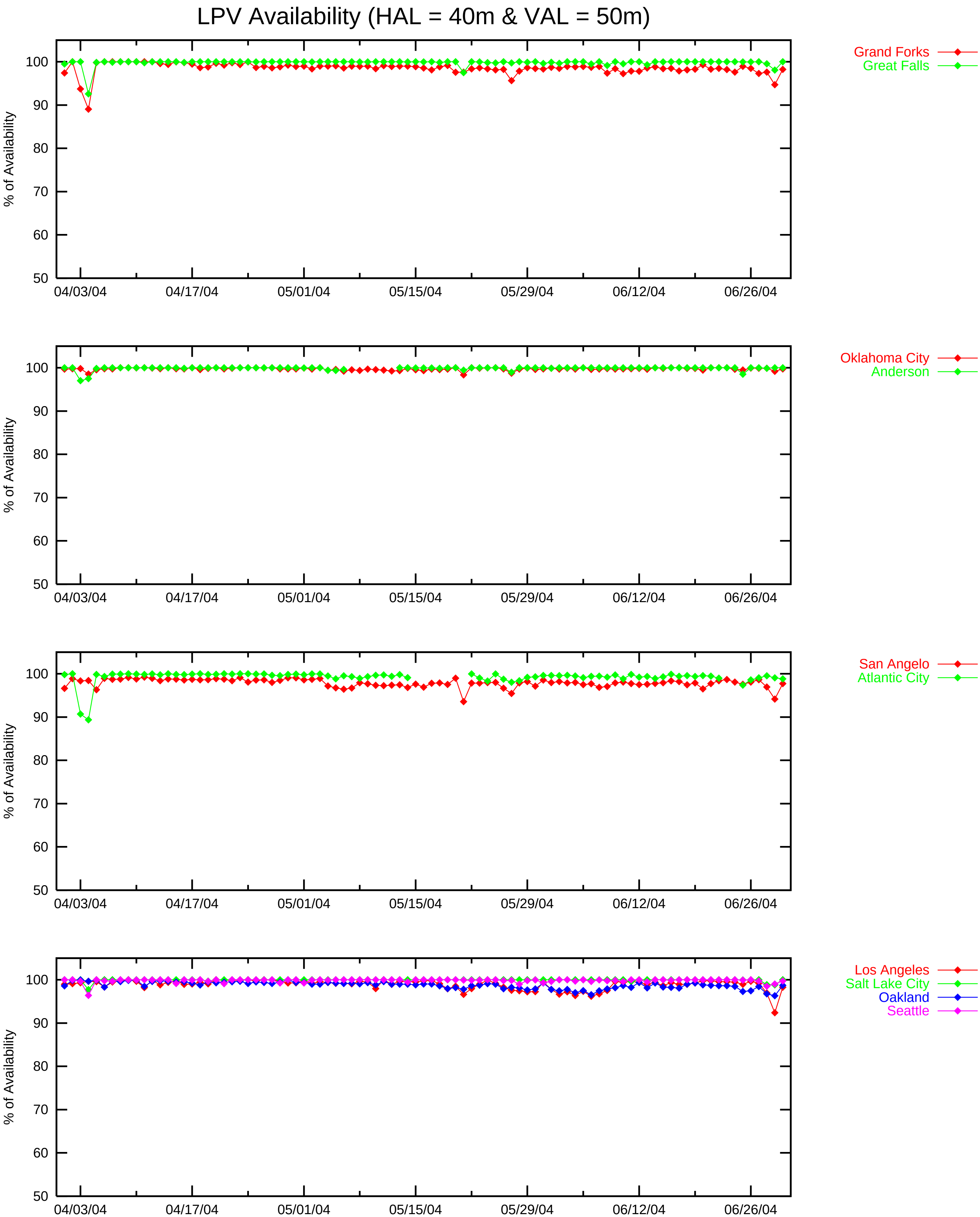


Figure 3•2 LNAV/VNAV Instantaneous Availability

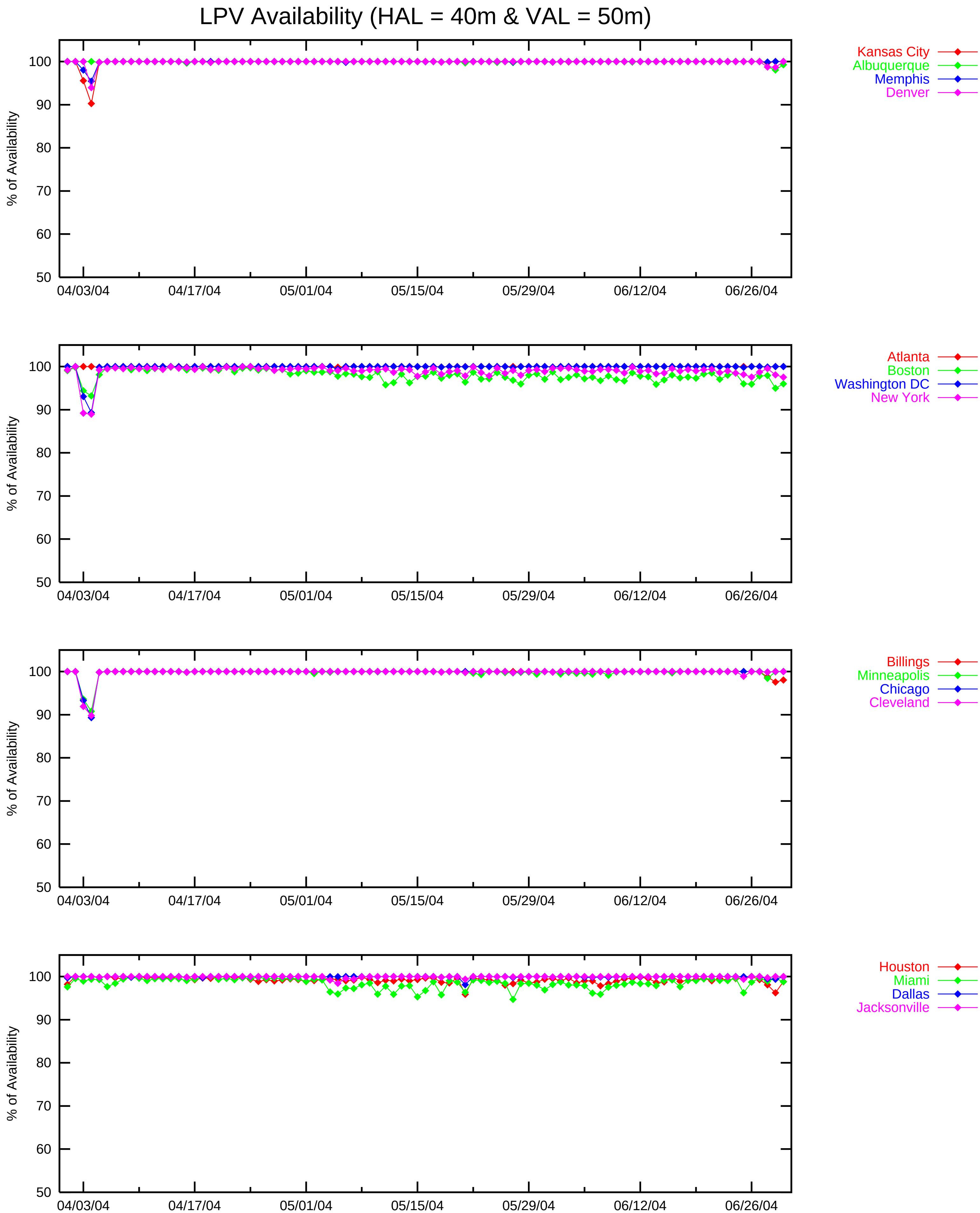


Figure 3•3 LPV Instantaneous Availability

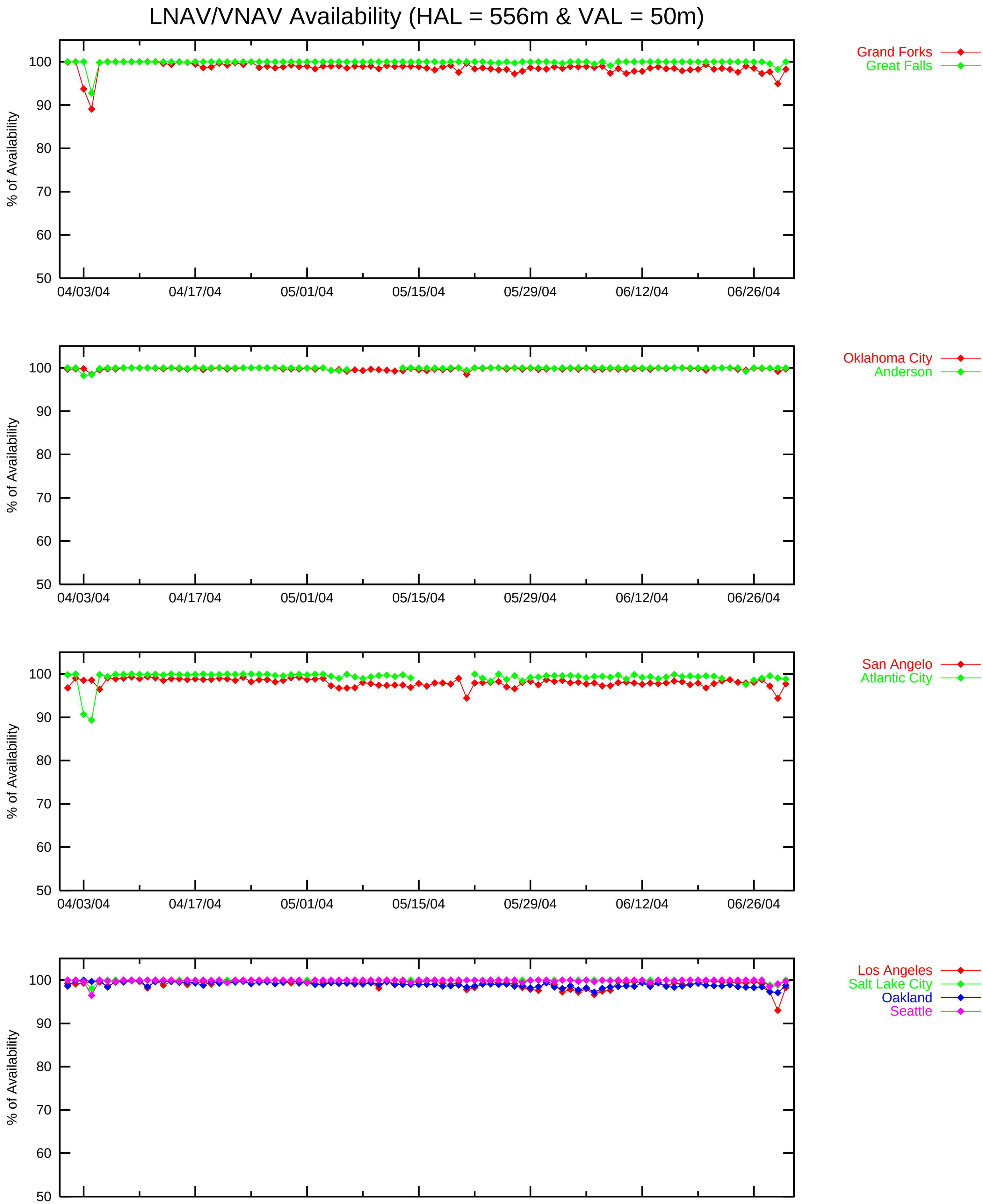


Figure 3•4 LPV Instantaneous Availability

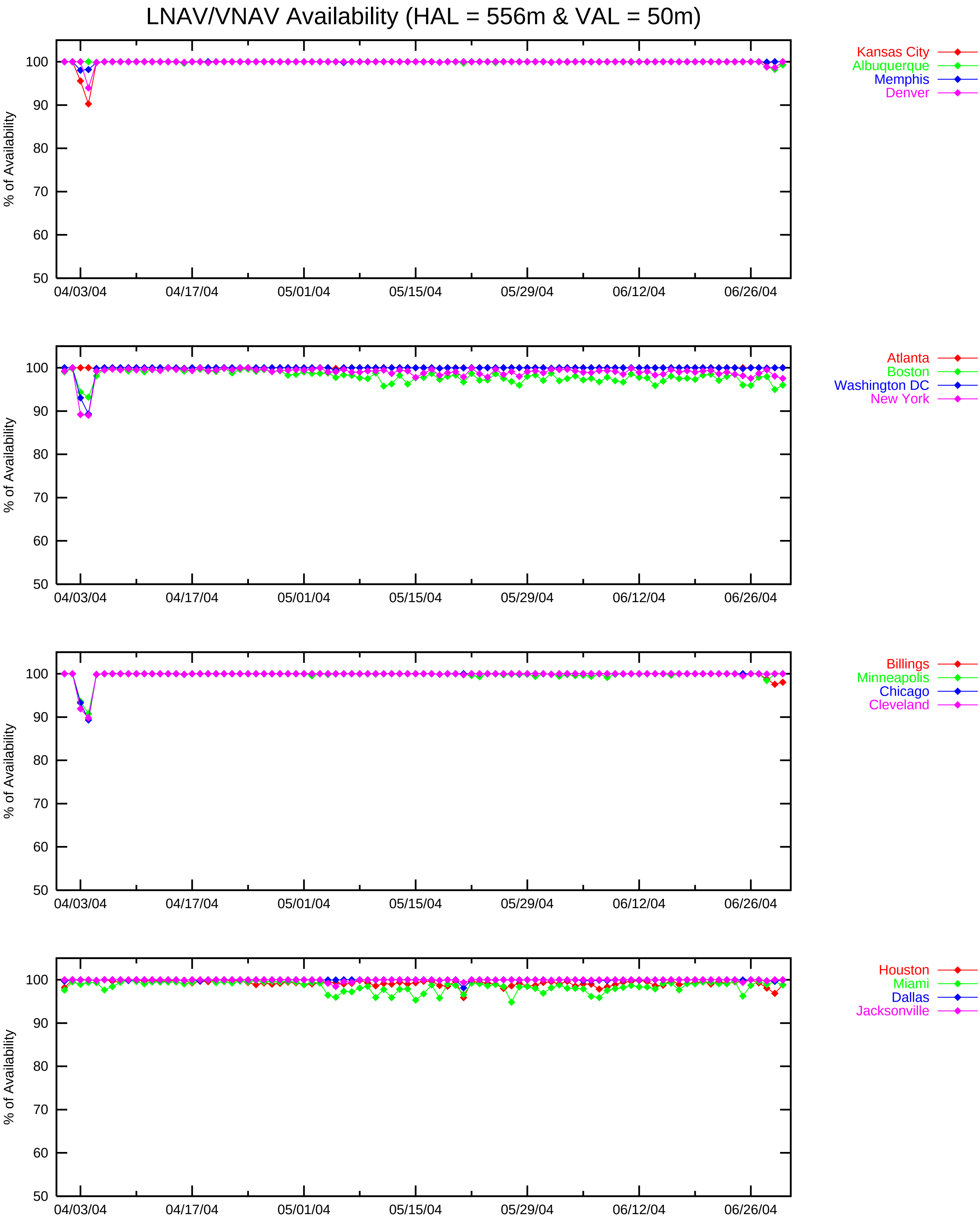


Figure 3•5 95% VPL , LPV and LNAV/VNAV Availability – NSTB sites

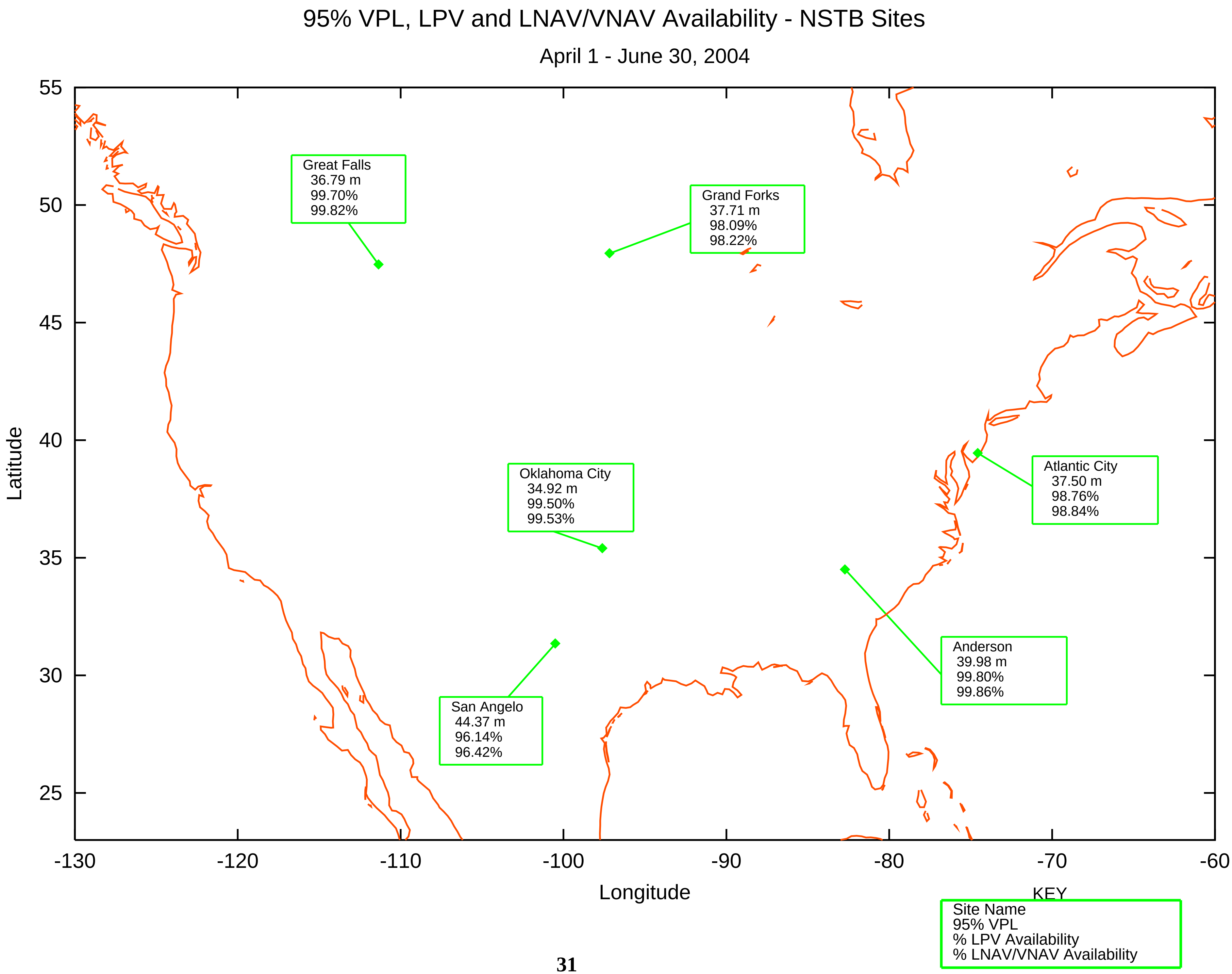
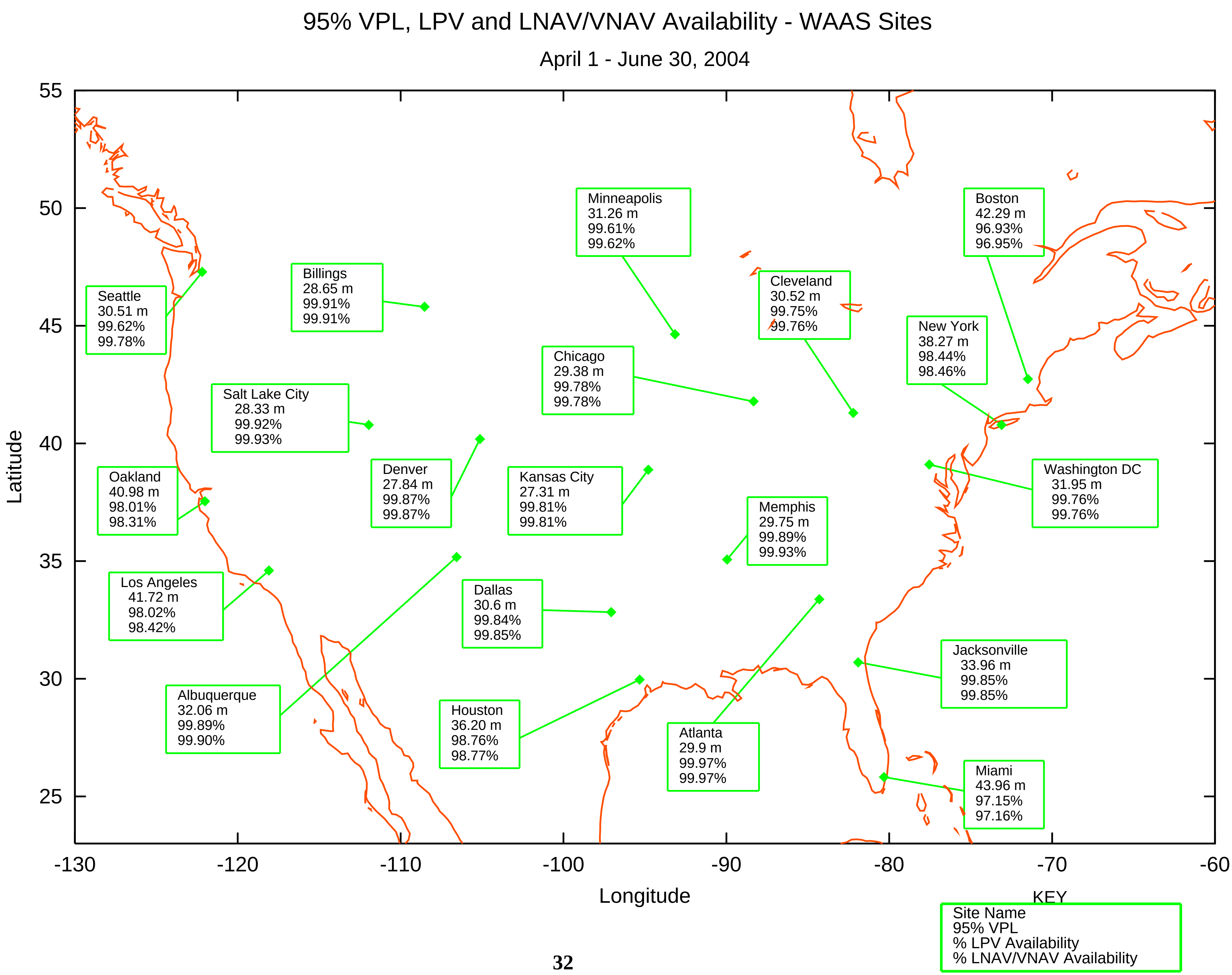


Figure 3•6 95% VPL , LPV and LNAV/VNAV Availability – WAAS sites



4.0 COVERAGE

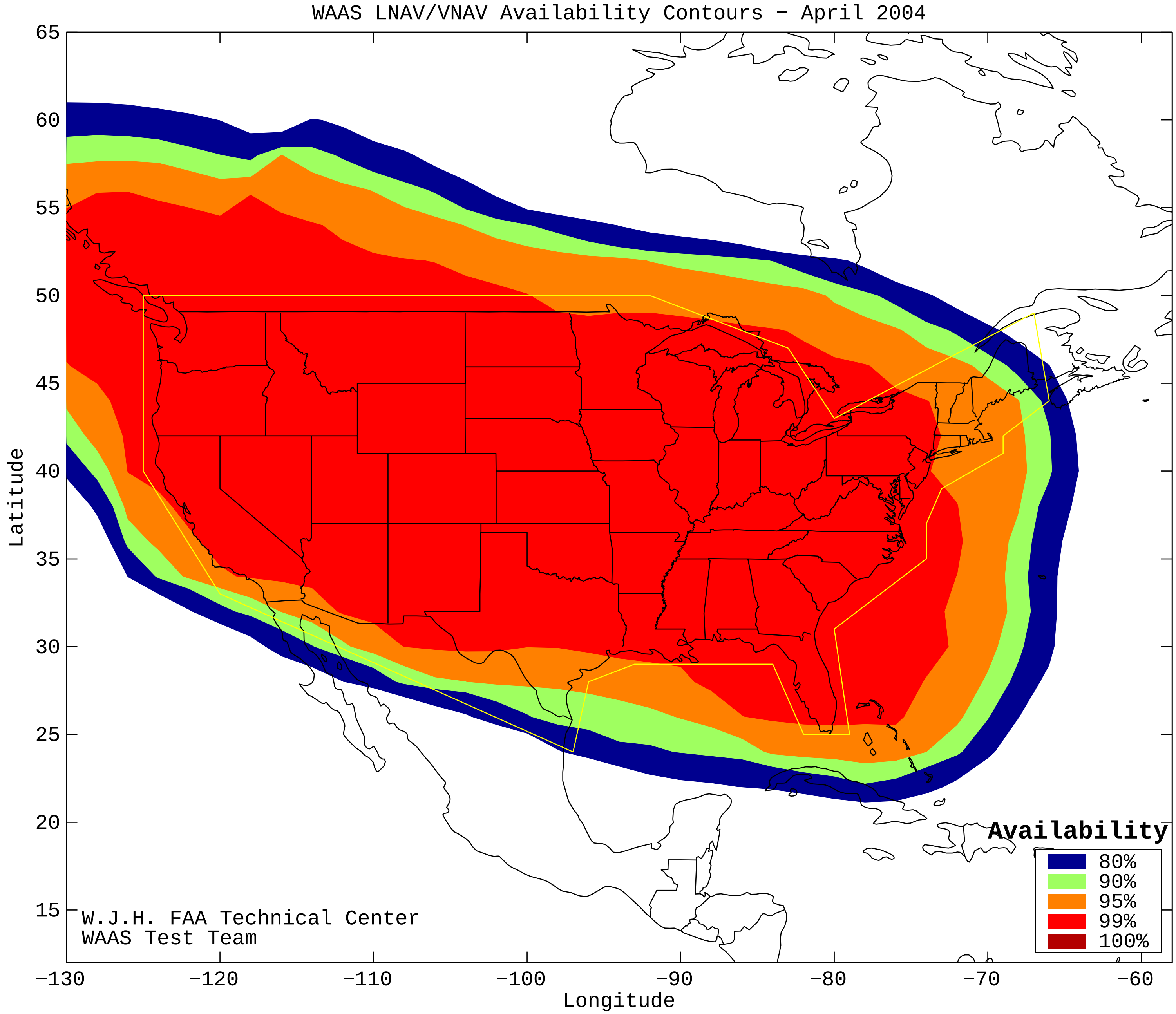
WAAS coverage area evaluation estimates the percent of service volume where WAAS is providing LPV, LNAV/VNAV and NPA services. The WAAS message and the GPS/GEO satellite status are used to determine WAAS availability across North America. For PA coverage, protection levels were calculated at two-minute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

Daily analysis for PA was conducted for both LPV and LNAV/VNAV service levels. Figures 4.1 to 4.3 and 4.5 to 4.7 show the WAAS LNAV/VNAV and LPV coverage area for each month for this quarter, respectively. Figures 4.4 and 4.8 show the rollup WAAS LNAV/VNAV and LPV coverage for the quarter. The coverage plots also provide 100, 99, 95, 90 and 80% availability contours. Figure 4.13 shows the daily WAAS LNAV/VNAV and LPV coverage at 99% availability and ionosphere Kp index values for this quarter.

In Figure 4-14, the drops in NPA coverage are due to GUS switchovers. The switchovers cause a loss of WAAS service for a period of up to 5 minutes, for LNAV/VNAV and LPV users. For enroute/NPA users the time of lost service is shorter.

Figure 4.9 to 4.11 show the NPA coverage area of each month and Figure 4.12 shows the rollup NPA coverage for the quarter. Daily analysis for NPA was based on a 99.9% availability requirement. The NPA coverage plots also provide 100, 99.9 and 99% availability contours. Figure 4.14 shows the daily NPA coverage at 99.9% availability and ionosphere Kp index values for this quarter.

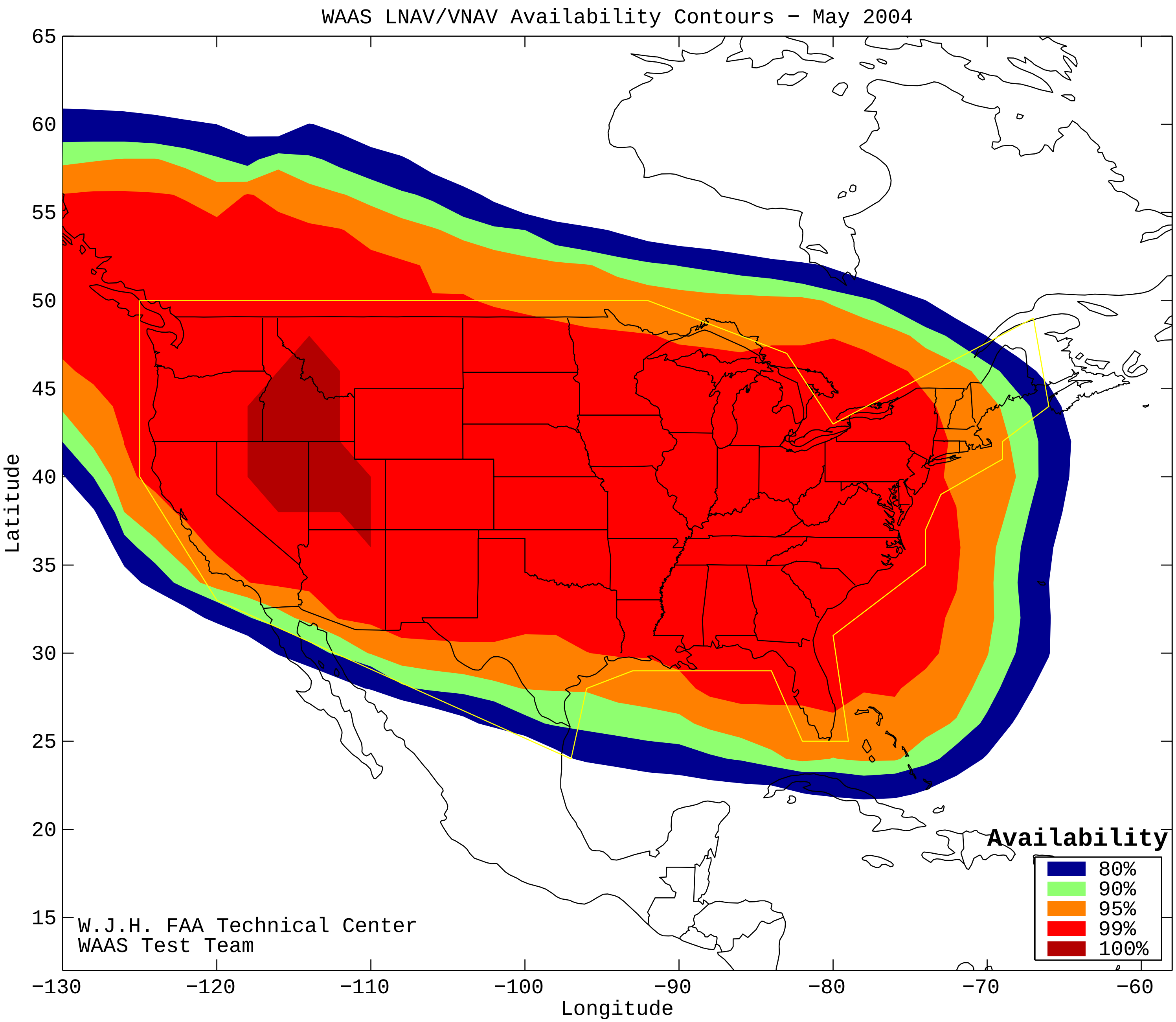
Figure 4•1 WAAS LNAV/VNAV Coverage - April



CONUS Coverage at 95% Availability = 96.36
CONUS Coverage at 99% Availability = 89.88
CONUS Coverage at 100% Availability = 0

SL = LNAV

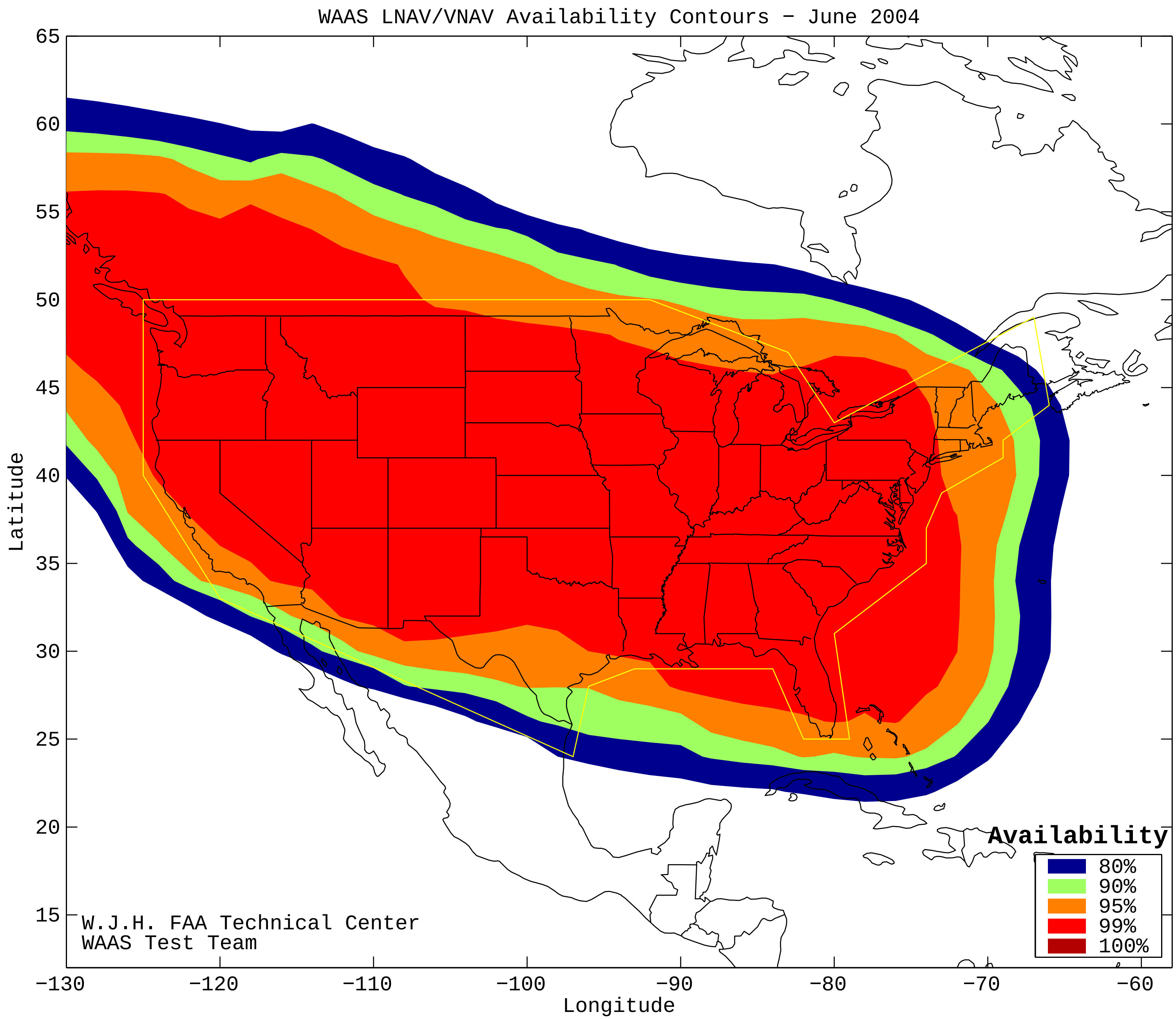
Figure 4•2 WAAS LNAV/VNAV Coverage - May



CONUS Coverage at 95% Availability = 95.14
CONUS Coverage at 99% Availability = 85.02
CONUS Coverage at 100% Availability = 8.907

SL = LNAV

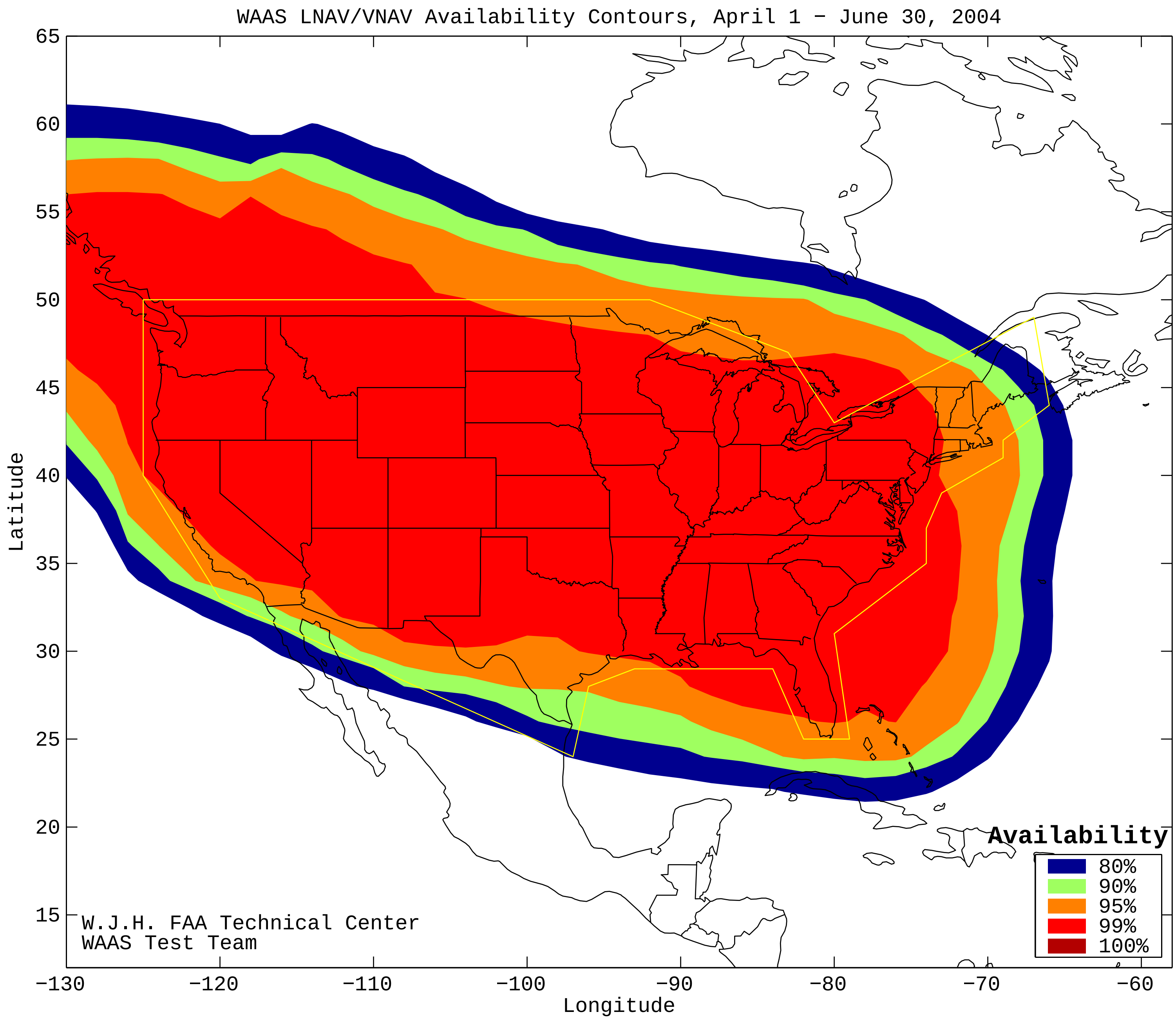
Figure 4•3 WAAS LNAV/VNAV Coverage – June



CONUS Coverage at 95% Availability = 95.14
CONUS Coverage at 99% Availability = 84.21
CONUS Coverage at 100% Availability = 0

SL = LNAV

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



CONUS Coverage at 95% Availability = 95.14
CONUS Coverage at 99% Availability = 85.43
CONUS Coverage at 100% Availability = 0

SL = LNAV

Figure 4•5 WAAS LPV Coverage - April

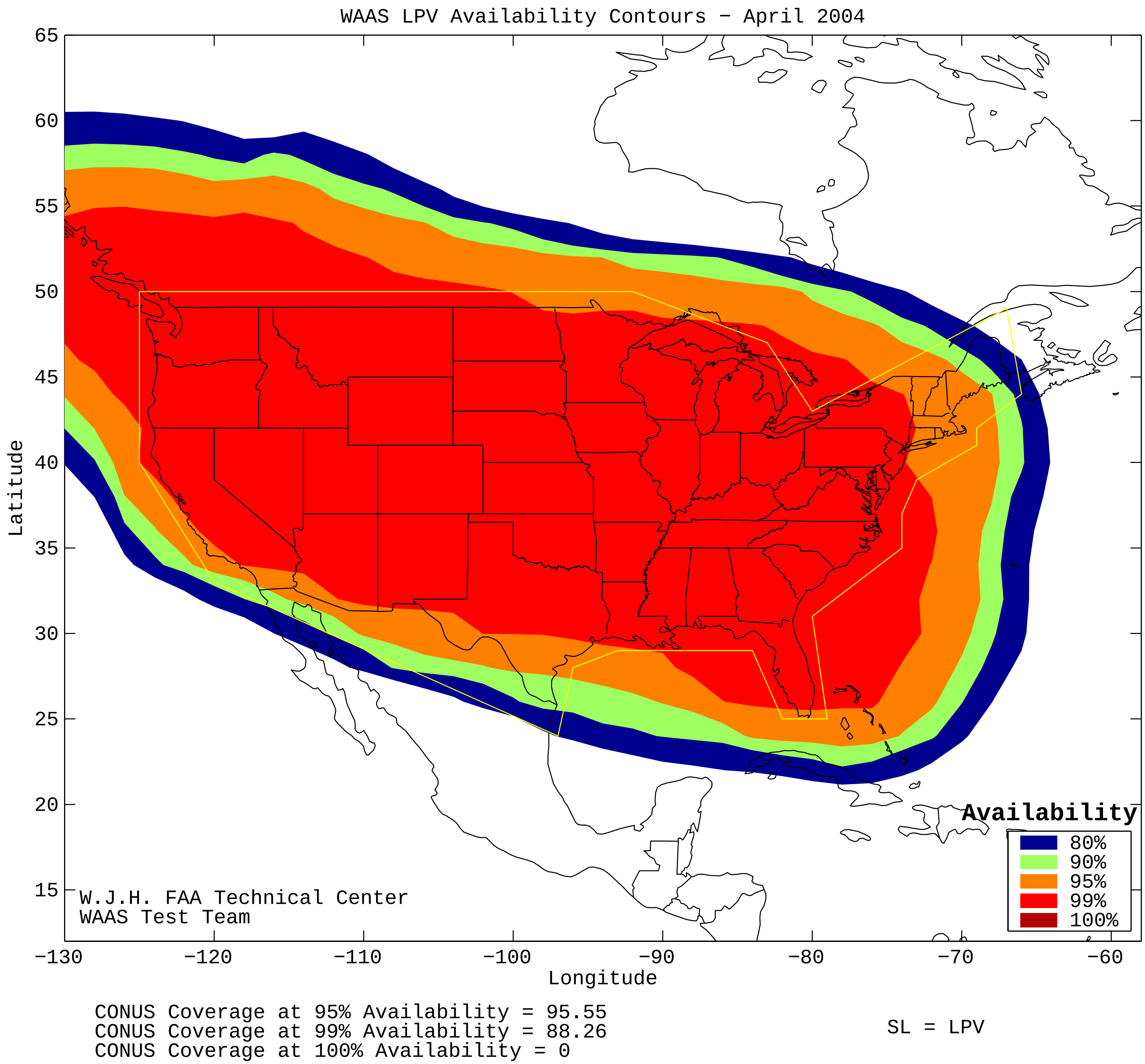
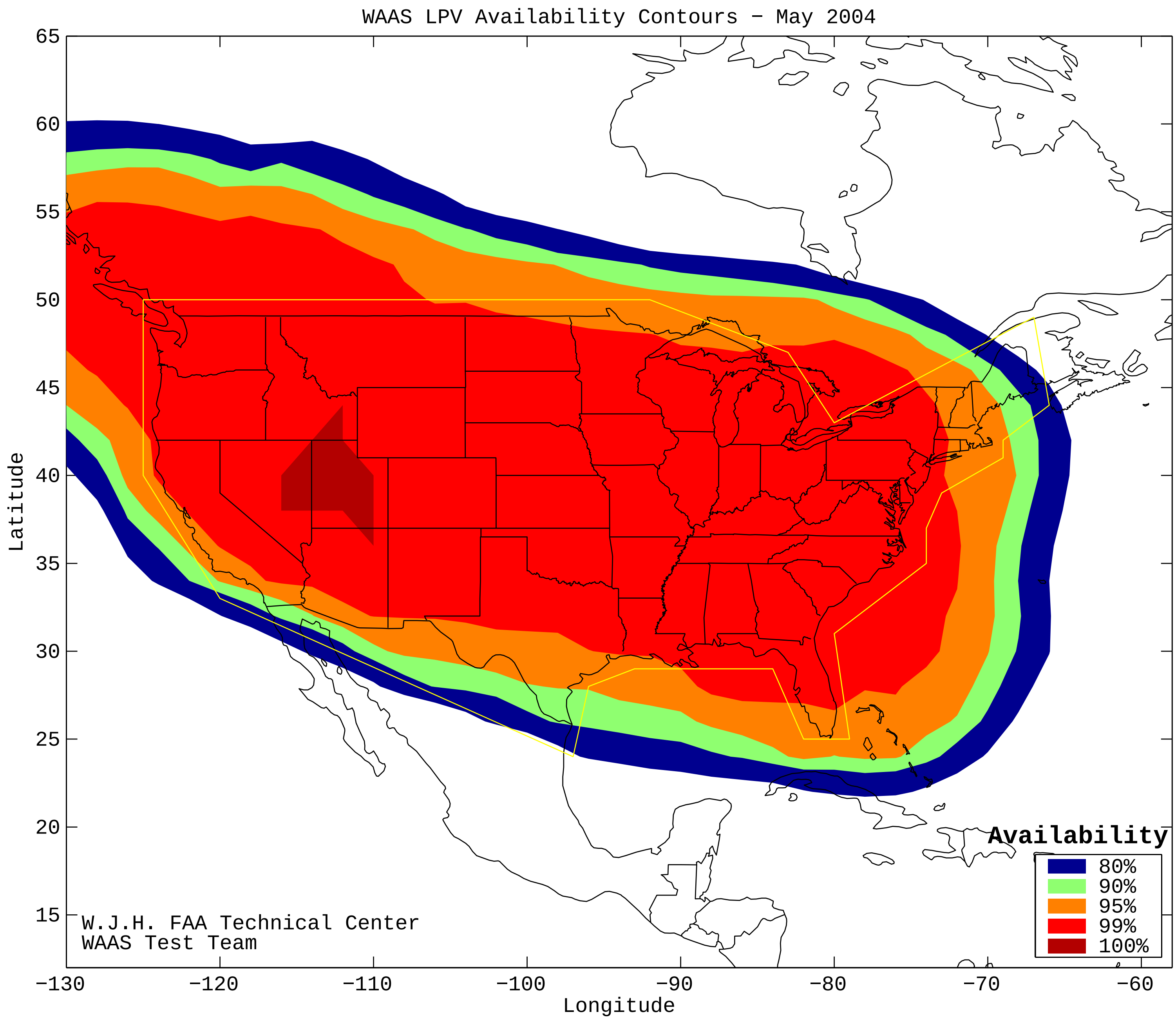


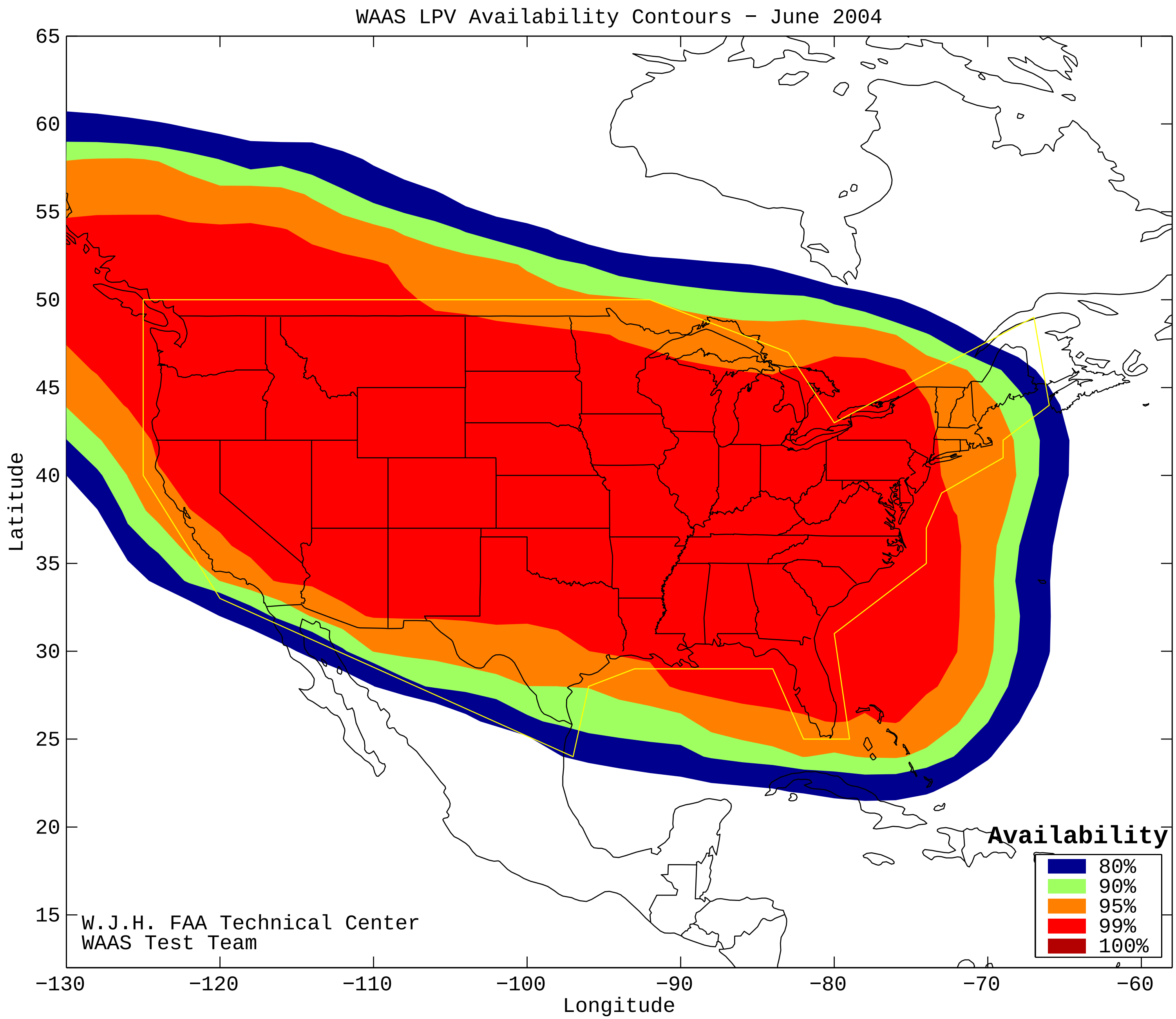
Figure 4•6 WAAS LPV Coverage - May



CONUS Coverage at 95% Availability = 93.93
CONUS Coverage at 99% Availability = 84.62
CONUS Coverage at 100% Availability = 4.858

SL = LPV

Figure 4•7 WAAS LPV Coverage - June



CONUS Coverage at 95% Availability = 94.33
CONUS Coverage at 99% Availability = 82.19
CONUS Coverage at 100% Availability = 0

SL = LPV

Figure 4•8 WAAS LPV Coverage for the Quarter

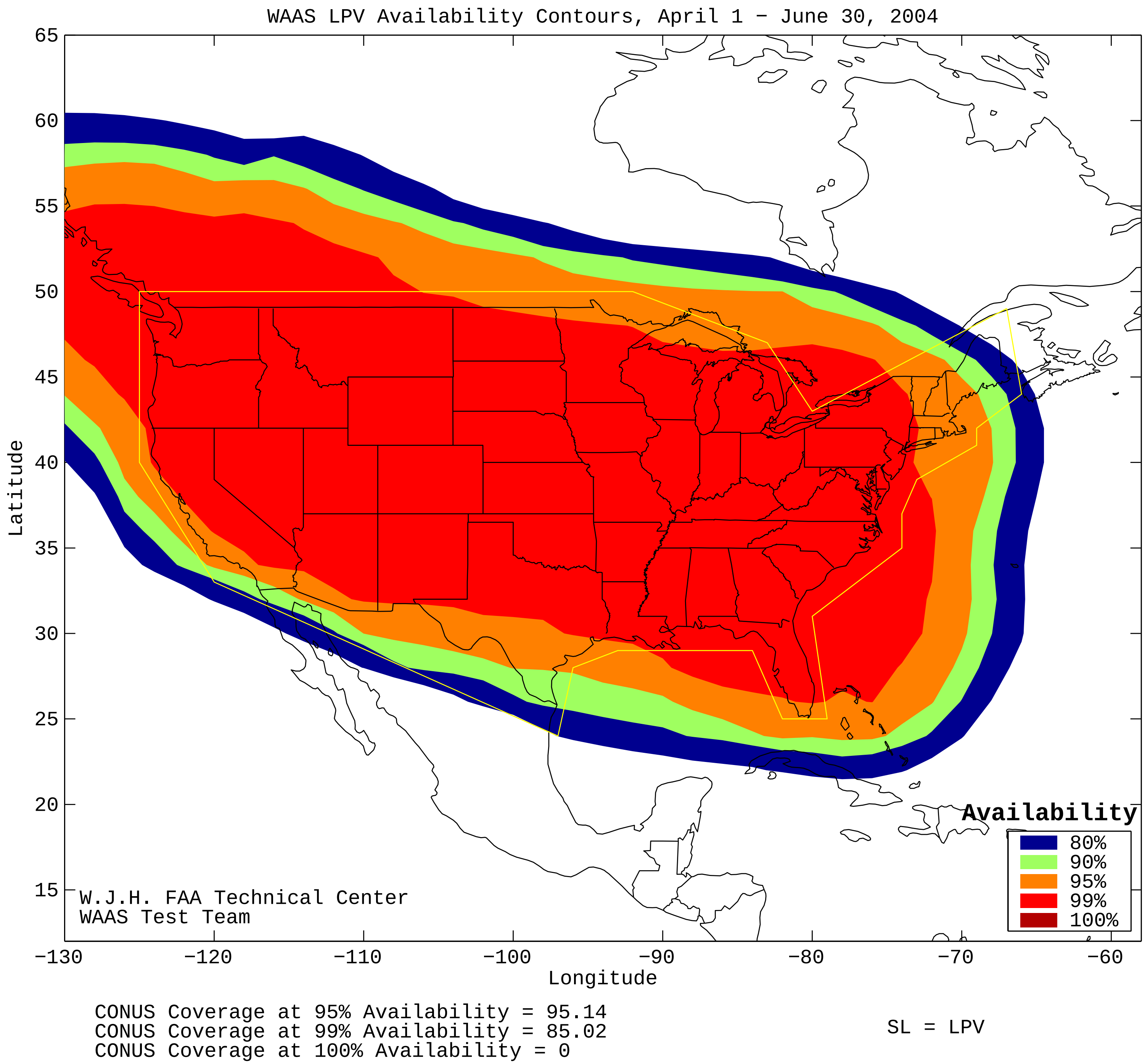
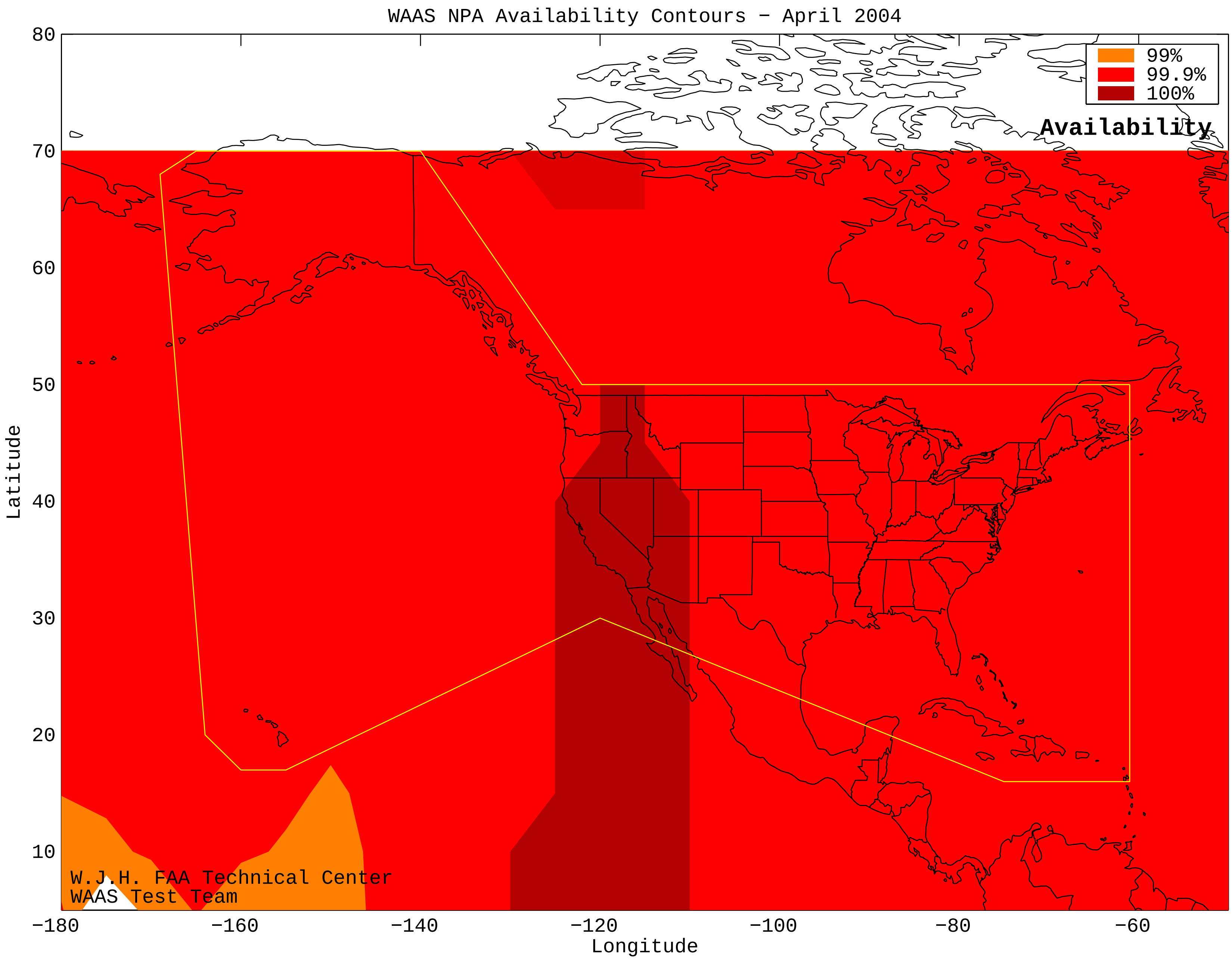


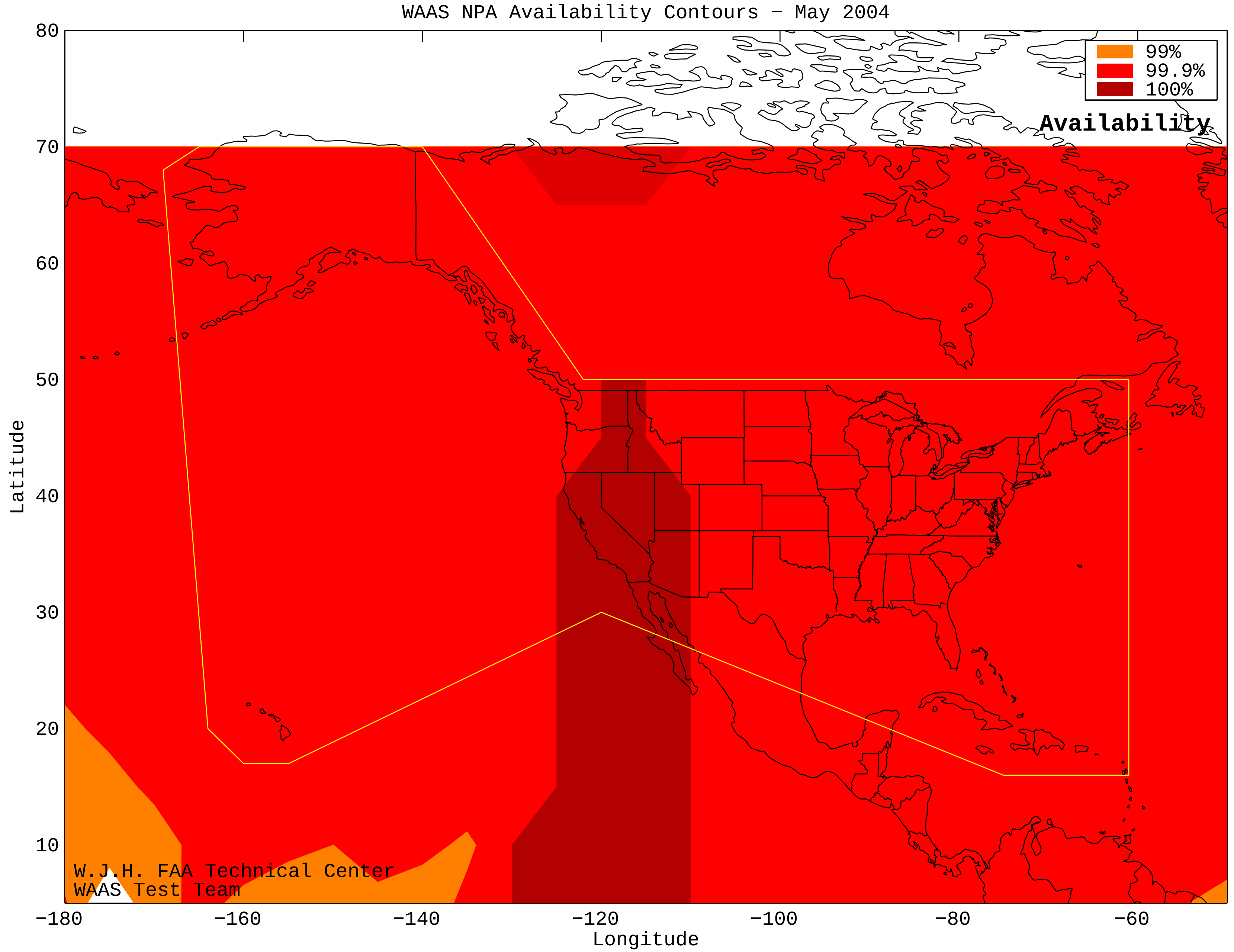
Figure 4•9 WAAS NPA Coverage - April



WAAS Coverage at 99% Availability = 100
WAAS Coverage at 99.9% Availability = 100
WAAS Coverage at 100% Availability = 10.29

SL = NPA

Figure 4•10 WAAS NPA Coverage – May



WAAS Coverage at 99% Availability = 100
WAAS Coverage at 99.9% Availability = 100
WAAS Coverage at 100% Availability = 10.29

SL = NPA

Figure 4•11 WAAS NPA Coverage - June

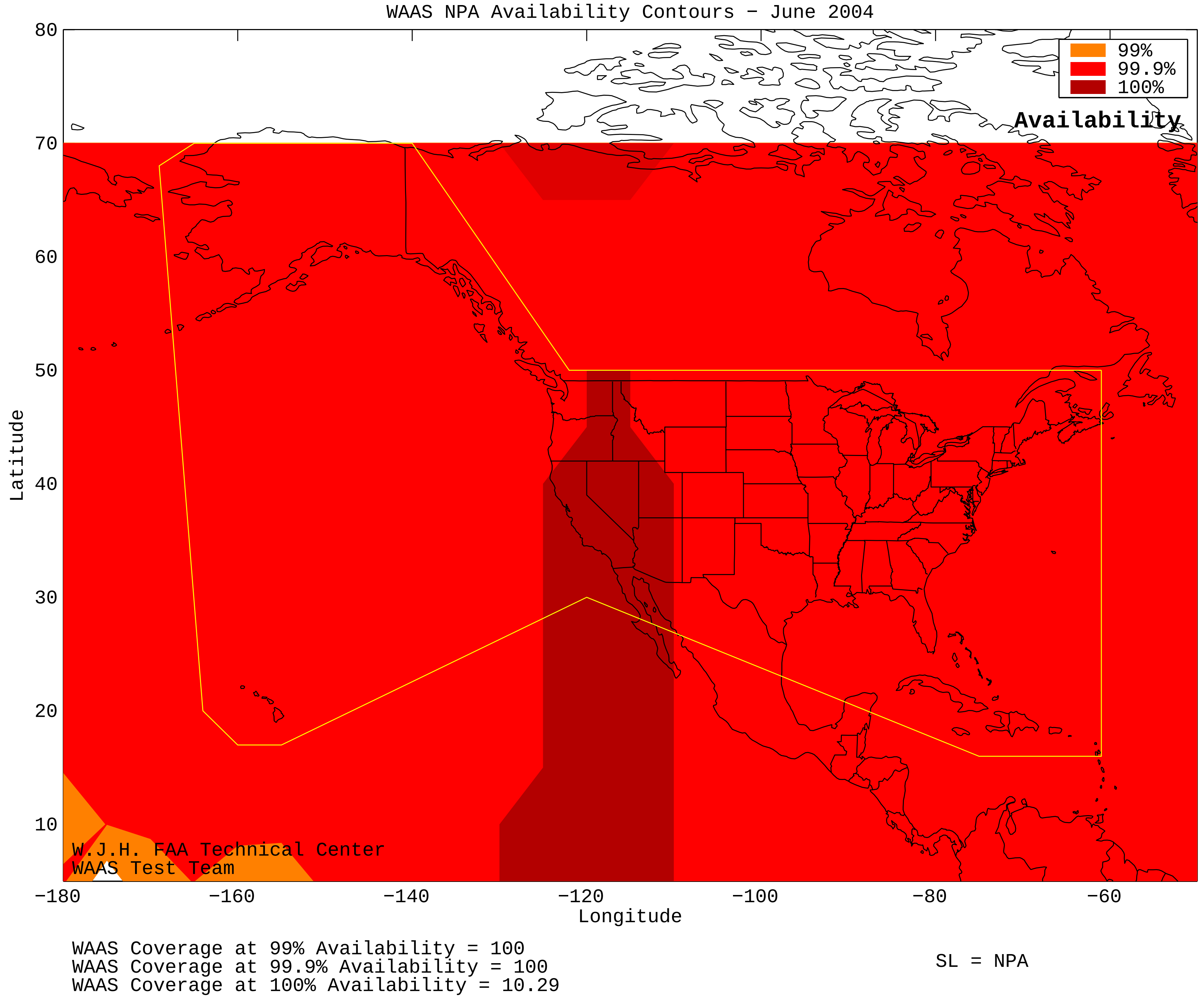


Figure 4•12 WAAS NPA Coverage for the Quarter

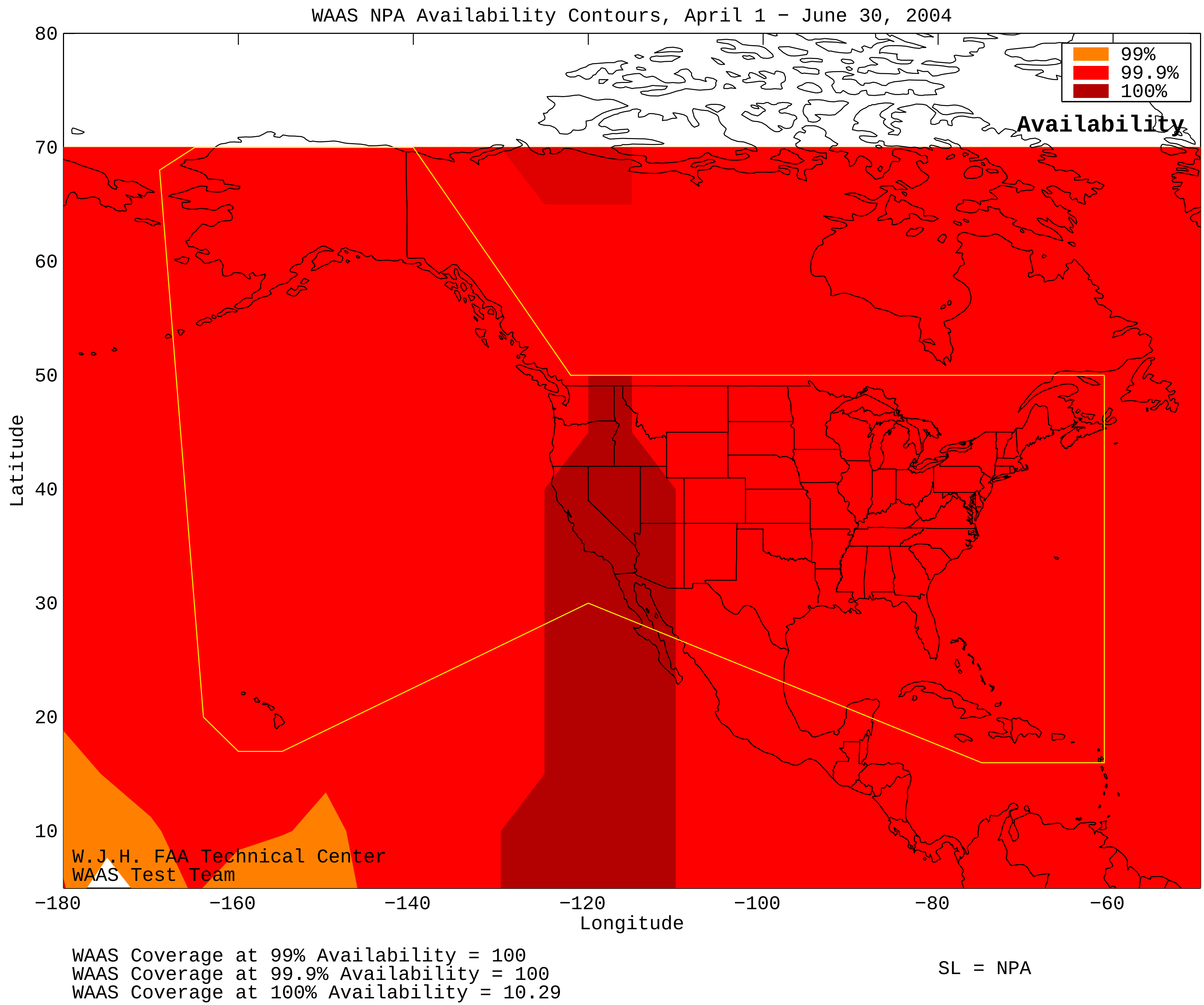


Figure 4-13 Daily WAAS LNAV/VNAV and LPV Coverage

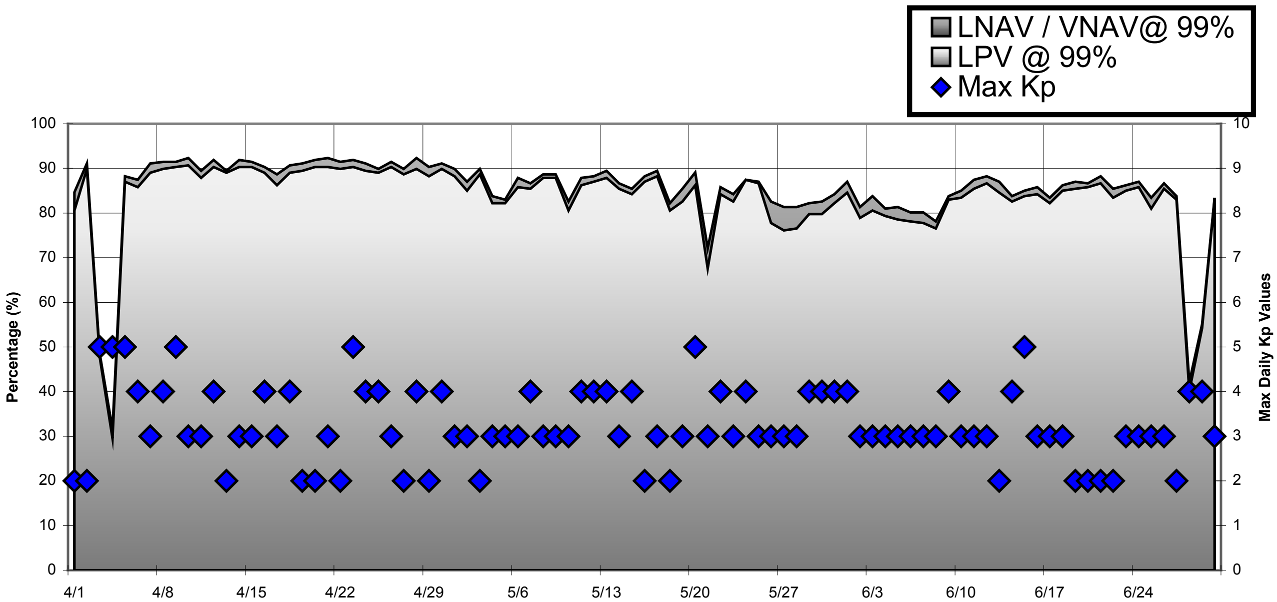
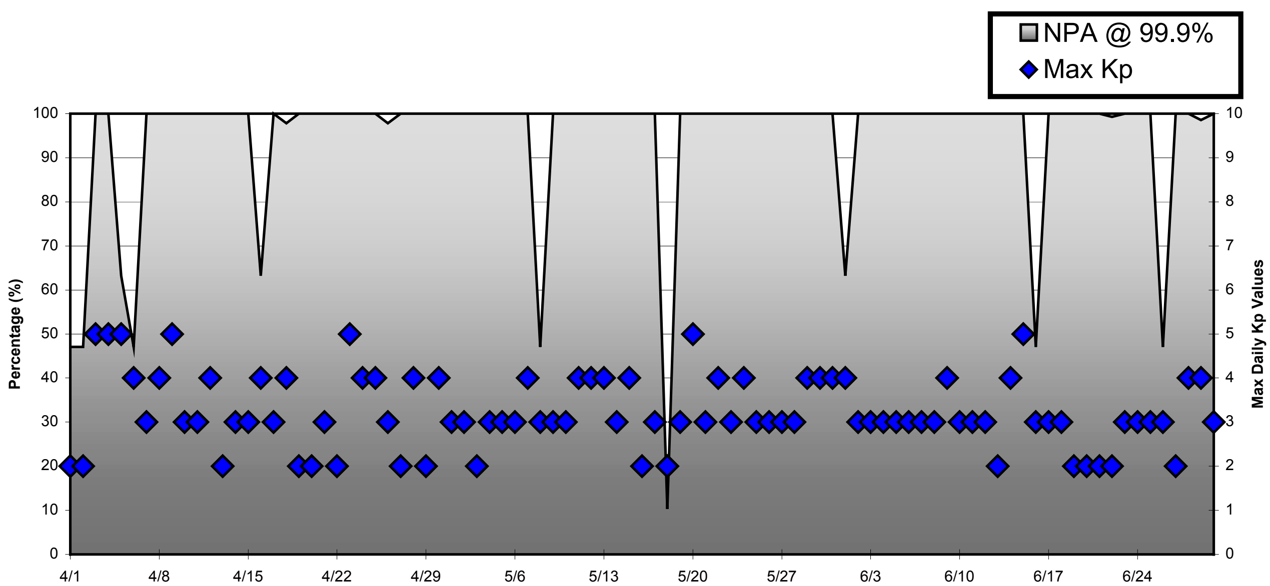


Figure 4-14 Daily NPA Coverage



5.0 CONTINUITY

The definition of PA and NPA continuity and availability definitions are based on the definition from the WAAS specification FAA-E-2892B Change 1. Future reports will use a different definition for continuity and availability to better reflect how these parameters affect operational performance of WAAS.

5.1 PA Continuity of Function

PA continuity of function was evaluated by monitoring the WAAS accuracy and integrity performance. Navigation error data for each reference site was divided into multiple bins consisting of 150 data samples. The position accuracy and integrity performance data for each bin was analyzed and statistics were generated to evaluate the data as follows:

- The horizontal and vertical position errors are less than 7.6 meter 95% of the time for each bin.
- No HMIs have occurred in the horizontal or vertical dimensions.
- User position tool maintains PA mode of operation as defined in Section 2.0.

If the above conditions are met, then the continuity flag is set to "1" to indicate the continuity of function is met for that particular flight segment. The continuity of function percentile statistic was computed for each site by summing the continuity flags of "1" together and dividing by the total number of test segments (bins) accumulated. Table 5.1 shows the PA Continuity of Function probability ranges from 0.994848 (Elko) to 1 (Salt Lake City).

Table 5-1 PA Continuity of Function

Location	PA Continuity of Function
Anderson	0.999898
Atlantic City	0.999895
Elko	0.994848
Grand Forks	0.999905
Great Falls	0.999904
Oklahoma City	0.999904
San Angelo	0.999882
Albuquerque	0.999904
Atlanta	0.999904
Billings	0.999900
Boston	0.999866
Chicago	0.999904
Cleveland	0.999904
Dallas	0.999866
Denver	0.999905
Houston	0.999904
Jacksonville	0.999905
Kansas City	0.999905
Los Angeles	0.999962
Memphis	0.999904
Miami	0.999904
Minneapolis	0.999904
New York	0.999924
Oakland	0.999962
Salt Lake City	100.00
Seattle	0.999962
Washington DC	0.999905

5.2 NPA Continuity of Navigation

NPA continuity of navigation was evaluated by monitoring the accuracy performance throughout each flight hour. Navigation error data for each site was divided into multiple bins consisting of 3600 data samples. The position accuracy data for each bin was analyzed and statistics were generated to evaluate the data. If the horizontal position error is less than 100 meters 95% of the time, then the continuity of navigation flag is set to "1" to indicate the continuity of navigation is met for that particular flight hour. The continuity of navigation percentile statistic was computed for each reference site by summing the continuity of navigation flags of "1" together and dividing by the total number of test hours (bins) accumulated. The NPA Continuity of Navigation column of Table 5.2 shows all evaluated sites passed the requirements with the maximum probability of 1.

5.3 NPA Continuity of Fault Detection

NPA continuity of fault detection was evaluated by monitoring the integrity performance throughout each flight hour. Navigation error data for each reference site was divided into multiple bins consisting of 3600 data samples. The horizontal and vertical position error data for each bin was analyzed and statistics were generated to evaluate the data as follows:

- No HMIs have occurred in the horizontal dimension.
- User maintains NPA navigation mode of operation as defined in Section 2.0.

If the above conditions are met, then the continuity of fault detection flag is set to "1" to indicate the continuity of fault detection is met for that particular flight hour. The continuity of fault detection percentile statistic was computed for each reference site by summing the continuity of fault detection flags of "1" together and dividing by the total number of test hours (bins) accumulated. The NPA Continuity of Fault Detection column of Table 5.2 shows the probability ranges from 0.992213 (Honolulu) to 0.99542 (Salt Lake City). These statistics do not include Receiver Autonomous Integrity Monitoring (RAIM)/Fault Detection and Exclusion (FDE) integrity functions.

Table 5-2 NPA Continuity

Location	Continuity of Navigation	Continuity of Fault Detection (Excluding RAIM/FDE)
Albuquerque	1	0.997250
Anchorage	1	0.994465
Atlanta	1	0.997252
Bethel	1	0.993922
Billings	1	0.997619
Boston	1	0.997246
Cleveland	1	0.997252
Cold Bay	1	0.993539
Fairbanks	1	0.993997
Honolulu	1	0.992213
Houston	1	0.997246
Juneau	1	0.994457
Kansas City	1	0.997253
Kotzebue	1	0.993467
Los Angeles	1	0.999083
Mauna Loa	1	0.992901
Miami	1	0.997248
Minneapolis	1	0.997250
Oakland	1	0.999084
Puerto Rico	1	0.997252
Salt Lake City	1	0.999542
Seattle	1	0.999084
Washington DC	1	0.997253

5.4 LPV Availability

LPV availability was evaluated by monitoring the accuracy, integrity and availability performance throughout each flight segment. Navigation error data for each reference site was divided into multiple bins consisting of 150 data samples. The position accuracy, integrity and availability performance data for each bin was analyzed and statistics were generated to evaluate the data as follows:

- The horizontal and vertical position errors are less than 7.6 meter 95% of the time for each bin.
- No HMIs have occurred in the horizontal or vertical dimensions.
- User maintains PA mode of operation as defined in section 2.0.
- VPL is less than or equal to 50m and HPL is less than or equal to 40 m.

If the above conditions are met, then the continuity of function flag is set to "1" to indicate the LPV availability is met for that particular flight segment. The availability percentile statistic was computed for each reference site by summing the continuity of function flags of "1" together and dividing by the total number of test segments (bins) accumulated. LPV Availability column of Table 5.3 shows the probability for availability ranges from 96.7402% (San Angelo) to 99.9519% (Denver).

5.5 LNAV/VNAV Availability

LNAV/VNAV availability was evaluated by monitoring the accuracy, integrity and availability performance throughout each flight segment. Navigation error data for each reference site was divided into multiple bins consisting of 150 data samples. The position accuracy, integrity and availability performance data for each bin was analyzed and statistics were generated to evaluate the data as follows:

- The horizontal and vertical position errors are less than 7.6 meter 95% of the time for each bin.
- No HMIs have occurred in the horizontal or vertical dimensions.
- User maintains PA mode of operation as defined in section 2.0.
- VPL is less than or equal to 50m and HPL is less than or equal to 556 m.

If the above conditions are met, then the continuity of function flag is set to "1" to indicate the LNAV/VNAV availability is met for that particular flight segment. The availability percentile statistic was computed for each reference site by summing the continuity of function flags of "1" together and dividing by the total number of test segments (bins) accumulated. The LPV Availability column of Table 5.3 shows the availability ranges from 96.1493% (San Angelo) to 99.9733% (Atlanta).

5.6 NPA Availability

NPA availability was evaluated by monitoring the accuracy, integrity and availability performance throughout each flight hour. Navigation error data for each reference site was divided into multiple bins consisting of 3600 data samples. The horizontal and vertical position error data for each bin was analyzed and statistics were generated to evaluate the data as follows:

- The horizontal position errors are less than 100 meters 95% of time for each bin
- No HMIs have occurred in the horizontal dimension.
- User maintains NPA navigation mode of operation as defined in Section 2.0.
- HPL is less than or equal to 556 meters.

If the above conditions are met, then the availability flag is set to "1" to indicate NPA availability is met for that particular flight hour. The NPA availability percentile statistic was computed for each reference site by summing the availability flags of "1" together and dividing by the total number of test hours (bins) accumulated.

The NPA Availability column of Table 5.4 shows the availability ranges from 99.1296% (Honolulu) to 99.9542% (Salt Lake City). These statistics do not include RAIM/FDE integrity functions.

Table 5-3 LPV and LNAV/VNAV Availability

Location	LPV Availability	LNAV/VNAV Availability
Anderson	0.998017	0.998631
Atlantic City	0.987676	0.988493
Elko	0.993575	0.994141
Grand Forks	0.980940	0.982296
Great Falls	0.997099	0.998232
Oklahoma City	0.995069	0.995319
San Angelo	0.961493	0.964297
Albuquerque	0.998911	0.999006
Atlanta	0.999733	0.999733
Billings	0.999100	0.999140
Boston	0.969314	0.969563
Chicago	0.997834	0.997892
Cleveland	0.997592	0.997688
Dallas	0.998411	0.998507
Denver	0.998721	0.998721
Houston	0.987620	0.987754
Jacksonville	0.998511	0.998530
Kansas City	0.998110	0.998110
Los Angeles	0.980299	0.984273
Memphis	0.998987	0.999312
Miami	0.971506	0.971640
Minneapolis	0.996196	0.996253
New York	0.984488	0.984698
Oakland	0.980116	0.983192
Salt Lake City	0.999217	0.999351
Seattle	0.996275	0.997803
Washington DC	0.997613	0.997652

Table 5-4 NPA Availability

Location	NPA Availability (Excluding RAIM/FDE)
Albuquerque	0.997250
Anchorage	0.994465
Atlanta	0.997252
Bethel	0.993922
Billings	0.997619
Boston	0.997246
Cleveland	0.997252
Cold Bay	0.993539
Fairbanks	0.993997
Honolulu	0.991296
Houston	0.997246
Juneau	0.994457
Kansas City	0.997253
Kotzebue	0.993467
Los Angeles	0.999083
Mauna Loa	0.991886
Miami	0.997248
Minneapolis	0.997250
Oakland	0.999084
Puerto Rico	0.997252
Salt Lake City	0.999542
Seattle	0.999084
Washington DC	0.997253

6.0 INTEGRITY

6.1 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 6.1) 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 6-1Safety Margin Index and HMI Statistics

Location	Safety Index		Number of HMIs
	Horizontal	Vertical	
Anderson	4.29	6.66	0
Atlantic City	6.00	5.92	0
Elko	2.40	2.54	0
Grand Forks	4.62	4.10	0
Great Falls	5.00	5.92	0
Oklahoma City	4.62	7.61	0
San Angelo	6.00	6.66	0
Albuquerque	4.62	7.61	0
Atlanta	4.00	7.61	0
Billings	4.62	6.66	0
Boston	6.00	6.66	0
Chicago	4.62	5.92	0
Cleveland	5.45	5.33	0
Dallas	3.16	4.10	0
Denver	4.29	3.81	0
Houston	5.45	5.92	0
Jacksonville	5.00	7.61	0
Kansas City	4.29	6.66	0
Los Angeles	5.45	5.92	0
Memphis	4.62	5.33	0
Miami	6.67	5.92	0
Minneapolis	5.45	4.85	0
New York	6.00	4.85	0
Oakland	6.67	5.33	0
Salt Lake City	4.62	5.92	0
Seattle	5.45	6.66	0
Washington DC	5.45	6.66	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 safety margin index never drops below 2.0 at any site. Also, Table 6.1 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.

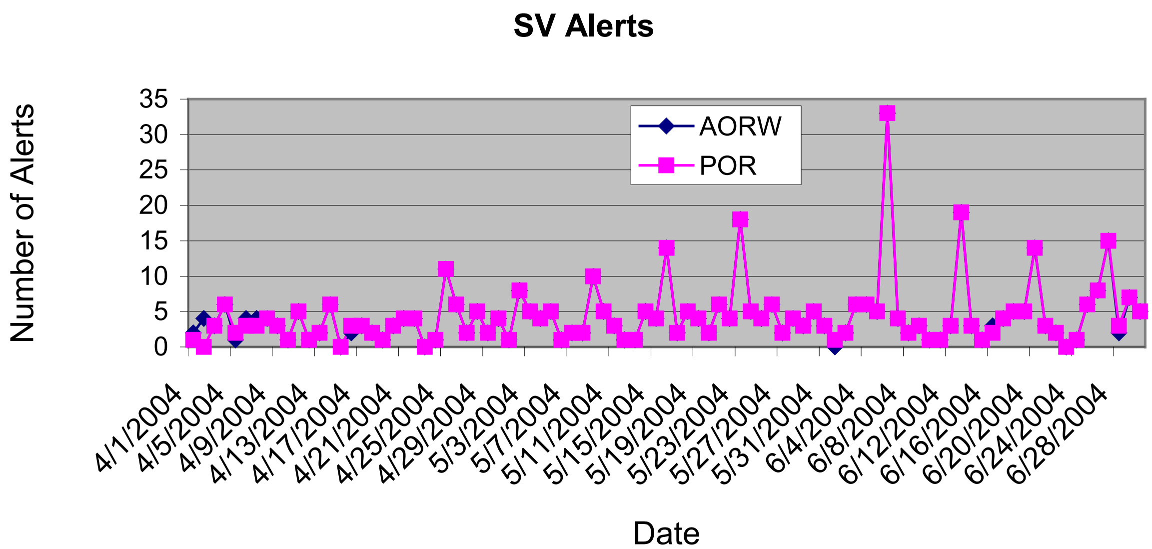
6.2 Broadcast Alerts

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. Ionospheric Grid Point (IGP) alerts increase the Grid Ionospheric Vertical Error (GIVE) of IGP's, which can affect the usage of satellites whose pierce points are in the vicinity of the IGP. An increase in either UDRE's or GIVE'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 continuity of fault detection to not be met for that flight segment. Table 6.2 shows the total number of alerts and the average number of alerts per day. Figure 6.1 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. Note that after March 11 the number of alerts drops dramatically. This is a result of the upgrade made to the WAAS on that date.

Table 6-2 WAAS SV Alert

	Number of Alerts		Average Alerts Per Day	
Message Type	**AORW**	**POR**	**AORW**	**POR**
2	227	226	2.494505	2.483516
3	149	147	1.637362	1.615384
6	2	3	0.021978	0.032967
24	108	120	1.186813	1.318681
26	0	0	0	0
Total Alerts	486	496	5.340659	5.450549

Figure 6-1 SV Daily Alert Trends



6.3 Availability of WAAS Messages (AORW & POR)

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 6.3 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 6.4 to 6.8 show fast correction, long correction, ephemeris covariance, ionosphere correction, and ionospheric mask message rates statistics broadcasted on AORW. The message rates statistics for POR are shown in table 6.9 to 6.13.

Table 6-3 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 6-4 WAAS Fast Correction and Degradation Message Rates - AORW

Message Type	**On Time**	**Late**	**Max Late Length (seconds)**
1	139844	0	0
2	1310688	179	35
3	1310451	211	29
7	74635	131	138
9	92138	0	0
10	74612	125	145
17	29693	1	310
24	1310302	247	29

Table 6-5 WAAS Long Correction Message Rates (Type 24 and 25) - AORW

SV	On Time	Late	Max Late Length (seconds)
1	46690	0	0
3	49800	0	0
4	52421	1	174
5	48700	0	0
6	47513	0	0
7	49171	1	170
8	38214	0	0
9	49361	0	0
10	51927	0	0
11	50589	0	0
13	47324	0	0
14	50102	0	0
15	46747	1	176
16	51762	0	0
17	49245	2	173
18	47433	1	162
19	46923	0	0
20	48136	1	177
21	43256	0	0
22	42963	0	0
24	52037	1	164
25	53264	1	168
26	48923	0	0
27	43928	0	0
28	42726	0	0
29	49101	0	0
30	49326	0	0
31	49344	1	171

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

SV	On Time	Late	Max Late Length (seconds)
1	41825	0	0
3	43866	1	239
4	42921	1	184
5	43986	1	137
6	41619	0	0
7	42231	1	124
8	33953	0	0
9	44252	1	194
10	43265	0	0
11	45194	1	149
13	41829	0	0
14	42663	1	215
15	41110	0	0
16	43146	0	0
17	41434	1	180
18	41535	0	0
19	40061	1	192
20	42173	0	0
21	35240	0	0
22	36214	1	192
24	41773	0	0
25	42045	1	121
26	40877	0	0
27	36162	1	121
28	36266	0	0
29	41175	1	192
30	42697	0	0
31	40929	1	194
122	82503	0	0
134	80639	1	194

Table 6-7 WAAS Ionospheric Correction Message Rates (Type 26) - AORW

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	27320	1	306
1	0	27310	5	576
1	1	27324	4	308
1	2	27308	3	308
1	3	27310	1	312
1	4	27314	4	576
2	0	27309	2	317
2	1	27312	3	307
2	2	27328	3	309
2	3	27314	1	301
2	4	27312	3	304
2	5	27332	3	310
3	0	27315	4	313

Table 6-8 WAAS Ionospheric Mask Message Rates (Type 18) - AORW

Band	On Time	Late	Max Late Length (seconds)
0	67558	0	0
1	67572	0	0
2	67582	0	0
3	67530	0	0

Table 6-9 WAAS Fast Correction and Degradation Message Rates - POR

Message Type	On Time	Late	Max Late Length (seconds)
1	136915	0	0
2	1297690	182	33
3	1297467	212	28
7	73101	118	140
9	91225	0	0
10	73109	101	139
17	29291	1	527
24	1297317	248	25

Table 6-10 WAAS Long Correction Message Rates (Type 24 and 25) - POR

SV	On Time	Late	Max Late Length (seconds)
1	46078	1	160
3	49240	0	0
4	51630	2	172
5	48188	0	0
6	46888	0	0
7	48508	0	0
8	37595	0	0
9	48832	0	0
10	51154	0	0
11	50045	0	0
13	46700	1	175
14	49506	0	0
15	46225	0	0
16	51064	1	154
17	48552	0	0
18	46889	0	0
19	46924	1	178
20	47614	0	0
21	42708	1	166
22	42474	0	0
24	51277	0	0
25	52561	0	0
26	48278	0	0
27	43271	0	0
28	42205	0	0
29	48432	0	0
30	48846	0	0
31	48756	0	0

Table 6-11 WAAS Ephemeris Covariance Message Rates (Type 28) – POR

SV	On Time	Late	Max Late Length (seconds)
1	41346	0	0
3	43460	1	239
4	42448	0	0
5	43603	1	137
6	41165	0	0
7	41781	0	0
8	33480	0	0
9	43846	1	134
10	42779	0	0
11	44788	1	122
13	41343	0	0
14	42293	2	210
15	40750	0	0
16	42645	1	185
17	40966	0	0
18	41143	1	182
19	40070	0	0
20	41729	2	183
21	34918	0	0
22	35864	1	186
24	41311	0	0
25	41662	0	0
26	40434	0	0
27	35759	1	138
28	35911	1	192
29	40693	2	193
30	42321	0	0
31	40541	1	127
122	81645	0	0
134	79635	0	0

Table 6-12 WAAS Ionospheric Correction Message Rates (Type 26) – POR

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	27072	5	305
0	1	27037	5	312
0	2	27035	4	311
1	0	27049	0	0
1	1	27048	1	301
1	2	27062	3	309
1	3	27037	4	307
1	4	27049	3	309
2	0	27044	6	578
2	1	27046	2	312
2	2	27043	5	308
2	3	27047	2	310

Table 6-13 WAAS Ionospheric Mask Message Rates (Type 18) - POR

Band	On Time	Late	Max Late Length (seconds)
0	66497	0	0
1	66493	0	0
2	66465	0	0

7.0 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 seven WAAS receivers during the quarter. Table 7.1 and 7.2 show the range error 95% index and 99.9% (3.29 sigma) bounding statistics for each SV at the selected locations. Last quarter 12 sites were evaluated but due processing issues the number of sites evaluated were reduced. During the evaluated period, all GPS satellite residual errors were less than 4.093 meters 95% of the time, and all satellites range errors were bounded 99.9% of the time by the UDRE except for PRN 25 at Minneapolis which was bounded 99.77%.

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 ionospheric delay interpolated from the IGP's and GPS dual frequency measurement at that GPS satellite.

GPS satellite ionospheric errors were calculated for seven WAAS receivers during the quarter. Table 7.3 and 7.4 show the ionospheric error 95% index and 99.9% (3.29 sigma) bounding statistics for each SV at the selected locations. All GPS satellite ionospheric errors were less than 3.095 meters 95% of the time and all satellites were bounded 100% of the time. Figures 7.1 to 7.4 show the daily trend of the 95% Range and Ionospheric Errors for Billings MT.

In this report seven sites are used for the range and ionosphere analysis. Due to data processing issues more sites could not be included in this report. Future reports will use more sites for this analysis.

Table 7-1 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	1.669	100.00	1.161	100.00	1.862	100.00	1.469	100.00	1.134	100.00	2.082	100.00
2	-	-	-	-	-	-	-	-	-	-	-	-
3	1.344	100.00	1.208	100.00	1.844	100.00	1.808	100.00	1.499	100.00	1.842	100.00
4	1.275	100.00	1.372	100.00	2.074	100.00	1.753	100.00	2.535	100.00	3.251	100.00
5	1.741	100.00	1.628	99.9993	1.698	100.00	1.620	100.00	1.348	100.00	1.463	100.00
6	1.271	100.00	1.324	99.4977	2.272	100.00	1.872	100.00	1.439	100.00	2.170	100.00
7	1.495	100.00	1.198	100.00	1.646	100.00	1.461	100.00	1.838	100.00	1.873	100.00
8	1.379	100.00	1.435	100.00	1.965	100.00	1.692	100.00	1.106	100.00	1.831	100.00
9	1.261	100.00	1.386	100.00	2.208	99.9857	1.907	100.00	2.386	100.00	1.876	100.00
10	1.833	100.00	2.269	100.00	1.508	100.00	1.209	100.00	1.176	100.00	1.537	100.00
11	1.799	100.00	1.796	100.00	1.652	100.00	1.347	100.00	2.634	100.00	1.111	100.00
12	-	-	-	-	-	-	-	-	-	-	-	-
13	1.494	100.00	1.380	100.00	1.841	100.00	1.568	100.00	1.218	100.00	1.825	100.00
14	1.712	100.00	1.644	100.00	1.625	100.00	1.313	100.00	1.747	100.00	1.185	100.00
15	1.276	100.00	1.358	99.9847	1.801	100.00	1.597	100.00	1.290	100.00	1.835	100.00
16	1.835	100.00	1.896	100.00	1.530	100.00	1.154	100.00	1.193	100.00	1.556	100.00
17	1.326	100.00	1.412	99.9988	1.680	100.00	1.440	100.00	1.865	100.00	1.782	100.00
18	1.737	100.00	1.558	100.00	1.381	100.00	1.245	100.00	1.985	100.00	0.957	100.00
19	4.762	99.4371	4.498	99.9725	3.908	99.9842	3.607	99.6517	4.405	100.00	3.507	100.00
20	2.059	100.00	1.798	100.00	1.463	100.00	1.750	100.00	1.836	100.00	1.576	100.00
21	2.042	100.00	2.185	100.00	1.676	100.00	1.822	100.00	2.106	100.00	0.992	100.00
22	1.84	100.00	1.765	100.00	1.400	100.00	1.527	100.00	1.981	100.00	1.298	100.00
23	-	-	-	-	-	-	-	-	-	-	-	-
24	1.403	100.00	1.224	100.00	2.231	100.00	1.876	100.00	2.789	100.00	2.299	100.00
25	1.461	100.00	1.234	99.9989	2.053	100.00	1.367	100.00	1.366	100.00	1.592	100.00
26	1.184	100.00	1.677	99.9996	2.152	99.9584	1.757	100.00	1.931	100.00	2.116	100.00
27	1.323	100.00	1.313	100.00	2.008	100.00	1.503	100.00	1.115	100.00	1.802	100.00
28	1.966	100.00	1.675	100.00	1.319	100.00	1.363	100.00	1.356	100.00	1.173	100.00
29	1.115	100.00	1.844	100.00	1.817	99.9569	2.031	100.00	1.397	100.00	1.749	100.00
30	1.312	100.00	1.456	99.6789	2.432	100.00	2.052	100.00	1.732	100.00	2.259	100.00
31	1.775	100.00	1.363	100.00	1.466	100.00	1.294	100.00	1.192	100.00	1.706	100.00
122	4.629	100.00	2.964	99.9999	3.294	100.00	3.393	100.00	2.384	100.00	3.314	100.00
134	-	-	-	-	-	-	-	-	-	-	-	-

Table 7-2 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	2.757	100.00	1.182	100.00	1.134	100.00	1.900	99.9567	1.716	100.00	1.641	100.00
2	-	-	-	-	-	-	-	-	-	-	-	-
3	2.754	100.00	1.517	100.00	1.266	100.00	1.353	100.00	1.913	100.00	1.430	100.00
4	2.797	100.00	1.762	100.00	1.451	100.00	1.669	100.00	2.313	100.00	1.828	100.00
5	3.267	99.7897	1.917	100.00	1.790	100.00	1.450	100.00	1.572	100.00	1.787	100.00
6	2.804	100.0000	1.259	100.00	1.715	100.00	1.806	100.00	2.039	100.00	1.632	100.00
7	2.938	100.0000	1.224	100.00	1.232	100.00	1.384	100.00	1.720	100.00	1.670	100.00
8	2.733	100.0000	1.132	100.00	1.071	100.00	1.399	100.00	1.793	100.00	1.451	100.00
9	2.511	99.8968	1.264	100.00	1.439	100.00	1.306	99.9988	2.020	100.00	1.691	100.00
10	3.253	100.00	1.341	100.00	2.126	100.00	1.622	100.00	1.595	100.00	1.607	100.00
11	2.742	100.00	1.476	100.00	1.533	100.00	1.558	100.00	1.508	100.00	1.830	100.00
12	-	-	-	-	-	-	-	-	-	-	-	-
13	2.657	100.00	1.125	100.00	1.344	100.00	1.723	100.00	1.768	100.00	1.458	100.00
14	2.696	100.00	1.572	100.00	1.837	100.00	1.569	99.9490	1.548	100.00	1.908	100.00
15	2.767	100.00	1.251	100.00	1.593	100.00	1.644	99.9270	1.745	100.00	1.451	100.00
16	3.048	100.00	1.284	100.00	1.515	100.00	1.662	99.9757	1.593	100.00	1.522	100.00
17	2.716	99.9994	1.216	100.00	1.404	100.00	1.191	100.00	2.026	100.00	1.576	100.00
18	3.068	99.9996	1.524	100.00	2.300	100.00	1.680	99.9140	1.699	100.00	1.934	100.00
19	5.754	97.4310	3.978	99.9971	4.331	99.9972	4.526	98.3404	4.168	99.1626	4.382	99.9997
20	3.113	99.9924	1.675	100.00	1.865	100.00	1.869	99.9999	1.693	100.00	1.798	100.00
21	3.205	100.00	1.692	100.00	2.188	100.00	1.918	99.9850	1.961	100.00	2.093	100.00
22	2.987	100.00	1.702	100.00	2.255	100.00	1.894	99.9292	1.824	100.00	2.021	100.00
23	-	-	-	-	-	-	-	-	-	-	-	-
24	2.765	100.00	1.741	100.00	1.826	100.00	1.767	100.00	2.560	99.9998	1.868	100.00
25	2.782	100.00	1.561	100.00	1.527	100.00	1.757	99.8563	1.781	100.00	1.589	100.00
26	2.694	100.00	1.746	100.00	1.338	100.00	2.083	100.00	2.145	100.00	1.877	100.00
27	2.634	100.00	1.348	100.00	1.142	100.00	1.455	100.00	1.812	100.00	1.498	100.00
28	3.135	99.9999	1.404	100.00	1.541	100.00	1.840	100.00	1.392	100.00	2.010	100.00
29	2.713	100.00	1.330	100.00	1.507	100.00	1.323	100.00	1.974	100.00	1.570	100.00
30	2.794	99.9892	1.686	100.00	1.298	100.00	1.445	100.00	2.157	100.00	1.892	100.00
31	2.965	100.00	1.163	100.00	1.432	100.00	1.693	99.9851	1.500	100.00	1.496	100.00
122	4.784	100.00	4.439	100.00	2.575	100.00	5.960	100.00	3.169	100.00	0.000	0.00
134	7.155	100.00	6.138	100.00	-	-	-	-	-	-	3.433	100.00

Table 7-3 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	0.672	100.00	0.442	100.00	1.016	100.00	0.764	100.00	0.647	100.00	1.348	100.00
2	-	-	-	-	-	-	-	-	-	-	-	-
3	0.466	100.00	0.566	100.00	0.914	100.00	0.931	100.00	0.819	100.00	1.024	100.00
4	0.568	100.00	0.756	100.00	1.305	100.00	1.028	100.00	1.602	100.00	2.111	100.00
5	0.909	100.00	0.772	100.00	0.785	100.00	0.761	100.00	0.745	100.00	0.717	100.00
6	0.488	100.00	0.621	100.00	1.282	100.00	0.989	100.00	0.694	100.00	1.395	100.00
7	0.763	100.00	0.728	100.00	0.885	100.00	0.680	100.00	1.047	100.00	1.251	100.00
8	0.768	100.00	0.845	100.00	1.061	100.00	0.817	100.00	0.722	100.00	1.182	100.00
9	0.449	100.00	0.638	100.00	1.149	100.00	1.002	100.00	1.261	100.00	1.009	100.00
10	1.154	100.00	1.281	100.00	0.748	100.00	0.677	100.00	0.991	100.00	0.805	100.00
11	0.865	100.00	0.878	100.00	0.723	100.00	0.539	100.00	1.425	100.00	0.637	100.00
12	-	-	-	-	-	-	-	-	-	-	-	-
13	0.686	100.00	0.683	100.00	1.029	100.00	0.849	100.00	0.619	100.00	1.168	100.00
14	1.245	100.00	0.930	100.00	0.830	100.00	0.798	100.00	1.118	100.00	0.695	100.00
15	0.788	100.00	0.577	100.00	0.911	100.00	0.882	100.00	0.871	100.00	0.950	100.00
16	1.049	100.00	1.112	100.00	0.743	100.00	0.551	100.00	0.848	100.00	0.938	100.00
17	0.539	100.00	0.657	100.00	1.046	100.00	0.743	100.00	1.106	100.00	1.073	100.00
18	1.320	100.00	0.995	100.00	0.867	100.00	0.776	100.00	1.376	100.00	0.633	100.00
19	3.535	100.00	3.173	100.00	2.723	100.00	2.846	100.00	3.382	100.00	2.518	100.00
20	1.057	100.00	1.015	100.00	0.705	100.00	0.663	100.00	0.922	100.00	0.777	100.00
21	1.591	100.00	1.357	100.00	0.978	100.00	1.160	100.00	1.429	100.00	0.584	100.00
22	1.516	100.00	1.146	100.00	0.966	100.00	1.022	100.00	1.472	100.00	0.716	100.00
23	-	-	-	-	-	-	-	-	-	-	-	-
24	0.700	100.00	0.676	100.00	1.542	100.00	1.151	100.00	1.870	100.00	1.658	100.00
25	0.740	100.00	0.729	100.00	1.408	100.00	0.873	100.00	1.109	100.00	0.933	100.00
26	0.455	100.00	0.781	100.00	1.341	100.00	0.811	100.00	0.977	100.00	1.386	100.00
27	0.715	100.00	0.741	100.00	1.208	100.00	0.695	100.00	0.682	100.00	1.275	100.00
28	1.267	100.00	1.147	100.00	0.882	100.00	0.644	100.00	0.958	100.00	0.637	100.00
29	0.473	100.00	0.693	100.00	0.930	100.00	0.939	100.00	0.689	100.00	1.091	100.00
30	0.408	100.00	0.748	100.00	1.331	100.00	1.014	100.00	0.774	100.00	1.142	100.00
31	1.002	100.00	0.821	100.00	0.782	100.00	0.624	100.00	0.644	100.00	1.009	100.00

Table 7-4 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	1.765	100.00	0.583	100.00	0.675	100.00	0.702	100.00	1.119	100.00	0.925	100.00
2	-	-	-	-	-	-	-	-	-	-	-	-
3	1.480	100.00	0.704	100.00	0.647	100.00	0.642	100.00	1.190	100.00	0.883	100.00
4	1.794	100.00	1.126	100.00	0.913	100.00	0.631	100.00	1.443	100.00	0.979	100.00
5	1.844	100.00	0.874	100.00	0.940	100.00	1.120	100.00	0.844	100.00	1.245	100.00
6	1.911	100.00	0.676	100.00	0.969	100.00	0.736	100.00	1.199	100.00	0.913	100.00
7	1.757	100.00	0.710	100.00	0.617	100.00	0.912	100.00	1.099	100.00	1.240	100.00
8	1.692	100.00	0.424	100.00	0.632	100.00	0.726	100.00	1.210	100.00	0.979	100.00
9	1.409	100.00	0.561	100.00	0.600	100.00	0.594	100.00	1.116	100.00	0.915	100.00
10	2.027	100.00	0.535	100.00	1.010	100.00	1.272	100.00	0.984	100.00	1.161	100.00
11	1.519	100.00	0.597	100.00	0.744	100.00	1.051	100.00	0.852	100.00	1.130	100.00
12	-	-	-	-	-	-	-	-	-	-	-	-
13	1.788	99.9965	0.490	99.9962	0.715	100.00	0.632	100.00	1.039	100.00	0.873	100.00
14	2.063	100.00	0.794	100.00	1.010	100.00	1.282	100.00	1.093	100.00	1.499	100.00
15	1.849	100.00	0.470	100.00	0.628	100.00	1.221	100.00	1.030	100.00	0.939	100.00
16	1.988	100.00	0.522	100.00	0.586	100.00	0.955	100.00	0.864	100.00	1.179	100.00
17	1.938	100.00	0.566	100.00	0.691	100.00	0.774	100.00	1.206	100.00	1.040	100.00
18	2.332	100.00	0.840	100.00	1.361	100.00	1.444	100.00	1.229	100.00	1.567	100.00
19	3.833	100.00	2.751	100.00	2.897	100.00	3.520	100.00	2.932	100.00	3.471	100.00
20	1.859	100.00	0.669	100.00	0.963	100.00	1.295	100.00	0.936	100.00	1.191	100.00
21	2.517	100.00	1.055	100.00	1.386	100.00	1.733	100.00	1.470	100.00	1.831	100.00
22	2.427	100.00	0.954	100.00	1.467	100.00	1.712	100.00	1.389	100.00	1.757	100.00
23	-	-	-	-	-	-	-	-	-	-	-	-
24	2.324	100.00	1.184	100.00	1.171	100.00	0.828	100.00	1.603	100.00	1.166	100.00
25	1.609	100.00	0.940	100.00	1.110	100.00	0.678	100.00	1.140	100.00	1.102	100.00
26	1.553	100.00	0.962	100.00	0.713	100.00	0.793	100.00	1.207	100.00	0.941	100.00
27	1.831	100.00	0.875	100.00	0.712	100.00	0.721	100.00	1.201	100.00	1.136	100.00
28	1.992	100.00	0.660	100.00	0.950	100.00	1.458	100.00	0.845	100.00	1.636	100.00
29	1.528	100.00	0.631	100.00	0.553	100.00	0.759	100.00	1.137	100.00	0.965	100.00
30	1.629	100.00	0.855	100.00	0.630	100.00	0.586	100.00	1.148	100.00	0.849	100.00
31	1.751	100.00	0.501	100.00	0.507	100.00	0.965	100.00	0.907	100.00	1.062	100.00

Figure 7•1 95% Range Error (SV 1—SV 16) – Washington, DC

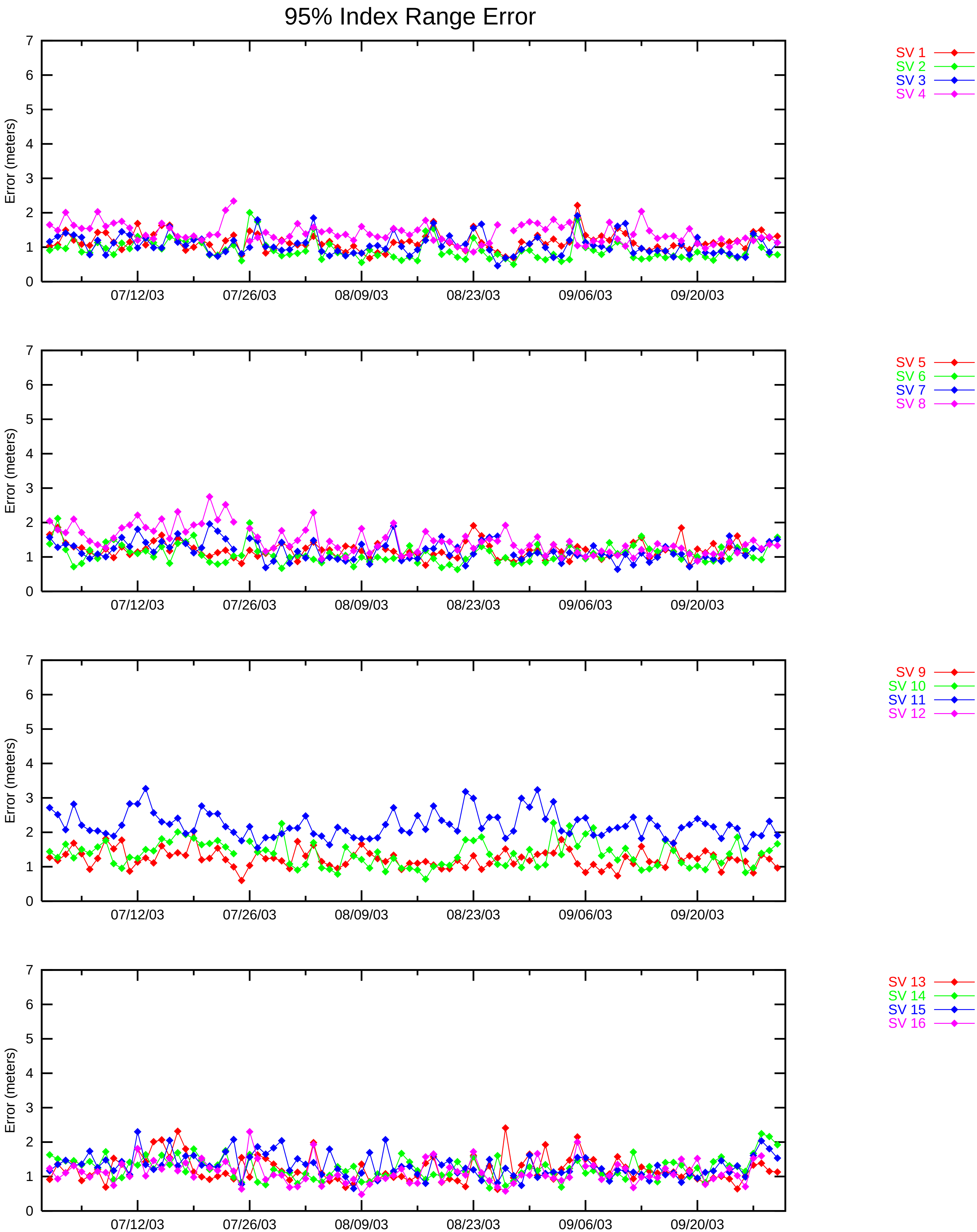


Figure 7•2 95% Range Error (SV 17—SV 31 and SV 122) –

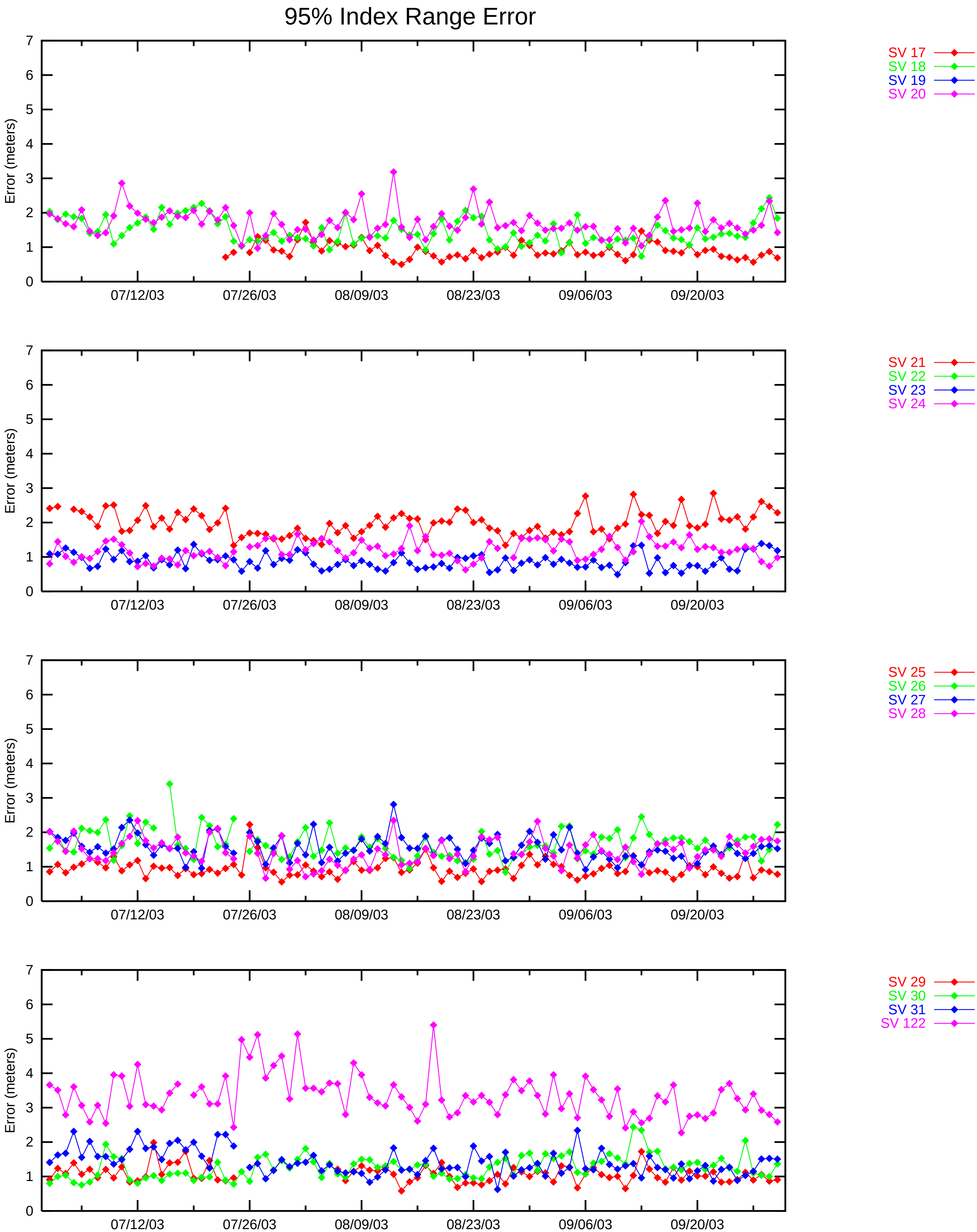


Figure 7•3 95% Ionospheric Error (SV 1—SV 16) – Washington, DC

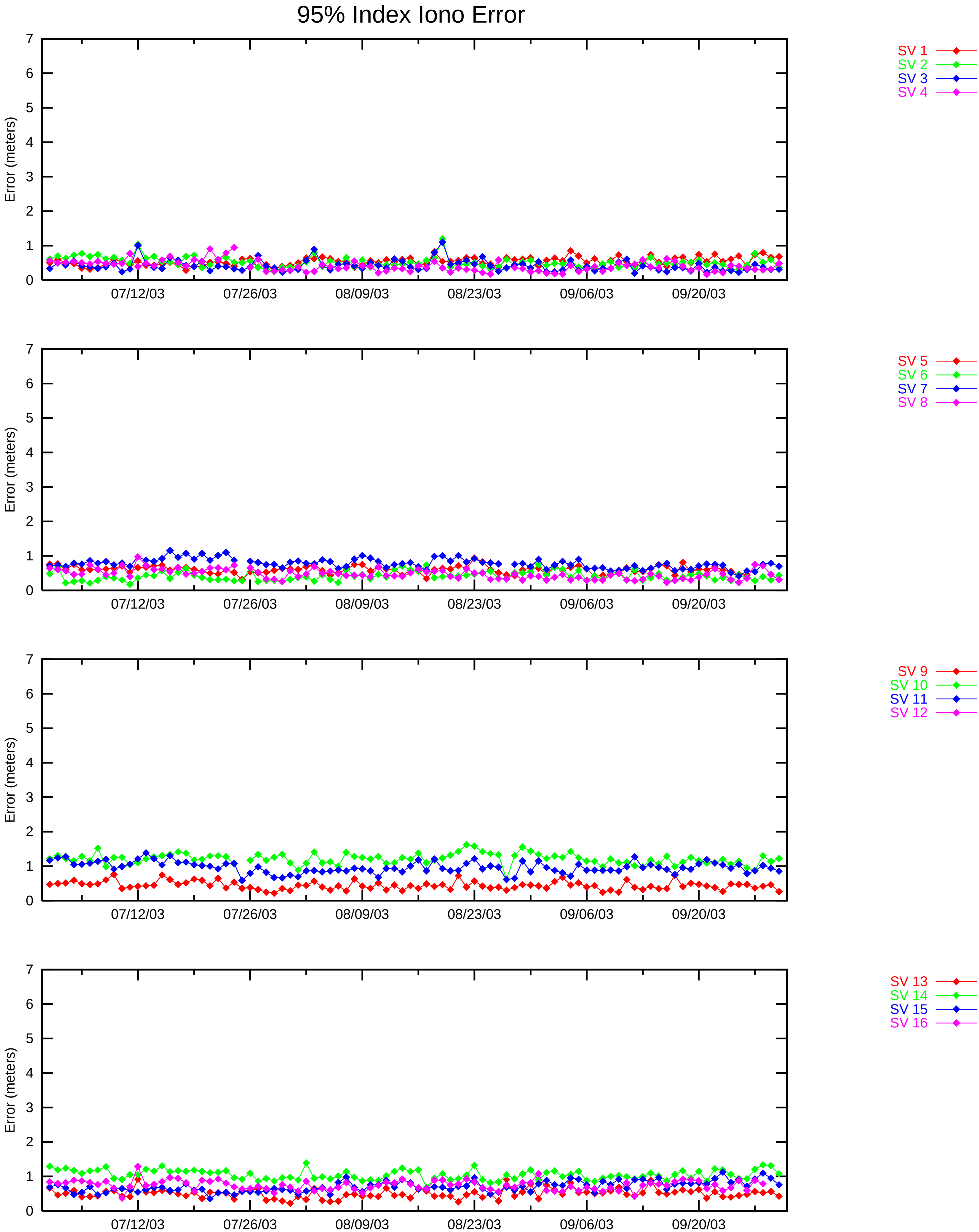
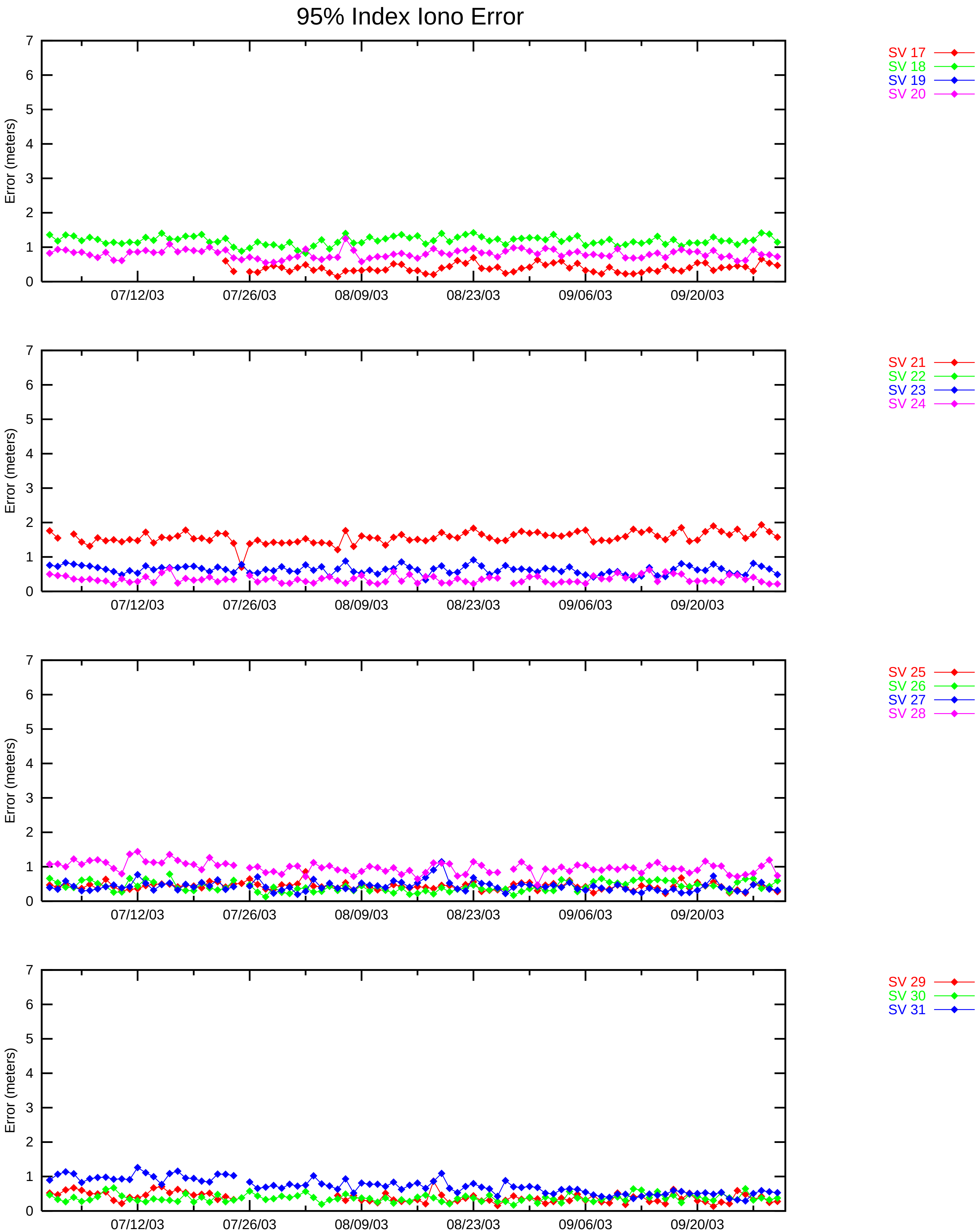


Figure 7•4 95% Ionospheric Error (SV 17—SV 31) – Washington, DC



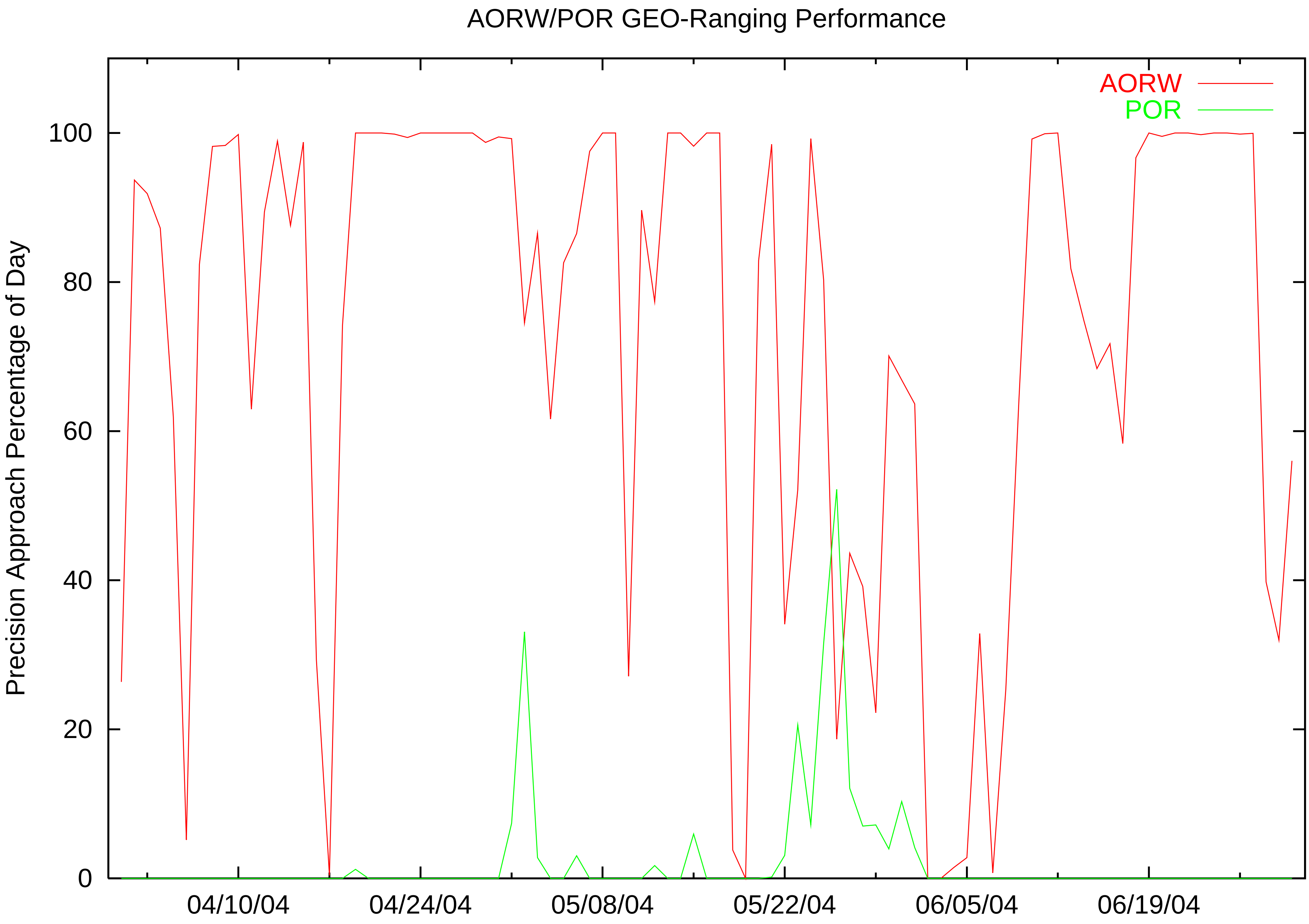
8.0 GEO RANGING PERFORMANCE

Table 8.1 shows the GEO-Ranging performance for AORW and POR satellites throughout the evaluated period. The percentage of PA ranging availability (i.e. the percentage of time a user receiver can use the GEO as a ranging source in a LNAV/VNAV or LPV position solution) for the AORW and POR is 73.02% and 2.6%, respectively. Figure 8.1 shows the trend of PA Ranging Availability for the AORW and POR satellite. The percentage of time the AOR-W GEO was available for PA ranging is lower this quarter than expected. The reason is thread switching by key WRSs and poor WRS receiver performance. The large drops in PA ranging availability for the AORW satellite is due to GUS switchovers. As in the past, the POR satellite as a ranging source has very low PA availability.

Table 8-1 GEO Ranging Availability

GEO	PA (%)	NPA (%)	Not Monitored (%)	Do Not Use (%)
AORW	73.02	24.70	1.11	1.18
POR	2.36	84.75	11.17	1.73

Figure 8•1 Daily PA GEO Ranging Availability Trend



9.0 WAAS PROBLEM SUMMARY

Title: Poor navigation performance at WAAS Minneapolis threads A receiver.

Description: Large position errors were observed at Minneapolis thread A receiver over the course of past several days (GPS week 1275). After comparing post process navigation error data from thread A and B, it appeared that thread A was having problems tracking GEO satellite PRN#122 (AORW). The vertical error at thread A toggled between 1meter and 10 meters (GPS time of week 347000-349500). This corresponded to acquisition and loss of GEO satellite PRN#122 from thread A's receiver track list. Minneapolis thread B receiver did not loss lock of GEO satellite PRN#122 during this time and did not exhibit poor navigation performance.

Title: Low AOR-W GEO Availability for PA

Description: In early May 2004 the PA ranging availability of the AOR-W GEO became erratic. PA ranging means that the UDREi is 11 (50 meters UDRE) or less. The ranging trend chart is shown in Figure 8.1. Analysis by Raytheon indicates this problem is due to excessive thread switching at the Miami WRS. A receiver replacement occurred at Miami on June 15. The problem did not completely go away but the PA ranging availability did improve. The more than expected failure rate of WAAS receivers also contributes to this problem. Also, during this timeframe, the overall 99% LPV coverage was less than normal. Though not due completely to the poor AOR-W PA ranging availability, it was a contributing factor.

10.0 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 3/28/04 to 6/26/04 of WAAS operation is presented in Table 10.1. Figures 10.1 and 10.2 provide a graphical representation of WAAS LPV service availability and outage counts for the same period, respectively.

Table 10-1 WAAS LPV Outages and Availability

Airport ID	Airport Name	City	State	Outages	Availability
79J	ANDALUSIA-OPP	ANDALUSIA/OP	AL	15	0.999639
KBHM	BIRMINGHAM INTL	BIRMINGHAM	AL	6	0.999833
KDHN	DOTHAN REGIONAL	DOTHAN	AL	17	0.999618
HSV	HUNTSVILLE INTL - CARL T JONES FIELD	HUNTSVILLE	AL	8	0.999271
MOB	MOBILE REGIONAL	MOBILE	AL	16	0.999487
EET	SHELBY COUNTY	ALABASTER	AL	7	0.999816
LIT	ADAMS FIELD	LITTLE ROCK	AR	9	0.999718
KVBT	BENTONVILLE MUNICIPAL/ LM THADDEN FLD	BENTONVILLE	AR	8	0.999010
KFSM	FORT SMITH REGIONAL	FORT SMITH	AR	9	0.999429
CDH	HARRELL FIELD	CAMDEN	AR	8	0.999749
KXNA	NORTHWEST ARKANSAS REGIONAL	FAYETTEVILLE/ SPRINGDALE/ROGERS	AR	9	0.999151
SRC	SEARCY MUNICIPAL	SEARCY	AR	9	0.999307
ASG	SPRINGDALE MUNICIPAL	SPRINGDALE	AR	8	0.999179
KARG	WALNUT RIDGE REGIONAL	WALNUT RIDGE	AR	9	0.998371
KPRC	ERNEST A LOVE FIELD	PRESCOTT	AZ	28	0.998743
KGCN	GRAND CANYON NATL PARK	GRAND CANYON	AZ	13	0.999373
IFP	LAUGHLIN/BULLHEAD INTL	BULLHEAD CITY	AZ	33	0.998570
KPHX	PHOENIX SKY HARBOR INTL	PHOENIX	AZ	65	0.995311
KTUS	TUCSON INTL	TUCSON	AZ	145	0.986328
RQE	WINDOW ROCK	WINDOW ROCK	AZ	11	0.999482
KDAG	BARSTOW-DAGGETT	DAGGETT	CA	106	0.993402
O60	CLOVERDALE MUNICIPAL	CLOVERDALE	CA	211	0.979737
IYK	INYOKERN	INYOKERN	CA	88	0.995394
KLAX	LOS ANGELES INTL	LOS ANGELES	CA	378	0.964543
KCRQ	MC CLELLAN-PALOMAR	CARLSBAD	CA	415	0.945321
KOAK	METROPOLITAN OAKLAND INTL	OAKLAND	CA	205	0.981986
ONT	ONTARIO INTL	ONTARIO	CA	265	0.978486

Airport ID	Airport Name	City	State	Outages	Availability
KPMD	PALMDALE PROD FLT/ TEST INSTLN	PALMDALE	CA	269	0.981927
KSMF	SACRAMENTO INTL	SACRAMENTO	CA	147	0.993562
KMHR	SACRAMENTO MATHER	SACRAMENTO	CA	139	0.994204
SAN	SAN DIEGO INTL – LINDBERGH FIELD	SAN DIEGO	CA	480	0.924907
KSFO	SAN FRANCISCO INTL	SAN FRANCISCO	CA	228	0.977124
SJC	SAN JOSE INTL	SAN JOSE	CA	212	0.982974
SVE	SUSANVILLE MUNICIPAL	SUSANVILLE	CA	36	0.998920
TNP	TWENTYNINE PALMS	TWENTYNINE PALMS	CA	114	0.992600
AKO	AKRON-COLORADO PLAINS REGIONAL	AKRON	CO	8	0.998736
CEZ	CORTEZ MUNICIPAL	CORTEZ	CO	12	0.999564
KDEN	DENVER INTL	DENVER	CO	10	0.999120
LHX	LA JUNTA MUNICIPAL	LA JUNTA	CO	8	0.999371
LAA	LAMAR MUNICIPAL	LAMAR	CO	22	0.999294
EEO	MEEKER	MEEKER	CO	9	0.999147
TAD	PERRY STOKES	TRINIDAD	CO	12	0.999660
2V2	VANCE BRAND	LONGMONT	CO	9	0.998978
2V5	WRAY	WRAY	CO	9	0.998750
HDN	YAMPA VALLEY	HAYDEN	CO	9	0.998984
KBDL	BRADLEY INTL	WINDSOR LOCKS	CT	179	0.981737
KDCA	RONALD REAGAN WASHINGTON INTL	WASHINGTON	DC	23	0.997192
KIAD	WASHINGTON DULLES INTL	WASHINGTON	DC	15	0.997434
KFLL	FORT LAUDERDALE/ HOLLYWOOD INTL	FORT LAUDERDALE	FL	203	0.982690
KGNV	GAINESVILLE REGIONAL	GAINESVILLE	FL	32	0.998509
KJAX	JACKSONVILLE INTL	JACKSONVILLE	FL	27	0.998745
KMIA	MIAMI INTL	MIAMI	FL	238	0.975864
KAPF	NAPLES MUNICIPAL	NAPLES	FL	179	0.982039
KOCF	OCALA INTL-JIM TAYLOR FLD	OCALA	FL	44	0.997966
KMCO	ORLANDO INTL	ORLANDO	FL	53	0.996776
KPBI	PALM BEACH INTL	WEST PALM BEACH	FL	117	0.991699
KPFN	PANAMA CITY-BAY COUNTY INTL	PANAMA CITY	FL	16	0.999635
KPNS	PENSACOLA REGIONAL	PENSACOLA	FL	20	0.999417
SRQ	SARASOTA/BRADENTON INTL	SARASOTA/BRADENTON	FL	66	0.995671
KRSW	SOUTHWEST FLORIDA INTL	FORT MYERS	FL	140	0.987776
KPIE	ST PETERSBURG – CLEARWATER INTL	ST PETERSBURG-CLEARWATER	FL	57	0.996719
KTLH	TALLAHASSEE RGNL	TALLAHASSEE	FL	28	0.999108
TPA	TAMPA INTL	TAMPA	FL	58	0.996772
KVRB	VERO BEACH MUNICIPAL	VERO BEACH	FL	73	0.995201
KSAV	SAVANNAH INTL	SAVANNAH	GA	20	0.999010
KACJ	SOUTHER FIELD	AMERICUS	GA	16	0.999610
KTBR	STATESBORO – BULLOCH COUNTY	STATESBORO	GA	17	0.999209
KATL	WILLIAM B HARTSFIELD ATLANTA INTL	ATLANTA	GA	10	0.999762
KIKV	ANKENY REGIONAL	ANKENY	IA	19	0.997567
DSM	DES MOINES INTL	DES MOINES	IA	19	0.997567
KMXO	MONTICELLO REGIONAL	MONTICELLO	IA	20	0.997478

Airport ID	Airport Name	City	State	Outages	Availability
CID	THE EASTERN IOWA	CEDAR RAPIDS	IA	16	0.997693
KBOI	BOISE AIR TERMINAL/ GOWEN FIELD	BOISE	ID	7	0.999608
EUL	CALDWELL INDUSTRIAL	CALDWELL	ID	9	0.999544
SUN	FRIEDMAN MEMORIAL	HAILEY	ID	7	0.999415
SZT	SANDPOINT	SANDPOINT	ID	25	0.997757
KARR	AURORA MUNICIPAL	CHICAGO/AURORA	IL	10	0.997829
KENL	CENTRALIA MUNICIPAL	CENTRALIA	IL	6	0.998000
MDW	CHICAGO MIDWAY	CHICAGO	IL	10	0.997833
KORD	CHICAGO-O'HARE INTL	CHICAGO	IL	12	0.997789
KFOA	FLORA MUNICIPAL	FLORA	IL	6	0.998000
KPIA	GREATER PEORIA REGIONAL	PEORIA	IL	7	0.997897
KRFD	GREATER ROCKFORD	ROCKFORD	IL	12	0.997773
KPPQ	PITTSFIELD PENSTONE MUNI	PITTSFIELD	IL	7	0.997980
MLI	QUAD-CITY	MOLINE	IL	9	0.997861
KTIP	RANTOUL NATL AVN CTR/ FRANK ELLIOT FIELD	RANTOUL	IL	8	0.997884
KSLO	SALEM-LECKRONE	SALEM	IL	6	0.998000
0I2	BRAZIL CLAY COUNTY	BRAZIL	IN	8	0.997897
FWA	FORT WAYNE INTL	FORT WAYNE	IN	7	0.997891
SER	FREEMAN MUNICIPAL	SEYMOUR	IN	7	0.997931
KIND	INDIANAPOLIS INTL	INDIANAPOLIS	IN	8	0.997889
SBN	MICHIANA REGIONAL TRANSPORTATION CTR	SOUTH BEND	IN	8	0.997871
KBMG	MONROE COUNTY	BLOOMINGTON	IN	7	0.997919
KANQ	TRI-STATE STEUBEN COUNTY	ANGOLA	IN	9	0.997849
EHA	ELKHART-MORTON COUNTY	ELKHART	KS	20	0.999434
KHYS	HAYS REGIONAL	HAYS	KS	20	0.998802
KOJC	JOHNSON COUNTY EXECUTIVE	OLATHE	KS	10	0.998010
KMHK	MANHATTAN REGIONLA	MANHATTAN	KS	18	0.997814
TOP	PHILIP BILLARD MUNICIPAL	TOPEKA	KS	14	0.997914
KCBK	SHALTZ FIELD	COLBY	KS	22	0.998547
KWLD	STROTHER FIELD	WINFIELD/ARKANSAS CITY	KS	17	0.998895
KULS	ULYSSES	ULYSSES	KS	20	0.999304
ICT	WICHITA MID-CONTINENTAL	WICHITA	KS	16	0.998605
KK22	BIG SANDY REGIONAL	PRESTONBURG	KY	7	0.997975
KLEX	BLUE GRASS	LEXINGTON	KY	8	0.997941
KCVG	CINCINNATI/NORTHERN KY INTL	COVINGTON/CINCINNATI	KY	8	0.997927
SDF	LOUISVILLE INTL – STANDIFORD FIELD	LOUISVILLE	KY	7	0.997945
KAEX	ALEXANDRIA INTL	ALEXANDRIA	LA	35	0.998187
L39	LEESVILLE	LEESVILLE	LA	52	0.997184
MSY	NEW ORLEANS INTL/ MOISANT FIELD	NEW ORLEANS	LA	36	0.998607
SHV	SHREVEPORT REGIONAL	SHREVEPORT	LA	16	0.999335
KBOS	GEN EDWARD LAWRENCE LOGAN INTL	BOSTON	MA	264	0.963894
OWD	NORWOOD MEMORIAL	NORWOOD	MA	247	0.966772
KPVC	PROVINCETOWN MUNICIPAL	PROVINCETOWN	MA	290	0.959829
KBWI	BALTIMORE-WASHINGTON INTL	BALTIMORE	MD	30	0.996699
DMW	CARROLL CNTY REGIONAL/ JACK B. POAGE FIELD	WESTMINSTER	MD	18	0.997360

Airport ID	Airport Name	City	State	Outages	Availability
FDK	FREDERICK MUNICIPAL	FREDERICK	MD	14	0.997475
W00	FREEWAY	MITCHELLVILLE	MD	29	0.996774
GAI	MONTGOMERY COUNTY AIRPARK	GAITHERSBURG	MD	16	0.997418
RJD	RIDGELY AIRPARK	RIDGELY	MD	58	0.993860
KPQI	N MAINE REGIONAL AIRPORT AT PRESQUE ISLE	PRESQUE ISLE	ME	1027	0.761887
PWM	PORTLAND INTL JETPORT	PORTLAND	ME	310	0.951698
AMN	ALMA/GRATIOT COMMUNITY	ALMA	MI	12	0.997604
KARB	ANN ARBOR MUNICIPAL	ANN ARBOR	MI	10	0.997675
KFNT	BISHOP INTL	FLINT	MI	13	0.997540
Y15	CHEBOYGAN COUNTY	CHEBOYGAN	MI	105	0.991970
CIU	CHIPPEWA COUNTY INTL	SAULT STE. MARIE	MI	128	0.990003
KDTW	DETROIT METROPOLITAN WAYNE CTY	DETROIT	MI	11	0.997638
KGRR	GERALD R FORD INTL	GRAND RAPIDS	MI	11	0.997708
KCMX	HOUGHTON COUNTY MEMORIAL	HANCOCK	MI	158	0.980786
KMBS	MBS INTL	SAGINAW	MI	16	0.997338
KMKG	MUSKEGON COUNTY	MUSKEGON	MI	15	0.997669
5D3	OWOSSO COMMUNITY	OWOSSO	MI	13	0.997571
HTL	ROSCOMMON COUNTY	HOUGHTON LAKE	MI	50	0.996172
BIV	TULIP CITY	HOLLAND	MI	11	0.997775
KBDE	BAUDETTE INTL	BAUDETTE	MN	164	0.981935
KBRD	BRAINERD-CROW WING CO REGIONAL	BRAINERD	MN	44	0.994138
KAXN	CHANDLER FIELD	ALEXANDRIA	MN	29	0.996156
KDLH	DULUTH INTL	DULUTH	MN	66	0.992401
KMSP	MINNEAPOLIS-ST PAUL INTL/ WOLD CHAMBERLAIN	MINNEAPOLIS	MN	31	0.996379
KRGK	RED WING REGIONAL	RED WING	MN	30	0.996691
KRST	ROCHESTER INTL	ROCHESTER	MN	23	0.997357
KJYG	ST JAMES MUNICIPAL	ST JAMES	MN	20	0.997362
M05	CARUTHERSVILLE MEMORIAL	CARUTHERSVILLE	MO	7	0.998058
KLBO	FLOYD W JONES LEBANON	LEBANON	MO	6	0.998118
KMCI	KANSAS CITY INTL	KANSAS CITY	MO	14	0.997929
KSTL	LAMBERT-ST LOUIS INTL	ST LOUIS	MO	6	0.998000
LXT	LEE'S SUMMIT MUNICIPAL	LEE'S SUMMIT	MO	7	0.998062
H41	MEXICO MEMORIAL	MEXICO	MO	6	0.998082
KDMO	SEDALIA MEMORIAL	SEDALIA	MO	6	0.998118
SGF	SPRINGFIELD-BRANSON REGIONAL	SPRINGFIELD	MO	7	0.998261
KMO6	WASHINGTON MEMORIAL	WASHINGTON	MO	6	0.998000
JAN	JACKSON INTL	JACKSON	MS	9	0.999738
0M6	PANOLA COUNTY	BATESVILLE	MS	8	0.999786
MPE	PHILADELPHIA MUNICIPAL	PHILADELPHIA	MS	7	0.999806
KBIL	BILLINGS LOGAN INTL	BILLINGS	MT	9	0.998573
KMLS	FRANK WILEY FIELD	MILES CITY	MT	12	0.997938
KHLN	HELENA REGIONAL	HELENA	MT	10	0.998704
KLWT	LEWISTOWN MUNICIPAL	LEWISTOWN	MT	12	0.998332
6S5	RAVALLI COUNTY	HAMILTON	MT	5	0.998830
KHBI	ASHEBORO MUNICIPAL	ASHEBORO	NC	17	0.997499
KAVL	ASHEVILLE REGIONAL	ASHEVILLE	NC	10	0.997924

Airport ID	Airport Name	City	State	Outages	Availability
HSE	BILLY MITCHELL	HATTERAS	NC	61	0.994470
SUT	BRUNSWICK COUNTY	SOUTHPORT	NC	47	0.996648
KCLT	CHARLOTTE/DOUGLAS INTL	CHARLOTTE	NC	10	0.997873
ECG	ELIZABETH CITY CGAS	ELIZABETH CITY	NC	48	0.995161
KFAY	FAYETTEVILLE REGIONAL/ GRANNIS FIELD	FAYETTEVILLE	NC	23	0.997043
HKY	HICKORY REGIONAL	HICKORY	NC	10	0.997830
KISO	KINSTON REGIONAL JETPORT AT STALLINGS FIELD	KINSTON	NC	43	0.996177
MEB	LAURINBURG	MAXTON	NC	22	0.997404
MCZ	MARTIN COUNTY	WILLIAMSTON	NC	45	0.995996
MRH	MICHAEL J. SMITH FIELD	BEAUFORT	NC	52	0.995087
KEQY	MONROE	MONROE	NC	16	0.998011
GSO	PIEDMONT TRIAD INTL	GREENSBORO	NC	12	0.997700
PGV	PITT-GREENVILLE	GREENVILLE	NC	44	0.996104
KRDU	RALEIGH-DURHAM INTL	RALEIGH/DURHAM	NC	23	0.996995
KRUQ	ROWAN COUNTY	SALISBURY	NC	11	0.997769
KTTA	SANFORD-LEE COUNTY RGNL	SANFORD	NC	22	0.997120
OCW	WARREN FIELD	WASHINGTON	NC	46	0.995798
KILM	WILMINGTON INTL	WILMINGTON	NC	46	0.996350
W03	WILSON INDUSTRIAL AIR CTR	WILSON	NC	30	0.996737
KFAR	HECTOR INTL	FARGO	ND	49	0.993745
MOT	MINOT INTL AIRPORT	MINOT	ND	94	0.992101
KANW	AINSWORTH MUNICIPAL	AINSWORTH	NE	6	0.998013
AUH	AURORA MUNICIPAL	AURORA	NE	19	0.997716
BIE	BEATRICE MUNICIPAL	BEATRICE	NE	18	0.997740
CSB	CAMBRIDGE MUNICIPAL	CAMBRIDGE	NE	22	0.998032
CEK	CRETE MUNICIPAL	CRETE	NE	18	0.997732
OMA	EPPLEY AIRFIELD	OMAHA	NE	18	0.997708
OKS	GARDEN COUNTY	OSHKOSH	NE	8	0.998505
GRN	GORDON MUNICIPAL	GORDON	NE	6	0.998060
KEAR	KEARNEY MUNICIPAL	KEARNEY	NE	20	0.997701
VTN	MILLER FIELD	VALENTINE	NE	6	0.998004
KLBF	NORTH PLATTE REGIONAL LEE BIRD FIELD	NORTH PLATTE	NE	8	0.998037
SCB	SCRIBNER STATE	SCRIBNER	NE	20	0.997672
SNY	SIDNEY MUNICIPAL	SIDNEY	NE	7	0.998716
MHT	MANCHESTER	MANCHESTER	NH	265	0.964531
KACY	ATLANTIC CITY INTL	ATLANTIC CITY	NJ	101	0.989086
K3NJ6	INDUCTOTHERM HELIPORT	RANCOCAS	NJ	93	0.990067
KMMU	MORRISTOWN MUNICIPAL	MORRISTOWN	NJ	90	0.990236
KEWR	NEWARK INTL	NEWARK	NJ	106	0.988188
7N7	SPITFIRE AERODROM	PEDRICTOWN	NJ	69	0.992437
KABQ	ALBUQUERQUE INTL SUNPORT	ALBUQUERQUE	NM	17	0.999518
KFMN	FOUR CORNERS REGIONAL	FARMINGTON	NM	12	0.999568
KLRU	LAS CRUCES INTL	LAS CRUCES	NM	73	0.992873
ELY	ELY AIRPORT/YELLAND FIELD	ELY	NV	8	0.999562
KLAS	MC CARRAN INTL	LAS VEGAS	NV	26	0.999157
ALB	ALBANY INTL	ALBANY	NY	153	0.988568
BUF	BUFFALO NIAGARA INTL	BUFFALO	NY	23	0.996810
KJHW	CHAUTAUQUA COUNTY/ JAMESTOWN	JAMESTOWN	NY	16	0.997231

Airport ID	Airport Name	City	State	Outages	Availability
KELM	ELMIRA/CORNING REGIONAL	ELMIRA	NY	27	0.996676
GFL	FLOYD BENNETT MEMORIAL	GLENS FALLS	NY	176	0.984808
ROC	GREATER ROCHESTER INTL	ROCHESTER	NY	30	0.996545
KJFK	JOHN F KENNEDY INTL	NEW YORK	NY	121	0.986265
LGA	LA GUARDIA	FLUSHING	NY	117	0.986871
LKP	LAKE PLACID	LAKE PLACID	NY	204	0.983401
PBG	PLATTSGURGH INTL	PLATTSGURGH	NY	240	0.979006
KSWF	STEWART INTL	NEWBURGH	NY	93	0.990043
KSYR	SYRACUSE HANCOCK INTL	SYRACUSE	NY	52	0.995720
FOK	THE FRANCIS S. GABRESKI	WESTHAMPTON BEACH	NY	157	0.981705
HPN	WESTCHESTER COUNTY	WHITE PLAINS	NY	125	0.986453
B16	WHITFORDS	WEEDSPORT	NY	41	0.996127
KCLE	CLEVELAND-HOPKINS INTL	CLEVELAND	OH	11	0.997562
KDAY	JAMES M COX DAYTON INTL	DAYTON	OH	8	0.997857
1G5	MEDINA MUNICIPAL	MEDINA	OH	12	0.997561
KCMH	PORT COLUMBUS INTL	COLUMBUS	OH	7	0.997888
KRZT	ROSS COUNTY	CHILLICOTHE	OH	8	0.997880
KTOL	TOLEDO EXPRESS	TOLEDO	OH	11	0.997694
KAVK	ALVA REGIONAL	ALVA	OK	18	0.999119
KCQB	CHANDLER MUNICIPAL	CHANDLER	OK	19	0.999120
KMKO	DAVIS FIELD	MUSKOGEE	OK	13	0.999299
2O8	HINTON MUNICIPAL	HINTON	OK	19	0.999221
KHBR	HOBART MUNICIPAL	HOBART	OK	18	0.999413
MDF	MORELAND MUNICIPAL	MORELAND	OK	17	0.999172
K2K4	SCOTT FIELD	MANGUM	OK	18	0.999414
KTUL	TULSA INTL	TULSA	OK	12	0.999217
OKC	WILL ROGERS WORLD AIRPORT	OKLAHOMA CITY	OK	19	0.999198
S07	BEND MUNICIPAL	BEND	OR	27	0.998585
KONP	NEWPORT MUNICIPAL	NEWPORT	OR	54	0.996752
PDX	PORTLAND INTL	PORTLAND	OR	44	0.997608
HIO	PORTLAND-HILLSBORO	HILLSBORO	OR	46	0.997403
S47	TILLAMOOK	TILLAMOOK	OR	53	0.996601
LGD	UNION COUNTY	LA GRANDE	OR	19	0.998950
KAGC	ALLEGHENY COUNTY	PITTSBURGH	PA	15	0.997607
KBFD	BRADFORD REGIONAL	BRADFORD	PA	17	0.997208
MDT	HARRISBURG INTL	HARRISBURG	PA	19	0.997197
KJST	JOHN MURTHA JOHNSTOWN-CAMBRIA COUNTY	JOHNSTOWN	PA	16	0.997479
ABE	LEHIGH VALLEY INTL	ALLENTOWN	PA	51	0.995185
PHL	PHILADELPHIA INTL	PHILADELPHIA	PA	74	0.991943
KPIT	PITTSBURGH INTL	PITTSBURGH	PA	15	0.997611
LHV	WILLIAM T. PIPER MEMORIAL	LOCK HAVEN	PA	18	0.997179
PVD	THEODORE FRANCIS GREEN STATE	PROVIDENCE	RI	217	0.973432
AND	ANDERSON REGIONAL	ANDERSON	SC	16	0.998744
KCHS	CHARLESTON AFB/INTL	CHARLESTON	SC	26	0.998326
KCAE	COLUMBIA METROPOLITAN	COLUMBIA	SC	15	0.998780
KGSP	GREENVILLE – SPARTANBURG INTL	GREER	SC	13	0.998496
KMYR	MYRTLE BEACH INTL	MYRTLE BEACH	SC	29	0.997628
KHON	HURON REGIONAL	HURON	SD	6	0.997961
FSD	JOE FOSS FIELD	SIOUX FALLS	SD	15	0.997684

Airport ID	Airport Name	City	State	Outages	Availability
1D1	MILBANK MUNICIPAL	MILBANK	SD	16	0.997615
KRAP	RAPID CITY REGIONAL	RAPID CITY	SD	7	0.997984
PHT	HENRY COUNTY	PARIS	TN	8	0.998044
CHA	LOVELL FIELD	CHATTANOOGA	TN	10	0.998871
TYS	MC GHEE TYSON	KNOXVILLE	TN	9	0.997949
KMEM	MEMPHIS INTL	MEMPHIS	TN	9	0.999082
KBNA	NASHVILLE INTL	NASHVILLE	TN	7	0.997983
KABI	ABILENE REGIONAL	ABILENE	TX	78	0.995036
ADS	ADDISON	DALLAS	TX	20	0.999268
AMA	AMARILLO INTL	AMARILLO	TX	20	0.999404
AUS	AUSTIN-BERGSTROM INTL	AUSTIN	TX	113	0.982330
KLBX	BRAZORIA COUNTY	ANGLETON/LAKE JACKSON	TX	119	0.968558
7F9	COMANCHE	COMANCHE	TX	76	0.994158
CRP	CORPUS CHRISTI INTL	CORPUS CHRISTI	TX	252	0.938717
KDAL	DALLAS LOVE FIELD	DALLAS	TX	20	0.999240
KDFW	DALLAS-FT WORTH INTL	DALLAS-FT WORTH	TX	20	0.999248
KDWH	DAVID WAYNE HOOKS MEMORIAL	HOUSTON	TX	110	0.988122
KDRT	DEL RIO INTL	DEL RIO	TX	187	0.957159
ELP	EL PASO INTL	EL PASO	TX	104	0.989706
KEFD	ELLINGTON FIELD	HOUSTON	TX	116	0.980761
KIAH	GEORGE BUSH INTERCONTINENTAL/HOUSTON	HOUSTON	TX	106	0.987375
KAXH	HOUSTON-SOUTHWEST	HOUSTON	TX	120	0.976608
KLBB	LUBBOCK INTL	LUBBOCK	TX	35	0.999038
MAF	MIDLAND INTL	MIDLAND	TX	115	0.992972
KCXO	MONTGOMERY COUNTY	CONROE	TX	90	0.992575
OSA	MOUNT PLEASANT MUNICIPAL	MOUNT PLEASANT	TX	16	0.999425
KSJT	SAN ANGELO RGNL/MATHIS FLD	SAN ANGELO	TX	127	0.990123
KSAT	SAN ANTONIO INTL	SAN ANTONIO	TX	133	0.966052
KSGR	SUGAR LAND MUNI/HULL FLD	HOUSTON	TX	117	0.978868
KTYR	TYLER POUNDS REGIONAL	TYLER	TX	22	0.999045
KHRL	VALLEY INTL	HARLINGEN	TX	500	0.904055
KIWS	WEST HOUSTON	HOUSTON	TX	115	0.983623
KHOU	WILLIAM P HOBBY	HOUSTON	TX	114	0.981047
BMC	BRIGHAM CITY	BRIGHAM CITY	UT	5	0.999513
KCDC	CEDAR CITY REGIONAL	CEDAR CITY	UT	8	0.999710
KKNB	KANAB MUNICIPAL	KANAB	UT	9	0.999544
LGU	LOGAN-CACHE	LOGAN	UT	5	0.999525
SLC	SALT LAKE CITY INTL	SALT LAKE CITY	UT	5	0.999536
MTV	BLUE RIDGE	MARTINSVILLE	VA	10	0.997688
LVL	BRUNSWICK MUNICIPAL	LAWRENCEVILLE	VA	27	0.996877
KCHO	CHARLOTTESVILLE-ALBEMARLE	CHARLOTTESVILLE	VA	14	0.997590
FKN	FRANKLIN MUNICIPAL – JOHN BEVERLY ROSE	FRANKLIN	VA	44	0.996009
JYO	LEESBURG MUNICIPAL/ GODFREY FIELD	LEESBURG	VA	15	0.997452
HEF	MANASSAS REGIONAL/ HARRY P. DAVIS FIELD	MANASSAS	VA	17	0.997410
KPHF	NEWPORT NEWS/ WILLIAMSBURG INTL	NEWPORT NEWS	VA	45	0.995656
KORF	NORFOLK INTL	NORFOLK	VA	47	0.995306

Airport ID	Airport Name	City	State	Outages	Availability
RIC	RICHMOND INTL	RICHMOND	VA	36	0.996628
AKQ	WAKEFIELD MUNICIPAL	WAKEFIELD	VA	43	0.996124
WAL	WALLOPS FLIGHT FACILITY	WALLOPS ISLAND	VA	55	0.994001
BTV	BURLINGTON INTL	BURLINGTON	VT	242	0.977986
BFI	BOEING FIELD/ KING COUNTY INTL	SEATTLE	WA	53	0.996570
FHR	FRIDAY HARBOR	FRIDAY HARBOR	WA	69	0.995724
KMWH	GRANT COUNTY INTL	MOSES LAKE	WA	37	0.997702
KSEA	SEATTLE-TACOMA INTL	SEATTLE	WA	53	0.996647
KGEG	SPOKANE INTL	SPOKANE	WA	23	0.998098
KGRB	AUTIN STRAUBEL INTL	GREEN BAY	WI	40	0.996433
3T3	BOYCEVILLE MUNICIPAL	BOYCEVILLE	WI	35	0.995911
KCWA	CENTRAL WISCONSIN	MOSINEE	WI	36	0.996050
MSN	DANE COUNTY REGIONAL-TRUAX FIELD	MADISON	WI	22	0.997415
SUE	DOOR COUNTY CHERRYLAND	STURGEON BAY	WI	60	0.995585
FLD	FOND DU LAC COUNTY	FOND DU LAC	WI	25	0.997231
MKE	GENERAL MITCHELL INTL	MILWAUKEE	WI	18	0.997603
KATW	OUTAGAMIE COUNTY REGIONAL	APPLETON	WI	34	0.996792
RHI	RHINELANDER-ONEIDA COUNTY	RHINELANDER	WI	68	0.994028
RYV	WATERTOWN MUNICIPAL	WATERTOWN	WI	25	0.997409
ETB	WEST BEND MUNICIPAL	WEST BEND	WI	24	0.997393
KMGW	MORGANTOWN MUNICIPAL – WLB HART FIELD	MORGANTOWN	WV	13	0.997635
KPKB	WOOD CO – GILL ROBB WILSON FIELD	PARKERSBURG	WV	10	0.997803
EVW	EVANSTON-UNITA CNTY – BURNS FIELD	EVANSTON	WY	5	0.999524
KCPR	NATRONA COUNTY INTL	CASPER	WY	7	0.998587
SAA	SHIVELY FIELD	SARATOGA	WY	9	0.998952

Figure 10•1 WAAS LPV Availability

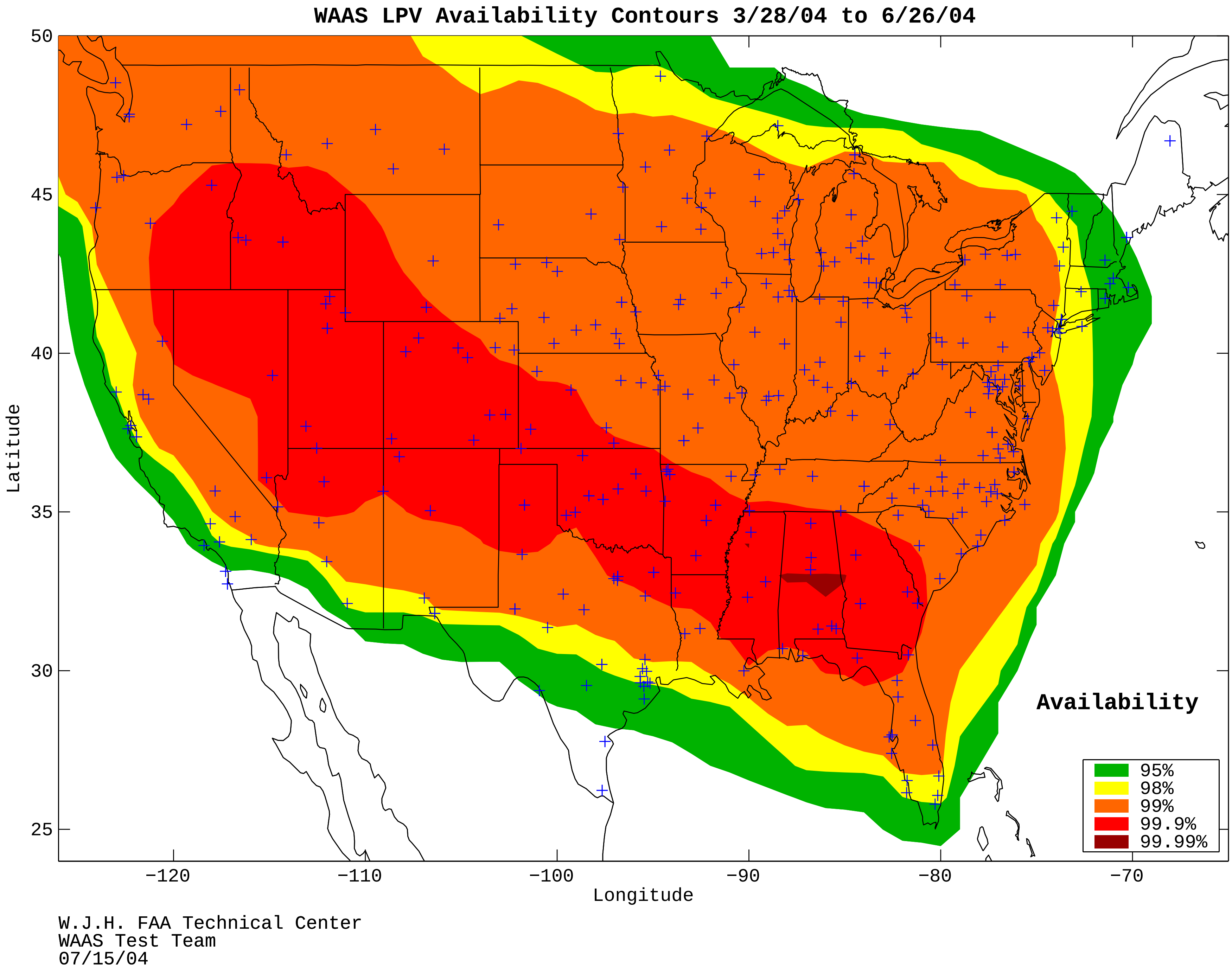
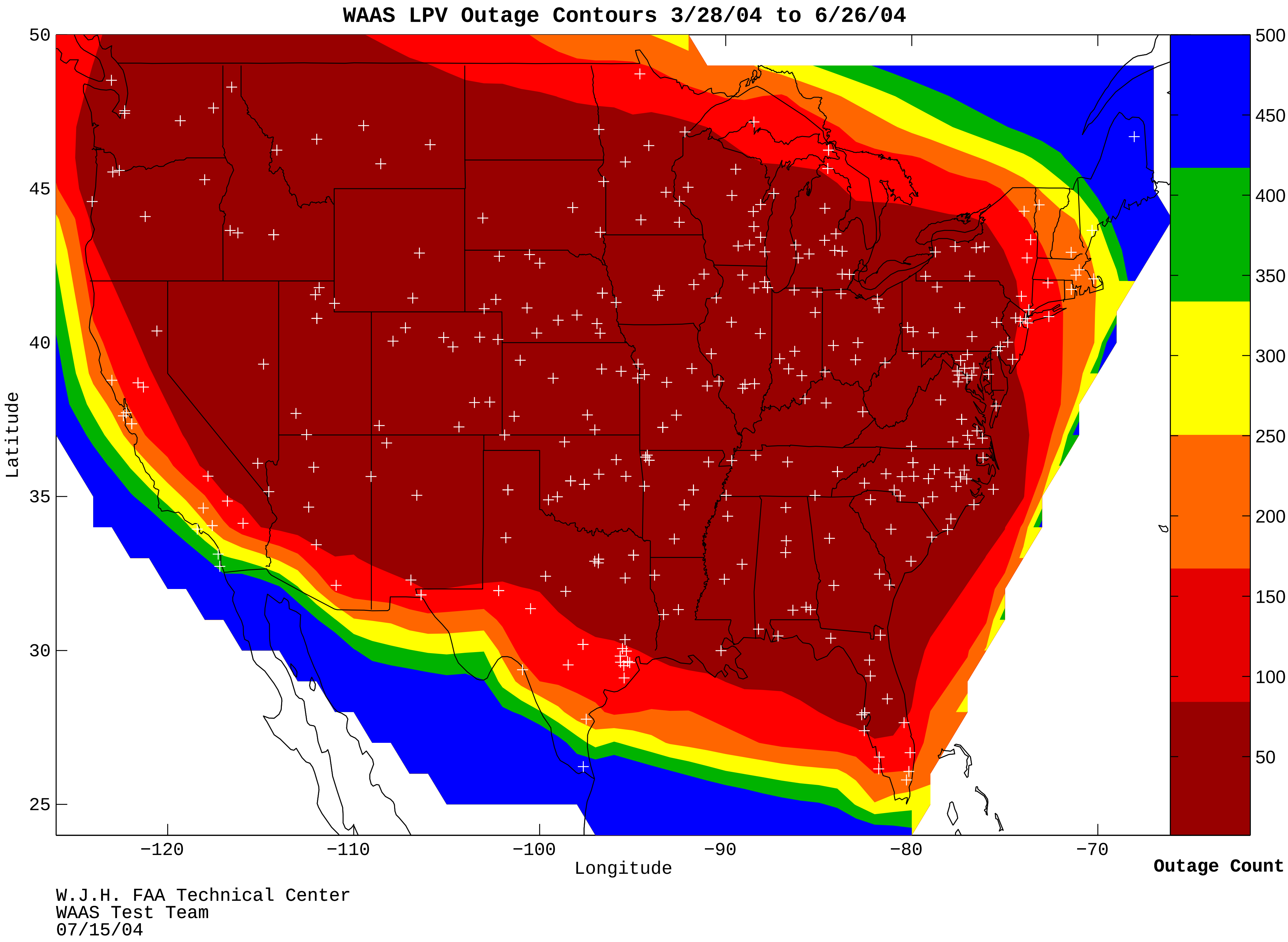


Figure 10•2 WAAS LPV Outage



11.0 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 11.1 recaps the results of that manual analysis.

Table 11-1 CNMP Bounding Statistics

WAAS Site	WRE	Jul 03	Aug 03	Sep 03	Oct 03	Nov 03	Dec 03	Jan 04	Feb 04	Mar 04	Apr 04	May 04	Jun 04
Albuquerque	A	green	orange	blue	green	blue	green	blue	blue	green	yellow	blue	blue
	B	blue	blue	blue	orange	green	blue	blue	blue	blue	yellow	blue	blue
	C	blue	green	blue	blue	blue	blue	green	blue	blue	blue	blue	blue
Anchorage	A	green	green	orange	orange	orange	blue	green	green	yellow	blue	yellow	blue
	B	green	green	red	red	orange	green	blue	blue	blue	blue	blue	green
	C	blue	green	green	green	orange	green	blue	blue	blue	blue	blue	blue
Atlanta	A	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	green	blue
	B	orange	blue	blue	green	green	blue	blue	blue	blue	yellow	blue	green
	C	blue	blue	blue	orange	blue	blue	blue	blue	green	blue	blue	blue
Billings	A	blue	blue	blue	blue	green	blue	blue	blue	blue	blue	blue	blue
	B	blue	blue	blue	blue	blue	blue	blue	blue	blue	yellow	blue	blue
	C	blue	blue	blue	green	blue	blue	blue	blue	blue	blue	blue	blue
Boston	A	blue	blue	green	green	blue	green	blue	green	blue	blue	blue	blue
	B	blue	blue	orange	blue	blue	blue	blue	blue	blue	blue	blue	blue
	C	green	green	blue	blue	blue	blue	blue	blue	blue	blue	blue	green
Chicago	A	blue	blue	green	blue	green	blue	orange	orange	blue	green	green	blue
	B	green	blue	orange	blue	green	blue	blue	blue	blue	green	green	green
	C	orange	blue	orange	blue	blue	orange	blue	blue	yellow	yellow	yellow	blue
Cleveland	A	green	orange	green	orange	orange	green	green	green	green	yellow	blue	yellow
	B	blue	green	blue	green	orange	green	blue	blue	yellow	green	green	blue
	C	blue	blue	blue	green	green	blue	green	blue	blue	green	blue	green
Cold Bay	A	blue	blue	blue	blue	blue	blue	blue	blue	red	blue	blue	blue
	B	green	orange	blue	blue	orange	blue	green	blue	blue	green	blue	green
	C	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
Dallas	A	blue	blue	blue	green	green	green	blue	green	green	red	yellow	green
	B	red	green	green	blue	blue	green	blue	blue	blue	blue	yellow	blue
	C	blue	green	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
Denver	A	blue	blue	blue	green	blue	green	green	blue	green	blue	blue	blue
	B	blue	blue	blue	blue	blue	blue	blue	blue	blue	yellow	blue	blue
	C	blue	blue	blue	blue	blue	blue	blue	blue	blue	yellow	blue	blue
Honolulu	A	orange	orange	orange	orange	green	orange	orange	orange	red	blue	green	red
	B	green	blue	green	blue	orange	blue	blue	blue	blue	blue	blue	blue
	C	orange	red	green	blue	green	blue	blue	green	blue	blue	blue	blue
Houston	A	red	orange	red	red	red	red	orange	red	red	red	yellow	yellow
	B	red	red	red	red	red	red	red	orange	red	red	red	red
	C	red	red	red	red	orange	red	red	red	red	yellow	yellow	green
Jacksonville	A	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
	B	green	blue	blue	blue	blue	blue	blue	green	blue	blue	blue	blue
	C	blue	blue	blue	blue	blue	green	blue	blue	blue	blue	red	blue
Juneau	A	blue	blue	orange	blue	blue	green	blue	blue	yellow	blue	blue	blue
	B	blue	blue	blue	blue	orange	orange	blue	blue	yellow	blue	yellow	green
	C	blue	orange	blue	blue	blue	blue	blue	green	green	blue	blue	blue
Kansas City	A	blue	blue	blue	green	orange	blue	blue	orange	yellow	yellow	blue	blue
	B	red	green	green	blue	green	blue	blue	orange	green	blue	blue	green
	C	blue	blue	red	blue	red	green	blue	blue	green	green	blue	blue
Los Angeles	A	blue	blue	green	blue	green	blue	blue	blue	blue	blue	blue	blue
	B	blue	blue	blue	blue	orange	blue	blue	blue	blue	blue	blue	blue
	C	green	blue	blue	orange	green	blue	orange	blue	blue	yellow	green	green
Memphis	A	green	blue	green	orange	blue	blue	blue	green	blue	blue	blue	blue
	B	blue	orange	green	blue	orange	orange	blue	blue	blue	blue	blue	blue
	C	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
Miami	A	green	blue	blue	orange	green	blue	green	green	green	yellow	blue	blue
	B	blue	blue	green	orange	orange	green	green	green	green	blue	green	blue
	C	red	red	green	red	red	green	orange	orange	red	yellow	yellow	green

WAAS Site	WRE	Jul 03	Aug 03	Sep 03	Oct 03	Nov 03	Dec 03	Jan 04	Feb 04	Mar 04	Apr 04	May 04	Jun 04
Minneapolis	A	blue	orange	green	blue	green	blue	blue	blue	yellow	blue	blue	blue
	B	blue	blue	green	green	orange	orange	blue	green	blue	blue	green	yellow
	C	blue	blue	green	blue	orange	blue	blue	blue	blue	green	green	yellow
New York	A	blue	green	blue	blue	blue	blue	blue	green	blue	blue	blue	blue
	B	blue	blue	blue	green	blue	blue	blue	green	green	green	blue	blue
	C	green	green	orange	orange	green	green	green	green	green	green	blue	blue
Oakland	A	orange	blue	blue	green	blue	blue	blue	orange	blue	green	blue	green
	B	blue	green	blue	red	orange	orange	blue	blue	blue	blue	yellow	blue
	C	red	green	blue	green	orange	red	blue	green	green	green	yellow	green
Salt Lake City	A	blue	green	blue	blue	blue	blue	green	blue	blue	blue	blue	blue
	B	blue	blue	green	red	green	blue	green	blue	blue	blue	blue	blue
	C	orange	blue	green	blue	blue	green	blue	blue	blue	blue	blue	blue
San Juan	A	orange	green	blue	green	green	blue	blue	blue	yellow	yellow	blue	blue
	B	blue	orange	blue	orange	orange	blue	green	blue	yellow	green	blue	blue
	C	blue	green	blue	orange	green	orange	green	blue	blue	yellow	yellow	blue
Seattle	A	blue	orange	blue	blue	blue	blue	blue	blue	blue	blue	blue	red
	B	blue	blue	blue	blue	orange	blue	blue	blue	blue	blue	blue	blue
	C	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	yellow	blue
Washington, DC	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	green	red	green	blue	blue	blue	blue

Δ (blue) **Excellent** - 3.29σ bounded 100%
Δ (green) **Good** - 4σ bounded 100%
Δ (yellow) **Fair** - 4σ bounded 100% with one worst satellite excluded (Requires manual review)
Δ (red) **Poor** – Requires manual review

12.0 WAAS EQUIPMENT OUTAGE

To determine if outages of any WAAS assets affects the SIS performance, failures to WAAS equipment is tracked. Some events, such as a GUS switchover, definitely affect SIS performance. Other events, like multiple WRE outages at a single WRS, may or may not affect SIS performance. During this quarter, the WRS outages were a factor in degraded PA ranging availability for the AOR-W GEO.

Data was collected from all WAAS sites to determine if any failures occurred. This data is made available through the WAAS External Interface (WEI). WAAS Test Team developed software parses the data so it is available for analysis. Any equipment failures are confirmed with the WAAS operational community.

During this reporting period there were a total of twenty-five GUS switchovers. The dates and times of the switchovers are shown in Table 12.1. The reasons for the switchovers include maintenance action, preventative maintenance, equipment failure, and operations policy. The operations policy refers to the policy that two GUSs cannot be in primary at the same site, in this case Santa Paula. To further explain, each GEO satellite for the WAAS has two uplink locations. The AORW satellite's uplinks are located at Clarksburg MD and Santa Paula CA. The POR satellite's uplinks are located at Brewster WA and Santa Paula CA (note that this uplink is physically independent from the AORW Santa Paula uplink, they are just located at the same facility). An uplink is normally in one of two modes: primary or backup. The primary uplink transmits the WAAS information to the respective GEO satellite. The backup uplink is a hot standby. When a switchover occurs there is a loss of the WAAS signal, for that particular GEO satellite, for approximately 10 seconds while the backup GUS locks in the GEO signal. The number of switchovers continues to be a concern due to the negative impact on WAAS users. The WAAS Operations organizations have been informed on the negative impacts of GUS switchovers. Policies have been implemented to help prevent the large number of switchovers that have occurred since WAAS commissioning.

There were also a large number of WRE outages during this quarter. Once again this quarter, the primary reasons for WRE outages were replacement of faulty receivers, the three-card reset and WRE Bias Monitor trips. Table 12.2 lists all the outages that affected reference stations.

There were two outages at the National Operations Command Center (NOCC) and Pacific Operations Command Center (POCC). None of these outages affected the WAAS SIS or WAAS operations. Table 12.3 lists all the outages at the NOCC and POCC for this reporting period.

NOTE: The tables below show dates and times according to GPS nomenclature. This quarter began on Week 1251, Day 4 (January 1, 2004) and ended Week 1264, Day 3 (March 31, 2004). Here is an explanation for the related column headings in all the following tables:

- *NSTB Week #: The GPS week begins 12:00:00 AM Sunday and ends 11:59:59 PM Saturday. The NSTB week is equal to the GPS week plus 1024.*
- *GPS Day: The first GPS day is Day 0 (Sunday) and Day 6 is Saturday.*
- *GPS Time: Number of seconds into the week since 12:00:00 AM Sunday.*

Table 12-1 WAAS GUS Switchovers from April 1, 2004 to June 30, 2004

NSTB Week	GPS Day	Satellite	GPS Time (Seconds)
1264	4	POR	412819
1264	4	AOR-W	416693
1264	5	POR	460998
1265	1	AOR-W	140607
1265	1	AOR-W	140614
1265	2	POR	198767
1266	4	POR	399629
1266	5	AOR-W	457320
1266	5	AOR-W	486577
1267	1	AOR-W	159282
1267	4	POR	402094
1269	6	POR	539177
1270	2	POR	231593
1271	2	AOR-W	176089
1271	2	STA-A	176097
1271	2	AOR-W	212713
1272	5	POR	503265
1273	2	AOR-W	236538
1275	3	POR	311733
1275	3	POR	317588
1276	2	POR	258234
1276	2	POR	258242
1276	3	POR	258234
1276	6	POR	543639
1277	1	AOR-W	120568

Table 12-2 WRE Outages from April 1, 2004 to June 30, 2004

NSTB Week	GPS Day	Site	Start Time (GPS Seconds)	End Time (GPS Seconds)	Duration (Seconds)
1264	4	BIL-A	409157	419545	10388
1264	5	BIL-A	442347	448175	5828
1264	5	BIL-A	448670	452250	3580
1264	5	BIL-A	465308	148405	287897
1265	1	ZAU-C	139049	141700	2651
1265	2	HNL-B	202649	205453	2804
1265	3	ZAB-C	319592	329990	10398
1265	4	ZDV-C	404166	408568	4402
1265	4	ZDV-B	409720	413217	3497
1266	2	ZOB-A	210792	213320	2528
1266	2	ZOB-C	226823	230126	3303

NSTB Week	GPS Day	Site	Start Time (GPS Seconds)	End Time (GPS Seconds)	Duration (Seconds)
1266	4	JNU-B	416276	437529	21253
1266	4	JNU-A	416290	417467	1177
1266	5	ZFW-A	451708	454589	2881
1266	5	ZFW-B	451721	474769	23048
1266	5	ZFW-A	475587	490647	15060
1266	5	BIL-C	501017	504538	3521
1266	5	ZLA-B	501585	505633	4048
1267	1	ZMP-B	109350	112604	3254
1267	1	ZLA-A	141019	144331	3312
1267	1	ZLA-B	141045	159153	18108
1267	1	ZAN-A	157923	170459	12536
1267	2	ZAU-B	182455	199990	17535
1267	2	ZAU-A	182467	185498	3031
1267	2	ZAN-A	191470	195236	3766
1267	2	ZFW-A	192298	199831	7533
1267	2	ZFW-B	192311	214918	22607
1267	2	ZMA-C	200513	202371	1858
1267	2	ZAN-A	231183	237243	6060
1267	2	ZAN-A	250122	288074	37952
1267	2	ZMP-A	256548	259717	3169
1267	3	JNU-C	329774	333020	3246
1267	6	ZOB-A	574064	578848	4784
1267	6	CDB-C	579266	582646	3380
1268	0	ZOA-B	30524	33737	3213
1268	0	ZLC-A	47189	51204	4015
1268	1	HNL-A	105476	110285	4809
1268	1	ZAN-C	131933	134870	2937
1268	2	ZSE-C	216162	219530	3368
1268	2	ZJX-C	234859	238964	4105
1268	3	ZAB-B	338432	341876	3444
1268	4	ZOA-A	355127	358219	3092
1268	5	ZLA-C	443963	446748	2785
1269	1	ZSU-C	164735	167906	3171
1269	2	HNL-C	216554	219983	3429
1269	3	ZMA-C	305586	311734	6148
1269	4	ZJX-C	355495	563582	812887
1269	6	ZAU-B	589404	2234	17630
1269	6	ZAU-A	589418	591614	2196
1270	0	ZTL-B	83647	88533	4886
1270	1	BIL-C	91253	94504	3251
1270	1	ZFW-A	109999	112552	2553
1270	1	ZFW-B	112587	127422	14835

NSTB Week	GPS Day	Site	Start Time (GPS Seconds)	End Time (GPS Seconds)	Duration (Seconds)
1270	1	ZTL-C	156848	159325	2477
1270	2	ZTL-A	215956	219251	3295
1270	2	ZBW-B	224012	240830	16818
1270	2	ZBW-A	224052	226357	2305
1270	3	ZBW-C	285969	290962	4993
1270	3	ZKC-C	312694	314940	2246
1270	5	ZNY-A	507374	510410	3036
1270	5	ZNY-B	507843	523514	15671
1270	6	ZSU-C	551221	554454	3233
1270	6	ZSU-C	576568	313352	341584
1271	1	ZOB-B	101474	104557	3083
1271	1	HNL-B	158697	161115	2418
1271	2	ZNY-B	204792	224641	19849
1271	2	ZNY-A	204804	207762	2958
1271	5	ZDC-C	439122	237785	403463
1271	5	ZJX-C	450193	238833	393440
1271	5	ZAU-A	469502	472219	2717
1271	5	ZAU-B	469518	486918	17400
1271	6	ZHU-B	550064	553147	3083
1271	6	CDB-A	574113	592498	18385
1271	6	CDB-B	574157	592508	18351
1271	6	CDB-C	574169	592519	18350
1272	0	ZHU-B	19754	22576	2822
1272	0	ZHU-A	21486	30006	8520
1272	0	JNU-C	70063	73281	3218
1272	0	ZOA-C	82798	93961	11163
1272	1	ZSE-B	154758	159286	4528
1272	2	ZLC-C	218298	221365	3067
1272	2	ZJX-B	235382	236551	1169
1272	3	HNL-C	272633	276242	3609
1272	3	ZJX-C	279689	546116	266427
1272	3	ZDC-C	306665	317517	10852
1272	3	ZAU-A	311828	314099	2271
1272	3	ZAU-B	311846	329921	18075
1272	3	ZAU-A	330736	348432	17696
1272	4	ZHU-A	359798	370289	10491
1272	4	ZMA-C	405323	412483	7160
1272	4	ZME-B	428406	431510	3104
1272	6	ZOA-C	602906	7365	9259
1273	0	ZDC-C	3106	8465	5359
1273	0	ZDC-C	59328	235701	176373
1273	3	ZDC-C	264286	294142	29856

NSTB Week	GPS Day	Site	Start Time (GPS Seconds)	End Time (GPS Seconds)	Duration (Seconds)
1273	3	ZKC-C	291721	295105	3384
1273	3	ZMA-C	305785	310139	4354
1273	3	ZBW-A	321342	323861	2519
1273	3	ZBW-B	321361	338613	17252
1273	3	ZDC-C	325050	228285	508035
1273	3	ZBW-A	339463	355258	15795
1273	4	ZME-C	393142	404043	10901
1273	4	ZME-A	419218	422619	3401
1273	5	BIL-A	469027	477264	8237
1273	5	ZOB-C	502498	505983	3485
1273	6	JNU-A	541526	543984	2458
1273	6	ZSU-C	583114	586824	3710
1273	6	ZLC-C	595773	599414	3641
1273	6	ZOA-C	601250	10112	13662
1274	0	ZLC-C	25410	30403	4993
1274	0	ZLC-C	41040	53395	12355
1274	0	ZLC-C	58073	62737	4664
1274	0	ZLC-C	79578	83151	3573
1274	1	ZLC-C	92999	243835	150836
1274	2	ZAB-A	207199	210215	3016
1274	3	JNU-B	307914	310999	3085
1274	4	ZSU-A	393343	397174	3831
1274	5	ZLA-A	444427	451590	7163
1274	5	ZLC-B	465295	469870	4575
1274	5	ZMP-C	512129	515825	3696
1274	6	ZKC-B	526296	529421	3125
1274	6	ZOB-B	581192	323891	-257301
1275	0	ZDC-C	1547	140256	138709
1275	0	ZSE-A	58213	61393	3180
1275	0	ZAB-A	58382	62534	4152
1275	1	ZAU-C	131344	162014	30670
1275	1	ZLA-B	144716	151124	6408
1275	2	ZMA-A	212833	226137	13304
1275	4	ZFW-A	377276	380302	3026
1275	4	ZFW-B	377457	398415	20958
1275	4	ZAU-A	396786	406841	10055
1275	4	BIL-B	399889	403617	3728
1275	6	ZDC-C	547611	409273	1071262
1275	6	JNU-A	551451	554173	2722
1275	6	JNU-A	551474	571936	20462
1276	1	ZSU-C	124640	130159	5519
1276	4	ZDC-B	387996	391112	3116

NSTB Week	GPS Day	Site	Start Time (GPS Seconds)	End Time (GPS Seconds)	Duration (Seconds)
1276	4	ZJX-C	413409	417507	4098
1277	0	ZME-C	25656	28803	3147
1277	3	ZJX-A	276625	278839	2214
1277	3	JNU-A	338619	343287	4668

Table 12-3 O&M Outages from April 1, 2004 to June 30, 2004

NSTB Week	GPS Day	Site	Start Time (GPS Seconds)	End Time (GPS Seconds)	Duration (Seconds)
1268	3	NOCC	308076	308938	862
1269	2	POCC	254264	257652	3388

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.

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.