

**WAAS Technical Report**  
**William J. Hughes Technical Center**  
**Pomona, New Jersey**  
**12/6/06**

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**DR# 42: Loss of Availability due to Extended Satellite Maintenance on SV 5**  
**(NANU 2006145)**

**GPS Week/Day: Week 1400 Day 2 – Week 1401 Day 1**  
**(11/7/06 – 11/13/06)**

**Discussion:**

On November 14, 2006, the US Coast Guard issued NANU 2006145 concerning satellite maintenance that had been performed on SV 5 during the week prior. The contents of the NANU are listed below. As indicated by the NANU type, SV 5 was unavailable for navigational purposes between the times listed.

2006145-----

NOTICE ADVISORY TO NAVSTAR USERS (NANU) 2006145  
SUBJ: SVN35 (PRN05) UNUSABLE JDAY 311/0135 - JDAY 317/2325

1. NANU TYPE: UNUSABLE  
NANU NUMBER: 2006145  
NANU DTG: 132327Z NOV 2006  
REFERENCE NANU: 2006139  
REF NANU DTG: 070207Z NOV 2006  
SVN: 35  
PRN: 5  
START JDAY: 311  
START TIME ZULU: 0135  
START CALENDAR DATE: 07 NOV 2006  
STOP JDAY: 317  
STOP TIME ZULU: 2325  
STOP CALENDAR DATE: 13 NOV 2006
2. CONDITION: GPS SATELLITE SVN35 (PRN05) WAS UNUSABLE ON JDAY 311  
(07 NOV 2006) BEGINNING 0135 ZULU UNTIL JDAY 317 (13 NOV 2006)  
ENDING 2325 ZULU.
3. POC: CIVILIAN - NAVCEN AT 703-313-5900, [HTTP://WWW.NAVCEN.USCG.GOV](http://WWW.NAVCEN.USCG.GOV)  
MILITARY - GPS OPERATIONS CENTER at [HTTP://GPS.AFSPC.AF.MIL/GPSOC](http://GPS.AFSPC.AF.MIL/GPSOC), DSN  
560-2541,  
COMM 719-567-2541, [gps\\_support@schriever.af.mil](mailto:gps_support@schriever.af.mil),  
[HTTP://gps.afspc.af.mil/gps](http://gps.afspc.af.mil/gps)  
MILITARY ALTERNATE - JOINT SPACE OPERATIONS CENTER, DSN 276-9994,  
COMM 805-606-9994, [SPACEAF.AOC@VANDENBERG.AF.MIL](mailto:SPACEAF.AOC@VANDENBERG.AF.MIL)

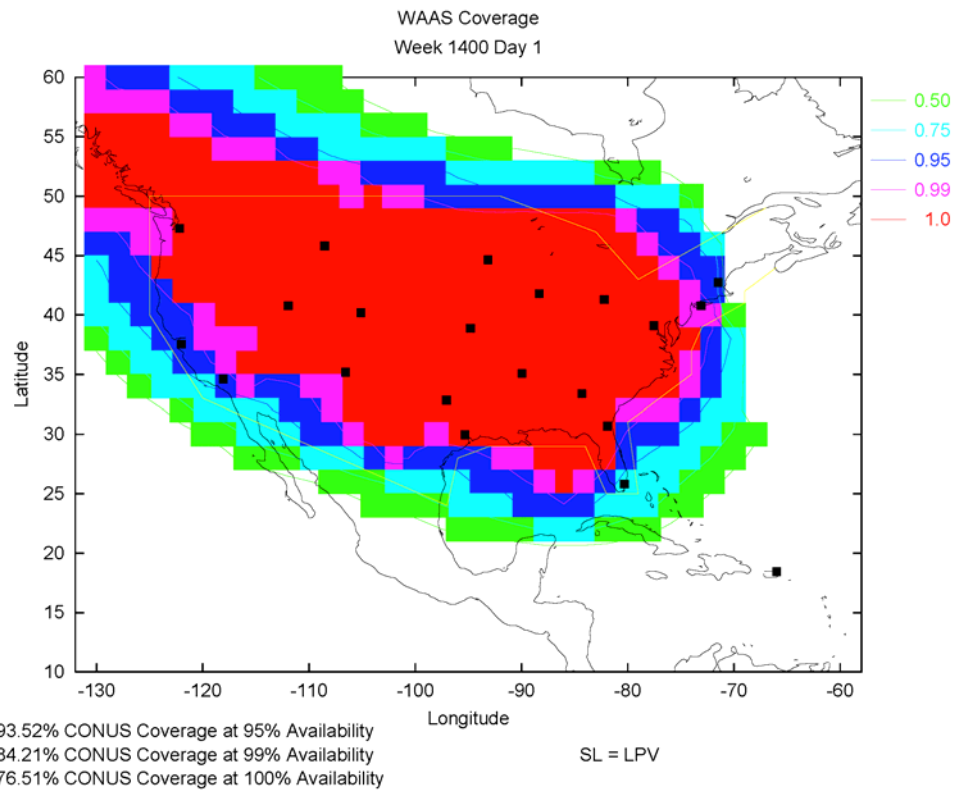
A drop in WAAS LPV service availability was observed during the week specified in NANU 2006145, namely Week 1400 Day 2 through Week 1401 Day 1 (11/7/06 – 11/13/06), inclusive. Figure 1 is the CONUS LPV coverage contour plot from the day prior to the start of the outage. Figure 2 shows the same for the first day of the outage. The loss of 99% and 100% Availability is readily apparent. The coverage area shrank inwards from most angles. Coverage plots from days during the outage looked similar to each other, though some were a bit worse due to other satellite outages. Plots from before and after the outage were similar to each other as well.

Figures 3 and 4 show an even more pronounced effect on the Alaska LPV coverage area—a complete loss of 99% LPV availability. Plots from days during the outage were similar, as with CONUS.

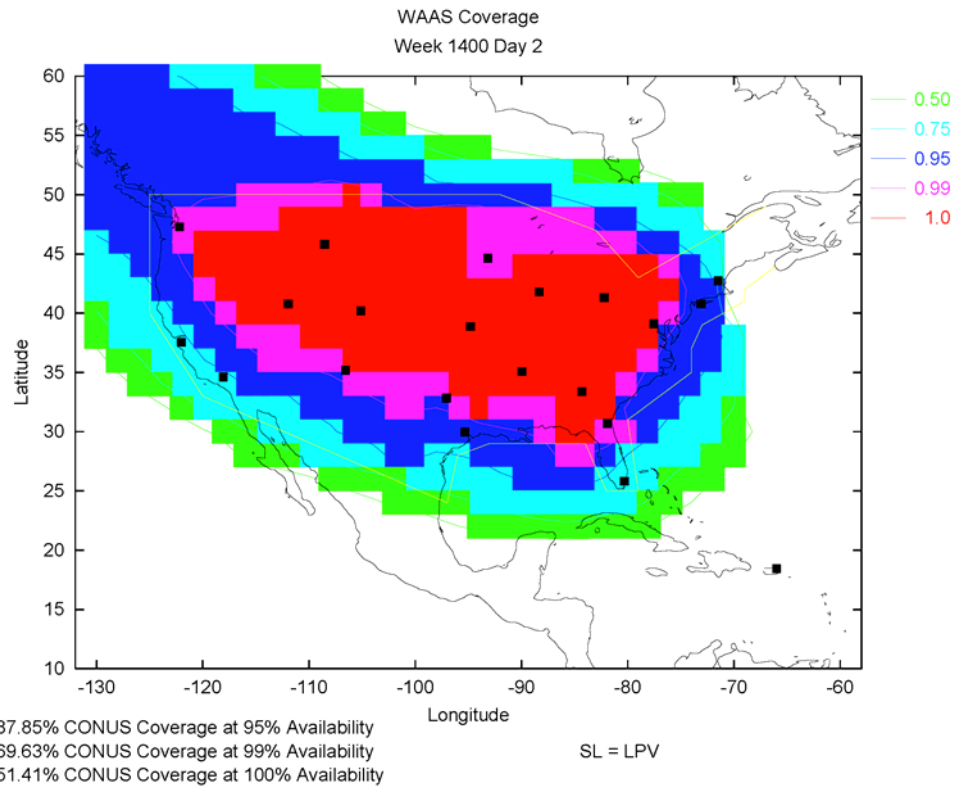
Comparing Figures 5 and 6 reveals a significant increase in maximum PDOP throughout much of North America. As with the coverage plots, max PDOP plots from the days of the SV 5 outage looked similar to each other, and the max PDOP improved once SV 5 returned to service.

An examination of Figures 1 through 6 shows the loss of CONUS and Alaska coverage occurred mostly in areas not surrounded by Wide-Area Reference Stations, where the maximum PDOP increased. This is consistent with the explanation that the loss of SV 5 as a ranging source had a significant effect on satellite geometry, causing the coverage loss.

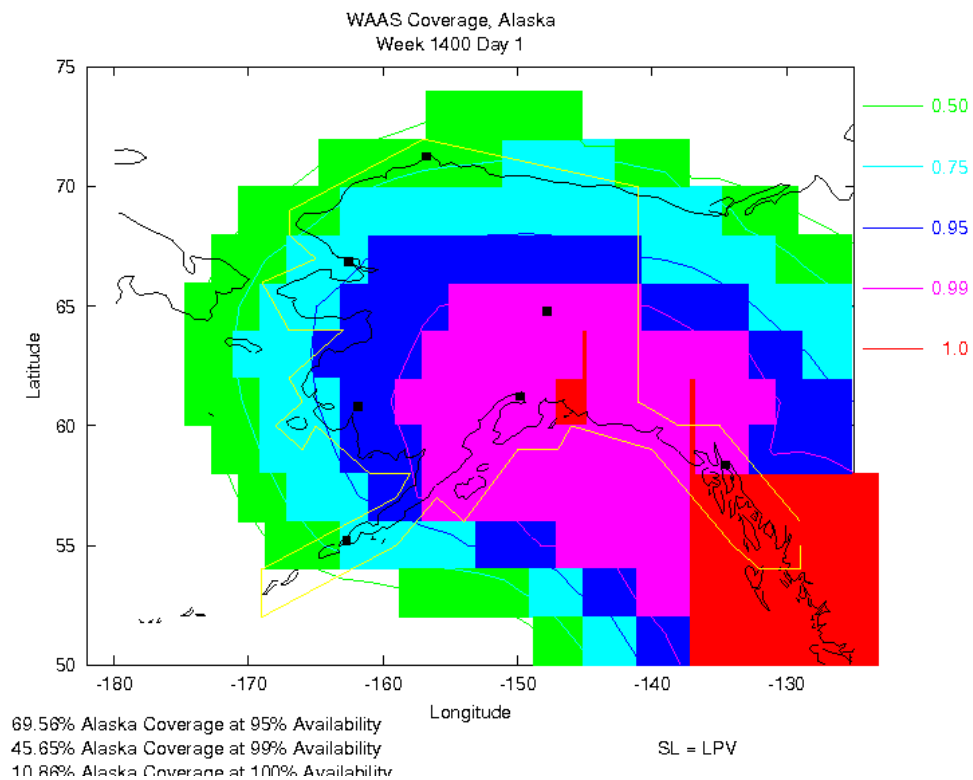
**Figure 1 – LPV Service Coverage Contour Plot, Week 1400 Day 1 (11/6/06)**



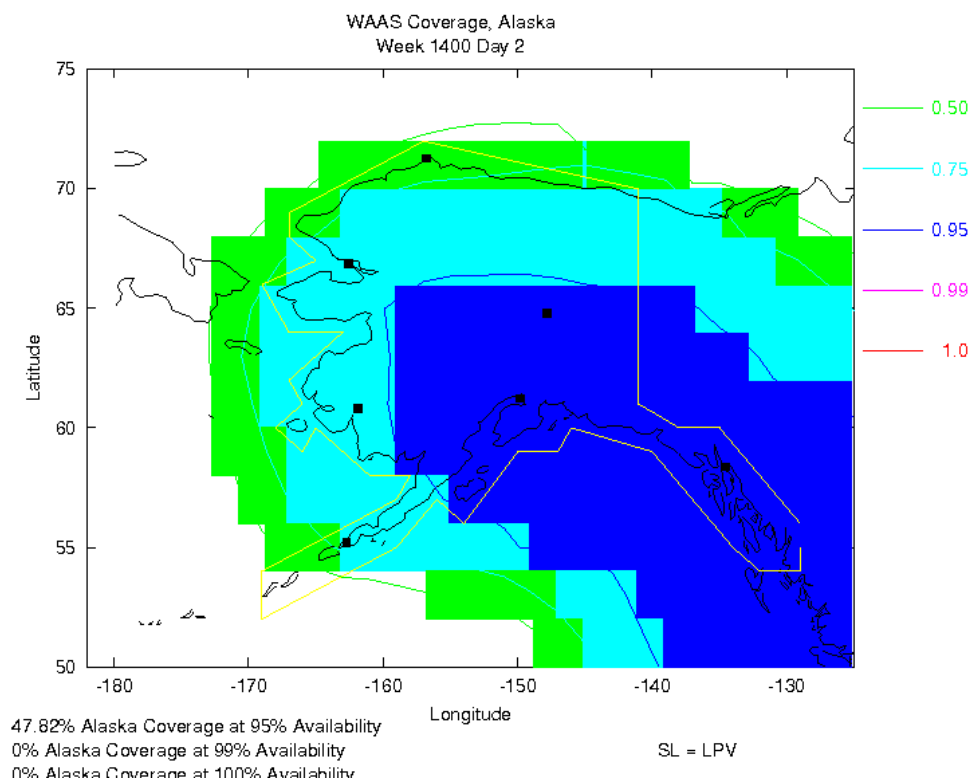
**Figure 2 – LPV Service Coverage Contour Plot, Week 1400 Day 2 (11/7/06)**



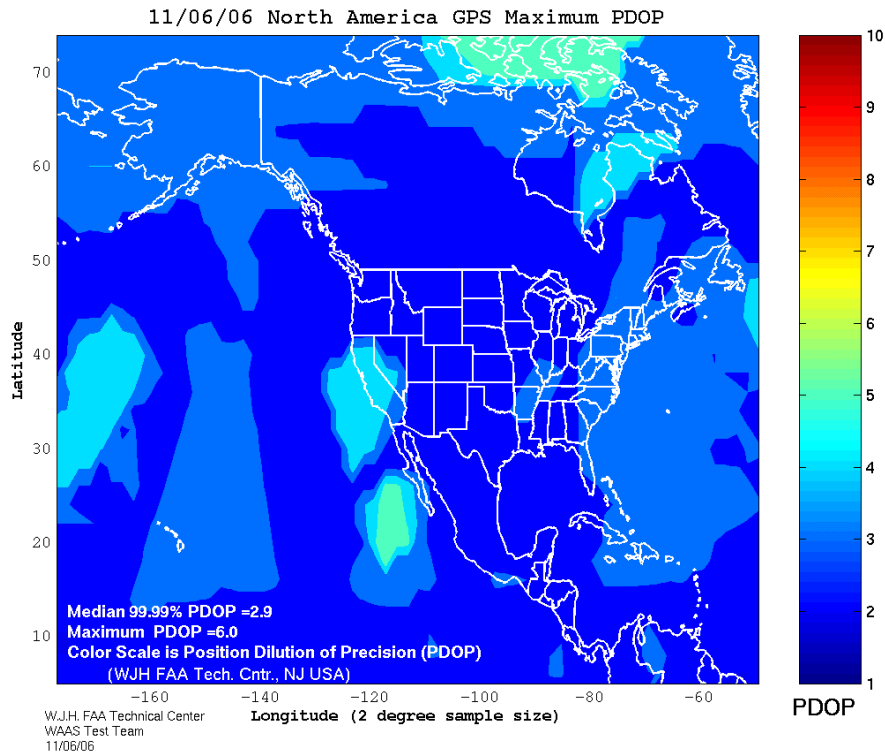
**Figure 3 – LPV Service Coverage Contour Plot, Week 1400 Day 1 (11/6/06)**



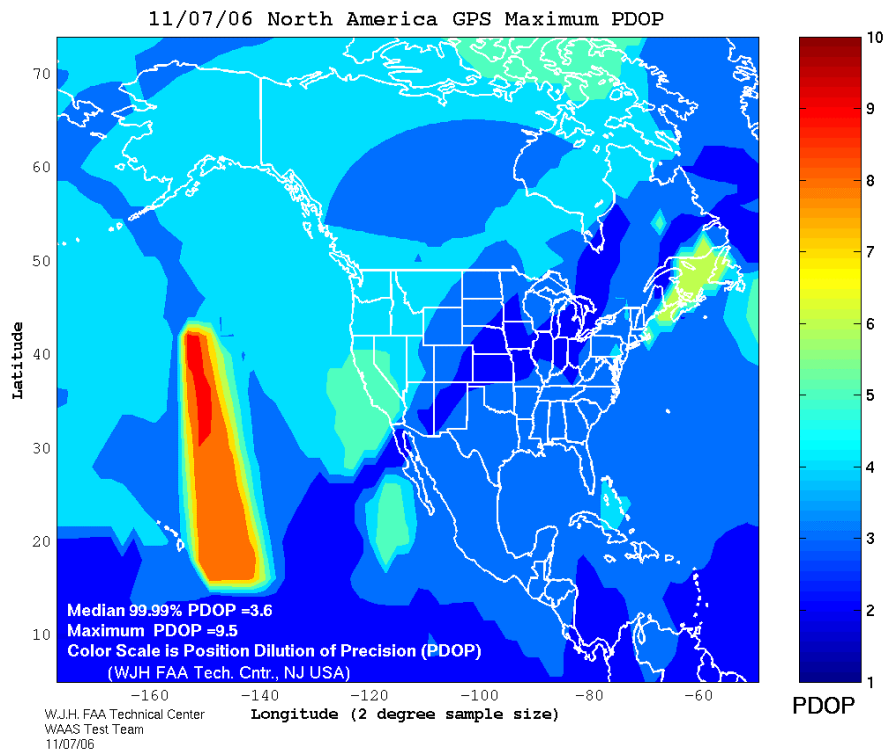
**Figure 4 – LPV Service Coverage Contour Plot, Week 1400 Day 2 (11/7/06)**



**Figure 5 – Maximum GPS PDOP Plot, Week 1400 Day 1 (11/6/06)**



**Figure 6 – Maximum GPS PDOP Plot, Week 1400 Day 2 (11/7/06)**

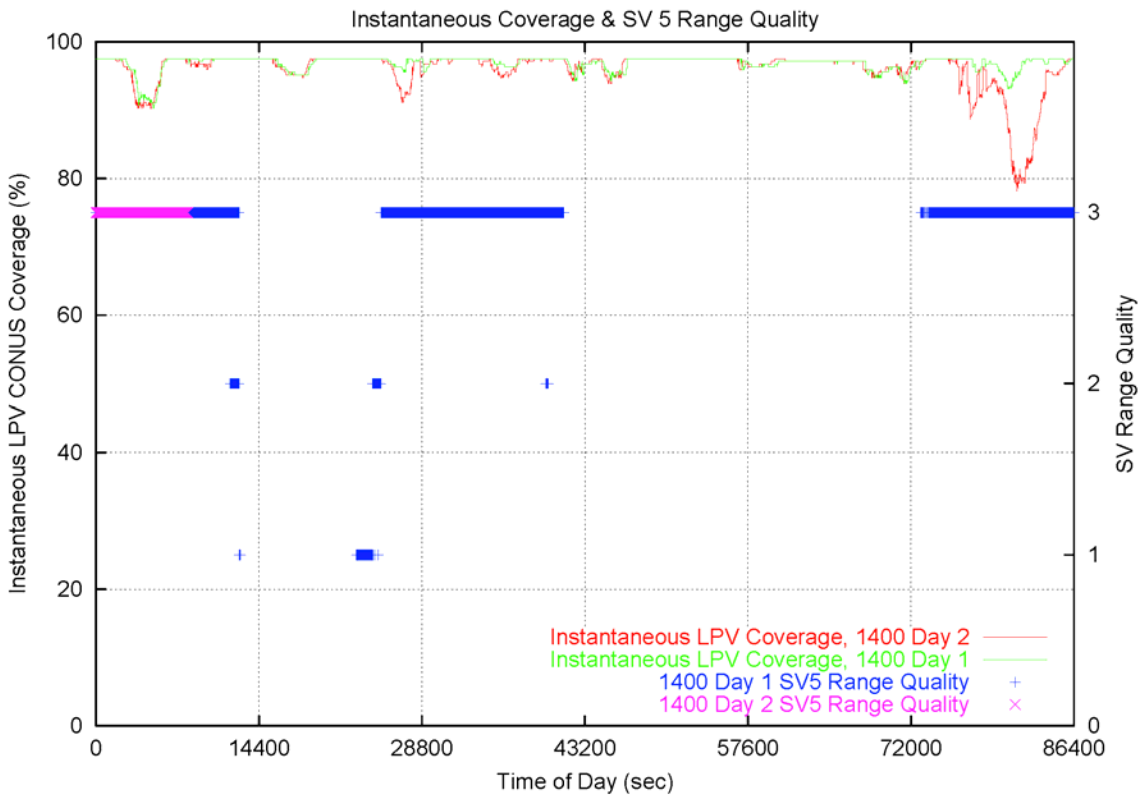


Figures 1 through 6 show a general spatial and time (daily) correlation between the SV 5 outage and loss of LPV Coverage. Figures 7 and 8 show a more specific time correlation.

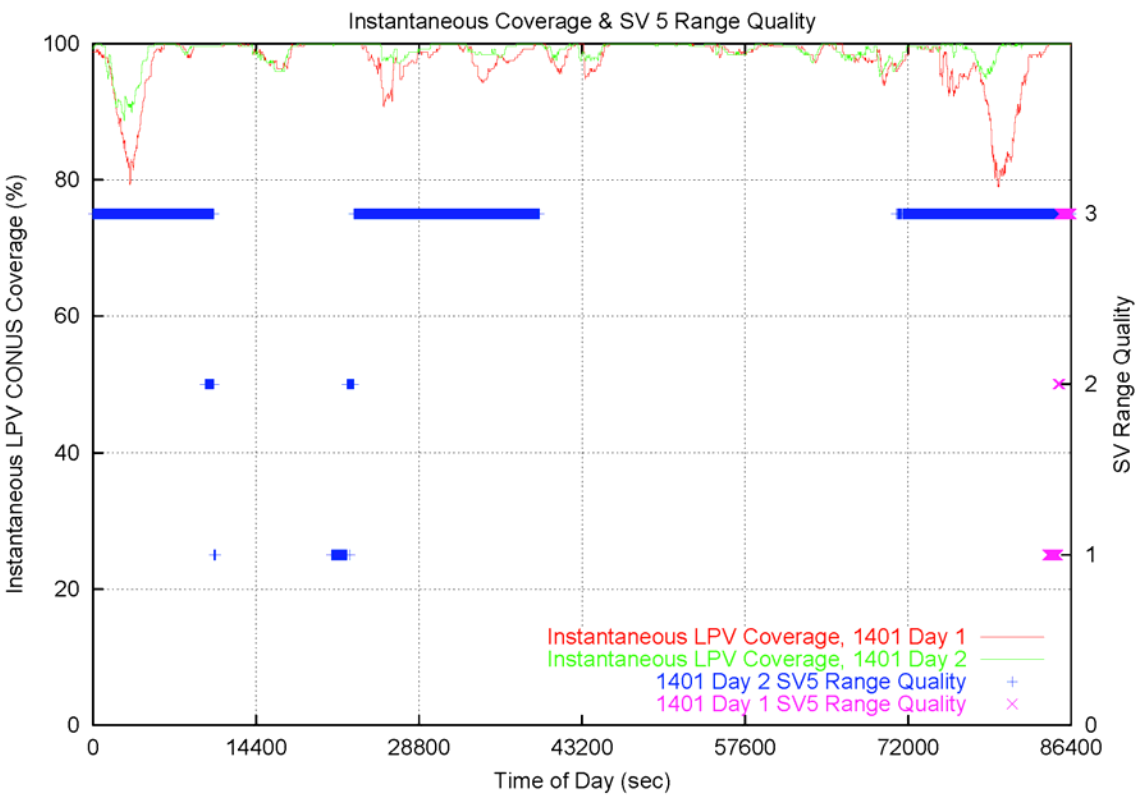
Figures 7 and 8 show the instantaneous LPV coverage over the CONUS service volume (30-second sampling), with the SV 5 range quality overlaid. Figure 7 includes the day before and first day of the outage. Figure 8 includes the last day of the outage, and the following day. In both figures, the loss of LPV coverage is most apparent during the times when SV 5 would have been available as a ranging source. (In Figures 7 and 8, note that the SV Range Quality of 1, 2, or 3 indicates SPS, NPA, or PA, respectively. Also note that the x-scale, Time of Day in seconds, is the GPS time of week modulo 86400.)

The difference in maximum coverage between figures 7 and 8 is due to the new WAAS GEO, CRW (CONUS Region West), coming online during the SV 5 outage. CRW's footprint covers area in New England that AOR-W's hasn't covered since before it was moved, thus the improvement. Comparing the two figures shows that the coverage losses happened at approximately the same times of day, and are of similar magnitude, with or without CRW.

**Figure 7 – Instantaneous LPV Coverage, Week 1400 Days 1 & 2 (11/6/06 – 11/7/06)**



**Figure 8 – Instantaneous LPV Coverage, Week 1401 Days 1 & 2 (11/13/06 – 11/14/06)**



## Conclusions:

The loss of SV 5 as a ranging source is the primary cause of reduced availability over the CONUS service volume on Week 1400 Day 2 (11/7/06) through Week 1401 Day 1 (11/13/06), inclusive. Satellite geometry was noticeably impacted during the time at which SV 5 would otherwise be available for PA ranging. Figure 9 is a trend of LPV coverage at 99% and 100% availability, with a red line showing the time during which SV 5 was unavailable as a PA ranging source.

**Figure 9 – Daily CONUS LPV Coverage Trend**

