Memo

Date: January 15, 2016
To: Kevin Stewart
From: Markus Ritsch
Subject: **December 2015 ALERT Data Analysis – Year End Report**

I. ALERT Data Source

Raw ALERT data records extracted from the Urban Drainage and Flood Control District's NovaStar 5 base station were analyzed for the period December 1 through December 31, 2015.

II. General System Analysis Summary

In 2015 data was received at the District through both the legacy ALERT channel and through the ALERT2 (concentrator plus A2 self-reports) channel. The following (Table 1) quantifies the data reports received by each channel.

Table 1. Reception of Data at Diamond Hill (Legacy, ALERT2 and Concentrator Reports)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Tot
Legacy	216,461	241,285	268,551	282,306	345,191	348,979	284,647	269,298	246,919	268,738	234,612	216,591	3,223,578
Concentrator	366,229	405,210	443,612	458,979	499,841	511,002	449,469	438,917	403,457	444,814	400,414	408,904	5,230,848
ALERT2	172,927	233,617	286,836	295,399	319,764	302,746	320,675	376,339	358,553	334,148	239,426	276,329	3,516,759
TOTAL	**755,617**	**80,112**	**998,999**	**1,036,684**	**1,164,796**	**1,162,727**	**1,054,791**	**1,084,554**	**1,008,929**	**1,047,700**	**874,452**	**901,824**	**11,971,185**
Conc+A2	539,156	638,827	730,448	754,378	819,605	813,748	770,144	815,256	762,010	778,962	639,840	685,233	8,747,607
Conc/Leg	1.69	1.68	1.65	1.63	1.45	1.46	1.58	1.63	1.63	1.66	1.71	1.89	1.62
DataChron	529,216	564,798	652,811	702,865	777,203	772,052	742,221	755,645	716,065	694,527	622,266	633,968	8,163,637

The District operates two redundant NovaStar5 base stations: the primary (ns5a) at Diamond Hill and a redundant base (ns5b) at Greenhouse Data. Additional analyses are conducted on the data received by these two base stations (Table 2). The data received by both base stations for the month are shown below.

Table 2. Comparison of Data Reception by ns5a and ns5b

NS5A (Diamond Hill)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Tot
Legacy	216,461	241,285	268,551	282,306	345,191	348,979	284,647	269,298	246,919	270,076	234,612	216,591	3,224,916
Concentrator	366,229	405,210	443,612	458,979	499,841	511,002	449,469	438,917	403,457	443,928	400,414	408,904	5,229,962
ALERT2	172,927	233,617	286,836	295,399	319,764	302,746	320,675	376,339	358,553	330,561	239,426	276,329	3,513,172
NS5B (Greenhouse)													
Legacy	244,232	241,143	268,417	262,549	341,926	341,600	288,199	269,168	246,796	268,738	234,514	216,608	3,223,890
Concentrator	409,951	405,875	444,660	430,407	499,657	502,908	456,087	440,313	405,243	444,814	401,831	408,909	5,250,655
ALERT2	191,784	234,150	289,044	275,955	319,750	299,635	328,435	381,397	365,140	334,148	242,539	276,613	3,538,590
Diff (NS5a-NS5b)													
Legacy (Digi One)	-27,771	142	134	19,757	3,265	7,379	-3,552	130	123	1,338	98	-17	1,026 (0.03%)
Concentrator (B2010)	-43,722	-665	-1,048	28,572	184	8,094	-6,618	-1,396	-1,786	-886	-1,417	-5	-20,693 (0.4%)
ALERT2 (B2010)	-18,857	-533	-2,208	19,444	14	3,111	-7,760	-5,058	-6,587	-3,587	-3,113	-284	-25,418 (0.7%)
Comments	Failed hard drive on ns5a		Tot A2 diff 1%	Outage on ns5b this month			Ns5a data collection was down on July 1		Total A2 diff about 1%				

In general, the feed from the legacy decoder (DigiOne) was better to the Diamond Hill base than to Greenhouse while the opposite was true for the B2010 ALERT2 decoder. This would lead one to believe the difference lies not in the network architecture between Diamond Hill and Greenhouse but rather has something to do with the serial-IP device.

The difference in reception between Diamond Hill and Greenhouse for the year was less than one percent.

The daily ratio of total concentrator reports received versus total legacy ALERT reports received is shown (Figure 1).

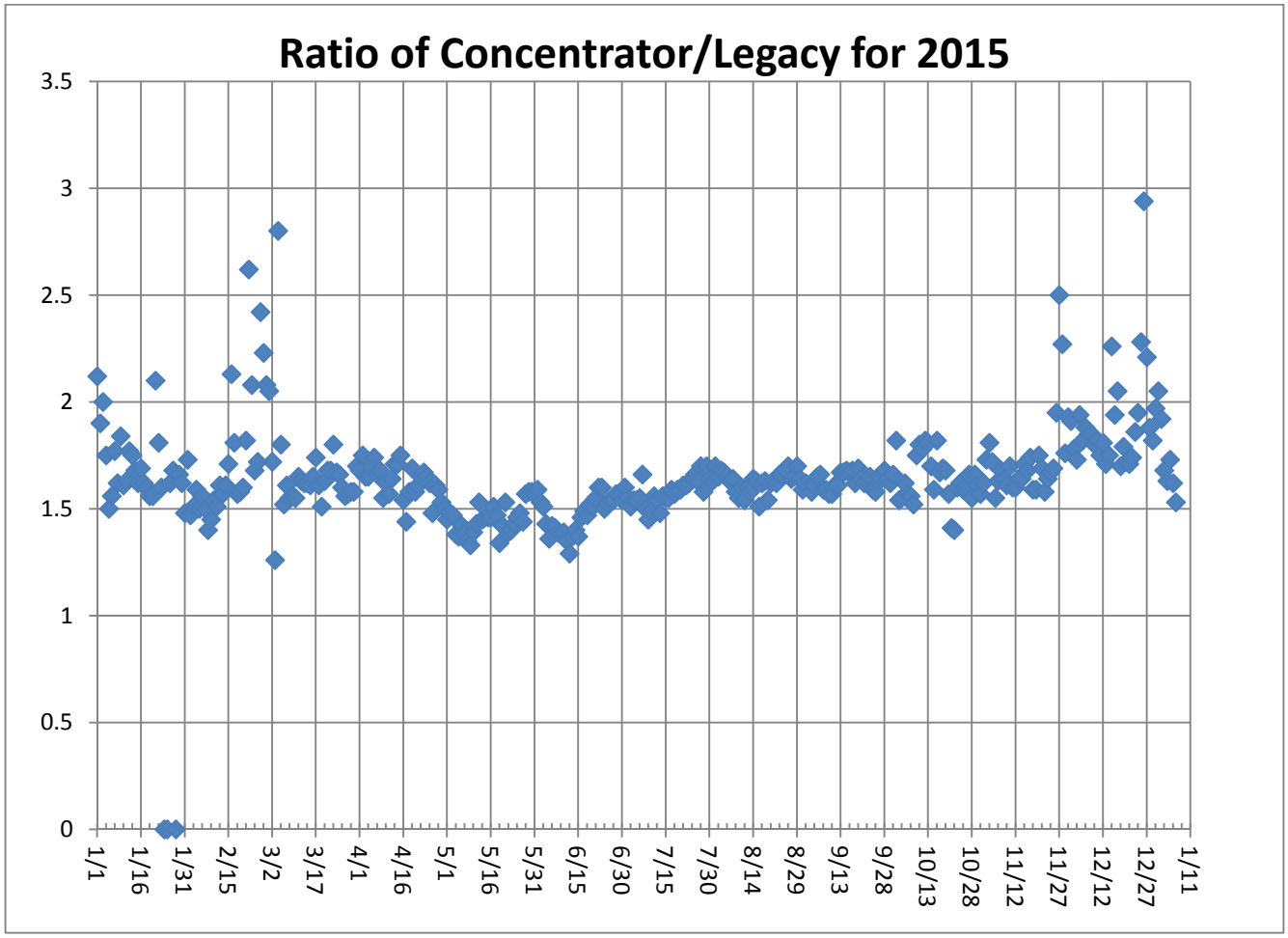


Figure 1. Daily Ratio of Concentrator Reports to Legacy Reports

The ratio becomes more volatile in the cold months as the Blue Mountain repeater has problems with legacy ALERT reporting when the temperature drops.

A. Continuous Operation of Base Receiver/Decoder

The base station at Diamond Hill received a total of 11,971,185 reports comprised of legacy, ALERT2 and concentrator reports from January 1 through December 31, 2015. The base station at Diamond Hill did not collect data continuously for the entire year. Data collection was down on the following days in 2015.

- January 24, 26, 27 and 29
- March 8 and March 19
- July 1

The only time during the flood season that data collection was down at Diamond Hill was on July 1st, 2015. The base station was down on July 1st from midnight until 9:30 am. The backup base station operated at Greenhouse did collect data during this period so no data was lost. The NovaStar5 base station running at Diamond Hill did not create the monthly data partition table at midnight, which is the normal procedure. The monthly data partition table was created at 9:30 am. This issue has been fixed in a subsequent release of NovaStar5.

B. Specific Issues Identified

Performance of the following sensors (Table 3) was questionable this month.

Table 3. Sensors with Poor Performance Characteristics

Sensor ID	Description	Comments
10027	West Creek Hayman	This station stopped reporting in November…WET to investigate
10026	Trumbull Hayman	Poor timer and event reporting
1440	WX-Elbert	Poor event performance
4270	Cannon Mountain	Poor event performance
4730	WX-Sugarloaf	Poor event performance
4550	Boulder Jail	Poor timer performance
1382	Unknown ID	Unknown id with many transmissions this month
4371, 4372, 4374, 4377, 4378	Unknown IDs	Possible coming from Gross Reservoir (4370)

C. Performance of New A2 Sites

This section of the report will look at specific reporting characteristics of the new A2 sites by analyzing their APDUID (Application PDU Identifier). The APDUID is a cyclical, incrementing counter from 0 to 6. Tracking skipped values and restarts of the application control byte counter provides useful insight into site performance and general network health. The performance of the cyclical counter is quantified for each A2 self-reporting site and repeater path (Table 4). Please note that the values presented in this table for the December report reflect the average performance for the site for the entire year…..not just the December value.

Table 4. APDUID Performance of A2 Sites by Source Address

Description	ID	W. Creek (6001)	Smoky Hill (6502)	Blue Mt. (6503)	Lee Hill (6505)	Gold Hill (6506)
Carr Street (10012)	100		0.934	0.961	0.877	0.802
Murphy Creek (10019)	870		0.966	0.956	0.944	0.953
Maple Grove (10013)	1000		0.981	0.811	0.927	0.964
Lena @ Nolte Pond (10025)	1020		0.966	0.978	0.935	0.952
Diamond Hill (10028)	1420		0.707	0.910	0.430	0.756
Newlin Gulch	3070		0.912	0.261	0.796	0.387
Heritage Regional Park	3090		0.671	0.339	0.760	0.882
Lower Left Hand (10018)	4453		0.990	--	0.930	0.062
Magnolia	6602		0.971	0.967	0.974	0.959
Blackstone**	100100		0.131	0.102	0.112	0.143
ETG @ Hampden**	100110		0.900	0.773	0.842	0.746
Upper Sellers	100140	0.864				
Haystack Road	100150	0.841				
Sand Cr at Colfax	100160		0.971	0.895	0.951	0.963
James Creek	100177		0.217	--	0.971	0.753
S. St. Vrain at Berry Ridge	100210		--	--	0.965	0.189
Arvada/Blunn Reservoir	100227		0.819	0.797	0.760	0.576
Havana Pond	100230		0.985	0.972	0.962	0.966
Westerly Creek Dam	100247		0.984	0.978	0.943	0.979
Trumbull (Hayman)	100260	0.832	--	--	--	--
West Creek (Hayman)	100270	0.872	--	--	--	--
Plum Creek at Sedalia	100290	0.765	--	--	--	--
Coal Creek at McCaslin	100300		--	--	--	--

**-the APDUID is disabled for these sites…..these are original HSE A2 transmitters and may not support the APDUID

D. ALERT2 Repeater Loading

The ALERT2 architecture utilizes 5 repeaters with a single transmit frequency (170.300 MHz) to Diamond Hill. The repeaters utilize a 20 second frame where each repeater is allocated a slot of specific size and an offset within the frame. The slot allocated to each repeater is sized appropriately to accommodate the total number of existing and future remote sites routed through that repeater. Each repeater is shown along with its designated slot (Table 5). Currently there is no pass-listing for the ALERT2 repeaters. Any remote ALERT2 site can be received by all repeaters and re-broadcast to the base except for West Creek which has an input frequency unique to Douglas County.

Table 5. ALERT2 Repeater Architecture

Repeater	Slot Size (sec)	Slot Offset (sec)	Source Address	ALERT2 Input Frequency (MHz)	ALERT2 Output Frequency (MHz) – received at Diamond Hill
West Creek	2	0	6001	169.425	170.300
Smoky	3	2	6502	169.525	170.300
Blue Mt.	4	5	6503	169.525	170.300
Lee Hill	3	9	6505	169.525	170.300
Gold Hill	3	12	6506	169.525	170.300
Magnolia	5	15	6507		170.300
Frame Size	20				

The following tables summarize the total number of reports received through each repeater (Table 6). This helps to quantify repeater loading for the ALERT2 backbone.

Table 6. ALERT2 Reports Received through Each Repeater (Only A2 Self Reports)

Month	West Creek (6001)	Smoky (6502)	Blue Mt. (6503)	Lee Hill (6505)	Gold Hill (6506)	TOTAL
Jan	0	44,501	44,636	44,783	39,007	172,927
Feb	0	58,543	56,150	61,160	57,764	233,617
Mar	346	73,198	69,604	77,968	65,323	286,439
Apr	595	73,711	69,568	79,215	72,310	295,399
May	5,259	78,694	72,340	86,297	77,174	319,764
June	11,987	72,449	65,742	82,998	69,570	302,746
July	28,595	75,379	71,394	79,026	74,041	328,435
Aug	28,409	92,299	84,057	84,363	87,211	376,339
Sep	26,809	84,143	84,776	84,289	85,123	365,140
Oct	19,775	82,683	83,390	63,475**	84,825	334,148
Nov	6,438	62,615	61,477	50,888	58,004	239,422
Dec	9,835	72,886	72,465	73,431	47,996	276,613

**** - The number of reports coming through Lee Hill declined in October**

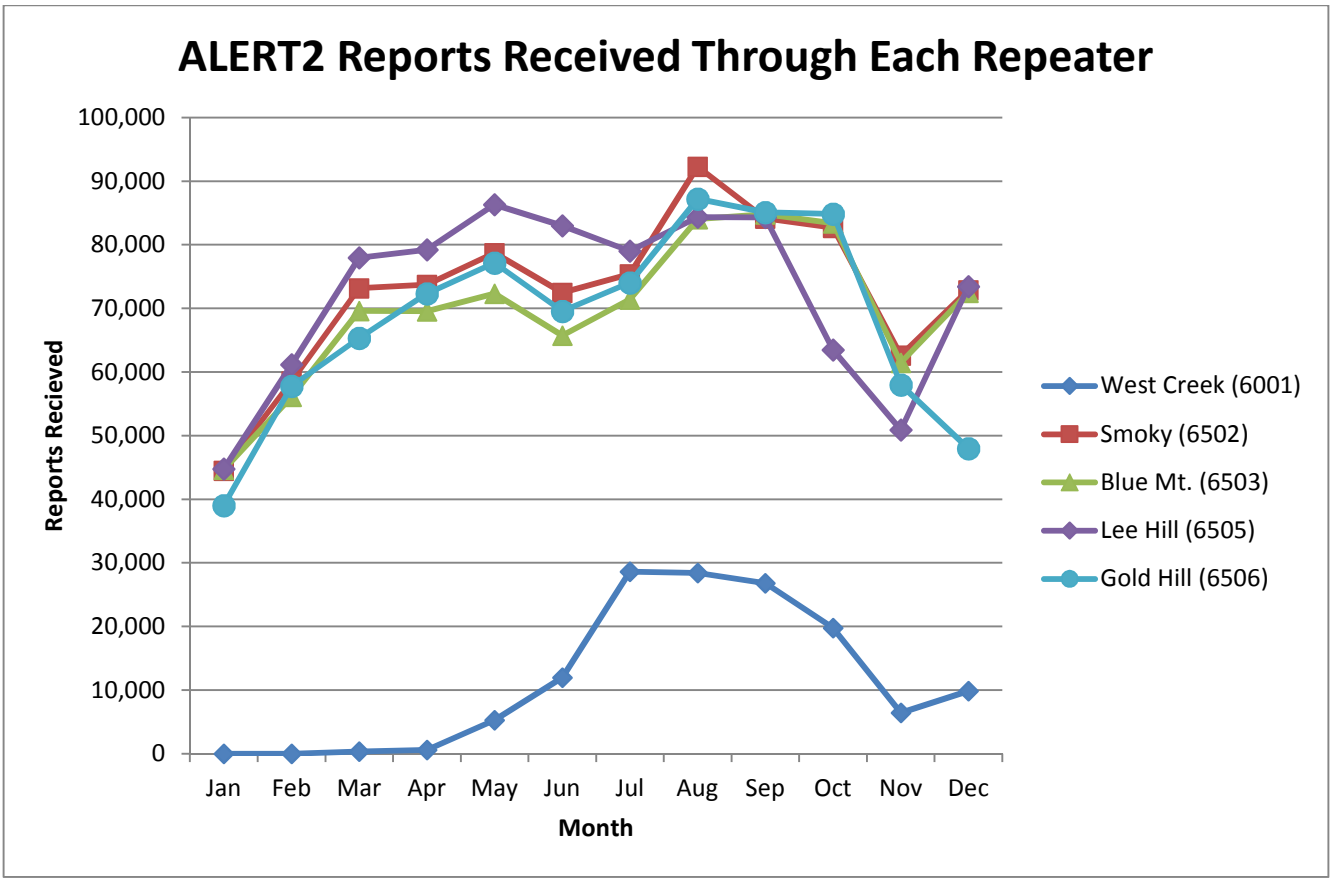


Figure 2. Reports received through each repeater (ALERT2 Only)

In general each of the primary repeaters in the District process an equivalent number of ALERT2 reports. Several months are evident where the throughput of one repeater is not consistent with the other three. The reduction of ALERT2 reports through Lee Hill in October is evident (Figure 2) as is the reduction of ALERT2 reports through Gold Hill in December.

The following tables summarize the system-wide latency of ALERT2 self-reports (Table 7 and Table 8).

Table 7. System-Wide Latency of ALERT2 Self-Reports (seconds)

Statistical Parameter	Value	Comments
Mean	64.54	The average time it took a report from the field to reach the base
Minimum	1	The minimum time it took for a report to go from the field to the base
Maximum	262	The maximum time it took for a report to go from the field to the base

Table 8. Summary of ALERT2 System-Wide Latency (seconds)

Statistical Parameter	Feb	Mar*	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	340	35.7	44.04	38.14	34.23	59.75	71.60	70.48	70.61	67.87	64.54
Minimum	5	3	3	3	3	4	3	4	4	2	1
Maximum	35,209	3,706	43,089	205	245	1,093	261	264	261	382	262
Station with Max Latency			Arvada Blunn (10022)	Sellers Gulch (10015)	Westerly Creek (10024)	Murphy Creek (870)	Magnolia WX (6601)	Magnolia WX (6601)	Magnolia WX (6601)	Magnolia WX (6601)	Magnolia WX (6601)

E. Rain Sensor Timer Reporting Summary

The following analysis assumes that each legacy rain sensor has a 12-hour timer-reporting interval and each A2 rain sensor has a 1-hour timer-reporting interval. The worst performing rain sensors for the month are summarized (Table 9).

Table 9. Monthly Summary of Sensors with Poor Timer Performance (Sensor ID)

Jan*	Feb*	Mar*	Apr	May	Jun	Jul	Aug	Sep	Oct*	Nov*	Dec*
4470	4470	4470	4850	2330	430	2330	1660	4850	10029	10026	100260
700	2330	4270	2330	310	2330	2360	430	100140	10027	10027	4550
2330	4870	2790	430	2360	3010	1570	2330	2850	10026	10029	4060
4240	3010	4240	5720	430	2360	430	2850	430	10024	4870	4080
3010	1660	4870	2970	4470	310	2850	1570	2330	4850	4850	1660
4870	4240	3010	2360	4870	1660	1660	2360	2360	4470	4550	4240

***- Only sensors that operate year-round (weather stations and stations in Boulder County) are included for the analysis in these months.**

Sensors identified as having poor timer performance in multiple months are shaded with unique colors. A developing trend can thus be identified from the color shading as the year progresses.

III. Rain Sensor Event Reporting Summary

A. District-Wide Total Tip/Count Statistics

The incrementing reports from all 1-mm rain sensors were analyzed to quantify the District-wide statistical total monthly tip summary (Table 10). For the months of January, February, March, October, November and December only the stations that operate year-round are included in the rain event analysis. These stations include all weather stations and the stations in Boulder County.

Table 10. District-Wide Total Tip/Count Statistical Summary

Statistical Parameter	Value	Comments
Mean	10.80	Only the 1-mm rain sensors were included in the analysis
Median	10	Only the 1-mm rain sensors were included in the analysis
Standard deviation	5.58	Only the 1-mm rain sensors were included in the analysis
Mean plus three standard deviations	27.53	Only the 1-mm rain sensors were included in the analysis
Mean minus two standard deviations	---	Only the 1-mm rain sensors were included in the analysis
Minimum total count	1	St. Antons (4570)
Maximum total count	25	Justice Center (4360)
Sensors showing **NO** rain for the month		--
Sensors greater than 3 SD (over reporting)		None

B. Monthly Average Tip/Count Summary

A monthly summary of the District-wide mean total tip/count is presented (Table 11).

Table 11. Monthly Summary of District-Wide Mean Total 1-mm Tip/Count

Year	Jan*	Feb*	Mar*	Apr	May	Jun	Jul	Aug	Sep	Oct*	Nov*	Dec*	Ave
2006	4.62	5.92	18.39	20.47	19.44	13.75	74.03	46.89	24.17	41.13	5.04	16.45	24.19
2007	11.56	5.40	29.75	65.03	68.30	15.87	36.20	46.38	22.13	29.50	6.54	11.29	29.00
2008	4.05	7.38	12.26	20.57	54.82	26.06	16.43	90.20	37.54	19.59	2.82	9.24	25.08
2009	6.33	3.11	11.37	59.26	63.45	68.00	65.00	20.00	27.29	30.24	11.00	5.60	30.89
2010	5.97	11.90	32.54	70.57	39.63	56.04	50.23	31.01	4.18	18.31	8.30	3.31	27.67
2011	6.78	7.45	7.54	33.94	92.68	39.42	90.87	18.25	37.67	25.73	10.41	13.59	32.03
2012	4.89	13.57	2.35	30.17	38.97	19.35	73.03	11.31	48.81	22.32	2.98	4.18	22.66
2013	2.96	14.31	21.86	35.96	45.87	16.39	52.33	50.63	229.74	29.64	5.86	4.00	42.46
2014	6.88	11.86	25.91	29.30	77.30	29.16	99.73	43.59	50.96	29.26	13.36	8.11	35.45
2015	9.88	24.42	20.78	69.75	143.07	86.93	54.59	29.95	7.16	53.28	22.08	10.80	44.39

***- Only sensors that operate year-round (weather stations and stations in Boulder County) are included for the analysis in these months.**

C. Sensors with a Jump of Six or More in the Sequential Count

Several sensors experienced a large jump in the sequential tip count (Table 12).

Table 12. Sensors with a Jump of 6 or More in Sequential Count

Sensor Description	Sensor ID	Comment
WX-A2-Trumbull (Hayman)	100260	A2 site not coming in cleanly through West Creek……WET to investigate

D. Sensor-by-Sensor Incrementing Count Summary

The system-wide reception rate of incrementing, 1-mm tip reports for the month was approximately 94 percent. A total of 802 incrementing reports were received and a total of 853 reports were expected. The total loss of incrementing reports for the month was approximately 7 percent. Those sensors with the worst event transmission performance are summarized (Table 13).

Table 13. Monthly Summary of Sensors with the Worst Performance

Jan*	Feb*	Mar*	Apr	May	Jun	Jul	Aug	Sep	Oct*	Nov*	Dec*
4470	2330	100150	100150	310	430	2790	2330	2240	4470	10026	1440
700	4470	4470	4240	1620	4470	430	430	2970	10027	10027	4270
4750	700	2340	430	2330	2330	2360	4330	1440	10026	5940	4730
4330	2320	100140	100140	430	2970	4870	4270	1040	4510	4870	5940
2790	4330	1520	2330	2230	2230	2850	4470	1710	4790	4240	10026
4870	4870	1100	1620	4470	2360	2330	1660	4330	2790	4030	2990

***-Only sensors that are operational year-round (weather stations and stations in Boulder County) are included for the analysis in these months.**

Sensors identified as having poor event performance in multiple months are shaded with unique colors. A developing trend can thus be identified from the color shading as the year progresses.

IV. Unknown Device Analysis – Received Data Log

The ALERT IDs present in the audio signal received by the decoder are compared against a list of "active" device IDs that are defined within NovaStar. Those IDs received by the decoder that are not defined within NovaStar are considered to be "unknown" and may be the result of radio noise or problems with the telemetry system. The reception of "unknown" device reports for the month is summarized (Table 14).

Table 14. Summary of Unknown IDs

Description	Concentrator	Legacy	A2
Total number of unknown IDs (IDs without a device definition)	207	229	0
Total reports from unknown IDs	619	678	0
Unknown IDs with only a single received report (potential noise)	114	138	0
Total reports from all IDs – RecData Log entire month	408,909	216,608	276,427
Unknown reports as a fraction of total reports	0.15%	0.31%	0%

The total number of reports from unknown sensors is very small relative to the total reports received for the month. Shown below (Table 15) are the total reports received from unknown sensor IDs for each month of the year.

Table 15. Monthly Summary of Total Reports from Unknown IDs (Concentrator)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	1,220	1,474	1,276	1,174	721	5,707	610	1,738	442	533	2,857	6,396
2011	1,231	2,165	3,065	1,254	2,051	439	489	456	191	683	747	861
2012	692	750	1,575	977	5,469	11,016	453	683	774	2,657	3,854	5,466
2013	4,265	994	1,100	2,589	3,623	6,973	5,230	1,070	4,429	781	13,459	1,213
2014	870	4,284	2,399	2,104	25,746	1,832	3,983	268	369	448	470	1,099
2015	542	9,137	1,524	1,007	946	699	1,179	1,860	1,153	1,063	600	619

The fraction of reports from unknown sensors relative to the total number of reports is shown below (Table 16).

Table 16. Monthly Percent of Unknown Sensor Reports (Concentrator)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	0.42%	0.56%	0.38%	0.32%	0.20%	1.61%	0.17%	0.49%	0.13%	0.16%	0.93%	1.88%
2011	0.39%	0.73%	0.90%	0.37%	0.58%	0.12%	0.12%	0.05%	0.12%	0.18%	0.22%	0.26%
2012	0.30%	0.25%	0.43%	0.26%	1.37%	2.74%	0.11%	0.18%	0.20%	0.72%	1.15%	1.62%
2013	1.40%	0.31%	0.29%	0.60%	0.37%	0.61%	0.82%	0.21%	0.96%	0.31%	5.37%	0.23%
2014	0.14%	0.94%	0.40%	0.34%	3.95%	0.34%	0.66%	0.03%	0.03%	0.07%	0.11%	0.26%
2015	0.15%	2.25%	0.34%	0.22%	0.19%	0.14%	0.26%	0.42%	0.29%	0.24%	0.15%	0.15%

Any month shaded in yellow has an excessive number of reports from unknown sensors.

A number of "unknown" sensors had multiple reports, which may indicate the existence of a transmitter that is sending information on an ID that is not currently defined within NovaStar. The unknown IDs with multiple reports including the number of reports received by each are shown (Table 17).

Table 17. Reports Received by Unknown IDs

Concentrator		Legacy ALERT		
Unknown ID	**Reports**	**Unknown ID**	**Reports**	**Comment**
1382	120	1382	111	
1430	26	1430	22	
4372	17	4372	17	Possibly coming from Gross Reservoir (ID 4370)
4371	16	4371	16	Possibly coming from Gross Reservoir (ID 4370)
4378	15	4378	14	Possibly coming from Gross Reservoir (ID 4370)
4377	13	2	54	Possibly coming from Gross Reservoir (ID 4370)
1470	12	1470	12	

V. Sensors with Invalid Reports

The sensors below (Table 18 and Table 19) have the largest number of invalid decodes as determined by the validation process defined at the District NovaStar5 base station. These invalid reports may indicate poor radio paths (bit flip/contention errors/random decode) or validation criteria that do not match the physical installation at the site.

Table 18. Rain Sensors with the Most Invalid Reports

Sensor ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temple Pond at DTC (630)	0	0	0	0	0	0	113	0	0	0	--	--
Bear Creek @ Lowell (1530)	5	6	2	1	15	9	0	0	0	1	--	--
Pine Cliff Road (2810)	4	5	6	4	2	7	5	5	7	4	4	6
Porphory Mtn (4850)	0	0	0	0	0	7	5	2	1	3	--	--
East/West Trailhead (3050)	0	0	0	0	0	5	4	1	1	3	1	7
Haskins Gulch (2820)	0	0	0	0	64	0	0	0	0	0	--	--
Wx-West Creek (3020)	0	0	10	4	13	1	0	2	0	0	--	--
Wx-Castle Rock (2750)	0	0	5	2	30	0	0	0	0	0	1	2
A2-Newlin Gulch (3070)	0	0	0	6	35	2	0	0	1	134	2	3
A2-Highland Heritage Park (3090)	0	0	0	0	0	0	0	0	0	121	--	1
CC at Stroh Road (2860)	0	0	0	0	0	0	0	10	0	0	--	--
Cannon Mt (4270)	0	0	0	0	0	0	0	8	0	1	--	--
A2-Upper Sellers Gulch (10014)	0	0	0	0	0	0	0	0	0	94	--	1
A2-Haystack (10015)	0	0	0	0	0	0	0	0	0	79	--	1

Table 19. Level Sensors with the Most Invalid Reports

Sensor ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Van Bibber @ Hwy 93 (333)	0	0	0	0	0	0	43	5	0	0	1	--
Horseshoe Park Drop (713)	0	0	0	0	0	0	198	0	0	1	3	--
Louisville Rec Ctr (1103)	0	0	0	0	0	0	94	4	0	0	4	--
Pine Cliff Road (2813)	0	0	0	0	0	0	41	17	0	3	1	4
Ferril Lake (1383)	666	667	725	720	261	0	0	0	0	307	709	728
Kelly Dam (413)	0	0	0	0	61	70	47	42	18	2	--	--
A2-Lena @ Nolte Pond (1023)	na	545	745	738	0	0	0	1	0	0	2	--
Piney at Liverpool (953)	0	0	228	232	26	0	0	0	0	0	--	--
Flying J (853)	0	0	52	60	60	58	61	62	59	62	30	--
Sanderson at Xavier (1343)	0	0	31	7	15	26	6	1	0	0	2	1
SPR at Henderson (1663)	0	0	0	0	0	0	18	10	5	3	8	9
Little Narrows (4473)	33	208	2	8	11	24	7	1	3	1	--	--
SPR at Dartmouth (1629)				49	58	3	0	51	96	0	--	--
Murphy Creek GC (873)	0	0	0	0	36	1	0	0	0	0	--	--
Marston Lake North (1523)	0	0	0	0	20	10	0	4	0	5	3	11
Bridge (4423)	0	0	0	0	0	32	3	0	0	0	--	--
SBC @ San Souci (4833)	0	0	0	0	0	26	1	1	6	0	--	--
Sand Creek Park (1803)	0	0	0	0	0	23	1	0	4	0	1	--
Newlin Gulch (3073)	0	0	0	0	0	0	0	34	0	0	--	--
A2-Highland Heritage Park (3093)	0	0	0	0	0	0	0	0	0	73	--	1
A2-Havana Pond (100237)	0	0	0	0	0	0	0	13	60	0	--	--
Lyons Diversion NSV (4563)	0	0	0	0	0	0	0	0	16	1	4	--
Red Rocks Park (2373)	0	0	0	0	0	0	0	0	10	1	--	--

VI. Rainfall Alarms and Intensity Analysis

The following rainfall rate alarms from the Urban Drainage and Flood Control District NovaStar 5.0 Web Server were identified this month.

There were no rainfall alarms this month.

Rain Timer Performance

Analyze Rain Sensors

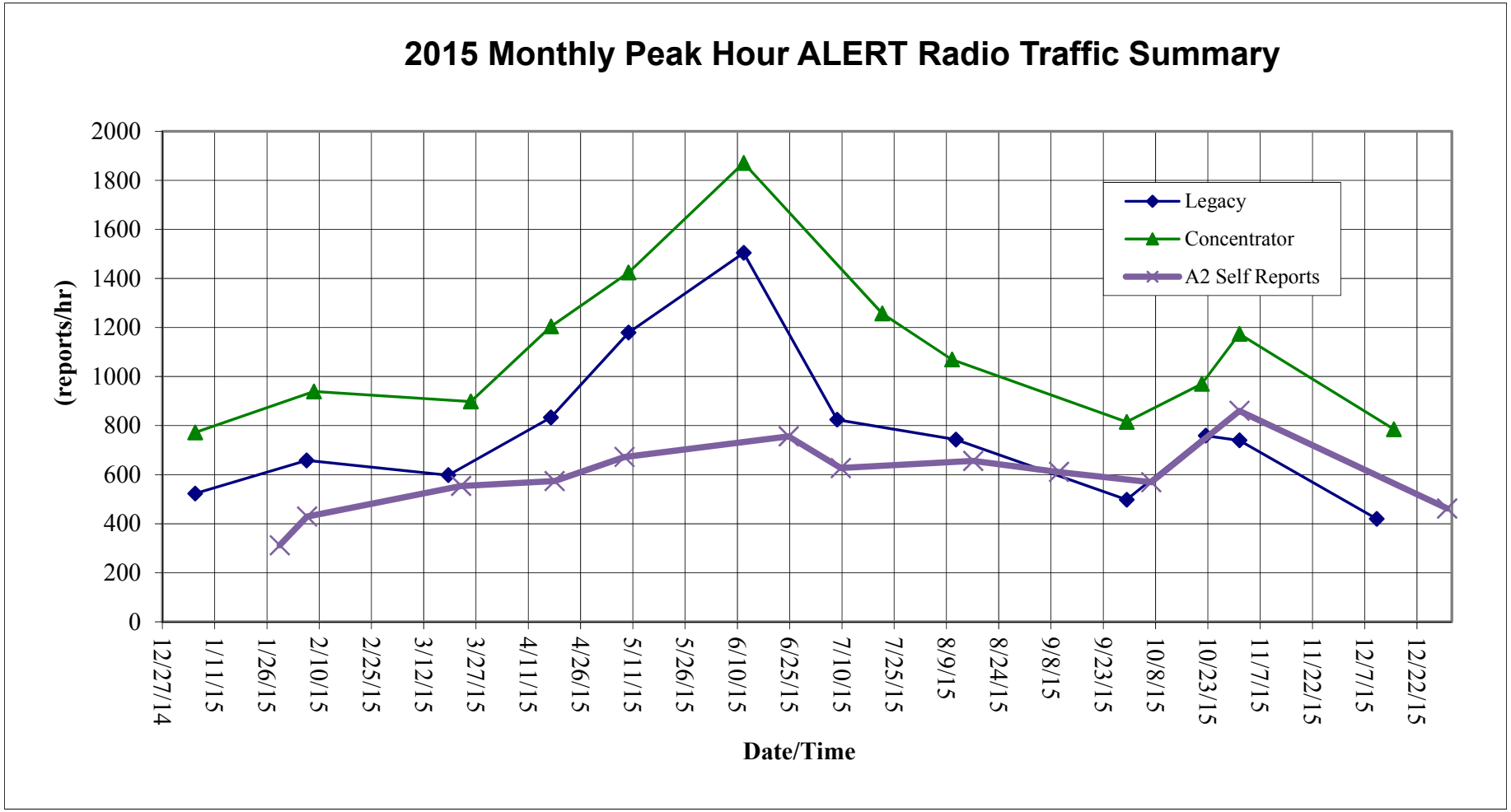
Rain Sensors	Description	Rcv	Timer	Exp	Performance
100260	Wx-A2-Trumbull (Hayman) - Precip	339		744	46%
4550	Boulder Jail	31	21:55	64	48%
4060	Lakeshore	33	17:36	64	52%
4080	Twin Sisters	37	16:02	64	58%
1660	SPR at Henderson	37	15:34	64	58%
4240	Sunset	38	12:24	64	59%
2330	Morrison	38	17:48	64	59%
4220	Fling's	41	15:21	64	64%
4810	Shanahan Ridge	42	17:08	64	66%
4150	Gold Hill	42	15:30	64	66%
4870	SBC @ SB Road	43	14:31	64	67%
4830	SBC @ San Souci	45	15:56	64	70%
4270	Cannon Mountain	45	14:48	64	70%
4170	Pine Brook	45	15:51	64	70%
4140	Logan Mill	45	15:02	64	70%
4010	Cresent	46	15:02	64	72%
100300	A2-CoalCreek at McCaslin - Precip	544		744	73%
5940	Log Jumper	47	13:45	64	73%
4180	Gold Lake	48	14:49	64	75%
4090	Magnolia	48	14:13	64	75%
4710	Wx-Ward C-1	49	13:27	64	77%
4850	Porphory Mtn	49	14:36	64	77%
4840	SBC@S Boulder Ditch	49	14:22	64	77%
4750	Wx-Louisville Lake	50	13:51	64	78%
4860	Fairview Peak	50	14:05	64	78%
4570	St. Antons	50	14:14	64	78%
2790	Wx-W. Cherry Creek	51	14:02	64	80%
2320	Choke Cherry Resvr	51	13:23	64	80%
4530	Winiger Ridge	52	13:46	64	81%
4130	Swiss Peaks	52	11:59	64	81%
4820	Doudy Draw	53	12:31	64	83%
4330	Hansen Rain	53	13:00	64	83%
100150	A2-Sellers Gulch at Haystack Precip	54	13:07	64	84%
100140	A2-Upper Sellers Gulch Precip	54	13:07	64	84%
3090	A2-Highland Heritage Park	54	13:07	64	84%
3070	A2-Newlin Gulch Precip	54	13:07	64	84%
4050	Walker Ranch	55	13:07	64	86%
4510	Pinewood Springs	56	12:47	64	88%
4490	Apple Valley	56	12:40	64	88%
4290	Red Hill	56	12:59	64	88%
4160	Sunshine	56	13:05	64	88%
4040	Martin Gulch	56	12:45	64	88%
3030	WX-Bingham Lake Park	57	12:53	64	89%
4200	Lazy Acres	57	12:57	64	89%
2980	Dakan Rd	57	12:38	64	89%
4730	Wx-Sugarloaf	58	11:06	64	91%
1520	Wx-Marston Lake North	58	12:13	64	91%
4790	Wx-Button Rock	58	12:27	64	91%
4310	Johnny Park	58	12:42	64	91%
4190	Slaughterhouse	58	12:25	64	91%
4070	Bear Peak	58	11:58	64	91%
3020	Wx-West Creek WX	59	12:26	64	92%
1460	Wx-Urban Farm	59	12:26	64	92%
2930	Wx-Spring Valley Rd-DougCnty	59	12:25	64	92%

2750	Wx-Castle Rock	59	12:13	64	92%
1920	Wx-Brighton	59	12:26	64	92%
4360	Justice Center	59	12:26	64	92%
4350	Conifer Hill	59	12:23	64	92%
4300	Big Elk Park	59	12:24	64	92%
4250	Geer Canyon	59	12:24	64	92%
4100	Filter Plant	59	12:25	64	92%
4030	Red Garden	59	12:26	64	92%
110	Ralston Reservoir	59	12:24	64	92%
2990	Wx-Tomah Rd-DougCnty	60	12:13	64	94%
750	Wx-Quincy Reservoir	60	11:56	64	94%
2710	Wx-Highlands Ranch WTP	60	12:00	64	94%
3010	WX-EPC at Hwy 105	60	12:13	64	94%
1440	Wx-Elbert	60	12:18	64	94%
4770	Wx-Cal-Wood Ranch	60	12:12	64	94%
140	Wx-Blue Mountain	60	12:13	64	94%
4520	Eagle Ridge	60	12:13	64	94%
4340	Riverside	60	11:58	64	94%
970	Pump Sta 3	60	12:12	64	94%
700	Toll Gate @ 6th	60	12:13	64	94%
200	Leyden Reservoir	60	12:23	64	94%
2730	Wx-Salisbury Park	61	12:00	64	95%
2210	Wx-Hiwan G.C.	61	12:00	64	95%
1570	Wx-Brighton Ditch	61	12:00	64	95%
920	Wx-Aurora Town Hall	61	12:00	64	95%
900	Wx-Aurora Reservoir	61	12:00	64	95%
4320	Lee Hill Rain 2012	61	11:58	64	95%
4260	Taylor Mountain	61	11:58	64	95%
4230	Golden Age	61	11:57	64	95%
4110	Betasso	61	11:57	64	95%
1640	SPR at Union Ave.	61	12:10	64	95%
1420	A2-Wx-Diamond Hill	61	12:00	64	95%
4020	Rio Grande	62	11:57	64	97%
1700	Cherry Cr @ Champa	62	11:54	64	97%
6601	A2-Magnolia WX-Precip	91	8:00	93	98%
100290	Wx-A2-PlumCr at Sedalia - Precip	733		744	99%
1000	A2-Maple Grove Resv.	742		744	100%
4880	Whispering Pines	66	11:00	64	103%

Rain Event Performance

	Reports Received	Reports Received	802		Analyze Rain Sensors			0	<<show stations with zero rain (1-yes, 0-no)									
	Systemwide Avg	Total Tips	853															
	94.02%	Data Loss	5.98%															
Description	**Sensor**	**Performance**	**1-tips**	**2-tips**	**3-tips**	**4-tips**	**5-tips**	**6-tips**	**>6-tips**	**Rcv**	**Exp**	**Miss**	**Hold**	**Bucket**				
Wx-Elbert	1440	40%	1	0	0	1	0	0	0	2	5	3	0	0.03937				
Cannon Mountain	4270	43%	2	0	0	0	1	0	0	3	7	4	0	0.03937	Mean	10.79747		
Wx-Sugarloaf	4730	60%	3	2	1	0	0	0	0	6	10	4	0	0.03937	Median	10		
Log Jumper	5940	63%	3	1	1	0	0	0	0	5	8	3	0	0.03937	St. Dev	5.57784		
Wx-A2-Trumbull (Hayma	100260	70%	6	0	0	1	0	0	0	7	10	3	0	0.03937	Mean plus 3 SD	27.53099		
Wx-Tomah Rd-DougCnt	2990	73%	5	3	0	0	0	0	0	8	11	3	0	0.03937	Min	1	St. Antons 4570	
Wx-Brighton	1920	78%	6	0	1	0	0	0	0	7	9	2	0	0.03937	Max	25	Justice Center 4360	
Ralston Reservoir	110	82%	8	0	1	0	0	0	0	9	11	2	0	0.03937				
Fling's	4220	82%	12	1	1	0	0	0	0	14	17	3	0	0.03937				
SBC @ SB Road	4870	85%	9	2	0	0	0	0	0	11	13	2	0	0.03937				
Red Garden	4030	85%	9	2	0	0	0	0	0	11	13	2	0	0.03937				
Doudy Draw	4820	86%	5	1	0	0	0	0	0	6	7	1	0	0.03937				
Morrison	2330	87%	11	2	0	0	0	0	0	13	15	2	0	0.03937				
WX-EPC at Hwy 105	3010	88%	6	1	0	0	0	0	0	7	8	1	0	0.01				
Apple Valley	4490	88%	6	1	0	0	0	0	0	7	8	1	0	0.03937				
Cresent	4010	88%	12	2	0	0	0	0	0	14	16	2	0	0.03937				
Hansen Rain	4330	89%	14	2	0	0	0	0	0	16	18	2	0	0.03937				
Magnolia	4090	89%	7	1	0	0	0	0	0	8	9	1	0	0.03937				
Eagle Ridge	4520	90%	8	1	0	0	0	0	0	9	10	1	0	0.03937				
Martin Gulch	4040	90%	17	2	0	0	0	0	0	19	21	2	0	0.03937				
Toll Gate @ 6th	700	91%	9	1	0	0	0	0	0	10	11	1	0	0.03937				
Wx-Ward C-1	4710	92%	10	1	0	0	0	0	0	11	12	1	0	0.03937				
Wx-Louisville Lake	4750	92%	10	1	0	0	0	0	0	11	12	1	0	0.03937				
Logan Mill	4140	93%	12	1	0	0	0	0	0	13	14	1	0	0.03937				
Gold Hill	4150	95%	17	1	0	0	0	0	0	18	19	1	0	0.03937				
A2-Maple Grove Resv.	1000	95%	18	1	0	0	0	0	0	19	20	1	0	0.03937				
Justice Center	4360	96%	23	1	0	0	0	0	0	24	25	1	0	0.03937				
Wx-West Creek WX	3020	100%	8	0	0	0	0	0	0	8	8	0	0	0.03937				
Wx-W. Cherry Creek	2790	100%	5	0	0	0	0	0	0	5	5	0	0	0.03937				
Wx-Urban Farm	1460	100%	4	0	0	0	0	0	0	4	4	0	0	0.03937				
Wx-Spring Valley Rd-Do	2930	100%	2	0	0	0	0	0	0	2	2	0	0	0.03937				
Wx-Salisbury Park	2730	100%	2	0	0	0	0	0	0	2	2	0	0	0.03937				
Wx-Quincy Reservoir	750	100%	7	0	0	0	0	0	0	7	7	0	0	0.03937				
Wx-Marston Lake North	1520	100%	10	0	0	0	0	0	0	10	10	0	1	0.03937				
Wx-Hiwan G.C.	2210	100%	8	0	0	0	0	0	0	8	8	0	0	0.03937				
Wx-Highlands Ranch W	2710	100%	6	0	0	0	0	0	0	6	6	0	0	0.03937				
Wx-Castle Rock	2750	100%	4	0	0	0	0	0	0	4	4	0	0	0.03937				
Wx-Cal-Wood Ranch	4770	100%	8	0	0	0	0	0	0	8	8	0	0	0.03937				
Wx-Button Rock	4790	100%	10	0	0	0	0	0	0	10	10	0	0	0.03937				
Wx-Blue Mountain	140	100%	8	0	0	0	0	0	0	8	8	0	0	0.03937				
WX-Bingham Lake Park	3030	100%	10	0	0	0	0	0	0	10	10	0	0	0.03937				
Winiger Ridge	4530	100%	15	0	0	0	0	0	0	15	15	0	0	0.03937				
A2-CoalCreek at McCas	100300	100%	14	0	0	0	0	0	0	14	14	0	0	0.03937				
Whispering Pines	4880	100%	16	0	0	0	0	0	0	16	16	0	0	0.03937				
SBC@S Boulder Ditch	4840	100%	16	0	0	0	0	0	0	16	16	0	0	0.03937				
SBC @ San Souci	4830	100%	16	0	0	0	0	0	0	16	16	0	0	0.03937				
Shanahan Ridge	4810	100%	15	0	0	0	0	0	0	15	15	0	0	0.03937				
St. Antons	4570	100%	1	0	0	0	0	0	0	1	1	0	0	0.03937				
Boulder Jail	4550	100%	17	0	0	0	0	0	0	17	17	0	0	0.03937				
Pinewood Springs	4510	100%	17	0	0	0	0	0	0	17	17	0	0	0.03937				
Conifer Hill	4350	100%	5	0	0	0	0	0	0	5	5	0	0	0.03937				
Riverside	4340	100%	12	0	0	0	0	0	0	12	12	0	0	0.03937				

Lee Hill Rain 2012	4320	100%	13	0	0	0	0	0	0	13	13	0	0	0.03937			
Johnny Park	4310	100%	23	0	0	0	0	0	0	23	23	0	0	0.03937			
Big Elk Park	4300	100%	4	0	0	0	0	0	0	4	4	0	0	0.03937			
Red Hill	4290	100%	24	0	0	0	0	0	0	24	24	0	0	0.03937			
Taylor Mountain	4260	100%	12	0	0	0	0	0	0	12	12	0	0	0.03937			
Geer Canyon	4250	100%	16	0	0	0	0	0	0	16	16	0	0	0.03937			
Sunset	4240	100%	10	0	0	0	0	0	0	10	10	0	0	0.03937			
Golden Age	4230	100%	6	0	0	0	0	0	0	6	6	0	0	0.03937			
Lazy Acres	4200	100%	17	0	0	0	0	0	0	17	17	0	0	0.03937			
Slaughterhouse	4190	100%	13	0	0	0	0	0	0	13	13	0	0	0.03937			
Gold Lake	4180	100%	2	0	0	0	0	0	0	2	2	0	0	0.03937			
Pine Brook	4170	100%	7	0	0	0	0	0	0	7	7	0	0	0.03937			
Sunshine	4160	100%	2	0	0	0	0	0	0	2	2	0	0	0.03937			
Swiss Peaks	4130	100%	9	0	0	0	0	0	0	9	9	0	0	0.03937			
Betasso	4110	100%	24	0	0	0	0	0	0	24	24	0	0	0.03937			
Filter Plant	4100	100%	5	0	0	0	0	0	0	5	5	0	0	0.03937			
Twin Sisters	4080	100%	5	0	0	0	0	0	0	5	5	0	0	0.03937			
Bear Peak	4070	100%	13	0	0	0	0	0	0	13	13	0	0	0.03937			
Lakeshore	4060	100%	10	0	0	0	0	0	0	10	10	0	0	0.03937			
Walker Ranch	4050	100%	5	0	0	0	0	0	0	5	5	0	0	0.03937			
Rio Grande	4020	100%	5	0	0	0	0	0	0	5	5	0	0	0.03937			
Choke Cherry Resvr	2320	100%	12	0	0	0	0	0	0	12	12	0	0	0.03937			
Cherry Cr @ Champa	1700	100%	9	0	0	0	0	0	0	9	9	0	0	0.03937			
SPR at Henderson	1660	100%	3	0	0	0	0	0	0	3	3	0	0	0.03937			
SPR at Union Ave.	1640	100%	10	0	0	0	0	0	0	10	10	0	0	0.03937			
A2-Wx-Diamond Hill	1420	100%	11	0	0	0	0	0	0	11	11	0	0	0.03937			
Leyden Reservoir	200	100%	8	0	0	0	0	0	0	8	8	0	0	0.03937			
		Total Tips	763	31	5	2	1	0	0	802	853	51	1				


2015 Monthly Peak Hour ALERT Radio Traffic Summary
(reports/hr)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
12/27/14
1/11/15
1/26/15
2/10/15
2/25/15
3/12/15
3/27/15
4/11/15
4/26/15
5/11/15
5/26/15
6/10/15
6/25/15
7/10/15
7/25/15
8/9/15
8/24/15
9/8/15
9/23/15
10/8/15
10/23/15
11/7/15
11/22/15
12/7/15
12/22/15
Date/Time
Legacy
Concentrator
A2 Self Reports

General System Analysis

Database Name	P:\A207-UDFCD-Data-Analysis\2015\12-2015\Novastar_extract_2015Dec.mdb			
First Date in Database	11/30/15 11:59 PM	**Total Days**	31.0	Summarize
Last Date in Database	12/31/15 11:59 PM	**Total Hours**	744.0	
Total Records Analyzed	408,909			

Records by Group	**Concentrator**	**Percent**	**Legacy**	**Percent**	**ALERT2**	**Percent**
Wind Data	176,264	43.11%	85,111	39.29%	144,137	53.71%
Temperature	68,748	16.81%	31,210	14.41%	43,739	16.30%
Relative Humidity	60,515	14.80%	31,190	14.40%	43,200	16.10%
Barometric Pressure	33,788	8.26%	18,560	8.57%	343	0.13%
Battery Voltage	19,548	4.78%	8,642	3.99%	17,511	6.52%
Solar Radiation	11,126	2.72%	10,419	4.81%	0	0.00%
Water Level	9,237	2.26%	8,175	3.77%	7,527	2.80%
Fuel Temperature	5,940	1.45%	5,468	2.52%	0	0.00%
Fuel Moisture	5,936	1.45%	5,415	2.50%	0	0.00%
Precipitation	5,479	1.34%	4,527	2.09%	6,469	2.41%
Wind Direction	4,732	1.16%	0	0.00%	3,142	1.17%
Soil Moisture	2,998	0.73%	2,658	1.23%	0	0.00%
Repeater Status Report	2,658	0.65%	2,929	1.35%	0	0.00%
ET-Hourly	740	0.18%	740	0.34%	0	0.00%
Unknown	619	0.15%	678	0.31%	0	0.00%
Hayman Battery	259	0.06%	0	0.00%	0	0.00%
12Hr Status Report	141	0.03%	129	0.06%	0	0.00%
Not Used	58	0.01%	53	0.02%	0	0.00%
Repeater Pass List	47	0.01%	541	0.25%	0	0.00%
ET-Daily	31	0.01%	31	0.01%	0	0.00%
GPS Lock	24	0.01%	110	0.05%	2,302	0.86%
Solar Power	14	0.00%	14	0.01%	0	0.00%
Handar 585 ALARM Status	7	0.00%	6	0.00%	0	0.00%
Dew Point Temperature	0	0.00%	0	0.00%	8,054	3.00%
Total	**408,909**	**100.00%**	**216,606**	**100.00%**	**276,424**	**100.00%**

Traffic Loading Summary	**Concentrator**		**Legacy**		**ALERT2**	
Alert Reports	408,909		216,606		276,424	
Average Daily Traffic	12,778		6,987		8,917	
Average Hourly Traffic	532		291		372	
Median Hourly Traffic	543	hour beginning	302	hour beginning	394	hour beginning
Peak Hourly Traffic	785	Dec 15, 9:00 AM	420	Dec 10, 10:00 AM	462	Dec 30, 4:00 PM
2nd Max	755	Dec 10, 12:00 AM	413	Dec 10, 12:00 PM	455	Dec 9, 12:00 PM
3rd Max	749	Dec 10, 1:00 AM	411	Dec 15, 9:00 AM	447	Dec 13, 12:00 PM
4th Max	745	Dec 23, 7:00 PM	410	Dec 9, 2:00 PM	443	Dec 21, 9:00 AM
5th Max	744	Dec 15, 8:00 AM	406	Dec 9, 11:00 PM	442	Dec 23, 6:00 PM