

Memo

Date: March 13, 2018
To: Kevin Stewart
From: Markus Ritsch
Subject: February 2018 ALERT Data Analysis

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 February 1 through February 28, 2018.

II. General System Analysis Summary

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

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

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Tot
Legacy ALERT (line 1)	208,189	170,938											379,127
Conc (line 2)	369,547	328,399											697,946
ALERT2 (line 4)	608,216	474,112											1,082,328
WestMin ALERT2 (line 8)		472,878											472,878
WestMin Conc (line 6)		327,438											327,438
TOTAL	1,185,952	1,773,765	0	0	0	0	0	0	0	0	0	0	2,959,717
Con/Leg	1.78	1.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.84
DataChr	713,367	590,020											1,303,387

A new ALERT2 receiver/decoder was installed in Westminster, Colorado in January of 2018. This redundant data feed was added to NovaStar5 in late January. The new data feeds (lines 6 and 8) were added to both the Diamond Hill base station and to the Greenhouse base station for backup. Data from this new source will be quantified as part of this report.

The District operates two 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	208,189	170,938											379,127
Concentrator	369,547	328,399											697,946
ALERT2	608,216	474,112											1,082,328
WestMin (Conc)		327,438											327,438
WestMin (A2)		472,878											472,878
NS5B (Greenhouse)													
Legacy	207,991	167,936											375,927
Concentrator	369,370	297,198											666,568
ALERT2	608,348	437,957											1,046,305
WestMin (Conc)		304,809											304,809
WestMin (A2)		446,873											446,873
Diff (NS5a-NS5b)													
Legacy (Digi One)	198	3,002	0	0	0	0	0	0	0	0	0	0	3,200
Concentrator (B2010)	177	31,201	0	0	0	0	0	0	0	0	0	0	31,378
ALERT2 (B2010)	-132	36,155	0	0	0	0	0	0	0	0	0	0	36,023
WestMin (Conc)	0	22,629	0										22,629
WestMin (A2)	0	26,005	0										26,005
Comments		Network issues experienced this month at DH											

The daily ratio of concentrator to legacy reports is shown (Figure 1).

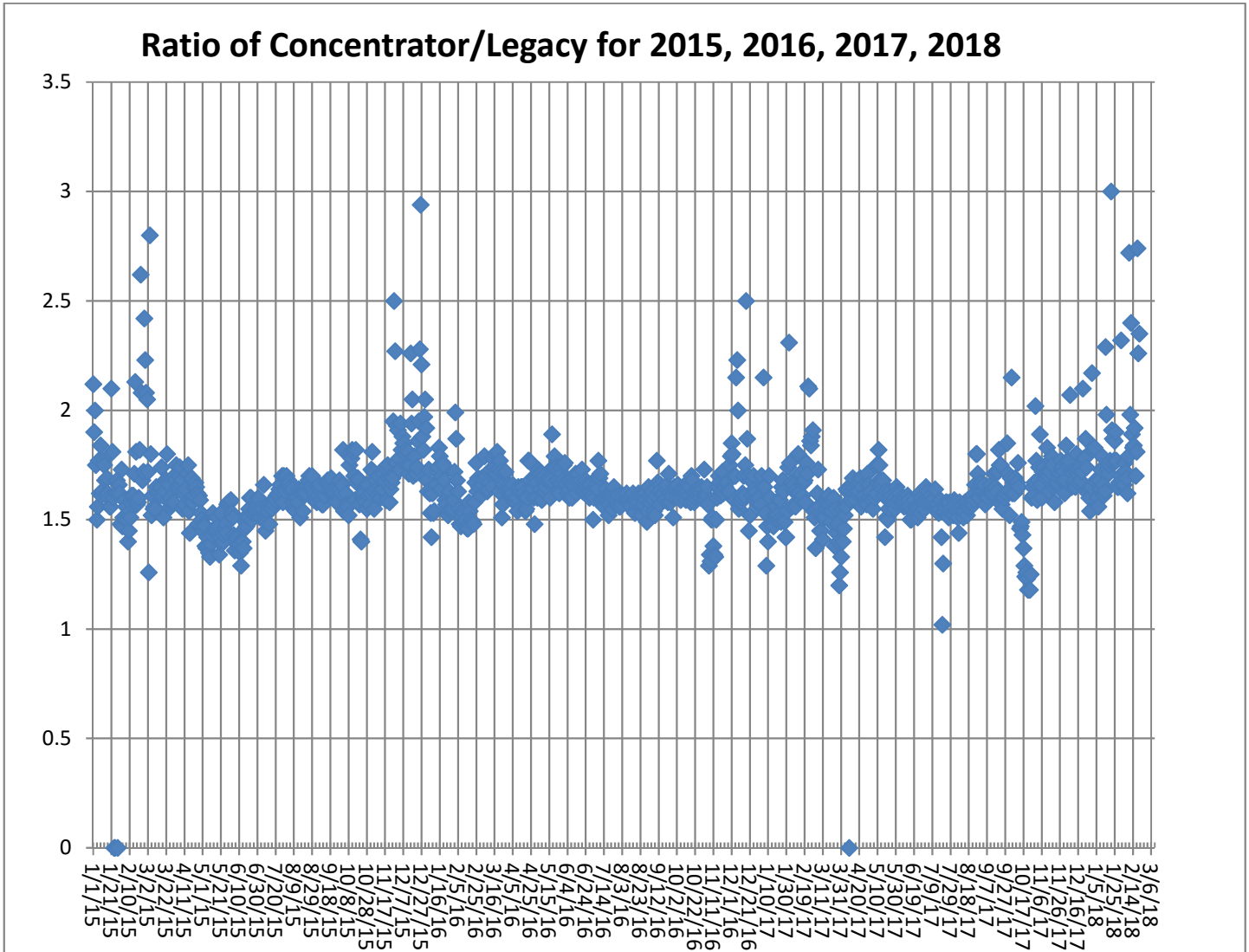


Figure 1. Daily Ratio of Concentrator Reports to Legacy Reports

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

The ratio on January 21, 2018 was very high with a value of 3. The system experienced a significant decrease in legacy ALERT reports on this day. The loss of ALERT legacy reports on January 21, 2018 are from Blue Mountain, Elbert, Urban Farm, and Marston Lake North. The most likely explanation is that the legacy ALERT output from the Blue Mountain repeater was down due to the cold weather experienced on both January 21 and January 15.

A cold spell in February likely contributed to the higher than expected ratio of concentration to legacy reporting.

A. Continuous Operation of Base Receiver/Decoder

The base station was in continuous operation for the entire month. Data was collected on a continuous basis for a total of 672 hours of operation. Outages of less than one hour are not identified.

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
2790	West Cherry Creek	Consistently poor timer performance
2810	Pine Cliff Road	Poor event performance
3020	West Creek WX	ALERT2 station with drifting clock (negative latency)
403	Montview Park	All values are flagged as questionable
0, 1, 2	Unknown	Unknown IDS transmitted on legacy ALERT

C. ALERT2 Repeater Loading

The District's 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 4). 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 4. 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 5). This helps to quantify repeater loading for the ALERT2 backbone.

Table 5. ALERT2 Reports Received through Each Repeater (Only A2 Self Reports)

Month-Yr	West Creek (6001)	Smoky (6502)	Blue Mt. (6503)	Lee Hill (6505)	Gold Hill (6506)	TOTAL
Jan-15	0	44,501	44,636	44,783	39,007	172,927
Feb-15	0	58,543	56,150	61,160	57,764	233,617
Mar-15	346	73,198	69,604	77,968	65,323	286,439
Apr-15	595	73,711	69,568	79,215	72,310	295,399
May-15	5,259	78,694	72,340	86,297	77,174	319,764
Jun-15	11,987	72,449	65,742	82,998	69,570	302,746
Jul-15	28,595	75,379	71,394	79,026	74,041	328,435
Aug-15	28,409	92,299	84,057	84,363	87,211	376,339
Sep-15	26,809	84,143	84,776	84,289	85,123	365,140
Oct-15	19,775	82,683	83,390	63,475**	84,825	334,148
Nov-15	6,438	62,615	61,477	50,888	58,004	239,422
Dec-15	9,835	72,886	72,465	73,431	47,996	276,613
Jan-16	4,034	38,348	36,826	37,168	19,768	138,160
Feb-16	11,732	93,120	99,206	96,284	99,188	399,530
Mar-16	12,533	126,123	134,329	140,226	139,536	552,747
Apr-16	13,262	128,473	130,223	135,499	133,197	540,654
May-16	27,002	125,098	124,280	138,033	130,513	544,926
Jun-16	30,405	117,877	111,309	133,036	122,798	515,425
Jul-16	37,492	108,334	102,335	115,028	110,577	473,766
Aug-16	48,323	130,666	123,827	136,746	131,957	571,519
Sep-16	49,555	122,625	115,898	129,454	127,606	545,138
Oct-16	51,170	111,105	110,038	116,087	116,489	504,889
Nov-2016	47,039	72,761	92,941	100,083	99,508	412,332
Dec-2016	48,946	102,329	97,321	79,274	102,097	429,967
Jan-2017	47,286	50,748**	27,307**	97,947	104,689	327,977
Feb-2017	45,366	96,629	94,065	88,239	98,411	422,710
Mar-2017	53,021	87,160**	33,983**	121,578	126,722	422,464
Apr-2017	49,833	110,418	116,486	122,506	120,727	519,970
May-2017	54,375	128,362	128,310	118,908	134,173	564,128
Jun-2017	60,671	131,745	124,019	146,333	138,056	600,824
Jul-2017	58,442	137,750	130,136	146,134	139,778	612,240
Aug-2017	60,322	136,739	128,716	145,280	139,257	610,314
Sep-2017	58,388	146,759	135,632	157,248	150,762	648,789
Oct-2017	48,644	148,071	149,899	159,639	157,788	664,041
Nov-2017	39,868	123,026	134,197	141,153	140,478	578,722
Dec-2017	38,801	138,219	137,672	142,389	141,303	598,384
Jan-2018	45,373	140,341	139,290	141,045	142,167	608,216
Feb-2018	30,490	110,604	109,467	111,922	111,629	474,112

** - The number of reports coming through these repeaters declined significantly

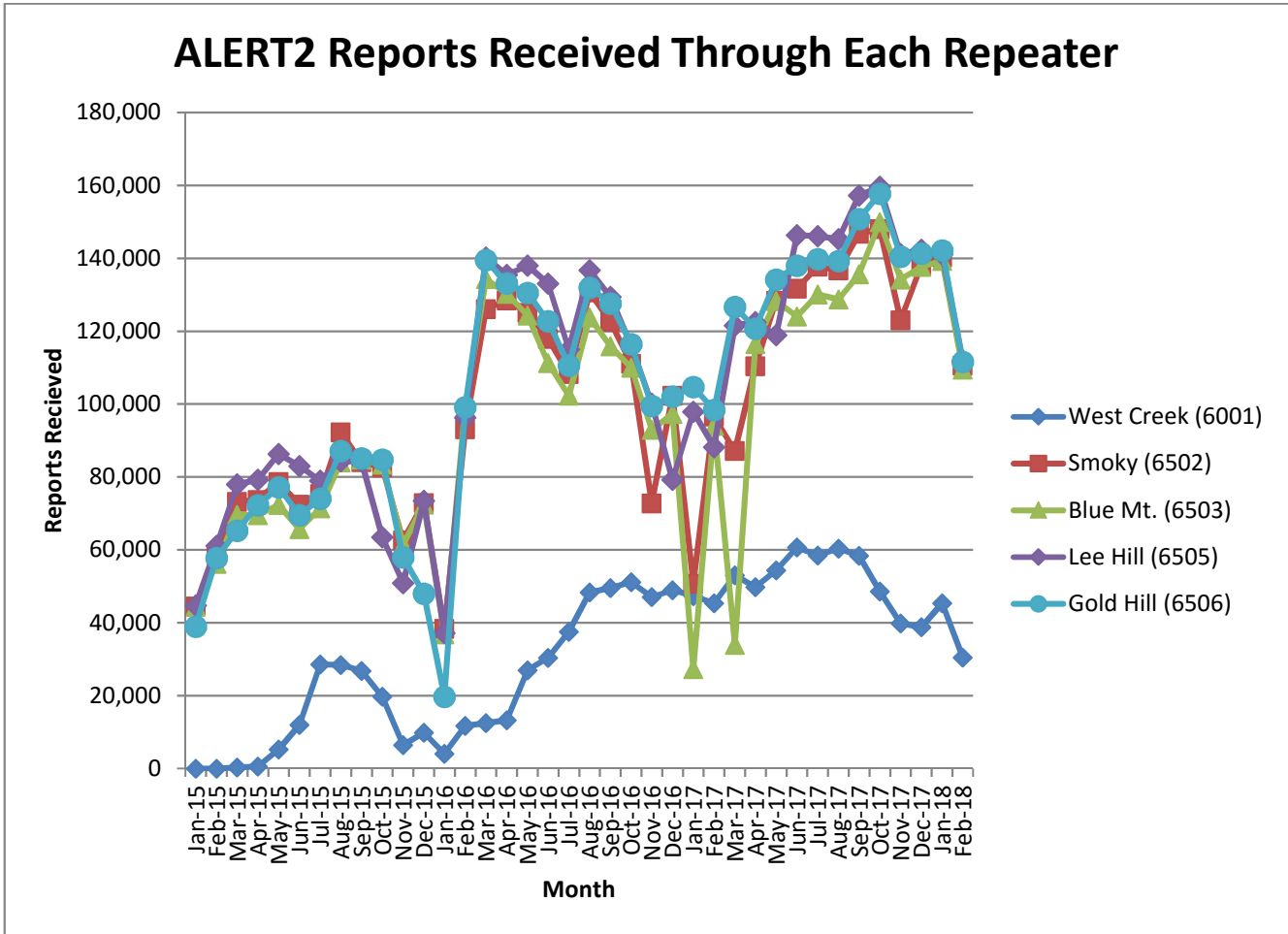


Figure 2. Reports received through each repeater (ALERT2 Only)

A convenient mechanism to track repeater performance throughout the year is to monitor total ALERT2 reports passed by each repeater. In general, each of the primary repeaters in the District process an equivalent number of ALERT2 reports because pass/block filtering is not being used. Several months are evident where the throughput of one repeater is not consistent with the other three.

Network outages were experienced on February 22 and February 23 which decreased the reception of data at the base station from all repeaters.

The following tables summarize the system-wide latency of ALERT2 self-reports (Table 6 and Table 7).

Table 6. System-Wide Latency of ALERT2 Self-Reports (seconds)

Statistical Parameter	Value (sec)	Comments
Mean	51.82	The average time it took a report from the field to reach the base
Minimum	-23	The minimum time it took for a report to go from the field to the base
Maximum	33597	The maximum time it took for a report to go from the field to the base

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

Statistical Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	48.79	51.82										
Minimum	-34	-23										
Maximum	37677	33597										
Station with Max Latency	West Creek WX	West Creek WX										

The negative latencies are observed only from the station West Creek WX. This is a HydroLynx transmitter. It is likely that the clock on this transmitter is drifting badly. A new GPS chip and EPROM are soon to be installed to help this station.

D. 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 8).

Table 8. Monthly Summary of Sensors with Poor Timer Performance (Sensor ID)

Jan*	Feb*	Mar*	Apr	May	Jun	Jul	Aug	Sep	Oct*	Nov*	Dec*
2790	2790										
4550	3020										
1660	1110										
2330	3010										
2980	1660										
5940	4550										

*- 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 9). 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 9. District-Wide Total Tip/Count Statistical Summary

Statistical Parameter	Value	Comments
Mean	8.34	Only the 1-mm rain sensors were included in the analysis
Median	8	Only the 1-mm rain sensors were included in the analysis
Standard deviation	5.05	Only the 1-mm rain sensors were included in the analysis
Mean plus three standard deviations	23.5	Only the 1-mm rain sensors were included in the analysis
Mean minus two standard deviations	0	Only the 1-mm rain sensors were included in the analysis
Minimum total count	1	7 Stations
Maximum total count	21	Justice Center (4360)
Sensors showing NO rain for the month		None
Sensors greater than 3 SD (over reporting)	0	

B. Monthly Average Tip/Count Summary

A monthly summary of the District-wide mean total tip/count is presented (Table 10).

Table 10. 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
2016	4.68	9.91	32.30	52.10	49.40	40.50	24.20	31.00	8.86	7.51	8.56	8.74	23.23
2017	13.3	5.84	27.70	39.10	99.60	15.33	40.80	44.58	40.74	31.88	7.38	5.35	31.13
2018	4.70	8.34											
Ave	6.66	9.95	18.67	40.48	60.96	32.83	52.11	35.68	41.48	26.03	8.03	7.74	28.32

*- 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

No sensors experienced a large jump in the sequential tip count (Table 11).

Table 11. Sensors with a Jump of 6 or More in Sequential Count

Sensor Description	Sensor ID	Comment
Pine Cliff Road	2810	All >6 tips were breaks in the data
Sunset	4240	All >6 tips were breaks in the data

D. Sensor-by-Sensor Incrementing Count Summary

The system-wide reception rate of incrementing, 1-mm tip reports for the month was approximately 96 percent. A total of 755 incrementing reports were received and a total of 792 reports were expected. The total loss of incrementing reports for the month was approximately 5 percent. Those sensors with the worst event transmission performance are summarized (Table 12).

Table 12. Monthly Summary of Sensors with the Worst Performance

Jan*	Feb*	Mar*	Apr	May	Jun	Jul	Aug	Sep	Oct*	Nov*	Dec*
1700	2810										
2980	1110										
4790	540										
4320	2330										
3010	4330										
3030	3020										

*-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 13).

Table 13. Summary of Unknown IDs

Description	Concentrator	Legacy	A2
Total number of unknown IDs (IDs without a device definition)	247	198	0
Total reports from unknown IDs	771	680	0
Unknown IDs with only a single received report (potential noise)	132	117	0
Total reports from all IDs – RecData Log entire month	328,399	170,938	474,112
Unknown reports as a fraction of total reports	0.23%	0.40%	0.00%

The total number of reports from unknown sensors is very small relative to the total reports received for the month. Shown below (Table 14) are the total reports received from unknown sensor IDs for each month of the year.

Table 14. 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
2016	323	1,241	3,085	3,586	1,268	945	1,408	2,029	1,413	753	617	879
2017	11,875	844	1,207	3,700	2,693	642	610	6,678	780	5,097	3,532	3,282
2018	788	771										

The fraction of reports from unknown sensors relative to the total number of reports is shown below (Table 15).

Table 15. 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%
2016	0.10%	0.30%	0.69%	0.82%	0.28%	0.22%	0.33%	0.50%	0.36%	0.18%	0.17%	0.22%
2017	3.29%	0.23%	0.31%	0.97%	0.58%	0.16%	0.16%	1.16%	0.21%	1.40%	0.96%	0.87%
2018	0.21%	0.23%										

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 16).

Table 16. Reports Received by Unknown IDs

Concentrator		Legacy ALERT		Comment
Unknown ID	Reports	Unknown ID	Reports	
		0,1,2	55,55,113	Legacy reports for IDs 0,1,2 only
3044	45			E Cherry Creek at Russellville possibly sending invalid ID
3047	40			E Cherry Creek at Russellville possibly sending invalid ID
3071	33			Newlin Gulch at Jordan Rd possibly sending invalid ID
1470	15	1470	15	Urban Farm possibly sending invalid ID

V. Sensors with Invalid Reports

The sensors below (Table 17 and Table 18) 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 17. Rain Sensors with the Most Invalid Reports

Sensor ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1530-Bear Cr. At Lowell	10	5										
630-Temple Pond DTC	--	--										
1100-Louisville Rec Ctr	--	--										
2810-Pine Cliff Rd.	14	10										
2880-Happy Canyon	--	--										
3010-Wx-EPC @ 105	3	5										
3050-E/W Trailhead	7	12										
4030-Red Garden	--	3										
4330-Hansen	--	3										
4240-Sunset	1	4										
4790-Wx-Button Rock	--	--										

Table 18. Level Sensors with the Most Invalid Reports

Sensor ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
413-Kelly Dam	--	--										
403-Montview Park	1171*	766*										
213-Leyden Confluence	--	--										
723-WTG above Conf Pond	--	--										
1483-Third Creek at DIA	--	--										
1523-Marston Lake North	9	7										
1649-SPR at 19 th Street	--	--										
2223-Evergreen Lake	--	--										
2273-Cub Cr below Blue	--	--										
2803-Columbine Open Space	--	--										
2813-Pine Cliff Road	15	13										
3013-EPC@Hwy 105	18	20										
4383-Eldorado Springs	--	4										
4593-Green Ditch	--	--										

*-Montview Park (403) All data values are marked as questionable data values because they exceeded an allowable upper boundary. Kate Malers developed a new rating for this site which needs to be incorporated into both NovaStar5 and Contrail in 2018.

VI. Stations and Sensors Out of Service on the Base Station

The following stations are currently out of service on the NovaStar5 base station.

-) 2880 – Happy Canyon at North Surrey Drive
-) 1330 – Roslyn DN

The following sensors are currently out of service on the NovaStar5 base station.

-) 403 – Montview Park Water Level PT
-) 746 – Quincy Reservoir Handar 585 ALARM Status

VII. Rainfall Alarms and Intensity Analysis

No rainfall rate alarms from the Urban Drainage and Flood Control District NovaStar 5.0 Web Server were identified this month.

General System Analysis

Database Name P:\A207-UDFCD-Data-Analysis\2018\02-2018\2018Feb.mdb

Summarize

First Date in Database	2/1/18 12:00 AM	Total Days	28.0
Last Date in Database	3/1/18 12:00 AM	Total Hours	672.0

Total Records Analyzed 973,449

Records by Group	Legacy	%	Concentrator	%	ALERT	%
Wind Data	68,815	40%	147,006	45%	184,095	39%
Temperature	27,202	16%	56,375	17%	73,910	16%
Relative Humidity	27,031	16%	50,481	15%	70,094	15%
Barometric Pressure	14,083	8%	23,598	7%	570	0%
Battery Voltage	5,637	3%	15,519	5%	39,887	8%
Water Level	4,784	3%	5,666	2%	25,744	5%
Fuel Temperature	4,689	3%	5,427	2%	0	0%
Fuel Moisture	4,669	3%	5,426	2%	0	0%
Precipitation	4,180	2%	5,502	2%	18,371	4%
Solar Radiation	3,758	2%	4,706	1%	37,178	8%
Soil Moisture	2,005	1%	2,691	1%	0	0%
Repeater Status Report	1,963	1%	1,804	1%	0	0%
Unknown	680	0%	771	0%	0	0%
ET-Hourly	664	0%	665	0%	0	0%
Repeater Pass List	502	0%	63	0%	0	0%
12Hr Status Report	102	0%	121	0%	0	0%
Water Temp	81	0%	112	0%	0	0%
Not Used	45	0%	51	0%	0	0%
ET-Daily	27	0%	27	0%	0	0%
Solar Power	19	0%	18	0%	0	0%
Handar 585 ALARM Status	2	0%	2	0%	0	0%
Hayman Battery	0	0%	2,200	1%	0	0%
GPS Lock	0	0%	168	0%	19,296	4%
Dew Point Temperature	0	0%	0	0%	4,967	1%
Total	170,938	100%	328,399	100%	474,112	100%

Traffic Loading Summary	Legacy	Concentrator	ALERT
Alert Reports	170,938	328,399	474,104
Average Daily Traffic	6,105	11,324	16,348
Average Hourly Traffic	254	472	681
Median Hourly Traffic	277	484	728
Peak Hourly Traffic	399	711	947
2nd Max	376	682	939
3rd Max	373	673	939
4th Max	372	666	938
5th Max	371	663	935
		hour beginning	hour beginning
		Feb 24, 10:00 AM	Feb 14, 1:00 PM
		Feb 13, 10:00 PM	Feb 14, 2:00 PM
		Feb 25, 1:00 PM	Feb 18, 1:00 PM
		Feb 24, 11:00 AM	Feb 14, 11:00 AM
		Feb 16, 9:00 PM	Feb 14, 12:00 PM
			Feb 20, 11:00 AM
			Feb 20, 9:00 AM
			Feb 20, 12:00 PM
			Feb 20, 10:00 AM
			Feb 20, 2:00 PM

Rain Timer Performance

Analyze Rain Sensors

0.50

0.915

Rain Sensors	Description	Rcv	Timer	Exp	Performance
2790	Wx-W. Cherry Creek	9	18:00	56	16%
3020	Wx-West Creek WX	321	1:00	672	48%
1110	Gunbarrel	29	12:09	56	52%
3010	WX-EPC at Hwy 105	29	18:15	56	52%
1660	SPR at Henderson	34	18:53	56	61%
4550	Boulder Jail	35	12:39	56	63%
2980	Dakan Rd	36	17:48	56	64%
5720	Four Mile Creek	36	17:27	56	64%
2330	Morrison	38	14:42	56	68%
5940	Log Jumper	40	16:32	56	71%
100260	Wx-A2-Trumbull (Hayman) - Precip	501	1:00	672	75%
4330	Hansen Rain	43	13:39	56	77%
4270	Cannon Mountain	44	13:08	56	79%
4240	Sunset	45	12:35	56	80%
4510	Pinewood Springs	46	12:17	56	82%
5810	Stump Bump	48	13:57	56	86%
5860	Cedar Mountain	48	13:52	56	86%
3030	WX-Bingham Lake Park	49	13:09	56	88%
2750	Wx-Castle Rock	50	12:19	56	89%
400	Montview Park	51	12:48	56	91%
1420	Wx-A2-Diamond Hill	51	13:02	56	91%
1520	Wx-Marston Lake North	51	12:31	56	91%
2710	Wx-Highlands Ranch WTP	51	12:59	56	91%
4340	Riverside	51	13:03	56	91%
4490	Apple Valley	51	13:04	56	91%
5880	Hackett Mountain	51	12:58	56	91%
750	Wx-Quincy Reservoir	52	12:45	56	93%
2990	Wx-Tomah Rd-DougCnty	52	12:47	56	93%
4100	Filter Plant	52	12:46	56	93%
5740	Trail Creek	52	12:43	56	93%
100200	Wx-A2-OneRain Weather - Precipitation	52	12:00	56	93%
100300	A2-CoalCreek at McCaslin - Precip	629	1:00	672	94%
1000	A2-Maple Grove Resv.	632	1:00	672	94%
100290	A2-PlumCr at Sedalia - Precip	632	1:00	672	94%
100410	A2-Brantner Gulch - Precip	632	1:00	672	94%
100420	A2-Thorncreek - Precip	634	1:00	672	94%
1440	Wx-Elbert	53	12:27	56	95%
1570	Wx-Brighton Ditch	53	12:27	56	95%
2320	Choke Cherry Resvr	53	11:44	56	95%
4030	Red Garden	53	11:44	56	95%
4300	Big Elk Park	53	12:25	56	95%
4360	Justice Center	53	11:21	56	95%
4770	Wx-Cal-Wood Ranch	53	12:30	56	95%
4790	Wx-Button Rock	53	12:14	56	95%
4870	SBC @ SB Road	53	12:31	56	95%
5730	West Creek	53	12:28	56	95%
100500	Upper Coal Creek at Camp Eden Rd - Precipitation	637	1:00	672	95%
4850	Porphory Mtn	640	1:00	672	95%
920	Wx-Aurora Town Hall	54	12:13	56	96%
1640	SPR at Union Ave.	54	11:57	56	96%
1700	Cherry Cr @ Champa	54	12:14	56	96%
1920	Wx-Brighton	54	12:14	56	96%
4040	Martin Gulch	54	11:21	56	96%
4050	Walker Ranch	54	12:10	56	96%

4190	Slaughterhouse	54	11:25	56	96%
4200	Lazy Acres	54	12:28	56	96%
4250	Geer Canyon	54	11:09	56	96%
4570	St. Antons	54	12:01	56	96%
1460	Wx-Urban Farm	55	12:00	56	98%
2930	Wx-Spring Valley Rd-DougCnty	55	12:03	56	98%
4010	Crescent	55	11:59	56	98%
4020	Rio Grande	55	11:42	56	98%
4070	Bear Peak	55	11:16	56	98%
4090	Magnolia	55	11:57	56	98%
4160	Sunshine	55	11:58	56	98%
4220	Fling's	55	11:58	56	98%
4230	Golden Age	55	11:58	56	98%
4320	Lee Hill Rain 2012	55	11:58	56	98%
200	Leyden Reservoir	56	11:57	56	100%
970	Pump Sta 3	56	11:46	56	100%
4080	Twin Sisters	56	11:43	56	100%
4180	Gold Lake	56	11:42	56	100%
4260	Taylor Mountain	56	11:58	56	100%
4310	Johnny Park	56	10:46	56	100%
4520	Eagle Ridge	56	11:33	56	100%
4830	SBC @ San Souci	56	11:32	56	100%
140	Wx-Blue Mountain	57	10:51	56	100%
700	Toll Gate @ 6th	57	11:32	56	100%
2730	Wx-Salisbury Park	57	11:12	56	100%
4060	Lakeshore	57	11:04	56	100%
4130	Swiss Peaks	57	11:42	56	100%
4170	Pine Brook	57	10:43	56	100%
4290	Red Hill	57	10:26	56	100%
4350	Conifer Hill	57	11:38	56	100%
4530	Winiger Ridge	57	10:48	56	100%
4750	Wx-Louisville Lake	57	11:33	56	100%
4880	Whispering Pines	57	11:29	56	100%
100270	Wx-A2-WestCreek (Hayman) - Precip	57	1:00	56	100%
4110	Betasso	58	11:23	56	100%
4140	Logan Mill	58	10:40	56	100%
4150	Gold Hill	58	10:42	56	100%
4860	Fairview Peak	58	11:07	56	100%
4710	Wx-Ward C-1	59	10:43	56	100%
4730	Wx-Sugarloaf	59	10:31	56	100%
4820	Doudy Draw	59	11:04	56	100%
4840	SBC@S Boulder Ditch	59	11:05	56	100%
4810	Shanahan Ridge	60	10:29	56	100%
2210	Wx-Hiwan G.C.	62	9:58	56	100%
6601	Wx-A2-Magnolia WX-Precip	90	7:16	84	100%

Rain Event Performance	Reports Received	Reports Received	755	Analyze Rain Sensors							<<show stations with zero rain (1=yes, 0=no)							
	Systemwide Avg	Total Tips	792															
	95.87%	Data Loss	4.67%															
Description	Sensor	Performance	1-tips	2-tips	3-tips	4-tips	5-tips	6-tips	>6-tips	Rcv	Exp	Miss	Hold	Bucket				
Pine Cliff Road	2810	50%	1	1	1	0	0	0	1	3	6	3	0	0.0393701				
Gunbarrel	1110	60%	4	1	0	1	0	0	0	6	10	4	0	0.0393701	Mean	8.337		
Parker/Mississippi	540	67%	1	1	0	0	0	0	0	2	3	1	0	0.0393701	Median	8		
Morrison	2330	73%	6	1	1	0	0	0	0	8	11	3	0	0.0393701	St. Dev	5.05		
Hansen Rain	4330	73%	6	1	1	0	0	0	0	8	11	3	0	0.0393701	Mean plus 3 SD	23.49		
Wx-West Creek WX	3020	75%	2	1	0	0	0	0	0	3	4	1	0	0.0393701	Mean minus 2 SD	0		
Rio Grande	4020	80%	3	1	0	0	0	0	0	4	5	1	0	0.0393701	Min	1		
Sunset	4240	83%	9	0	1	0	0	0	1	10	12	2	0	0.0393701	Max	21		
Wx-A2-Trumbull (Hayman) - Precip	100260	83%	4	1	0	0	0	0	0	5	6	1	0	0.0393701		7		
Pinewood Springs	4510	84%	14	1	1	0	0	0	0	16	19	3	0	0.0393701				
Red Garden	4030	86%	5	1	0	0	0	0	0	6	7	1	0	0.0393701				
Martin Gulch	4040	87%	12	0	1	0	0	0	0	13	15	2	0	0.0393701				
Wx-Blue Mountain	140	88%	6	1	0	0	0	0	0	7	8	1	0	0.0393701				
Dakan Rd	2980	88%	6	1	0	0	0	0	0	7	8	1	0	0.0393701				
Wx-Button Rock	4790	88%	6	1	0	0	0	0	0	7	8	1	0	0.0393701				
Johnny Park	4310	88%	14	0	1	0	0	0	0	15	17	2	0	0.0393701				
WX-EPC at Hwy 105	3010	89%	7	1	0	0	0	0	0	8	9	1	0	0.0393701				
Choke Cherry Resvr	2320	92%	10	1	0	0	0	0	0	11	12	1	0	0.0393701				
Geer Canyon	4250	93%	13	1	0	0	0	0	0	14	15	1	0	0.0393701				
SBC @ SB Road	4870	93%	13	1	0	0	0	0	0	14	15	1	0	0.0393701				
Slaughterhouse	4190	94%	15	1	0	0	0	0	0	16	17	1	0	0.0393701				
Betasso	4110	95%	17	1	0	0	0	0	0	18	19	1	0	0.0393701				
Justice Center	4360	95%	19	1	0	0	0	0	0	20	21	1	0	0.0393701				
Leyden Reservoir	200	100%	12	0	0	0	0	0	0	12	12	0	0	0.0393701				
Montview Park	400	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701				
Virginia Court	510	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701				
Fire Station #19	530	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701				
Toll Gate @ 6th	700	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701				
Wx-Quincy Reservoir	750	100%	6	0	0	0	0	0	0	6	6	0	0	0.0393701				
Mission Viejo Park	760	100%	6	0	0	0	0	0	0	6	6	0	0	0.0393701				
Side Creek Park	830	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701				
Flying J	850	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701				
Wx-Aurora Town Hall	920	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701				
A2-Maple Grove Resv.	1000	100%	19	0	0	0	0	0	0	19	19	0	1	0.0393701				
Denver Zoo	1360	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701				
Wx-A2-Diamond Hill	1420	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701				
Wx-Urban Farm	1460	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701				
Wx-Marston Lake North	1520	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701				
SPR at Union Ave.	1640	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701				
Cherry Cr @ Champa	1700	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701				
Wx-Brighton	1920	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701				
Wx-Hiwan G.C.	2210	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701				
Wx-Salisbury Park	2730	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701				
Wx-Castle Rock	2750	100%	4	0	0	0	0	0	0	4	4	0	0	0.0393701				
Wx-Spring Valley Rd-DougCnty	2930	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701				
Wx-Tomah Rd-DougCnty	2990	100%	12	0	0	0	0	0	0	12	12	0	0	0.0393701				
WX-Bingham Lake Park	3030	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701				
Crescent	4010	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701				
Walker Ranch	4050	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701				
Lakeshore	4060	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701				
Bear Peak	4070	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701				
Twin Sisters	4080	100%	4	0	0	0	0	0	0	4	4	0	0	0.0393701				
Magnolia	4090	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701				
Filter Plant	4100	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701				
Swiss Peaks	4130	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701				
Logan Mill	4140	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701				
Gold Hill	4150	100%	13	0	0	0	0	0	0	13	13	0	0	0.0393701				

Sunshine	4160	100%	4	0	0	0	0	0	0	4	4	0	0	0.0393701
Pine Brook	4170	100%	13	0	0	0	0	0	0	13	13	0	0	0.0393701
Gold Lake	4180	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701
Lazy Acres	4200	100%	14	0	0	0	0	0	0	14	14	0	0	0.0393701
Fling's	4220	100%	18	0	0	0	0	0	0	18	18	0	0	0.0393701
Golden Age	4230	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701
Taylor Mountain	4260	100%	11	0	0	0	0	0	0	11	11	0	0	0.0393701
Cannon Mountain	4270	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701
Red Hill	4290	100%	17	0	0	0	0	0	0	17	17	0	0	0.0393701
Big Elk Park	4300	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701
Lee Hill Rain 2012	4320	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701
Riverside	4340	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701
Conifer Hill	4350	100%	11	0	0	0	0	0	0	11	11	0	0	0.0393701
Apple Valley	4490	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701
Eagle Ridge	4520	100%	11	0	0	0	0	0	0	11	11	0	0	0.0393701
Winiger Ridge	4530	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701
Boulder Jail	4550	100%	15	0	0	0	0	0	0	15	15	0	0	0.0393701
St. Antons	4570	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701
Wx-Ward C-1	4710	100%	14	0	0	0	0	0	0	14	14	0	0	0.0393701
Wx-Sugarloaf	4730	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701
Wx-Louisville Lake	4750	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701
Wx-Cal-Wood Ranch	4770	100%	6	0	0	0	0	0	0	6	6	0	0	0.0393701
Shanahan Ridge	4810	100%	14	0	0	0	0	0	0	14	14	0	0	0.0393701
Doudy Draw	4820	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701
SBC @ San Souci	4830	100%	11	0	0	0	0	0	0	11	11	0	0	0.0393701
SBC@S Boulder Ditch	4840	100%	14	0	0	0	0	0	0	14	14	0	0	0.0393701
Whispering Pines	4880	100%	13	0	0	0	0	0	0	13	13	0	0	0.0393701
Four Mile Creek	5720	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701
West Creek	5730	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701
Trail Creek	5740	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701
Stump Bump	5810	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701
Cedar Mountain	5860	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701
Hackett Mountain	5880	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701
Log Jumper	5940	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701
A2-Blackstone Precip	100100	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701
A2-PlumCr at Sedalia - Precip	100290	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701
A2-CoalCreek at McCaslin - Precip	100300	100%	16	0	0	0	0	0	0	16	16	0	0	0.0393701
Upper Coal Creek at Camp Eden Rd - Precipitation	100500	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701
		Total Tips	727	20	7	1	0	0						
Porphory Mtn	4850	100%	10	0	0	0	0	0	0	10	10	0	0	0.01
Fairview Peak	4860	100%	6	0	0	0	0	0	0	6	6	0	0	0.01
Wx-A2-Magnolia WX-Precip	6601	100%	28	0	0	0	0	0	0	28	28	0	0	0.01
Wx-A2-OneRain Weather - Precipitation	100200	89%	23	0	0	1	0	0	0	24	27	3	0	0.01

2018 Monthly Peak Hour ALERT Radio Traffic Summary

