

Memo

Date: May 2, 2012
To: Kevin Stewart
From: Markus Ritsch
Subject: April 2012 ALERT Data Analysis

I. ALERT Data Source

Raw ALERT data records extracted from the Urban Drainage and Flood Control District's NovaStar 5.0 base station were analyzed for the period April 1 through April 30, 2012.

II. General System Analysis Summary

A total of 378,331 legacy ALERT data reports were analyzed. Meteorological sensors account for 78 percent, water level sensors 7 percent, and rain sensors 4 percent of the total monthly records.

The system-wide radio traffic loading was 12,611 reports per day with an average hourly loading of 525 reports. The peak hour of radio traffic loading was 1,058 reports, which occurred on April 11th, between 11:00 PM and 11:59 PM. A plot of monthly average and peak hourly traffic loading is provided.

A. Specific Issues Identified this Month

Performance of the following sensors (Table 1) was questionable this month.

Table 1. Rain Sensors with Poor Performance Characteristics

Rain ID	Description	Timer	Event	Comments
900	Wx-Aurora Reservoir	152%	100%	Many duplicate timer reports
2890	Spruce Mt – DC	22%	0%	This site was fixed by WET on 4/27/2012
1383	Ferril Lake	n/a	n/a	The current reference level on NS5 seems wrong for this sensor
4490	Apple Valley	65%	64%	Poor timer and event performance in general
1640/1643	SPR at Union Ave.	35%	92%	Stage reports have intermittent 0 values resulting in invalid data
2270	Cub Cr. Below Blue	58%	94%	
2970	Rampart Range Road	58%	100%	Problems with Sutron database connection to NS5
2980	Dakan Road	97%	65%	Poor event performance
121	Unknown sensor IDs with excessive reports. These IDs came from station 120, West Woods. The invalid IDs all started reporting on 4/2/12 at 10:59:09 AM and they stopped reporting on 4/3/12 at 10:06:48 AM.			
122				
124				
127, 128				

B. Continuous Operation of Base Receiver/Decoder

The ALERT and ALERT2 data feeds on the NS5 base computer were in continuous operation for the entire month.

III. Rain Sensor Timer Reporting Summary

The following analysis assumes that each rain sensor has a 12-hour timer-reporting interval. The worst performing rain sensors for the month are summarized (Table 2).

Table 2. Monthly Summary of Sensors with Poor Timer Performance (Sensor ID)

Jan*	Feb*	Mar*	Apr	May	Jun	Jul	Aug	Sep	Oct*	Nov*	Dec*
2320	4550	4270	2890								
1460	1460	4870	1640								
1520	4470	4790	2270								
1440	1520	4850	2970								
1000	1440	4570	4490								
4520	140	4070	3010								

*. 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.

IV. 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 3). 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 3. District-Wide Total Tip/Count Statistical Summary

Statistical Parameter	Value	Comments
Mean	30.17	Only the 1-mm rain sensors were included in the analysis
Median	30	Only the 1-mm rain sensors were included in the analysis
Standard deviation	7.70	Only the 1-mm rain sensors were included in the analysis
Mean plus three standard deviations	53.29	Only the 1-mm rain sensors were included in the analysis
Minimum total count	0	ID 2190 (Squaw Mountain) – No Rain!
Maximum total count	52	ID 2910 (East Cherry Creek – Douglas County)

B. Monthly Average Tip/Count Summary

A monthly summary of the District-wide mean total tip/count is presented (Table 4).

Table 4. 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									

*- 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 5).

Table 5. Sensors with a Jump of 6 or More in Sequential Count

Sensor Description	Sensor ID	Comment
Choke Cherry Reservoir	2320	Bad decode on 4/15/2012 12:26:14 PM
SBC @ SB Road	4870	Bad decode on 4/30/2012 10:28:24 PM
Broomfield 3207	1200	Likely field calibration jump on 4/4/2012 1:34:22 PM
EPC at Hwy 105	3010	This station experienced numerous reporting problems for the entire month!

D. Sensor-by-Sensor Incrementing Count Summary

The system-wide reception rate of incrementing, 1-mm tip reports for the month was approximately 95 percent. A total of 5,401 incrementing reports were received and a total of 5,692 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 6).

Table 6. Monthly Summary of Sensors with the Most Missed Tips

Jan*	Feb*	Mar*	Apr	May	Jun	Jul	Aug	Sep	Oct*	Nov*	Dec*
1700	2980	2710	4490								
1420	3030	4860	2980								
4490	4240	2930	1660								
2980	1520	3030	3010								
1660	4490	2990	2320								
4090	1420	4050	4470								

*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.

V. Heavy Radio Traffic Analysis

Periods exceeding 700 messages per hour are analyzed independently in an attempt to quantify data loss rates from rain sensors using their sequential tip count series.

A. The Heaviest Hourly Traffic Periods This Month

The hourly periods of highest radio traffic this month are shown (Table 7). Each hour exceeding 700 reports was analyzed to quantify the number of missing rain reports for that hour.

Table 7. Heavy Radio Traffic Periods

Day	Hr	Expected Tips	Received Tips	Total Load	Loss
11	23	250	250	1058	0
14	23	162	162	1044	0
15	0	89	89	992	0
26	21	232	229	949	1.29%
3	14	127	127	934	0
4	11	298	286	824	4.02%
15	10	109	104	817	4.58%
4	12	233	229	754	1.72%
11	22	104	91	722	12.50%

VI. 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 8).

Table 8. Summary of Unknown IDs

Description	Quantity
Total number of unknown IDs (IDs without a device definition)	427
Total reports from unknown IDs	977
Unknown IDs with only a single received report (potential noise)	280
Total reports from all IDs – RecData Log entire month	378,331
Unknown reports as a fraction of total reports	0.26%

The total number of reports from unknown sensors is very small relative to the total reports received for the month. Shown below (Table 9) are the total reports received from unknown sensor IDs for each month of the year.

Table 9. Monthly Summary of Total Reports from Unknown IDs

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								

The fraction of reports from unknown sensors relative to the total number of reports is shown below (Table 10).

Table 10. Monthly Percent of Unknown Sensor Reports

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%								

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 11).

Table 11. Reports Received by Unknown IDs

Unknown ID	Total Reports
121	42
122	41
124	32
127	26
1423	23
128	21
4323	21
4321	19
1934	15
1919	13
1631	11
1534	10
1933	8
1470	7
1926	7
1953	7
2768	7
4269	7

The “unknown” device reports are analyzed temporally to understand when they are received during the day (Table 12). The goal of this analysis is to determine a pattern of occurrence that may correspond to a source of noise in the system, such as the use of a wireless microphone nearby.

Table 12. Temporal Distribution of Received Reports

Hour (AM)	Reports	Hour (PM)	Reports
0:00-00:59	63	12:00-12:59	58
1:00-1:59	30	1:00-1:59	31
2:00-2:59	49	2:00-2:59	48
3:00-3:59	60	3:00-3:59	28
4:00-4:59	89	4:00-4:59	25
5:00-5:59	48	5:00-5:59	33
6:00-6:59	49	6:00-6:59	72
7:00-7:59	27	7:00-7:59	73
8:00-8:59	103	8:00-8:59	42
9:00-9:59	96	9:00-9:59	32
10:00-10:59	102	10:00-10:59	39
11:00-11:59	102	11:00-11:59	72

VII. Sensors with Invalid Reports

The following sensors had a large number of invalid reports (bit flip/contention errors/random decode):

Sensor	Description	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1643	SPR at Union Ave. (level)	43	16								
1383	Ferril Lake (level) – bad calibration		81								
123	West Woods (level) – fixed on 4/24/12		30								
2813	Pine Cliff Road (level)		9								
4840	SBC@S Boulder Ditch (Px)	3	3								
900	Wx-Aurora Reservoir (Px) – bad decodes		8								
4090	Magnolia (Px)		4								
4310	Johnny Park (Px)		5								

VIII. 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.

Urban Drainage and Flood Control District
ALERT Web Server

4150	Gold Hill Precipitation-BO	FMC-BA 0.25" in 1 Hour Rainfall	04/04/2012 12:57:57	Edit
4080	Twin Sisters Precipitation-BO	FMC-BA 0.25" in 1 Hour Rainfall	04/04/2012 12:12:19	Edit
4180	Gold Lake Precipitation-BO	FMC-BA 0.25" in 1 Hour Rainfall	04/04/2012 12:09:57	Edit
4170	Pine Brook Precipitation-BO	FMC-BA 0.25" in 1 Hour Rainfall	04/04/2012 12:04:11	Edit
4730	Sugarloaf Precipitation-BO	FMC-BA 0.25" in 1 Hour Rainfall	04/04/2012 11:57:35	Edit
4850	Porphyry Mountain Precipitation-BO	FMC-BA 0.25" in 1 Hour Rainfall	04/04/2012 11:55:03	Edit

4160	Sunshine Precipitation-BO	FMC-BA 0.25" in 1 Hour Rainfall	04/15/2012 13:47:49	Edit
4090	Magnolia Precipitation-BO	FMC-BA 0.25" in 1 Hour Rainfall	04/15/2012 14:03:09	Edit
4150	Gold Hill Precipitation-BO	FMC-BA 0.25" in 1 Hour Rainfall	04/15/2012 14:16:13	Edit
4090	Magnolia Precipitation-BO	FMC-BA 0.25" in 1 Hour Rainfall	04/04/2012 11:52:06	Edit
4130	Swiss Peaks Precipitation-BO	FMC-BA 0.25" in 1 Hour Rainfall	04/04/2012 11:47:38	Edit
4160	Sunshine Precipitation-BO	FMC-BA 0.25" in 1 Hour Rainfall	04/04/2012 11:45:05	Edit
4140	Logan Mill Precipitation-BO	FMC-BA 0.25" in 1 Hour Rainfall	04/04/2012 11:40:37	Edit
4200	Lazy Acres Precipitation-BO	FMC-BA 0.25" in 1 Hour Rainfall	04/04/2012 11:39:50	Edit
4110	Betasso Precipitation-BO	FMC-BA 0.25" in 1 Hour Rainfall	04/04/2012 11:39:12	Edit
4190	Slaughterhouse Precipitation-BO	FMC-BA 0.25" in 1 Hour Rainfall	04/04/2012 11:37:27	Edit
4100	Filter Plant Precipitation-BO	FMC-BA 0.25" in 1 Hour Rainfall	04/04/2012 11:07:28	Edit
4240	Sunset Precipitation-BO	FMC-BA 0.25" in 1 Hour Rainfall	04/04/2012 10:51:07	Edit
4230	Golden Age Precipitation-BO	FMC-BA 0.25" in 1 Hour Rainfall	04/04/2012 10:25:25	Edit
4850	Porphyry Mountain Precipitation-BO	FMC-BA 0.50" in 1 Hour Rainfall	04/04/2012 12:15:27	

General System Analysis

Database Name P:\A207-UDFCD-Data-Analysis\2012\04-2012\Novastar_extract_2012Apr.mdb

First Date in Database	4/1/12 12:00 AM	Total Days	30.0
Last Date in Database	4/30/12 11:59 PM	Total Hours	720.0

Total Records Analyzed 378,331

Records by Group

Wind Gust	63,266	17%
Temperature	63,052	17%
Relative Humidity	59,609	16%
Barometric Pressure	30,209	8%
Wind Speed Average & Azimuth	28,533	8%
Water Level	25,827	7%
Battery Voltage	21,348	6%
Wind Direction	20,586	5%
Wind Speed Average	20,105	5%
Precipitation	16,179	4%
Solar Radiation	9,093	2%
Fuel Moisture	5,688	2%
Fuel Temperature	5,685	2%
Soil Moisture	2,621	1%
Repeater Status Report	2,435	1%
Wind ALERT	1,784	0%
Unknown	977	0%
Repeater Pass List	593	0%
12Hr Status Report	478	0%
Hayman Battery	134	0%
Handar 585 ALARM Status	95	0%
Wind Direction ALERT	19	0%
Solar Power	12	0%
ALERT/A2 Testing	2	0%
Longmont Flow Gage	1	0%
Total	378,331	

Records by Major Group

Meteorologic Sensors	294,453	78%
Water Level Sensors	25,828	7%
Rain Sensors	16,179	4%
Soil and Fuel Sensors	13,994	4%
Sensor Status Transmissions	3,613	1%
Total	354,067	

Traffic Loading Summary

Alert Reports	378,331	
Average Daily Traffic	12,611	
Average Hourly Traffic	525	
Median Hourly Traffic	519	hour beginning
Peak Hourly Traffic	1,058	Apr 11, 11:00 PM
2nd Max	1,044	Apr 14, 11:00 PM
3rd Max	992	Apr 15, 12:00 AM
4th Max	949	Apr 26, 9:00 PM
5th Max	934	Apr 3, 2:00 PM

Rain Timer Performance

Analyze Rain Sensors

Rain ID	Description	Rcv	Timer	Exp	Performance
2890	Spruce Mt - Douglas	13	6:30	60	22%
1640	SPR at Union Ave.	21	12:42	60	35%
2270	Cub Cr below Blue	35	19:34	60	58%
2970	Rampart Range Rd	35	12:00	60	58%
4490	Apple Valley	39	17:26	60	65%
3010	EPC at Hwy 105	41	12:00	60	68%
2230	Bear Cr below Cub	44	17:34	60	73%
2320	Choke Cherry Resvr	45	15:36	60	75%
4870	SBC @ SB Road	45	14:06	60	75%
4270	Cannon Mountain	47	13:30	60	78%
1900	Niver Detention	49	12:13	60	82%
4470	Little Narrows	49	13:06	60	82%
4510	Pinewood Springs	50	13:21	60	83%
1660	SPR at Henderson	51	13:02	60	85%
4330	Hansen Rain	51	12:49	60	85%
4020	Rio Grande	53	11:58	60	88%
1710	Shop Creek	54	13:02	60	90%
3050	East/West Trailhead	55	12:30	60	92%
4750	Wx-Louisville Lake	55	12:00	60	92%
4820	Doudy Draw	55	12:44	60	92%
2940	Willow Creek - DougCnty	56	12:30	60	93%
540	Parker/Mississippi	57	11:57	60	95%
2950	DC Public Works	57	12:00	60	95%
3080	Tallman Gulch	57	11:31	60	95%
3090	Highland Heritage Park	57	12:00	60	95%
4290	Red Hill	57	11:58	60	95%
110	Ralston Reservoir	58	11:58	60	97%
400	Montview Park	58	11:58	60	97%
420	Expo Park	58	11:58	60	97%
510	Virginia Court	58	11:57	60	97%
530	Fire Station #19	58	11:43	60	97%
800	Sable Ditch @ 18th	58	11:57	60	97%
1620	Slaughterhouse Glch	58	11:58	60	97%
2240	Cold Sprg Glch conf	58	11:49	60	97%
2250	Rosedale	58	11:43	60	97%
2280	Kinney Peak	58	11:33	60	97%
2980	Dakan Rd	58	11:29	60	97%
4190	Slaughterhouse	58	11:58	60	97%
4260	Taylor Mountain	58	12:12	60	97%
4300	Big Elk Park	58	12:27	60	97%
4570	St. Antons	58	11:45	60	97%
4790	Wx-Button Rock	58	10:37	60	97%
940	Sampson Gulch	59	11:43	60	98%
1030	NREL/S. Table Mtn.	59	11:44	60	98%
2330	Morrison	59	11:58	60	98%
2820	Haskins Gulch Conf	59	11:46	60	98%
2910	East Cherry Cr-Douglas	59	12:00	60	98%
3060	Fire Sta 47	59	12:00	60	98%
4110	Betasso	59	12:15	60	98%
4160	Sunshine	59	11:44	60	98%
4200	Lazy Acres	59	11:59	60	98%
4230	Golden Age	59	11:15	60	98%
4240	Sunset	59	11:43	60	98%
4310	Johnny Park	59	11:43	60	98%

330	Van Bibber @ Hwy 93	60	11:19	60	100%
520	Jewell Detention	60	11:44	60	100%
1100	Louisville Rec Ctr	60	11:19	60	100%
1330	Roslyn	60	11:46	60	100%
1350	Chatfield COE	60	11:32	60	100%
1720	Cherry Cr @ Steele	60	11:57	60	100%
1800	Sand Creek Park	60	11:31	60	100%
2260	Brook Forest	60	11:44	60	100%
2800	Columbine Open Space	60	11:07	60	100%
2850	Cherry Cr bl Bayou Glch	60	11:46	60	100%
2880	Happy Canyon at N Surrey Dr	60	11:20	60	100%
2960	Indian Creek	60	11:46	60	100%
3040	CC @ Prairie Canyon Ranch	60	11:46	60	100%
4030	Red Garden	60	11:45	60	100%
4040	Martin Gulch	60	11:42	60	100%
4060	Lakeshore	60	11:29	60	100%
4180	Gold Lake	60	11:14	60	100%
4220	Fling's	60	10:58	60	100%
4520	Eagle Ridge	60	11:33	60	100%
4530	Winiger Ridge	60	11:17	60	100%
4830	SBC @ San Souci	60	11:58	60	100%
4840	SBC@S Boulder Ditch	60	11:30	60	100%
410	Kelly Dam	61	11:58	60	102%
500	Havana Park	61	11:30	60	102%
600	Harvard Gulch Park	61	11:30	60	102%
620	Quincy/Highline	61	11:43	60	102%
720	Confluence Pond	61	11:29	60	102%
810	Granby Ditch @ 6th	61	11:17	60	102%
820	ETG @ Buckley	61	11:30	60	102%
870	Murphy Creek GC	61	11:31	60	102%
1040	Lena @ U.S. Hwy 6	61	11:40	60	102%
1460	Wx-Urban Farm	61	11:32	60	102%
1530	Bear Creek @ Lowell	61	11:29	60	102%
2730	Wx-Salisbury Park	61	11:05	60	102%
2840	Sulphur Gulch	61	11:31	60	102%
4010	Crescent	61	11:30	60	102%
4050	Walker Ranch	61	11:16	60	102%
4090	Magnolia	61	11:30	60	102%
4170	Pine Brook	61	11:33	60	102%
4250	Geer Canyon	61	11:30	60	102%
4340	Riverside	61	11:17	60	102%
4810	Shanahan Ridge	61	11:15	60	102%
430	Utah Park	62	11:26	60	103%
440	Fire Station #7	62	11:16	60	103%
650	Iliff Pond	62	11:18	60	103%
710	Horseshoe Park Drop	62	11:30	60	103%
730	No Name @ Quincy	62	11:16	60	103%
760	Mission Viejo Park	62	11:15	60	103%
840	Fire Station 12	62	11:20	60	103%
850	Flying J	62	11:07	60	103%
860	Sand Cr at Colfax	62	11:19	60	103%
1000	Maple Grove Resv.	62	11:04	60	103%
1050	Jeffco Fairgrounds	62	11:18	60	103%
1300	Hidden Lake	62	11:16	60	103%
1360	Denver Zoo	62	11:20	60	103%
1440	Wx-Elbert	62	11:07	60	103%
1810	Sand Creek at mouth	62	11:31	60	103%
2210	Wx-Hiwan G.C.	62	11:21	60	103%
2340	El Rancho	62	11:06	60	103%

2810	Pine Cliff Road	62	11:20	60	103%
2920	West Cherry Head-Douglas Cnty	62	11:17	60	103%
4070	Bear Peak	62	11:18	60	103%
4080	Twin Sisters	62	11:04	60	103%
4100	Filter Plant	62	11:20	60	103%
4350	Conifer Hill	62	11:31	60	103%
4360	Justice Center	62	11:26	60	103%
4550	Boulder Jail	62	11:18	60	103%
150	Nott Creek	63	10:53	60	105%
200	Leyden Reservoir	63	11:05	60	105%
300	Van Bibber Park	63	11:06	60	105%
310	Guy Hill Ranch	63	11:20	60	105%
320	Sports Complex	63	11:18	60	105%
700	Toll Gate @ 6th	63	10:50	60	105%
750	Wx-Quincy Reservoir	63	11:03	60	105%
830	Side Creek Park	63	10:52	60	105%
950	Piney at Liverpool	63	11:05	60	105%
1010	Denver West	63	11:04	60	105%
1060	Heritage Square	63	11:06	60	105%
1420	Wx-Diamond Hill	63	11:08	60	105%
1550	Lakewood CC	63	11:10	60	105%
1700	Cherry Cr @ Champa	63	11:10	60	105%
2190	Wx-Squaw Mountain	63	11:13	60	105%
2350	Idledale	63	11:18	60	105%
2370	Red Rocks Park	63	11:03	60	105%
2870	Cottonwood (Apache)	63	11:02	60	105%
2900	Russelville Gulch-Douglas	63	11:09	60	105%
3070	Newlin Gulch	63	10:54	60	105%
4130	Swiss Peaks	63	11:06	60	105%
4150	Gold Hill	63	11:04	60	105%
140	Wx-Blue Mountain	64	11:00	60	107%
220	Upper Leyden	64	10:52	60	107%
610	Harvard @ Jackson	64	10:50	60	107%
630	Temple Pond at DTC	64	10:43	60	107%
1110	Gunbarrel	64	10:32	60	107%
1320	SPR at 3rd Ave	64	11:07	60	107%
1340	Sanderson at Xavier	64	11:08	60	107%
1370	West Metro FS13	64	10:53	60	107%
1400	Upper Sloan Det.	64	11:06	60	107%
1480	Third Creek at DIA	64	10:53	60	107%
1500	Powers Park	64	11:00	60	107%
2860	CC at Stroh Rd	64	10:53	60	107%
4140	Logan Mill	64	11:03	60	107%
4860	Fairview Peak	64	11:06	60	107%
120	West Woods	65	10:50	60	108%
210	Leyden Confluence	65	10:51	60	108%
640	Goldsmith @ Eastman	65	11:14	60	108%
1310	LDC at 64th	65	10:41	60	108%
2310	Genesee Village	65	10:43	60	108%
2360	Indian Hills	65	10:42	60	108%
2710	Wx-Highlands Ranch WTP	65	10:40	60	108%
2930	Wx-Spring Valley Rd-DougCnty	65	10:31	60	108%
1200	Broomfield 3207	67	9:48	60	112%
1920	Wx-Brighton	68	10:00	60	113%
2750	Wx-Castle Rock	68	10:12	60	113%
4710	Wx-Ward C-1	68	9:41	60	113%
1600	Englewood Dam	69	10:12	60	115%
2990	Wx-Tomah Rd-DougCnty	69	10:03	60	115%
4770	Wx-Cal-Wood Ranch	69	9:50	60	115%

4850	Porphory Mtn	69	9:14	60	115%
3030	WX-Bingham Lake Park	70	9:52	60	117%
1520	Wx-Marston Lake North	72	9:36	60	120%
4730	Wx-Sugarloaf	76	8:46	60	127%
920	Wx-Aurora Town Hall	79	8:28	60	132%
970	Pump Sta 3	79	8:24	60	132%
1570	Wx-Brighton Ditch	79	8:31	60	132%
3020	Wx-West Creek WX	84	8:04	60	140%
900	Wx-Aurora Reservoir	91	7:10	60	152%
5720	Four Mile Creek	16	12:00	60	27%
5730	West Creek	26	9:54	60	43%
5740	Trail Creek	29	10:09	60	48%
5810	Stump Bump	31	9:51	60	52%
5860	Cedar Mountain	28	10:33	60	47%
5880	Hackett Mountain	28	10:34	60	47%
5940	Log Jumper	4	4:00	60	7%

Rain Event Performance			Reports Received	5,401	Analyze Rain Sensors											
		Systemwide Avg	Total Tips	5,692												
		94.89%	Data Loss	5.11%												
Description	Sensor	Performance	1-tips	2-tips	3-tips	4-tips	5-tips	6-tips	>6-tips	Rcv	Exp	Miss	Hold	Bucket		
Apple Valley	4490	64%	5	1	0	1	0	0	0	7	11	4	0	0.0393701		
Dakan Rd	2980	65%	33	15	2	0	1	1	0	52	80	28	0	0.0393701		
SPR at Henderson	1660	72%	10	2	0	1	0	0	0	13	18	5	0	0.0393701		
EPC at Hwy 105	3010	76%	75	8	1	2	0	0	1	86	113	16	0	0.0393701		0.01
Choke Cherry Resvr	2320	77%	24	0	0	0	0	0	1	24	31	0	0	0.0393701		
Little Narrows	4470	79%	12	2	1	0	0	0	0	15	19	4	0	0.0393701		
Red Hill	4290	81%	15	1	0	1	0	0	0	17	21	4	0	0.0393701		
SBC @ SB Road	4870	82%	22	4	1	0	0	0	1	27	33	6	0	0.0393701		
Bear Cr below Cub	2230	82%	21	6	0	0	0	0	0	27	33	6	0	0.0393701		
Doudy Draw	4820	83%	28	1	0	0	0	1	0	30	36	6	0	0.0393701		
Kinney Peak	2280	85%	23	5	0	0	0	0	0	28	33	5	1	0.0393701		
Rosedale	2250	85%	24	5	0	0	0	0	0	29	34	5	1	0.0393701		
Cannon Mountain	4270	86%	23	1	0	1	0	0	0	25	29	4	0	0.0393701		
Shop Creek	1710	87%	22	4	0	0	0	0	0	26	30	4	0	0.0393701		
Twin Sisters	4080	87%	22	4	0	0	0	0	0	26	30	4	0	0.0393701		
Willow Creek - DougCnty	2940	88%	25	2	1	0	0	0	0	28	32	4	0	0.0393701		
Kelly Dam	410	88%	21	1	1	0	0	0	0	23	26	3	0	0.0393701		
Cold Sprg Glch conf	2240	89%	29	2	1	0	0	0	0	32	36	4	0	0.0393701		
Golden Age	4230	89%	14	2	0	0	0	0	0	16	18	2	0	0.0393701		
Highland Heritage Park	3090	90%	24	3	0	0	0	0	0	27	30	3	0	0.0393701		
Magnolia	4090	90%	25	1	1	0	0	0	0	27	30	3	0	0.0393701		
Hansen Rain	4330	90%	25	1	1	0	0	0	0	27	30	3	0	0.0393701		
Gunbarrel	1110	90%	17	0	1	0	0	0	0	18	20	2	0	0.0393701		
Wx-Button Rock	4790	90%	16	2	0	0	0	0	0	18	20	2	0	0.0393701		
Morrison	2330	91%	26	3	0	0	0	0	0	29	32	3	0	0.0393701		
Porphory Mtn	4850	91%	89	6	2	0	0	0	0	97	107	10	1	0.0393701		0.01
Newiin Gulch	3070	91%	35	4	0	0	0	0	0	39	43	4	0	0.0393701		
Side Creek Park	830	91%	27	3	0	0	0	0	0	30	33	3	0	0.0393701		
Logan Mill	4140	91%	27	3	0	0	0	0	0	30	33	3	0	0.0393701		
Pine Brook	4170	91%	18	2	0	0	0	0	0	20	22	2	0	0.0393701		
Crescent	4010	91%	28	3	0	0	0	0	0	31	34	3	0	0.0393701		
Sand Creek Park	1800	91%	19	2	0	0	0	0	0	21	23	2	0	0.0393701		
Bear Peak	4070	92%	30	3	0	0	0	0	0	33	36	3	0	0.0393701		
WX-Bingham Lake Park	3030	92%	31	3	0	0	0	0	0	34	37	3	0	0.0393701		
Winiger Ridge	4530	92%	31	3	0	0	0	0	0	34	37	3	0	0.0393701		
Indian Hills	2360	92%	32	3	0	0	0	0	0	35	38	3	0	0.0393701		
Virginia Court	510	92%	22	2	0	0	0	0	0	24	26	2	0	0.0393701		
Wx-Salisbury Park	2730	92%	22	2	0	0	0	0	0	24	26	2	0	0.0393701		
SPR at Union Ave.	1640	92%	11	1	0	0	0	0	0	12	13	1	0	0.0393701		
Eagle Ridge	4520	92%	11	1	0	0	0	0	0	12	13	1	0	0.0393701		
Columbine Open Space	2800	93%	34	3	0	0	0	0	0	37	40	3	0	0.0393701		
Fairview Peak	4860	93%	116	6	2	0	0	0	0	124	134	10	0	0.0393701		0.01
Roslyn	1330	93%	23	2	0	0	0	0	0	25	27	2	0	0.0393701		
Sampson Gulch	940	93%	35	3	0	0	0	0	0	38	41	3	0	0.0393699		
Cherry Cr @ Champa	1700	93%	13	1	0	0	0	0	0	14	15	1	0	0.0393701		
Slaughterhouse Glch	1620	94%	27	2	0	0	0	0	0	29	31	2	0	0.0393701		
Cherry Cr bl Bayou Glch	2850	94%	28	2	0	0	0	0	0	30	32	2	0	0.0393701		
CC @ Prairie Canyon Ranch	3040	94%	30	2	0	0	0	0	0	32	34	2	0	0.0393701		
Quincy/Highline	620	94%	31	2	0	0	0	0	0	33	35	2	0	0.0393701		
Red Rocks Park	2370	94%	31	2	0	0	0	0	0	33	35	2	0	0.0393701		
Lakeshore	4060	94%	31	2	0	0	0	0	0	33	35	2	0	0.0393701		
SBC @ San Souci	4830	94%	31	2	0	0	0	0	0	33	35	2	0	0.0393701		
Rio Grande	4020	94%	32	2	0	0	0	0	0	34	36	2	0	0.0393701		
Guy Hill Ranch	310	94%	16	1	0	0	0	0	0	17	18	1	0	0.0393701		
Cub Cr below Blue	2270	94%	16	1	0	0	0	0	0	17	18	1	0	0.0393701		
Sunset	4240	94%	16	1	0	0	0	0	0	17	18	1	0	0.0393701		
Sand Cr at Colfax	860	95%	33	2	0	0	0	0	0	35	37	2	0	0.0393701		
Gold Hill	4150	95%	33	2	0	0	0	0	0	35	37	2	0	0.0393701		
Brook Forest	2260	95%	35	0	1	0	0	0	0	36	38	2	0	0.0393701		
NREL/S. Table Mtn.	1030	95%	17	1	0	0	0	0	0	18	19	1	0	0.0393701		
Piney at Liverpool	950	95%	36	0	1	0	0	0	0	37	39	2	0	0.0393701		
Fire Station 12	840	95%	37	2	0	0	0	0	0	39	41	2	0	0.0393701		
Jeffco Fairgrounds	1050	95%	19	1	0	0	0	0	0	20	21	1	0	0.0393701		
El Rancho	2340	95%	19	1	0	0	0	0	0	20	21	1	0	0.0393701		
Wx-Louisville Lake	4750	95%	19	1	0	0	0	0	0	20	21	1	0	0.0393701		
Haskins Gulch Conf	2820	95%	39	2	0	0	0	0	0	41	43	2	0	0.0393701		
Sand Creek at mouth	1810	95%	20	1	0	0	0	0	0	21	22	1	0	0.0393701		
Ralston Reservoir	110	96%	22	1	0	0	0	0	0	23	24	1	0	0.0393701		
Walker Ranch	4050	96%	22	1	0	0	0	0	0	23	24	1	0	0.0393701		
Wx-Elbert	1440	96%	45	2	0	0	0	0	0	47	49	2	0	0.0393701		
Leyden Reservoir	200	96%	23	1	0	0	0	0	0	24	25	1	0	0.0393701		
East Cherry Cr-Douglas	2910	96%	48	2	0	0	0	0	0	50	52	2	0	0.0393701		
Wx-Blue Mountain	140	96%	24	1	0	0	0	0	0	25	26	1	1	0.0393701		
Expo Park	420	96%	24	1	0	0	0	0	0	25	26	1	0	0.0393701		
Harvard Gulch Park	600	96%	24	1	0	0	0	0	0	25	26	1	0	0.0393701		
Wx-Diamond Hill	1420	96%	24	1	0	0	0	0	0	25	26	1	0	0.0393701		
Wx-Urban Farm	1460	96%	24	1	0	0	0	0	0	25	26	1	0	0.0393701		

Horseshoe Park Drop	710	96%	25	1	0	0	0	0	0	0	26	27	1	0	0.0393701
Wx-Sugarloaf	4730	96%	25	1	0	0	0	0	0	0	26	27	1	0	0.0393701
ETG @ Buckley	820	96%	26	1	0	0	0	0	0	0	27	28	1	0	0.0393701
Flying J	850	96%	26	1	0	0	0	0	0	0	27	28	1	0	0.0393701
Boulder Jail	4550	96%	26	1	0	0	0	0	0	0	27	28	1	0	0.0393701
Montview Park	400	97%	27	1	0	0	0	0	0	0	28	29	1	0	0.0393701
Confluence Pond	720	97%	27	1	0	0	0	0	0	0	28	29	1	0	0.0393701
Third Creek at DIA	1480	97%	27	1	0	0	0	0	0	0	28	29	1	0	0.0393701
Cherry Cr @ Steele	1720	97%	27	1	0	0	0	0	0	0	28	29	1	0	0.0393701
Big Elk Park	4300	97%	27	1	0	0	0	0	0	0	28	29	1	0	0.0393701
Van Bibber @ Hwy 93	330	97%	28	1	0	0	0	0	0	0	29	30	1	0	0.0393701
Maple Grove Resv.	1000	97%	28	1	0	0	0	0	0	0	29	30	1	0	0.0393701
Sanderson at Xavier	1340	97%	28	1	0	0	0	0	0	0	29	30	1	0	0.0393701
Slaughterhouse	4190	97%	28	1	0	0	0	0	0	0	29	30	1	0	0.0393701
Lazy Acres	4200	97%	28	1	0	0	0	0	0	0	29	30	1	0	0.0393701
Taylor Mountain	4260	97%	28	1	0	0	0	0	0	0	29	30	1	0	0.0393701
Bear Creek @ Lowell	1530	97%	29	1	0	0	0	0	0	0	30	31	1	0	0.0393701
Swiss Peaks	4130	97%	29	1	0	0	0	0	0	0	30	31	1	0	0.0393701
Fire Station #19	530	97%	30	1	0	0	0	0	0	0	31	32	1	0	0.0393701
Sunshine	4160	97%	30	1	0	0	0	0	0	0	31	32	1	0	0.0393701
Fling's	4220	97%	30	1	0	0	0	0	0	0	31	32	1	0	0.0393701
Granby Ditch @ 6th	810	97%	31	1	0	0	0	0	0	0	32	33	1	0	0.0393701
Cottonwood (Apache)	2870	97%	36	1	0	0	0	0	0	0	37	38	1	0	0.0393701
DC Public Works	2950	97%	37	1	0	0	0	0	0	0	38	39	1	0	0.0393701
Wx-Ward C-1	4710	97%	37	1	0	0	0	0	0	0	38	39	1	0	0.0393701
Idledale	2350	98%	38	1	0	0	0	0	0	0	39	40	1	0	0.0393701
Pump Sta 3	970	98%	39	1	0	0	0	0	0	0	40	41	1	1	0.0393701
Wx-Brighton Ditch	1570	98%	39	1	0	0	0	0	0	0	40	41	1	0	0.0393701
Sulphur Gulch	2840	98%	40	1	0	0	0	0	0	0	41	42	1	0	0.0393701
Martin Gulch	4040	98%	43	1	0	0	0	0	0	0	44	45	1	1	0.0393701
Pine Cliff Road	2810	98%	44	1	0	0	0	0	0	0	45	46	1	0	0.0393701
Russelville Gulch-Douglas	2900	100%	51	0	0	0	0	0	0	0	51	51	0	0	0.0393701
Temple Pond at DTC	630	100%	43	0	0	0	0	0	0	0	43	43	0	0	0.0393701
Wx-Tomah Rd-DougCnty	2990	100%	42	0	0	0	0	0	0	0	42	42	0	0	0.0393701
Wx-West Creek WX	3020	100%	42	0	0	0	0	0	0	0	42	42	0	0	0.0393701
Red Garden	4030	100%	42	0	0	0	0	0	0	0	42	42	0	0	0.0393701
Utah Park	430	100%	41	0	0	0	0	0	0	0	41	41	0	0	0.0393701
Powers Park	1500	100%	41	0	0	0	0	0	0	0	41	41	0	0	0.0393701
West Cherry Head-Douglas	2920	100%	40	0	0	0	0	0	0	0	40	40	0	0	0.0393701
Nott Creek	150	100%	39	0	0	0	0	0	0	0	39	39	0	0	0.0393701
Murphy Creek GC	870	100%	39	0	0	0	0	0	0	0	39	39	0	0	0.0393701
CC at Stroh Rd	2860	100%	39	0	0	0	0	0	0	0	39	39	0	0	0.0393701
West Woods	120	100%	38	0	0	0	0	0	0	0	38	38	0	1	0.0393701
Betasso	4110	100%	38	0	0	0	0	0	0	0	38	38	0	0	0.0393701
Shanahan Ridge	4810	100%	38	0	0	0	0	0	0	0	38	38	0	0	0.0393701
Genesee Village	2310	100%	37	0	0	0	0	0	0	0	37	37	0	0	0.0393701
Fire Sta 47	3060	100%	37	0	0	0	0	0	0	0	37	37	0	0	0.0393701
Fire Station #7	440	100%	35	0	0	0	0	0	0	0	35	35	0	0	0.0393701
Harvard @ Jackson	610	100%	35	0	0	0	0	0	0	0	35	35	0	0	0.0393701
Wx-Aurora Town Hall	920	100%	33	0	0	0	0	0	0	0	33	33	0	0	0.0393701
Wx-Marston Lake North	1520	100%	33	0	0	0	0	0	0	0	33	33	0	1	0.0393701
Wx-Aurora Reservoir	900	100%	33	0	0	0	0	0	0	0	33	33	0	0	0.0393699
Goldsmith @ Eastman	640	100%	32	0	0	0	0	0	0	0	32	32	0	0	0.0393701
Mission Viejo Park	760	100%	32	0	0	0	0	0	0	0	32	32	0	0	0.0393701
SBC@S Boulder Ditch	4840	100%	32	0	0	0	0	0	0	0	32	32	0	0	0.0393701
No Name @ Quincy	730	100%	31	0	0	0	0	0	0	0	31	31	0	0	0.0393701
Denver Zoo	1360	100%	31	0	0	0	0	0	0	0	31	31	0	0	0.0393701
Lakewood CC	1550	100%	31	0	0	0	0	0	0	0	31	31	0	0	0.0393701
Gold Lake	4180	100%	31	0	0	0	0	0	0	0	31	31	0	0	0.0393701
St. Antons	4570	100%	31	0	0	0	0	0	0	0	31	31	0	0	0.0393701
Indian Creek	2960	100%	30	0	0	0	0	0	0	0	30	30	0	0	0.0393701
Tallman Gulch	3080	100%	30	0	0	0	0	0	0	0	30	30	0	0	0.0393701
Filter Plant	4100	100%	30	0	0	0	0	0	0	0	30	30	0	0	0.0393701
Geer Canyon	4250	100%	30	0	0	0	0	0	0	0	30	30	0	0	0.0393701
Upper Leyden	220	100%	29	0	0	0	0	0	0	0	29	29	0	0	0.0393701
Denver West	1010	100%	29	0	0	0	0	0	0	0	29	29	0	0	0.0393701
Happy Canyon at N Surrey L	2880	100%	29	0	0	0	0	0	0	0	29	29	0	0	0.0393701
Sports Complex	320	100%	28	0	0	0	0	0	0	0	28	28	0	0	0.0393701
Wx-Quincy Reservoir	750	100%	28	0	0	0	0	0	0	0	28	28	0	0	0.0393701
Leyden Confluence	210	100%	27	0	0	0	0	0	0	0	27	27	0	0	0.0393701
Parker/Mississippi	540	100%	27	0	0	0	0	0	0	0	27	27	0	0	0.0393701
Hidden Lake	1300	100%	27	0	0	0	0	0	0	0	27	27	0	0	0.0393701
Wx-Castle Rock	2750	100%	27	0	0	0	0	0	0	0	27	27	0	0	0.0393701
Toll Gate @ 6th	700	100%	26	0	0	0	0	0	0	0	26	26	0	0	0.0393701
Sable Ditch @ 18th	800	100%	26	0	0	0	0	0	0	0	26	26	0	0	0.0393701
Wx-Highlands Ranch WTP	2710	100%	26	0	0	0	0	0	0	0	26	26	0	0	0.0393701
East/West Trailhead	3050	100%	26	0	0	0	0	0	0	0	26	26	0	0	0.0393701
Riverside	4340	100%	26	0	0	0	0	0	0	0	26	26	0	0	0.0393701
Justice Center	4360	100%	26	0	0	0	0	0	0	0	26	26	0	0	0.0393701
Broomfield 3207	1200	100%	24	1	0	0	0	0	0	1	25	25	1	0	0.0393701
Jewell Detention	520	100%	25	0	0	0	0	0	0	0	25	25	0	0	0.0393701
Wx-Hiwan G.C.	2210	100%	25	0	0	0	0	0	0	0	25	25	0	0	0.0393701

Johnny Park	4310	100%	25	0	0	0	0	0	0	25	25	0	0	0.0393701
Conifer Hill	4350	100%	25	0	0	0	0	0	0	25	25	0	0	0.0393701
Van Bibber Park	300	100%	24	0	0	0	0	0	0	24	24	0	0	0.0393701
Lena @ U.S. Hwy 6	1040	100%	24	0	0	0	0	0	0	24	24	0	0	0.0393701
Chatfield COE	1350	100%	24	0	0	0	0	0	0	24	24	0	0	0.0393701
Englewood Dam	1600	100%	24	0	0	0	0	0	0	24	24	0	0	0.0393701
Wx-Brighton	1920	100%	24	0	0	0	0	0	0	24	24	0	0	0.0393701
Wx-Spring Valley Rd-DougC	2930	100%	24	0	0	0	0	0	0	24	24	0	0	0.0393701
Louisville Rec Ctr	1100	100%	23	0	0	0	0	0	0	23	23	0	0	0.0393701
SPR at 3rd Ave	1320	100%	23	0	0	0	0	0	0	23	23	0	0	0.0393701
Wx-Cal-Wood Ranch	4770	100%	23	0	0	0	0	0	0	23	23	0	0	0.0393701
Havana Park	500	100%	22	0	0	0	0	0	0	22	22	0	0	0.0393701
Iliff Pond	650	100%	22	0	0	0	0	0	0	22	22	0	0	0.0393701
West Metro FS13	1370	100%	22	0	0	0	0	0	0	22	22	0	0	0.0393701
Upper Sloan Det.	1400	100%	22	0	0	0	0	0	0	22	22	0	0	0.0393701
LDC at 64th	1310	100%	20	0	0	0	0	0	0	20	20	0	0	0.0393701
Heritage Square	1060	100%	18	0	0	0	0	0	0	18	18	0	0	0.0393701
Pinewood Springs	4510	100%	15	0	0	0	0	0	0	15	15	0	0	0.0393701
Niver Detention	1900	100%	12	0	0	0	0	0	0	12	12	0	0	0.0393701
Rampart Range Rd	2970	100%	9	0	0	0	0	0	1	9	9	0	0	0.0393701
		TOTAL	5167	208	17	6	1	2	5	5401	5692	274	8	
Four Mile Creek	5720	100%	1	0	0	0	0	0	1	1	1	0	0	0.0393701
West Creek	5730	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701
Trail Creek	5740	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701
Stump Bump	5810	100%	2	0	0	0	0	0	0	2	2	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%	2	0	0	0	0	0	0	2	2	0	0	0.0393701

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