

Memo



Date: December 11, 2007
To: Kevin Stewart and Chad Kudym
From: Markus Ritsch
Subject: November 2007 ALERT Data Analysis

I. ALERT Data Source

Raw ALERT data records extracted from the Urban Drainage and Flood Control District's Nova Star 4.0 base station (ALERT 2) were analyzed for the period November 1 through November 30, 2007.

II. General System Analysis Summary

A total of 236,567 individual data records were analyzed from the ALERT 2 base station. Meteorological sensors account for 70 percent, water level sensors 6 percent, and rain sensors 2 percent of the total monthly transmissions.

Ninety-nine point seven percent of the received data reports were flagged as "good" by the Nova Star validation process. Roughly 817 reports were flagged as "bad". Of these "bad" reports, 148 originated from Brighton Ditch Wx (ID 1574).

The system-wide radio traffic loading this month was 7,886 reports per day with an average hourly loading of 329 reports. The peak hourly traffic loading was 689 reports, which occurred on November 4th between 1:00 AM and 2:00 AM. A plot of monthly average and peak hourly traffic loading is provided.

A total of 64 reports were received from the Hayman gages this month. These gages were winterized by OneRain in October.

The sensors reporting most frequently this month are all wind sensors and include:

1. Castle Rock (ID 2747 - ALERT wind) with 3,602 reports,
2. Salisbury Park (ID 2727 - ALERT wind) with 3,395 reports, and
3. Ward C-1 (ID 4707 - ALERT wind) with 2,957 reports,

The reports from the above sensors are distributed evenly throughout the month.

The sensors reporting infrequently this month include:

1. Cold Sprg Gulch Conf (ID 2240) with 1 report,
2. Bear Creek below Cub (ID 2230) with 1 report,
3. Holly Dam (ID 1610) with 1 report,
4. Englewood Dam (ID 1600) with 1 report, and
5. Denver Zoo (ID 1360) with 1 report.

Note that many stations within the District are shut-down over the winter. The reporting for these stations is minimal or non-existent beginning in October and November.

III. Rain Sensor Timer Reporting Summary

The following analysis assumes that each rain sensor has a 12-hour timer reporting interval. System-wide the ALERT 2 base station received approximately 82 percent of the non-incrementing timer reports. The worst performing rain sensors for the month are summarized (Table 1).

Table 1. Monthly Summary of Sensors with Poor Timer Performance (Sensor ID)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct*	Nov*	Dec
750	1330	2310	1810	1810	1810	1810	1600	1330	2340	1500	
4470	1460	1710	540	310	1710	4560	410	1340	2250	1530	
4560	2330	2350	310	540	4470	2350	1350	1360	2230	1620	
4240	4170	2240	850	850	1500	2250	2190	1370	2240	600	
4510	4470	2250	1710	1710	4290	4200	4820	2310	2310	610	
				900	540	4240	4830	1030	2360	1320	

* - Many District stations are taken out-of-service for the winter beginning in October which influences timer performance.

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.

Sensor ID 1460 has a 24-hour timer reporting interval and is not included in the timer reporting analysis.

Sensor ID 1810 has an 18-hour timer reporting interval and is not included in the timer reporting analysis after the month of July.

IV. Rain Sensor Event Reporting Summary

A. District-Wide Total Tip/Count Statistics

The incrementing reports from all 1-mm rain sensors (excluding Hayman sensors) that reported for the entire month were analyzed to quantify the District-wide statistical total monthly tip summary (Table 2).

Table 2. District-Wide Total Tip/Count Statistical Summary

Statistical Parameter	Value	Comments
Mean	6.54	Only the 1-mm rain sensors were included in the analysis
Median	6	Only the 1-mm rain sensors were included in the analysis
Standard deviation	4.06	Only the 1-mm rain sensors were included in the analysis
Mean plus three standard deviations	18.18	Only the 1-mm rain sensors were included in the analysis
Minimum total count	1	Salisbury Park (ID 2730)
Maximum total count	25	Button Rock (ID 4790)

A monthly summary of the District-wide mean total tip/count is presented (Table 3).

Table 3. 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		

The average precipitation experienced district-wide in November was decreased from the previous month of October. The District-wide precipitation experienced in November of 2007 was increased slightly from that experienced in the same month in 2006.

The rain sensor with the lowest tip count total for the month was Salisbury Park (ID 2730) with 1 tip.

The rain sensor with the highest tip count total for the month was Button Rock (ID 4790). This sensor was also the only sensor reporting more than the system-wide mean plus 3 standard deviations.

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

Two rain sensors experienced a jump in the sequential tip count of more than six. The tip count series for each sensor was manually inspected and summarized below.

a. Button Rock (ID 4790)

On November 27th, this sensor experiences a jump of 9 in the sequential count between 10:12:32 AM and 10:41:58 AM. Nothing in the sequential count series suggests the jump is erroneous.

Table 4. Button Rock (ID 4790) - Large Jump in Count

Date/Time	Sensor ID	Count
11/26/2007 8:46:26 PM	4790	284
11/27/2007 8:46:25 AM	4790	284
11/27/2007 9:49:34 AM	4790	284
11/27/2007 10:05:29 AM	4790	284
11/27/2007 10:07:23 AM	4790	285
11/27/2007 10:11:20 AM	4790	286
11/27/2007 10:11:42 AM	4790	287
11/27/2007 10:12:32 AM	4790	290
11/27/2007 10:41:58 AM	4790	299
11/27/2007 10:42:26 AM	4790	301
11/27/2007 10:47:06 AM	4790	302
11/27/2007 10:47:50 AM	4790	303
11/27/2007 8:46:39 PM	4790	303
11/28/2007 8:46:39 AM	4790	303
11/28/2007 8:46:41 PM	4790	303

b. Brighton (ID 1920)

On November 2nd, this sensor experiences a jump of 11 in the sequential count at 9:08:44 AM. Nothing in the sequential count series suggests the jump is erroneous.

Table 5. Brighton (ID 1920) – Large Jump in Count

Date/Time	Sensor ID	Count
11/1/2007 10:19:30 AM	1920	223
11/1/2007 10:19:33 PM	1920	223
11/2/2007 9:08:44 AM	1920	234
11/2/2007 9:09:09 AM	1920	235
11/2/2007 10:19:31 AM	1920	235
11/2/2007 10:19:33 PM	1920	235
11/3/2007 10:19:32 AM	1920	235
11/3/2007 10:19:34 PM	1920	235

The reason for these large data gaps is not known. Both sensors have a complete data record for the entire month. The monthly sequential count series looks good for both sensors.

C. Sensor-by-Sensor Incrementing Count Summary

The system-wide reception rate of incrementing, 1-mm, tip reports for the month was approximately 91 percent. A total of 452 incrementing reports were received and a total of 497 were expected. The total loss of incrementing reports for the month was approximately 9 percent. Those sensors with the worst rain event transmission performance characteristics 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
2320	1330	540	1350	860	1710	2370	1350	1810	1710	1920	
2190	4080	310	310	4710	1350	150	2310	520	860	4790	
4710	1640	4470	1100	1810	310	1700	540	1360	540	1700	
4090	4050	850	860	1350	1700	1350	1300	1700	850	4180	
4820	4180	4570	540	400	210	850	1920	1710	900	4770	
				4570	110	2340	840	1350	1100	1810	

* Note that the outage of the Blue Mountain repeater caused a large data gap in the sequential count series for many sensors and thus the incrementing tip report performance statistics are skewed this month.

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.

The incrementing data series for each sensor is inspected to identify periods of missing data. Sensor 1920 and 4790 are discussed in the previous section.

a. Cherry Creek at Champa (ID 1700)

This sensor has a continuous record for the entire month. Three sequential data transmissions were missed on November 1.

Date/Time	Sensor ID	Count
11/1/2007 2:01:25 AM	1700	1572
11/1/2007 2:01:26 PM	1700	1575
11/2/2007 2:01:24 AM	1700	1575
11/2/2007 2:01:26 PM	1700	1575
11/3/2007 2:01:24 AM	1700	1575

b. Gold Lake (ID 4180)

This sensor has a continuous record for the entire month. Three sequential data transmissions were missed on November 1.

Date/Time	Sensor ID	Count
11/1/2007 12:06:02 AM	4180	25
11/1/2007 11:49:29 AM	4180	28
11/1/2007 12:29:38 PM	4180	28
11/2/2007 12:01:59 AM	4180	28
11/2/2007 11:59:54 AM	4180	28

c. Calwood Ranch (ID 4770)

This sensor has a continuous record for the entire month. Five sequential data transmissions were missed on November 19.

Date/Time	Sensor ID	Count
11/18/2007 2:25:42 PM	4770	1988
11/19/2007 2:25:43 AM	4770	1988
11/19/2007 1:52:09 PM	4770	1993
11/19/2007 1:52:31 PM	4770	1994

d. Sand Creek at Mouth (ID 1810)

This sensor has a continuous record for the entire month. Two sequential data transmissions were missed on November 5.

Date/Time	Sensor ID	Count
11/4/2007 7:52:38 AM	1810	329
11/5/2007 1:52:37 AM	1810	329
11/5/2007 7:52:40 PM	1810	331
11/6/2007 1:52:39 PM	1810	331
11/7/2007 7:52:38 AM	1810	331
11/8/2007 1:52:38 AM	1810	331

V. Heavy Radio Traffic Analysis

Periods exceeding 600 messages per hour are analyzed independently in an attempt to identify rain gage sequences where 3 or more, sequential messages were lost.

A. November 4, 2007

The heaviest radio traffic for the month occurred on November 4 between 1:00 AM and 2:00 AM.

The distribution of hourly reports for the period is as follows:

- 11/4/2007 from 12:00 am to 1:00 am (348 reports)
- 11/4/2007 from 1:00 am to 2:00 am (689 reports)
- 11/4/2007 from 2:00 am to 3:00 am (342 reports)
- 11/4/2007 from 3:00 am to 4:00 am (333 reports)

The distribution of ALERT data reports for this period is provided (Table 7). The heavy traffic is dominated by reports from wind, temperature, and relative humidity sensors.

Table 7. Peak Traffic Period Sensor Report Distribution

Sensor Group	Reports	Percentage
None-ALERT-ID	297	17%
Wind Gust	268	16%
Temperature	253	15%
Relative Humidity	217	13%
Wind Speed Average & Azimuth	206	12%
Wind Direction	140	8%
Wind Speed Average	103	6%
Water Level PT-HSE	70	4%
Precipitation	39	2%
Solar Radiation	30	2%
Barometric Pressure	18	1%
Battery Voltage HSE	18	1%
Battery Voltage Digital	13	1%
Water Level PT	11	1%
Fuel Moisture	5	0%
Fuel Temperature	5	0%
Battery Voltage Analog	3	0%
Repeater Pass List	3	0%

Battery	2	0%
Handar 585 ALARM Status	2	0%
Precipitation - Mean	2	0%
Precipitation - Test	2	0%
Water Level Float	2	0%
12Hr Status Report	1	0%
Hayman Precipitation	1	0%
Repeater Status Report	1	0%
Total	1,712	100%

Incrementing rain records from the 1-mm gages for the heavy radio traffic period were examined to characterize the loss of sequential incrementing tip transmissions (Table 8). Overall, approximately 0.00% of the incrementing tip reports were lost for this period.

Table 8. Peak Traffic Analysis - Loss of Incrementing Tip Reports

Heavy Traffic Period (Nov 4, 2007)	Occurrences of loss of sequential tip reports during period			
	Loss of 2 tips	Loss of 3 tips	Loss of 4 tips	Loss of 5 tips
12:00 am to 4:00 pm	0	0	0	0

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 9).

Table 9. Summary of Unknown IDs

Description	Quantity
Total number of unknown IDs (IDs without a device definition)	142
Total reports from unknown IDs	269
Unknown IDs with only a single received report (potential noise)	101
Total reports from all IDs – RecData Log entire month	196,288
Unknown reports as a fraction of total reports	0.14%

The total number of reports from unknown sensor IDs is small relative to the total reports received for the month.

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 quantified (Table 10).

Table 10. Reports Received by Unknown IDs

Unknown Sensor ID	Number of Reports
4013	15
4384	13
4381	11
4382	11
2232	8
4748	8
4636	7
2216	6
4766	5
4775	4
4756	4
4039	4

Unknown Sensor ID	Number of Reports
4091	4
2238	4
2224	4
4063	4
4831	3
4768	3
4765	3
4763	3
4760	3
4740	3

The “unknown” device reports are analyzed temporally to understand when they are received during the day (Table 11). 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 11. Temporal Distribution of Unknown Reports

Hour (AM)	Reports	Hour (PM)	Reports
0:00-00:59	13	12:00-12:59	14
1:00-1:59	6	1:00-1:59	14
2:00-2:59	10	2:00-2:59	12
3:00-3:59	9	3:00-3:59	8
4:00-4:59	4	4:00-4:59	8
5:00-5:59	9	5:00-5:59	6
6:00-6:59	6	6:00-6:59	9
7:00-7:59	9	7:00-7:59	16
8:00-8:59	16	8:00-8:59	15
9:00-9:59	41	9:00-9:59	7
10:00-10:59	17	10:00-10:59	7
11:00-11:59	10	11:00-11:59	3

Reports from unknown sensors occur each hour of the day. The hour from 9:00 am to 10:00 am received the highest number of reports for the month.

Unknown sensor 4013 reports on a 12 hour timed interval through November 7th. It has several random reports on November 8th then reports once on November 14th and is not heard from again during the month (Table 12). Is it possible that OneRain took a transmitter out of service on the 14th which was transmitting the unknown ID of 4013?

Table 12. Unknown Sensor 4013 Reporting

Date/Time	Sensor ID	Data
11/1/2007 9:43:01 AM	4013	13
11/1/2007 9:41:06 PM	4013	13
11/2/2007 9:37:14 PM	4013	13
11/3/2007 9:35:17 AM	4013	13
11/4/2007 8:31:25 AM	4013	13
11/4/2007 8:29:31 PM	4013	13
11/5/2007 8:25:39 PM	4013	13
11/6/2007 8:23:43 AM	4013	13
11/6/2007 10:45:30 AM	4013	1631
11/6/2007 8:21:48 PM	4013	13
11/7/2007 8:19:51 AM	4013	13
11/8/2007 12:01:39 AM	4013	14
11/8/2007 10:24:05 AM	4013	10
11/8/2007 10:24:57 AM	4013	15
11/14/2007 7:07:40 PM	4013	1391

Unknown sensor IDs 4381, 4382, and 4384 all occurred between 9:00 am and 10:00 am on November 8th. This explains the large occurrence of unknown reports for the hour between 9 and 10 (Table 11).

VII. Issues Identified this Month

Sensors with a large number of invalid reports (other than Wind Gust sensors):

1. Brighton Ditch Wx (ID 1574 – Solar Radiation) with 148 reports,
2. Squaw Mountain (ID 2192 – Temperature) with 72 reports, and
3. Squaw Mountain (ID 2191 – Relative Humidity) with 29 reports.

Sensors reporting frequently:

4. Castle Rock (ID 2747 - ALERT wind) with 3,602 reports,
5. Salisbury Park (ID 2727 – ALERT wind) with 3,395 reports, and
6. Ward C-1 (ID 4707 – ALERT wind) with 2,957 reports.

Sensors reporting infrequently (under reporting):

7. Cold Spring Gulch Conf (ID 2240) with 1 report,
8. Bear Creek below Cub (ID 2230) with 1 report,
9. Holly Dam (ID 1610) with 1 report,
10. Englewood Dam (ID 1600) with 1 report, and
11. Denver Zoo (ID 1360) with 1 report.

Poor timer reporting:

It is difficult to evaluate the timer performance of sensors in November because many stations are winterized during this month which impacts the analysis.

Low rain total:

- 12. **Salisbury Park (ID 2730)** – This sensor recorded only 1 tip for the entire month. Nothing suspicious in the data series. Surrounding stations also had low monthly totals.

High rain total:

- 13. **Button Rock (ID 4790)** – This sensor recorded a total of 25 tips for the month. This sensor transmitted 10 more tips than the next highest reporting rain sensor which was Brighton (ID 1920).

Large Jump in Sequential Count Value:

- 14. **Button Rock (ID 4790)** - On November 27th, this sensor experiences a jump of 9 in the sequential count between 10:12:32 AM and 10:41:58 AM. Nothing in the sequential count series suggests the jump is erroneous.
- 15. **Brighton (ID 1920)** - On November 2nd, this sensor experiences a jump of 11 in the sequential count at 9:08:44 AM. Nothing in the sequential count series suggests the jump is erroneous.

Reports from “Unknown Sensors”:

- 16. **4381, 4382, and 4384** – These IDs each reported approximately 11 transmissions on November 8th between 9:00 am and 10:00 am. No other transmissions are seen during the remainder of the month so the issue seems to be resolved.
- 17. **Crescent (ID 4013)** – The transmitter at this location should be re-programmed so that ID 4013 is not transmitted. This ID was transmitted only through November 14, so the issue may have been resolved.
- 18. The following table shows the “unknown” sensor IDs and the total number of reports received during the month. These reports indicate the existence of a transmitter that is sending information on an ID that is not currently defined within NovaStar.

Unknown Sensor ID	Number of Reports
4013	15
4384	13
4381	11
4382	11
2232	8
4748	8
4636	7
2216	6
4766	5
4775	4
4756	4
4039	4
4091	4
2238	4
2224	4
4063	4
4831	3
4768	3
4765	3
4763	3
4760	3
4740	3

General System Analysis

Database Name P:\A207-UDFCD-Data-Analysis\2007_Nov\Novastar_extract_2007Nov.mdb

First Date in Database	11/1/07 12:00 AM	Total Days	30.0
Last Date in Database	11/30/07 11:59 PM	Total Hours	720.0

Total Records Analyzed 236567

Records by Group

None-ALERT-ID	42943	18%
Wind Gust	36782	16%
Temperature	33928	14%
Relative Humidity	33260	14%
Wind Speed Average & Azimuth	19926	8%
Wind Direction	18856	8%
Wind Speed Average	15229	6%
Water Level PT-HSE	10748	5%
Precipitation	5278	2%
Solar Radiation	4293	2%
Battery Voltage HSE	3742	2%
Barometric Pressure	3620	2%
Battery Voltage Digital	2470	1%
Water Level PT	1266	1%
Water Level Float	881	0%
Repeater Pass List	588	0%
Fuel Moisture	560	0%
Fuel Temperature	560	0%
Battery Voltage Analog	482	0%
Repeater Status Report	457	0%
Precipitation - Mean	372	0%
Precipitation - Test	237	0%
Battery	189	0%
12Hr Status Report	116	0%
Longmont Flow Gage	113	0%
Handar 585 ALARM Status	99	0%
Hayman Precipitation	64	0%
Soil Moisture	59	0%
Longmont Water Level PT	54	0%
Total	237172	

Records by Major Group

Meteorologic Sensors	165894	70%
Water Level Sensors	13062	6%
Sensor Status Transmissions	7954	3%
Rain Sensors	5278	2%
Soil and Fuel Sensors	1179	0%
Total	193367	

Records by Validation Type

Good	0	235750	99.65%
Questionable	1	817	0.00
Total		236567	

Sensors With Most Invalid Data

Description	Sensor	Reports
Brighton Ditch Wx	1574	148
Squaw Mountain	2192	72
Blue Mountain	139	65
Blue Mountain	137	52
Louisville Lake	4744	35

Traffic Loading Summary

Alert Reports	236567	
Average Daily Traffic	7886	
Average Hourly Traffic	329	
Median Hourly Traffic	330	hour beginning
Peak Hourly Traffic	689	11/4/07 1:00 AM
2nd Max	465	11/27/2007 9:00
3rd Max	453	11/27/2007 11:00
4th Max	447	11/13/2007 7:00
5th Max	447	11/13/2007 7:00

General System Analysis

Reports per Sensor			
Description	Sensor	Reports	Fraction of Total
None-ALERT-ID	9233	3679	2%
Castle Rock	2747	3602	2%
Salisbury Park	2727	3395	1%
Ward C-1	4707	2957	1%
None-ALERT-ID	9353	2914	1%
Stapleton	1465	2871	1%
Stapleton	1464	2865	1%
Stapleton	1467	2858	1%
None-ALERT-ID	9232	2853	1%
Stapleton	1466	2850	1%
Elbert	1438	2833	1%
Elbert	1441	2831	1%
Elbert	1442	2831	1%
Elbert	1437	2822	1%
Elbert	1439	2805	1%
None-ALERT-ID	9241	2779	1%
None-ALERT-ID	9261	2758	1%
None-ALERT-ID	9201	2754	1%
Blue Mountain	138	2745	1%
Blue Mountain	141	2745	1%
Marston Lake North	1526	2743	1%
Blue Mountain	142	2742	1%
Marston Lake North	1521	2740	1%
Blue Mountain	139	2735	1%
Squaw Mountain	2188	2734	1%
Blue Mountain	137	2732	1%
Castle Rock	2744	2715	1%
Boulder Cr at Broadway	4583	2707	1%
Green Ditch	4593	2707	1%
Salisbury Park	2724	2676	1%
Squaw Mountain	2192	2661	1%
None-ALERT-ID	9272	2533	1%
Squaw Mountain	2189	2510	1%
Squaw Mountain	2187	2486	1%
Squaw Mountain	2191	2485	1%
Ward C-1	4704	2435	1%
None-ALERT-ID	9231	2393	1%
None-ALERT-ID	9211	2383	1%
Quincy Reservoir	751	2236	1%
None-ALERT-ID	9251	2230	1%
Salisbury Park	2732	2218	1%
None-ALERT-ID	9271	2206	1%
None-ALERT-ID	9273	2169	1%
None-ALERT-ID	9354	2155	1%
Diamond Hill	1414	2142	1%
None-ALERT-ID	9355	2123	1%
Sugarloaf	4724	2120	1%

Rain Timer Performance

			Analyze Rain Sensors			
			systemwide average (days) 0.5184		Average	
					82%	
Rain Sensors	Description	Rcvd	Interval	Expected	Performance	
1500	Powers Park	2	11:57	60.00	3%	
1530	Bear Creek @ Lowell	2	11:57	60.00	3%	
1620	Slaughterhouse Glch	2	11:57	60.00	3%	
600	Harvard Gulch Park	8	11:48	60.00	13%	
610	Harvard @ Jackson	8	11:48	60.00	13%	
1320	SPR at 3rd Ave	8	11:49	60.00	13%	
1340	Sanderson at Xavier	8	11:51	60.00	13%	
1030	NREL/S. Table Mtn.	21	12:30	60.00	35%	
1100	Louisville Rec Ctr	23	14:37	60.00	38%	
1400	Upper Sloan Det.	23	11:54	60.00	38%	
1110	Gunbarrel	25	13:27	60.00	42%	
1200	Broomfield 3207	27	12:22	60.00	45%	
1460	Stapleton	29	23:57	60.00	48%	
1810	Sand Creek at mouth	37	17:58	60.00	62%	
4060	Lakeshore	43	15:29	60.00	72%	
4750	Louisville Lake	47	15:19	60.00	78%	
2210	Hiwan G.C.	48	11:58	60.00	80%	
4170	Pine Brook	48	14:28	60.00	80%	
2190	Squaw Mountain	50	13:56	60.00	83%	
4560	Lyons Diversion NSV	50	13:56	60.00	83%	
4010	Crescent	51	13:26	60.00	85%	
4730	Sugarloaf	51	13:53	60.00	85%	
4820	Doudy Draw	51	13:43	60.00	85%	
4080	Twin Sisters	52	13:14	60.00	87%	
4200	Lazy Acres	52	13:14	60.00	87%	
4290	Red Hill	52	12:57	60.00	87%	
4510	Pinewood Springs	52	13:28	60.00	87%	
4530	Winiger Ridge	52	13:30	60.00	87%	
4850	Porphory Mtn	52	13:32	60.00	87%	
4130	Swiss Peaks	53	13:16	60.00	88%	
4240	Sunset	53	12:43	60.00	88%	
4470	Little Narrows	53	13:07	60.00	88%	
750	Quincy Reservoir	54	12:53	60.00	90%	
1660	SPR at Henderson	54	13:17	60.00	90%	
4490	Apple Valley	54	12:54	60.00	90%	
4570	St. Antons	54	12:40	60.00	90%	
700	Toll Gate @ 6th	55	12:41	60.00	92%	
2940	Willow Creek - DougCnty	55	12:39	60.00	92%	
4070	Bear Peak	55	12:52	60.00	92%	
4220	Fling's	55	12:41	60.00	92%	
4810	Shanahan Ridge	55	12:52	60.00	92%	
4860	Fairview Peak	55	12:43	60.00	92%	
900	Aurora Reservoir	56	12:38	60.00	93%	
1480	Third Creek at DIA	56	12:40	60.00	93%	
2330	Morrison	56	12:37	60.00	93%	
4030	Red Garden	56	12:39	60.00	93%	
4090	Magnolia	56	12:39	60.00	93%	
4110	Betasso	56	12:26	60.00	93%	
4150	Gold Hill	56	12:40	60.00	93%	
4180	Gold Lake	56	12:50	60.00	93%	
4710	Ward C-1	56	12:40	60.00	93%	
410	Kelly Dam	57	12:23	60.00	95%	
740	Smoky Hill	57	12:25	60.00	95%	
1420	Diamond Hill	57	12:12	60.00	95%	
1920	Brighton	57	12:26	60.00	95%	
2730	Salisbury Park	57	12:38	60.00	95%	
2930	Spring Valley Rd - DougCnty	57	12:25	60.00	95%	
4020	Rio Grande	57	12:10	60.00	95%	
4100	Filter Plant	57	12:12	60.00	95%	
4140	Logan Mill	57	12:23	60.00	95%	
4190	Slaughterhouse	57	12:25	60.00	95%	

4260	Taylor Mountain	57	12:25	60.00	95%
4270	Cannon Mountain	57	12:37	60.00	95%
4310	Johnny Park	57	12:23	60.00	95%
4330	Indian Ruins	57	12:39	60.00	95%
4350	Conifer Hill	57	12:25	60.00	95%
4360	Justice Center	57	12:10	60.00	95%
4520	Eagle Ridge	57	12:38	60.00	95%
4840	SBC@S Boulder Ditch	57	12:10	60.00	95%
140	Blue Mountain	58	11:52	60.00	97%
1440	Elbert	58	12:11	60.00	97%
1640	SPR at Union Ave.	58	12:12	60.00	97%
1700	Cherry Cr @ Champa	58	11:58	60.00	97%
2220	Evergreen Lake	58	12:22	60.00	97%
2750	Castle Rock	58	12:11	60.00	97%
4050	Walker Ranch	58	12:23	60.00	97%
4230	Golden Age	58	12:10	60.00	97%
4250	Geer Canyon	58	12:10	60.00	97%
4300	Big Elk Park	58	12:10	60.00	97%
4830	SBC @ San Souci	58	12:10	60.00	97%
920	Aurora Town Hall Wx	59	12:11	60.00	98%
1520	Marston Lake North	59	11:45	60.00	98%
1570	Brighton Ditch Wx	59	11:58	60.00	98%
2710	Highlands Ranch WTP	59	11:58	60.00	98%
2820	Haskins Gulch Conf	59	11:58	60.00	98%
4160	Sunshine	59	11:56	60.00	98%
4770	Cal-Wood Ranch	59	11:58	60.00	98%
1540	Sanderson at Xavier	60	11:56	60.00	100%
4040	Martin Gulch	60	11:56	60.00	100%
4340	Riverside	60	11:56	60.00	100%
4790	Button Rock	61	11:47	60.00	102%

Rain Event Performance		Reports Received	452	Analyze Rain Sensors										
	Systemwide Avg	Total Tips	497											
	91%	Data Loss	9.05%											
Rain Sensor	Performance	1-tips	2-tips	3-tips	4-tips	5-tips	6-tips	>6-tips	Rcvd	Exp	Miss	Holdoff	Bucket	
1920	27%	4	0	0	0	0	0	1	4	15	11	0	0.0393701	
4790	52%	11	1	1	0	0	0	1	13	25	12	0	0.0393701	
1700	60%	2	0	1	0	0	0	0	3	5	2	0	0.0393701	
4180	67%	3	0	1	0	0	0	0	4	6	2	0	0.0393701	
4770	67%	7	0	0	0	1	0	0	8	12	4	0	0.0393701	
1810	75%	2	1	0	0	0	0	0	3	4	1	0	0.0393701	
4080	75%	4	2	0	0	0	0	0	6	8	2	0	0.0393701	
4520	75%	2	1	0	0	0	0	0	3	4	1	0	0.0393701	
1640	80%	3	1	0	0	0	0	0	4	5	1	0	0.0393701	
4170	83%	4	1	0	0	0	0	0	5	6	1	0	0.0393701	
140	86%	5	1	0	0	0	0	0	6	7	1	0	0.0393701	
4020	88%	6	1	0	0	0	0	0	7	8	1	0	0.0393701	
4820	88%	6	1	0	0	0	0	0	7	8	1	0	0.0393701	
4040	89%	7	1	0	0	0	0	0	8	9	1	0	0.0393701	
4090	90%	8	1	0	0	0	0	0	9	10	1	0	0.0393701	
4350	90%	8	1	0	0	0	0	0	9	10	1	0	0.0393701	
4240	92%	10	1	0	0	0	0	0	11	12	1	0	0.0393701	
4150	93%	12	1	0	0	0	0	0	13	14	1	0	0.0393701	
410	100%	4	0	0	0	0	0	0	4	4	0	0	0.0393701	
610	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701	
650	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701	
700	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701	
740	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701	
900	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393699	
920	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701	
1110	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701	
1400	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701	
1420	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701	
1460	100%	4	0	0	0	0	0	0	4	4	0	0	0.0393701	
1480	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701	
1520	100%	5	0	0	0	0	0	0	5	5	0	1	0.0393701	
1540	100%	4	0	0	0	0	0	0	4	4	0	0	0.0393701	
1570	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701	
1660	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701	
2210	100%	3	0	0	0	0	0	0	3	3	0	2	0.0393701	
2320	100%	4	0	0	0	0	0	0	4	4	0	0	0.0393701	
2330	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701	
2710	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701	
2730	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701	
2820	100%	4	0	0	0	0	0	0	4	4	0	0	0.0393701	
2930	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701	
2940	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701	
4010	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701	
4030	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701	
4050	100%	6	0	0	0	0	0	0	6	6	0	0	0.0393701	
4060	100%	7	0	0	0	0	0	0	7	7	0	1	0.0393701	
4070	100%	6	0	0	0	0	0	0	6	6	0	0	0.0393701	
4100	100%	4	0	0	0	0	0	0	4	4	0	1	0.0393701	
4110	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701	
4130	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701	
4140	100%	12	0	0	0	0	0	0	12	12	0	0	0.0393701	
4160	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701	
4190	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701	
4200	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701	
4220	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701	
4230	100%	11	0	0	0	0	0	0	11	11	0	0	0.0393701	
4250	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701	
4260	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701	
4270	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701	
4290	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701	
4300	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701	
4310	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701	
4330	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701	
4340	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701	
4360	100%	12	0	0	0	0	0	0	12	12	0	2	0.0393701	
4470	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701	
4490	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701	
4510	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701	
4530	100%	9	0	0	0	0	0	0	9	9	0	1	0.0393701	
4570	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701	
4710	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701	
4730	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701	
4750	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701	
4810	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701	
4830	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701	
4840	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701	
	Total Tips	433	15	3	0	1	0	2	452	497	45	8		

