

Memo



Date: August 6, 2007
To: Kevin Stewart and Chad Kudym
From: Markus Ritsch
Subject: July 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 July 1 through July 31, 2007.

II. General System Analysis Summary

A total of 257,543 individual data records were analyzed. Meteorological sensors accounted for approximately 56 percent, water level sensors 13 percent and rain sensors 6 percent of the total monthly reports.

Ninety-nine percent of the received data reports were flagged as "good" by the Nova Star validation process. Roughly 1,368 reports were flagged as "bad". Of these "bad" reports, 880 originated from the wind sensor (ID 2189) at Squaw Mountain.

The system-wide radio traffic loading this month was 8,308 reports per day with an average hourly loading of 346 reports. The peak hourly traffic load in terms of reports received at the base station was 1,015 reports, which occurred on July 27th between 5:00 PM and 6:00 PM. The actual number of reports during this hour was higher, probably on the order of 1,100 to 1,200 reports. A plot of monthly average and peak hourly traffic loading is provided.

A total of 1,960 rain tip reports were received from the Hayman gages this month. The Hayman gages accounted for less than 1% of the monthly total received radio traffic.

The sensors reporting most frequently this month include:

1. Boulder Creek at Broadway (ID 4583) with 3,395 reports,
2. Salisbury Park (ID 2727) with 3,042 reports,
3. Stapleton (ID 1464) with 2,934 reports,
4. Stapleton (ID 1466) with 2,894 reports,
5. Marston Lake North (ID 1521) with 2,882 reports,
6. Squaw Mountain (ID 2189) with 2,845 reports,
7. Elbert (ID 1439) with 2,844 reports,
8. Stapleton (ID 1465) with 2,841 reports, and
9. Green Ditch (ID 4593) with 2,835 reports.

The sensors reporting infrequently this month include:

1. Rowena (ID 4433) with 3 reports,
2. SPR at Dartmouth (ID 1626) with 4 reports,
3. Gunbarrel (ID 1113) with 12 reports, and
4. ETG @ Buckley (ID 823) with 16 reports.

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 90 percent of the non-incrementing timer reports. The 5 worst-performing rain sensors for the month are summarized (Table 1).

Table 1. Monthly Summary of Sensors with Poor Timer Performance

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
750	1330	2310	1810	1810	1810	1810					
4470	1460	1710	540	310	1710	4560					
4560	2330	2350	310	540	4470	2350					
4240	4170	2240	850	850	1500	2250					
4510	4470	2250	1710	1710	4290	4200					
				900	540	4240					

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.

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	36.20	Only the 1-mm rain sensors were included in the analysis
Median	33	Only the 1-mm rain sensors were included in the analysis
Standard deviation	21.86	Only the 1-mm rain sensors were included in the analysis
Mean plus three standard deviations	101.78	Several sensors for the month are outside the Mean +/- 3 Std Dev
Minimum total count	8	IDs 820, 1060, 1370
Maximum total count	139	Powers Park (ID 1500)

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						

The average precipitation experienced district-wide in July was increased from the previous month of June. The District-wide precipitation experienced in July of 2007 was less than that experienced in the same month in 2006.

The rain sensor with the highest tip count total for the month was Powers Park (ID 1500). This was the second month in a row that this sensor has experienced the most rainfall. As described on the District's web site, this site may be influenced by irrigation.

Several sensors experienced a total tip count of more than the system-wide mean plus 3 standard deviations including Powers Park (ID 1500), and Murphy Creek Golf Course (ID 870).

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

Three rain sensors experienced a jump in their sequential tip count of more than six. The tip count series for these sensors was manually inspected and discussed in the following paragraphs.

Red Rocks Park (ID 2370)

On July 27th the count value jumped from 9 to 23 at 5:57:41 PM. The count value of 9 was a timer transmission. The total jump in count of 14 was validated by the base station.

Date/Time	Sensor ID	Count
7/27/2007 1:10:21 AM	2370	9
7/27/2007 1:10:24 PM	2370	9
7/27/2007 5:57:41 PM	2370	23
7/27/2007 8:28:19 PM	2370	27
7/27/2007 11:11:45 PM	2370	28
7/28/2007 12:20:28 AM	2370	29

Nott Creek (ID 150)

On July 30th the count value jumped from 22 to 34 at 4:58:09 PM. The count value of 22 was a timer transmission. The total jump in count of 12 was validated by the base station.

Date/Time	Sensor ID	Count
7/30/2007 12:48:06 AM	150	22
7/30/2007 12:48:08 PM	150	22
7/30/2007 4:58:09 PM	150	34
7/31/2007 12:48:08 AM	150	34

Cherry Creek near Champa (ID 1700)

On July 27th the count value jumped from 1470 to 1480 at 5:55:26 PM. The total jump in count of 10 was validated by the base station.

Date/Time	Sensor ID	Count
7/27/2007 5:39:27 PM	1700	1469
7/27/2007 5:41:26 PM	1700	1470
7/27/2007 5:55:26 PM	1700	1480
7/27/2007 6:16:27 PM	1700	1482
7/27/2007 6:39:26 PM	1700	1483

C. Sensor-by-Sensor Incrementing Count Summary

The system-wide reception rate of incrementing, 1-mm, tip reports for the month was approximately 90 percent. A total of 4,778 incrementing reports were received and a total of 5,285 were expected. The total loss of incrementing reports for the month was approximately 10 percent. Those sensors with the worst rain event transmission performance characteristics are summarized (Table 4).

Table 4. 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					
2190	4080	310	310	4710	1350	150					
4710	1640	4470	1100	1810	310	1700					
4090	4050	850	860	1350	1700	1350					
4820	4180	4570	540	400	210	850					
				4570	110	2340					

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.

Red Rocks Park (ID 2370)

This sensor reported data for the entire month and experienced numerous missing reports on July 27th which was a day with heavy rainfall.

Nott Creek (ID 150)

This sensor reported data for the entire month and experienced numerous missing reports on July 27th which was a day with heavy rainfall.

Cherry Creek at Champa (ID 1700)

This sensor reported data for the entire month and experienced numerous missing reports on July 27th which was a day with heavy rainfall.

Chatfield COE (ID 1350)

This sensor reported data for the entire month and experienced numerous missing reports on July 27th which was a day with heavy rainfall.

Flying J (ID 850)

This sensor reported data for the entire month and experienced numerous missing reports on July 27th which was a day with heavy rainfall.

EI Ranch (ID 2340)

This sensor reported data for the entire month and experienced numerous missing reports on July 27th which was a day with heavy rainfall. This sensor also exhibited a large number of “bad” data reports for the month.

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. July 27, 2007

The heaviest radio traffic for the month occurred in the evening of July 27th between 3:00 PM and 10:00 PM.

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

- 7/27/2007 from 3:00 pm to 4:00 pm (345 reports)
- 7/27/2007 from 4:00 pm to 5:00 pm (515 reports)
- 7/27/2007 from 5:00 pm to 6:00 pm (1,015 reports)
- 7/27/2007 from 6:00 pm to 7:00 pm (1,009 reports)
- 7/27/2007 from 7:00 pm to 8:00 pm (693 reports)
- 7/27/2007 from 8:00 pm to 9:00 pm (537 reports)
- 7/27/2007 from 9:00 pm to 10:00 pm (467 reports)

The peak hour of traffic occurred from 5:00 PM to 6:00 PM when 1,015 reports were received. The period of heaviest traffic was generally a 5 hour period from 4:00 PM to 9:00 PM. The ALERT data for this period was examined more closely to characterize the distribution of sensor traffic (Table 5). During this time the radio traffic was dominated by rain and water level reports.

Table 5. Peak Traffic Period Sensor Report Distribution

Sensor Group	Reports	Percent
Water Level PT-HSE	1,321	32%
Precipitation	992	24%
Wind Gust	290	7%
Relative Humidity	269	6%
Water Level Float	257	6%
Temperature	232	6%
Wind Direction	140	3%
Precipitation - Mean	113	3%
Wind Speed Average	105	3%
Wind Speed Average & Azimuth	103	2%
Hayman Precipitation	102	2%
Water Level PT	94	2%
Battery Voltage HSE	52	1%
Solar Radiation	28	1%
Battery Voltage Digital	22	1%
Barometric Pressure	14	0%
Battery Voltage Analog	14	0%
Fuel Moisture	13	0%
Fuel Temperature	13	0%
Repeater Pass List	5	0%
Handar 585 ALARM Status	4	0%
Repeater Status Report	4	0%
Precipitation - Test	2	0%
12Hr Status Report	1	0%
Battery	1	0%
Total	4,191	

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 6).

Table 6. Peak Traffic Analysis - Loss of Incrementing Tip Reports

Heavy Traffic Period July 27, 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
3:00 pm to 10:00 pm	12	1	0	0

Lost rain reports are evident during the heavy rain period on July 27th from 3:00 pm to 10:00 pm. The majority of lost reports include single and double tip reports. The loss of 3 or more sequential tip reports was observed only once. The only rain sensor to lose 3 sequential reports was Red Rocks Park (ID 2370).

Thirteen percent of the incrementing rain reports were lost during the heavy traffic period.

The loss of 3 or more sequential data reports forms a limit of data degradation that causes a serious problem in the evaluation of alarm threshold conditions to support the flood mitigation needs of emergency responders within the District. The loss of sequential reports is a problem at stream sensors because it could cause the delay in triggering critical alarm conditions.

A water level sensor located at Union Avenue is programmed to report 4 times each hour. Periods where 1 sequential report is missing are evident from the data record (Figure 1). More than 3 missing reports are not evident.

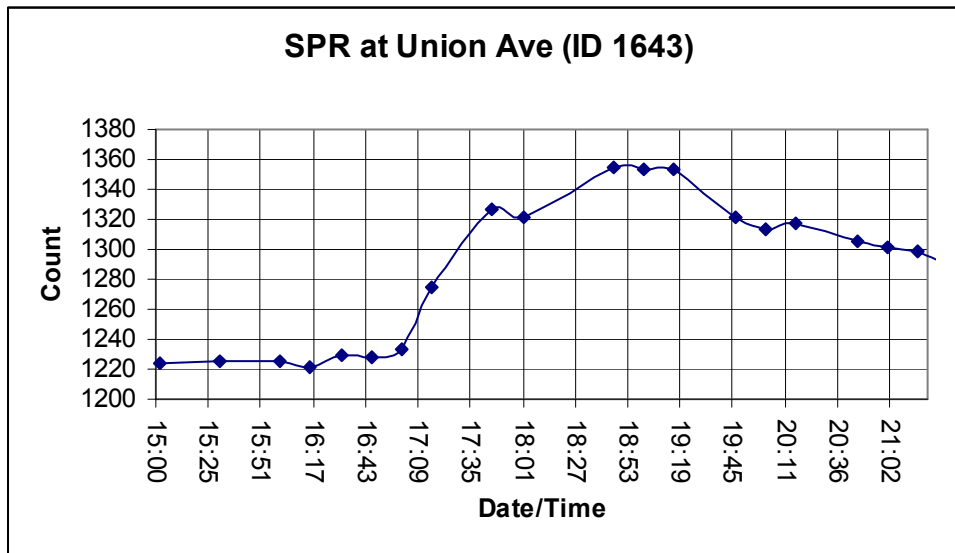


Figure 1. SPR at Union Ave Water Level Plot for July 27 Storm Period

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 7).

Table 7. Summary of Unknown IDs

Description	Quantity
Total number of unknown IDs (IDs without a device definition)	123
Total reports from unknown IDs	331
Unknown IDs with only a single received report (potential noise)	101
Total reports from all IDs – RecData Log entire month	211,694
Unknown reports as a fraction of total reports	0.15%

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 8).

Table 8. Reports Received by Unknown IDs

Unknown Sensor ID	Number of Reports
	63 – this sensor was recently re-programmed
2754	
2239	58
4013	58
1470	11

Unknown Sensor ID	Number of Reports
1635	3
201	3
202	3
4087	3
1314	2
1317	2

The “unknown” device reports were analyzed temporally to understand when they were received during the day (Table 9). 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 9. Temporal Distribution of Unknown Reports

Hour (AM)	Reports	Hour (PM)	Reports
0:00-00:59	6	12:00-12:59	9
1:00-1:59	17	1:00-1:59	15
2:00-2:59	3	2:00-2:59	9
3:00-3:59	7	3:00-3:59	9
4:00-4:59	25	4:00-4:59	32
5:00-5:59	14	5:00-5:59	16
6:00-6:59	1	6:00-6:59	4
7:00-7:59	11	7:00-7:59	15
8:00-8:59	5	8:00-8:59	7
9:00-9:59	22	9:00-9:59	29
10:00-10:59	13	10:00-10:59	21
11:00-11:59	21	11:00-11:59	20

Unknown reports were received during each hour and their distribution throughout the day is shown (Figure 2).

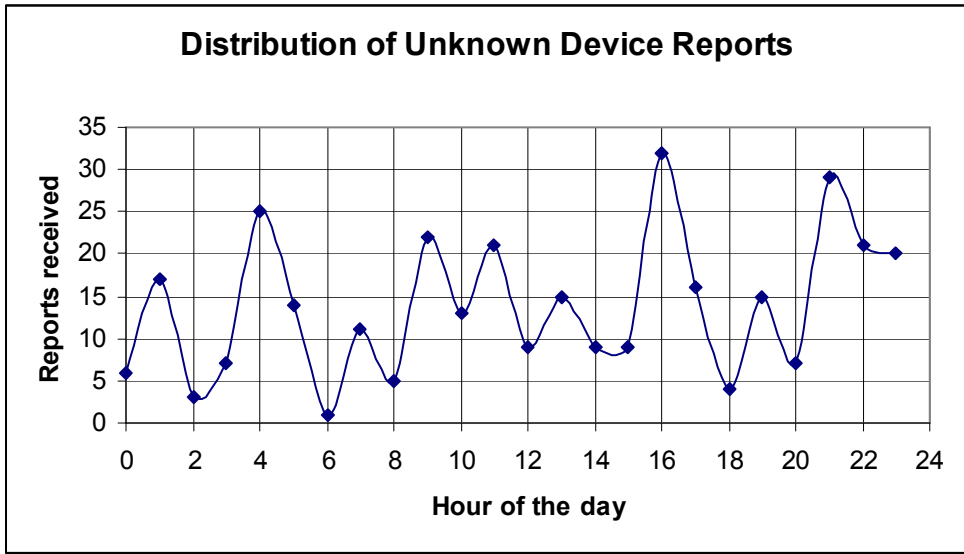


Figure 2. Daily Distribution of Unknown Device Reports

VII. Issues Continued from Previous Month

The following issues were identified last month.

1. **Sand Cr at Mouth (ID 1810), Parker/Mississippi (ID 540), Shop Creek (ID 1710) and Little Narrows (ID 4470):** These sensors all had poor timer performance for the past several months.
2. **Shop Creek (1710), Chatfield COE (1350), Guy Hill Ranch (310), Cherry Creek at Champa (1700), Leyden Confluence (210), Ralston Reservoir (110):** These sensors all exhibited poor event performance for the month. The loss of incrementing reports occurred primarily on June 12th during a heavy precipitation period from approximately 2:00 PM to 7:00 PM.
3. **Ralston Reservoir (ID 110):** The incrementing tip count series missed 9 incrementing reports on June 12th and did not catch up to the correct count until the timer report on June 13th.
4. **Elbert (ID 1440):** On June 28th at 9:04:35 AM a new data series is received at the base station on ID 1440. The month-long count series terminates at 336 on June 28th on at timer report received at 12:05:17 AM. At approximately 9:00 AM on the June 28th a new series is evident that begins at count value 69 and counts up to a value of 78 by 11:00:00 AM on June 28th. The count then jumps back to 336 at the timer interval of June 28th at 12:05:16 PM. A second independent ALERT transmitter may have sent incrementing count values on June 28th which confused the base station. The total rainfall accumulation validated at the base station is in error because of the incrementing tip counts added by the second series of data transmissions. Was it possible that a field calibration took place elsewhere in the system and the transmitter being calibrated was accidentally set to ID 1440?
5. **Reports from “Unknown” Sensor IDs:** 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.

Sensor ID Reports Received	
2239	57
4013	53
1470	14
4031	9
1316	7
1312	6
4601	5
1314	4
1311	4
4739	3
4766	3
2818	3
4053	3

VIII. Issues Identified this Month

Further investigation into the following issues is recommended:

- Those sensors reporting most frequently this month include:
 - Boulder Creek at Broadway (ID 4583) with 3,395 reports,
 - Salisbury Park (ID 2727) with 3,042 reports,
 - Stapleton (ID 1464) with 2,934 reports,
 - Stapleton (ID 1466) with 2,894 reports,
 - Marston Lake North (ID 1521) with 2,882 reports,
 - Squaw Mountain (ID 2189) with 2,845 reports,
 - Elbert (ID 1439) with 2,844 reports,
 - Stapleton (ID 1465) with 2,841 reports, and
 - Green Ditch (ID 4593) with 2,914 reports.
- The following sensors reported infrequently this month and should be inspected:
 - Rowena (ID 4433) with 3 reports,
 - SPR at Dartmouth (ID 1626) with 4 reports,
 - Gunbarrel (ID 1113) with 12 reports, and
 - ETG @ Buckley (ID 823) with 16 reports.
- Sand Creek at Mouth (ID 1810):** This sensor has shown poor timer performance for the past several months.
- Chatfield COE (ID 1350):** This sensor has shown poor event performance for the past several months.
- El Ranch (ID 2340):** This sensor exhibited a large number of “bad” or invalid data reports for the month. It is also a sensor with lower than average timer and event reporting statistics.
- Hidden Lake (ID 1300):** This sensor reported no rainfall for the entire month when nearby stations recorded between 30 to 50 tips. There may be a problem at this station. Why did it report no rain?
- Reports from “Unknown” Sensor IDs:** 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
2239 – Cold Sprg Gulch Conf?	58
4013 – Crescent?	58
1470	11
1635	3
201	3
202	3
4087	3
1314	2
1317	2

- What is the status of the following rain sensors: 2830, 430, 4120, and 4500? Are these sensors all still out of service?

General System Analysis

Database Name P:\A207-UDFCD-Data-Analysis\2007_Jul\Novastar_extract_2007Jul.mdb

First Date in Database	7/1/07 12:00 AM	Total Days	31.0
Last Date in Database	7/31/07 11:59 PM	Total Hours	744.0

Total Records Analyzed 257543

Records by Group

None-ALERT-ID	46069	18%
Wind Gust	35637	14%
Relative Humidity	32829	13%
Temperature	30643	12%
Water Level PT-HSE	25321	10%
Wind Speed Average & Azimuth	16520	6%
Wind Direction	14353	6%
Precipitation	14210	6%
Wind Speed Average	9937	4%
Battery Voltage HSE	6419	2%
Water Level PT	4647	2%
Battery Voltage Digital	3296	1%
Solar Radiation	2934	1%
Water Level Float	2461	1%
Hayman Precipitation	1960	1%
Barometric Pressure	1931	1%
Precipitation - Mean	1743	1%
Fuel Moisture	1456	1%
Fuel Temperature	1442	1%
Battery Voltage Analog	858	0%
Handar 585 ALARM Status	844	0%
Repeater Pass List	605	0%
Repeater Status Report	480	0%
Precipitation - Test	248	0%
12Hr Status Report	223	0%
Longmont Flow Gage	164	0%
Battery	117	0%
Soil Moisture	65	0%
Longmont Water Level PT	56	0%
Solar Power	5	0%
Total	257473	

Records by Major Group

Meteorologic Sensors	144784	56%
Water Level Sensors	32649	13%
Rain Sensors	14210	6%
Sensor Status Transmissions	12730	5%
Soil and Fuel Sensors	2963	1%
Total	207336	

Records by Validation Type

Good	0	256175	99%
Questionable	1	1368	1%
Total		257543	

Sensors With Most Invalid Data

Description	Sensor	Reports
Squaw Mountain	2189	880
Louisville Lake	4744	42
Castle Rock	2744	28
Salisbury Park	2724	26
Blue Mountain	143	23

Traffic Loading Summary

Alert Reports	257543	
Average Daily Traffic	8308	
Average Hourly Traffic	346	
Median Hourly Traffic	338	hour beginning
Peak Hourly Traffic	1015	7/27/07 5:00 PM

Rain Timer Performance

Analyze Rain Sensors

systemwide average (days)
0.5180

Systemwide Average
90%

Rain Sensors	Description	Rcvd	Average Timer Interval	Expected	Performance
100	Carr Street	59	12:24	62.00	95%
110	Ralston Reservoir	50	14:11	62.00	81%
120	West Woods	56	13:07	62.00	90%
140	Blue Mountain	60	12:13	62.00	97%
150	Nott Creek	55	12:16	62.00	89%
200	Leyden Reservoir	60	12:11	62.00	97%
210	Leyden Confluence	59	12:23	62.00	95%
220	Upper Leyden	58	12:14	62.00	94%
300	Van Bibber Park	57	12:25	62.00	92%
310	Guy Hill Ranch	54	12:59	62.00	87%
320	Sports Complex	58	12:24	62.00	94%
330	Van Bibber @ Hwy 93	65	10:54	62.00	105%
400	Montview Park	58	12:37	62.00	94%
410	Kelly Dam	58	12:12	62.00	94%
420	Expo Park	59	11:57	62.00	95%
440	Fire Station #7	59	12:23	62.00	95%
500	Havana Park	59	12:19	62.00	95%
510	Virginia Court	52	12:56	62.00	84%
520	Jewell Detention	57	12:26	62.00	92%
530	Fire Station #19	56	13:08	62.00	90%
540	Parker/Mississippi	58	11:57	62.00	94%
600	Harvard Gulch Park	61	11:58	62.00	98%
610	Harvard @ Jackson	59	11:57	62.00	95%
620	Quincy/Highline	57	12:42	62.00	92%
630	Temple Pond at DTC	58	11:57	62.00	94%
640	Goldsmith @ Eastman	60	12:15	62.00	97%
650	Iliff Pond	56	12:59	62.00	90%
700	Toll Gate @ 6th	59	12:00	62.00	95%
710	Horseshoe Park Drop	59	12:24	62.00	95%
720	Confluence Pond	57	12:30	62.00	92%
730	No Name @ Quincy	60	12:10	62.00	97%
740	Smoky Hill	60	12:13	62.00	97%
750	Quincy Reservoir	58	12:14	62.00	94%
760	Mission Viejo Park	55	12:34	62.00	89%
800	Sable Ditch @ 18th	59	12:25	62.00	95%
810	Granby Ditch @ 6th	59	12:11	62.00	95%
820	ETG @ Buckley	60	12:10	62.00	97%
830	Side Creek Park	55	11:57	62.00	89%
840	Fire Station 12	56	12:44	62.00	90%
850	Flying J	59	12:00	62.00	95%
860	Sand Cr at Colfax	119	6:06	62.00	192%
870	Murphy Creek GC	56	12:30	62.00	90%
900	Aurora Reservoir	49	13:50	62.00	79%
1000	Maple Grove Resv.	58	12:37	62.00	94%
1010	Denver West	58	12:39	62.00	94%
1020	Lena @ Nolte Pond	57	12:51	62.00	92%
1030	NREL/S. Table Mtn.	59	12:25	62.00	95%
1040	Lena @ U.S. Hwy 6	58	12:26	62.00	94%
1050	Jeffco Fairgrounds	56	12:40	62.00	90%
1060	Heritage Square	59	12:10	62.00	95%
1100	Louisville Rec Ctr	54	12:59	62.00	87%
1110	Gunbarrel	58	12:14	62.00	94%
1200	Broomfield 3207	52	14:18	62.00	84%
1300	Hidden Lake	59	12:10	62.00	95%
1310	LDC at 64th	59	12:10	62.00	95%
1320	SPR at 3rd Ave	57	12:25	62.00	92%
1330	Roslyn	54	13:28	62.00	87%
1340	Sanderson at Xavier	56	12:56	62.00	90%
1350	Chatfield COE	56	13:09	62.00	90%
1360	Denver Zoo	60	12:13	62.00	97%
1370	West Metro FS13	58	12:13	62.00	94%
1400	Upper Sloan Det.	54	13:11	62.00	87%
1420	Diamond Hill	60	12:12	62.00	97%
1440	Elbert	57	12:30	62.00	92%
1460	Stapleton	28	1:08	62.00	45%
1480	Third Creek at DIA	58	12:40	62.00	94%
1500	Powers Park	54	12:44	62.00	87%
1520	Marston Lake North	59	12:25	62.00	95%
1530	Bear Creek @ Lowell	59	12:11	62.00	95%
1540	Sanderson at Xavier	61	11:57	62.00	98%
1600	Englewood Dam	60	12:11	62.00	97%
1610	Holly Dam	59	12:22	62.00	95%
1620	Slaughterhouse Glch	60	12:11	62.00	97%
1640	SPR at Union Ave.	59	12:27	62.00	95%
1660	SPR at Henderson	57	12:26	62.00	92%
1700	Cherry Cr @ Champa	56	13:07	62.00	90%
1710	Shop Creek	58	12:41	62.00	94%
1720	Cherry Cr @ Steele	57	13:00	62.00	92%

1800	Sand Creek Park	57	12:51	62.00	92%
1810	Sand Creek at mouth	39	18:00	62.00	63%
1900	Niver Detention	58	12:52	62.00	94%
1920	Brighton	60	12:13	62.00	97%
2190	Squaw Mountain	54	13:25	62.00	87%
2210	Hiwan G.C.	55	12:00	62.00	89%
2220	Evergreen Lake	60	12:10	62.00	97%
2230	Bear Cr below Cub	58	12:15	62.00	94%
2240	Cold Sprg Glch conf	55	12:32	62.00	89%
2250	Rosedale	48	11:38	62.00	77%
2260	Brook Forest	55	12:17	62.00	89%
2270	Cub Cr below Blue	61	12:14	62.00	98%
2280	Kinney Peak	61	12:00	62.00	98%
2310	Genesee Village	52	13:12	62.00	84%
2320	Choke Cherry Resvr	218		62.00	
2330	Morrison	62	11:44	62.00	100%
2340	El Rancho	51	13:49	62.00	82%
2350	Idledale	46	15:04	62.00	74%
2360	Indian Hills	61	12:00	62.00	98%
2370	Red Rocks Park	53	12:16	62.00	85%
2710	Highlands Ranch WTP	61	12:00	62.00	98%
2730	Salisbury Park	57	12:14	62.00	92%
2750	Castle Rock	60	12:13	62.00	97%
2810	Pine Cliff Road	57	12:55	62.00	92%
2820	Haskins Gulch Conf	59	12:27	62.00	95%
2840	Sulphur Gulch	56	12:44	62.00	90%
4010	Crescent	51	13:27	62.00	82%
4020	Rio Grande	57	12:44	62.00	92%
4030	Red Garden	54	13:03	62.00	87%
4040	Martin Gulch	59	12:12	62.00	95%
4050	Walker Ranch	60	11:57	62.00	97%
4060	Lakeshore	51	13:43	62.00	82%
4070	Bear Peak	57	12:43	62.00	92%
4080	Twin Sisters	49	12:35	62.00	79%
4090	Magnolia	52	13:06	62.00	84%
4100	Filter Plant	58	12:29	62.00	94%
4110	Betasso	59	12:28	62.00	95%
4130	Swiss Peaks	50	14:23	62.00	81%
4140	Logan Mill	52	13:17	62.00	84%
4150	Gold Hill	53	12:49	62.00	85%
4160	Sunshine	58	12:13	62.00	94%
4170	Pine Brook	55	12:44	62.00	89%
4180	Gold Lake	53	11:57	62.00	85%
4190	Slaughterhouse	59	12:14	62.00	95%
4200	Lazy Acres	48	13:42	62.00	77%
4220	Fling's	55	12:37	62.00	89%
4230	Golden Age	59	11:57	62.00	95%
4240	Sunset	48	14:21	62.00	77%
4250	Geer Canyon	59	12:26	62.00	95%
4260	Taylor Mountain	56	13:08	62.00	90%
4270	Cannon Mountain	55	12:51	62.00	89%
4290	Red Hill	50	13:27	62.00	81%
4300	Big Elk Park	60	11:57	62.00	97%
4310	Johnny Park	60	11:57	62.00	97%
4330	Indian Ruins	60	12:13	62.00	97%
4340	Riverside	60	12:14	62.00	97%
4350	Conifer Hill	57	12:15	62.00	92%
4360	Justice Center	59	12:25	62.00	95%
4470	Little Narrows	53	13:13	62.00	85%
4490	Apple Valley	56	12:27	62.00	90%
4510	Pinewood Springs	54	12:47	62.00	87%
4520	Eagle Ridge	61	12:00	62.00	98%
4530	Winiger Ridge	51	12:53	62.00	82%
4560	Lyons Diversion NSV	42	17:01	62.00	68%
4570	St. Antons	49	12:39	62.00	79%
4710	Ward C-1	54	12:36	62.00	87%
4730	Sugarloaf	54	13:04	62.00	87%
4750	Louisville Lake	53	13:30	62.00	85%
4770	Cal-Wood Ranch	60	12:18	62.00	97%
4790	Button Rock	56	12:50	62.00	90%
4810	Shanahan Ridge	59	12:11	62.00	95%
4820	Doudy Draw	48	14:18	62.00	77%
4840	SBC@S Boulder Ditch	57	12:26	62.00	92%

Rain Event Performance		Reports Received	Analyze Rain Sensors											
	Systemwide Avg	Total Tips												
	90%	Data Loss												
Rain Sensor	Performance	1-tips	2-tips	3-tips	4-tips	5-tips	6-tips	>6-tips	Rcvd	Exp	Miss	Holdoff	Bucket	
2370	24%	6	1	1	1	0	0	2	9	38	6	0	0.0393701	
150	46%	13	2	2	1	0	0	1	18	39	9	1	0.0393701	
1700	67%	24	4	0	0	0	0	1	28	42	4	0	0.0393701	
1350	68%	15	4	1	0	1	0	0	21	31	10	0	0.0393701	
850	75%	13	4	1	0	0	0	0	18	24	6	0	0.0393701	
2310	75%	27	7	1	1	0	0	0	36	48	12	1	0.0393701	
860	77%	16	2	2	0	0	0	0	20	26	6	0	0.0393701	
2280	77%	19	4	0	1	0	0	0	24	31	7	4	0.0393701	
2340	78%	11	2	1	0	0	0	0	14	18	4	0	0.0393701	
4470	78%	34	11	1	0	0	0	0	46	59	13	0	0.0393701	
1200	78%	14	3	1	0	0	0	0	18	23	5	0	0.0393701	
1310	79%	28	8	1	0	0	0	0	37	47	10	0	0.0393701	
1340	79%	20	5	1	0	0	0	0	26	33	7	0	0.0393701	
4170	80%	16	3	1	0	0	0	0	20	25	5	0	0.0393701	
4060	80%	18	6	0	0	0	0	0	24	30	6	0	0.0393701	
4570	81%	40	10	1	0	0	0	0	51	63	12	0	0.0393701	
4790	83%	49	7	1	1	0	0	0	58	70	12	0	0.0393701	
4010	83%	12	3	0	0	0	0	0	15	18	3	0	0.0393701	
4220	84%	42	8	1	0	0	0	0	51	61	10	0	0.0393701	
4530	84%	31	7	0	0	0	0	0	38	45	7	0	0.0393701	
730	85%	10	0	1	0	0	0	0	11	13	2	0	0.0393701	
320	85%	18	4	0	0	0	0	0	22	26	4	0	0.0393701	
4130	85%	19	2	1	0	0	0	0	22	26	4	0	0.0393701	
1520	85%	24	3	1	0	0	0	0	28	33	5	0	0.0393701	
2240	85%	15	1	1	0	0	0	0	17	20	3	1	0.0393701	
4240	85%	31	2	2	0	0	0	0	35	41	6	0	0.0393701	
810	86%	10	2	0	0	0	0	0	12	14	2	0	0.0393701	
1030	86%	10	2	0	0	0	0	0	12	14	2	0	0.0393701	
530	86%	15	3	0	0	0	0	0	18	21	3	0	0.0393701	
4360	86%	16	1	1	0	0	0	0	18	21	3	0	0.0393701	
1000	86%	21	2	1	0	0	0	0	24	28	4	0	0.0393701	
4150	86%	36	5	1	0	0	0	0	42	49	7	0	0.0393701	
410	86%	27	5	0	0	0	0	0	32	37	5	0	0.0393701	
1530	87%	40	5	1	0	0	0	0	46	53	7	0	0.0393701	
1900	87%	23	4	0	0	0	0	0	27	31	4	0	0.0393701	
4090	87%	42	5	1	0	0	0	0	48	55	7	0	0.0393701	
1010	88%	18	3	0	0	0	0	0	21	24	3	0	0.0393701	
520	88%	24	4	0	0	0	0	0	28	32	4	0	0.0393701	
1110	88%	30	5	0	0	0	0	0	35	40	5	5	0.0393701	
4180	88%	32	1	2	0	0	0	0	35	40	5	0	0.0393701	
210	88%	13	2	0	0	0	0	0	15	17	2	0	0.0393701	
330	88%	13	2	0	0	0	0	0	15	17	2	1	0.0393701	
2330	88%	13	2	0	0	0	0	0	15	17	2	0	0.0393701	
4230	88%	53	8	0	0	0	0	0	61	69	8	1	0.0393701	
1040	89%	7	1	0	0	0	0	0	8	9	1	0	0.0393701	
1800	89%	7	1	0	0	0	0	0	8	9	1	0	0.0393701	
840	89%	21	3	0	0	0	0	0	24	27	3	0	0.0393701	
4140	89%	29	2	1	0	0	0	0	32	36	4	0	0.0393701	
4080	89%	35	5	0	0	0	0	0	40	45	5	0	0.0393701	
4710	89%	70	10	0	0	0	0	0	80	90	10	0	0.0393701	
510	89%	29	4	0	0	0	0	0	33	37	4	0	0.0393701	
4510	89%	37	5	0	0	0	0	0	42	47	5	0	0.0393701	
870	89%	83	9	1	0	0	0	0	93	104	11	0	0.0393701	
1100	89%	15	2	0	0	0	0	0	17	19	2	0	0.0393701	
1360	90%	16	2	0	0	0	0	0	18	20	2	0	0.0393701	
1640	90%	32	4	0	0	0	0	0	36	40	4	0	0.0393701	
4490	90%	33	4	0	0	0	0	0	37	41	4	0	0.0393701	
4750	90%	17	2	0	0	0	0	0	19	21	2	0	0.0393701	
1710	91%	26	3	0	0	0	0	0	29	32	3	0	0.0393701	
4730	91%	35	4	0	0	0	0	0	39	43	4	0	0.0393701	
1050	91%	9	1	0	0	0	0	0	10	11	1	0	0.0393701	
2360	91%	9	1	0	0	0	0	0	10	11	1	0	0.0393701	
2810	91%	9	1	0	0	0	0	0	10	11	1	0	0.0393701	
4820	91%	9	1	0	0	0	0	0	10	11	1	0	0.0393701	
2320	91%	27	3	0	0	0	0	0	30	33	3	0	0.0393701	
1420	91%	37	2	1	0	0	0	0	40	44	4	0	0.0393701	
4290	91%	28	3	0	0	0	0	0	31	34	3	0	0.0393701	
310	91%	29	3	0	0	0	0	0	32	35	3	0	0.0393701	
4770	92%	73	7	0	0	0	0	0	80	87	7	0	0.0393701	
2190	92%	44	2	1	0	0	0	0	47	51	4	1	0.0393701	
120	92%	11	1	0	0	0	0	0	12	13	1	0	0.0393701	
2270	92%	22	2	0	0	0	0	0	24	26	2	2	0.0393701	
600	93%	34	3	0	0	0	0	0	37	40	3	0	0.0393701	
4520	93%	23	2	0	0	0	0	0	25	27	2	0	0.0393701	

1500	93%	120	8	1	0	0	0	0	129	139	10	0	0.0393701
4190	93%	72	6	0	0	0	0	0	78	84	6	0	0.0393701
750	93%	13	1	0	0	0	0	0	14	15	1	0	0.0393701
400	93%	26	2	0	0	0	0	0	28	30	2	0	0.0393701
650	93%	40	3	0	0	0	0	0	43	46	3	0	0.0393701
700	94%	14	1	0	0	0	0	0	15	16	1	0	0.0393701
1810	94%	14	1	0	0	0	0	0	15	16	1	0	0.0393701
1400	94%	28	2	0	0	0	0	0	30	32	2	0	0.0393701
720	94%	42	3	0	0	0	0	0	45	48	3	0	0.0393701
2820	94%	42	3	0	0	0	0	0	45	48	3	0	0.0393701
420	94%	86	4	1	0	0	0	0	91	97	6	0	0.0393701
630	94%	73	1	2	0	0	0	0	76	81	5	0	0.0393701
4330	94%	58	4	0	0	0	0	0	62	66	4	0	0.0393701
4260	94%	60	4	0	0	0	0	0	64	68	4	0	0.0393701
1480	94%	31	2	0	0	0	0	0	33	35	2	2	0.0393701
2710	94%	31	2	0	0	0	0	0	33	35	2	0	0.0393701
2250	94%	33	0	1	0	0	0	0	34	36	2	1	0.0393701
110	95%	17	1	0	0	0	0	0	18	19	1	0	0.0393701
620	95%	34	2	0	0	0	0	0	36	38	2	0	0.0393701
1320	95%	35	2	0	0	0	0	0	37	39	2	0	0.0393701
500	95%	53	3	0	0	0	0	0	56	59	3	0	0.0393701
440	95%	18	1	0	0	0	0	0	19	20	1	0	0.0393701
1600	95%	19	1	0	0	0	0	0	20	21	1	0	0.0393701
2840	95%	19	1	0	0	0	0	0	20	21	1	0	0.0393701
760	95%	39	2	0	0	0	0	0	41	43	2	0	0.0393701
1720	95%	39	2	0	0	0	0	0	41	43	2	1	0.0393701
4200	95%	59	3	0	0	0	0	0	62	65	3	0	0.0393701
900	95%	20	1	0	0	0	0	0	21	22	1	0	0.0393699
4020	95%	20	1	0	0	0	0	0	21	22	1	0	0.0393701
4050	95%	20	1	0	0	0	0	0	21	22	1	0	0.0393701
4310	96%	62	1	1	0	0	0	0	64	67	3	0	0.0393701
2350	96%	21	1	0	0	0	0	0	22	23	1	0	0.0393701
4040	96%	21	1	0	0	0	0	0	22	23	1	0	0.0393701
610	96%	42	2	0	0	0	0	0	44	46	2	0	0.0393701
4340	96%	65	3	0	0	0	0	0	68	71	3	0	0.0393701
4030	96%	22	1	0	0	0	0	0	23	24	1	0	0.0393701
1440	96%	51	2	0	0	0	0	0	53	55	2	1	0.0393701
4160	96%	53	2	0	0	0	0	0	55	57	2	0	0.0393701
4070	97%	27	1	0	0	0	0	0	28	29	1	0	0.0393701
2260	97%	28	1	0	0	0	0	0	29	30	1	1	0.0393701
2730	97%	30	1	0	0	0	0	0	31	32	1	0	0.0393701
2230	97%	32	1	0	0	0	0	0	33	34	1	1	0.0393701
4250	97%	32	1	0	0	0	0	0	33	34	1	0	0.0393701
4300	97%	68	2	0	0	0	0	0	70	72	2	0	0.0393701
4270	97%	69	2	0	0	0	0	0	71	73	2	0	0.0393701
540	97%	37	1	0	0	0	0	0	38	39	1	0	0.0393701
640	98%	45	1	0	0	0	0	0	46	47	1	0	0.0393701
1620	98%	48	1	0	0	0	0	0	49	50	1	0	0.0393701
830	98%	50	1	0	0	0	0	0	51	52	1	0	0.0393701
2750	98%	58	1	0	0	0	0	0	59	60	1	0	0.0393701
4350	99%	68	1	0	0	0	0	0	69	70	1	0	0.0393701
820	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701
1060	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701
1370	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701
1460	100%	11	0	0	0	0	0	0	11	11	0	0	0.0393701
710	100%	12	0	0	0	0	0	0	12	12	0	0	0.0393701
740	100%	12	0	0	0	0	0	0	12	12	0	0	0.0393701
1330	100%	12	0	0	0	0	0	0	12	12	0	0	0.0393701
1660	100%	13	0	0	0	0	0	0	13	13	0	0	0.0393701
220	100%	14	0	0	0	0	0	0	14	14	0	1	0.0393701
300	100%	14	0	0	0	0	0	0	14	14	0	0	0.0393701
800	100%	14	0	0	0	0	0	0	14	14	0	0	0.0393701
1540	100%	14	0	0	0	0	0	0	14	14	0	0	0.0393701
200	100%	15	0	0	0	0	0	0	15	15	0	0	0.0393701
4810	100%	17	0	0	0	0	0	0	17	17	0	0	0.0393701
4840	100%	18	0	0	0	0	0	0	18	18	0	0	0.0393701
140	100%	23	0	0	0	0	0	0	23	23	0	0	0.0393701
100	100%	34	0	0	0	0	0	0	34	34	0	0	0.0393701
4100	100%	34	0	0	0	0	0	0	34	34	0	0	0.0393701
2210	100%	40	0	0	0	0	0	0	40	40	0	1	0.0393701
1920	100%	42	0	0	0	0	0	0	42	42	0	0	0.0393701
4110	100%	45	0	0	0	0	0	0	45	45	0	0	0.0393701
	Total Tips	4369	363	40	5	1	0	4	4778	5285	462		

