Memo

Water & Earth Technologies, Inc.
Water Resources and Environmental Consulting

Date: May 2, 2008

To: Kevin Stewart and Chad Kudym

From: Markus Ritsch

Subject: **April 2008 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 April 1 through April 30, 2008.

II. General System Analysis Summary

A total of 302,353 individual processed data records were analyzed from the ALERT 2 base station. Of the total, approximately 259,833 were ALERT radio reports. Meteorological sensors account for 79 percent, water level sensors 9 percent, and rain sensors 5 percent of the total monthly transmissions.

Ninety-nine percent of the received data reports were flagged as "good" by the Nova Star validation process. Roughly 2,552 reports were flagged as "bad". Of these "bad" reports, 1,091 originated from Quincy Reservoir (ID 757-Wind Gust and ID 755), 580 invalid reports came from Aurora Reservoir (ID 908-Solar Radiation), and 98 invalid reports came from Ralston Reservoir (ID 113).

The system-wide radio traffic loading was 10,078 reports per day with an average hourly loading of 420 reports. The peak hourly traffic loading was 772 reports, which occurred on April 17, between 11:00 AM and 12:00 PM. A plot of monthly average and peak hourly traffic loading is provided.

A total of 650 reports were received from the Hayman rain sensors this month. These reports make up less than 1% of the total reports for the month.

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

1. Quincy Reservoir (ID 749 - Wind) with 7,216 reports,
2. Marston Lake North (ID 1521 - Relative Humidity) with 5,022 reports,
3. Castle Rock (ID 2747 - Wind) with 4,503 reports, and
4. Salisbury Park (ID 2727 - Wind) with 4,577 reports.

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

The sensors reporting infrequently this month include:

1. Utah Park (ID 430) with 1 report, - *this station may be discontinued*
2. SPR at Dartmouth (ID 1626 Handar 585 alarm status) with 2 reports,
3. Stapleton (ID 1463 – barometric pressure) with 3 reports,
4. Gunbarrel (ID 1113 – water level) with 6 reports,
5. SPR at Henderson (ID 1656) with 7 reports, and
6. SPR at 19th Street (ID 1646) with 8 reports.

All stations should be up and running and fully functional before April 1.

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 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
2190	1660	1350	1710								
140	2190	110	540								
4150	140	2190	1600								
4060	4170	1370	1350								
4470	4150	620	710								
4530	4530	840	4330								

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.

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) are 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	20.57	Only the 1-mm rain sensors were included in the analysis
Median	19.5	Only the 1-mm rain sensors were included in the analysis
Standard deviation	9.63	Only the 1-mm rain sensors were included in the analysis
Mean plus three standard deviations	49.47	Only the 1-mm rain sensors were included in the analysis
Minimum total count	1	Brighton ETO (ID 1570)
Maximum total count	70	Aurora Town Hall (ID 920)

The highest reporting rain sensor was Aurora Town Hall (ID 920) and the lowest reporting rain sensor was Brighton ETO (ID 1570). One sensor reported more than the system-wide mean plus 3 standard deviations and this was Aurora Town Hall. Data from sensors reporting more than the system-wide mean plus three standard deviations are inspected manually.

B. Aurora Town Hall (ID 920)

This sensor reported 70 incrementing transmissions (2.76 inches) for the month. Nothing suspicious is evident in the incrementing count series, other than a lot of tips were recorded. This sensor is **not** identified as being affected by lawn irrigation.

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	11.29	29.00
2008	4.05	7.38	12.26	20.57									

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

Several sensors had a jump in sequential count of more than six this month (Table 4). These large jumps are investigated through a manual inspection of the count series.

Table 4. Sensors with a Jump of More than 6 in Sequential Count

Sensor Description	Sensor ID	Comment
Marston Lake North	1520	Count values jump between expected count series and 2046/2047 on April 4 and 7. Transmitter looks to have been serviced and fixed on April 7, 2008.
Sulphur Gulch	2840	Large jump on station start-up, 4/1/08

D. Sensor-by-Sensor Incrementing Count Summary

The system-wide reception rate of incrementing, 1-mm tip reports for the month was approximately 94 percent. A total of 2,967 incrementing reports were received and a total of 3,168 were expected. The total loss of incrementing reports for the month was approximately 6 percent. Those sensors with the worst rain event transmission performance characteristics are summarized (Table 5).

Table 5. Monthly Summary of Sensors with the Most Missed Tips

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1640	4520	2930	1710								
2190	4820	540	1600								
750	4530	2730	540								
4570	4470	2210	700								
2990	4810	110	110								
--	700	1350	840								

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 those sensors with an event performance of less than 70 % is manually inspected.

a. Shop Creek (ID 1710)

This sensor has a continuous series for the entire month. A large number of reports were not received on April 9, April 10 and April 11. Other than the missing reports, the continuous incrementing series looks reasonable.

b. Englewood Dam (ID 1600)

This sensor has a continuous series from April 2 through April 29. A large number of reports were not received on April 9 and April 10. Other than the missing reports, the continuous incrementing series looks reasonable.

c. Parker/Mississippi (ID 540)

This sensor has a continuous series from April 1 through April 27. A large number of reports were not received on April 9 and April 10. Other than the missing reports, the continuous incrementing series looks reasonable.

Since each sensor was missing a large number of reports on April 9 and April 10, it may be that the base station was not receiving data during this period.

V. Heavy Radio Traffic Analysis

For each month, periods exceeding 700 messages per hour are analyzed independently in an attempt to identify rain tip sequences where 3 or more, sequential messages are lost.

A. The Heaviest Traffic Period This Month

The hourly periods of highest radio traffic this month include:

- April 17 from 11:00 AM to 12:00 PM (772 reports)
- April 17 from 12:00 PM to 1:00 PM (732 reports)
- April 17 from 10:00 AM to 11:00 AM (693 reports)
- April 7 from 12:00 PM to 1:00 PM (633 reports)

B. April 17, 2008

The distribution of hourly traffic around the peak hour is summarized:

- April 17 from 11:00 AM to 12:00 PM (772 reports)
- April 17 from 12:00 PM to 1:00 PM (732 reports)
- April 17 from 10:00 AM to 11:00 AM (693 reports)

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). Overall, 8% of the incrementing tip reports were lost during this period.

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

	Occurrences of lost sequential tip reports during period			
Heavy Traffic Period (April 17, 2008)	**Loss of 2 sequential tips**	**Loss of 3 sequential tips**	**Loss of 4 sequential tips**	**Loss of 5 sequential tips**
9:00 AM to 2:00 PM	5	1	0	0

One sensor, Slaughterhouse (ID 4190) lost three sequential incrementing reports during the 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)	209
Total reports from unknown IDs	2,001
Unknown IDs with only a single received report (potential noise)	134
Total reports from all IDs – RecData Log entire month	259,833
Unknown reports as a fraction of total reports	0.77%

The total number of reports from unknown sensors 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 shown (Table 8).

Table 8. Reports Received by Unknown IDs

Unknown Sensor	Reports
4765	100
117	70
112	66
116	66
111	63
114	62
118	62
135	61
2355	60
205	60
1635	59
2315	59
2375	58
505	58
4763	57
2265	57
2245	57
1385	56
1725	56
4762	56
2255	56
635	55
2235	55
155	54
335	54
1115	52
2285	50
1650	50
1655	29
1665	22
4766	10

The "unknown" device reports are analyzed temporally to understand when they are 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	114	12:00-12:59	104
1:00-1:59	192	1:00-1:59	106
2:00-2:59	48	2:00-2:59	61
3:00-3:59	52	3:00-3:59	39
4:00-4:59	40	4:00-4:59	56
5:00-5:59	35	5:00-5:59	41
6:00-6:59	92	6:00-6:59	87
7:00-7:59	159	7:00-7:59	169
8:00-8:59	122	8:00-8:59	121
9:00-9:59	104	9:00-9:59	104
10:00-10:59	194	10:00-10:59	165
11:00-11:59	258	11:00-11:59	246

Reports from unknown sensors occur each hour of the day. A peak in the reception of "unknown" sensors is evident around noon and at midnight.

VII. Issues Identified this Month

Sensors with a large number of invalid reports:

1. Quincy Reservoir (ID 757) - Wind with 1,028 invalid reports,
2. Aurora Reservoir (ID 908) - Solar Radiation with 580 invalid reports,
3. Squaw Mountain (ID 2192) - Temperature with 95 reports,
4. Quincy Reservoir (ID 755) - Battery Voltage with 63 reports, and
5. Ralston Reservoir (ID 113) - Water Level PT with 98 reports.

Sensors reporting frequently (over reporting):

6. Quincy Reservoir (ID 749) - Wind with 7,216 reports,
7. Marston Lake North (ID 1521) - Relative Humidity with 5,022 reports,
8. Castle Rock (ID 2747) - Wind with 4,503 reports, and
9. Salisbury Park (ID 2727) - Wind with 4,577 reports.

Sensors reporting infrequently (under reporting):

10. Utah Park (ID 430) with 1 report,
11. SPR at Dartmouth (ID 1626) with 2 reports,
12. Stapleton (ID 1463) with 3 reports,
13. Gunbarrel (ID 1113) with 6 report,
14. SPR at Henderson (ID 1656) with 7 reports, and
15. SPR at 19th Street (ID 1646) with 8 reports.

Poor timer reporting:

The following sensors reported for the entire month and showed poor timer performance.

16. **Shop Creek (ID 1710) -** Only 45% of the timer reports received for the entire month.
17. **Parker/Mississippi (ID 540)** - Only 52% of the event reports were received.
18. **Englewood Dam (ID 1600)** - Only 63% of the event reports were received.
19. **Chatfield COE (ID 1350) -** Only 65% of the timer reports received for the entire month.
20. **Horseshoe Park Drop (ID 710)** - Only 67% of the timer reports were received from this sensor.
21. **Indian Ruins (ID 4330)** - Only 67% of the timer reports were received from this sensor.

Poor event reporting:

The following sensors reported for the entire month and showed poor event performance.

22. **Shop Creek (ID 1710) -** Only 52% of the timer reports received for the entire month.
23. **Englewood Dam (ID 1600)** - Only 60% of the event reports were received
24. **Parker/Mississippi (ID 540)** - Only 62% of the event reports were received.

Low rain total:

25. **Brighton ETO (ID 1570) -** This sensor recorded only 1 tip for the entire month. Nothing suspicious in the data series. Surrounding stations also had low monthly totals.
26. **Elbert (ID 1440) -** This sensor recorded only 4 tips for the entire month.

27. **Salisbury Park (ID 2730) -** This sensor recorded only 4 tips for the entire month.
28. **Castle Rock (ID 2750) -** This sensor recorded only 5 tips for the entire month.

High rain total:

29. **Aurora Town Hall (ID 920)** - This was the highest recording sensor for the month with a total of 70 tips. Nothing suspicious was identified in the incrementing series.
30. **Gold Lake (ID 4180)** - This sensor had a total of 42 tips for the month.
31. **St. Antons (ID 4570)** - This sensor had a total of 41 tips for the month.
32. **Gold Hill (ID 4150)** - This sensor had a total of 38 tips for the month.

Large Jump in Sequential Count (bit flip errors/contention loss/transmitter problems):

33. **Marston Lake North (ID 1520)** - This sensor experienced several large jumps in count due to transmitter problems that were resolved by OneRain on April 7, 2008. Beginning on April 8, it reports normally.
34. **Sulphur Gulch (ID 2840)** - This sensor experienced several large jumps in count on April 1.

Reports from "Unknown Sensors":

35. The following table shows the "unknown" sensor IDs and the total number of reports received during the month. These reports indicate the existence of transmitters that are sending information on an ID that is not currently defined within NovaStar.

Unknown Sensor	Reports
4765	100
117	70
112	66
116	66
111	63
114	62
118	62
135	61
2355	60
205	60
1635	59
2315	59
2375	58
505	58
4763	57
2265	57
2245	57
1385	56
1725	56
4762	56
2255	56
635	55
2235	55
155	54
335	54
1115	52
2285	50
1650	50
1655	29
1665	22
4766	10

General System Analysis

Database Name P:\A207-UDFCD-Data-Analysis\2008_Apr\Novastar_extract_2008Apr.mdb

First Date in Database	4/1/08 12:00 AM	**Total Days**	30.0
Last Date in Database	4/30/08 11:59 PM	**Total Hours**	720.0

Total Records Analyzed 302353

Records by Group

Wind Gust	49736	16%
None-ALERT-ID	45412	15%
Relative Humidity	35864	12%
Temperature	34364	11%
Wind Speed Average & Azimuth	25213	8%
Wind Direction	19263	6%
Wind Speed Average	16302	5%
Water Level PT-HSE	13023	4%
Precipitation	12166	4%
Barometric Pressure	9125	3%
Solar Radiation	8544	3%
Water Level Float	6346	2%
Battery Voltage HSE	6222	2%
Battery Voltage Analog	3385	1%
Battery Voltage Digital	3026	1%
Water Level PT	2521	1%
Fuel Moisture	2185	1%
Fuel Temperature	2183	1%
Precipitation - Mean	1714	1%
Hayman Precipitation	650	0%
Longmont Water Level PT	630	0%
Repeater Pass List	611	0%
Repeater Status Report	479	0%
12Hr Status Report	346	0%
Precipitation - Test	244	0%
Battery	229	0%
Longmont Flow Gage	115	0%
Soil Moisture	64	0%
Handar 585 ALARM Status	60	0%
Total	300022	99%
	254610	

Records by Major Group

Meteorologic Sensors	198411	79%
Water Level Sensors	22635	9%
Sensor Status Transmissions	14129	6%
Rain Sensors	12166	5%
Soil and Fuel Sensors	4432	2%
Total	251773	100%

Records by Validation Type

Good	0	299801	99%
Questionable	1	2552	1%
	Total	302353	

Sensors With Most Invalid Data

Description	**Sensor**	**Reports**
Quincy Reservoir	757	1028
Aurora Reservoir	908	580
Ralston Reservoir	113	98
Squaw Mountain	2192	95
Quincy Reservoir	755	63

Traffic Loading Summary

Alert Reports	302353	
Average Daily Traffic	10078	
Average Hourly Traffic	420	
Median Hourly Traffic	417	hour beginning
Peak Hourly Traffic	772	4/17/08 11:00 AM
2nd Max	732	4/17/08 12:00 PM
3rd Max	693	4/17/08 10:00 AM
4th Max	633	4/7/08 12:00 PM
5th Max	633	4/7/08 12:00 PM

Rain Timer Performance

Analyze Rain Sensors

			systemwide average (days) 0.5194		age 90%
Rain Sensors	**Description**	**Rcvd**	**Average Timer Interval**	**Exp**	**Performance**
1710	Shop Creek	27	21:16	60.00	45%
540	Parker/Mississippi	31	18:11	60.00	52%
1600	Englewood Dam	38	15:29	60.00	63%
1350	Chatfield COE	39	15:10	60.00	65%
710	Horseshoe Park Drop	40	13:01	60.00	67%
4330	Indian Ruins	40	12:48	60.00	67%
620	Quincy/Highline	44	15:12	60.00	73%
2190	Squaw Mountain	44	15:47	60.00	73%
4510	Pinewood Springs	45	14:48	60.00	75%
2280	Kinney Peak	46	13:13	60.00	77%
4530	Winiger Ridge	48	14:25	60.00	80%
4560	Lyons Diversion NSV	48	14:17	60.00	80%
510	Virginia Court	49	13:57	60.00	82%
4860	Fairview Peak	49	13:13	60.00	82%
630	Temple Pond at DTC	50	14:06	60.00	83%
840	Fire Station 12	50	12:49	60.00	83%
2730	Salisbury Park	50	13:18	60.00	83%
4240	Sunset	50	13:21	60.00	83%
110	Ralston Reservoir	51	12:31	60.00	85%
1200	Broomfield 3207	51	13:40	60.00	85%
4090	Magnolia	51	13:03	60.00	85%
4170	Pine Brook	51	13:23	60.00	85%
4570	St. Antons	51	13:18	60.00	85%
1110	Gunbarrel	52	13:01	60.00	87%
1370	West Metro FS13	52	12:46	60.00	87%
1620	Slaughterhouse Glch	52	13:33	60.00	87%
1800	Sand Creek Park	52	13:17	60.00	87%
4150	Gold Hill	52	12:51	60.00	87%
4180	Gold Lake	52	14:03	60.00	87%
4340	Riverside	52	13:03	60.00	87%
4710	Ward C-1	52	12:56	60.00	87%
4850	Porphory Mtn	52	12:52	60.00	87%
820	ETG @ Buckley	53	13:29	60.00	88%
920	Aurora Town Hall Wx	53	12:00	60.00	88%
1100	Louisville Rec Ctr	53	13:29	60.00	88%
2230	Bear Cr below Cub	53	13:49	60.00	88%
2250	Rosedale	53	12:49	60.00	88%
2270	Cub Cr below Blue	53	13:40	60.00	88%
2840	Sulphur Gulch	53	12:43	60.00	88%
4130	Swiss Peaks	53	13:02	60.00	88%
4270	Cannon Mountain	53	13:00	60.00	88%
530	Fire Station #19	54	12:27	60.00	90%
850	Flying J	54	12:30	60.00	90%
1460	Stapleton	27	1:39	30.00	90%
1540	Sanderson at Xavier	54	12:28	60.00	90%
2260	Brook Forest	54	13:01	60.00	90%
2310	Genesee Village	54	12:29	60.00	90%
4020	Rio Grande	54	12:30	60.00	90%
4470	Little Narrows	54	13:00	60.00	90%
4490	Apple Valley	54	13:16	60.00	90%
4820	Doudy Draw	54	13:01	60.00	90%
100	Carr Street	55	12:43	60.00	92%
200	Leyden Reservoir	55	12:52	60.00	92%
300	Van Bibber Park	55	12:43	60.00	92%
310	Guy Hill Ranch	55	12:55	60.00	92%
410	Kelly Dam	55	12:56	60.00	92%
440	Fire Station #7	55	12:42	60.00	92%

700	Toll Gate @ 6th	55	12:44	60.00	92%
730	No Name @ Quincy	55	12:54	60.00	92%
760	Mission Viejo Park	55	12:26	60.00	92%
800	Sable Ditch @ 18th	55	12:41	60.00	92%
1400	Upper Sloan Det.	55	12:56	60.00	92%
4060	Lakeshore	55	12:21	60.00	92%
4730	Sugarloaf	55	12:45	60.00	92%
4750	Louisville Lake	55	13:00	60.00	92%
4810	Shanahan Ridge	55	12:57	60.00	92%
4840	SBC@S Boulder Ditch	55	12:28	60.00	92%
400	Montview Park	56	12:56	60.00	93%
500	Havana Park	56	12:26	60.00	93%
520	Jewell Detention	56	12:40	60.00	93%
750	Quincy Reservoir	56	12:26	60.00	93%
830	Side Creek Park	56	12:26	60.00	93%
1010	Denver West	56	12:27	60.00	93%
1030	NREL/S. Table Mtn.	56	12:27	60.00	93%
1550	Lakewood CC	56	12:15	60.00	93%
2340	El Rancho	56	12:27	60.00	93%
2370	Red Rocks Park	56	12:12	60.00	93%
2750	Castle Rock	56	12:27	60.00	93%
2810	Pine Cliff Road	56	12:29	60.00	93%
2820	Haskins Gulch Conf	56	11:59	60.00	93%
2940	Willow Creek - DougCnty	56	12:14	60.00	93%
4010	Cresent	56	12:59	60.00	93%
4200	Lazy Acres	56	12:14	60.00	93%
4220	Fling's	56	12:29	60.00	93%
4260	Taylor Mountain	56	12:27	60.00	93%
4290	Red Hill	56	12:28	60.00	93%
4830	SBC @ San Souci	56	12:26	60.00	93%
120	West Woods	57	12:12	60.00	95%
150	Nott Creek	57	11:57	60.00	95%
210	Leyden Confluence	57	12:12	60.00	95%
220	Upper Leyden	57	12:29	60.00	95%
320	Sports Complex	57	12:12	60.00	95%
650	Iliff Pond	57	12:42	60.00	95%
720	Confluence Pond	57	12:25	60.00	95%
810	Granby Ditch @ 6th	57	12:26	60.00	95%
870	Murphy Creek GC	57	12:13	60.00	95%
1000	Maple Grove Resv.	57	12:12	60.00	95%
1050	Jeffco Fairgrounds	57	12:26	60.00	95%
1060	Heritage Square	57	12:26	60.00	95%
1340	Sanderson at Xavier	57	12:30	60.00	95%
1480	Third Creek at DIA	57	12:27	60.00	95%
1630	SPR at Dartmouth	57	11:17	60.00	95%
1700	Cherry Cr @ Champa	57	12:27	60.00	95%
1810	Sand Creek at mouth	38	18:00	40.00	95%
1900	Niver Detention	57	12:25	60.00	95%
2220	Evergreen Lake	57	12:23	60.00	95%
2240	Cold Sprg Glch conf	57	12:27	60.00	95%
2330	Morrison	57	12:42	60.00	95%
2350	Idledale	57	12:12	60.00	95%
2360	Indian Hills	57	12:27	60.00	95%
2710	Highlands Ranch WTP	57	12:29	60.00	95%
2930	Spring Valley Rd - DougCnt	57	12:00	60.00	95%
4040	Martin Gulch	57	12:13	60.00	95%
4080	Twin Sisters	57	12:27	60.00	95%
4100	Filter Plant	57	12:30	60.00	95%
4110	Betasso	57	12:15	60.00	95%
4140	Logan Mill	57	12:13	60.00	95%
4190	Slaughterhouse	57	12:30	60.00	95%
4250	Geer Canyon	57	12:12	60.00	95%

4360	Justice Center	57	12:27	60.00	95%
140	Blue Mountain	58	12:08	60.00	97%
330	Van Bibber @ Hwy 93	58	11:58	60.00	97%
600	Harvard Gulch Park	58	12:12	60.00	97%
640	Goldsmith @ Eastman	58	12:13	60.00	97%
900	Aurora Reservoir	58	12:13	60.00	97%
1020	Lena @ Nolte Pond	58	12:12	60.00	97%
1040	Lena @ U.S. Hwy 6	58	11:59	60.00	97%
1300	Hidden Lake	58	12:12	60.00	97%
1320	SPR at 3rd Ave	58	11:57	60.00	97%
1360	Denver Zoo	58	12:14	60.00	97%
1440	Elbert	58	12:13	60.00	97%
1530	Bear Creek @ Lowell	58	12:12	60.00	97%
1610	Holly Dam	58	12:10	60.00	97%
1920	Brighton	58	12:13	60.00	97%
2210	Hiwan G.C.	58	12:13	60.00	97%
2920	st Cherry Head-Douglas C	58	12:00	60.00	97%
4050	Walker Ranch	58	11:58	60.00	97%
4350	Conifer Hill	58	12:12	60.00	97%
4520	Eagle Ridge	58	12:01	60.00	97%
4790	Button Rock	58	12:00	60.00	97%
420	Expo Park	59	11:58	60.00	98%
610	Harvard @ Jackson	59	11:57	60.00	98%
1330	Roslyn	59	12:00	60.00	98%
1500	Powers Park	59	12:10	60.00	98%
1570	Brighton Ditch Wx	59	12:00	60.00	98%
1640	SPR at Union Ave.	59	12:00	60.00	98%
1720	Cherry Cr @ Steele	59	11:57	60.00	98%
2990	Tomah Rd-Douglas Cnty	59	12:00	60.00	98%
4030	Red Garden	59	11:59	60.00	98%
4070	Bear Peak	59	12:10	60.00	98%
4230	Golden Age	59	11:57	60.00	98%
4300	Big Elk Park	59	11:57	60.00	98%
4310	Johnny Park	59	11:57	60.00	98%
130	Simms Street	60	11:57	60.00	100%
740	Smoky Hill	60	11:47	60.00	100%
860	Sand Cr at Colfax	60	7:29	60.00	100%
1310	LDC at 64th	60	11:58	60.00	100%
1420	Diamond Hill	60	12:00	60.00	100%
1520	Marston Lake North	60	10:44	60.00	100%
1660	SPR at Henderson	60	10:47	60.00	100%
2320	Choke Cherry Resvr	223		223.00	100%
4160	Sunshine	60	11:30	60.00	100%
4770	Cal-Wood Ranch	60	11:42	60.00	100%

Rain Event Performance

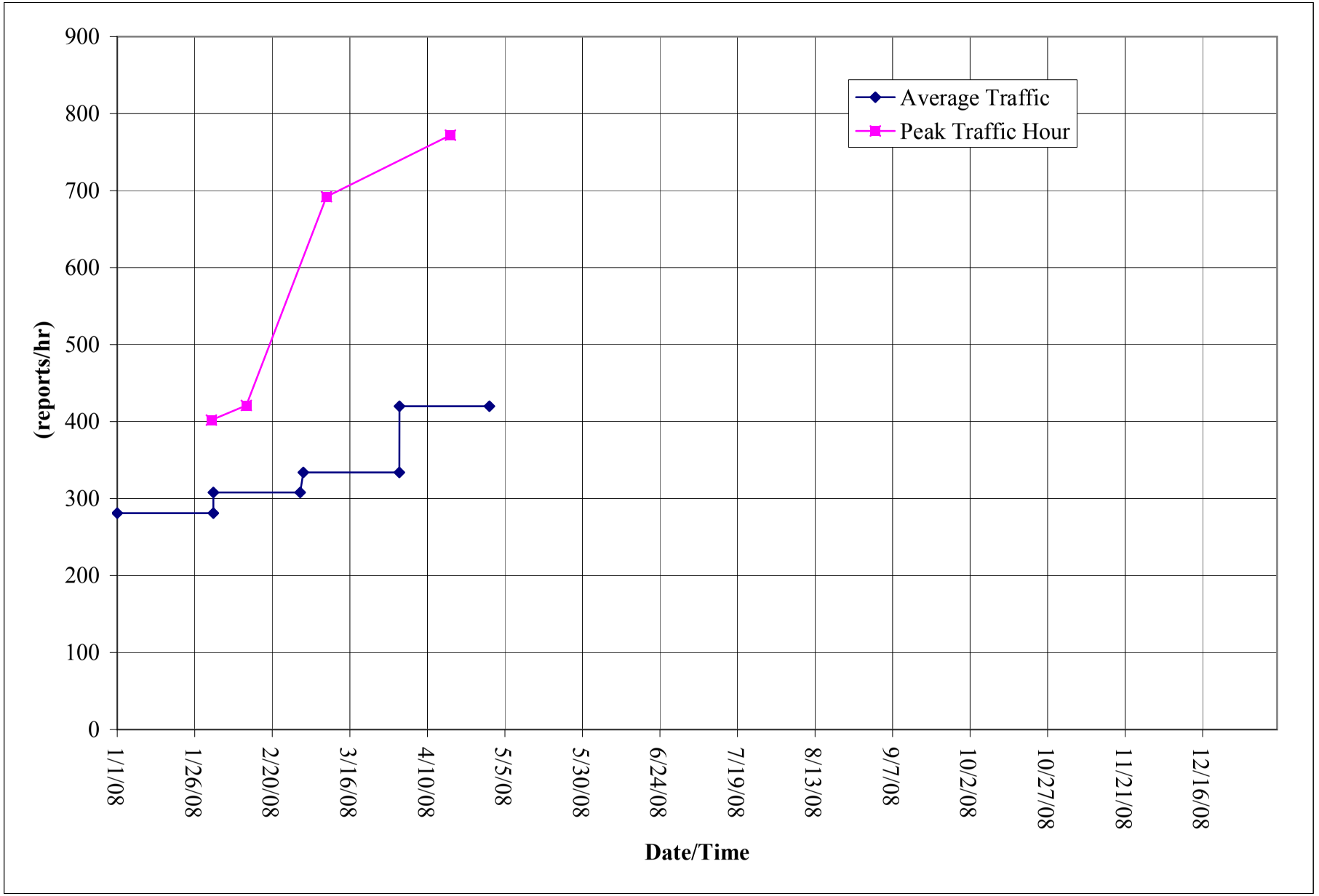
Analyze Rain Sensors

		Reports Received	2967
	Systemwide Avg	Total Tips	3168
	94%	Data Loss	6.34%

Rain Sensor	Performance	1-tips	2-tips	3-tips	4-tips	5-tips	6-tips	>6-tips	Rcvd	Exp	Miss	Hold	Bucket
1710	52%	8	0	1	0	2	0	0	11	21	10	0	0.0393701
1600	60%	5	0	0	0	1	0	0	6	10	4	0	0.0393701
540	62%	6	1	0	0	1	0	0	8	13	5	0	0.0393701
700	70%	6	0	0	1	0	0	0	7	10	3	0	0.0393701
110	71%	9	1	2	0	0	0	0	12	17	5	0	0.0393701
840	77%	15	1	0	0	1	0	0	17	22	5	0	0.0393701
1620	80%	10	1	1	0	0	0	0	12	15	3	0	0.0393701
4170	83%	15	4	0	0	0	0	0	19	23	4	0	0.0393701
2230	83%	17	2	1	0	0	0	0	20	24	4	0	0.0393701
850	83%	8	2	0	0	0	0	0	10	12	2	0	0.0393701
4130	84%	22	3	1	0	0	0	0	26	31	5	0	0.0393701
1720	84%	14	1	1	0	0	0	0	16	19	3	0	0.0393701
1350	85%	9	2	0	0	0	0	0	11	13	2	0	0.0393701
4830	85%	19	4	0	0	0	0	0	23	27	4	0	0.0393701
4510	86%	26	3	1	0	0	0	0	30	35	5	0	0.0393701
1100	86%	10	2	0	0	0	0	0	12	14	2	0	0.0393701
900	86%	5	1	0	0	0	0	0	6	7	1	0	0.0393699
1660	86%	5	1	0	0	0	0	0	6	7	1	0	0.0393701
720	86%	21	4	0	0	0	0	0	25	29	4	0	0.0393701
2250	86%	22	2	1	0	0	0	0	25	29	4	0	0.0393701
1520	87%	15	2	0	0	0	0	2	13	15	2	0	0.0393701
1370	87%	11	2	0	0	0	0	0	13	15	2	0	0.0393701
760	87%	17	3	0	0	0	0	0	20	23	3	0	0.0393701
2240	87%	18	1	1	0	0	0	0	20	23	3	0	0.0393701
530	88%	12	2	0	0	0	0	0	14	16	2	0	0.0393701
860	88%	12	2	0	0	0	0	0	14	16	2	0	0.0393701
2340	88%	12	2	0	0	0	0	0	14	16	2	0	0.0393701
810	88%	13	2	0	0	0	0	0	15	17	2	0	0.0393701
4710	89%	28	4	0	0	0	0	0	32	36	4	0	0.0393701
710	89%	14	2	0	0	0	0	0	16	18	2	0	0.0393701
4530	89%	30	2	1	0	0	0	0	33	37	4	0	0.0393701
440	89%	15	2	0	0	0	0	0	17	19	2	0	0.0393701
1040	89%	16	0	1	0	0	0	0	17	19	2	0	0.0393701
4190	90%	26	0	0	1	0	0	0	27	30	3	0	0.0393701
100	90%	16	2	0	0	0	0	0	18	20	2	0	0.0393701
4570	90%	33	4	0	0	0	0	0	37	41	4	0	0.0393701
4040	91%	27	3	0	0	0	0	0	30	33	3	0	0.0393701
2840	91%	9	1	0	0	0	0	1	10	11	1	0	0.0393701
500	91%	9	1	0	0	0	0	0	10	11	1	0	0.0393701
1800	91%	9	1	0	0	0	0	0	10	11	1	0	0.0393701
2280	91%	19	2	0	0	0	0	0	21	23	2	0	0.0393701
4110	91%	29	3	0	0	0	0	0	32	35	3	0	0.0393701
4260	91%	29	3	0	0	0	0	0	32	35	3	0	0.0393701
2350	92%	20	2	0	0	0	0	0	22	24	2	0	0.0393701
4770	92%	20	2	0	0	0	0	0	22	24	2	0	0.0393701
1050	92%	10	1	0	0	0	0	0	11	12	1	0	0.0393701
1110	92%	10	1	0	0	0	0	0	11	12	1	0	0.0393701
150	92%	21	2	0	0	0	0	0	23	25	2	0	0.0393701
2330	92%	22	2	0	0	0	0	0	24	26	2	2	0.0393701
820	92%	11	1	0	0	0	0	0	12	13	1	0	0.0393701
1030	92%	11	1	0	0	0	0	0	12	13	1	0	0.0393701
1400	92%	11	1	0	0	0	0	0	12	13	1	0	0.0393701
4240	93%	23	2	0	0	0	0	0	25	27	2	0	0.0393701
4840	93%	23	2	0	0	0	0	0	25	27	2	0	0.0393701
920	93%	60	5	0	0	0	0	0	65	70	5	0	0.0393701
1360	93%	25	2	0	0	0	0	0	27	29	2	0	0.0393701
4010	93%	25	2	0	0	0	0	0	27	29	2	1	0.0393701
4340	93%	25	2	0	0	0	0	0	27	29	2	0	0.0393701
300	93%	13	1	0	0	0	0	0	14	15	1	0	0.0393701
510	93%	13	1	0	0	0	0	0	14	15	1	0	0.0393701
4020	94%	27	2	0	0	0	0	0	29	31	2	0	0.0393701
1010	94%	14	1	0	0	0	0	0	15	16	1	0	0.0393701
4140	94%	31	2	0	0	0	0	0	33	35	2	0	0.0393701
600	94%	16	1	0	0	0	0	0	17	18	1	0	0.0393701
1640	94%	16	1	0	0	0	0	0	17	18	1	0	0.0393701
2920	94%	16	1	0	0	0	0	0	17	18	1	0	0.0393701
4150	95%	34	2	0	0	0	0	0	36	38	2	0	0.0393701
120	95%	17	1	0	0	0	0	0	18	19	1	0	0.0393701
750	95%	17	1	0	0	0	0	0	18	19	1	0	0.0393701
620	95%	18	1	0	0	0	0	0	19	20	1	0	0.0393701

1420	95%	18	1	0	0	0	0	0	19	20	1	0	0.0393701
2810	95%	18	1	0	0	0	0	0	19	20	1	0	0.0393701
2820	95%	18	1	0	0	0	0	0	19	20	1	0	0.0393701
4180	95%	38	2	0	0	0	0	0	40	42	2	0	0.0393701
1340	95%	19	1	0	0	0	0	0	20	21	1	0	0.0393701
4470	95%	20	1	0	0	0	0	0	21	22	1	0	0.0393701
4080	96%	23	1	0	0	0	0	0	24	25	1	0	0.0393701
4090	96%	23	1	0	0	0	0	0	24	25	1	0	0.0393701
4100	96%	23	1	0	0	0	0	0	24	25	1	0	0.0393701
4730	96%	23	1	0	0	0	0	0	24	25	1	0	0.0393701
2360	96%	24	1	0	0	0	0	0	25	26	1	0	0.0393701
4200	96%	24	1	0	0	0	0	0	25	26	1	0	0.0393701
830	96%	25	1	0	0	0	0	0	26	27	1	0	0.0393701
2320	96%	26	1	0	0	0	0	0	27	28	1	0	0.0393701
4290	96%	26	1	0	0	0	0	0	27	28	1	0	0.0393701
4360	96%	26	1	0	0	0	0	0	27	28	1	0	0.0393701
4300	97%	28	1	0	0	0	0	0	29	30	1	0	0.0393701
2270	97%	29	1	0	0	0	0	0	30	31	1	0	0.0393701
4070	97%	29	1	0	0	0	0	0	30	31	1	1	0.0393701
4270	97%	29	1	0	0	0	0	0	30	31	1	0	0.0393701
4810	97%	30	1	0	0	0	0	0	31	32	1	0	0.0393701
4030	97%	32	1	0	0	0	0	0	33	34	1	0	0.0393701
4350	97%	32	1	0	0	0	0	0	33	34	1	0	0.0393701
4160	97%	33	1	0	0	0	0	0	34	35	1	0	0.0393701
4220	97%	34	1	0	0	0	0	0	35	36	1	1	0.0393701
4330	97%	34	1	0	0	0	0	0	35	36	1	0	0.0393701
200	100%	31	0	0	0	0	0	0	31	31	0	0	0.0393701
4310	100%	30	0	0	0	0	0	0	30	30	0	0	0.0393701
2310	100%	29	0	0	0	0	0	0	29	29	0	0	0.0393701
2990	100%	29	0	0	0	0	0	0	29	29	0	0	0.0393701
2260	100%	27	0	0	0	0	0	0	27	27	0	0	0.0393701
4050	100%	26	0	0	0	0	0	0	26	26	0	0	0.0393701
1550	100%	25	0	0	0	0	0	0	25	25	0	0	0.0393701
4060	100%	24	0	0	0	0	0	0	24	24	0	0	0.0393701
4250	100%	24	0	0	0	0	0	0	24	24	0	0	0.0393701
1530	100%	23	0	0	0	0	0	0	23	23	0	0	0.0393701
1000	100%	22	0	0	0	0	0	0	22	22	0	0	0.0393701
4790	100%	22	0	0	0	0	0	0	22	22	0	0	0.0393701
4820	100%	22	0	0	0	0	0	0	22	22	0	0	0.0393701
610	100%	21	0	0	0	0	0	0	21	21	0	0	0.0393701
4490	100%	21	0	0	0	0	0	0	21	21	0	0	0.0393701
630	100%	20	0	0	0	0	0	0	20	20	0	0	0.0393701
4230	100%	20	0	0	0	0	0	0	20	20	0	0	0.0393701
320	100%	19	0	0	0	0	0	0	19	19	0	0	0.0393701
2370	100%	19	0	0	0	0	0	0	19	19	0	0	0.0393701
140	100%	18	0	0	0	0	0	0	18	18	0	1	0.0393701
330	100%	18	0	0	0	0	0	0	18	18	0	0	0.0393701
220	100%	17	0	0	0	0	0	0	17	17	0	0	0.0393701
870	100%	17	0	0	0	0	0	0	17	17	0	0	0.0393701
1330	100%	17	0	0	0	0	0	0	17	17	0	0	0.0393701
2210	100%	17	0	0	0	0	0	0	17	17	0	0	0.0393701
4520	100%	17	0	0	0	0	0	0	17	17	0	0	0.0393701
210	100%	16	0	0	0	0	0	0	16	16	0	0	0.0393701
1320	100%	16	0	0	0	0	0	0	16	16	0	0	0.0393701
4750	100%	16	0	0	0	0	0	0	16	16	0	0	0.0393701
650	100%	15	0	0	0	0	0	0	15	15	0	0	0.0393701
1060	100%	15	0	0	0	0	0	0	15	15	0	0	0.0393701
1540	100%	15	0	0	0	0	0	0	15	15	0	0	0.0393701
640	100%	13	0	0	0	0	0	0	13	13	0	0	0.0393701
2710	100%	13	0	0	0	0	0	0	13	13	0	0	0.0393701
520	100%	12	0	0	0	0	0	0	12	12	0	0	0.0393701
1300	100%	12	0	0	0	0	0	0	12	12	0	0	0.0393701
310	100%	11	0	0	0	0	0	0	11	11	0	0	0.0393701
1200	100%	11	0	0	0	0	0	0	11	11	0	0	0.0393701
1310	100%	11	0	0	0	0	0	0	11	11	0	0	0.0393701
1700	100%	11	0	0	0	0	0	0	11	11	0	0	0.0393701
2930	100%	11	0	0	0	0	0	0	11	11	0	0	0.0393701
400	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701
410	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701
740	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701
800	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701
1480	100%	10	0	0	0	0	0	0	10	10	0	1	0.0393701
420	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701
730	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701
1460	100%	8	0	0	0	0	0	0	8	8	0	1	0.0393701

1810	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701
2940	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701
1900	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701
1920	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701
2190	100%	6	0	0	0	0	0	0	6	6	0	0	0.0393701
2750	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701
1440	100%	4	0	0	0	0	0	0	4	4	0	0	0.0393701
2730	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
	Total Tips	**2801**	**151**	**12**	**2**	**5**	**0**	**3**	**2967**	**3168**	**201**	**8**	


900
800
700
600
500
400
300
200
100
0
(reports/hr)
Average Traffic
Peak Traffic Hour
1/1/08
1/26/08
2/20/08
3/16/08
4/10/08
5/5/08
5/30/08
6/24/08
7/19/08
8/13/08
9/7/08
10/2/08
10/27/08
11/21/08
12/16/08
Date/Time