Memo

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

Date: July 2, 2008

To: Kevin Stewart and Chad Kudym

From: Markus Ritsch

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

II. General System Analysis Summary

A total of 339,742 data records were analyzed from the ALERT 2 base station. Meteorological sensors account for 60 percent, water level sensors 12 percent, and rain sensors 4 percent of the total monthly records.

More than ninety-nine percent (99.72%) of the received data reports were flagged as "good" by the Nova Star validation process. Roughly 949 reports were flagged as "bad". Of these "bad" reports, 308 originated from the water level sensor at Horseshoe Park Drop (ID 713). Also, Red Garden precipitation (ID 4030) reported 29 invalid reports.

The system-wide radio traffic loading was 11,325 reports per day with an average hourly loading of 472 reports. The peak hourly traffic loading was 984 reports, which occurred on June 5, between 7:00 AM and 8:00 AM. A plot of monthly average and peak hourly traffic loading is provided.

A total of 942 reports were received from the Hayman rain sensors this month. These reports make up less than 1% of the total reports for the month.

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 88 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	1600	1600						
140	2190	110	540	540	110						
4150	140	2190	1600	1710	950						
4060	4170	1370	1350	4080	1710						
4470	4150	620	710	4060	540						
4530	4530	840	4330	4150	4530						

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 and excluding Aurora Town Hall-920) 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	26.06	Only the 1-mm rain sensors were included in the analysis
Median	21.00	Only the 1-mm rain sensors were included in the analysis
Standard deviation	18	Only the 1-mm rain sensors were included in the analysis
Mean plus three standard deviations	80	Only the 1-mm rain sensors were included in the analysis
Minimum total count	2	Lookout One (ID 950) and Rosedale (ID 2250)
Maximum total count	132	Expo Park (ID 420)

The highest reporting rain sensor was Expo Park (ID 420) with 132 tips. This sensor is influenced by irrigation sprinklers.

Other than Expo Park, two sensors (920 and 1500) reported more than the system-wide mean plus 3 standard deviations and are inspected manually.

a. Aurora Town Hall Wx (ID 920)

This station utilizes a "distrometer" sensor which is influenced by birds that use the sensor as a perch causing it to record rainfall. Nothing suspicious is evident in the incrementing count series, other than a lot of tips were recorded.

b. Powers Park (ID 1500)

This sensor is also influenced by irrigation sprinklers. Nothing suspicious is evident in the incrementing count series, other than a lot of tips were recorded.

B. Monthly Average Tip/Count Summary

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	54.82	26.06							

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 (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
Red Garden	4030	A large number of invalidated reports were noticed on June 15.
Guy Hill Ranch	310	This sensor recorded a large jump in count on June 5 between 6:00 am and 6:30 am due to corrupt data transmissions (bit flip errors).
Englewood Dam	1600	This sensor recorded a large jump in count on June 5 when a number of sequential data reports were lost.

D. 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 3,438 incrementing reports were received and a total of 3,804 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 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	1600	1600						
2190	4820	540	1600	2320	2750						
750	4530	2730	540	4150	2710						
4570	4470	2210	700	1710	310						
2990	4810	110	110	4710	4090						
--	700	1350	840	1350	4170						

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.

c. Guy Hill Ranch (ID 310)

On June 5th, this sensor has a large number of corrupt and/or lost reports likely due to contention with reports from other stations.

d. Englewood Dam (ID 1600)

On June 5th, this sensor has a large number of corrupt and/or lost reports likely due to contention with reports from other stations.

e. Highlands Ranch (ID 2710)

This sensor experienced a large jump in count on June 11th due to a field maintenance visit.

f. Castle Rock (ID 2750)

The radio antenna and mast were destroyed at this station in early June. The mast and antenna were replaced later in the month, but a large jump in count at the base station resulted when the station came back on-line.

V. Heavy Radio Traffic Analysis

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 Hourly Traffic Periods This Month

The hourly periods of highest radio traffic this month include:

- June 5 from 5:00 AM to 6:00 AM (833 reports)
- June 5 from 6:00 AM to 7:00 AM (921 reports)
- June 5 from 7:00 AM to 8:00 AM (984 reports)
- June 5 from 8:00 AM to 9:00 AM (867 reports)
- June 4 from 11:00 PM to 12:00 PM (847 reports)

B. June 5, 2008

The heaviest traffic period occurred on June 5th. The distribution of hourly traffic around the peak hour is summarized:

- June 5 from 5:00 AM to 6:00 AM (833 reports)
- June 5 from 6:00 AM to 7:00 AM (921 reports)
- June 5 from 7:00 AM to 8:00 AM (984 reports)
- June 5 from 8:00 AM to 9:00 AM (867 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). During the heavy traffic period on June 5th, a total of 1,084 reports were expected and only 969 were received yielding a loss of approximately 10.6% of the incrementing transmissions.

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

	Occurrences of lost sequential tip reports during period			
Heavy Traffic Period (June 5, 2008)	**Loss of 2 sequential tips**	**Loss of 3 sequential tips**	**Loss of 4 sequential tips**	**Loss of 5 sequential tips**
4:00 AM to 10:00 AM	13	5	0	0

The hourly traffic rates experienced during the storm on the morning of June 5th were only on the order of 950 transmissions per hour. Yet this storm had five rain sensors that experienced a loss of three sequential reports. This storm was unique in that a large number of sensors experienced a great number of lost sequential reports. The sensors include: 310, 1050, 1340, 4140, and 4510. These sensors are identified on the map (Total precipitation accumulation for June 2008) accompanying this report. It is interesting to note that they are not all in the same geographical region.

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)	147
Total reports from unknown IDs	208
Unknown IDs with only a single received report (potential noise)	112
Total reports from all IDs – RecData Log entire month	287,307
Unknown reports as a fraction of total reports	0.07%

The total number of reports from unknown sensors is very 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 ID	No Reports
1663	8
4091	7
1314	4
4766	4
2249	4
1631	3
4769	3
2761	3
1470	3
2809	3
1312	3
4646	3
1317	3
4636	3
4739	2
1311	2
1316	2
1056	2
1628	2
1611	2
1619	2
4088	2
4093	2
4094	2
1318	2
892	2
709	2
969	2
3625	2
949	2
939	2
688	2
2219	2
2839	2
862	2

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	5	12:00-12:59	9
1:00-1:59	3	1:00-1:59	9
2:00-2:59	4	2:00-2:59	9
3:00-3:59	8	3:00-3:59	5
4:00-4:59	6	4:00-4:59	8
5:00-5:59	8	5:00-5:59	15
6:00-6:59	11	6:00-6:59	10
7:00-7:59	6	7:00-7:59	10
8:00-8:59	6	8:00-8:59	8
9:00-9:59	8	9:00-9:59	11
10:00-10:59	15	10:00-10:59	12
11:00-11:59	14	11:00-11:59	8

VII. Issues Identified this Month

Sensors with a large number of invalid reports:

1. **Horseshoe Park Drop (ID 713)** - Water Level PT with 308,
2. **Louisville Lake (ID 4744)** - Wind Gust with 36 reports,
3. **Salisbury Park (ID 2724)** - Wind Gust with 34 reports,
4. **Red Garden (ID 4030)** - Precipitation with 29 reports, and
5. **Cal-Wood Ranch (ID 4774)** – Barometric Pressure 26 reports.

Sensors reporting frequently (over reporting):

6. **Quincy Reservoir (ID 749 - Wind)** with 5,879 reports,
7. **Boulder Creek at Broadway (ID 4583 - Water Level)** with 10,442 reports (OneRain reports that wave action triggers many transmissions due to a delta set at 0.1 feet),
8. **Horseshoe Park Drop (ID 713 - Water Level)** with 5,774 reports, and
9. **Salisbury Park (ID 2727 - Wind)** with 3,455 reports.

Sensors reporting infrequently (under reporting):

10. **Englewood Dam (ID 1605 – Battery)** with 17 reports,
11. **Castle Oaks Road (ID 2835 – Battery)** with 18 reports,
12. **WTG above Conf Pond (ID 723 – Water Level)** with 18 reports, and
13. **Sable Ditch @ 18th (ID 803 – Water Level)** with 24 reports.

Poor timer reporting:

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

14. **Englewood Dam (ID 1600)** - Only 28% of the timer reports were received.
15. **Ralston Reservoir (ID 110)** - Only 62% of the timer reports were received.
16. **Lookout One (ID 950) -** Only 68% of the timer reports received for the entire month.
17. **Aurora Reservoir (ID 900) -** Only 72% of the timer reports received for the entire month.
18. **Parker/Mississippi (ID 540)** - Only 73% of the timer reports were received from this sensor.
19. **Shop Creek (ID 1710)** - Only 77% 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.

20. **Englewood Dam (ID 1600)** - Only 43% of the event reports were received.
21. **Castle Rock (ID 2750)** - Only 50% of the event reports were received.
22. **Guy Hill Ranch (ID 310)** - Only 57% of the event reports were received from this sensor.

Low rain total:

23. **Lookout One (ID 950) -** This sensor recorded only 2 tips for the entire month.
24. **Rosedale (ID 2250) -** This sensor recorded only 2 tips for the entire month.

High rain total:

25. **Expo Park (ID 420) –** This sensor recorded a total of 132 tips for the month. This station is noted for being influenced by sprinkler irrigation.
26. **Powers Park (ID 1500) –** This sensor recorded a total of 87 tips for the month. This station is noted for being influenced by sprinkler irrigation.
27. **Temple Pond at DTC (ID 630)** - This sensor recorded a total of 69 tips for the month. This station is noted for being influenced by sprinkler irrigation.

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

28. **Englewood Dam (ID 1600)** - This sensor experienced several large jumps in count on June 5th.
29. **Guy Hill Ranch (ID 310)** - This sensor experienced a large jump in count on June 5th.

Reports from "Unknown Sensors":

30. 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 ID	No Reports
1663	8
4091	7
1314	4
4766	4
2249	4
1631	3
4769	3
2761	3
1470	3
2809	3
1312	3
4646	3
1317	3
4636	3
4739	2
1311	2
1316	2
1056	2
1628	2
1611	2
1619	2
4088	2
4093	2
4094	2
1318	2
892	2
709	2
969	2
3625	2
949	2

General System Analysis

Database Name P:\A207-UDFCD-Data-Analysis\2008_June\Novastar_extract_2008June.n

First Date in Database	6/1/08 12:00 AM	**Total Days**	30.0
Last Date in Database	6/30/08 11:59 PM	**Total Hours**	720.0

Total Records Analyzed 339742

Records by Group

None-ALERT-ID	51929	15%
Wind Gust	47089	14%
Temperature	39937	12%
Relative Humidity	37746	11%
Water Level PT-HSE	32224	9%
Wind Direction	19652	6%
Barometric Pressure	17511	5%
Wind Speed Average & Azim	16715	5%
Wind Speed Average	16343	5%
Precipitation	12163	4%
Solar Radiation	8792	3%
Battery Voltage HSE	6975	2%
Water Level Float	4681	1%
Battery Voltage Digital	3662	1%
Fuel Temperature	3537	1%
Fuel Moisture	3518	1%
Water Level PT	3503	1%
Battery Voltage Analog	3437	1%
Soil Moisture	2776	1%
Precipitation - Mean	1662	0%
Hayman Precipitation	942	0%
Repeater Pass List	593	0%
Repeater Status Report	466	0%
Longmont Flow Gage	419	0%
12Hr Status Report	341	0%
Battery	234	0%
Precipitation - Test	234	0%
Longmont Water Level PT	107	0%
Battery Voltage	76	0%
Handar 585 ALARM Status	57	0%
Solar Power	1	0%
Total	337322	

Records by Major Group

Meteorologic Sensors	203785	60%
Water Level Sensors	40934	12%
Sensor Status Transmission	15532	5%
Rain Sensors	12163	4%
Soil and Fuel Sensors	9831	3%
Total	282245	

Records by Validation Type

Good	0	338793	100%
Questionable	1	949	0%
	Total	339742	

Sensors With Most Invalid Data

Description	Sensor	Reports
Horseshoe Park Drop	713	308
Louisville Lake	4744	36
Salisbury Park	2724	34
Red Garden	4030	29
Sugarloaf	4724	28

Traffic Loading Summary

Alert Reports	339742	
Average Daily Traffic	11325	
Average Hourly Traffic	472	
Median Hourly Traffic	458	hour beginning
Peak Hourly Traffic	984	6/5/08 7:00 AM
2nd Max	921	6/5/08 6:00 AM
3rd Max	867	6/5/08 8:00 AM
4th Max	847	6/4/08 11:00 PM
5th Max	833	6/5/08 5:00 AM

Rain Timer Performance

Analyze Rain Sensors

			systemwide average (days) 0.5230		90%
Sensor	**Description**	**Rcvd**	**Interval**	**Exp**	**Performance**
1600	Englewood Dam	17	9:20	60.00	28%
110	Ralston Reservoir	37	19:35	60.00	62%
950	Lookout One	41	12:16	60.00	68%
900	Aurora Reservoir	43	14:35	60.00	72%
540	Parker/Mississippi	44	15:01	60.00	73%
320	Sports Complex	45	12:51	60.00	75%
4530	Winiger Ridge	45	15:57	60.00	75%
1710	Shop Creek	46	15:37	60.00	77%
850	Flying J	47	14:34	60.00	78%
4510	Pinewood Springs	47	14:45	60.00	78%
4060	Lakeshore	48	14:34	60.00	80%
4010	Cresent	49	14:18	60.00	82%
4080	Twin Sisters	49	13:31	60.00	82%
4180	Gold Lake	49	14:00	60.00	82%
4560	Lyons Diversion NSV	49	14:14	60.00	82%
4750	Louisville Lake	49	13:49	60.00	82%
4770	Cal-Wood Ranch	49	13:23	60.00	82%
310	Guy Hill Ranch	50	13:17	60.00	83%
1110	Gunbarrel	50	13:47	60.00	83%
4090	Magnolia	50	13:29	60.00	83%
4130	Swiss Peaks	50	13:51	60.00	83%
4570	St. Antons	50	13:21	60.00	83%
1660	SPR at Henderson	51	13:29	60.00	85%
2230	Bear Cr below Cub	51	12:44	60.00	85%
2330	Morrison	51	13:49	60.00	85%
4150	Gold Hill	51	12:57	60.00	85%
4300	Big Elk Park	51	14:00	60.00	85%
4470	Little Narrows	51	13:14	60.00	85%
4850	Porphory Mtn	51	13:51	60.00	85%
4860	Fairview Peak	51	12:50	60.00	85%
1100	Louisville Rec Ctr	52	13:44	60.00	87%
1350	Chatfield COE	52	13:29	60.00	87%
2240	Cold Sprg Glch conf	52	13:00	60.00	87%
2940	Willow Creek - DougCnty	52	13:00	60.00	87%
4100	Filter Plant	52	12:43	60.00	87%
4710	Ward C-1	52	13:04	60.00	87%
4820	Doudy Draw	52	13:09	60.00	87%
4830	SBC @ San Souci	52	13:11	60.00	87%
150	Nott Creek	53	13:23	60.00	88%
630	Temple Pond at DTC	53	12:24	60.00	88%
870	Murphy Creek GC	53	13:16	60.00	88%
1620	Slaughterhouse Glch	53	13:16	60.00	88%
4070	Bear Peak	53	12:55	60.00	88%
4170	Pine Brook	53	13:11	60.00	88%
4270	Cannon Mountain	53	13:01	60.00	88%
4730	Sugarloaf	53	13:50	60.00	88%
4840	SBC@S Boulder Ditch	53	13:09	60.00	88%
710	Horseshoe Park Drop	54	12:29	60.00	90%
800	Sable Ditch @ 18th	54	12:29	60.00	90%
820	ETG @ Buckley	54	12:43	60.00	90%
830	Side Creek Park	54	13:09	60.00	90%
1000	Maple Grove Resv.	54	12:56	60.00	90%
1050	Jeffco Fairgrounds	54	13:09	60.00	90%
1440	Elbert	54	13:13	60.00	90%
1500	Powers Park	54	12:21	60.00	90%
1550	Lakewood CC	54	13:11	60.00	90%
1900	Niver Detention	54	12:55	60.00	90%

2340	El Rancho	54	13:11	60.00	90%
4220	Fling's	54	12:27	60.00	90%
4240	Sunset	54	12:59	60.00	90%
4290	Red Hill	54	12:41	60.00	90%
4810	Shanahan Ridge	54	13:09	60.00	90%
120	West Woods	55	12:56	60.00	92%
440	Fire Station #7	55	12:41	60.00	92%
720	Confluence Pond	55	12:41	60.00	92%
810	Granby Ditch @ 6th	55	12:27	60.00	92%
1030	NREL/S. Table Mtn.	55	12:54	60.00	92%
1060	Heritage Square	55	12:25	60.00	92%
4040	Martin Gulch	55	12:54	60.00	92%
4140	Logan Mill	55	12:56	60.00	92%
4200	Lazy Acres	55	12:56	60.00	92%
4260	Taylor Mountain	55	12:55	60.00	92%
4350	Conifer Hill	55	12:55	60.00	92%
4490	Apple Valley	55	12:40	60.00	92%
4790	Button Rock	55	12:42	60.00	92%
140	Blue Mountain	56	12:41	60.00	93%
330	Van Bibber @ Hwy 93	56	12:12	60.00	93%
420	Expo Park	56	12:19	60.00	93%
520	Jewell Detention	56	12:29	60.00	93%
530	Fire Station #19	56	12:25	60.00	93%
620	Quincy/Highline	56	12:12	60.00	93%
750	Quincy Reservoir	56	12:40	60.00	93%
840	Fire Station 12	56	12:14	60.00	93%
1370	West Metro FS13	56	12:41	60.00	93%
1420	Diamond Hill	56	12:13	60.00	93%
1540	Sanderson at Xavier	56	12:25	60.00	93%
1570	Brighton Ditch Wx	56	12:14	60.00	93%
1610	Holly Dam	56	12:37	60.00	93%
2270	Cub Cr below Blue	56	12:39	60.00	93%
2310	Genesee Village	56	12:25	60.00	93%
2350	Idledale	56	12:26	60.00	93%
2820	Haskins Gulch Conf	56	12:40	60.00	93%
2930	Spring Valley Rd - DougCnty	56	12:28	60.00	93%
4030	Red Garden	56	12:28	60.00	93%
4190	Slaughterhouse	56	12:12	60.00	93%
4340	Riverside	56	12:40	60.00	93%
100	Carr Street	57	12:26	60.00	95%
220	Upper Leyden	57	12:27	60.00	95%
300	Van Bibber Park	57	12:25	60.00	95%
410	Kelly Dam	57	12:11	60.00	95%
600	Harvard Gulch Park	57	12:25	60.00	95%
650	Iliff Pond	57	11:57	60.00	95%
700	Toll Gate @ 6th	57	12:14	60.00	95%
730	No Name @ Quincy	57	12:12	60.00	95%
740	Smoky Hill	57	12:13	60.00	95%
920	Aurora Town Hall Wx	57	12:00	60.00	95%
1010	Denver West	57	12:25	60.00	95%
1020	Lena @ Nolte Pond	57	12:25	60.00	95%
1300	Hidden Lake	57	12:11	60.00	95%
1320	SPR at 3rd Ave	57	12:24	60.00	95%
1330	Roslyn	57	12:13	60.00	95%
1530	Bear Creek @ Lowell	57	12:25	60.00	95%
1630	SPR at Dartmouth	57	12:21	60.00	95%
1720	Cherry Cr @ Steele	57	12:11	60.00	95%
2210	Hiwan G.C.	57	12:28	60.00	95%
2220	Evergreen Lake	57	12:23	60.00	95%
2280	Kinney Peak	57	12:11	60.00	95%
2370	Red Rocks Park	57	12:11	60.00	95%
2810	Pine Cliff Road	57	12:11	60.00	95%

2840	Sulphur Gulch	57	11:58	60.00	95%
2990	Tomah Rd-Douglas Cnty	57	12:27	60.00	95%
4050	Walker Ranch	57	12:11	60.00	95%
4110	Betasso	57	12:26	60.00	95%
4250	Geer Canyon	57	12:26	60.00	95%
4310	Johnny Park	57	12:11	60.00	95%
4360	Justice Center	57	12:25	60.00	95%
1460	Stapleton	29	23:59	30.00	97%
200	Leyden Reservoir	58	12:13	60.00	97%
610	Harvard @ Jackson	58	11:57	60.00	97%
760	Mission Viejo Park	58	11:57	60.00	97%
1040	Lena @ U.S. Hwy 6	58	12:13	60.00	97%
1340	Sanderson at Xavier	58	12:13	60.00	97%
1480	Third Creek at DIA	58	12:13	60.00	97%
1520	Marston Lake North	58	12:14	60.00	97%
2190	Squaw Mountain	58	12:20	60.00	97%
2260	Brook Forest	58	11:58	60.00	97%
2360	Indian Hills	58	12:11	60.00	97%
2750	Castle Rock	58	11:33	60.00	97%
2920	West Cherry Head-Douglas Cnty	58	12:13	60.00	97%
4020	Rio Grande	58	12:11	60.00	97%
4160	Sunshine	58	12:11	60.00	97%
4230	Golden Age	58	12:25	60.00	97%
130	Simms Street	59	11:57	60.00	98%
500	Havana Park	59	11:57	60.00	98%
1310	LDC at 64th	59	11:58	60.00	98%
1360	Denver Zoo	59	12:00	60.00	98%
1700	Cherry Cr @ Champa	59	12:00	60.00	98%
1920	Brighton	59	12:00	60.00	98%
2250	Rosedale	59	11:48	60.00	98%
4520	Eagle Ridge	59	12:00	60.00	98%
1810	Sand Creek at mouth	37	18:33	37.00	100%
2710	Highlands Ranch WTP	62	11:32	60.00	103%
2730	Salisbury Park	62	10:57	60.00	103%
860	Sand Cr at Colfax	109	6:31	60.00	182%

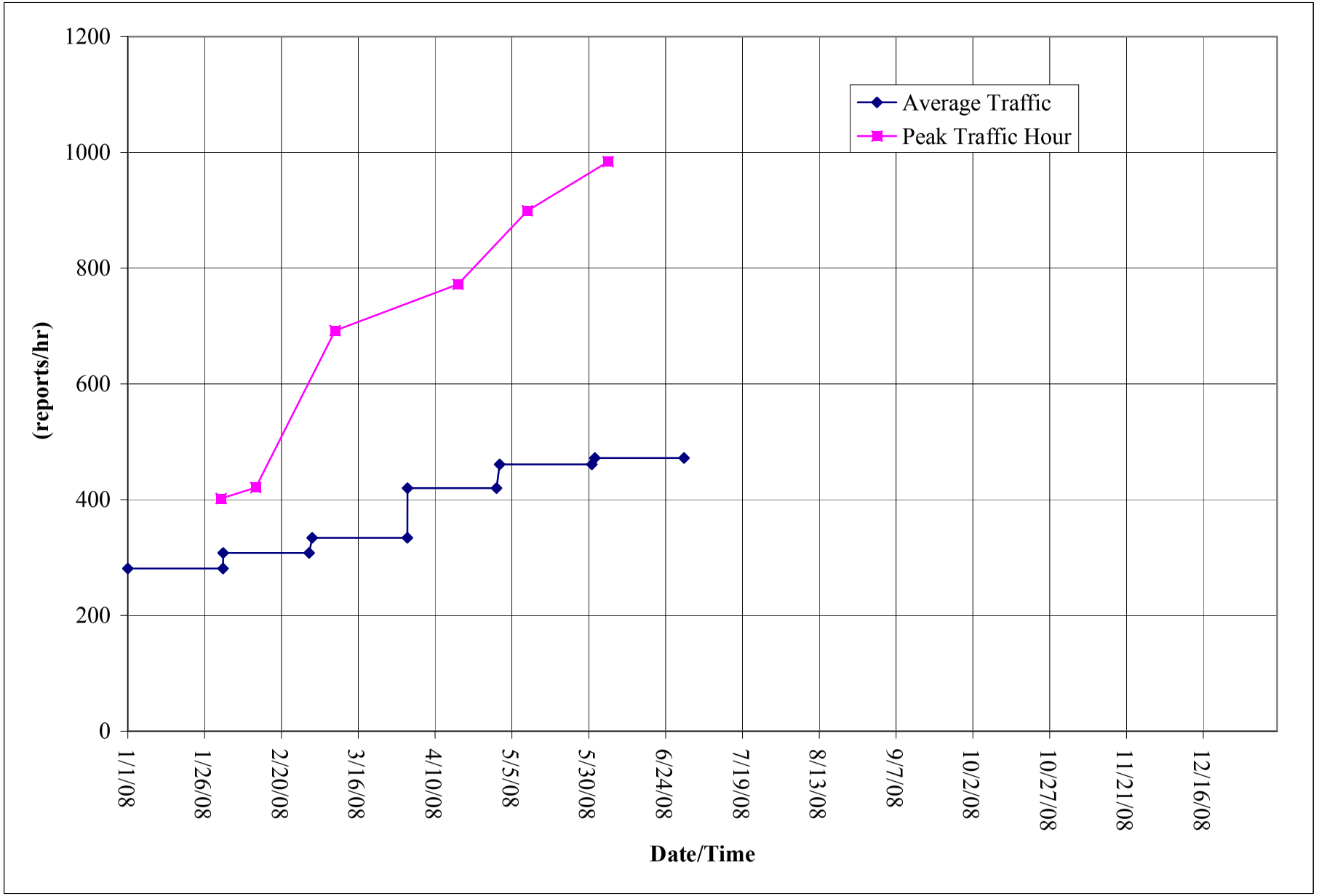
Rain Event Performance

Analyze Rain Sensors

	Reports Rece	3438	
	Systemwide Avg	Total Tips	3804
	90%	Data Loss	9.62%

Sensor	Performance	1-tips	2-tips	3-tips	4-tips	5-tips	6-tips	>6-tips	Rcv	Exp	Miss	Hold	Bucket
420	91%	110	8	2	0	0	0	0	120	132	12	0	0.0393701
920	97%	82	3	0	0	0	0	0	85	88	3	0	0.0393701
1500	93%	75	6	0	0	0	0	0	81	87	6	0	0.0393701
630	94%	61	4	0	0	0	0	0	65	69	4	0	0.0393701
4250	93%	53	4	0	0	0	0	0	57	61	4	0	0.0393701
4220	88%	45	5	1	0	0	0	0	51	58	7	0	0.0393701
4180	89%	42	6	0	0	0	0	0	48	54	6	0	0.0393701
4160	100%	54	0	0	0	0	0	0	54	54	0	0	0.0393701
4770	85%	37	8	0	0	0	0	0	45	53	8	0	0.0393701
4470	77%	31	7	1	1	0	0	0	40	52	12	0	0.0393701
4200	90%	42	3	1	0	0	0	0	46	51	5	0	0.0393701
500	96%	47	2	0	0	0	0	0	49	51	2	0	0.0393701
4290	96%	46	2	0	0	0	0	0	48	50	2	0	0.0393701
4340	96%	44	2	0	0	0	0	0	46	48	2	0	0.0393701
4270	83%	32	6	1	0	0	0	0	39	47	8	0	0.0393701
4260	94%	41	3	0	0	0	0	0	44	47	3	0	0.0393701
4350	94%	41	3	0	0	0	0	0	44	47	3	0	0.0393701
4150	80%	31	4	1	1	0	0	0	37	46	9	0	0.0393701
4140	91%	39	1	0	1	0	0	0	41	45	4	0	0.0393701
4510	80%	29	4	1	1	0	0	0	35	44	9	0	0.0393701
4730	95%	40	0	1	0	0	0	0	41	43	2	0	0.0393701
4130	90%	34	4	0	0	0	0	0	38	42	4	0	0.0393701
4190	90%	35	2	1	0	0	0	0	38	42	4	0	0.0393701
4710	85%	30	4	1	0	0	0	0	35	41	6	0	0.0393701
4520	83%	27	5	1	0	0	0	0	33	40	7	0	0.0393701
4170	72%	19	7	2	0	0	0	0	28	39	11	0	0.0393701
4790	82%	26	5	1	0	0	0	0	32	39	7	0	0.0393701
4110	90%	31	4	0	0	0	0	0	35	39	4	0	0.0393701
4240	92%	33	3	0	0	0	0	0	36	39	3	0	0.0393701
4300	95%	35	2	0	0	0	0	0	37	39	2	0	0.0393701
120	100%	39	0	0	0	0	0	0	39	39	0	0	0.0393701
4080	82%	25	5	1	0	0	0	0	31	38	7	0	0.0393701
4310	92%	31	3	0	0	0	0	0	34	37	3	0	0.0393701
4490	94%	32	2	0	0	0	0	0	34	36	2	0	0.0393701
4230	97%	34	1	0	0	0	0	0	35	36	1	0	0.0393701
4090	71%	18	5	1	1	0	0	0	25	35	10	0	0.0393701
4810	89%	27	4	0	0	0	0	0	31	35	4	0	0.0393701
4030	94%	32	0	1	0	0	0	1	33	35	2	0	0.0393701
4360	94%	30	2	0	0	0	0	0	32	34	2	0	0.0393701
760	100%	34	0	0	0	0	0	0	34	34	0	0	0.0393701
200	94%	29	2	0	0	0	0	0	31	33	2	0	0.0393701
4830	81%	20	6	0	0	0	0	0	26	32	6	0	0.0393701
4100	88%	24	4	0	0	0	0	0	28	32	4	0	0.0393701
4070	91%	26	3	0	0	0	0	0	29	32	3	0	0.0393701
4840	90%	25	3	0	0	0	0	0	28	31	3	0	0.0393701
4570	83%	21	3	1	0	0	0	0	25	30	5	0	0.0393701
4040	87%	22	4	0	0	0	0	0	26	30	4	0	0.0393701
4060	79%	18	4	1	0	0	0	0	23	29	6	0	0.0393701
2210	100%	29	0	0	0	0	0	0	29	29	0	1	0.0393701
4820	86%	21	2	1	0	0	0	0	24	28	4	0	0.0393701
740	96%	26	1	0	0	0	0	0	27	28	1	0	0.0393701
2330	96%	26	1	0	0	0	0	0	27	28	1	0	0.0393701
330	100%	28	0	0	0	0	0	0	28	28	0	0	0.0393701
4530	85%	20	2	1	0	0	0	0	23	27	4	0	0.0393701
4020	96%	25	1	0	0	0	0	0	26	27	1	0	0.0393701
2340	81%	16	5	0	0	0	0	0	21	26	5	0	0.0393701
1570	92%	22	2	0	0	0	0	0	24	26	2	0	0.0393701
520	84%	17	4	0	0	0	0	0	21	25	4	0	0.0393701
1050	84%	19	1	0	1	0	0	0	21	25	4	0	0.0393701
2270	92%	22	0	1	0	0	0	0	23	25	2	0	0.0393701
220	96%	23	1	0	0	0	0	0	24	25	1	1	0.0393701
4010	75%	12	6	0	0	0	0	0	18	24	6	0	0.0393701
4050	92%	20	2	0	0	0	0	0	22	24	2	0	0.0393701
1440	100%	24	0	0	0	0	0	0	24	24	0	0	0.0393701
1110	78%	14	3	1	0	0	0	0	18	23	5	0	0.0393701
1040	83%	16	2	1	0	0	0	0	19	23	4	0	0.0393701
810	87%	17	3	0	0	0	0	0	20	23	3	0	0.0393701
140	91%	19	2	0	0	0	0	0	21	23	2	0	0.0393701
1540	96%	21	1	0	0	0	0	0	22	23	1	0	0.0393701
1480	100%	23	0	0	0	0	0	0	23	23	0	0	0.0393701
1100	86%	16	3	0	0	0	0	0	19	22	3	0	0.0393701
1030	91%	18	2	0	0	0	0	0	20	22	2	0	0.0393701

310	57%	11	1	0	0	0	0	1	12	21	9	0	0.0393701
750	100%	21	0	0	0	0	0	0	21	21	0	0	0.0393701
1060	100%	21	0	0	0	0	0	0	21	21	0	0	0.0393701
730	95%	18	1	0	0	0	0	0	19	20	1	0	0.0393701
150	100%	20	0	0	0	0	0	0	20	20	0	0	0.0393701
2310	100%	20	0	0	0	0	0	0	20	20	0	0	0.0393701
700	84%	13	3	0	0	0	0	0	16	19	3	0	0.0393701
820	84%	13	3	0	0	0	0	0	16	19	3	0	0.0393701
4750	84%	13	3	0	0	0	0	0	16	19	3	0	0.0393701
800	95%	17	1	0	0	0	0	0	18	19	1	0	0.0393701
2260	95%	17	1	0	0	0	0	0	18	19	1	0	0.0393701
2370	95%	17	1	0	0	0	0	0	18	19	1	0	0.0393701
610	100%	19	0	0	0	0	0	0	19	19	0	1	0.0393701
2350	100%	19	0	0	0	0	0	0	19	19	0	0	0.0393701
1010	89%	14	2	0	0	0	0	0	16	18	2	0	0.0393701
840	94%	16	1	0	0	0	0	0	17	18	1	0	0.0393701
850	100%	18	0	0	0	0	0	1	18	18	0	0	0.0393701
1460	100%	18	0	0	0	0	0	0	18	18	0	1	0.0393701
2840	100%	18	0	0	0	0	0	0	18	18	0	0	0.0393701
2730	76%	10	2	1	0	0	0	0	13	17	4	0	0.0393701
860	82%	11	3	0	0	0	0	0	14	17	3	0	0.0393701
2190	88%	13	2	0	0	0	0	0	15	17	2	0	0.0393701
1920	94%	15	1	0	0	0	0	0	16	17	1	0	0.0393701
100	100%	17	0	0	0	0	0	0	17	17	0	0	0.0393701
410	75%	9	2	1	0	0	0	0	12	16	4	0	0.0393701
320	94%	14	1	0	0	0	0	0	15	16	1	0	0.0393701
1000	94%	14	1	0	0	0	0	0	15	16	1	0	0.0393701
1660	94%	14	1	0	0	0	0	0	15	16	1	0	0.0393701
2240	94%	14	1	0	0	0	0	0	15	16	1	0	0.0393701
600	100%	16	0	0	0	0	0	0	16	16	0	0	0.0393701
620	87%	11	2	0	0	0	0	0	13	15	2	0	0.0393701
650	93%	13	1	0	0	0	0	0	14	15	1	0	0.0393701
1620	93%	13	1	0	0	0	0	0	14	15	1	0	0.0393701
900	100%	15	0	0	0	0	0	0	15	15	0	1	0.0393699
1600	43%	6	0	0	0	0	0	1	6	14	8	0	0.0393701
2750	50%	5	0	0	1	1	0	0	7	14	7	0	0.0393701
110	86%	11	0	1	0	0	0	0	12	14	2	0	0.0393701
300	93%	12	1	0	0	0	0	0	13	14	1	0	0.0393701
540	93%	12	1	0	0	0	0	0	13	14	1	0	0.0393701
710	93%	12	1	0	0	0	0	0	13	14	1	0	0.0393701
1720	85%	9	2	0	0	0	0	0	11	13	2	0	0.0393701
2360	85%	9	2	0	0	0	0	0	11	13	2	0	0.0393701
2810	85%	9	2	0	0	0	0	0	11	13	2	0	0.0393701
1710	92%	11	1	0	0	0	0	0	12	13	1	0	0.0393701
1550	100%	13	0	0	0	0	0	0	13	13	0	0	0.0393701
2230	100%	13	0	0	0	0	0	0	13	13	0	0	0.0393701
530	75%	7	1	1	0	0	0	0	9	12	3	0	0.0393701
1340	75%	8	0	0	1	0	0	0	9	12	3	0	0.0393701
1330	100%	12	0	0	0	0	0	0	12	12	0	0	0.0393701
1420	100%	12	0	0	0	0	0	0	12	12	0	0	0.0393701
720	91%	9	1	0	0	0	0	0	10	11	1	0	0.0393701
870	100%	11	0	0	0	0	0	0	11	11	0	0	0.0393701
2990	100%	11	0	0	0	0	0	0	11	11	0	0	0.0393701
1360	90%	8	1	0	0	0	0	0	9	10	1	0	0.0393701
1900	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701
2280	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701
1310	89%	7	1	0	0	0	0	0	8	9	1	0	0.0393701
1350	89%	7	1	0	0	0	0	0	8	9	1	0	0.0393701
2820	89%	7	1	0	0	0	0	0	8	9	1	0	0.0393701
830	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701
1520	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701
440	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701
1320	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
1530	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701
1700	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701
2930	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701
2940	86%	5	1	0	0	0	0	0	6	7	1	0	0.0393701
1300	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701
1810	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701
2920	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701
2710	100%	4	0	0	0	0	0	0	4	4	0	0	0.0393701
950	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701
2250	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701
	Total Tips	**3136**	**264**	**29**	**8**	**1**	**0**	**4**	**3438**	**3804**	**366**	**5**	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1000
800
600
400
200
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