

Memo



Date: May 5, 2009
To: Kevin Stewart and Chad Kudym
From: Markus Ritsch
Subject: April 2009 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, 2009.

II. General System Analysis Summary

A total of 279,175 data records were analyzed from the ALERT 2 base station. Meteorological sensors account for 75 percent, water level sensors 10 percent, and rain sensors 6 percent of the total monthly records.

More than ninety-nine percent (99%) of the received data reports were flagged as "good" by the Nova Star validation process.

The system-wide radio traffic loading was 9,306 reports per day with an average hourly loading of 388 reports. The peak hourly traffic loading was 884 reports, which occurred on April 27, between 11:00 AM and 12:00 PM. A plot of monthly average and peak hourly traffic loading is provided.

A. Specific Issues Identified this Month

- The ALERT2 base station was periodically "down" and not able to receive data from April 15th through April 18th. The base station was back on-line beginning on April 19, 2009.
- Only three reports were received from Denver Zoo (ID 1360).
- West Metro Fire Station 13 (ID 1370) reported an unexpected large number of incrementing reports.
- SPR at Union Avenue (ID 1640) reported only three incrementing reports and it seems to have stopped reporting on April 15, 2009.
- Undefined sensor ID 1373 is an open analog port on a rain-only transmitter. The transmitter should be re-programmed to turn off the analog port.
- A large number of reports were received from an un-defined sensor – 4733.
- The following rain sensors had poor event and timer performance in April: 110, 140, 700, 840, 2310, 2370, 1530, 1640, 1350, 2820, 2850, 1440.

B. Recommendations

We suspect that a marginal/poor radio path exists between several gages in Douglas County and the UDFCD repeater currently handling the traffic from these stations. Based upon the poor timer and event reporting characteristics, the following gages should be routed through the West Creek repeater rather than through the UDFCD repeater:

- Cherry Creek below Bayou Gulch (ID 2850)
- Plum Creek at Pine Cliff Road (ID 2820)
- Castle Rock Weather (ID 2750)
- Elbert County Weather (ID 1440)

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 81 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
2850	4030	2840	1360								
1650	4200	1020	1640								
1810	4490	1040	700								
4250	4520	1720	2270								
4790	4790	1030	1600								
4300	4020	1550	2850								

*-Timer statistics are skewed in these months because system start-up occurs. The network should be fully operational by April 1.

Sensor ID 1460 has a 24-hour timer reporting interval and Sensor ID 1810 has an 18-hour timer-reporting interval.

Sensors identified as having poor timer performance in multiple months are shaded with unique colors. A developing trend can thus be identified from the color shading as the year progresses.

IV. Rain Sensor Event Reporting Summary

A. District-Wide Total Tip/Count Statistics

The incrementing reports from all 1-mm rain sensors were analyzed to quantify the District-wide statistical total monthly tip summary (Table 2).

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

Statistical Parameter	Value	Comments
Mean	59.26	Only the 1-mm rain sensors were included in the analysis
Median	58	Only the 1-mm rain sensors were included in the analysis
Standard deviation	20.05	Only the 1-mm rain sensors were included in the analysis
Mean plus three standard deviations	119.4	Only the 1-mm rain sensors were included in the analysis
Minimum total count	3	SPR at Union Ave (ID 1640)
Maximum total count	133	West Metro FS13 (ID 1370)

The highest reporting rain sensor this month was West Metro FS13 (ID 1370) with 133 tips. A number of sensors reported high precipitation (more than 100 tips) including 4810, 4030, and 4110. Irrigation sprinklers do not influence the sensors at this time of the year. Only one sensor reported more than the mean plus three standard deviations and this was West Metro FS13.

The data record was manually inspected for West Metro FS13 (ID 1370). This station is highly suspect due to a number of large jumps in the sensor count value. The high precipitation accumulation for the month of April is most likely not accurate.

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	16.43	90.20	37.54	19.59	2.82	9.24	25.08
2009	6.33	3.11	11.37	59.26									

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

The majority of established sensors experienced a jump in sequential count of more than six. This was due to base station malfunction for a period of time during the month (April 15th through April 18th) (Table 4).

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

Sensor Description	Sensor ID	Comment
West Metro FS13	1370	A large jump in tip count occurs between April 15 and April 18, 2009.
Cub Creek below Blue	2270	A large jump in tip count occurs between April 15 and April 18, 2009.
Toll Gate at 6th	700	A large jump in tip count occurs between April 15 and April 18, 2009.
Morrison	2330	A large jump in tip count occurs between April 15 and April 18, 2009.

D. Sensor-by-Sensor Incrementing Count Summary

The system-wide reception rate of incrementing, 1-mm tip reports for the month was approximately 88.1 percent. A total of 7,730 incrementing reports were received and a total of 8,771 were expected. The total loss of incrementing reports for the month was approximately 11.87 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
140	4030	860	860								
4490	4470	840	840								
1420	4490	700	1640								
4040	4110	2840	2850								
4160	4510	1340	700								
4470	4790	920	1350								

* - Event statistics are poor in February and March due to system start-up.

** - Poor event performance is evident at every station because the ALERT2 base station was unable to receive data for part of this month.

Sensors identified as having poor event performance in multiple months are shaded with unique colors. A developing trend can thus be identified from the color shading as the year progresses.

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:

Peak Traffic Periods	Reports/hour	Hour Beginning
Peak Hourly Traffic	884	4/27/09 11:00 AM
2nd Max	795	4/19/09 10:00 AM
3rd Max	793	4/27/09 10:00 AM
4th Max	790	4/27/09 12:00 PM
5th Max	763	4/19/09 11:00 AM

B. April 27, 2009

The heaviest traffic period occurred on April 27, between 10:00 AM and 12:59 PM. 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, a total of 945 reports were expected and 792 were received yielding a loss of approximately 16.19% of the incrementing transmissions.

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

Heavy Traffic Period (April 27)	Occurrences of lost sequential tip reports during period			
	Loss of 3 sequential tips	Loss of 4 sequential tips	Loss of 5 sequential tips	Loss of 6 or more sequential tips
10:00 AM to 12:59 PM	3	2	0	0

The heavy traffic period was composed primarily of reports from precipitation sensors. Those precipitation sensors that lost three or more sequential reports during this heavy traffic period include:

- Van Bibber @ Hwy 93 (ID 330)
- Marston Lake North (ID 1520)
- Castle Rock (ID 2750)
- Carr Street (ID 100)
- NREL/S. Table Mtn. (ID 1030)

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)	372
Total reports from unknown IDs	1,432
Unknown IDs with only a single received report (potential noise)	274
Total reports from all IDs – RecData Log entire month	275,468
Unknown reports as a fraction of total reports	0.52%

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. Reports Received by Unknown IDs

Unknown ID	Reports
4733	244
8102**	139
8101**	112
8100**	111
1373*	98
1470	81
4469	23
4419	21
1954	21
1950	13
1499	13
2224	13
1647	9
1953	8
1949	7
4031	7
2215	7
1869	6
741	6
2228	6
2239	6
1657	6
2271	5
2238	5
1951	5
2249	5
2216	5
2217	5
2229	5
1359	4
2339	4
4749	4
2232	4
2272	4
629	4
2736	4

729	4
2720	3
1631	3
2465	3
2221	3
4646	3
621	3
4644	3
866	3
2468	3
4829	3
1365	3
696	3
4047	2
1454	2
1430	2
4046	2
4036	2
1102	2
4199	2
4033	2
4039	2
2469	2
2237	2
2247	2
2259	2
2269	2
2277	2
2278	2
2309	2
2349	2
1775	2
2358	2
2869	2
4043	2
1927	2
2721	2
2743	2

* - may be an open analog port on a rain only transmitter

** - these reports may be from a newly installed station not yet defined on ALERT2

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	78	12:00-12:59	101
1:00-1:59	43	1:00-1:59	115
2:00-2:59	33	2:00-2:59	59
3:00-3:59	65	3:00-3:59	95
4:00-4:59	28	4:00-4:59	63
5:00-5:59	22	5:00-5:59	47
6:00-6:59	56	6:00-6:59	92
7:00-7:59	31	7:00-7:59	44
8:00-8:59	17	8:00-8:59	36
9:00-9:59	98	9:00-9:59	79
10:00-10:59	75	10:00-10:59	40
11:00-11:59	72	11:00-11:59	43

VII. Reporting Issues Identified this Month

Precipitation sensors with a large number of invalid reports (duplicates/bit flip/contention errors/random decode):

Description	Sensor ID	No. of Invalid Reports
Harvard @ Jackson	610	12
Cherry Cr bl Bayou Glch	2850	10
Bear Cr below Cub	2230	8
Parker/Mississippi	540	8
Hiwan G.C.	2210	8
Red Garden	4030	6
Haskins Gulch Conf	2820	5
Chatfield COE	1350	5
Cold Sprg Glch conf	2240	5
Button Rock	4790	5
Pine Cliff Road	2810	4
Harvard Gulch Park	600	3
Martin Gulch	4040	2
Slaughterhouse Glch	1620	2
SPR at Union Ave.	1640	2
Jeffco Fairgrounds	1050	2
Sugarloaf	4730	2
El Rancho	2340	2
Rosedale	2250	2
Indian Hills	2360	2

Sensors reporting frequently (over reporting):

Description	Group	Sensor ID	Reports
Quincy Reservoir	Wind Gust	749	6971
Spring Valley Road	Wind Speed Average & Azimuth	2927	5048
Castle Rock	Wind Speed Average & Azimuth	2747	4155
Salisbury Park	Wind Speed Average & Azimuth	2727	3847
Temple Pond at DTC	Water Level PT-HSE	633	3184
Castle Rock	Temperature	2752	2729
Cal-Wood Ranch	Temperature	4772	2718
Cal-Wood Ranch	Barometric Pressure	4774	2717
Cal-Wood Ranch	Relative Humidity	4771	2706
Castle Rock	Relative Humidity	2751	2668
Aurora Reservoir	Solar Radiation	908	2653
Squaw Mountain	Wind Direction	2188	2636
Aurora Reservoir	Barometric Pressure	903	2615
Squaw Mountain	Temperature	2192	2613

Sensors reporting infrequently (under reporting):

Description	Group	Sensor ID	Reports
Quincy Reservoir	Wind Speed Average & Azimuth	747	1
Stapleton	Barometric Pressure	1463	1
Cherry Cr @ Champa	Water Level PT-HSE	1703	1
Idledale	Handar 585 ALARM Status	2346	1
Lena @ U.S. Hwy 6	Water Level PT-HSE	1043	2
No Name @ Quincy	Water Level PT-HSE	733	2
Bear Cr below Cub	Handar 585 ALARM Status	2226	2
Denver Zoo	Precipitation	1360	3
West Metro FS13	Battery Voltage Digital	1378	4
Kinney Peak	Handar 585 ALARM Status	2276	7
Little Narrows	Water Level PT-HSE	4473	14
Sand Cr at Colfax	Water Level PT-HSE	863	14
Van Bibber @ Hwy 93	Water Level PT	333	15
Hayman	Hayman Precipitation	5780	16
Harvard Gulch Park	Water Level PT-HSE	603	18
SPR at Union Ave.	Precipitation	1640	21
Bridge	Battery Voltage HSE	4425	21
Fire Station 12	Battery Voltage Digital	844	22
Squaw Mountain	Battery Voltage Digital	2186	24
Sand Cr at Colfax	Battery Voltage Digital	865	26
SPR at Union Ave.	Battery Voltage HSE	1645	26
Leyden Confluence	Battery Voltage HSE	215	26
Stapleton	Battery Voltage Digital	1468	28
Gunbarrel	Water Level PT	1113	28

General System Analysis

Database Name

P:\A207-UDFCD-Data-Analysis\2009\04-2009\Novastar_extract_2009Apr.mdb

First Date in Database
Last Date in Database

4/1/09 12:00 AM
4/30/09 11:59 PM

Total Days
Total Hours

30.0
720.0

Total Records Analyzed

279175

Records by Group

Wind Gust	46600	17%
Temperature	39899	14%
Relative Humidity	39715	14%
Wind Speed Average & Azimuth	25525	9%
Water Level PT-HSE	20464	7%
Barometric Pressure	19328	7%
Wind Direction	16467	6%
Precipitation	15951	6%
Wind Speed Average	13515	5%
Solar Radiation	8639	3%
Battery Voltage HSE	6601	2%
Water Level Float	4875	2%
Battery Voltage Digital	3543	1%
Battery Voltage Analog	3276	1%
Water Level PT	2656	1%
Soil Moisture	2446	1%
Fuel Temperature	2127	1%
Fuel Moisture	2100	1%
Hayman Precipitation	1035	0%
Longmont Flow Gage	780	0%
Repeater Pass List	560	0%
Repeater Status Report	459	0%
Longmont Water Level PT	436	0%
Battery	427	0%
Wing Gust	368	0%
12Hr Status Report	318	0%
Precipitation - Test	209	0%
Battery Voltage	110	0%
Handar 585 ALARM Status	58	0%
Solar Power	35	0%
Total	278522	

Records by Major Group

Meteorologic Sensors	209688	75%
Water Level Sensors	29211	10%
Rain Sensors	15951	6%
Sensor Status Transmissions	14850	5%
Soil and Fuel Sensors	6673	2%
Total	276373	

Records by Validation Type

Good	0	277738	99%
Questionable	1	1437	1%
Total		279175	

Sensors With Most Invalid Data

Description	Sensor	Reports
Blue Mountain	137	124
Blue Mountain	139	124
Ferril Lake	1383	86
Quincy Reservoir	755	71
Elbert	1437	54

Traffic Loading Summary

Alert Reports	279175	
Average Daily Traffic	9306	
Average Hourly Traffic	388	
Median Hourly Traffic	395	hour beginning
Peak Hourly Traffic	884	4/27/09 11:00 AM
2nd Max	793	4/19/09 10:00 AM
3rd Max	793	4/27/09 10:00 AM
4th Max	793	4/27/09 12:00 PM
5th Max	763	4/19/09 11:00 AM

Rain Timer Performance

			Analyze Rain Sensors		
			systemwide average (days)		
			0.5379	82%	
ID	Description	Rcv	Interval	Exp	Performance
1360	Denver Zoo	2	0:04	60.00	3%
1640	SPR at Union Ave.	16	14:34	60.00	27%
700	Toll Gate @ 6th	23	14:41	60.00	38%
2270	Cub Cr below Blue	23	12:42	60.00	38%
1600	Englewood Dam	27	11:58	60.00	45%
2850	Cherry Cr bl Bayou Glch	27	13:54	60.00	45%
140	Blue Mountain	29	12:31	60.00	48%
1440	Elbert	30	15:21	60.00	50%
1350	Chatfield COE	32	14:52	60.00	53%
4730	Sugarloaf	33	11:00	60.00	55%
110	Ralston Reservoir	35	13:12	60.00	58%
2370	Red Rocks Park	37	14:57	60.00	62%
310	Guy Hill Ranch	38	16:23	60.00	63%
1530	Bear Creek @ Lowell	39	12:42	60.00	65%
2340	El Rancho	39	13:05	60.00	65%
2820	Haskins Gulch Conf	39	14:47	60.00	65%
4560	Lyons Diversion NSV	41	16:47	60.00	68%
2240	Cold Sprg Glch conf	43	13:05	60.00	72%
4060	Lakeshore	43	13:11	60.00	72%
2250	Rosedale	44	13:05	60.00	73%
540	Parker/Mississippi	45	13:37	60.00	75%
840	Fire Station 12	45	13:12	60.00	75%
2280	Kinney Peak	45	13:25	60.00	75%
2350	Idledale	45	13:27	60.00	75%
2360	Indian Hills	46	13:24	60.00	77%
4010	Crescent	46	14:21	60.00	77%
4080	Twin Sisters	46	14:00	60.00	77%
4220	Fling's	46	13:27	60.00	77%
4510	Pinewood Springs	46	14:25	60.00	77%
220	Upper Leyden	47	13:00	60.00	78%
1040	Lena @ U.S. Hwy 6	47	14:03	60.00	78%
1320	SPR at 3rd Ave	47	13:15	60.00	78%
1620	Slaughterhouse Glch	47	12:36	60.00	78%
1710	Shop Creek	47	13:32	60.00	78%
2310	Genesee Village	47	12:41	60.00	78%
2920	West Cherry Head-Douglas Cnty	47	12:36	60.00	78%
100	Carr Street	48	12:56	60.00	80%
640	Goldsmith at Eastman	48	13:13	60.00	80%
970	Pump Sta 3	48	12:54	60.00	80%
1000	Maple Grove Resv.	48	12:40	60.00	80%
1050	Jeffco Fairgrounds	48	12:57	60.00	80%
1370	West Metro FS13	48	12:40	60.00	80%
2810	Pine Cliff Road	48	13:39	60.00	80%
2990	Tomah Rd-Douglas Cnty	48	13:42	60.00	80%
4240	Sunset	48	13:13	60.00	80%
4530	Winiger Ridge	48	13:56	60.00	80%
4570	St. Antons	48	14:19	60.00	80%
150	Nott Creek	49	13:17	60.00	82%
320	Sports Complex	49	13:15	60.00	82%
600	Harvard Gulch Park	49	12:54	60.00	82%
920	Aurora Town Hall Wx	49	13:10	60.00	82%
1030	NREL/S. Table Mtn.	49	12:16	60.00	82%
1310	LDC at 64th	49	13:43	60.00	82%
1550	Lakewood CC	49	13:57	60.00	82%

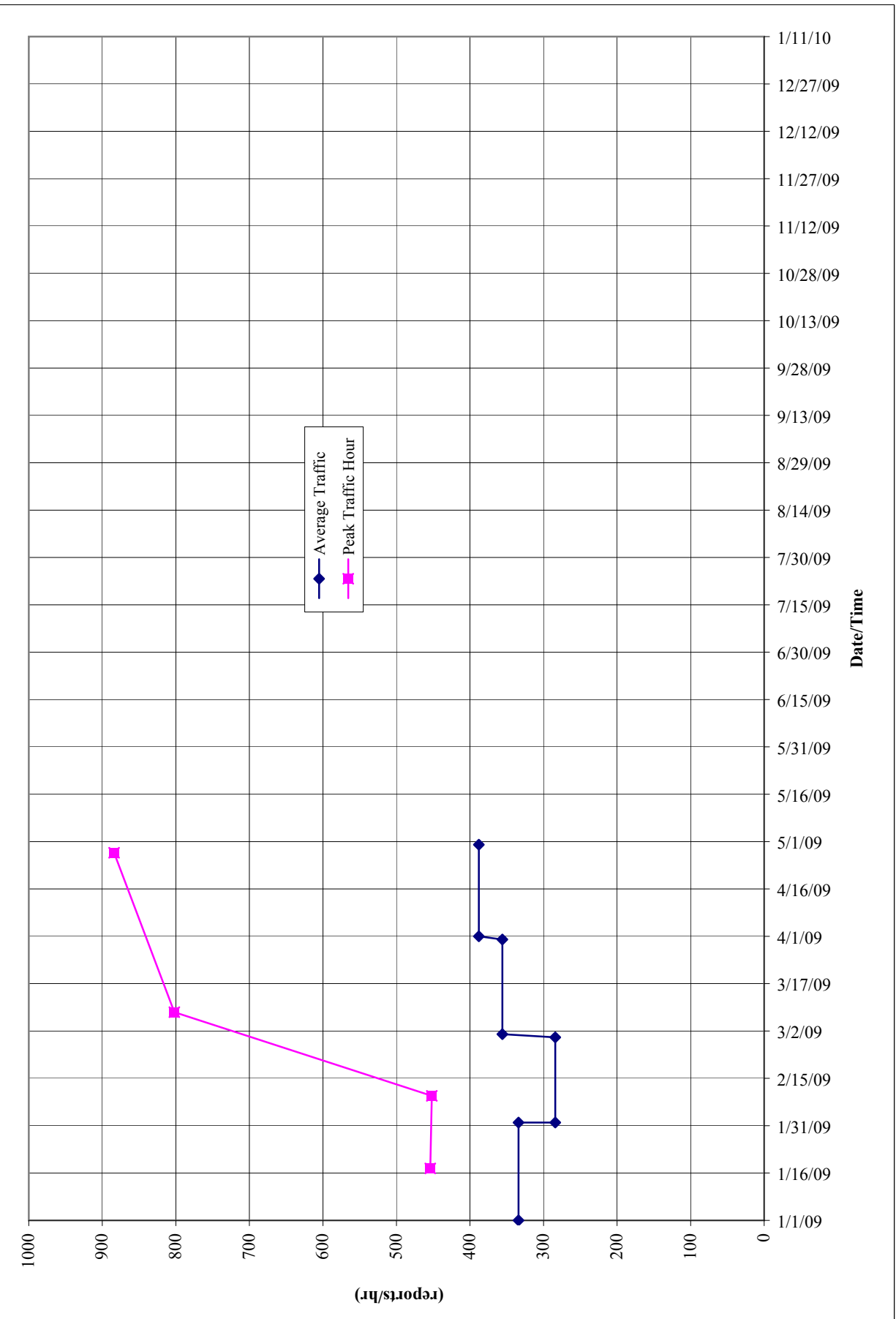
2190	Squaw Mountain	49	14:20	60.00	82%
2730	Salisbury Park	49	14:06	60.00	82%
4170	Pine Brook	49	13:19	60.00	82%
4750	Louisville Lake	49	13:08	60.00	82%
330	Van Bibber @ Hwy 93	50	12:34	60.00	83%
850	Flying J	50	12:52	60.00	83%
1570	Brighton Ditch Wx	50	12:17	60.00	83%
1920	Brighton	50	13:42	60.00	83%
2330	Morrison	50	12:16	60.00	83%
4040	Martin Gulch	50	13:51	60.00	83%
4130	Swiss Peaks	50	14:24	60.00	83%
4140	Logan Mill	50	12:55	60.00	83%
4150	Gold Hill	50	12:37	60.00	83%
4180	Gold Lake	50	13:54	60.00	83%
4710	Ward C-1	50	13:22	60.00	83%
4830	SBC @ San Souci	50	13:19	60.00	83%
620	Quincy/Highline	51	13:30	60.00	85%
720	Confluence Pond	51	13:04	60.00	85%
940	Sampson Gulch	51	12:51	60.00	85%
1010	Denver West	51	13:20	60.00	85%
1520	Marston Lake North	51	12:34	60.00	85%
1630	SPR at Dartmouth	51	13:38	60.00	85%
1660	SPR at Henderson	51	13:23	60.00	85%
2260	Brook Forest	51	12:57	60.00	85%
2840	Sulphur Gulch	51	12:17	60.00	85%
2940	Willow Creek - DougCnty	51	13:07	60.00	85%
4550	Boulder Jail	51	12:54	60.00	85%
4790	Button Rock	51	12:38	60.00	85%
4850	Porphory Mtn	51	12:56	60.00	85%
120	West Woods	52	13:13	60.00	87%
130	Simms Street	52	13:36	60.00	87%
300	Van Bibber Park	52	12:51	60.00	87%
500	Havana Park	52	13:04	60.00	87%
530	Fire Station #19	52	13:11	60.00	87%
610	Harvard @ Jackson	52	12:32	60.00	87%
800	Sable Ditch @ 18th	52	12:48	60.00	87%
870	Murphy Creek GC	52	12:32	60.00	87%
900	Aurora Reservoir	52	12:50	60.00	87%
1100	Louisville Rec Ctr	52	13:11	60.00	87%
1300	Hidden Lake	52	12:49	60.00	87%
1340	Sanderson at Xavier	52	12:53	60.00	87%
1420	Diamond Hill	52	12:17	60.00	87%
1900	Niver Detention	52	12:45	60.00	87%
4090	Magnolia	52	13:20	60.00	87%
4100	Filter Plant	52	12:35	60.00	87%
4340	Riverside	52	12:35	60.00	87%
4520	Eagle Ridge	52	12:34	60.00	87%
4810	Shanahan Ridge	52	12:57	60.00	87%
4820	Doudy Draw	52	12:57	60.00	87%
4840	SBC@S Boulder Ditch	52	12:24	60.00	87%
4860	Fairview Peak	52	12:19	60.00	87%
410	Kelly Dam	53	12:45	60.00	88%
630	Temple Pond at DTC	53	12:53	60.00	88%
710	Horseshoe Park Drop	53	12:44	60.00	88%
730	No Name @ Quincy	53	12:15	60.00	88%
810	Granby Ditch @ 6th	53	12:49	60.00	88%
820	ETG @ Buckley	53	12:29	60.00	88%
830	Side Creek Park	53	12:29	60.00	88%
1020	Lena @ Nolte Pond	53	13:20	60.00	88%

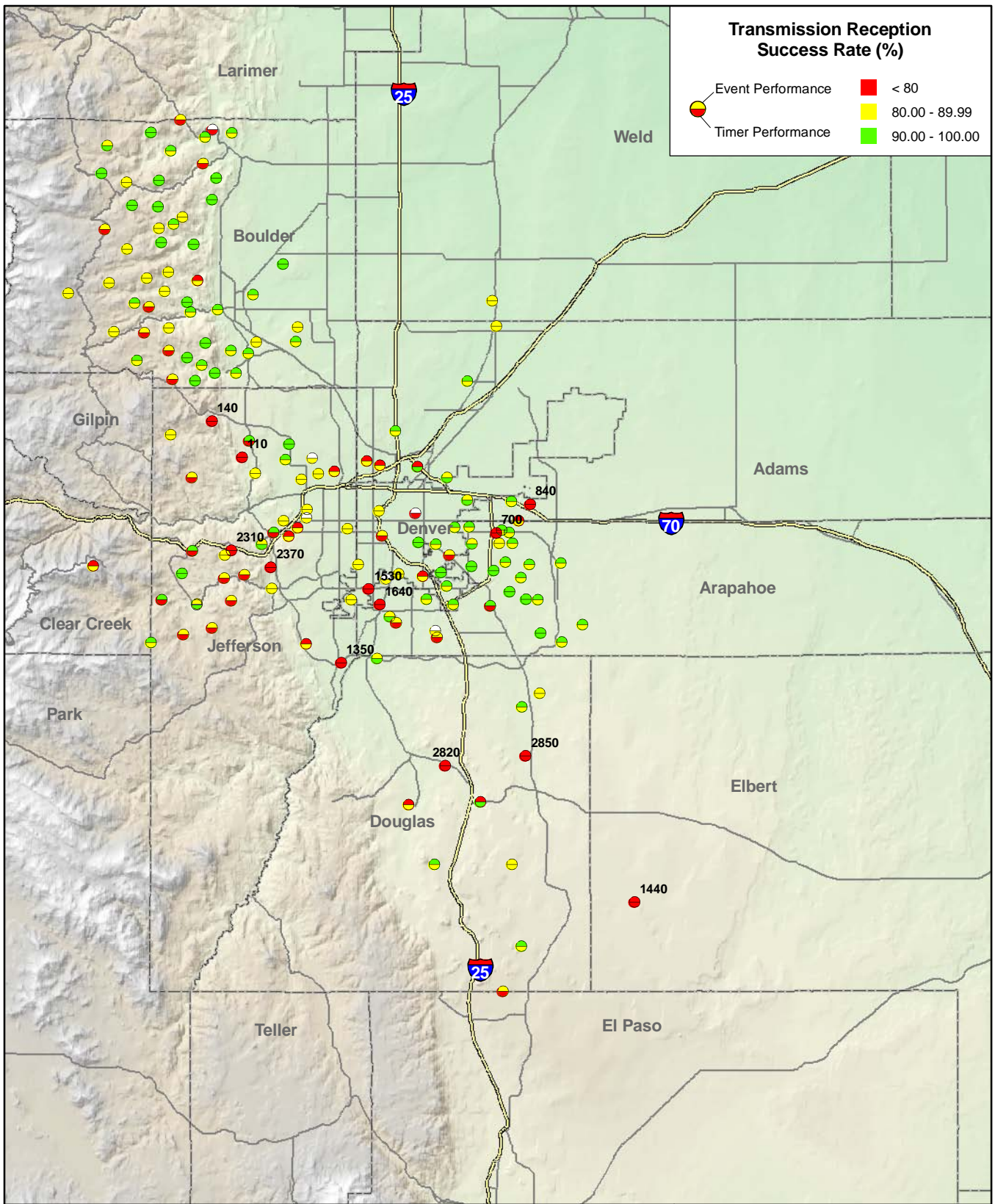
1610	Holly Dam	53	13:20	60.00	88%
2930	Spring Valley Rd - DougCnty	53	13:04	60.00	88%
4160	Sunshine	53	13:16	60.00	88%
4230	Golden Age	53	12:29	60.00	88%
4360	Justice Center	53	12:15	60.00	88%
4490	Apple Valley	53	12:15	60.00	88%
1460	Stapleton	27	23:59	30.00	90%
200	Leyden Reservoir	54	12:15	60.00	90%
650	Iliff Pond	54	12:30	60.00	90%
1060	Heritage Square	54	12:51	60.00	90%
2750	Castle Rock	54	12:32	60.00	90%
4030	Red Garden	54	12:20	60.00	90%
4070	Bear Peak	54	13:10	60.00	90%
4110	Betasso	54	13:15	60.00	90%
4200	Lazy Acres	54	11:59	60.00	90%
4260	Taylor Mountain	54	12:15	60.00	90%
4310	Johnny Park	54	13:08	60.00	90%
420	Expo Park	55	12:34	60.00	92%
440	Fire Station #7	55	12:30	60.00	92%
750	Quincy Reservoir	55	12:45	60.00	92%
760	Mission Viejo Park	55	12:31	60.00	92%
950	Piney at Liverpool	55	12:30	60.00	92%
1110	Gunbarrel	55	12:14	60.00	92%
1330	Roslyn	55	12:15	60.00	92%
1720	Cherry Cr @ Steele	55	12:30	60.00	92%
2230	Bear Cr below Cub	55	13:42	60.00	92%
4020	Rio Grande	55	12:15	60.00	92%
4050	Walker Ranch	55	12:31	60.00	92%
4250	Geer Canyon	55	12:16	60.00	92%
4290	Red Hill	55	12:16	60.00	92%
4350	Conifer Hill	55	12:50	60.00	92%
4770	Cal-Wood Ranch	55	12:18	60.00	92%
1810	Sand Creek at mouth	28	22:54	30.00	93%
520	Jewell Detention	56	12:13	60.00	93%
4270	Cannon Mountain	56	11:57	60.00	93%
4300	Big Elk Park	56	11:58	60.00	93%
1500	Powers Park	57	9:34	60.00	95%
2710	Highlands Ranch WTP	57	12:00	60.00	95%
4190	Slaughterhouse	57	12:15	60.00	95%
2210	Hiwan G.C.	59	11:42	60.00	98%
2220	Evergreen Lake	61	11:33	60.00	102%
4470	Little Narrows	68	8:33	60.00	113%
860	Sand Cr at Colfax	100	6:37	60.00	167%

Rain Event Performance				Analyze Rain Sensors										
		Reports Received	7730											
	Systemwide Avg	Total Tips	8771											
	88.1%	Data Loss	11.87%											
ID	Performance	1-tips	2-tips	3-tips	4-tips	5-tips	6-tips	>6-tips	Rcv	Exp	Miss	Hold	Bucket	
860	56%	7	0	2	0	1	0	1	10	18	8	0	0.0393701	
840	57%	19	3	0	0	3	1	2	26	46	20	0	0.0393701	
1640	67%	1	1	0	0	0	0	0	2	3	1	0	0.0393701	
2850	68%	15	1	1	2	0	0	0	19	28	9	0	0.0393701	
700	68%	18	8	1	1	0	0	3	28	41	13	0	0.0393701	
1350	69%	10	0	0	0	0	1	0	11	16	5	0	0.0393701	
1440	69%	21	5	2	0	1	0	1	29	42	13	0	0.0393701	
110	70%	19	7	1	1	0	0	1	28	40	12	0	0.0393701	
1810	72%	28	13	2	0	0	0	1	43	60	17	0	0.0393701	
140	72%	15	1	1	0	1	0	0	18	25	7	0	0.0393701	
1370	72%	73	14	6	2	0	1	3	96	133	37	0	0.0393701	
2820	74%	32	10	3	0	0	0	1	45	61	16	0	0.0393701	
2750	74%	23	4	0	2	0	0	0	29	39	10	0	0.0393701	
100	75%	27	4	0	1	1	0	1	33	44	11	0	0.0393701	
4170	75%	36	11	1	1	0	0	0	49	65	16	0	0.0393701	
1300	76%	23	4	0	0	0	1	0	28	37	9	0	0.0393701	
2370	76%	46	7	2	1	1	0	1	57	75	18	0	0.0393701	
2190	76%	11	1	0	1	0	0	0	13	17	4	0	0.0393701	
1310	77%	38	6	4	0	0	0	1	48	62	14	0	0.0393701	
970	77%	17	7	0	0	0	0	1	24	31	7	0	0.0393701	
1530	78%	35	5	2	1	0	0	1	43	55	12	0	0.0393701	
1050	79%	26	5	2	0	0	0	1	33	42	9	0	0.0393701	
1010	79%	38	7	3	0	0	0	1	48	61	13	0	0.0393701	
2310	79%	58	14	0	2	0	0	0	74	94	20	0	0.0393701	
610	79%	46	7	1	2	0	0	1	56	71	15	0	0.0393701	
2810	79%	39	4	0	1	0	1	2	45	57	12	0	0.0393701	
1420	80%	43	12	1	0	0	0	1	56	70	14	0	0.0393701	
1520	80%	45	9	1	1	0	0	1	56	70	14	0	0.0393701	
310	80%	24	2	1	1	0	0	0	28	35	7	0	0.0393701	
1030	80%	24	3	0	0	1	0	1	28	35	7	0	0.0393701	
1000	81%	36	9	1	0	0	0	2	46	57	11	0	0.0393701	
4570	81%	42	6	3	0	0	0	0	51	63	12	0	0.0393701	
4060	81%	28	6	1	0	0	0	0	35	43	8	0	0.0393701	
540	82%	31	9	0	0	0	0	2	40	49	9	0	0.0393701	
1550	82%	39	4	3	0	0	0	1	46	56	10	0	0.0393701	
4090	82%	51	8	0	0	0	1	0	60	73	13	0	0.0393701	
300	82%	30	6	1	0	0	0	1	37	45	8	0	0.0393701	
1920	83%	40	6	2	0	0	0	1	48	58	10	0	0.0393701	
4080	83%	46	5	0	2	0	0	0	53	64	11	0	0.0393701	
1060	83%	35	3	0	0	0	1	1	39	47	8	0	0.0393701	
2920	83%	34	3	1	1	0	0	1	39	47	8	0	0.0393701	
1320	84%	49	5	3	0	0	0	1	57	68	11	0	0.0393701	
420	84%	71	7	0	1	0	1	1	80	95	15	0	0.0393701	
330	84%	41	6	0	1	0	0	1	48	57	9	0	0.0393701	
2330	85%	53	6	0	0	0	1	2	60	71	11	0	0.0393701	
1500	85%	56	8	2	0	0	0	1	66	78	12	0	0.0393701	
1330	85%	46	8	1	0	0	0	1	55	65	10	0	0.0393701	
4180	85%	48	4	3	0	0	0	0	55	65	10	0	0.0393701	
4710	85%	31	0	1	0	1	0	0	33	39	6	0	0.0393701	
4160	85%	14	3	0	0	0	0	0	17	20	3	0	0.0393701	
2360	85%	62	7	0	0	0	1	0	70	82	12	0	0.0393701	
4340	85%	39	8	0	0	0	0	0	47	55	8	0	0.0393701	
2230	86%	76	6	0	1	0	1	0	84	98	14	0	0.0393701	
2710	86%	41	6	1	0	0	0	1	48	56	8	0	0.0393701	
2350	86%	57	11	0	0	0	0	1	68	79	11	0	0.0393701	
1340	86%	49	6	0	1	0	0	1	56	65	9	0	0.0393701	
4730	86%	39	4	0	1	0	0	0	44	51	7	0	0.0393701	
2280	86%	48	9	0	0	0	0	0	57	66	9	0	0.0393701	
4220	86%	45	5	0	1	0	0	0	51	59	8	0	0.0393701	
4010	86%	56	6	2	0	0	0	0	64	74	10	0	0.0393701	
4150	87%	56	8	1	0	0	0	0	65	75	10	0	0.0393701	
2840	87%	45	8	0	0	0	0	1	53	61	8	0	0.0393701	
4240	87%	17	3	0	0	0	0	1	20	23	3	0	0.0393701	
4140	87%	59	6	2	0	0	0	0	67	77	10	0	0.0393701	
4300	87%	41	5	1	0	0	0	0	47	54	7	0	0.0393701	
4510	87%	47	6	1	0	0	0	1	54	62	8	0	0.0393701	
2320	87%	48	6	1	0	0	0	0	55	63	8	0	0.0393701	
4470	88%	67	11	0	0	0	0	1	78	89	11	0	0.0393701	
4750	88%	32	3	1	0	0	0	1	36	41	5	0	0.0393701	
1570	88%	57	9	0	0	0	0	1	66	75	9	0	0.0393701	
2240	88%	57	9	0	0	0	0	1	66	75	9	0	0.0393701	
1460	88%	47	4	0	1	0	0	1	52	59	7	0	0.0393701	
320	89%	42	4	1	0	0	0	1	47	53	6	0	0.0393701	

150	89%	70	8	1	0	0	0	0	79	89	10	0	0.0393701
2940	89%	36	3	1	0	0	0	0	40	45	5	0	0.0393701
920	89%	28	4	0	0	0	0	1	32	36	4	0	0.0393701
1600	89%	29	2	1	0	0	0	1	32	36	4	0	0.0393701
600	89%	44	4	1	0	0	0	1	49	55	6	0	0.0393701
2270	89%	37	3	1	0	0	0	3	41	46	5	0	0.0393701
4840	90%	69	7	1	0	0	0	1	77	86	9	0	0.0393701
1620	90%	46	6	0	0	0	0	1	52	58	6	0	0.0393701
4810	90%	92	9	1	0	0	0	1	102	113	11	0	0.0393701
1710	90%	42	5	0	0	0	0	1	47	52	5	0	0.0393701
2250	90%	69	6	1	0	0	0	1	76	84	8	1	0.0393701
500	90%	52	4	1	0	0	0	1	57	63	6	0	0.0393701
4530	91%	44	3	1	0	0	0	0	48	53	5	0	0.0393701
4830	91%	62	5	1	0	0	0	1	68	75	7	0	0.0393701
2340	91%	45	3	1	0	0	0	0	49	54	5	1	0.0393701
200	91%	46	5	0	0	0	0	1	51	56	5	0	0.0393701
220	91%	46	5	0	0	0	0	1	51	56	5	0	0.0393701
4050	91%	57	4	1	0	0	0	0	62	68	6	0	0.0393701
4270	91%	47	5	0	0	0	0	0	52	57	5	0	0.0393701
4770	91%	39	2	1	0	0	0	0	42	46	4	0	0.0393701
640	91%	48	5	0	0	0	0	1	53	58	5	0	0.0393701
4130	92%	50	3	1	0	0	0	0	54	59	5	0	0.0393701
2260	92%	69	7	0	0	0	0	0	76	83	7	0	0.0393701
4790	92%	42	4	0	0	0	0	1	46	50	4	0	0.0393701
800	92%	44	2	1	0	0	0	1	47	51	4	0	0.0393701
440	92%	66	6	0	0	0	0	1	72	78	6	0	0.0393701
650	92%	44	4	0	0	0	0	1	48	52	4	0	0.0393701
4820	92%	56	5	0	0	0	0	1	61	66	5	1	0.0393701
810	93%	58	5	0	0	0	0	1	63	68	5	0	0.0393701
940	93%	58	5	0	0	0	0	1	63	68	5	0	0.0393699
2930	93%	37	3	0	0	0	0	1	40	43	3	0	0.0393701
1040	93%	51	2	1	0	0	0	1	54	58	4	0	0.0393701
4310	94%	54	4	0	0	0	0	0	58	62	4	0	0.0393701
900	94%	41	3	0	0	0	0	1	44	47	3	0	0.0393699
530	94%	55	4	0	0	0	0	1	59	63	4	0	0.0393701
630	94%	59	4	0	0	0	0	1	63	67	4	0	0.0393701
410	94%	46	3	0	0	0	0	1	49	52	3	0	0.0393701
2990	95%	67	4	0	0	0	0	0	71	75	4	0	0.0393701
4350	95%	67	4	0	0	0	0	0	71	75	4	0	0.0393701
4040	95%	84	5	0	0	0	0	0	89	94	5	0	0.0393701
4360	95%	86	3	1	0	0	0	1	90	95	5	0	0.0393701
120	95%	51	3	0	0	0	0	1	54	57	3	0	0.0393701
520	95%	51	3	0	0	0	0	1	54	57	3	0	0.0393701
4100	95%	52	3	0	0	0	0	0	55	58	3	0	0.0393701
2210	95%	74	0	0	0	1	0	0	75	79	4	1	0.0393701
4020	95%	74	4	0	0	0	0	1	78	82	4	0	0.0393701
1720	95%	59	3	0	0	0	0	1	62	65	3	0	0.0393701
720	95%	41	0	1	0	0	0	1	42	44	2	0	0.0393701
4030	95%	102	3	1	0	0	0	1	106	111	5	0	0.0393701
4070	96%	82	4	0	0	0	0	0	86	90	4	0	0.0393701
830	96%	41	2	0	0	0	0	1	43	45	2	0	0.0393701
1100	96%	42	2	0	0	0	0	1	44	46	2	0	0.0393701
4290	96%	67	3	0	0	0	0	1	70	73	3	0	0.0393701
4200	96%	70	3	0	0	0	0	0	73	76	3	0	0.0393701
4190	96%	49	2	0	0	0	0	1	51	53	2	0	0.0393701
710	96%	50	2	0	0	0	0	1	52	54	2	0	0.0393701
730	96%	52	2	0	0	0	0	1	54	56	2	0	0.0393701
850	97%	58	2	0	0	0	0	1	60	62	2	0	0.0393701
4260	97%	58	2	0	0	0	0	0	60	62	2	0	0.0393701
4520	97%	30	1	0	0	0	0	1	31	32	1	0	0.0393701
760	97%	61	2	0	0	0	0	1	63	65	2	0	0.0393701
4110	97%	100	3	0	0	0	0	0	103	106	3	0	0.0393701
1900	97%	34	1	0	0	0	0	1	35	36	1	0	0.0393701
2730	97%	36	1	0	0	0	0	1	37	38	1	0	0.0393701
4550	98%	78	2	0	0	0	0	1	80	82	2	0	0.0393701
870	98%	50	1	0	0	0	0	1	51	52	1	0	0.0393701
4490	98%	55	1	0	0	0	0	1	56	57	1	0	0.0393701
4250	98%	64	1	0	0	0	0	1	65	66	1	0	0.0393701
620	99%	68	1	0	0	0	0	1	69	70	1	0	0.0393701
950	100%	62	0	0	0	0	0	1	62	62	0	0	0.0393701
1110	100%	55	0	0	0	0	0	1	55	55	0	0	0.0393701
820	100%	52	0	0	0	0	0	1	52	52	0	0	0.0393701
750	100%	50	0	0	0	0	0	1	50	50	0	0	0.0393701
1660	100%	49	0	0	0	0	0	1	49	49	0	0	0.0393701
4230	100%	12	0	0	0	0	0	1	12	12	0	0	0.0393701
Total Tips		6916	672	90	30	11	11	112	7730	8771	1041	4	

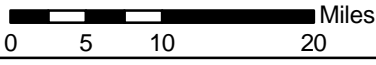
Monthly Traffic Loading





Transmission Reception Success Rate (%)

Event Performance		< 80
Timer Performance		80.00 - 89.99
		90.00 - 100.00



PROJECT NUMBER: A207	DRAWN BY: RJN
FILENAME: 04-2009 Performance.mxd	DESIGNED BY: MLR
DATE: 05/05/2009	CHECKED BY: MLR

**Transmission Performance
April 2009**

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