EXHIBIT O6

NOTICE OF VIOLATION - FOLLOW-UP STUDY

STONY CREEK NO. 1 INTERCEPTOR
FLOW AND CAPACITY STUDY
UPDATE NO. 2

SEPTEMBER 17, 2015

PREPARED FOR:

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EXECUTIVE SUMMARY

A flow and capacity analysis is being performed for the Stony Creek No. 1 Interceptor between North Wales Road and the Timberlake Pump Station, which is a distance of 7,680 feet, or 1.45 miles. A previous report was provided to East Norriton Township in May of 2015, entitled Stony Creek No. 1 Interceptor Flow and Capacity Study - Update No. 1. This report is Update Number 2 with regard to the progress made by East Norriton Township in determining whether flows exceed the capacity of certain portions the Interceptor and capacity of the Timberlake Pump Station to which the Interceptor discharges.

Between May 15 and June 15, 2015, flow was metered by CSL Services, Inc. of Pennsauken, New Jersey, at MH 375, 337, 299 and 251 within the Stony Creek No. 1 Interceptor. The purpose of the metering was to evaluate the impact of rain events on overall flow rates within specific portions of the Interceptor and to compare measured flow rates with interceptor capacity. Additional flow metering was performed at MH 251, from June 16 through July 16, 2015, in order to further compare metered flows with those recorded at the Timberlake Pump Station. Evidence of previous surcharges was noted during installation of the flow metering devices at MH 375 and MH 251.

Flow metering in MH 375, 337 and 299 did not reveal flow rates above capacity of the downstream interceptor during the monitoring period. However, with regard to MH 251, peak flows exceeded upstream and downstream capacity of the interceptor for extended time periods on June 27 into June 28 and again on July 9. Surcharge conditions were recorded for a continuous period of approximately 11 hours, beginning in the early evening of June 27 and continuing into the early morning of June 28, which coincided with a precipitation event of 2.9 inches. Surcharge conditions were also recorded for a continuous period of approximately 3.25 hours during the late evening of July 9, 2015, which coincided with a precipitation event of 1.5 inches. Based on the surcharge elevations recorded at MH 251, no Sanitary Sewer Overflows occurred.

Totalized flows metered at MH 251 were compared with those recorded at the Timberlake Pump Station, as presented in Table 7 of this report. On certain dates, the flow rates recorded at MH 251 exceeded those recorded at Timberlake Pump Station. This could be explained by limits to the calibration range of the magnetic flow meter at the Timberlake Pump Station and errors in accuracy of the meters at both locations.

We offer the following recommendations:

1. Investigate the magnetic flow meter location within the Timberlake Pump Station relative to upstream and downstream pipe fittings, in order to assess impacts to accuracy.

2. Adjust the Timberlake Pump Station flow meter calibration range upward to allow recording of flows exceeding 3,500 gallons per minute.

3. Monitor and record the water elevation within the pump station wet well on a continuous basis, if not being done already. Synchronize data collection for wet well level, metered flow and number of pumps operating simultaneously in order to establish a clearer picture of capacity limitations within the pump station, if any. If it is determined that the pump capacity at the Timberlake Pump Station needs to be increased, perform an engineering feasibility study.

4. Perform additional flow metering at MH 251. In this regard, the elevation of the Manhole Rim at MH 251 should be tied to the pump station datum, such that the water level elevation in the Manhole can be correlated with the elevation within the Pump Station Wet Well. Also determine the exact locations of MH 249, MH 250 and the manhole that contributes flow from Timberlake Apartments. Meter the flow and monitor levels within these manholes simultaneously with MH 251 in order to allow further comparison with the flow and levels within the Timberlake Pump Station.

6. Perform additional flow monitoring at MH 375 and another manhole within Section 2 of the Stony Creek No. 1 Interceptor during the fall of 2015 in order to further evaluate the impact of precipitation events on possible surcharge conditions and downstream interceptor capacity.

7. In the long term future, perform infiltration and inflow studies within the gravity sewer system feeding the Stony Creek No. 1 Interceptor upstream of MH 375, at MH 331(which receives flow from Stony Creek Road through MH 432), as well as at MH 300, which receives flow from gravity sewers along Germantown Pike.

SECTION 1.0
INTERCEPTOR METERING LOCATIONS AND FLOW ESTIMATE

1.1 General Description of Interceptor

A flow and capacity analysis has been performed for the Stony Creek No. 1 Interceptor from North Wales Road to the Timberlake Pump Station, which is a distance of 7,680 feet, or 1.45 miles. Figure 1 provides a map of the Stony Creek No. 1 Interceptor. Sewer Manholes are numbered from the Timberlake Pump Station, beginning at Sewer Manhole (MH) 249 and progressing upstream in a northward direction, across Germantown Pike and parallel with Stony Creek, reaching MH 353, approximately 500 feet south of Township Line Road. Here the interceptor turns eastward, crossing the Conrail Railroad, past Deer Run and Stony Creek Residential Developments, terminating at its upstream end at MH 381 in North Wales Road. Between MH 249 and 300, the sewer is 18-inch Reinforced Concrete Sewer Pipe (RCSP). Between MH 300 and 331 it is 15-inch Vitrified Clay Pipe (VCP). Between MH 331 and 342 it is 12-inch VCP. Upstream from MH 342, the remaining portion of the interceptor is 10-inch VP.

Existing plans of the Stony Creek No. 1 Interceptor are described in the Stony Creek Interceptor Flow and Capacity Study Update No. 1. Figure 1 shows an overall plan of the interceptor and Table 1 provides a detailed description of each interceptor pipe run between manholes, including pipe invert, type, length, slope and capacity.

1.2 Description of Flow Monitoring Locations

Figure 1 is a map of the Stony Creek No. 1 Interceptor, showing locations where flows were metered between September 12, 2014 and November 18, 2014. Specifically, these locations are as follows:

- Interceptor Manhole 378, located on the southeast side of North Wales Road, one manhole downstream of the confluence with Stony Creek Condominiums. Main interceptor flow was measured.

- Interceptor Manhole 373, located at the northwest boundary with the Conrail Railroad. Only the flow entering the interceptor from Deer Run Residential Development was metered at this location.

- Interceptor Manhole 331, located four manholes upstream of Germantown Pike, receiving flow from residential development through an easement from Stony Creek Road. Only flow from the residential development entering the interceptor was metered at this location.

The results of metering at the above manhole locations were discussed in a separate report entitled Stony Creek No. 1 Interceptor Flow and Capacity Study- Update No. 1, dated May 1, 2015.

Additional metering was performed between May 15 and June 15, 2015. These new locations, as shown in Figure 1, are as follows:

- Interceptor Manhole 375, located northwest of the Conrail Railroad, between Manhole 373 and 378. This Manhole is located in Section 1 of the Interceptor.

- Interceptor Manhole 337, located approximately in the middle of Section 3 of the Interceptor.

- Interceptor Manhole 299, located upstream of Germantown Pike and just downstream of Manhole 300, which receives interceptor flow and flow from gravity sewers in Germantown Pike, Penn Square Road and Stanbridge Street.

- Interceptor Manhole 251, located just upstream of the Timberlake Pump Station and receiving flow from Manhole 299 plus flow from Germantown Pump Station, Einstein Pump Station, Felton Road Pump Station and miscellaneous gravity subdrainage areas along Germantown Pike.

All of the above sewer manholes were metered between May 15 and June 15, 2015. Interceptor Manhole 251 was also metered for an extended period between June 16 and July 16, 2015. Flow metering was conducted by CSL Services Inc. of Pennsauken, New Jersey. Flow Reports are provided in Appendix A and B. The report in Appendix A summarizes the results of metering for all manholes during the period of May 15 through June 15, 2015. The report in Appendix B summarizes the results of metering in Interceptor Manhole 251 during the extended period of June 16 through July 16, 2015.

It should be noted that the daily velocity, flow and depth values presented for each metering location in the CSL Reports are average values taken from 96 separate instantaneous readings (15 minutes apart) on each day. Therefore, the overall summary charts provided for each manhole at the beginning of the reports are averages of these average values over the metering period and are not pertinent to our evaluation of conditions at each location. CEC has performed additional data manipulation based on the complete excel spreadsheet files for each manhole location, separating each day into separate data sets in order to totalize flow and determine absolute maximum values for level, velocity and flow rates on each day and for the overall monitoring period span. Section 3.0 provides a summary of this information in Tables 2 through 7 as well as our analysis of the flow data relative to capacity of the interceptor and the Timberlake Pump Station.

1.3 Development Tributary to Each Metering Manhole Based on EDUs

The Stony Creek No. 1 Interceptor flows to Timberlake Pump Station, which receives flow from the Stony Creek No. 1 Interceptor, Germantown Pump Station, Einstein Pump Station and gravity flow from the remaining drainage area. Figure 2 provides a flow schematic that illustrates the Timberlake Pump Station Drainage Area. The Stony Creek No. 1 Interceptor is differentiated in orange line type in Figure 2. This Figure has been revised to distinguish between the manhole locations metered previously in September through November of 2014 from the manhole locations recently metered from May 15 through July 16, 2015. The number

of EDUs contributing flow to the Stony Creek No. 1 Interceptor is estimated for the new manhole metering locations as follows:

A. Manhole 375: 721 EDUs – breakdown as follows

- 558 EDUs from development along North Wales Road and from development North and West of North Wales Road (CEC Count).
- 163 EDUs from Stony Creek Condominiums (number provided by Bryan Bortnichak).

B. Manhole 337: 859 EDUs – breakdown as follows

- 721 EDUs from Manhole 375
- 138 EDUs from Deer Run Development (number provided by Bryan Bortnichak).

(Additional flow from East Norriton Middle School, which is approximately 12–15 EDUs is negligible and was not included for the purpose of this investigation)

C. Manhole 299: 1381 EDUs – breakdown as follows

- 859 EDUs from Manhole 337
- 467 EDUs from development along Stony Creek Road, Norwood Lane, Sycamore Lane, Green Hill Lane, Oak Tree Road, Beechwood Road, Brookside Road, Bryans Road, Orchard Road, Woodlawn Road, Cottage Lane and a portion of Penn Square Road. (CEC Count).
- 55 EDUs from Penn Square Road, Portions of Germantown Pike, Dorp Lane, Dorp Circle and Stainbridge Street.

D. Manhole 251: 3677 EDUs – breakdown as follows

- 1,381 EDUs from Manhole 299
- 2,296 EDUs from the east end of East Norriton Township, including 1730 EDUs from Germantown Pump Station, 390 EDUs from Einstein Pump Station and 176 EDUs from gravity sewer areas along Germantown Pike, including Kenwood Road, Norriton Drive, Avon Road, Pinecrest Road, Dermon Road, Scenic Road, North Wales Road, Portions of Barbara Drive, portions of Denise Road, portions of Michelle Drive and portions of Germantown Pike (Felton Road Pump Station – Unknown)

E. Timberlake Pump Station: 4144 EDUs – breakdown as follows:

Flow at Timberlake Pump Station is comprised of the above flow from Stony Creek No. 1 Interceptor, plus the following additional development:

- 318 EDUs from Timberlake Development (number provided by Bryan Bortnichak).
- 67 EDUs from Briarwood (number provided by Bryan Bortnichak)
- 82 EDUs from Barley Sheaf Drive (CEC Count)
- Felton Road – Unknown

1.4 Average Flow Estimate for Stony Creek No. 1 Interceptor

Based on the above, calculated average Stony Creek No. 1 Interceptor flow expected at each manhole location is as follows:

A. Manhole 375:

172,100 gpd, based on EDU Count and assumed flow per EDU of 250 gpd, except for Stony Creek Condominiums, which are assumed to have a flow rate of 200 gpd per EDU.

B. Manhole 337:

206,600 gpd, which includes estimated flow from MH 375 as described above, plus 34,500 gpd average flow from Deer Run, based on EDU count at flow rate of 250 gpd per EDU.

C. Manhole 299:

337,100 gpd, which includes estimated flow from MH 337 plus 116,750 gpd average flow from development tributary to the interceptor from Stony Creek Road, and 13,750 gpd from gravity sewer areas along Germantown Pike, based on EDU Count at flow rate of 250 gpd per EDU.

C. Manhole 251:

911,100 gpd, which includes estimated flow from MH 299 plus 2296 EDUs from the east end of East Norriton Township.

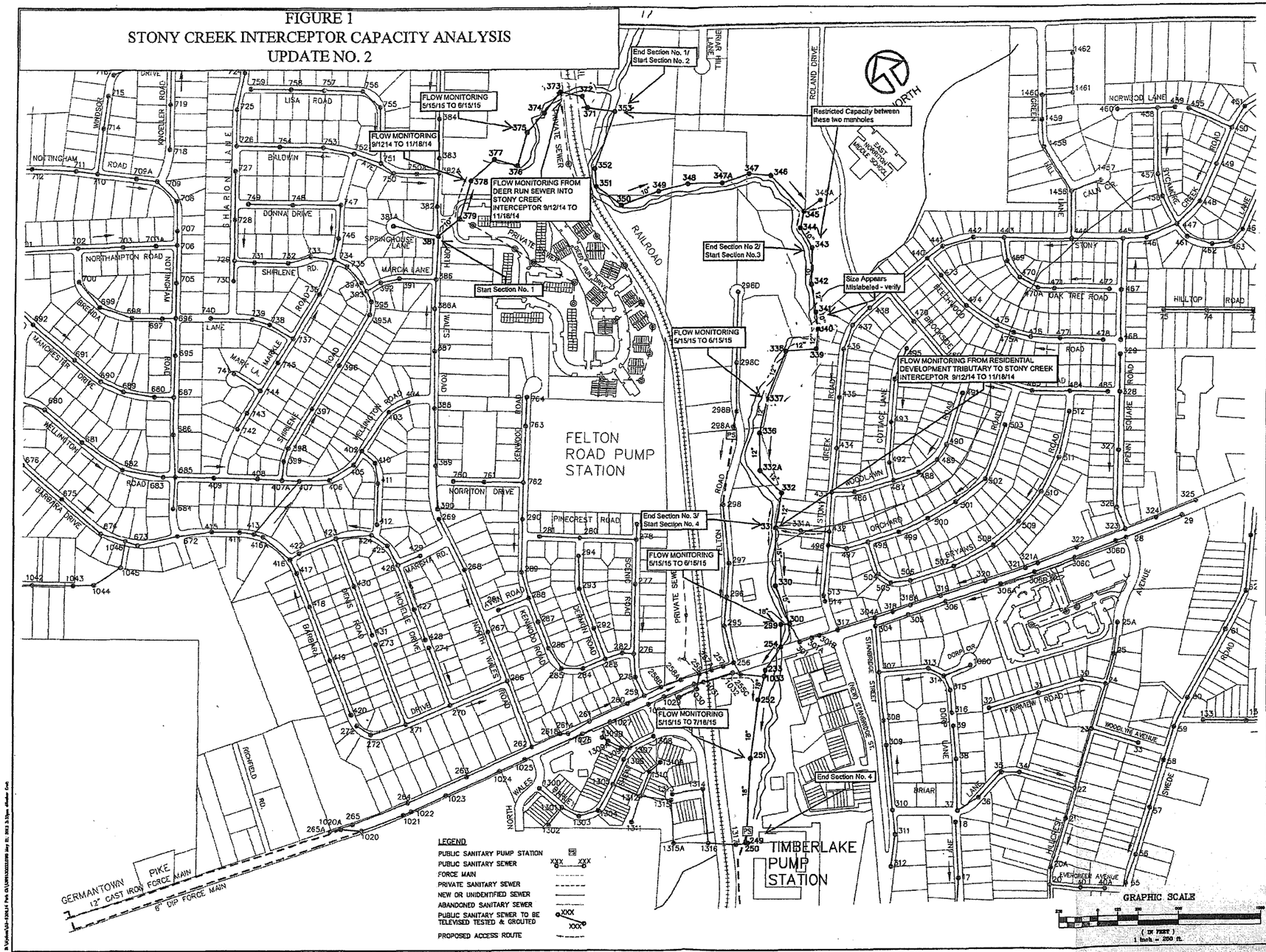
D. Timberlake Pump Station:

1,011,950 gpd, which includes flow at MH 251 plus 318 EDUs from Timberlake Development at 200 gpd/EDU, 67 EDUs from Briarwood at 250 gpd/EDU, and 82 EDUs from Barley Sheaf Drive Residential Development at 250 gpd/EDU.

In summary, flow tributary to the Timberlake Pump Station is estimated to be 4,144 EDUs. Of this, 3663 EDUs are expected to generate a flow rate of 250 gpd per EDU and 481 EDUs associated with Stony Creek Condominiums and Timberlake Apartments are assumed to generate a lower flow rate of 200 gpd per EDU. This estimate does not include flow from Felton Road or any other commercial, institutional or industrial use (schools, food establishments, office condominiums along Germantown Pike, etc.).

Actual recorded average flow to Timberlake Pump Station for the monitoring period of May 15 through June 15, 2015 was 837,364 gpd and for the extended monitoring period between June 16 and July 16, 2015 was 1,189,541 gpd. This is equivalent to a difference from the average flow estimate of minus 17.25% for the first monitoring period and plus 17.55% for the second monitoring period, which is a total flow differential of 34.8%.

FIGURE 1
STONY CREEK INTERCEPTOR CAPACITY ANALYSIS
UPDATE NO. 2



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STONY CREEK INTERCEPTOR
SITUATED IN
EAST NORRITON TOWNSHIP
PREPARED FOR
EAST NORRITON TOWNSHIP
2501 STANBRIDGE STREET
EAST NORRITON, PA 19401

DATE	07-18-12
CADD FILE	1396130033
JOB NO	12-9609.09
DSG BY	BMF
DWN BY	DCF
CKD BY	KEH
SCALE	1"=250'
DRAWER NUMBER	039-107
SHEET 1 OF 1 SHEETS	

DRAWING NUMBER
C-101

TABLE 1
STONY CREEK INTERCEPTOR CAPACITY ANALYSIS
MAXIMUM FLOW CAPACITIES - based on Manning's Equation (for given slope)

Manning's Equation

Q =(1.486/n) * A * R^ 0.667 * S^ 0/5

WHERE:

Q = Cubic Feet Per Second

A = Cross-Sectional Area of Pipe (sf)

R = Hydraulic Radius (Pipe dia./4) (ft.)

S = Slope (ft./ft.) **Based on Calculated slope from in/out inverts and stationing, not slope stated on plan**

n = Manning Coeff of Roughness

DOWNSTREAM MANHOLE			UPSTREAM MANHOLE			LENGTH	SLOPE		PIPE MATERIAL	D	A	R	n	Q (Based on Calculated Slope)			VELOCITY
							Calculated	From Plan\									
NO.	RIM	INVERT	NO.	RIM	INVERT	(FEET)	(FT/FT)	(FT/FT)		(FT)	(SF)	(FT)		(CFS)	(MGD)	(GPM)	(FPS)
249	156	147.73	250	155.2	147.93	80	0.002500	0.0026	RCSP	1.500	1.7671	0.375	0.013	5.250452	3.393958	2356.6	2.97
250	155.2	147.93	251	159	150.93	389	0.007712	0.0081	RCSP	1.500	1.7671	0.375	0.013	9.221733	5.961043	4139.0	5.22
251	159	150.93	252	160.4	151.86	333	0.002793	0.0026	RCSP	1.500	1.7671	0.375	0.013	5.549401	3.587201	2490.7	3.14
252	160.4	151.86	253	160.1	152.28	167.7	0.002504	0.0026	RCSP	1.500	1.7671	0.375	0.013	5.255146	3.396992	2358.7	2.97
253	160.1	152.28	254	159.8	152.58	125.8	0.002385	0.0026	RCSP	1.500	1.7671	0.375	0.013	5.127988	3.314795	2301.6	2.90
254	159.8	152.58	299	161.9	152.82	118	0.002034	0.0025	RCSP	1.500	1.7671	0.375	0.013	4.735778	3.061266	2125.6	2.68
299	161.9	152.82	300	164.3	153.00	84	0.002143	0.002	RCSP	1.500	1.7671	0.375	0.013	4.860974	3.142194	2181.8	2.75
300	164.3	155.06	330	161.9	156.59	263.5	0.005806	0.006	VP	1.250	1.2272	0.313	0.013	4.920460	3.180647	2208.5	4.01
330	161.9	156.59	331	164.6	158.60	328	0.006128	0.006	VP	1.250	1.2272	0.313	0.013	5.054887	3.267542	2268.8	4.12
331	164.6	158.93	332	168.3	159.59	224.5	0.002940	0.003	VP	1.000	0.7854	0.250	0.013	1.930879	1.248144	866.6	2.46
332	168.3	159.59	332A	167	161.24	251	0.006574	0.0066	VP	1.000	0.7854	0.250	0.013	2.887330	1.866406	1295.9	3.68
332A	167	161.24	336	171.1	162.76	294	0.005170	0.0066	VP	1.000	0.7854	0.250	0.013	2.560587	1.655195	1149.3	3.26
336	171.1	162.76	337	169.8	163.32	186.5	0.003003	0.003	VP	1.000	0.7854	0.250	0.013	1.951398	1.261408	875.8	2.48
337	169.8	163.32	338	171.7	164.21	275.5	0.003000	0.003	VP	1.000	0.7854	0.250	0.013	1.950527	1.260845	875.5	2.48
338	171.7	164.21	339	175.7	164.67	155	0.002968	0.003	VP	1.000	0.7854	0.250	0.013	1.940012	1.254048	870.7	2.47
339	175.7	164.67	340	171.9	165.06	127.5	0.003059	0.0025	VP	1.000	0.7854	0.250	0.013	1.969557	1.273146	884.0	2.51
340	171.9	165.06	341	175.2	166.22	115.5	0.010043	0.01	VP	1.000	0.7854	0.250	0.013	3.568858	2.306954	1601.8	4.54
341	175.2	166.22	342	176.4	167.99	169	0.010473	0.01	VP	1.000	0.7854	0.250	0.013	3.644472	2.355832	1635.7	4.64
342	176.4	167.99	343	177.4	170.30	232	0.009957	0.01	VP	0.833	0.5450	0.208	0.013	2.182798	1.410988	979.7	4.01

TABLE 1
STONY CREEK INTERCEPTOR CAPACITY ANALYSIS
MAXIMUM FLOW CAPACITIES - based on Manning's Equation (for given slope)

Manning's Equation

Q =(1.486/n) * A * R^ 0.667 * S^ 0/5

WHERE:

Q = Cubic Feet Per Second

A = Cross-Sectional Area of Pipe (sf)

R = Hydraulic Radius (Pipe dia./4) (ft.)

S = Slope (ft./ft.) Based on Calculated slope from in/out inverts and stationing, not slope stated on plan

n = Manning Coeff of Roughness

DOWNSTREAM MANHOLE			UPSTREAM MANHOLE			LENGTH	SLOPE		PIPE MATERIAL	D	A	R	n	Q (Based on Calculated Slope)			VELOCITY
							Calculated	From Plan									
NO.	RIM	INVERT	NO.	RIM	INVERT	(FEET)	(FT/FT)	(FT/FT)		(FT)	(SF)	(FT)		(CFS)	(MGD)	(GPM)	(FPS)
343	177.4	170.30	344	178.2	170.85	135	0.004074	0.004	VP	0.833	0.5450	0.208	0.013	1.396259	0.902559	626.7	2.56
344	178.2	170.85	345	179.4	171.22	95	0.003895	0.004	VP	0.833	0.5450	0.208	0.013	1.365182	0.882471	612.7	2.51
345	179.4	171.22	346	179.5	172.46	310	0.004000	0.004	VP	0.833	0.5450	0.208	0.013	1.383508	0.894316	621.0	2.54
346	179.5	172.46	347	180.3	173.01	136	0.004044	0.004	VP	0.833	0.5450	0.208	0.013	1.391116	0.899235	624.4	2.55
347	180.3	173.01	347A	179.9	173.65	160.5	0.003988	0.004	VP	0.833	0.5450	0.208	0.013	1.381351	0.892922	620.0	2.53
347A	179.9	173.65	348	181	174.50	212.5	0.004000	0.004	VP	0.833	0.5450	0.208	0.013	1.383508	0.894316	621.0	2.54
348	181	174.50	349	182.5	175.19	173.5	0.003977	0.004	VP	0.833	0.5450	0.208	0.013	1.379515	0.891735	619.2	2.53
349	182.5	175.19	350	185.4	176.22	259.5	0.003969	0.004	VP	0.833	0.5450	0.208	0.013	1.378166	0.890863	618.6	2.53
350	185.4	176.22	351	186.3	176.98	188	0.004043	0.004	VP	0.833	0.5450	0.208	0.013	1.390847	0.899061	624.3	2.55
351	186.3	176.98	352	187.4	177.52	132.5	0.004075	0.004	VP	0.833	0.5450	0.208	0.013	1.396499	0.902714	626.8	2.56
352	187.4	177.52	353	188.9	178.93	355	0.003972	0.004	VP	0.833	0.5450	0.208	0.013	1.378627	0.891162	618.8	2.53
353	188.9	178.93	371	190.8	184.04	210	0.024333	0.0242	VP	0.833	0.5450	0.208	0.013	3.412340	2.205779	1531.6	6.26
371	190.8	184.04	372	192.5	185.83	75	0.023867	0.0242	VP	0.833	0.5450	0.208	0.013	3.379461	2.184525	1516.8	6.20
372	192.5	185.83	373	195.8	188.52	157	0.017134	0	VP	0.833	0.5450	0.208	0.013	2.863373	1.850920	1285.2	5.25
373	195.8	188.52	374	196.9	189.92	96	0.014583	0.0146	VP	0.833	0.5450	0.208	0.013	2.641678	1.707614	1185.7	4.85
374	196.9	189.92	375	197.9	192.08	158	0.013671	0.014	VP	0.833	0.5450	0.208	0.013	2.557702	1.653330	1148.0	4.69
375	197.9	192.08	376	200.9	195.41	208.5	0.015971	0.016	VP	0.833	0.5450	0.208	0.013	2.764526	1.787024	1240.8	5.07
376	200.9	195.41	377	206.3	199.49	164	0.024878	0.0248	VP	0.833	0.5450	0.208	0.013	3.450323	2.230331	1548.6	6.33
377	206.3	199.49	378	208.5	201.50	201.5	0.009975	0.01	VP	0.833	0.5450	0.208	0.013	2.184802	1.412283	980.6	4.01
378	208.5	201.50	379	212.4	204.81	332	0.009970	0.01	VP	0.833	0.5450	0.208	0.013	2.184221	1.411907	980.3	4.01
379	212.4	204.81	381	216.3	206.50	181	0.009337	0.0093	VP	0.833	0.5450	0.208	0.013	2.113760	1.366360	948.7	3.88
						7860											

Top of Spread Sheet is most downstream section of the Stony Creek Interceptor. Progression of spreadsheet is from downstream to upstream, beginning at Section 4 and progressing upstream to Section 1.

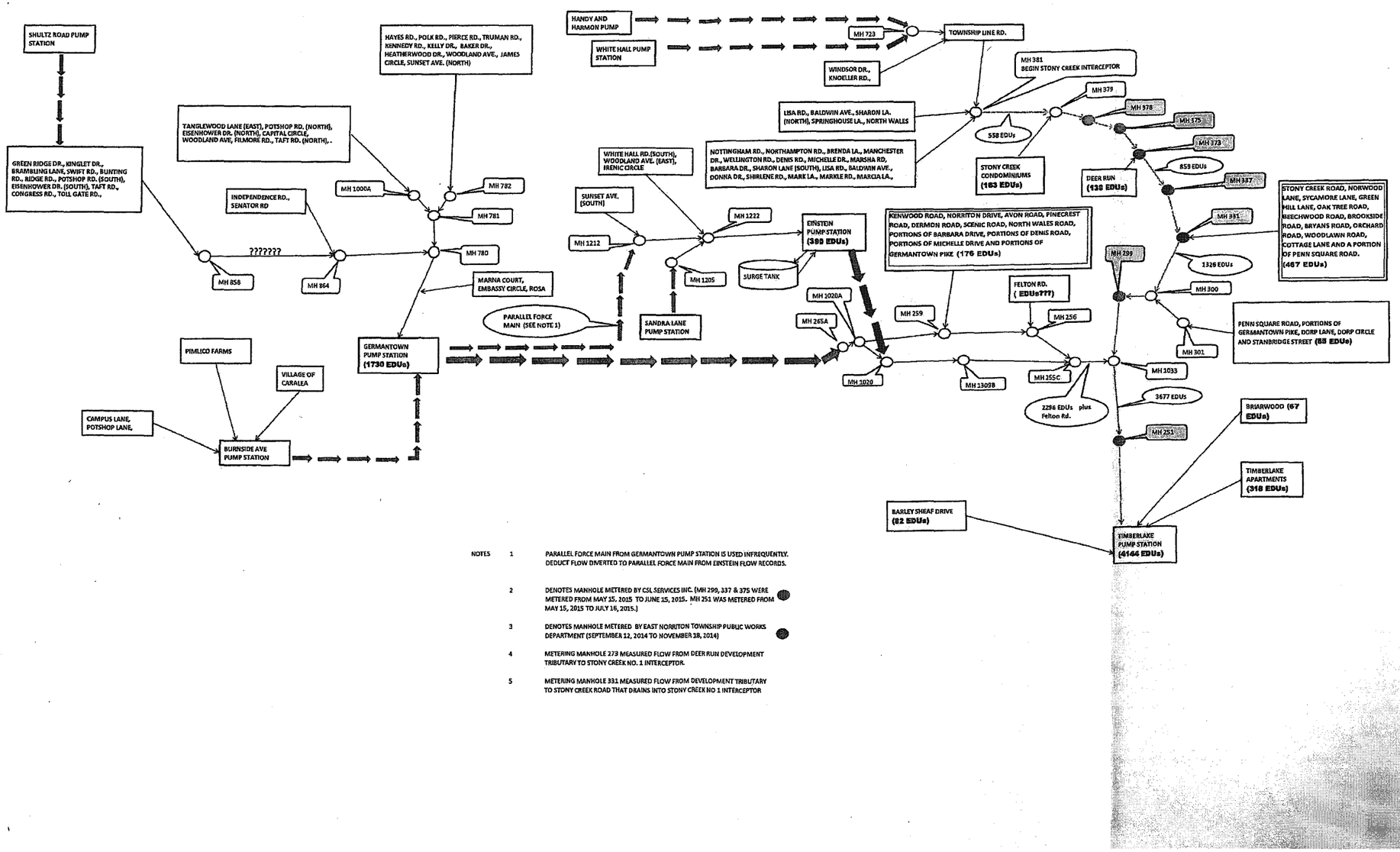
Blue shaded portion represents Section No. 4 of the Stony Creek Interceptor, which is the most downstream section leading to Timberlake Pump Station.

Green shaded portion represents Section No. 3 of the Stony Creek Interceptor.

Yellow shaded portion represents Section No. 2 of the Stony Creek Interceptor.

Orange shaded portion represents Section No. 1 of the Stony Creek Interceptor, which is the most upstream section, terminating at MH 381 in North Wales Road..

FIGURE 2
TIMBERLAKE PUMP STATION FLOW SCHEMATIC



NOTES

1. PARALLEL FORCE MAIN FROM GERMANTOWN PUMP STATION IS USED INFREQUENTLY. DEDUCT FLOW DIVERTED TO PARALLEL FORCE MAIN FROM EINSTEIN FLOW RECORDS.
2. DENOTES MANHOLE METERED BY CSL SERVICES INC. (MH 290, 337 & 375 WERE METERED FROM MAY 15, 2015 TO JUNE 15, 2015. MH 251 WAS METERED FROM MAY 15, 2015 TO JULY 16, 2015.)
3. DENOTES MANHOLE METERED BY EAST NORRITON TOWNSHIP PUBLIC WORKS DEPARTMENT (SEPTEMBER 12, 2014 TO NOVEMBER 18, 2014)
4. METERING MANHOLE 379 MEASURED FLOW FROM DEER RUN DEVELOPMENT TRIBUTARY TO STONY CREEK NO. 1 INTERCEPTOR.
5. METERING MANHOLE 331 MEASURED FLOW FROM DEVELOPMENT TRIBUTARY TO STONY CREEK ROAD THAT DRAINS INTO STONY CREEK NO 1 INTERCEPTOR

SECTION 2.0
STONY CREEK NO. 1 INTERCEPTOR CAPACITY ANALYSIS

2.1 Full Flow Capacity

Table 1 provides a capacity evaluation of Stony Creek No. 1 Interceptor based on existing plans provided by East Norriton Township. A description of the capacity evaluation process was described in an earlier report, entitled Stony Creek No. 1 Interceptor Flow and Capacity Study – Update No. 1, dated May 1, 2015, and will not be repeated in this Update However, the conclusions reached with regard to capacity are repeated below for reference.

2.2 Sectional Analysis of Capacity

2.2.1 *Section No. 1*

With respect to capacity, it was found that the upstream most reach, between MH 381 and MH 353, the estimated full flow capacity of the 10-inch interceptor is between 1.37 and 2.23 mgd (between 949 and 1549 gpm, respectively). This section is shaded orange on Table 1, at the bottom of page 2.

2.2.2 *Section No. 2*

Between MH 353 and MH 343, full flow capacity of the 10-inch interceptor drops significantly to between 0.88 and 0.90 mgd (between 613 and 627 gpm, respectively), due to the reduced slope in this section. This section is shaded yellow on page 2 of Table 1.

2.2.3 *Section No. 3*

Between MH 343 and MH 331, full flow capacity increases to 1.25 mgd (867 gpm), with intermittent sections having a greater capacity of between 1.66 MGD and 2.35 MGD (between 1150 and 1,636 gpm, respectively). With the exception of the upstream most portion of this section of Interceptor, the increased capacity is primarily associated with an increase in pipe diameter from 10-inch to 12-inch. This section is shaded green on page 1 of Table 1.

2.2.4 *Section No. 4*

Downstream of MH 331, the interceptor increases in diameter to 15-inch in order to accommodate the additional flow entering from Stony Creek Road. It subsequently increases to 18-inch pipe downstream of MH 300. Full flow capacity of the final section of Interceptor ranges between 3.06 MGD and 3.59 mgd (2,126 to 2,491 gpm, respectively), except for one isolated section near the pump station with a capacity of 5.96 mgd. This section is shaded blue on page 1 of Table 1.

SECTION 3.0
FLOW METERING AND DATA ANALYSIS

3.1 General Description and Correlation with Precipitation Events

Between May 15 and June 15, 2015, flow was metered at MH 375, 337, 299 and 251 in an effort to further evaluate the impact of rain events on overall flow rates and to compare measured flow rates with interceptor capacity. CSL Services, Inc. of Pennsauken, New Jersey performed the flow monitoring using Pressure sensors to measure depth combined with continuous wave Doppler sensors to measure velocity. Flows were recorded at 15 minute intervals. Tables 2 through 5 present daily flow data summaries as compared with rain events for each manhole. For Manhole 251, which is directly upstream of the Timberlake Pump Station, Table 5 presents those flows as well for comparison purposes. As noted previously, Manhole 251 does not include flow from Timberlake Apartments (318 EDU), Briarwood (67 EDUs), or Barley Sheaf Drive (82 EDUs), all of which discharge downstream of MH 251.

Rain events are as taken from the following data sources:

- East Norriton Township Rain Gauge, reported every month by East Norriton Sewer Maintenance Supervisor, Edward White.
- FAA Wings Field Airport (Lat. 40.14, Lon. 75.27, Elev. 302 Ft) as supplied through Pennsylvania State University, entitled "Pennsylvania State Climatologist".
- NOAA Norristown, PA US (Lat. 40.120, Lon. 75.358, Elev. 70 Ft) as supplied through the NOAA National Climatic Data Center.

The Norristown and Wings Field Airport weather stations are both approximately equidistant to the Stony Creek No. 1 Interceptor, being 4.85 miles apart and each approximately 3.0 miles from the interceptor.

Precipitation data that was previously obtained from NOAA Graterford 1 E, PA US (Lat. 40.230, Lon. 75.435, Elev. 240 Ft), was ignored for this updated analysis, due to distance relative to the interceptor location being twice that of the other two monitoring locations.

3.2 Flow Data Analysis

3.2.1 *Flow Metering at MH 375 (TABLE 2)*

The average flow recorded in MH 375 of 181,533 gpd is slightly higher than the estimated flow of 172,100. The Peak Daily Flow of 371,745 gpd was 205% of average day flow; this flow is associated with 1.5 inches of rain at the East Norriton Rain Gauge on June 8, 2015. The Peak 15 minute flow of 490.6 gpm is 389% of average flow.

In order to evaluate this flow relative to downstream capacity in Section 2 of Stony Creek No. 1 Interceptor, which has a limiting capacity of 612 gpm, flows from Deer Run entering at Manhole 373 must be added to the above. However, based on the maximum flow measured at downstream manhole 337, the additional peak flow contributed from Deer Run did not cause interceptor flow to exceed 566 gpm, which is still below the limiting capacity.

During installation of the flow meter in Manhole 375, CSL recorded evidence of a previous surcharge to a depth 3 feet below the rim, due to either heavy rain infiltration or a downstream blockage. In this regard, it should be noted that a section of interceptor between Manhole 372 and 371 was replaced in September of 2014, due to damaged and cracked pipe. These repairs may have been sufficient to eliminate future surcharges at Manhole 375, since there is no information as to when the earlier surcharge occurred relative to replacement of that interceptor manhole run.

3.2.2 *Flow Metering at MH 337 (TABLE 3)*

The average flow recorded in MH 337 of 228,188 gpd is slightly higher than the estimated flow of 206,600 gpd. The Peak Daily Flow of 438,328 gpd was 192% of average day flow; this flow is associated with 1.5 inches of rain at the East Norriton Rain Gauge on June 8, 2015. The Peak 15 minute flow of 566.7 gpm is 357% of average flow. This manhole lies within Section 3 of the Stony Creek Interceptor, which has a limiting capacity of 867 gpm. Therefore, there is no indication of capacity exceedance based on the data collected. We further note that CSL did not indicate any visual evidence of previous surcharge conditions within this manhole.

3.2.3 *Flow Metering at MH 299 (TABLE 4)*

The average flow recorded in MH 299 of 308,282 gpd is slightly less than the estimated flow of 337,100 gpd. The Peak Daily Flow of 536,818 gpd was 174% of average day flow; this flow is associated with 1.5 inches of rain at the East Norriton Rain Gauge on June 8, 2015. The Peak 15 minute flow of 711 gpm is 332% of average flow. This manhole lies within Section 4 of the Stony Creek Interceptor, which has a limiting capacity of 2,126 gpm. Therefore, there is no indication of capacity exceedance based on the data collected. We further note that CSL did not indicate any visual evidence of previous surcharge conditions within this manhole.

3.2.4 *Flow Metering at MH 251 (TABLES 5, 6 & 7)*

The average flow recorded in MH 251 during the first monitoring period of May 15 through June 15, 2015 was 679,419 gpd, which significantly less than the estimated flow of 911,100 gpd. The Peak Daily Flow of 1,544,568 gpd was 227% of average day flow; this flow is associated with 1.5 inches of rain at the East Norriton Rain Gauge on June 8, 2015. The Peak 15 minute flow of 1750 gpm is 371% of average flow. This manhole lies within Section 4 of the Stony Creek Interceptor, which has a limiting capacity of 2,126 gpm. Therefore, there is no indication of capacity exceedance based on the data collected.

During installation of the flow meter in Manhole 251, evidence of a previous surcharge was noted, although depth of the surcharge beneath the rim was not indicated in the report from CSL.

The average flow recorded in MH 251 during the extended metering period of June 16 through July 16, 2015 was 1,120,685 gpd, which is 23% more than the estimated flow of 911,100 gpd. The Peak Daily Flow of 3,140,516 gpd was 280% of average day flow during the second metering period; this flow is associated with 2.9 inches of rain at the East Norriton Rain Gauge on June 27, 2015. The Peak 15 minute flow of 4085 gpm is 525% of average flow. This manhole lies within Section 4 of the Stony Creek Interceptor, which has a limiting capacity of 2,126 gpm. Flow exceeds capacity of the interceptor downstream of MH 251, between Manhole 249 and 250, which has a capacity of 2357 gpm. This assumes that these manholes receive flow from MH 251 prior to entering the Timberlake Pump Station; however the exact location of these manholes is unknown and must be investigated further to confirm what flows they actually receive from other sources, if any, and whether they are in fact a part of the main interceptor.

Flow at MH 251 during this period also exceeds capacity of the Timberlake Pump Station, which is noted to be 3,170 gpm in the 2014 Chapter 94 Collection System Questionnaire. Associated with this exceedance, surcharge conditions existed between 6:45 pm on June 27 through 5:45 am on June 28, with maximum levels in the manhole reaching 56.88 inches above the pipe invert. However, since the depth of the manhole is 8.6 feet, there was no SSO involved.

Another peak 15 minute flow rate of 3,779 gpm was noted on July 9, 2015, this flow is associated with 1.5 inches of rain at the East Norriton Rain Gauge on that date. This flow rate also exceeds the downstream capacity of the interceptor between Manhole 249 and 250, which has a capacity of 2357 gpm, as well as the capacity of the pump station. Associated with this exceedance, surcharge conditions existed between 8:45 pm and midnight on July 9, with maximum levels in the manhole reaching 46.93 inches above the pipe invert. Again, as noted above, since the depth of the manhole is 8.6 feet, there was no SSO involved.

3.3 Metered Flows at MH 251 Compared with Timberlake Pump Station Records

Tables 5 and 6, which present a summary of daily and peak flows at Manhole 251, also includes flow records for Timberlake PS, as reported by East Norriton Township. During the peak flow period of June 28, 2015, the total daily metered flow at Manhole 251 exceeded the recorded flow at the Timberlake Pump Station, despite additional flow contributions downstream of Manhole 251 from Timberlake Development, Briarwood and Barley Sheaf Drive. The daily flow for Manhole 251 is recorded to be 3,140,516 gallons, whereas the daily flow recorded for the Timberlake Pump Station was 2,981,416 gallons.

Other dates on which the flow recorded at MH 251 exceeded that recorded for the Timberlake Pump Station are noted in Table 7.

This differential could be explained for the following reasons:

1. Accuracy of the portable flow meter at MH 251 could be off between 5 and 10 percent of actual pump station flow.

2. Accuracy of the pump station flow meter could be off by 5 percent or more due to location relative to pipe bends or other fittings and valves that could affect accuracy.

3. Based on review of a calibration report for the pump station flow meter, as provided in the 2014 Chapter 94 Collection System Questionnaire, the calibration range of the meter is limited to 3500 gpm (20 mA max signal), This would mean that flow peaks above that range would not be recorded. It should be noted that although the maximum pumping capacity of the pump station at normal levels may be 3,170 gpm, the capacity of the pumps within the station could be significantly higher and capable of meeting the inflow if the surcharge level in the pump station rose to reduce static head sufficiently to offset the additional inflow demand and reach equilibrium. In addition, it is not known if the pump station capacity, as recorded, was based on a single pump; multiple pumps operating in parallel could have a significantly higher discharge rate.

TABLE 2
STONY CREEK INTERCEPTOR MANHOLE 375 (10" VP)

DATE	MAX LEVEL (INCHES)	MAX VELOCITY (FT/S)	MAX FLOW RATE (GPM)	DAILY TOTAL FLOW (GAL)	MAX 15 MINUTE FLOW		RAINFALL (INCHES)		
					(GAL)	(GPM)	East Norriton	Wingsfield	Norristown
5/15/2015	2.65	3.43	175.0	156,995	2,604.2	173.6			
5/16/2015	2.87	3.51	204.2	172,182	3,036.5	202.4	0.10	0.06	
5/17/2015	2.82	3.57	200.7	179,797	2,864.6	191.0			
5/18/2015	2.62	3.47	172.2	159,240	2,541.7	169.4			
5/19/2015	2.88	3.44	200.7	156,042	2,619.8	174.7		0.01	0.1
5/20/2015	2.70	3.41	179.2	148,349	2,588.5	172.6			
5/21/2015	2.64	3.35	167.4	155,849	2,479.2	165.3		0.01	
5/22/2015	2.63	3.66	182.6	143,953	2,666.7	177.8			0.1
5/23/2015	2.40	3.38	150.7	139,615	2,177.1	145.1			
5/24/2015	2.72	3.72	195.1	155,557	2,916.7	194.4			
5/25/2015	2.75	3.82	198.6	178,214	2,932.3	195.5			
5/26/2015	2.88	3.84	224.3	156,594	3,250.0	216.7			
5/27/2015	2.59	3.68	182.6	156,911	2,677.1	178.5	0.30	0.19	
5/28/2015	2.60	3.73	188.2	143,089	2,588.5	172.6		0.02	0.15
5/29/2015	2.61	3.90	197.9	147,438	2,817.7	187.8			0.01
5/30/2015	2.60	3.61	177.1	158,016	2,625.0	175.0			
5/31/2015	2.59	3.71	186.1	158,953	2,703.1	180.2			
6/1/2015	3.38	4.12	300.7	243,354	4,406.3	293.8	2.25	1.06	1.09
6/2/2015	3.07	3.29	197.9	217,839	2,838.5	189.2		0.13	0.66
6/3/2015	3.14	3.22	204.9	205,646	3,020.8	201.4		0.06	0.25
6/4/2015	2.79	3.85	215.3	185,281	3,031.3	202.1			
6/5/2015	2.83	3.51	191.7	173,469	2,776.0	185.1	0.25	0.03	0.21
6/6/2015	2.69	3.52	186.8	179,115	2,692.7	179.5		0.01	0.1
6/7/2015	2.80	3.56	193.8	178,219	2,843.8	189.6			
6/8/2015	5.03	4.06	492.4	237,281	7,359.4	490.6	1.50	0.95	
6/9/2015	4.83	3.91	435.4	371,745	6,447.9	429.9		0.11	1.27
6/10/2015	2.97	3.57	209.0	218,016	3,104.2	206.9			0.1
6/11/2015	2.97	3.49	198.6	199,260	2,885.4	192.4			
6/12/2015	2.74	3.50	188.2	180,219	2,703.1	180.2		0.03	
6/13/2015	2.91	3.57	209.7	185,938	2,984.4	199.0			0.12
6/14/2015	2.90	3.53	208.3	190,036	2,854.2	190.3	0.25	0.11	
6/15/2015	2.74	3.49	186.8	176,833	2,718.8	181.3		0.01	0.14
Minimum	**2.40**	**3.22**	**150.7**	**139,615**	**2,177.1**	**145.1**			
Average	**2.92**	**3.61**	**212.6**	**181,533**	**3,086.1**	**205.7**	**4.65**	**2.79**	**4.30**
Maximum	**5.03**	**4.12**	**492.4**	**371,745**	**7,359.4**	**490.6**	(TOTAL)	(TOTAL)	(TOTAL)

TABLE 3
STONY CREEK INTERCEPTOR MANHOLE 337 (12" VP)

DATE	MAX LEVEL (INCHES)	MAX VELOCITY (FT/S)	MAX FLOW RATE (GPM)	DAILY TOTAL FLOW (GAL)	MAX 15 MINUTE FLOW		RAINFALL (INCHES)		
					(GAL)	(GPM)	East Norriton	Wingsfield	Norristown
5/15/2015	4.66	1.78	205.6	175,021	2,869.8	191.3			
5/16/2015	5.06	1.85	253.5	199,750	3,625.0	241.7	0.10	0.06	
5/17/2015	4.87	1.98	256.9	199,641	3,546.9	236.5			
5/18/2015	4.75	1.88	204.9	187,688	3,062.5	204.2			
5/19/2015	4.90	1.95	236.1	194,745	3,468.8	231.3		0.01	0.1
5/20/2015	4.84	1.98	250.0	190,026	3,567.7	237.8			
5/21/2015	4.81	1.91	228.5	186,682	3,343.8	222.9		0.01	
5/22/2015	4.93	1.85	235.4	177,781	3,218.8	214.6			0.1
5/23/2015	4.81	1.91	235.4	179,161	3,489.6	232.6			
5/24/2015	5.01	2.08	270.1	195,552	3,500.0	233.3			
5/25/2015	5.25	2.03	270.8	220,906	3,921.9	261.5			
5/26/2015	5.33	2.01	263.2	198,589	3,656.3	243.8			
5/27/2015	4.92	1.88	251.4	195,953	3,421.9	228.1	0.30	0.19	
5/28/2015	5.14	2.08	285.4	192,776	3,734.4	249.0		0.02	0.15
5/29/2015	4.92	1.81	242.4	191,297	3,489.6	232.6			0.01
5/30/2015	4.95	1.81	248.6	196,802	3,567.7	237.8			
5/31/2015	5.15	1.95	273.6	222,885	3,734.4	249.0			
6/1/2015	6.73	2.15	420.8	339,609	6,281.3	418.8	2.25	1.06	1.09
6/2/2015	5.76	1.91	309.0	278,130	4,593.8	306.3		0.13	0.66
6/3/2015	5.85	1.86	293.8	255,698	4,302.1	286.8		0.06	0.25
6/4/2015	5.39	1.95	282.6	237,802	4,020.8	268.1			
6/5/2015	5.62	1.88	304.2	227,052	4,395.8	293.1	0.25	0.03	0.21
6/6/2015	5.30	1.91	253.5	232,911	3,541.7	236.1		0.01	0.1
6/7/2015	5.53	1.95	304.9	250,828	4,322.9	288.2			
6/8/2015	8.50	2.35	598.6	296,854	8,500.0	566.7	1.50	0.95	
6/9/2015	8.09	2.20	502.8	438,328	7,843.8	522.9		0.11	1.27
6/10/2015	5.53	1.86	277.8	264,307	4,093.8	272.9			0.1
6/11/2015	5.76	1.89	295.1	238,146	3,984.4	265.6			
6/12/2015	5.41	1.98	264.6	225,979	3,770.8	251.4		0.03	
6/13/2015	5.73	2.01	334.7	238,276	4,161.5	277.4			0.12
6/14/2015	5.84	1.88	279.9	248,969	4,052.1	270.1	0.25	0.11	
6/15/2015	5.53	1.71	250.7	223,865	3,489.6	232.6		0.01	0.14
Minimum	**2.66**	**0.571**	**42.4**	**175,021**	**2,869.8**	**191.3**			
Average	**4.36**	**1.330**	**158.5**	**228,188**	**4,080.4**	**272.0**	**4.65**	**2.79**	**4.30**
Maximum	**8.50**	**2.35**	**598.6**	**438,328**	**8,500.0**	**566.7**	(TOTAL)	(TOTAL)	(TOTAL)

TABLE 4
STONY CREEK INTERCEPTOR MANHOLE 299 (18" RCSP)

DATE	MAX LEVEL (INCHES)	MAX VELOCITY (FT/S)	MAX FLOW RATE (GPM)	DAILY TOTAL FLOW (GAL)	MAX 15 MINUTE FLOW		RAINFALL (INCHES)		
					(GAL)	(GPM)	East Norriton	Wingsfield	Norristown
5/15/2015	7.34	2.35	311.1	290,901	4,375.0	291.7			
5/16/2015	6.649	2.35	354.9	293,344	4,630.2	308.7	0.10	0.06	
5/17/2015	7.811	2.35	320.8	296,583	4,640.6	309.4			
5/18/2015	6.575	2.249	297.9	280,042	3,880.2	258.7			
5/19/2015	5.707	2.182	295.8	271,109	4,239.6	282.6		0.01	0.1
5/20/2015	8.046	2.283	281.3	277,135	4,015.6	267.7			
5/21/2015	6.708	2.216	286.8	266,818	3,911.5	260.8		0.01	
5/22/2015	6.943	2.182	275.7	267,370	3,906.3	260.4			0.1
5/23/2015	5.825	2.182	309.0	271,177	4,224.0	281.6			
5/24/2015	5.869	2.249	294.4	267,151	3,817.7	254.5			
5/25/2015	6.825	2.212	346.5	274,281	4,437.5	295.8			
5/26/2015	6.59	2.216	287.5	263,458	4,067.7	271.2			
5/27/2015	6.59	2.283	297.9	268,724	3,968.8	264.6	0.30	0.19	
5/28/2015	6.016	2.35	347.9	248,182	4,312.5	287.5		0.02	0.15
5/29/2015	7.134	2.182	295.1	260,786	3,713.5	247.6			0.01
5/30/2015	6.487	2.283	313.2	257,406	4,130.2	275.3			
5/31/2015	6.178	2.283	322.9	282,781	4,515.6	301.0			
6/1/2015	8.796	2.548	524.3	438,557	7,609.4	507.3	2.25	1.06	1.09
6/2/2015	7.605	2.449	429.2	390,073	5,203.1	346.9		0.13	0.66
6/3/2015	8.017	2.583	430.6	374,010	6,135.4	409.0		0.06	0.25
6/4/2015	6.913	2.358	356.3	321,250	4,703.1	313.5			
6/5/2015	7.914	2.391	336.1	316,922	4,875.0	325.0	0.25	0.03	0.21
6/6/2015	6.516	2.324	340.3	314,531	4,859.4	324.0		0.01	0.1
6/7/2015	7.384	2.358	424.3	323,302	5,468.8	364.6			
6/8/2015	11.4	2.949	722.2	385,458	10,666.7	711.1	1.50	0.95	
6/9/2015	11.032	3.038	719.4	536,818	9,744.8	649.7		0.11	1.27
6/10/2015	7.369	2.316	347.2	328,328	4,791.7	319.4			0.1
6/11/2015	8.267	2.283	319.4	308,370	4,343.8	289.6			
6/12/2015	6.413	2.381	334.7	302,984	4,458.3	297.2		0.03	
6/13/2015	7.266	2.246	338.2	297,193	4,994.8	333.0			0.12
6/14/2015	7.561	2.548	393.8	300,531	5,453.1	363.5	0.25	0.11	
6/15/2015	6.855	2.148	297.9	289,448	4,119.8	274.7		0.01	0.14
Minimum	**5.71**	**2.15**	**275.7**	**248,182**	**3,713.5**	**247.6**			
Average	**7.27**	**2.35**	**361.0**	**308,282**	**4,944.2**	**329.6**	**4.65**	**2.79**	**4.30**
Maximum	**11.40**	**3.04**	**722.2**	**536,818**	**10,666.7**	**711.1**	(TOTAL)	(TOTAL)	(TOTAL)

TABLE 5
STONY CREEK INTERCEPTOR MANHOLE 251 (18" RCSP)

DATE	MAX LEVEL (INCHES)	MAX VELOCITY (FT/S)	MAX FLOW RATE (GPM)	DAILY TOTAL FLOW (GAL)	MAX 15 MINUTE FLOW		TIMBERLAKE PS FLOW (GAL)	RAINFALL (INCHES)		
					(GAL)	(GPM)		East Norriton	Wingsfield	Norristown
5/15/2015	6.70	3.89	959.7	578,745	12,390.6	826.0	520,973			
5/16/2015	6.89	3.762	1031.9	557,833	13,171.9	878.1	539,321	0.10	0.06	
5/17/2015	5.74	3.385	656.3	453,615	8,880.2	592.0	555,192			
5/18/2015	6.77	3.762	1010.4	520,031	11,599.0	773.3	No Data			
5/19/2015	6.78	3.664	1000.7	470,505	10,713.5	714.2	No Data		0.01	0.1
5/20/2015	6.90	3.34	866.0	454,979	9,739.6	649.3	No Data			
5/21/2015	6.35	3.533	848.6	543,510	12,187.5	812.5	No Data		0.01	
5/22/2015	6.70	3.79	934.7	556,839	12,031.3	802.1	No Data			0.1
5/23/2015	6.89	3.662	1004.2	535,974	12,786.5	852.4	No Data			
5/24/2015	5.74	3.662	712.5	477,807	8,869.8	591.3	No Data			
5/25/2015	6.77	3.782	793.8	518,135	10,041.7	669.4	No Data			
5/26/2015	6.78	3.782	827.1	495,219	9,942.7	662.8	No Data			
5/27/2015	6.95	3.533	888.2	526,031	12,500.0	833.3	No Data	0.30	0.19	
5/28/2015	6.18	3.927	894.4	555,089	10,958.3	730.6	No Data		0.02	0.15
5/29/2015	6.36	4.25	934.0	626,552	11,932.3	795.5	No Data			0.01
5/30/2015	6.38	3.99	893.1	549,906	12,406.3	827.1	No Data			
5/31/2015	6.21	3.67	844.4	522,380	10,916.7	727.8	No Data			
6/1/2015	7.02	4.12	1132.6	818,833	14,557.3	970.5	848,000	2.25	1.06	1.09
6/2/2015	7.08	4.12	1100.7	777,349	13,234.4	882.3	800,000		0.13	0.66
6/3/2015	6.51	4.31	954.9	696,880	13,270.8	884.7	624,431		0.06	0.25
6/4/2015	7.06	4.341	1244.4	831,203	15,541.7	1,036.1	874,119			
6/5/2015	7.31	4.112	1243.8	753,141	16,203.1	1,080.2	827,299	0.25	0.03	0.21
6/6/2015	7.62	4.604	1463.2	805,104	16,338.5	1,089.2	816,590		0.01	0.1
6/7/2015	6.97	4.616	1117.4	814,953	16,406.3	1,093.8	800,452			
6/8/2015	9.20	4.826	1782.6	911,448	25,468.8	1,697.9	973,056	1.50	0.95	
6/9/2015	9.24	5.019	1829.2	1,544,568	26,255.2	1,750.3	1,750,363		0.11	1.27
6/10/2015	7.35	4.741	1066.7	950,547	14,906.3	993.8	987,474			0.1
6/11/2015	6.88	4.719	971.5	841,792	14,244.8	949.7	885,054			
6/12/2015	6.70	4.523	877.8	750,948	11,380.2	758.7	830,066		0.03	
6/13/2015	6.66	4.728	1006.9	800,792	14,041.7	936.1	813,101			0.12
6/14/2015	6.41	4.733	953.5	757,141	13,541.7	902.8	811,179	0.25	0.11	
6/15/2015	6.34	4.858	934.7	743,552	11,807.3	787.2	815,878		0.01	0.14
Minimum	**5.74**	**3.34**	**656.3**	**453,615**	**8,869.8**	**591.3**	**520,973**			
Average	**6.86**	**4.12**	**1024.4**	**679,419**	**13,383.3**	**892.2**	**837,364**	**4.65**	**2.79**	**4.30**
Maximum	**9.24**	**5.02**	**1829.2**	**1,544,568**	**26,255.2**	**1750.3**	**1,750,363**	(TOTAL)	(TOTAL)	(TOTAL)

TABLE 6
STONY CREEK INTERCEPTOR MANHOLE 251 (18" RCSP)

DATE	MAX LEVEL (INCHES)	MAX VELOCITY (FT/S)	MAX FLOW RATE (GPM)	DAILY TOTAL FLOW (GAL)	MAX 15 MINUTE FLOW		TIMBERLAKE PS FLOW (GAL)	RAINFALL (INCHES)		
					(GAL)	(GPM)		East Norriton	Wingsfield	Norristown
6/16/2015	7.40	4.45	896.5	704,099	13,307.3	887.2	789,269			
6/17/2015	6.52	4.42	1,127.8	732,203	15,354.2	1,023.6	758,066			0.08
6/18/2015	6.61	4.68	1,094.4	862,333	13,765.6	917.7	921,768	0.25	0.35	0.43
6/19/2015	6.86	4.66	1,047.9	808,854	14,677.1	978.5	827,753		0.02	0.07
6/20/2015	6.69	4.62	1,135.4	786,120	14,656.3	977.1	777,259		0.01	
6/21/2015	7.72	4.97	1,615.3	1,108,771	18,244.8	1,216.3	1,096,053	0.50	0.41	0.6
6/22/2015	7.11	4.83	1,116.7	843,354	16,026.0	1,068.4	869,842			
6/23/2015	7.50	4.43	1,036.1	812,875	14,447.9	963.2	850,389	0.40	0.17	
6/24/2015	7.02	4.23	993.8	827,906	13,734.4	915.6	821,348			0.51
6/25/2015	6.57	4.78	1,075.7	814,620	15,130.2	1,008.7	807,346		0.31	
6/26/2015	7.32	4.54	1,022.9	819,844	15,078.1	1,005.2	907,401		0.1	0.29
6/27/2015	56.88	5.28	4,187.5	2,252,172	61,270.8	4,084.7	2,378,249	2.90	0.5	1.02
6/28/2015	42.87	5.12	3,910.4	3,140,516	57,463.5	3,830.9	2,981,416		1.35	2.23
6/29/2015	8.16	4.22	1,272.2	1,072,661	15,208.3	1,013.9	1,484,041			0.1
6/30/2015	8.01	4.41	1,349.3	1,051,953	16,802.1	1,120.1	1,336,661	0.90	0.17	
7/1/2015	9.09	5.44	1,931.9	1,714,740	27,994.8	1,866.3	1,852,515	0.30	0.45	0.65
7/2/2015	7.46	4.54	1,411.1	1,240,823	19,765.6	1,317.7	1,299,306		0.01	0.01
7/3/2015	7.12	5.12	1,425.0	1,081,536	16,729.2	1,115.3	1,081,833			
7/4/2015	7.26	4.98	1,284.7	944,521	17,786.5	1,185.8	973,994	0.10	0.01	
7/5/2015	6.87	4.77	1,198.6	876,422	14,885.4	992.4	942,791			0.03
7/6/2015	6.78	4.59	1,156.9	885,161	16,166.7	1,077.8	893,769		0.01	
7/7/2015	6.66	4.71	1,113.9	838,563	15,802.1	1,053.5	879,584			0.06
7/8/2015	7.11	4.48	1,249.3	854,229	15,947.9	1,063.2	876,874	0.30	0.09	
7/9/2015	46.93	4.86	3,855.6	1,289,708	56,682.3	3,778.8	1,403,059	1.50	1.16	0.5
7/10/2015	8.90	4.93	1,902.1	1,716,818	33,890.6	2,259.4	1,781,606			1.58
7/11/2015	7.52	4.78	1,396.5	1,180,156	19,526.0	1,301.7	1,187,079			
7/12/2015	6.35	4.85	1,152.8	900,083	15,119.8	1,008.0	1,053,241			
7/13/2015	6.66	4.46	1,188.2	830,927	13,286.5	885.8	968,220			
7/14/2015	7.55	4.94	1,487.5	856,891	16,619.8	1,108.0	939,836		0.04	0.06
7/15/2015	9.05	6.13	2,006.9	1,757,620	29,604.2	1,973.6	1,818,284	1.10	0.52	0.81
7/16/2015	7.86	4.68	1,416.0	1,134,755	19,406.3	1,293.8	1,316,915			0.27
Minimum	**6.35**	**4.22**	**896.5**	**704,099**	**13,286.5**	**885.8**	**758,066**			
Average	**11.37**	**4.77**	**1550.3**	**1,120,685**	**21,431.6**	**1428.8**	**1,189,541**	**8.25**	**5.68**	**9.30**
Maximum	**56.88**	**6.13**	**4187.5**	**3,140,516**	**61,270.8**	**4084.7**	**2,981,416**	(TOTAL)	(TOTAL)	(TOTAL)

TABLE 7
COMPARISON OF FLOWS - MH 251 AND TIMBERLAKE PUMP STATION

DATE	MH 251 FLOW (GAL)	TIMBERLAKE PS FLOW (GAL)	TIMBERLAKE - MH 251 (GAL)	RAINFALL (INCHES)		
				East Norriton	Wingsfield	Norristown
5/15/2015	578,745	520,973	-57,772			
5/16/2015	557,833	539,321	-18,512	0.10	0.06	
5/17/2015	453,615	555,192	101,577			
5/18/2015	520,031	No Data	No Data			
5/19/2015	470,505	No Data	No Data		0.01	0.1
5/20/2015	454,979	No Data	No Data			
5/21/2015	543,510	No Data	No Data		0.01	
5/22/2015	556,839	No Data	No Data			0.1
5/23/2015	535,974	No Data	No Data			
5/24/2015	477,807	No Data	No Data			
5/25/2015	518,135	No Data	No Data			
5/26/2015	495,219	No Data	No Data			
5/27/2015	526,031	No Data	No Data	0.30	0.19	
5/28/2015	555,089	No Data	No Data		0.02	0.15
5/29/2015	626,552	No Data	No Data			0.01
5/30/2015	549,906	No Data	No Data			
5/31/2015	522,380	No Data	No Data			
6/1/2015	818,833	848,000	29,167	2.25	1.06	1.09
6/2/2015	777,349	800,000	22,651		0.13	0.66
6/3/2015	696,880	624,431	-72,449		0.06	0.25
6/4/2015	831,203	874,119	42,916			
6/5/2015	753,141	827,299	74,158	0.25	0.03	0.21
6/6/2015	805,104	816,590	11,486		0.01	0.1
6/7/2015	814,953	800,452	-14,501			
6/8/2015	911,448	973,056	61,608	1.50	0.95	
6/9/2015	1,544,568	1,750,363	205,795		0.11	1.27
6/10/2015	950,547	987,474	36,927			0.1
6/11/2015	841,792	885,054	43,262			
6/12/2015	750,948	830,066	79,118		0.03	
6/13/2015	800,792	813,101	12,309			0.12
6/14/2015	757,141	811,179	54,038	0.25	0.11	
6/15/2015	743,552	815,878	72,326		0.01	0.14
6/16/2015	704,099	789,269	85,170			
6/17/2015	732,203	758,066	25,863			0.08
6/18/2015	862,333	921,768	59,435	0.25	0.35	0.43
6/19/2015	808,854	827,753	18,899		0.02	0.07
6/20/2015	786,120	777,259	-8,861		0.01	
6/21/2015	1,108,771	1,096,053	-12,718	0.50	0.41	0.6
6/22/2015	843,354	869,842	26,488			
6/23/2015	812,875	850,389	37,514	0.40	0.17	
6/24/2015	827,906	821,348	-6,558			0.51
6/25/2015	814,620	807,346	-7,274		0.31	
6/26/2015	819,844	907,401	87,557		0.1	0.29
6/27/2015	2,252,172	2,378,249	126,077	2.90	0.5	1.02
6/28/2015	3,140,516	2,981,416	-159,100		1.35	2.23
6/29/2015	1,072,661	1,484,041	411,380			0.1
6/30/2015	1,051,953	1,336,661	284,708	0.90	0.17	
7/1/2015	1,714,740	1,852,515	137,775	0.30	0.45	0.65
7/2/2015	1,240,823	1,299,306	58,483		0.01	0.01
7/3/2015	1,081,536	1,081,833	297			
7/4/2015	944,521	973,994	29,473	0.10	0.01	
7/5/2015	876,422	942,791	66,369			0.03
7/6/2015	885,161	893,769	8,608		0.01	
7/7/2015	838,563	879,584	41,021			0.06
7/8/2015	854,229	876,874	22,645	0.30	0.09	
7/9/2015	1,289,708	1,403,059	113,351	1.50	1.16	0.5
7/10/2015	1,716,818	1,781,606	64,788			1.58
7/11/2015	1,180,156	1,187,079	6,923			
7/12/2015	900,083	1,053,241	153,158			
7/13/2015	830,927	968,220	137,293			
7/14/2015	856,891	939,836	82,945		0.04	0.06
7/15/2015	1,757,620	1,818,284	60,664	1.10	0.52	0.81
7/16/2015	1,134,755	1,316,915	182,160			0.27
Minimum	**453,615**	**520,973**				
Average	**896,550**	**1,060,170**		12.90	8.47	13.60
Maximum	**3,140,516**	**2,981,416**		(TOTAL)	(TOTAL)	(TOTAL)

SECTION 4.0
CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

Between May 15 and June 15, 2015, flow was metered at MH 375, 337, 299 and 251 in an effort further to evaluate the impact of rain events on overall flow rates and to compare measured flow rates with interceptor capacity. Additional flow metering was performed at MH 251, from June 16 through July 16, 2015, in order to further compare metered flows with those recorded at the Timberlake Pump Station. Evidence of previous surcharges was noted during installation of the flow monitoring devices at MH 375 and MH 251.

With regard to MH 375, the peak flow recorded during the metering period never exceeded the downstream limiting capacity of the interceptor. However, the difference was just 46 gpm, which suggests that there may be some surcharging occurring during heavy precipitation events. However, there were repairs made downstream of MH 375, between MH 372 and 371 which may have alleviated or minimized the surcharge condition at MH 375.

Flow metering MH 337 and MH 299 did not indicate any flow exceedances. There was no evidence of surcharges in either manhole and flows were well below capacity limitations of the downstream interceptor.

As noted above, evidence of previous surcharging was observed at MH 251 at the time the meter was installed. Peak flows recorded during the first metering period of May 15 to June 15 did not exceed the downstream interceptor capacity and no surcharge occurred. During the extended metering period of June 16 through July 16, 2015, peak flows exceeded upstream and downstream capacity of the interceptor for extended time periods on June 27 into June 28 and again on July 9. Surcharge conditions were recorded for a continuous period of approximately 11 hours, beginning in the early evening of June 27 and continuing into the early morning of June 28, which coincided with a precipitation event of 2.9 inches. Surcharge conditions were also recorded for a continuous period of approximately 3.25 hours during the late evening of July 9, 2015, which coincided with a precipitation event of 1.5 inches.

Totalized flows metered at MH 251 were compared with those recorded at the Timberlake Pump Station, as presented in Table 7 of this report. On certain dates, the flow rates recorded at MH 251 exceeded those recorded at Timberlake Pump Station.

This flow differential could be explained for the following reasons:

1. Accuracy of the portable flow meter at MH 251 could be off by 5 percent or more of actual pump station flow.

2. Accuracy of the pump station flow meter could be off by 5 percent or more due to location of the meter relative to pipe bends or other fittings and valves that could affect accuracy.

3. The calibration range of the pump station flow meter is limited to 3500 gpm (20 mA max signal), which is less than the maximum flows recorded at MH 251. This would mean that flow peaks above that range would not be recorded.

Although the maximum pumping capacity of the Timberlake Pump station at normal levels is reported to be 3,170 gpm, the capacity of the pumps within the station could be significantly higher and capable of meeting the inflow if the surcharge level in the pump station rose to reduce the pump head pressure required to discharge the additional inflow. Furthermore, it may be that the pump station capacity, as reported in the East Norriton Township Chapter 94 Questionnaire, is based on a single pump. If so, then multiple pumps operating in parallel could produce a significantly higher discharge rate capable of handling the increased inflow.

4.2 Recommendations

We recommend that the magnetic flow meter location within the Timberlake Pump Station be investigated relative to upstream and downstream pipe fittings, in order to assess impacts to accuracy. Also, we recommend that the Timberlake Pump Station flow meter calibration range be adjusted upward to allow recording of flows exceeding 3500 gallons per minute.

Once the above is completed, we recommend that the water elevation within the pump station be recorded on a continuous basis, if not already. These water elevations should be synchronized with the metered flow rates and number of pumps operating simultaneously to provide a clearer picture of capacity limitations within the pump station, if any. If pump capacity needs to be increased, an engineering feasibility study will be necessary.

Additional flow metering should be performed at MH 251 and should be further compared with metered Pump Station flows. In this regard, the elevation of the Manhole Rim at MH 251 should first be tied to the pump station datum, such that the water level elevation in the Manhole can be correlated with the elevation within the Pump Station Wet Well. This would allow a determination as to whether the surcharge at MH 251 is controlled by the level in the wet well or by the limiting capacity of the interceptor between MH 251 and the Pump Station.

The exact locations of MH 249 and 250, which are generally shown in the vicinity of the Timberlake Pump Station, should be established. If these manholes receive downstream flow contributions not recorded at MH 251 (Timberlake Apartments, Briarwood and Barley Sheaf Drive), flow and levels within these manholes should be monitored relative to the Pump Station. If not, the manhole contributing flow from Timberlake Apartments should be located. These manholes should be metered simultaneously with MH 251 to aid in checking totalized flow into the Pump Station.

With regard to MH 375, additional flow metering should be performed in the fall of 2015 for an extended period to further evaluate the impact of precipitation events on possible surcharge conditions and downstream capacity within Section 2 of Stony Creek No. 1 Interceptor. Another downstream metering location should also be selected within Section 2 in order to allow further insight as to the extent and impact of surcharge within that section.

In the long term future, we recommend additional infiltration and inflow studies within the gravity sewer system feeding the Interceptor upstream of MH 375, at MH 331(which receives flow from Stony Creek Road through MH 402), as well as at MH 300, which receives flow from gravity sewers along Germantown Pike.

APPENDIX A

CSL REPORT DATED JULY 2, 2015

CSL Services, Inc. *Customized Solutions to your Flow Metering Needs*

To: Mr. Lane P. Bodley, P.E.
Carroll Engineering Corporation
949 Easton Road
Warrington, PA 18976

From: Alyson Lee
Project Manager

Date: July 2, 2015

RE: East Norriton, PA Stony Creek Interceptor Temporary Flow Monitoring

Enclosed is the data for 5/15/2015 through 6/15/2015. The data provided for each site is as follows:

- Flow, Level & Velocity Hydrograph
- Level vs. Velocity Scattergraph
- Daily Tabular Flow Summary Report
- Site Report
- CD containing the reports in pdf form and the raw data in Excel format.

The data may also be viewed from our website www.cslservices.com.

User Name: eastnorriton
Password: 1234

Please feel free to contact me should you have any questions.

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Monitoring Summary:

Overview:
The 4 sites were monitored by area/velocity flow meters installed between May 14th, 2015 through June 16th, 2015. The flow meter is essentially a computer designed to operate in a sewer environment. Sensors provide depth (from which area is calculated) and velocity measurements which are used to determine flow rate. Every 15 minutes, the meter takes a depth and velocity measurement. The flow meter utilizes pressure sensors to measure depth, and a continuous wave Doppler sensor to measure velocity.

MH-375
The flow meter provided 100% uptime during the monitoring period.

The sensor was installed in the upstream 10" pipe. As evidenced by the hydrograph and scattergraph, this site exhibited typical open channel, free flow. During the wet weather events, the flow remained in pipe and maintained free flow conditions.

The following table summarizes the average daily depth, velocity, and flow data collected at this site:

	Depth (in)	Velocity (fps)	Flow Rate (MGD)
Minimum	1.965	2.487	0.140
Average	2.314	2.828	0.182
Maximum	3.381	3.504	0.374

MH-337
The flow meter provided 100% uptime during the monitoring period.

The sensor was installed in the downstream 12" pipe. As evidenced by the hydrograph and scattergraph, this site exhibited typical open channel, free flow. During the wet weather events, the flow remained in pipe and maintained free flow conditions.

The following table summarizes the average daily depth, velocity, and flow data collected at this site:

	Depth (in)	Velocity (fps)	Flow Rate (MGD)
Minimum	3.735	1.177	0.175
Average	4.361	1.330	0.228
Maximum	6.269	1.626	0.441

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MH-299
The flow meter provided 100% uptime during the monitoring period.

The sensor was installed in the upstream 18" pipe. As evidenced by the hydrograph and scattergraph, this site exhibited typical open channel, free flow. During the wet weather events, the flow remained in pipe and maintained free flow conditions.

The following table summarizes the average daily depth, velocity, and flow data collected at this site:

	Depth (in)	Velocity (fps)	Flow Rate (MGD)
Minimum	4.571	1.580	0.249
Average	5.056	1.712	0.308
Maximum	7.352	1.961	0.539

MH-251
The flow meter provided 100% uptime during the monitoring period.

The sensor was installed in the upstream 18" pipe. As evidenced by the hydrograph and scattergraph, this site exhibited typical open channel, free flow. During the wet weather events, the flow remained in pipe and maintained free flow conditions.

The following table summarizes the average daily depth, velocity, and flow data collected at this site:

	Depth (in)	Velocity (fps)	Flow Rate (MGD)
Minimum	4.170	2.024	0.459
Average	4.685	2.724	0.680
Maximum	6.828	3.661	1.488

Summary

The conditions at the 4 metering locations were suitable for flow monitoring and based on the quality of the depth and velocity data, the continuity equation (Q = V*A) was used to calculate flow. CSL's review of the flow data, the meter calibrations, field maintenance logs have verified that the flow meters have provided accurate, reliable and repeatable flow data.

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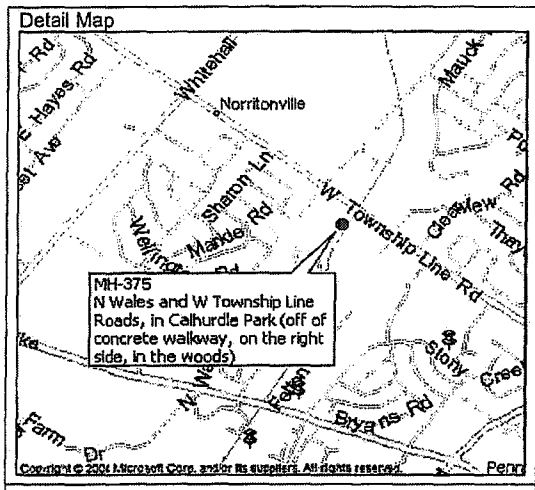
SITE REPORT

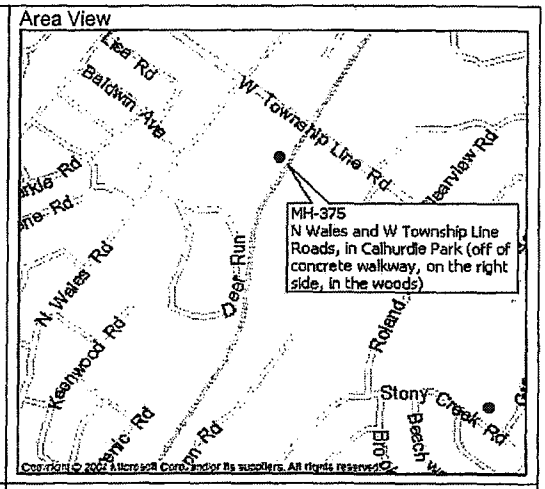
Project: East Norriton Temporary Flow Metering Study	Date: 5/14/15	Time: 10:15	Name: C. LaClaire
Manhole #: MH-375	Pipe Diameter: 10"	Town: East Norriton	
Address/Location: N Wales and W Township Line Roads, in Calhurdle Park (off of concrete walkway, on the right side, in the woods)			
Latitude: N 40°9'27"	Longitude: W 75°19'36"	Access: Drive	
Safety: Standard CSE		Manhole Depth: 8'3"	
Gas Investigation: Good	Manhole Condition: Good	Traffic: Standard	
Flow Meter: AV Meter		Sensor Configuration: Pressure Depth, Doppler Velocity	

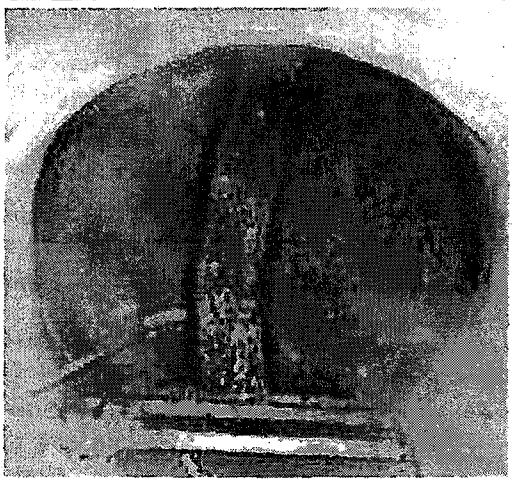
Site Comments: Evidence of surcharge 3' from rim. Sensor is installed in the upstream pipe.
Silt: None

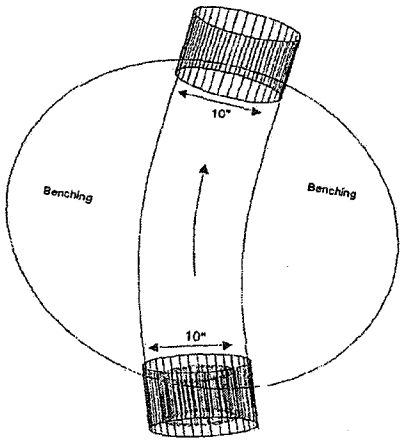
Detail Map

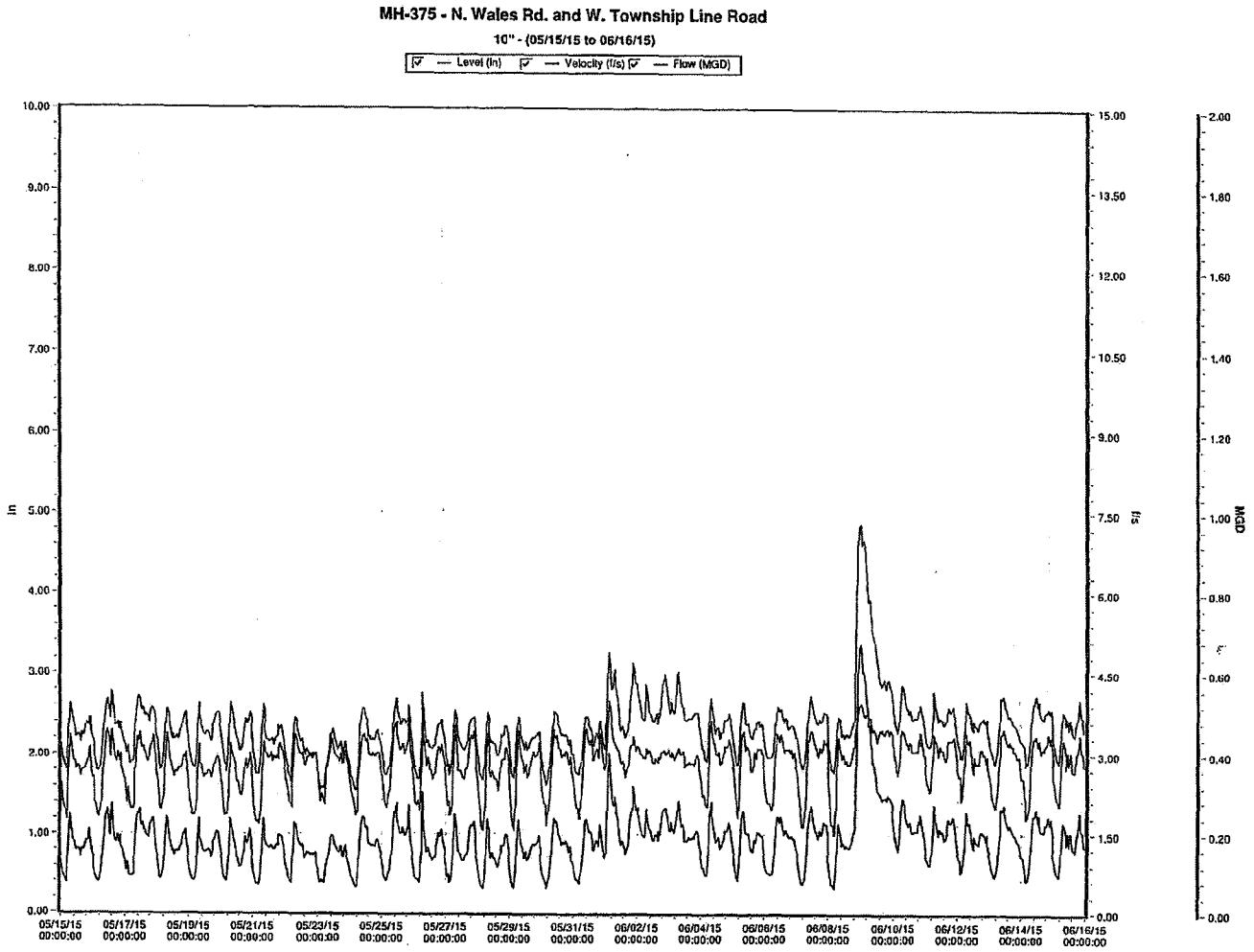


Area View



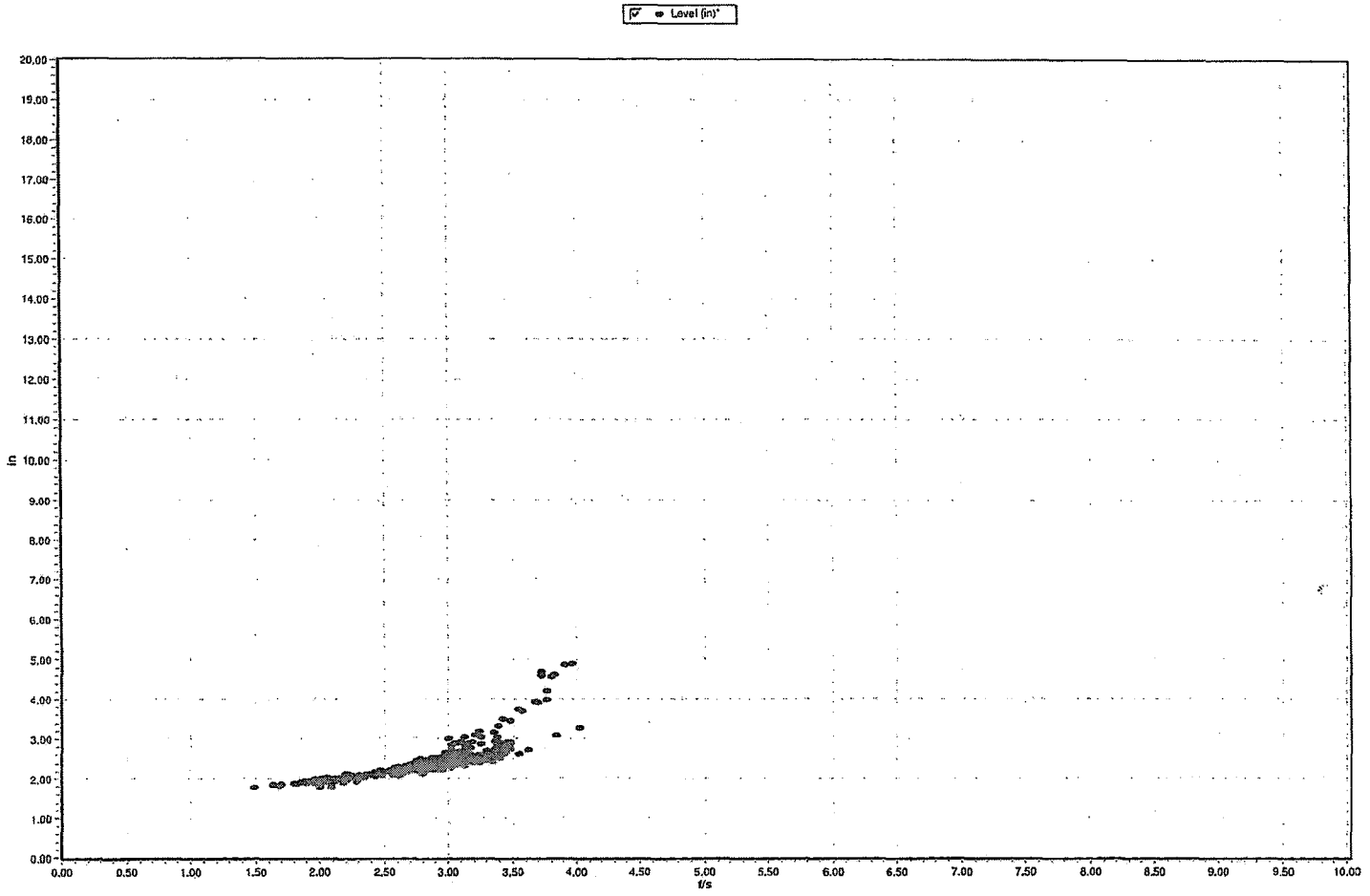





MH-375 - N. Wales Rd. and W. Township Line Road
10" - (05/15/15 to 06/16/15)
Level (in)
Velocity (f/s)
Flow (MGD)
in
f/s
MGD
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
15.00
13.50
12.00
10.50
9.00
7.50
6.00
4.50
3.00
1.50
0.00
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
05/15/15 00:00:00
05/17/15 00:00:00
05/19/15 00:00:00
05/21/15 00:00:00
05/23/15 00:00:00
05/25/15 00:00:00
05/27/15 00:00:00
05/29/15 00:00:00
05/31/15 00:00:00
06/02/15 00:00:00
06/04/15 00:00:00
06/06/15 00:00:00
06/08/15 00:00:00
06/10/15 00:00:00
06/12/15 00:00:00
06/14/15 00:00:00
06/16/15 00:00:00

MH-375 - N. Wales Rd. and W. Township Line Road

10" - (06/01/15 to 07/01/15)



MH-375 - N. Wales Rd. and W. Township Line Road
10" - (05/15/15 to 06/16/15)

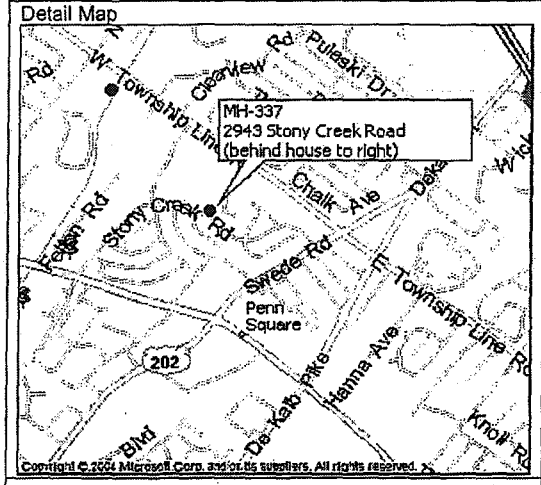
Time	Velocity (f/s)	Level (in)	Flow (MGD)
05/15/15 00:00:00	2.634	2.219	0.157
05/16/15 00:00:00	2.743	2.281	0.172
05/17/15 00:00:00	2.774	2.343	0.180
05/18/15 00:00:00	2.654	2.231	0.159
05/19/15 00:00:00	2.568	2.251	0.156
05/20/15 00:00:00	2.487	2.210	0.148
05/21/15 00:00:00	2.716	2.155	0.156
05/22/15 00:00:00	2.798	2.005	0.144
05/23/15 00:00:00	2.787	1.965	0.140
05/24/15 00:00:00	2.764	2.100	0.155
05/25/15 00:00:00	2.919	2.236	0.178
05/26/15 00:00:00	2.744	2.141	0.157
05/27/15 00:00:00	2.729	2.153	0.157
05/28/15 00:00:00	2.569	2.104	0.143
05/29/15 00:00:00	2.660	2.096	0.147
05/30/15 00:00:00	2.774	2.129	0.158
05/31/15 00:00:00	2.793	2.130	0.159
06/01/15 00:00:00	3.135	2.681	0.243
06/02/15 00:00:00	2.988	2.599	0.218
06/03/15 00:00:00	2.904	2.542	0.206
06/04/15 00:00:00	2.936	2.314	0.185
06/05/15 00:00:00	2.816	2.272	0.174
06/06/15 00:00:00	2.852	2.301	0.179
06/07/15 00:00:00	2.786	2.308	0.178
06/08/15 00:00:00	2.885	2.607	0.235
06/09/15 00:00:00	3.504	3.381	0.374
06/10/15 00:00:00	3.125	2.513	0.218
06/11/15 00:00:00	3.003	2.414	0.199
06/12/15 00:00:00	2.857	2.324	0.180
06/13/15 00:00:00	2.892	2.337	0.186
06/14/15 00:00:00	2.868	2.378	0.190
06/15/15 00:00:00	2.815	2.323	0.178
Minimum	**2.487**	**1.965**	**0.140**
Average	**2.828**	**2.314**	**0.182**
Maximum	**3.504**	**3.381**	**0.374**
Total			

SITE REPORT

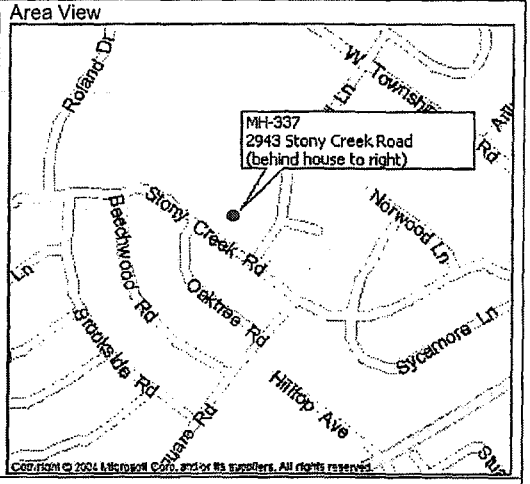
Project: East Norriton Temporary Flow Metering Study	Date: 5/14/15	Time: 12:31	Name: C. LaClaire
Manhole #: MH-337	Pipe Diameter: 12"	Town: East Norriton	
Address/Location: 2943 Stony Creek Road (behind house to right)			
Latitude: N 40°9'4"	Longitude: W 75°19'34"	Access: Walk	
Safety: Standard CSE		Manhole Depth: 5' 9"	
Gas Investigation: Good	Manhole Condition: Good	Traffic: Standard	
Flow Meter: AV Meter		Sensor Configuration: Pressure Depth, Doppler Velocity	

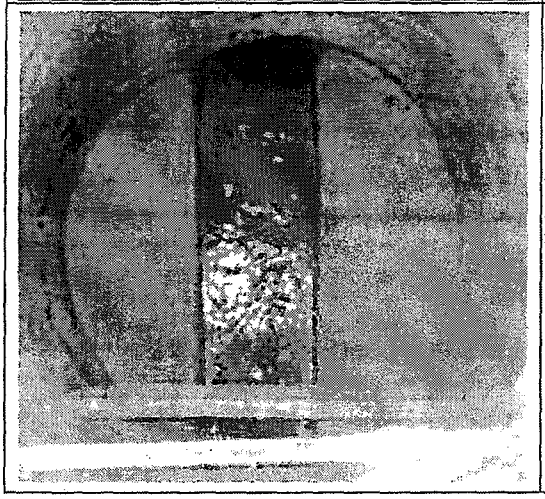
Site Comments: Sensor is installed in the downstream pipe.
Silt: None

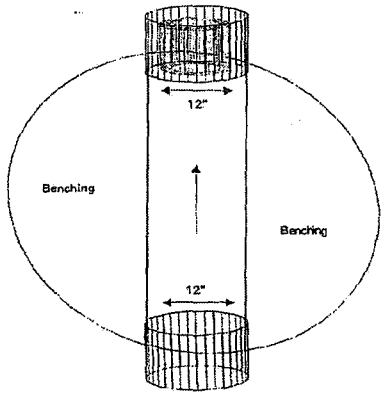
Detail Map



Area View

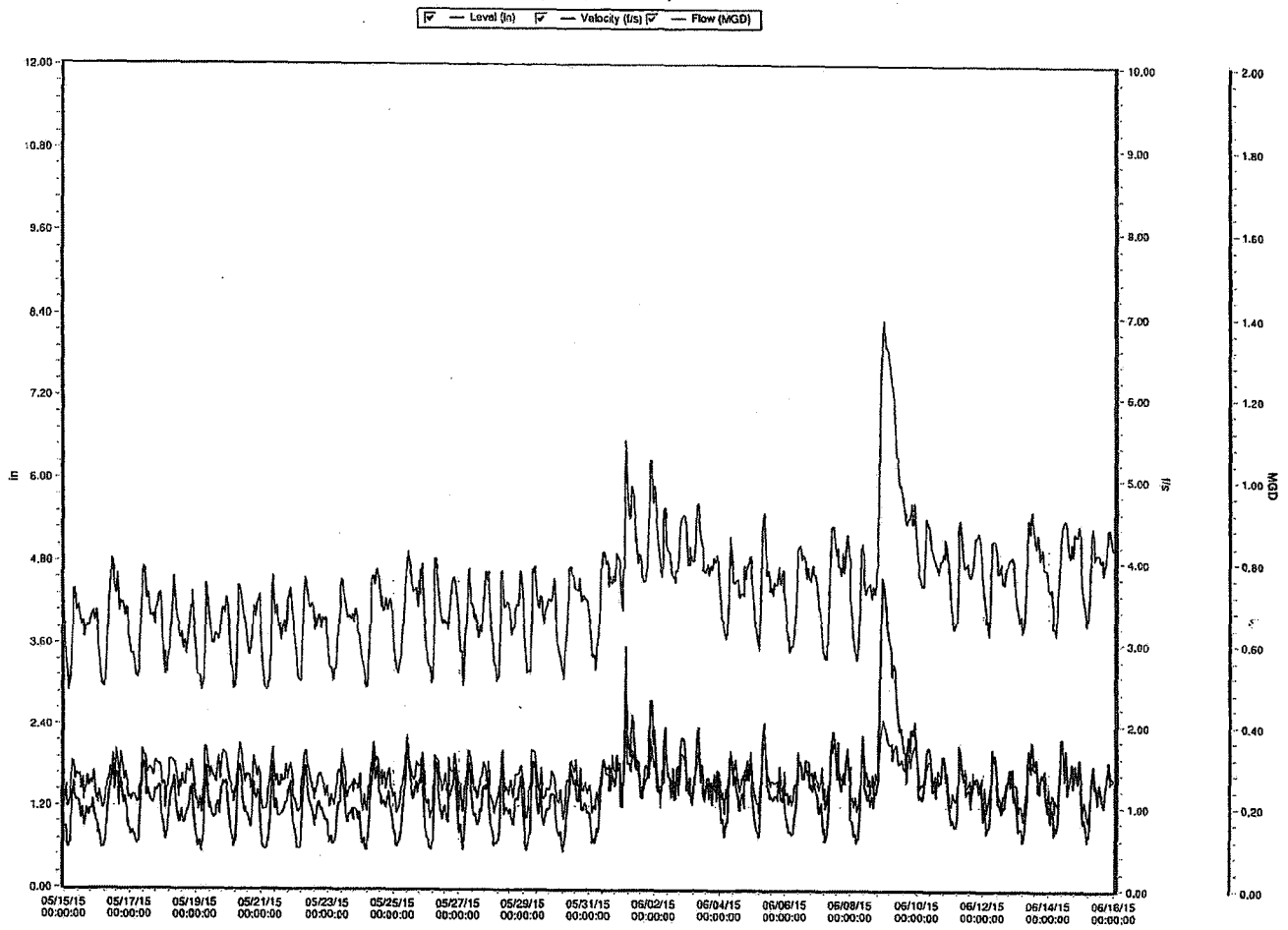






MH-337 - 2943 Stony Creek Rd.

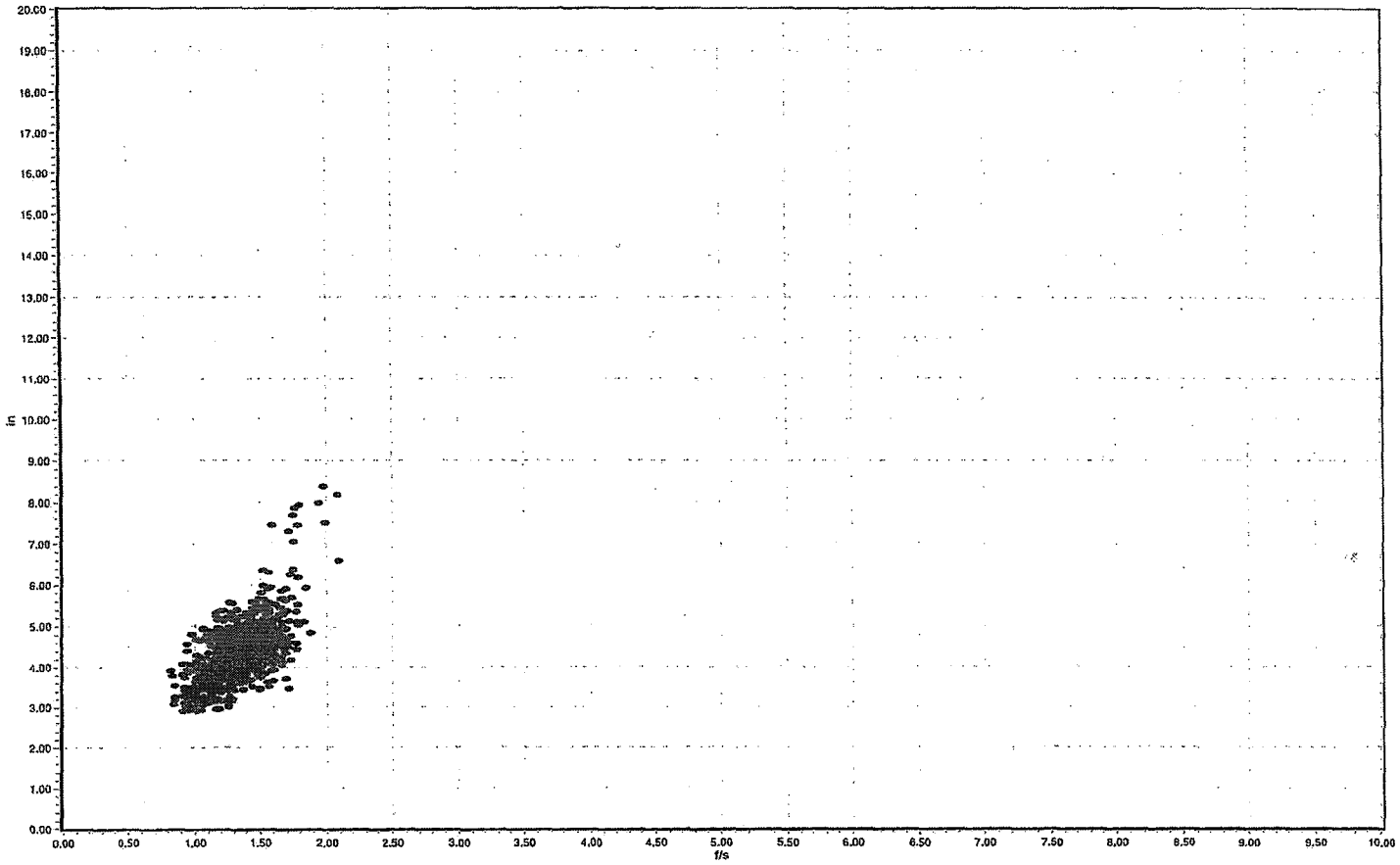
12" - (05/15/15 to 06/16/15)



MH-337 - 2943 Stony Creek Rd.

12" - (05/15/15 to 06/16/15)

Level (in)



MH-337 - 2943 Stony Creek Rd.
12" - (05/15/15 to 06/16/15)

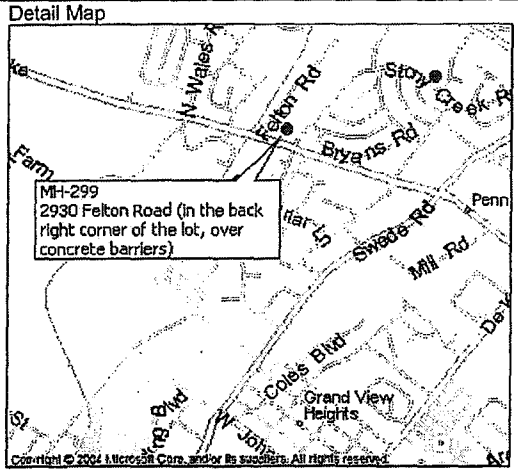
Time	Velocity (f/s)	Level (in)	Flow (MGD)
05/15/15 00:00:00	1.257	3.792	0.175
05/16/15 00:00:00	1.323	3.966	0.200
05/17/15 00:00:00	1.360	3.899	0.200
05/18/15 00:00:00	1.350	3.788	0.188
05/19/15 00:00:00	1.411	3.735	0.195
05/20/15 00:00:00	1.363	3.767	0.190
05/21/15 00:00:00	1.312	3.811	0.187
05/22/15 00:00:00	1.252	3.823	0.178
05/23/15 00:00:00	1.264	3.831	0.179
05/24/15 00:00:00	1.298	3.956	0.196
05/25/15 00:00:00	1.381	4.132	0.221
05/26/15 00:00:00	1.305	3.994	0.198
05/27/15 00:00:00	1.300	3.993	0.196
05/28/15 00:00:00	1.277	3.982	0.193
05/29/15 00:00:00	1.255	4.022	0.191
05/30/15 00:00:00	1.256	4.102	0.197
05/31/15 00:00:00	1.328	4.285	0.223
06/01/15 00:00:00	1.528	5.340	0.339
06/02/15 00:00:00	1.379	5.006	0.278
06/03/15 00:00:00	1.309	4.888	0.257
06/04/15 00:00:00	1.369	4.445	0.238
06/05/15 00:00:00	1.305	4.429	0.227
06/06/15 00:00:00	1.349	4.411	0.233
06/07/15 00:00:00	1.400	4.502	0.251
06/08/15 00:00:00	1.411	4.865	0.294
06/09/15 00:00:00	1.626	6.269	0.441
06/10/15 00:00:00	1.362	4.870	0.265
06/11/15 00:00:00	1.273	4.707	0.238
06/12/15 00:00:00	1.244	4.601	0.226
06/13/15 00:00:00	1.260	4.721	0.239
06/14/15 00:00:00	1.280	4.826	0.249
06/15/15 00:00:00	1.177	4.778	0.225
Minimum	**1.177**	**3.735**	**0.175**
Average	**1.330**	**4.361**	**0.228**
Maximum	**1.626**	**6.269**	**0.441**
Total			

SITE REPORT

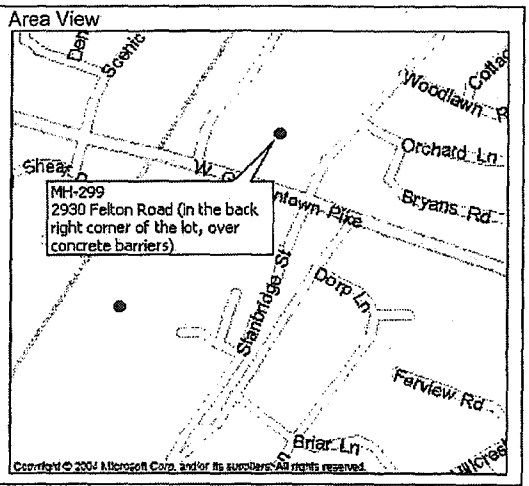
Project: East Norriton Temporary Flow Metering Study	Date: 5/14/15	Time: 17:20	Name: C. LaClaire
Manhole #: MH-299	Pipe Diameter: 18"	Town: East Norriton	
Address/Location: 2930 Felton Road (in the back right corner of the lot, over concrete barriers)			
Latitude: N 40°8'54"	Longitude: W 75°18'43"	Access: Walk	
Safety: Standard CSE		Manhole Depth: 15'2"	
Gas Investigation: Good	Manhole Condition: Good	Traffic: Standard	
Flow Meter: AV Meter		Sensor Configuration: Pressure Depth, Doppler Velocity	

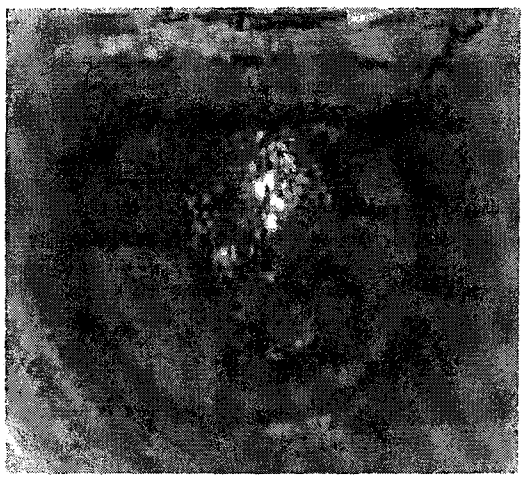
Site Comments: Sensor is installed in the upstream pipe.	
Silt: None	

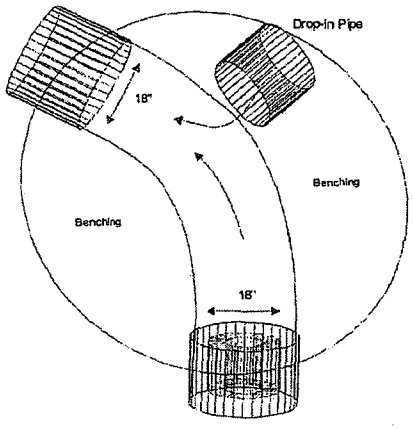
Detail Map

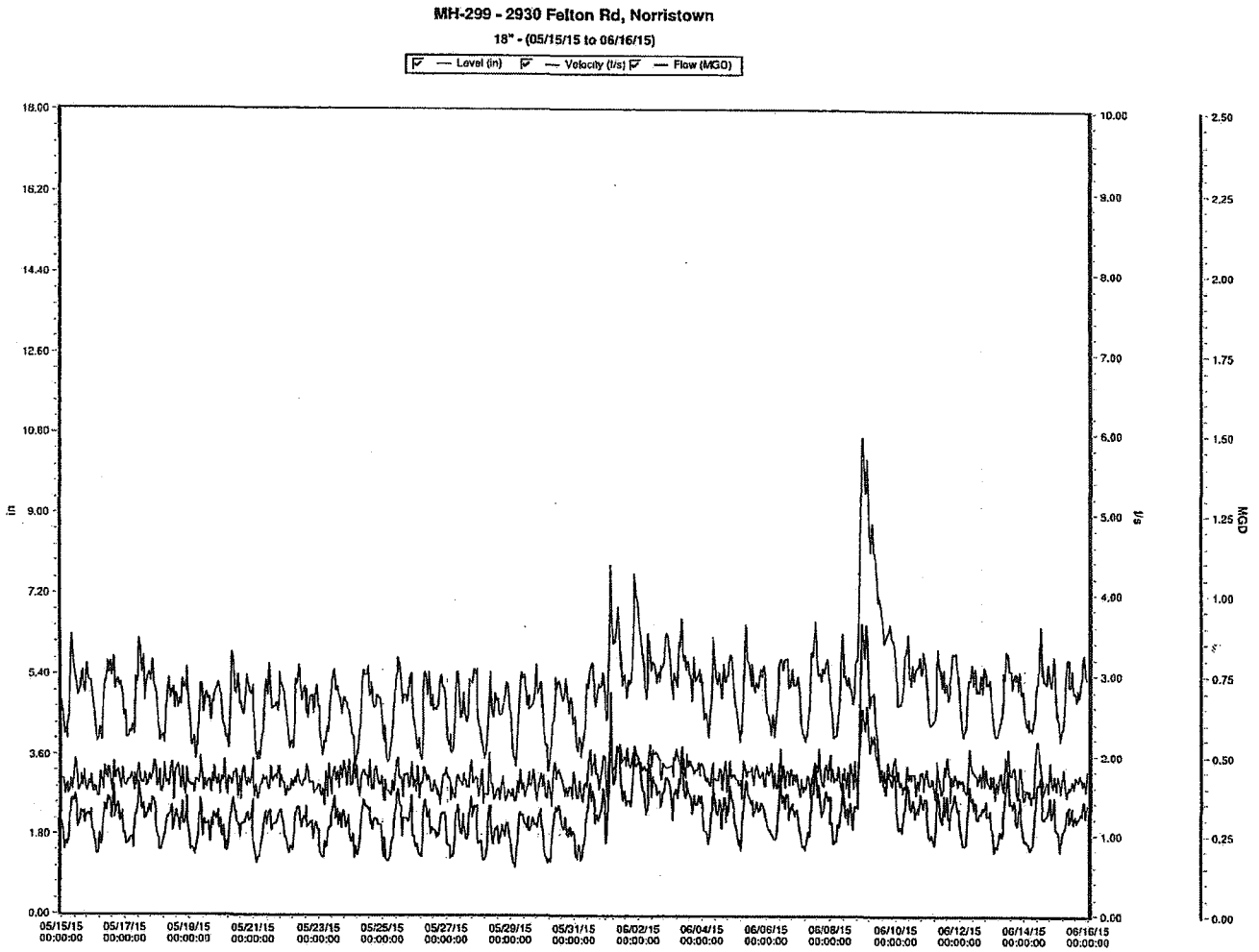


Area View



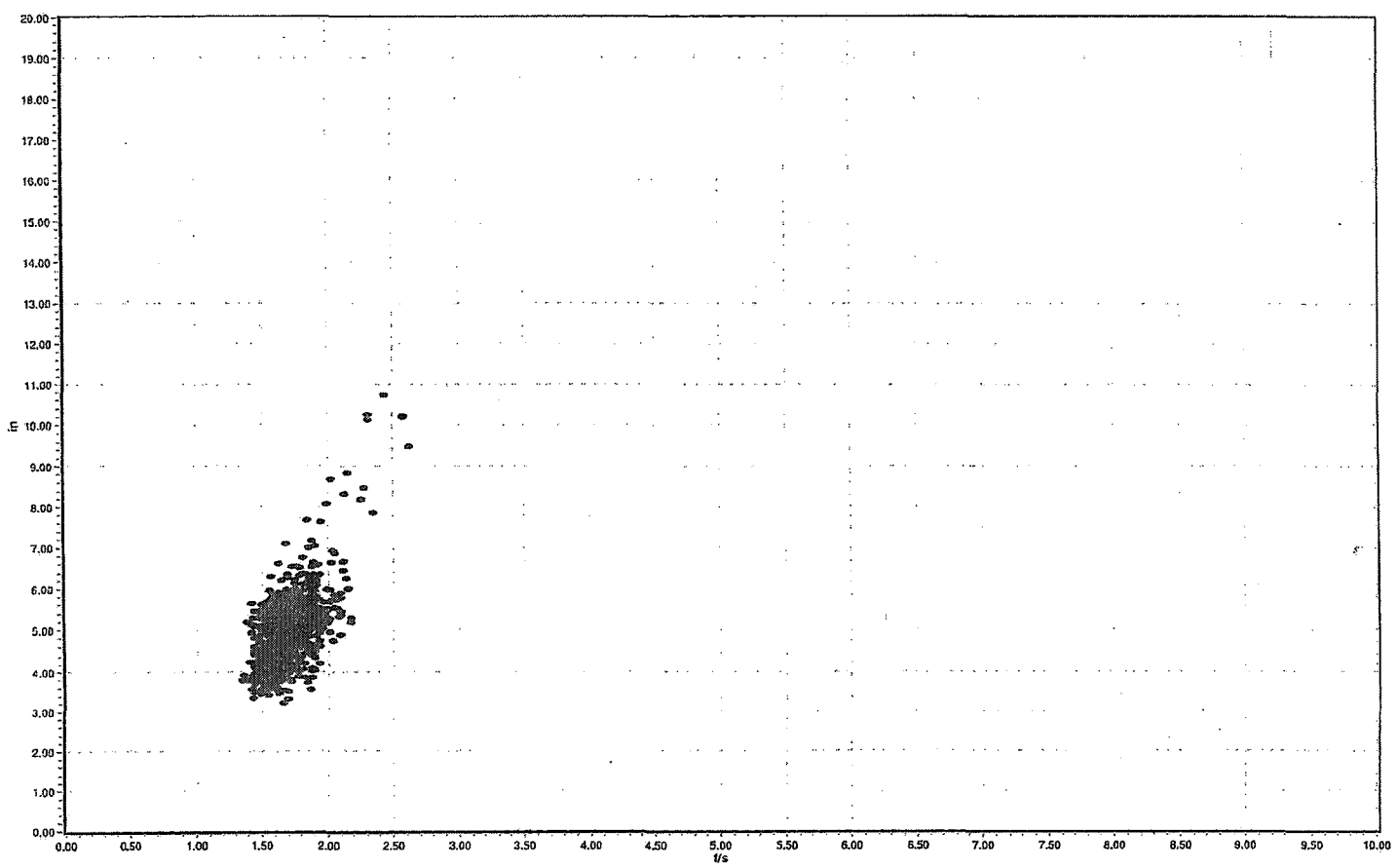





MH-299 - 2930 Felton Rd, Norristown
18" - (05/15/15 to 06/16/15)
Level (in)
Velocity (f/s)
Flow (MGD)
in
f/s
MGD
18.00
16.20
14.40
12.60
10.80
9.00
7.20
5.40
3.60
1.80
0.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
05/15/15 00:00:00
05/17/15 00:00:00
05/19/15 00:00:00
05/21/15 00:00:00
05/23/15 00:00:00
05/25/15 00:00:00
05/27/15 00:00:00
05/29/15 00:00:00
05/31/15 00:00:00
06/02/15 00:00:00
06/04/15 00:00:00
06/06/15 00:00:00
06/08/15 00:00:00
06/10/15 00:00:00
06/12/15 00:00:00
06/14/15 00:00:00
06/16/15 00:00:00

MH-299 - 2930 Felton Rd, Norristown

18" - (05/15/15 to 06/16/15)



MH-299 - 2930 Felton Rd, Norristown
18" - (05/15/15 to 06/16/15)

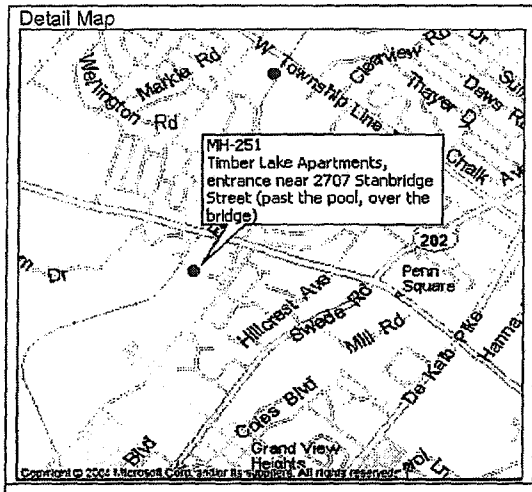
Time	Velocity (f/s)	Level (in)	Flow (MGD)
05/15/15 00:00:00	1.643	5.017	0.291
05/16/15 00:00:00	1.678	4.942	0.294
05/17/15 00:00:00	1.701	4.959	0.296
05/18/15 00:00:00	1.695	4.753	0.280
05/19/15 00:00:00	1.675	4.654	0.271
05/20/15 00:00:00	1.678	4.774	0.278
05/21/15 00:00:00	1.659	4.644	0.267
05/22/15 00:00:00	1.652	4.678	0.267
05/23/15 00:00:00	1.691	4.621	0.271
05/24/15 00:00:00	1.685	4.600	0.268
05/25/15 00:00:00	1.665	4.698	0.274
05/26/15 00:00:00	1.642	4.648	0.264
05/27/15 00:00:00	1.644	4.685	0.269
05/28/15 00:00:00	1.580	4.571	0.249
05/29/15 00:00:00	1.601	4.688	0.260
05/30/15 00:00:00	1.632	4.572	0.257
05/31/15 00:00:00	1.708	4.692	0.282
06/01/15 00:00:00	1.961	6.088	0.439
06/02/15 00:00:00	1.894	5.665	0.391
06/03/15 00:00:00	1.885	5.496	0.374
06/04/15 00:00:00	1.735	5.197	0.322
06/05/15 00:00:00	1.739	5.128	0.317
06/06/15 00:00:00	1.731	5.117	0.314
06/07/15 00:00:00	1.758	5.130	0.323
06/08/15 00:00:00	1.822	5.742	0.383
06/09/15 00:00:00	1.957	7.352	0.539
06/10/15 00:00:00	1.691	5.416	0.328
06/11/15 00:00:00	1.684	5.160	0.309
06/12/15 00:00:00	1.707	5.016	0.303
06/13/15 00:00:00	1.681	4.998	0.297
06/14/15 00:00:00	1.669	5.045	0.300
06/15/15 00:00:00	1.645	5.043	0.292
Minimum	**1.580**	**4.571**	**0.249**
Average	**1.712**	**5.056**	**0.308**
Maximum	**1.961**	**7.352**	**0.539**
Total			

SITE REPORT

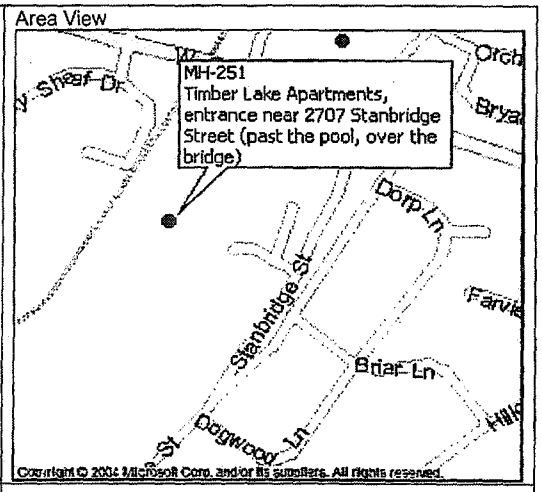
Project: East Norriton Temporary Flow Metering Study	Date: 5/14/15	Time: 16:01	Name: C. LaClaire
Manhole #: MH-251	Pipe Diameter: 18"	Town: East Norriton	
Address/Location: Timber Lake Apartments, near 2707 Stanbridge Street (past the pool, over the bridge)			
Latitude: N 40°8'56"	Longitude: W 75°19'44"	Access: Walk	
Safety: Standard CSE		Manhole Depth: 8'6"	
Gas Investigation: Good	Manhole Condition: Good	Traffic: Standard	
Flow Meter: AV Meter		Sensor Configuration: Pressure Depth, Doppler Velocity	

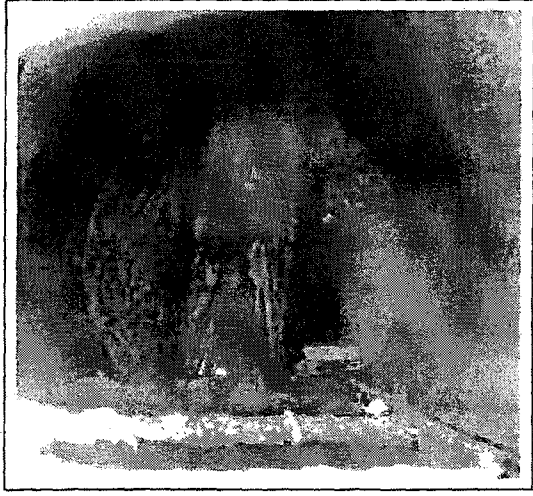
Site Comments: Evidence of surcharge. Sensor is installed in the upstream pipe.
Silt: None

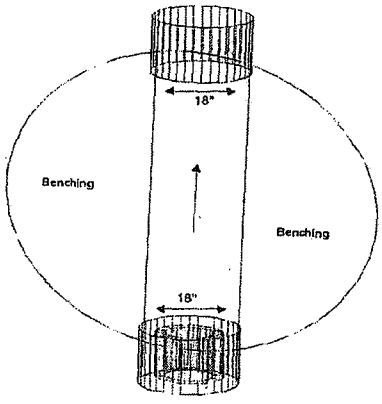
Detail Map



Area View

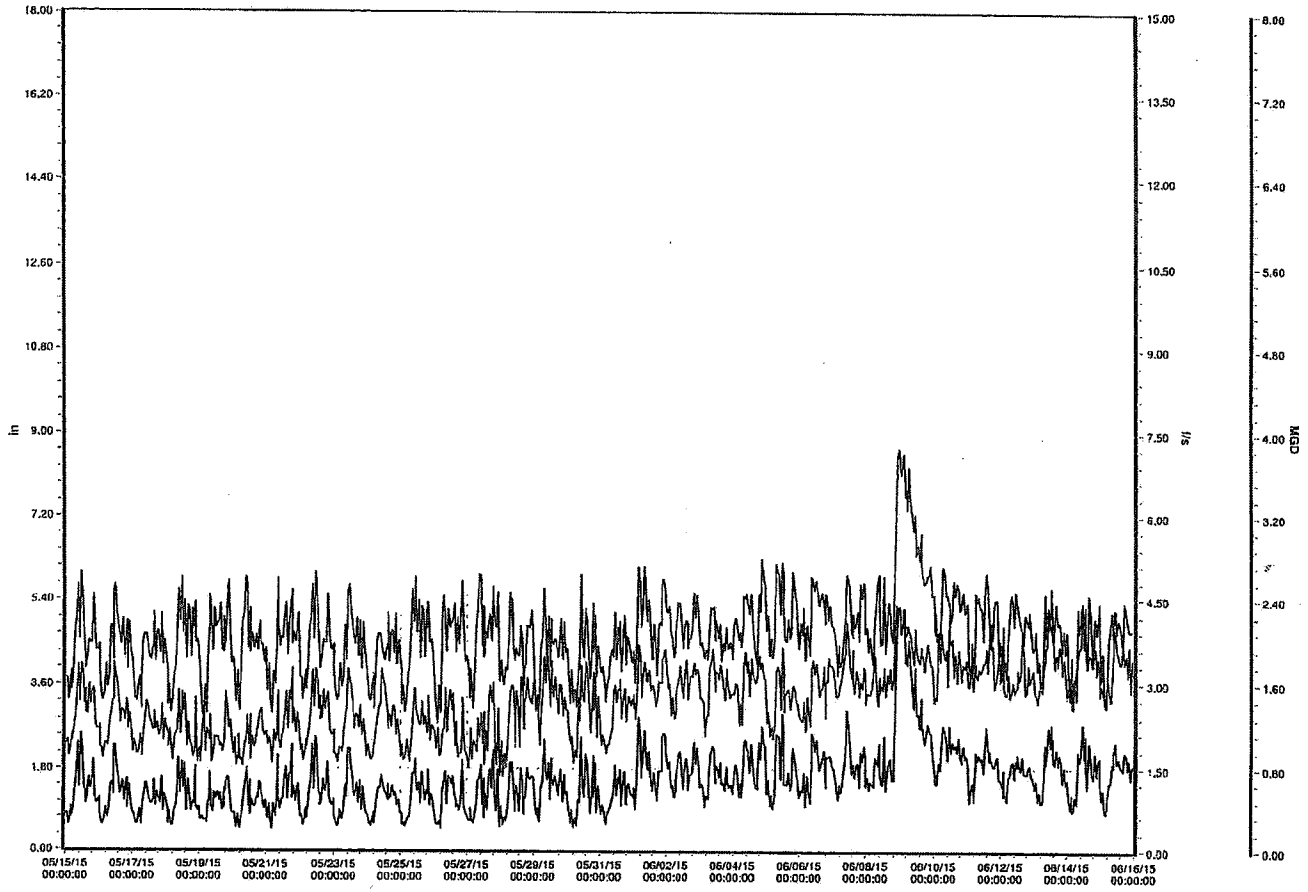






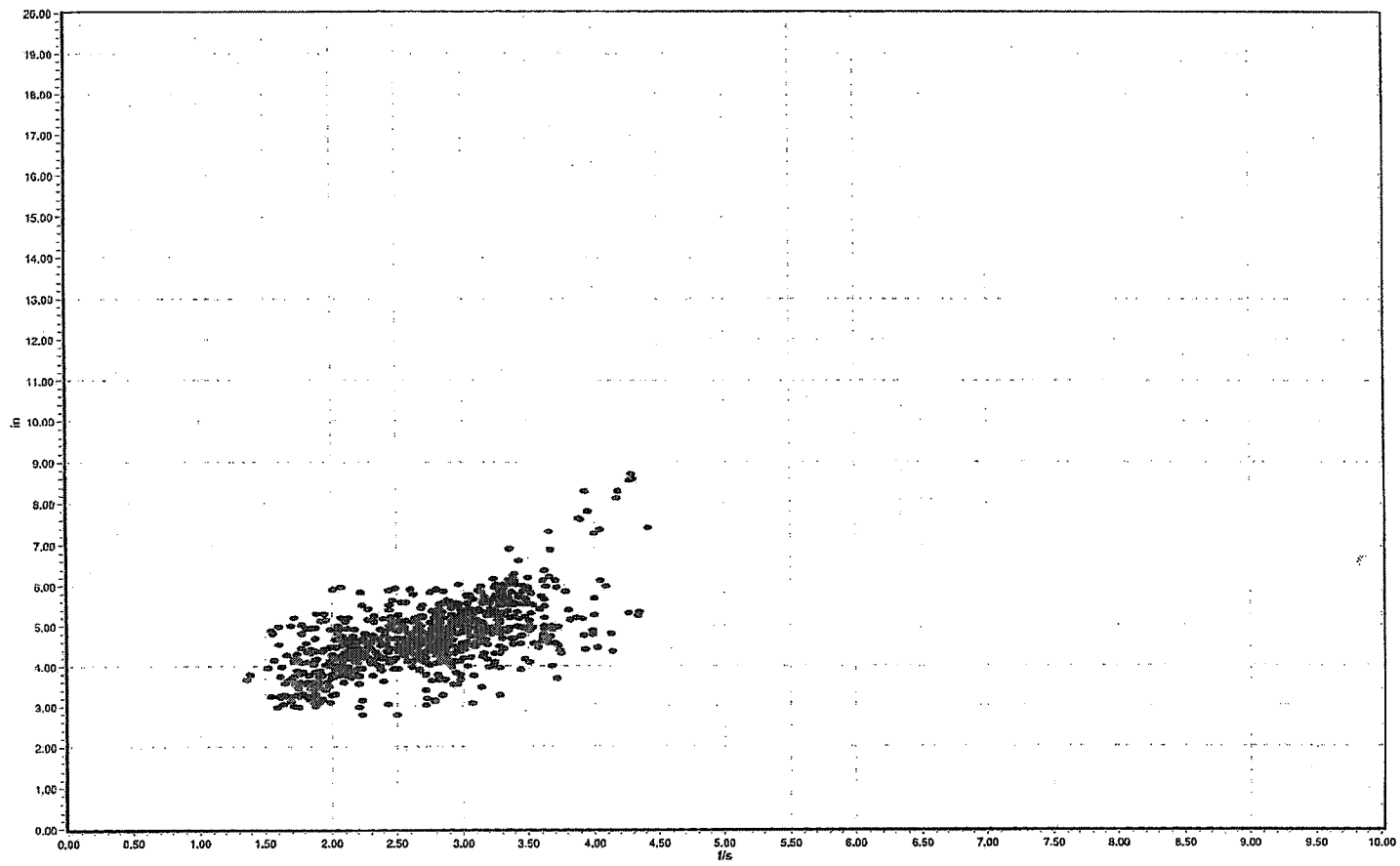
MH-251 - Behind Timber Lake Apartments

18" - (05/15/15 to 06/16/15)



MH-251 - Behind Timber Lake Apartments

18" - (05/15/15 to 06/16/15)



MH-251 - Behind Timber Lake Apartments
18" - (05/15/15 to 06/16/15)

Time	Velocity (f/s)	Level (in)	Flow (MGD)
05/15/15 00:00:00	2.527	4.446	0.586
05/16/15 00:00:00	2.400	4.387	0.551
05/17/15 00:00:00	2.189	4.179	0.459
05/18/15 00:00:00	2.154	4.530	0.516
05/19/15 00:00:00	2.078	4.459	0.469
05/20/15 00:00:00	2.024	4.404	0.459
05/21/15 00:00:00	2.278	4.465	0.539
05/22/15 00:00:00	2.427	4.446	0.564
05/23/15 00:00:00	2.300	4.387	0.530
05/24/15 00:00:00	2.313	4.179	0.478
05/25/15 00:00:00	2.220	4.530	0.522
05/26/15 00:00:00	2.157	4.463	0.490
05/27/15 00:00:00	2.136	4.634	0.522
05/28/15 00:00:00	2.513	4.403	0.572
05/29/15 00:00:00	2.820	4.298	0.621
05/30/15 00:00:00	2.512	4.183	0.546
05/31/15 00:00:00	2.453	4.170	0.524
06/01/15 00:00:00	3.082	5.007	0.834
06/02/15 00:00:00	2.965	4.849	0.766
06/03/15 00:00:00	2.952	4.561	0.696
06/04/15 00:00:00	3.065	5.041	0.831
06/05/15 00:00:00	2.730	5.075	0.752
06/06/15 00:00:00	2.930	5.157	0.815
06/07/15 00:00:00	3.151	4.885	0.808
06/08/15 00:00:00	3.228	5.348	0.974
06/09/15 00:00:00	3.661	6.828	1.488
06/10/15 00:00:00	3.410	5.289	0.956
06/11/15 00:00:00	3.318	4.903	0.832
06/12/15 00:00:00	3.108	4.771	0.751
06/13/15 00:00:00	3.366	4.652	0.802
06/14/15 00:00:00	3.384	4.421	0.756
06/15/15 00:00:00	3.308	4.560	0.762
Minimum	**2.024**	**4.170**	**0.459**
Average	**2.724**	**4.685**	**0.680**
Maximum	**3.661**	**6.828**	**1.488**
Total			

APPENDIX B

CSL REPORT DATED AUGUST 5, 2015

CSL Services, Inc. *Customized Solutions to your Flow Metering Needs*

To: Mr. Lane P. Bodley, P.E.
Carroll Engineering Corporation
949 Easton Road
Warrington, PA 18976

From: Alyson Lee
Project Manager

Date: August 5, 2015

RE: East Norriton, PA Stony Creek Interceptor Temporary Flow Monitoring, MH-251

Enclosed is the data for 6/16/2015 through 7/15/2015. The data provided is as follows:

- Flow, Level & Velocity Hydrograph
- Level vs. Velocity Scattergraph
- Daily Tabular Flow Summary Report

The data may also be viewed from our website www.cslservices.com.

User Name: eastnorriton
Password: 1234

Please feel free to contact me should you have any questions.

7905 BROWNING ROAD • SUITE 316 • PENNSAUKEN, NEW JERSEY 08109
PHONE: 856-755-9440 • FAX: 856-755-9445 • cslservices.com

CSL Services, Inc. *Customized Solutions to your Flow Metering Needs*

Monitoring Summary:

Overview:
MH-251 was monitored by an area/velocity flow meter installed between May 14th, 2015 through July 17th, 2015. The flow meter is essentially a computer designed to operate in a sewer environment. Sensors provide depth (from which area is calculated) and velocity measurements which are used to determine flow rate. Every 15 minutes, the meter takes a depth and velocity measurement. The flow meter utilizes pressure sensors to measure depth, and a continuous wave Doppler sensor to measure velocity.

MH-251
The flow meter provided 100% uptime during the monitoring period.

The sensor was installed in the upstream 18" pipe. As evidenced by the hydrograph and scattergraph, this site exhibited typical open channel, free flow. During the wet weather events, the flow remained in pipe and maintained free flow conditions.

The following table summarizes the minimum, average and maximum daily depth, velocity, and flow data collected at this site for this reporting period:

	Depth (in)	Velocity (fps)	Flow Rate (MGD)
Minimum	4.279	3.052	0.698
Average	6.128	3.437	1.121
Maximum	16.820	4.106	3.042

Summary

The conditions at this metering location was suitable for flow monitoring and based on the quality of the depth and velocity data, the continuity equation (Q = V*A) was used to calculate flow. CSL's review of the flow data, the meter calibrations, field maintenance logs have verified that the flow meters have provided accurate, reliable and repeatable flow data.

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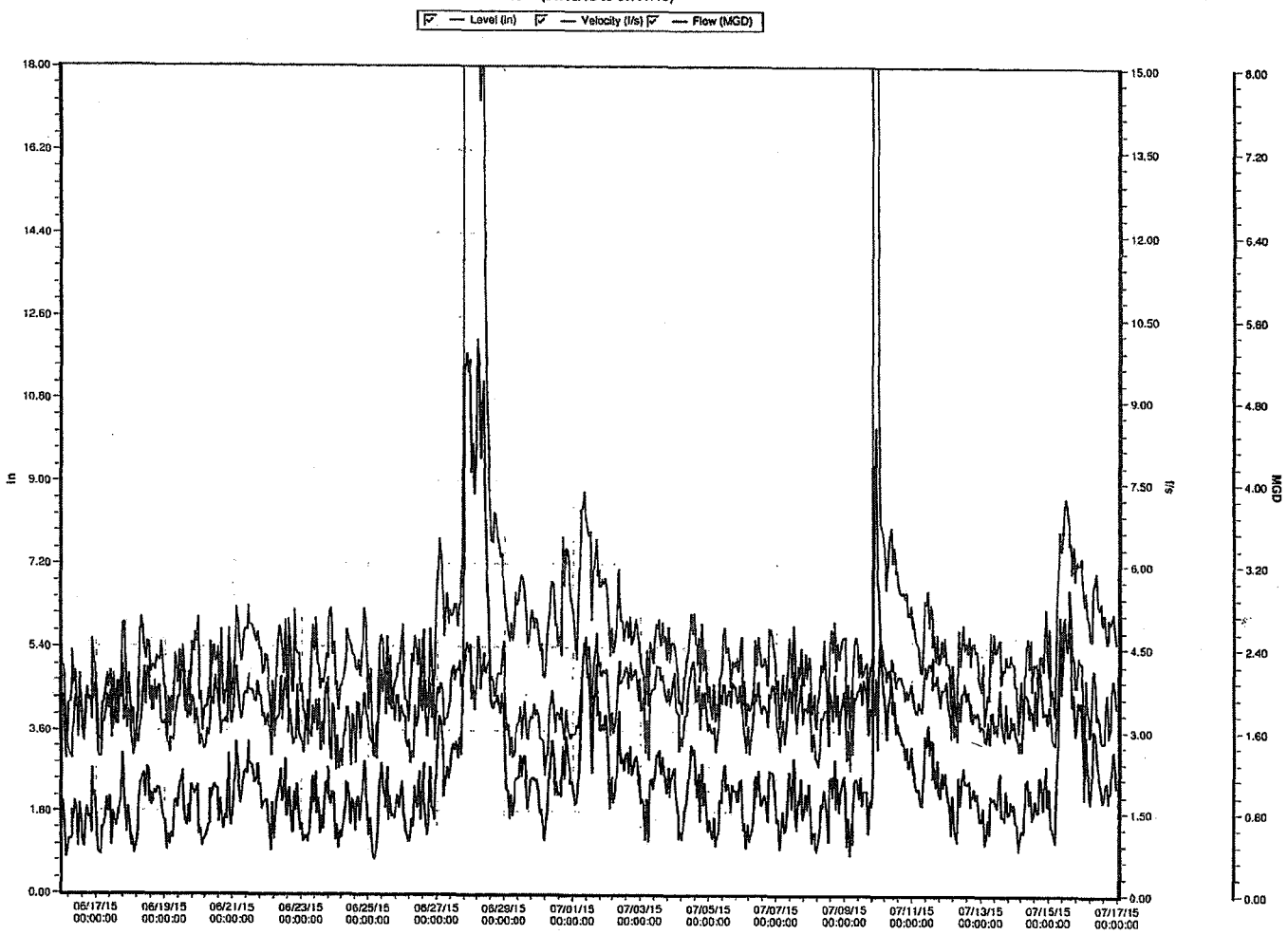
MH-251 - Behind Timber Lake Apartments

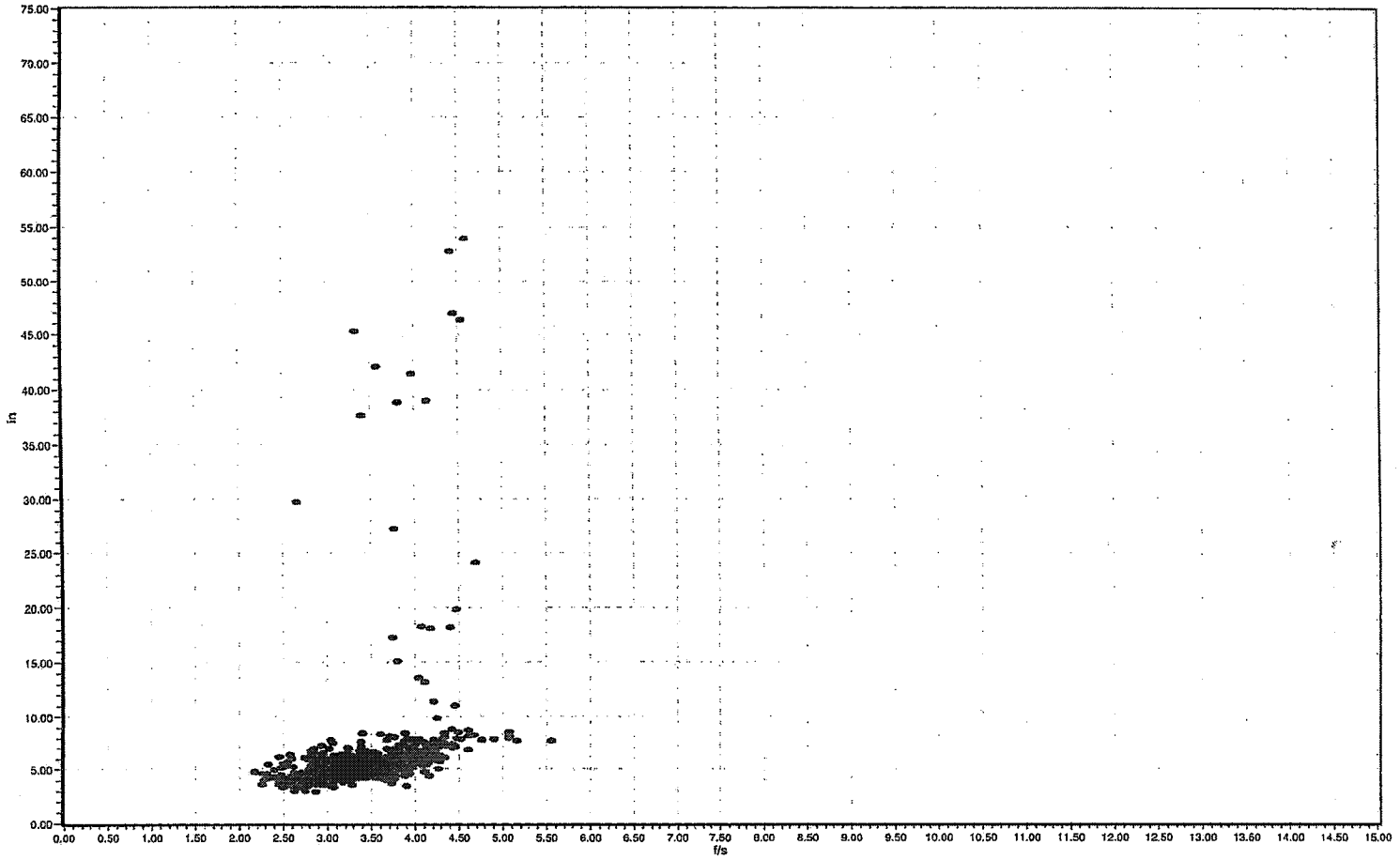
18" - (06/16/15 to 07/17/15)

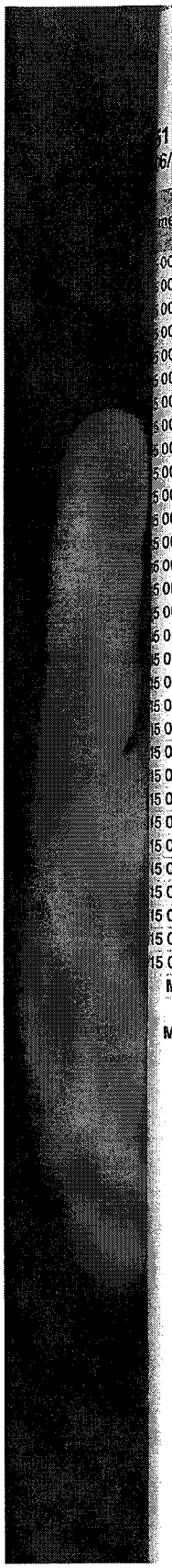


MH-251 - Behind Timber Lake Apartments

18" - (06/16/15 to 07/17/15)

Level (in)





1 - Behind Timber Lake Apartments
6/16/15 to 07/17/15)

me	Velocity (f/s)	Level (in)	Flow (MGD)	Flow Volume (gal)
00:00:00	3.275	4.279	0.698	698486.063
00:00:00	3.225	4.392	0.723	723048.750
00:00:00	3.369	4.918	0.872	872103.563
00:00:00	3.295	4.732	0.803	803428.063
00:00:00	3.272	4.689	0.795	794682.125
00:00:00	3.581	5.537	1.107	1107008.375
00:00:00	3.219	4.978	0.838	837932.313
00:00:00	3.121	4.948	0.809	808577.938
00:00:00	3.053	5.113	0.830	829627.375
00:00:00	3.374	4.686	0.822	821890.750
00:00:00	3.242	4.974	0.852	851827.938
00:00:00	3.880	16.820	2.339	2338763.500
00:00:00	4.045	14.374	3.042	3041560.250
00:00:00	3.065	6.104	1.054	1054119.000
00:00:00	3.052	6.133	1.062	1061580.875
00:00:00	3.976	7.178	1.732	1732427.000
00:00:00	3.742	5.804	1.218	1218477.875
00:00:00	3.659	5.366	1.081	1080668.375
00:00:00	3.436	5.057	0.938	937795.813
00:00:00	3.424	4.810	0.873	873278.563
00:00:00	3.360	4.937	0.885	885195.500
00:00:00	3.321	4.775	0.834	833526.438
00:00:00	3.207	5.004	0.872	872409.313
00:00:00	3.381	9.746	1.357	1356934.125
00:00:00	3.978	6.993	1.658	1658481.750
00:00:00	3.773	5.592	1.171	1170832.500
00:00:00	3.325	5.031	0.891	891075.688
00:00:00	3.101	5.023	0.831	831412.375
00:00:00	3.336	4.982	0.868	868013.125
00:00:00	4.106	6.931	1.754	1754365.000
00:00:00	3.346	6.066	1.145	1145084.250
Minimum	**3.052**	**4.279**	**0.698**	**698486.063**
Average	**3.437**	**6.128**	**1.121**	
Maximum	**4.106**	**16.820**	**3.042**	**3041560.250**
Total				**34754614.563**