Preliminary Desktop Assessment Sewer System Infiltration/Inflow (I/I) Study

Town of Tewksbury, Massachusetts

Provided By

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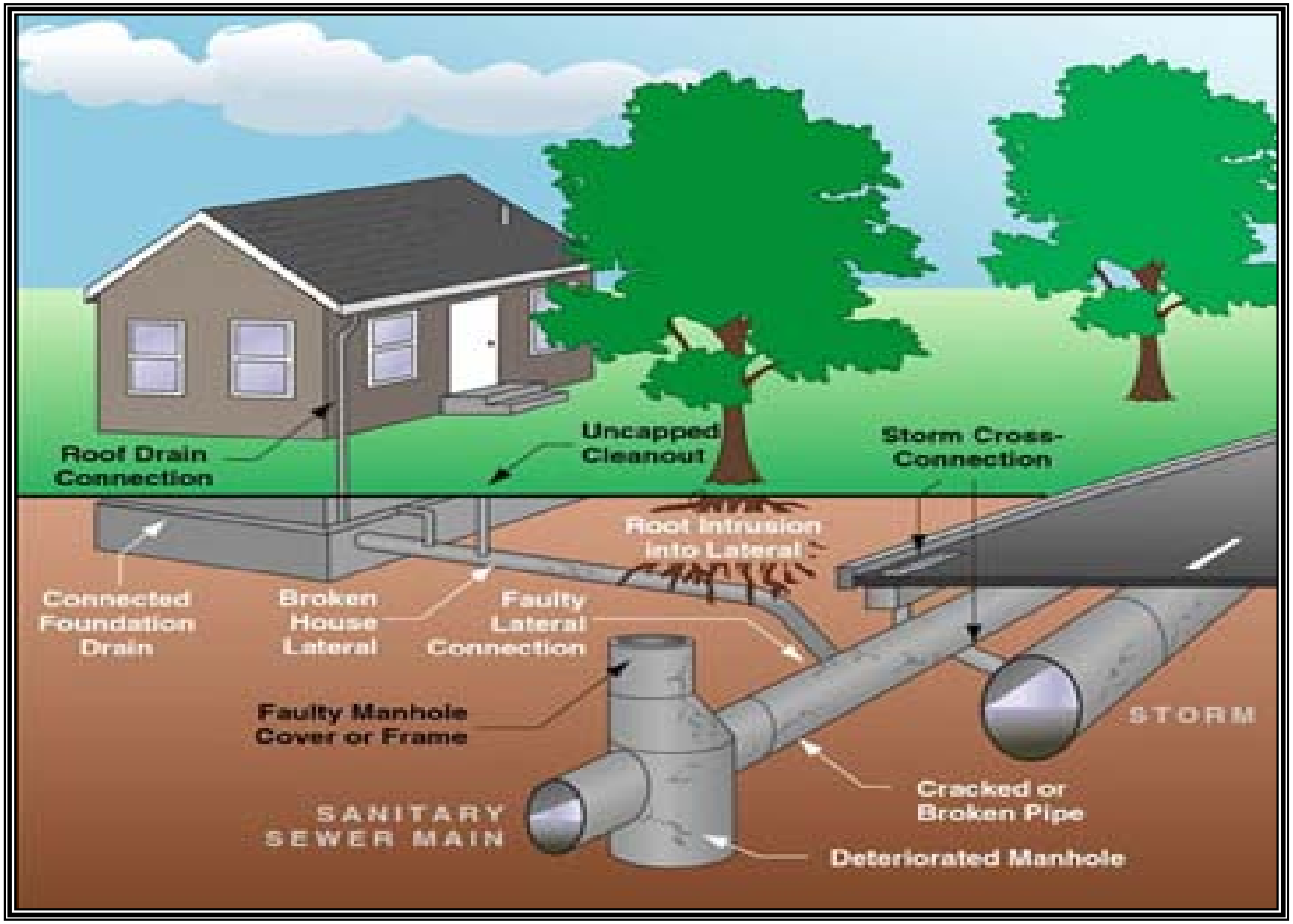
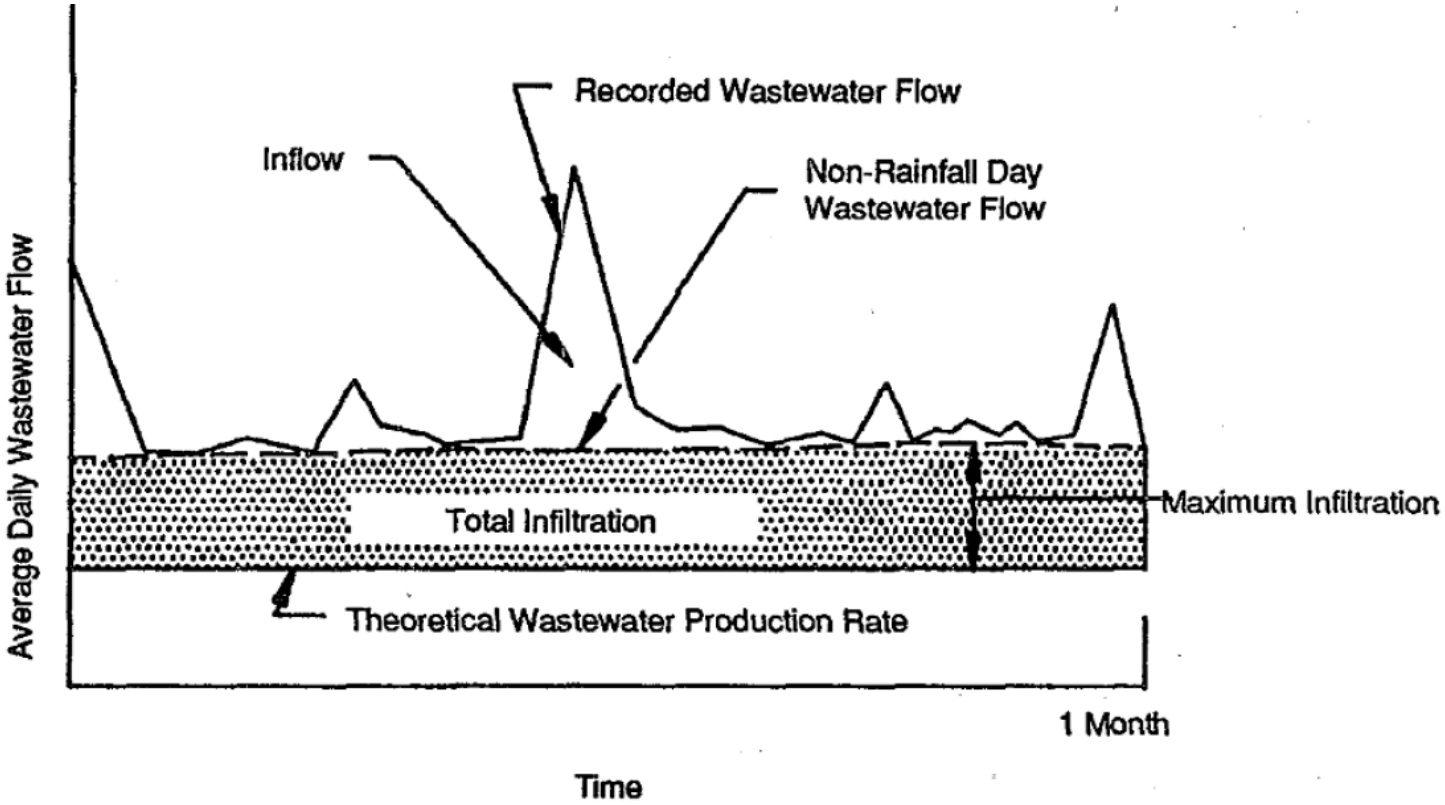
Sources of Infiltration and Inflow

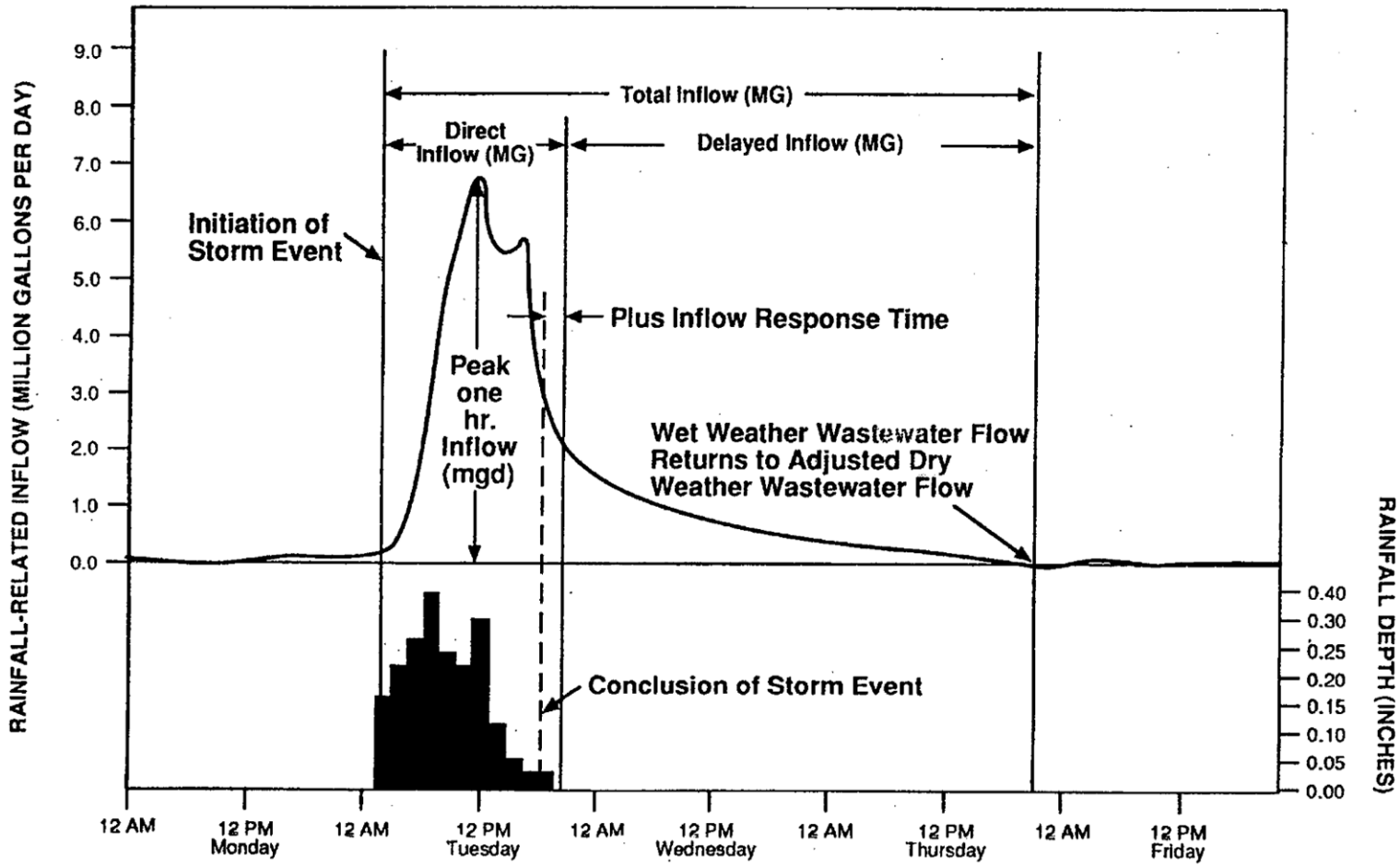


Infiltration Estimation



Use 80% of Water Consumption or Low Groundwater, Dry Weather Wastewater Flows (August) for Theoretical Wastewater Production Rate.

Inflow Estimation



Why does I/I occur?

- Normal aging of materials (piping and manholes)
- Normal earth movements and settlement (opens joints or causes cracks)
- Adjacent flooding conditions causing movement (opens joints or causes cracks)
- Overburden loads causing shifting and/or cracking
- Impacts by other utility contractors working adjacent to sewer
- Root Intrusion from abutting trees
- Groundwater level and movement impacting piping bedding
- Breakdown of pipe and manhole gasketing/joint materials
- Sump pumps, outside or garage drains and roof leaders

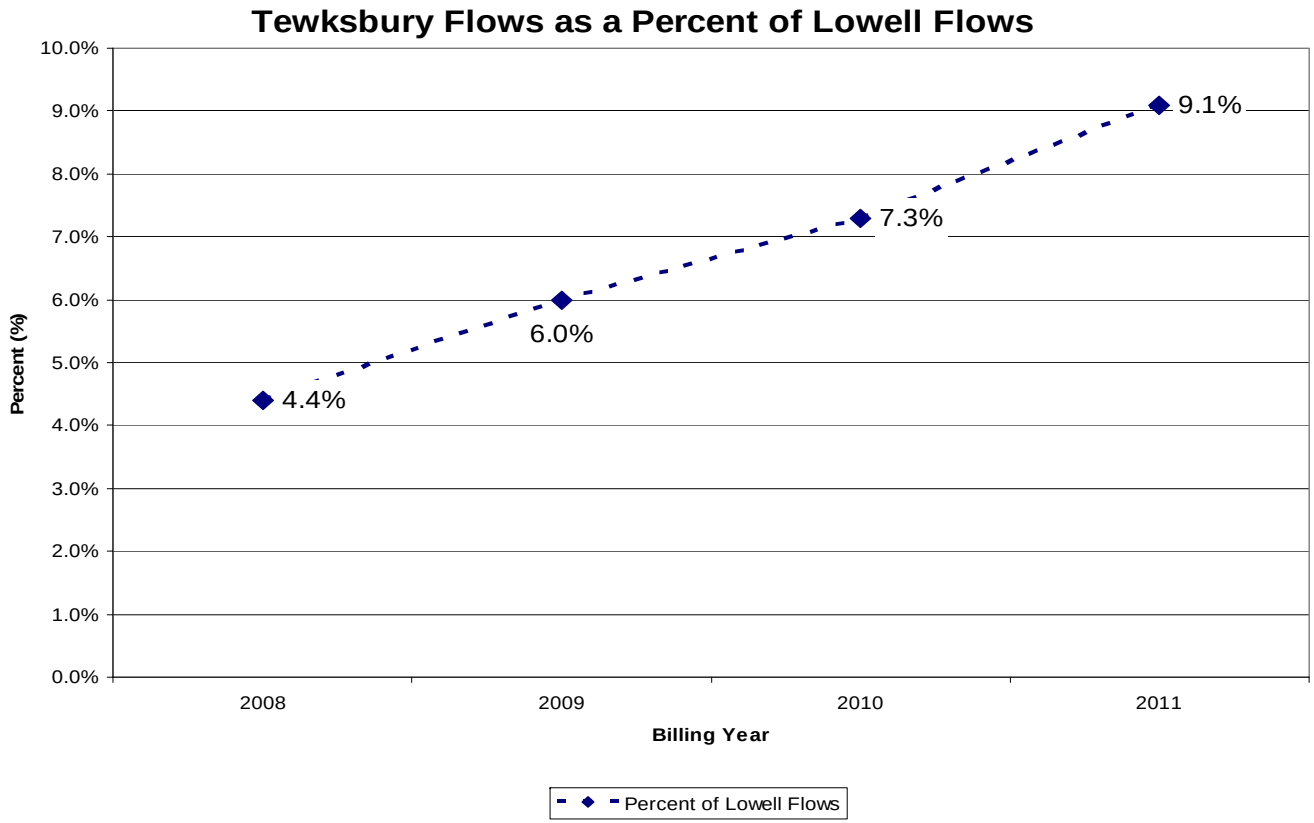
Infiltration and Inflow Control is an On-going Problem which <u>cannot</u> be avoided only minimized.

You will never be able to remove it entirely…just not Cost Effective.

Regulatory Requirements

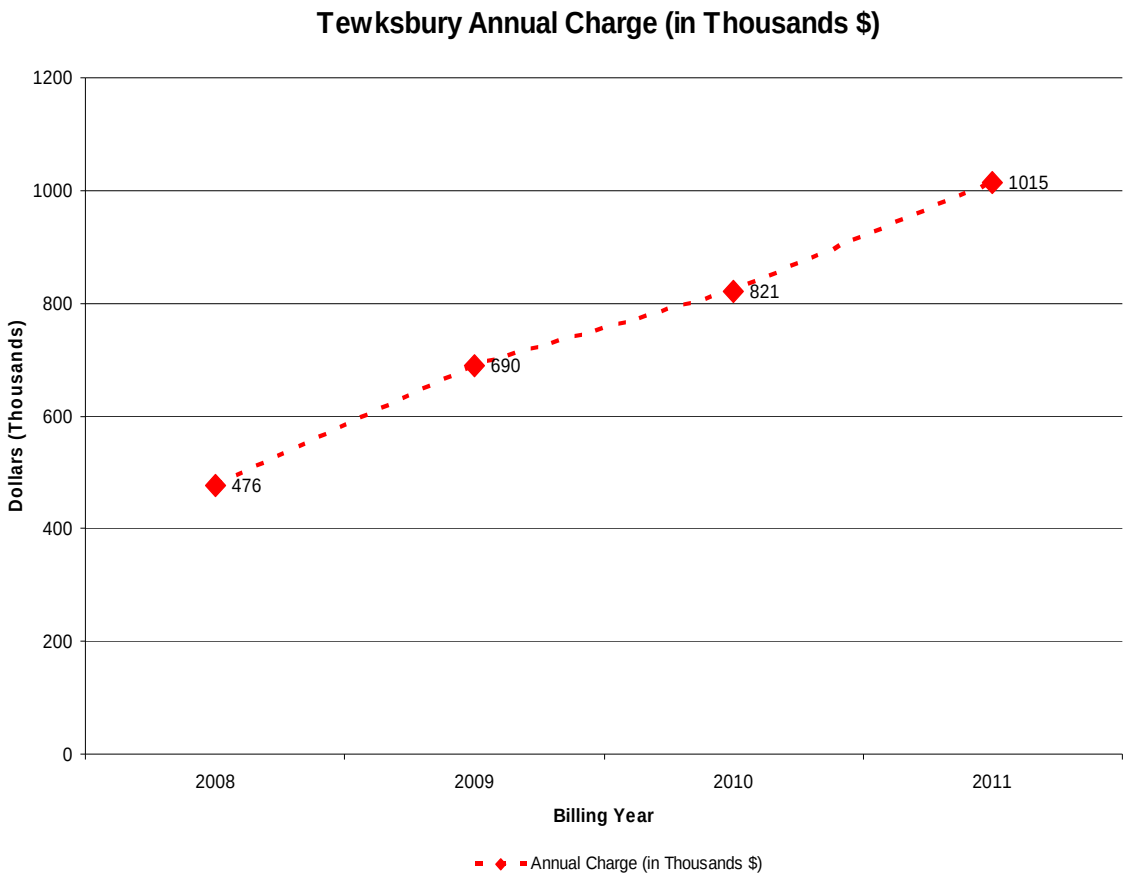
- Town is required by EPA/MADEP as co-permittees of the Lowell NPDES Permit (MA0100633) to develop and implement an Infiltration/Inflow Control Plan and annually submit a report on previous year actions.
- The permit stipulates the following requirements:
  1. An Infiltration and Inflow Control Plan must be in place …it must be ongoing and suitably funded.
  2. The Sewer Department should be suitably staffed for O&M tasks.
  3. A Preventative Maintenance program should be in place.
  4. The Plans primary focus must be to eliminate back-ups and overflows by eliminating illegal sump pumps and roof drains.
  5. The Control Plan should identify and prioritize problem areas and address identified issues.
  6. The Town should have a public education component.

Recent Trends



Lowell spent over $50M for sewer separation in recent years with plans for future work and additional I/I Reduction Measures. Tewksbury Flows represent a higher percentage of the Total Flow…moving from 4.4% to 9.1% in just 3 Years.

Economic Incentives



Without an active I/I Reduction program, Tewksbury's costs will continue to grow.

2008….. $476K

2009….. $690K

2010….. $821K

2011…..$1.01M

2012….. $1.2M+ ???

Overall Cost Impacts

- Using 2010 data… due to slightly above average precipitation (Bedford weather station measured 46.92” vs. annual average of 42.00”)
- **Annual I/I Influences**

  2010 Average Wastewater Flow was ……2.28 MGD

  Dry weather & low groundwater months flows average ……1.55 MGD

  Potential I/I within system “on average”……0.73 MGD

  32% of Total Flow

  Based on 2010 Lowell billings of $821K, I/I has a cost of $263K annually
- **Potential Inflow Influences**

  Examine wet weather months…

  March 2010 (with Area Flooding)…… 5.67 MGD

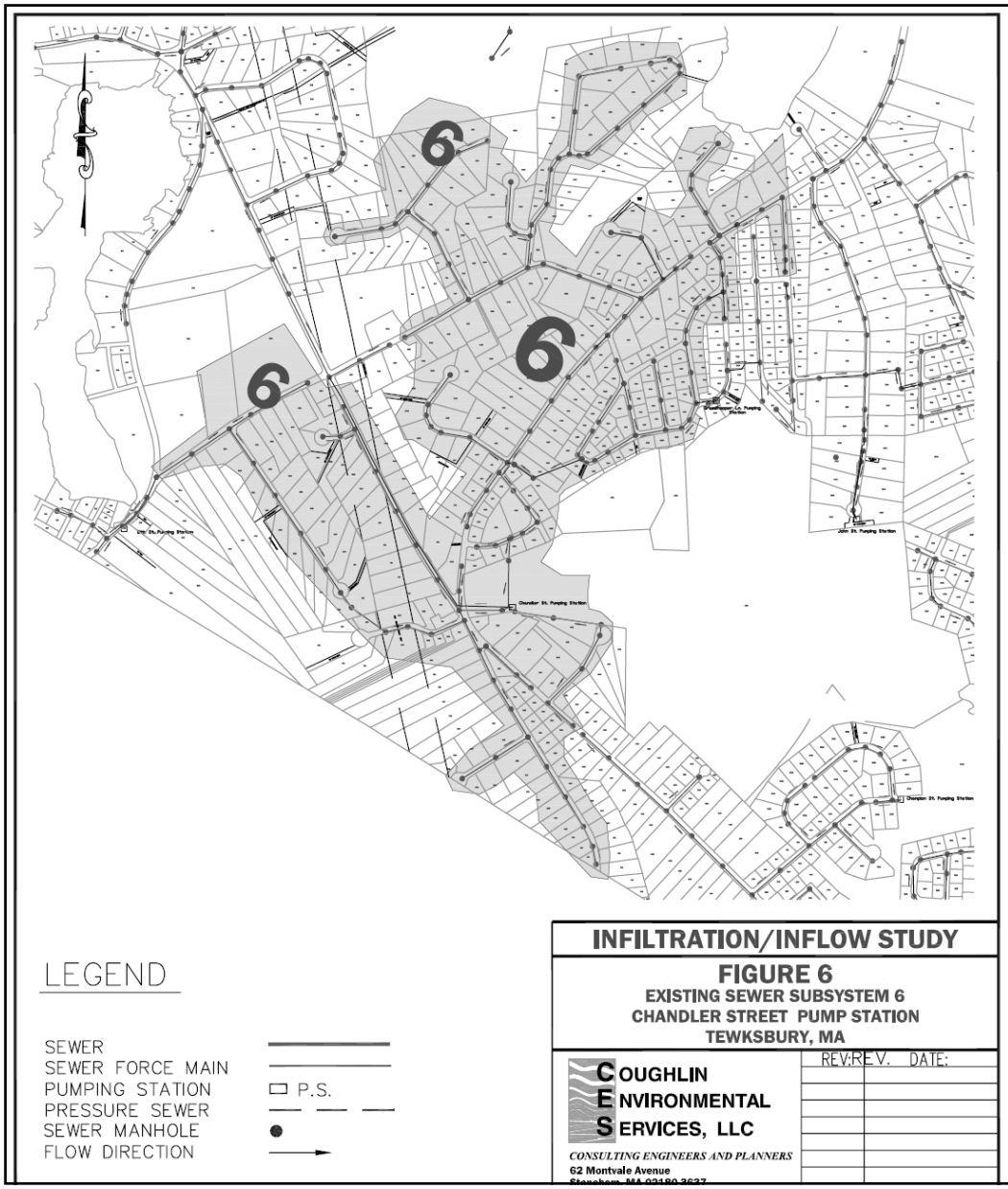
  Dry weather & low groundwater months flows average …… 1.55 MGD

  Potential I/I (primarily Inflow) for a single month averaged…… 4.12 MGD

  Based on 2010 Lowell billings this single month increase costs by $38K and also accounted for 13.6% of the Average Annual I/I burden
- Estimated to cost the Town about **$300K+** annually (2010)

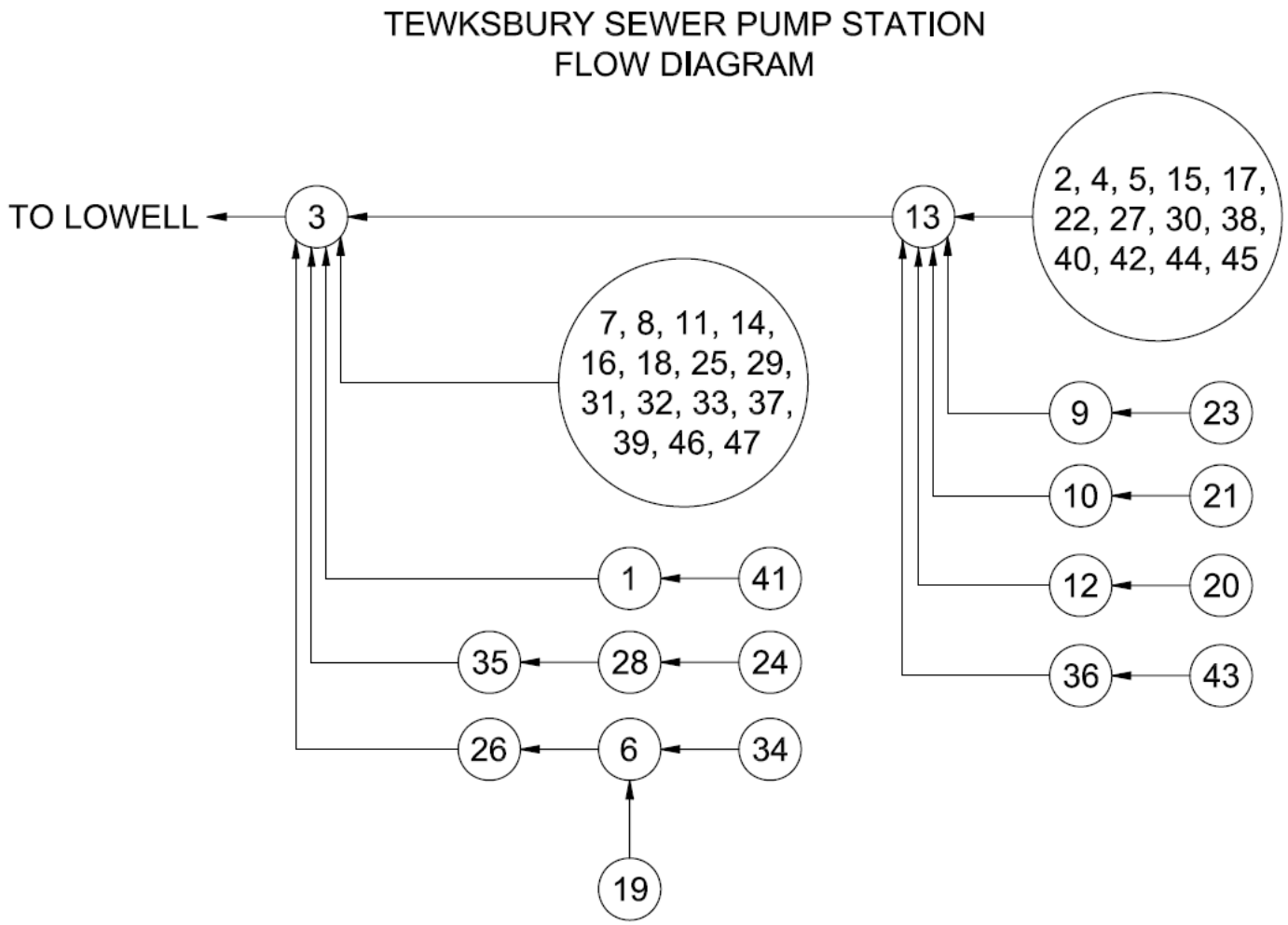
CES Desktop Study

- Obtain Run-Time data from all Pump Stations through the Mission Control Monitoring system.
- Conduct Draw-down tests at the pump stations to determine actual pump output
- Using pump output determine flows for each station (46 Pump Stations)
- Review past construction plans for sewer projects and define each pump stations tributary area, developing sub-basin plans.
- Analyze each pump station collection system and using pipe lengths and diameters determine the inch-diameter-miles (standardized unit) of sewer in each sub-basin (approximately 170 miles of main line piping)
- Obtain water consumption data and breakdown data to establish sub-basin consumption, examine station flows in relation to average consumption data
- Examine station flows in relation to dry weather & low groundwater condition (August)
- Examine climatological data to select a representative analysis period (2010)
- Examine sub-basin characteristics to determine I/I potentials- examine pipe age, pipe material, soil conditions, proximity to wetlands and floodplain, groundwater conditions, etc)
- Review historical back-ups and overflows
- Conduct limited flow monitoring (MIIA Grant) to assess I/I in susceptible areas
- Analyze all Pump Station and the Burnham Flow Meter data in terms of Infiltration and Inflow contributions, identifying problematic areas



Individual Sub-basin Map development and inch-diameter-mile calculations for each of the 46 Wastewater Pump Stations

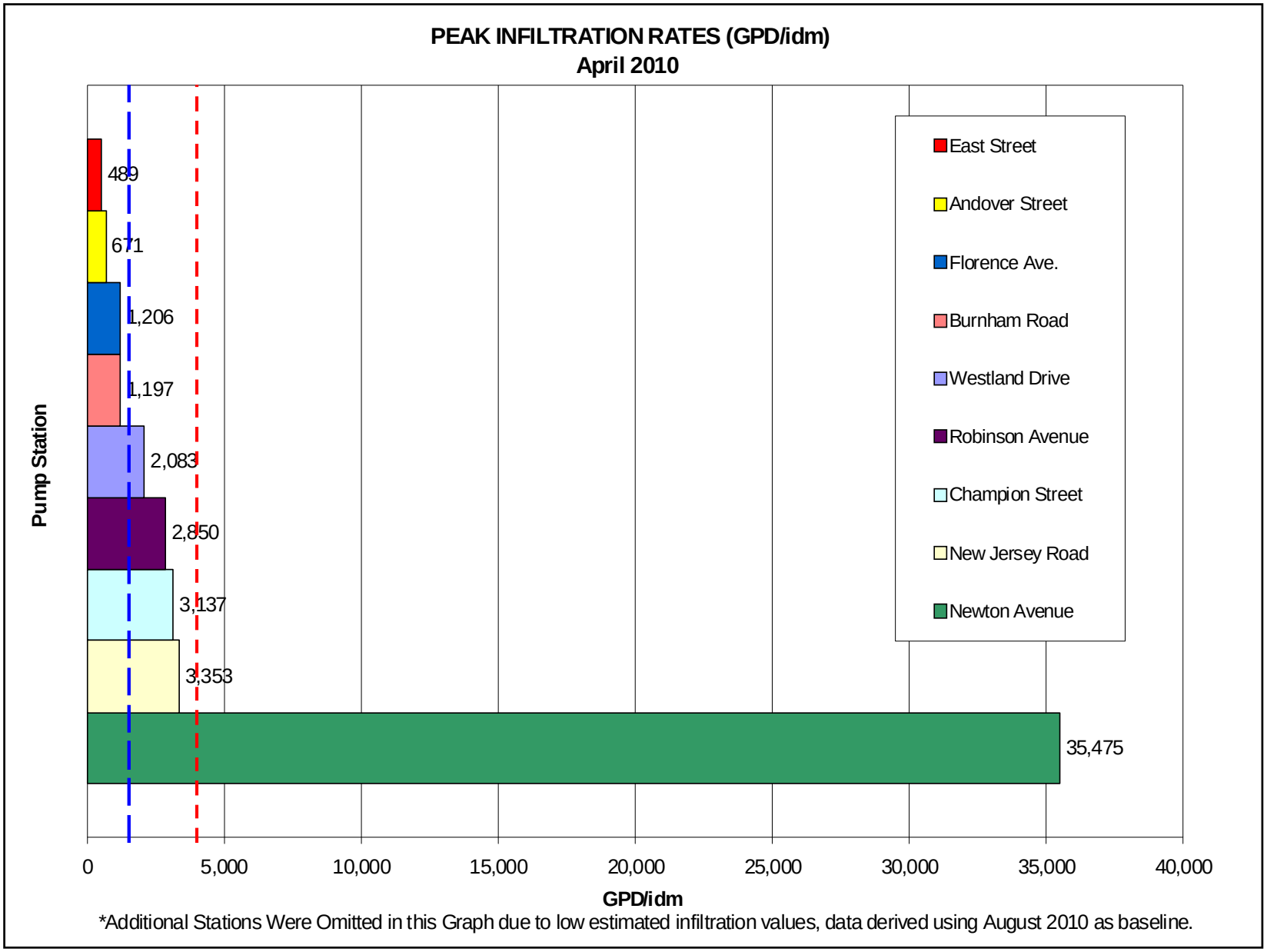
Pump Station Connectivity Diagram

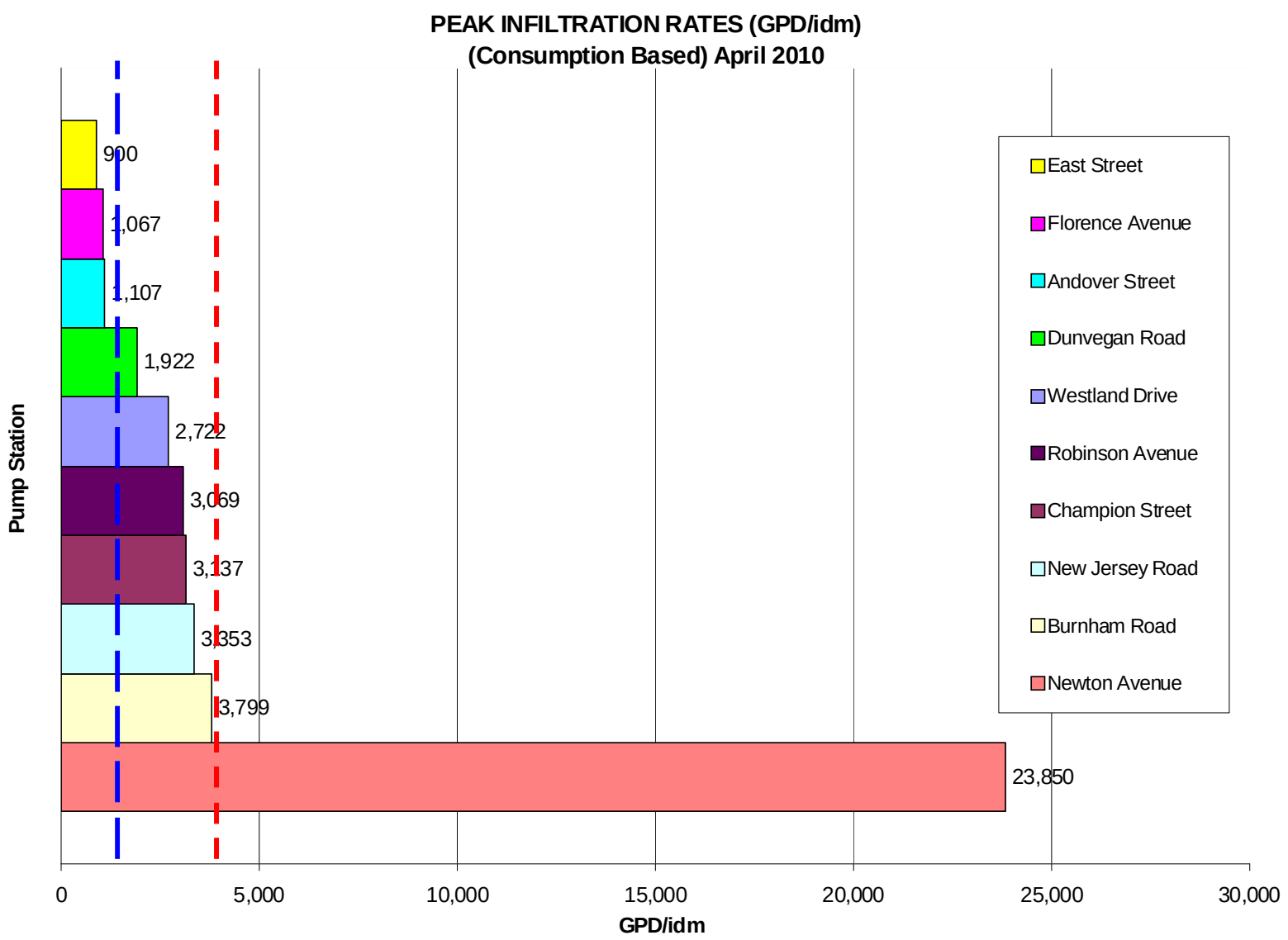


Conducting Draw-Down Testing
to estimate actual pump output and capacity

Desktop Calculations

- Determine Pump Station flows
- Run two independent assessments
  1. Using August dry weather, low groundwater
  2. Using water consumption data (80%)
- Examine various storm events in 2010 and early morning periods for flow anomalies
- Determine Baseline Infiltration
  1. Baseline Infiltration
  2. Direct and Delayed Inflow
- Compensate for Tributary Pump Station Influences
- Express data in GPD per inch-diameter–mile terms so as to compare and identify priorities


PEAK INFILTRATION RATES (GPD/idm)
April 2010
Pump Station
489
671
1,206
1,197
2,083
2,850
3,137
3,353
35,475
East Street
Andover Street
Florence Ave.
Burnham Road
Westland Drive
Robinson Avenue
Champion Street
New Jersey Road
Newton Avenue
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000
40,000
GPD/idm
*Additional Stations Were Omitted in this Graph due to low estimated infiltration values, data derived using August 2010 as baseline.



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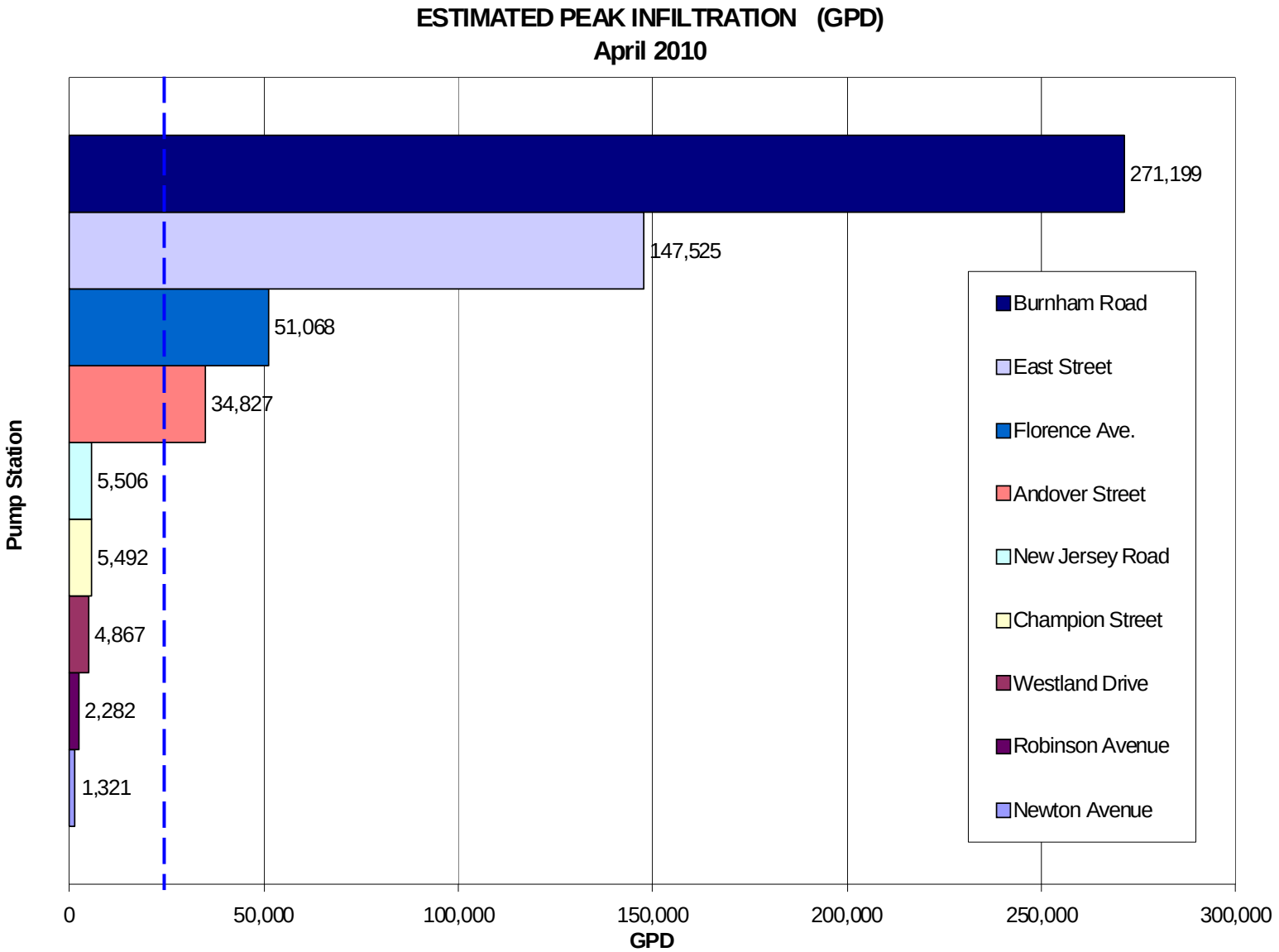

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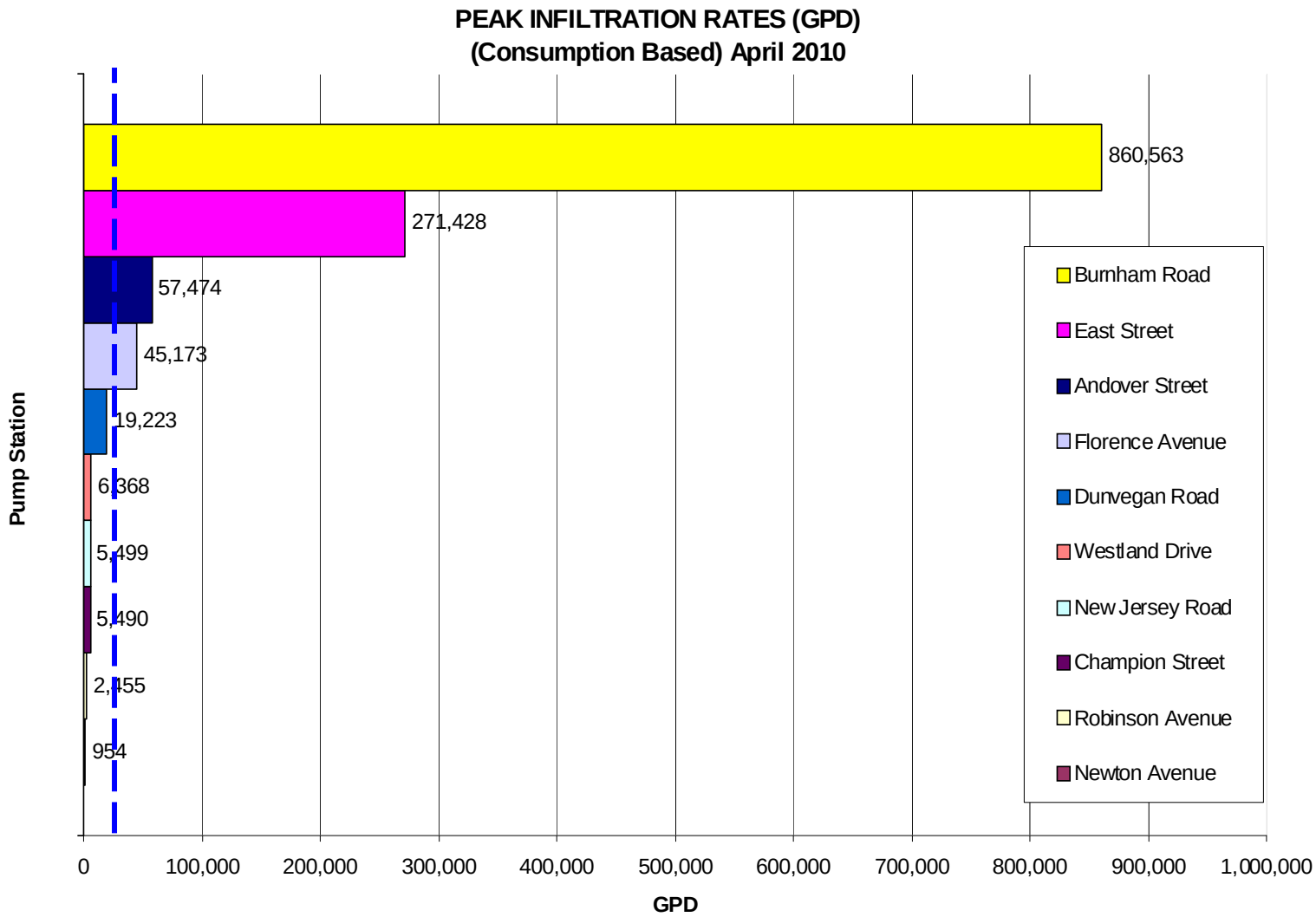
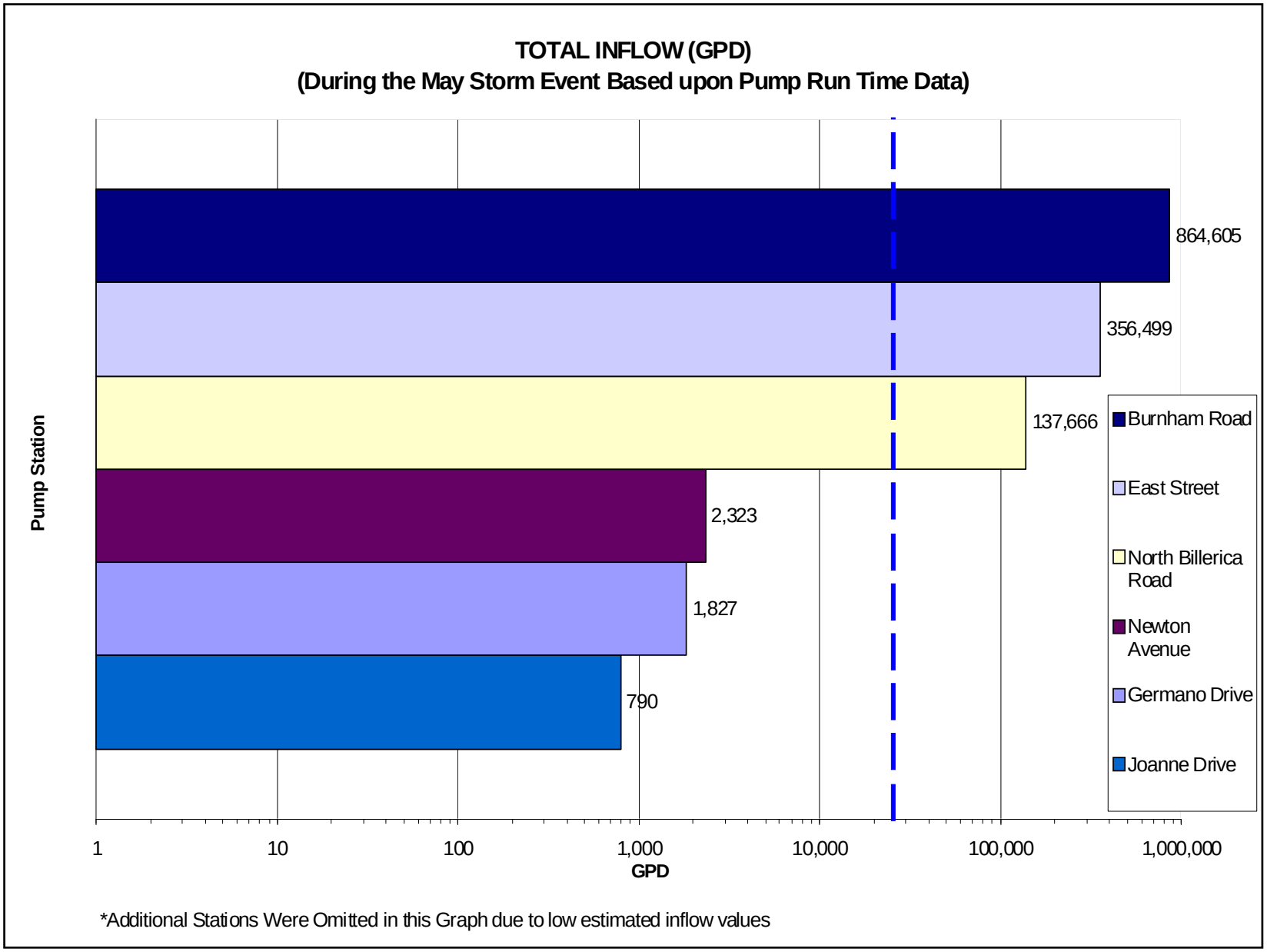
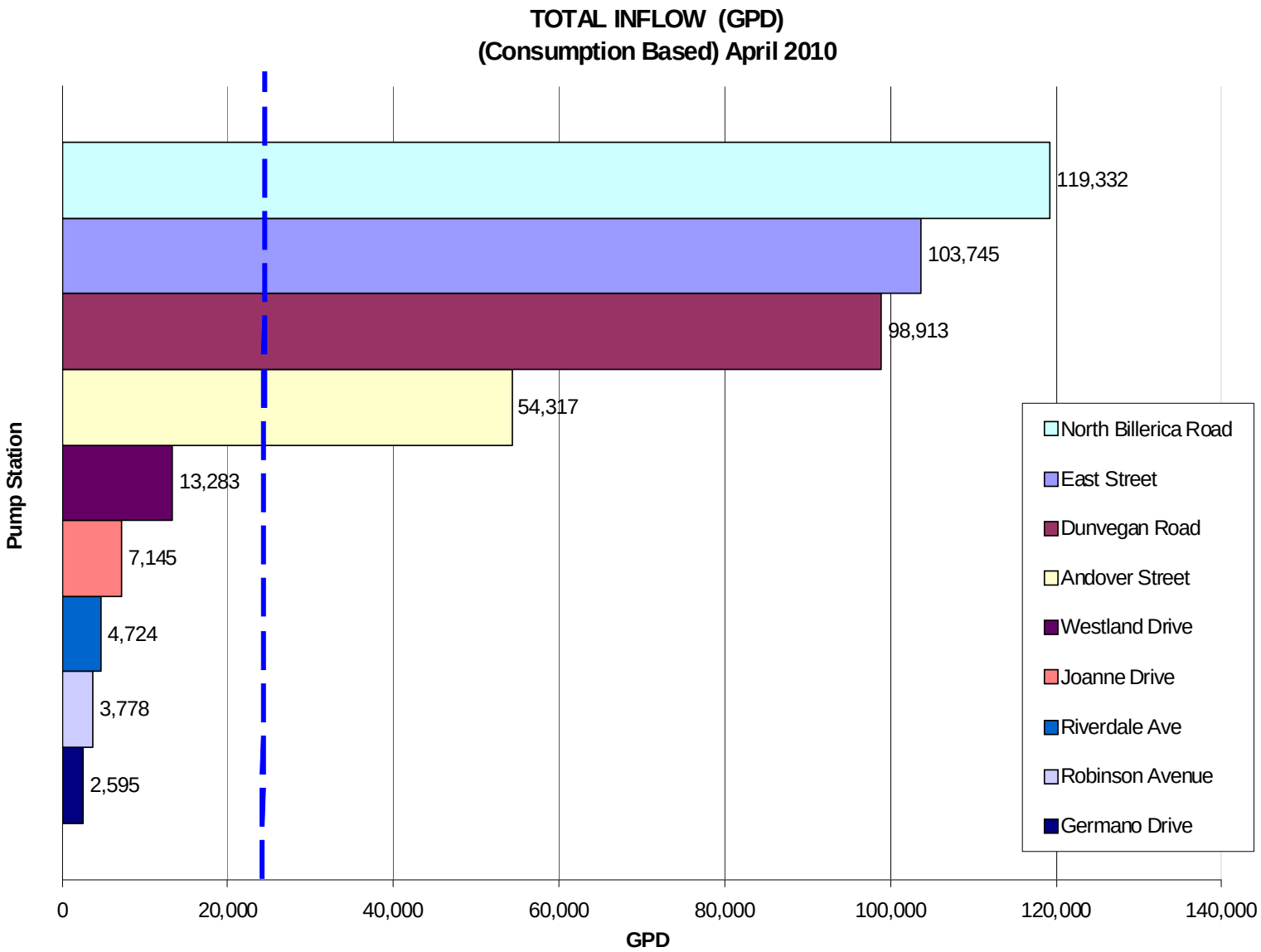


*Additional Stations Were Omitted in this Graph due to low estimated infiltration values. Note: Burnham calculated by subtraction of the other basins and as such may be over-stated due to under-estimation of upstream influences (other sub-basins).


TOTAL INFLOW (GPD)
(During the May Storm Event Based upon Pump Run Time Data)
Pump Station
864,605
356,499
137,666
2,323
1,827
790
Burnham Road
East Street
North Billerica Road
Newton Avenue
Germano Drive
Joanne Drive
1
10
100
1,000
10,000
100,000
1,000,000
GPD
*Additional Stations Were Omitted in this Graph due to low estimated inflow values

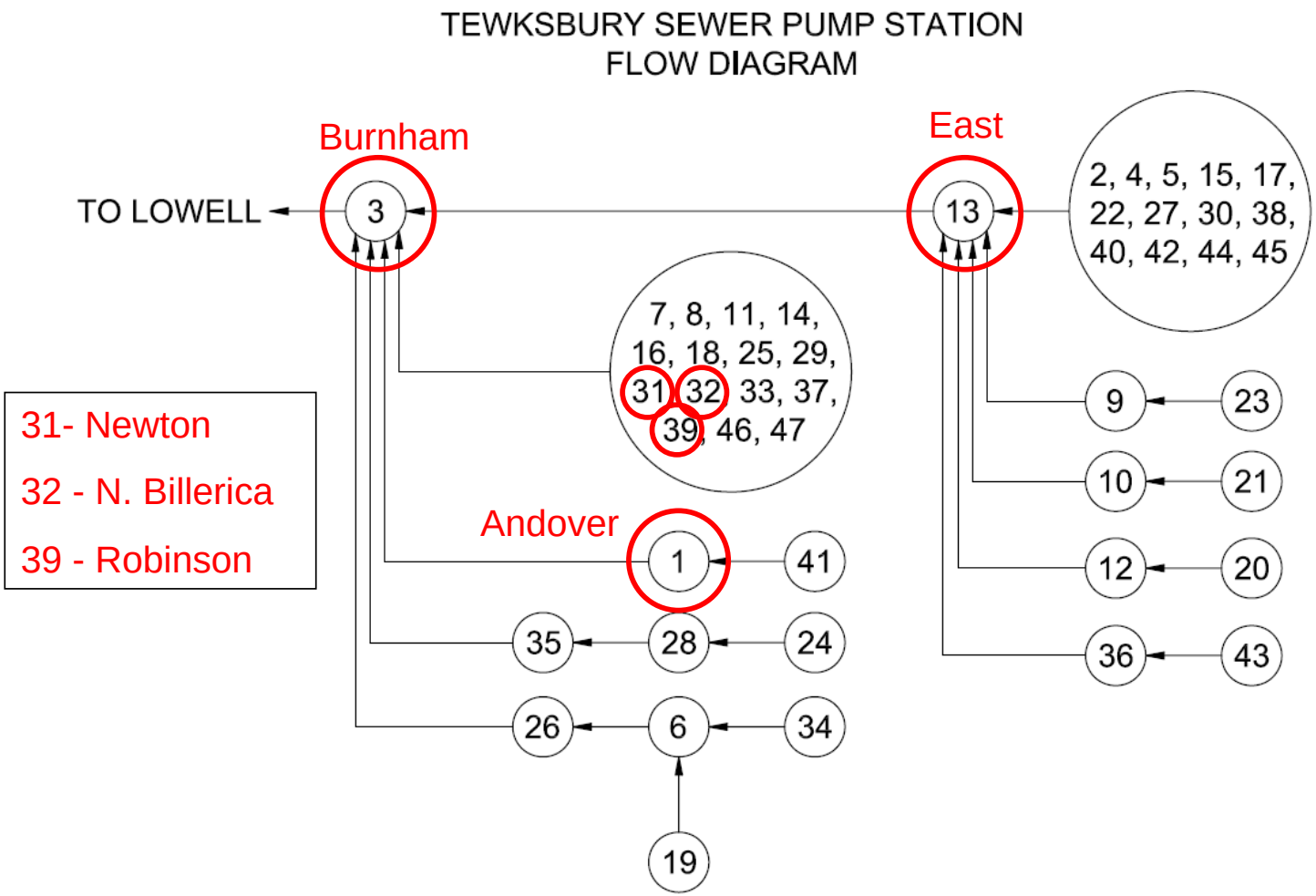


*Additional Stations Were Omitted in this Graph due to low estimated infiltration values

Priority Sub-basins

	Infiltration with August Baseflow	Infiltration with Consumption Baseflow	Direct Inflow with August Baseflow	Direct Inflow with Consumption Baseflow	Delayed Inflow with August Baseflow	Delayed Inflow with Consumption Baseflow		# of Times Thresholds Exceeded		Ranking
EAST STREET	X	X	X	X	X		=	5		1
ANDOVER STREET	X	X		X		X	=	4		2
ROBINSON AVENUE	X	X		X		X	=	4		3
BURNHAM ROAD	X	X			X	X	=	4		4
NEWTON AVENUE	X	X	X		X		=	4		5
NORTH BILLERICA			X	X	X	X	=	4		6

PRIORITY SUB-BASINS



Flow Monitoring

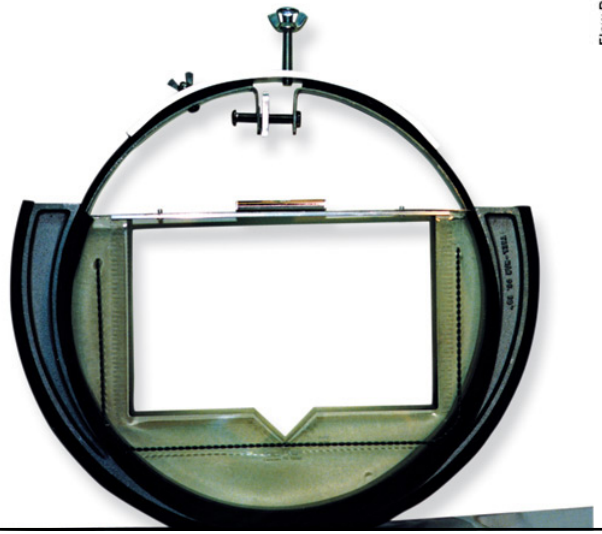
Used to define the flow contributions from intersecting pipes and to record wet weather influences.

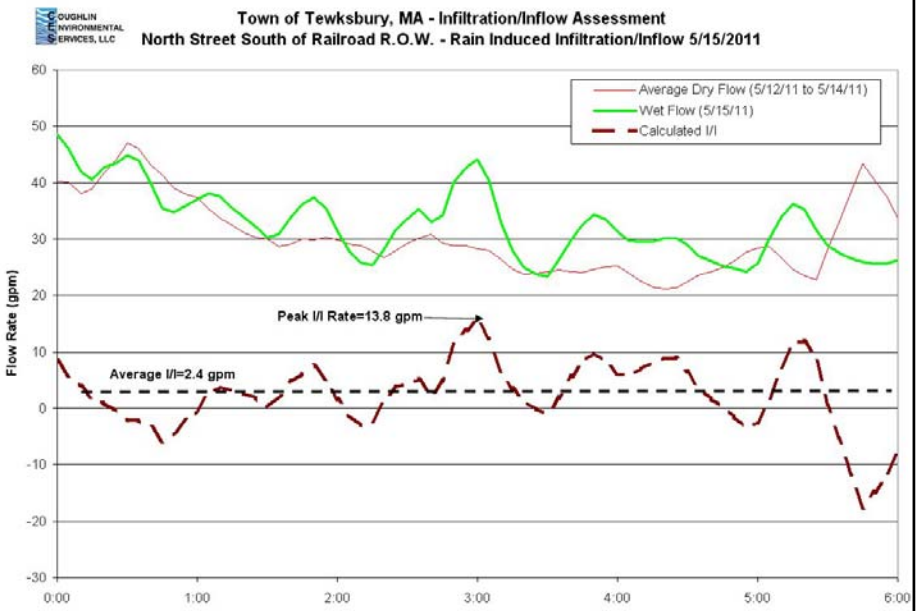
2150 Area Velocity System

Advanced area velocity technology in modular form.

- Microprocessor-based low profile sensor
- Span calibration not required
- No temperature drift
- Automatic gain control
- No "draw down" effect
- Variable rate data storage

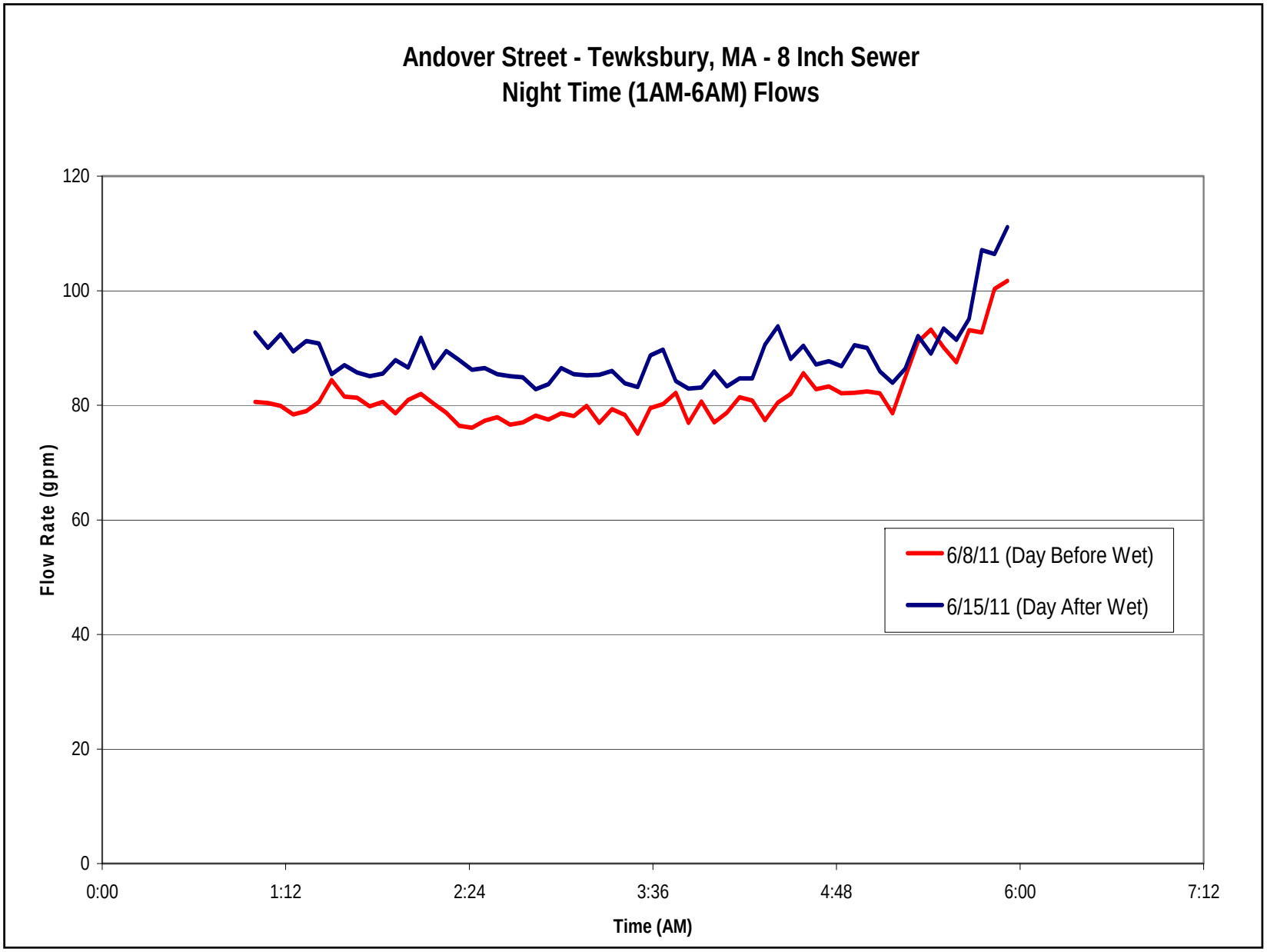
Shown with 2191 Battery Module

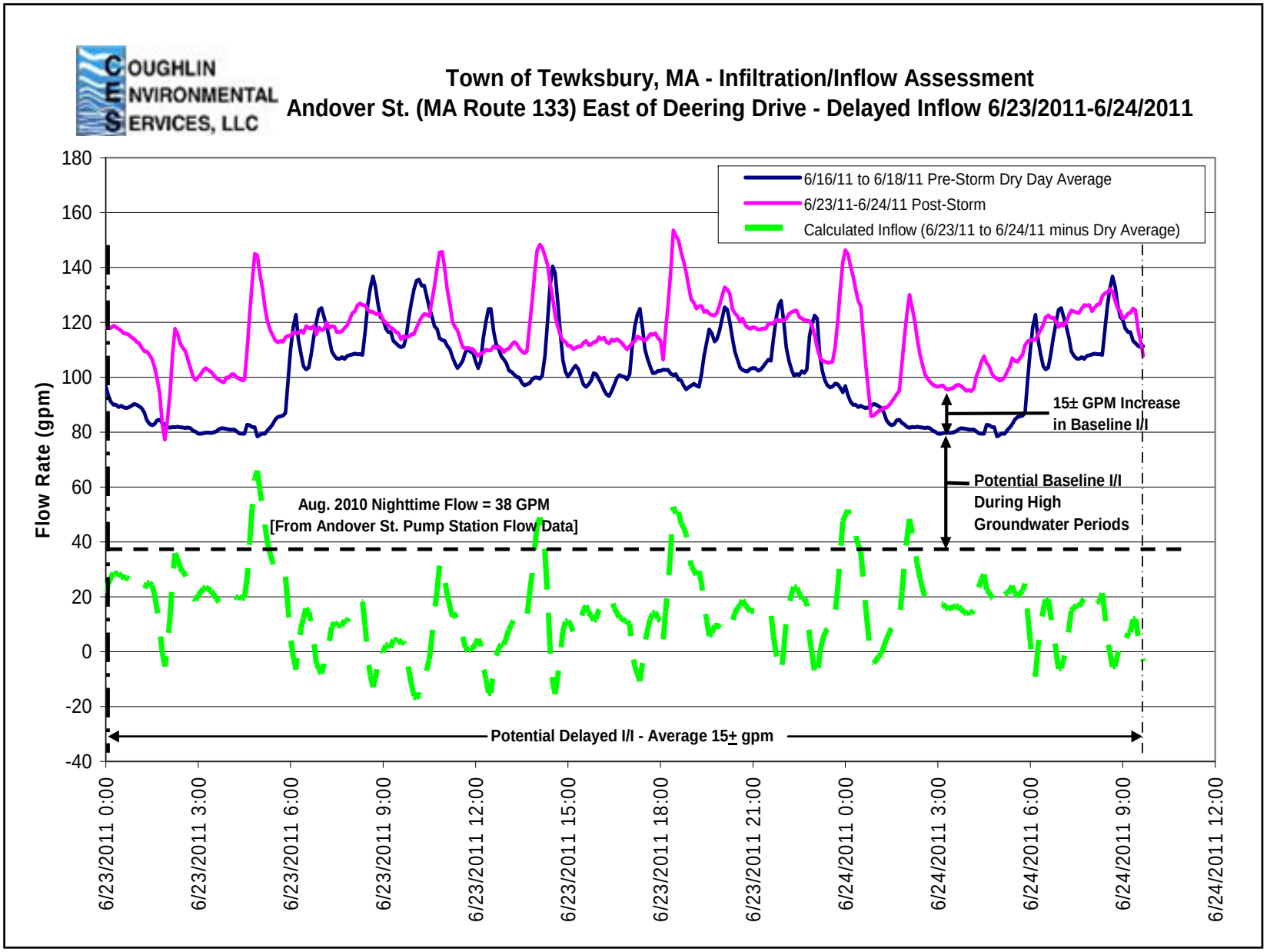


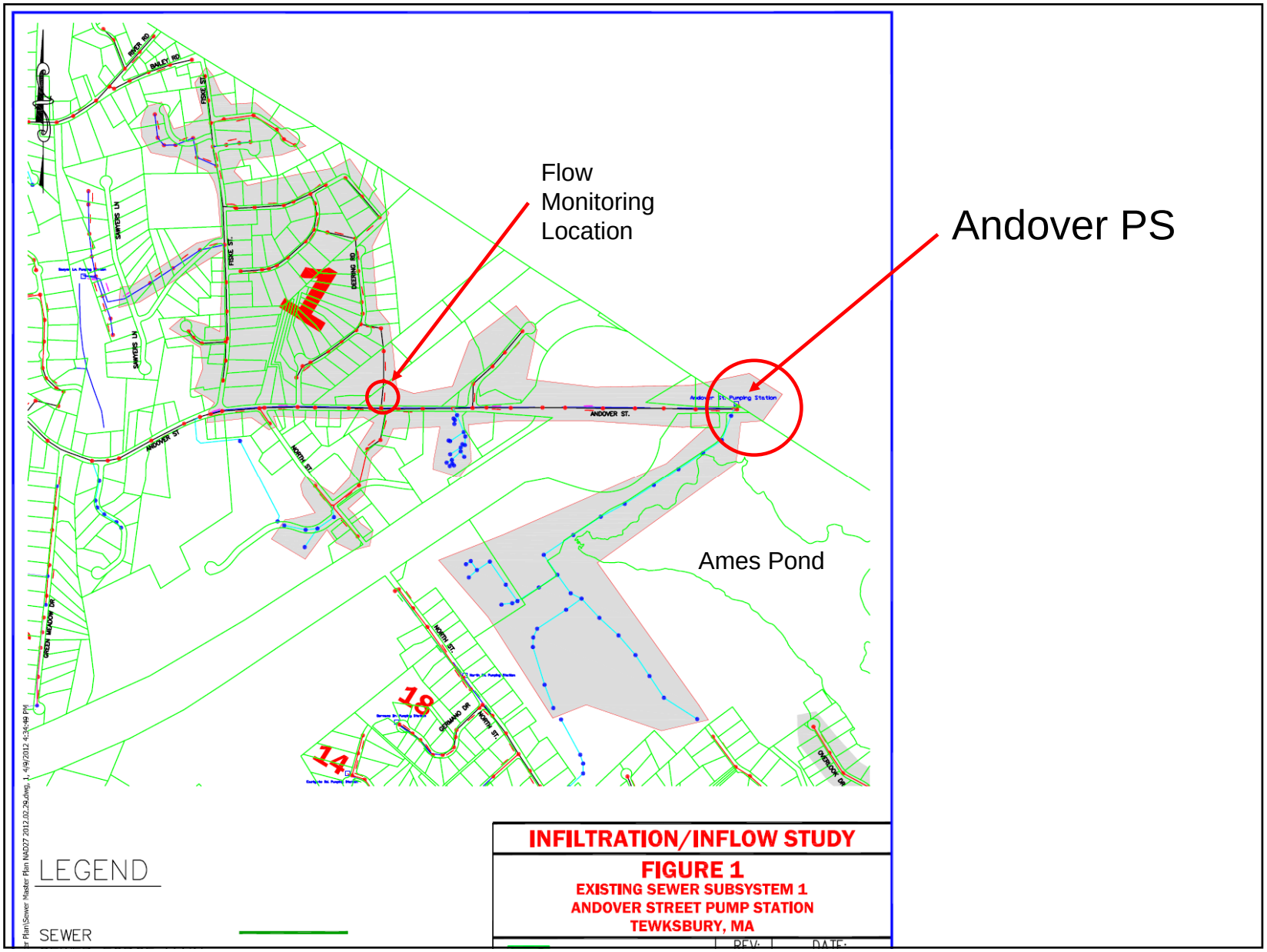


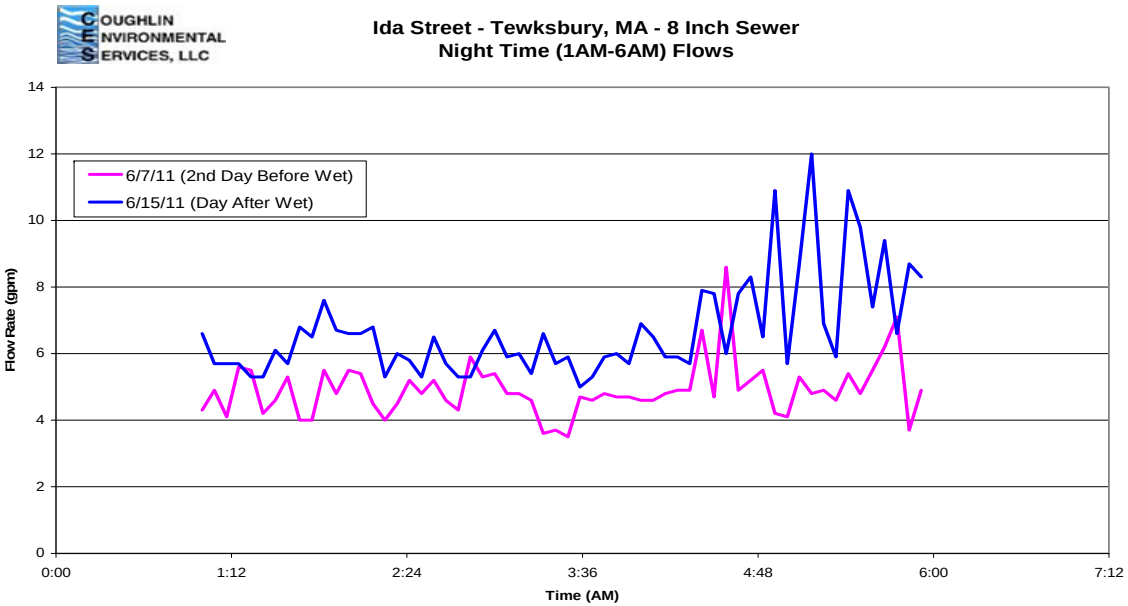
Flow Monitoring Locations

Location #	Sub-basin	Location	Pipe Size	Installed	Removed
1	3	Clark Road near Trull Brook	12"	5/4/2011	5/26/2011
2	13	Main St. (Rear of Dominos Pizza)	15"	5/4/2011	5/26/2011
3	3	North St. South of Railroad R.O.W.	10"	5/4/2011	5/26/2011
4	15	Parker Ave. near Silver Lake	8"	5/4/2011	5/26/2011
5	1	Andover St. (MA Route 133) East of Deering Drive	8"	5/26/2011	6/24/2011
6	13	Charme Rd. near Content Brook	10"	5/26/2011	6/24/2011
7	13	Rear of Ida Street near Heath Brook	8"	5/26/2011	6/24/2011
8	13	Rear of Ida Street near Heath Brook	10"	5/26/2011	6/24/2011
9	13	Main St. (Rear of Burger King)	12"	5/26/2011	6/24/2011


Andover Street - Tewksbury, MA - 8 Inch Sewer
Night Time (1AM-6AM) Flows
Flow Rate (gpm)
120
100
80
60
40
20
0
0:00
1:12
2:24
3:36
4:48
6:00
7:12
Time (AM)
6/8/11 (Day Before Wet)
6/15/11 (Day After Wet)


COUGHLIN ENVIRONMENTAL SERVICES, LLC
Town of Tewksbury, MA - Infiltration/Inflow Assessment
Andover St. (MA Route 133) East of Deering Drive - Delayed Inflow 6/23/2011-6/24/2011
6/16/11 to 6/18/11 Pre-Storm Dry Day Average
6/23/11-6/24/11 Post-Storm
Calculated Inflow (6/23/11 to 6/24/11 minus Dry Average)
Flow Rate (gpm)
180
160
140
120
100
80
60
40
20
0
-20
-40
15± GPM Increase in Baseline I/I
Potential Baseline I/I During High Groundwater Periods
Aug. 2010 Nighttime Flow = 38 GPM
[From Andover St. Pump Station Flow Data]
Potential Delayed I/I - Average 15± gpm
6/23/2011 0:00
6/23/2011 3:00
6/23/2011 6:00
6/23/2011 9:00
6/23/2011 12:00
6/23/2011 15:00
6/23/2011 18:00
6/23/2011 21:00
6/24/2011 0:00
6/24/2011 3:00
6/24/2011 6:00
6/24/2011 9:00
6/24/2011 12:00

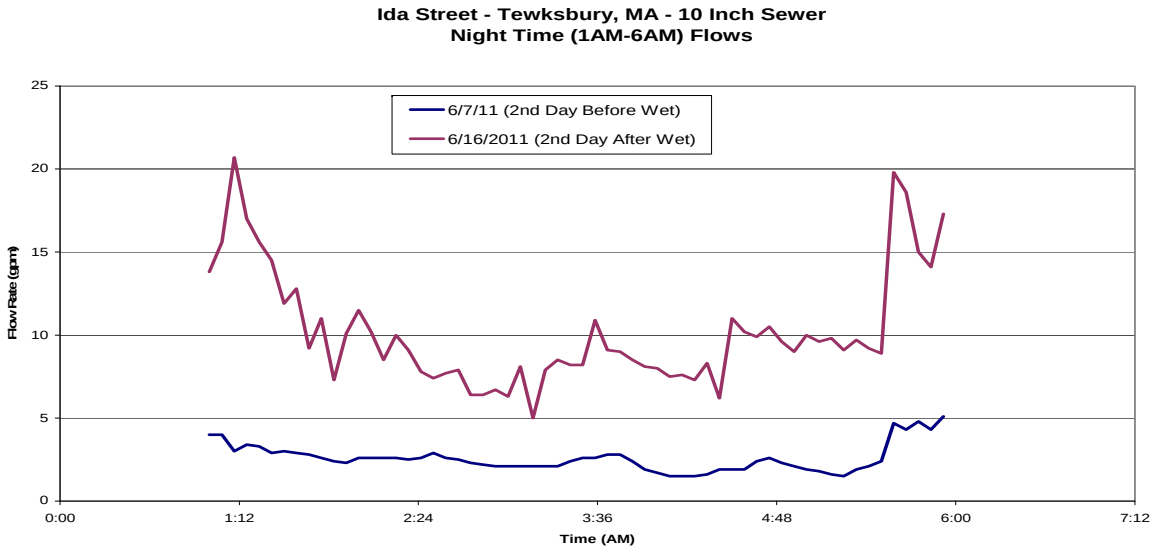

Flow
Monitoring
Location
Andover PS
Ames Pond
ANDOVER ST.
ANDOVER ST
NORTH ST.
FISKE ST.
SAWYERS LN
DEERING RD
GERMANO DR
GREEN MEADOW DR
OVERLOOK DR
18
14
LEGEND
SEWER
INFILTRATION/INFLOW STUDY
FIGURE 1
EXISTING SEWER SUBSYSTEM 1
ANDOVER STREET PUMP STATION
TEWKSBURY, MA
REV:
DATE:



East Street PS

Sub-Basin

(Near Heath Brook)



Strategy Moving Forward

Goal : Try to identify the largest cost generating aspects of I/I and remediate those to reduce operational costs.

"Grab at the Lowest Hanging Fruit"

First : Narrow area for further study using Manhole night-time observations, flow monitoring and potentially flow isolation

Second: Provide CCTV inspection of the mains to identify specific I/I sources and help to identify cost effective remediation strategies

Third: Implement remediation strategies while continuing with I/I assessment to allow more immediate cost relief.

Fourth: Re-assess remediation effectiveness.

Report Recommendations

- Includes a three phase approach to further assessment, evaluation and remediation concentrating on the most efficient and cost effective measures given a limited budget.

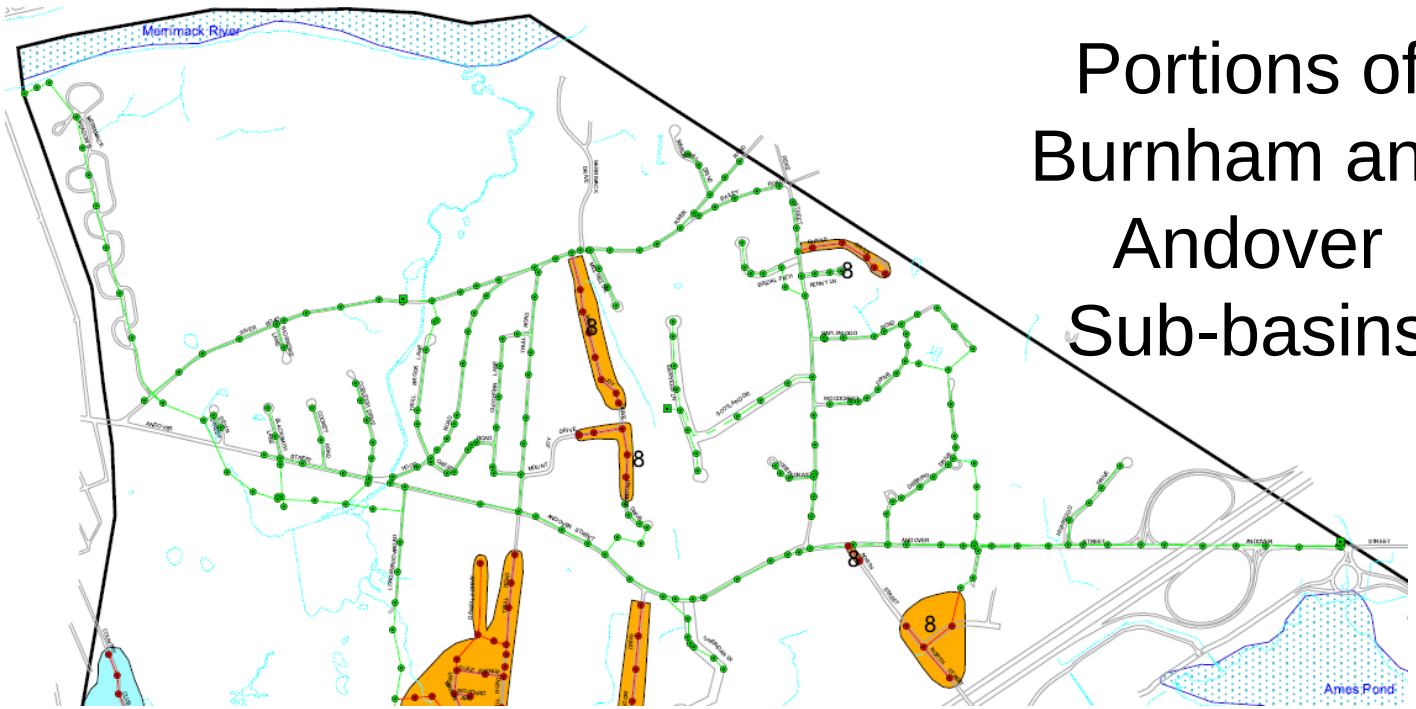
- Phase One - $117K – additional flow monitoring, manhole inspection, CCTV inspection in high priority areas…limited manhole repairs

- Phase Two - $158K – limited flow monitoring, manhole inspection and repair, piping repairs including testing and sealing joints and spot/liner repairs, some smoke testing

- Phase Three - $73K+ - manhole and piping repairs as required. Based upon previous phases, additional measures potentially needed. Some re-assessment also targeted to evaluate effectiveness of past repairs.

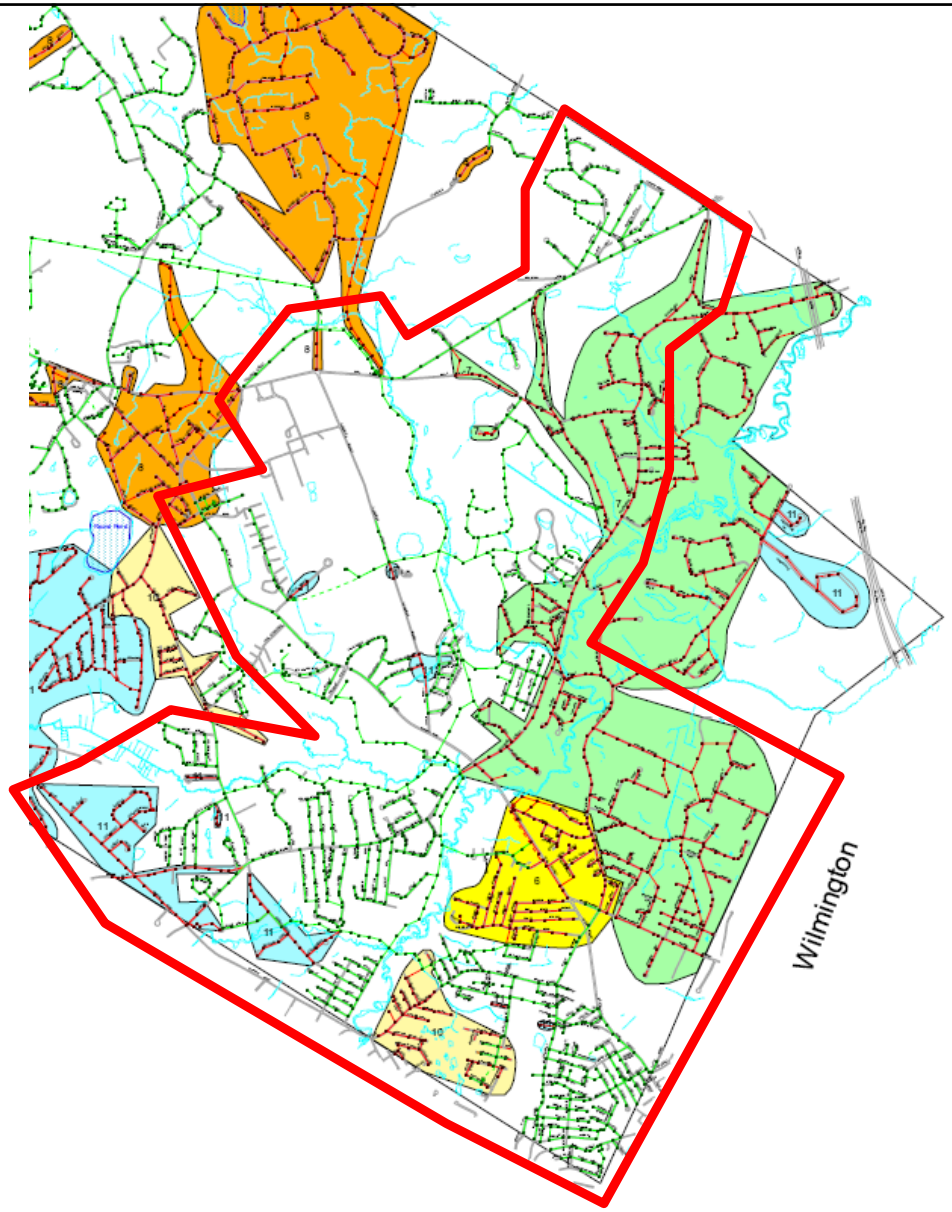
FY12 - Initial Pipeline CCTV and Manhole Inspection Area

Area between River Road and Route 133- Burnham and Andover Sub-Basins



Portions of Burnham and Andover Sub-basins

East Street Sub-basin

- Additional flow monitoring to better define largest contributing branches and allow refined targeting for FY13 work.

  - In FY13 High Priority manhole inspections and water-tight manhole rehabilitation. Target East Street Sub-basin due to high flooding potential.