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New Jersey Agricultural Experiment Station

Methodologies to document impact on water quality from installation of small Best Management Practices (BMPs)

Presented to New Jersey Water Supply Authority and New Jersey Department Of Environmental Protection

February 14, 2010

Pat Rector

Ben Pearson

Project undertaken on the Peters Brook Watershed, Somerset County, NJ

Rector, P, C. Obropta, C., and B. Pearson

Outline

- **NJWRRI and Grant Objectives - Pat**
- **Peters Brook -Pat**
- **Earlier Project –Ben**
- **Rain Garden Project Van Derveer School- Pat and Ingrid**
- **Neighborhood Rain Barrel Workshops and Results – Pat**
- **Stingray–Ben**
- **WinSLAMM – Ben**
- **Biological – Pat**
- **Conclusions/Wrap-up –Pat**
- **Questions/Discussions-All**

NJWRRI

- The New Jersey Water Resources Research Institute is a federally funded program of research, training and information transfer concerning all aspects of fresh and estuarine water in the state.

Grant

- This project is designed to evaluate three methods of tracking cumulative implementation of Best Management Practices (BMPs) on a subwatershed scale and determine the method that best documents water quality improvements.
- The criteria for determining the most appropriate methodology to document water quality improvement will include: ease of use; cost; technical expertise necessary; and the ability to indicate the effects of cumulative BMPs in a subwatershed.
- Three methods will be evaluated to document water quality improvement due to implementation. The three methods are: modeling; monitoring (chemical /biological); and monitoring of flow to determine volume reductions.
- Funding = $20,000

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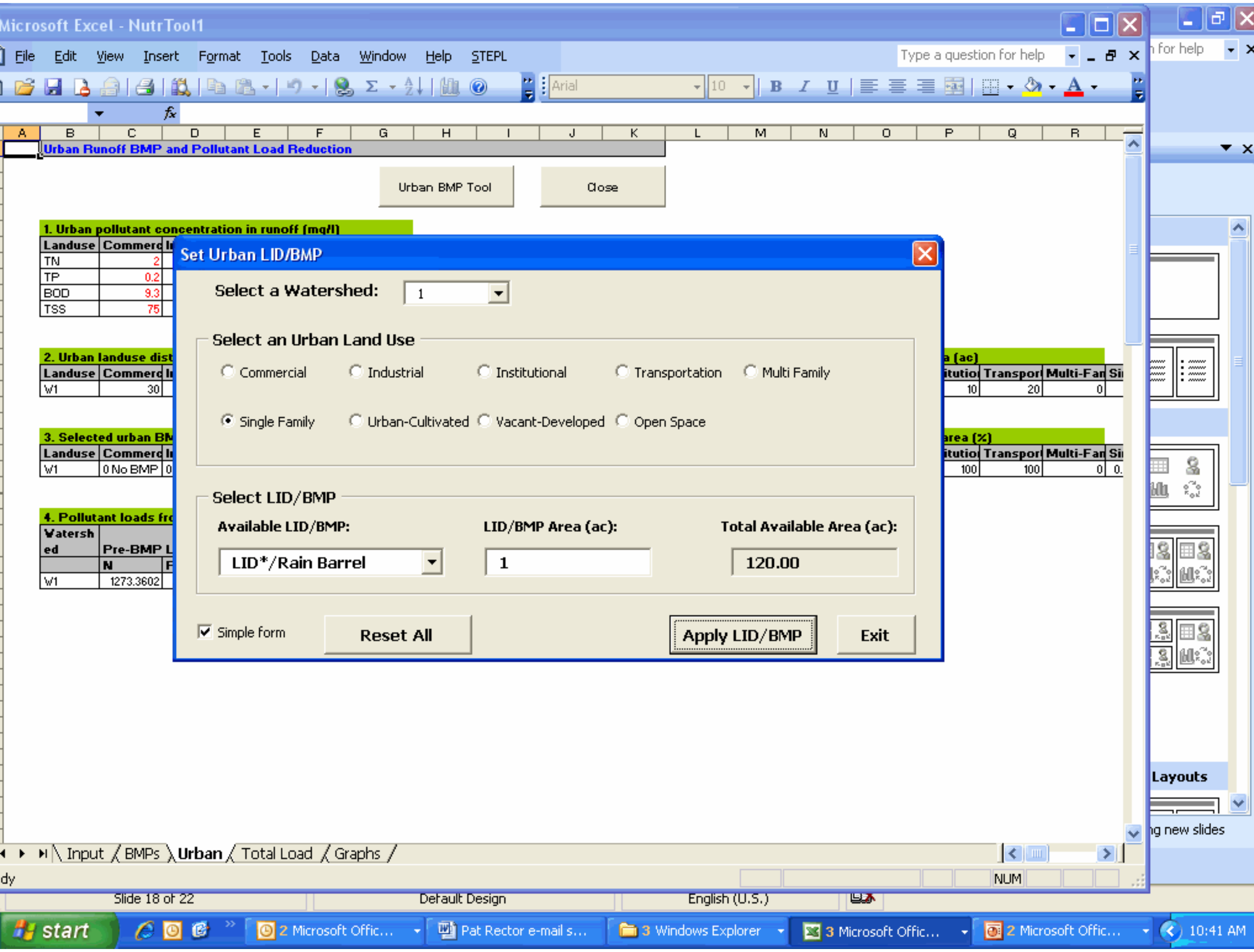
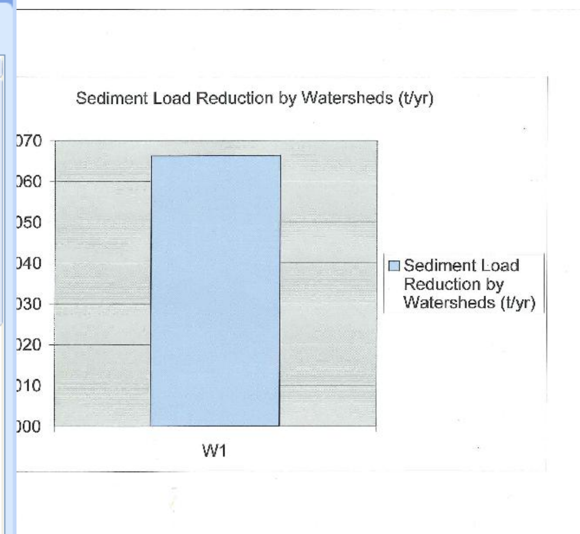
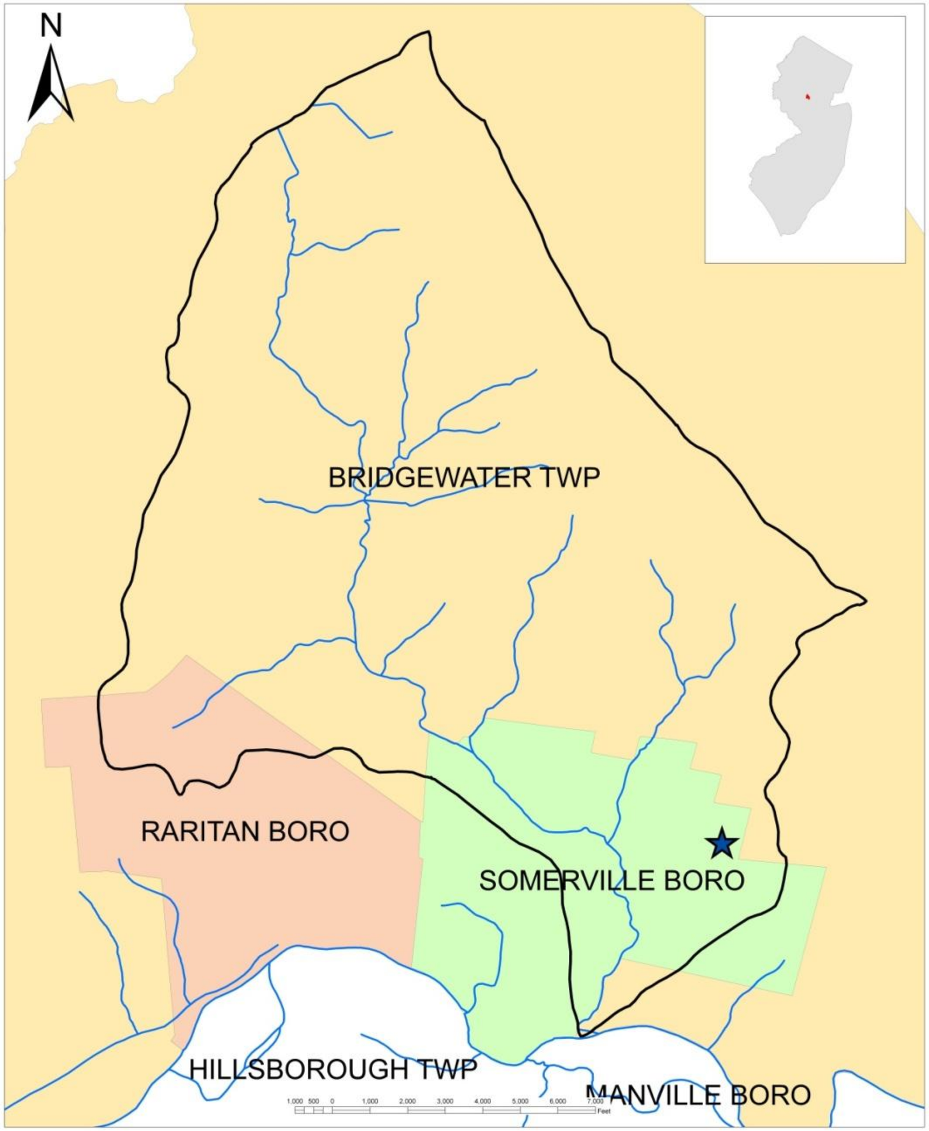
STEP-L Reductions from installations of urban BMPs



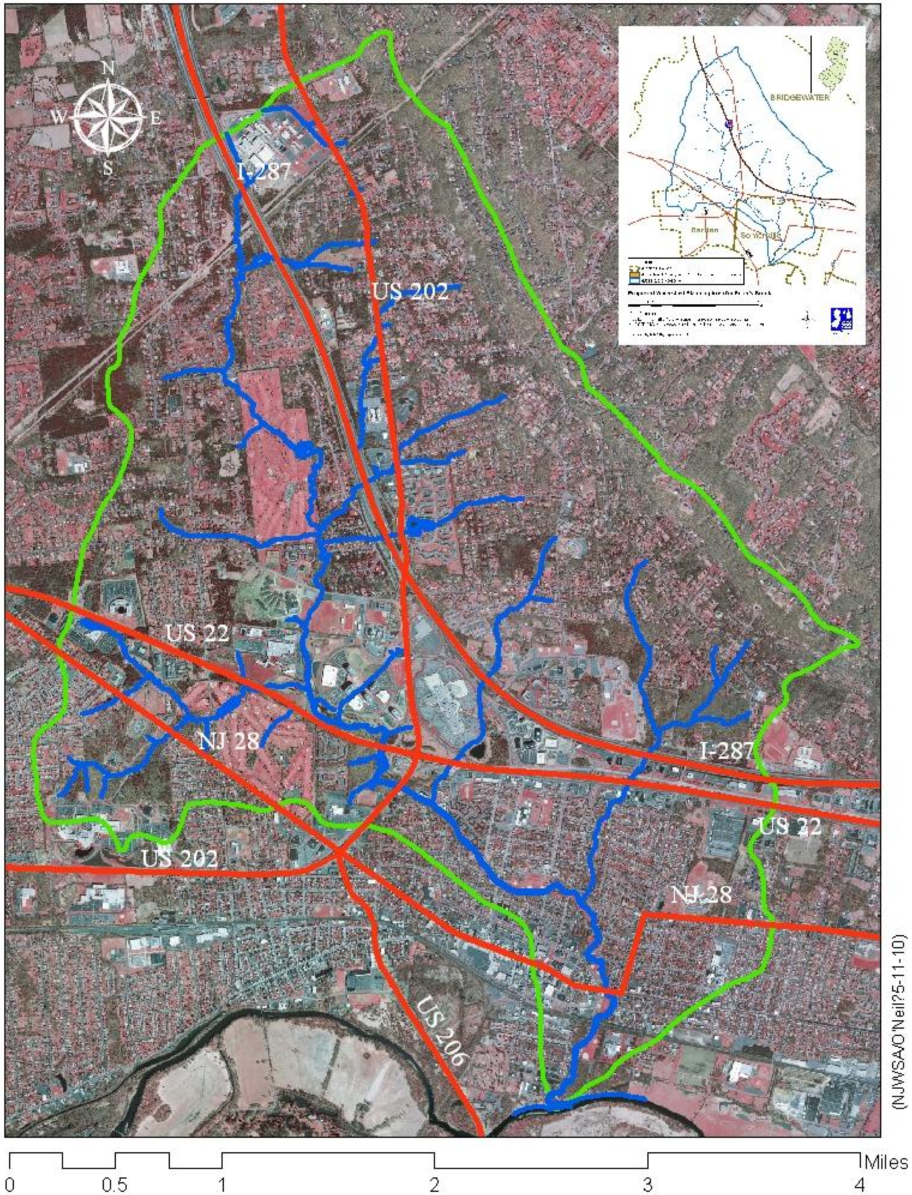


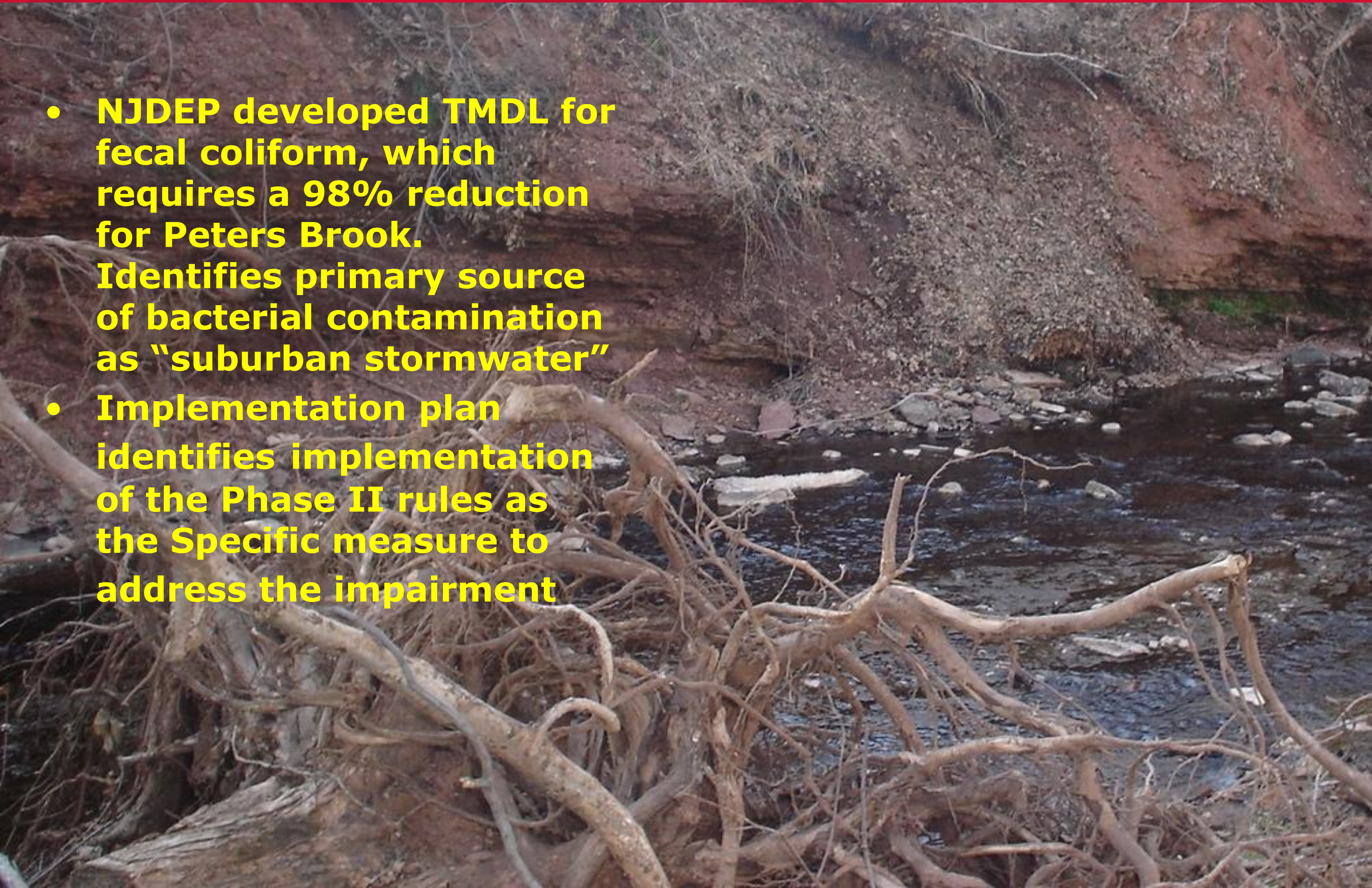
Peters Brook

Peters Brook Watershed



Peters Brook Study Area





- **NJDEP developed TMDL for fecal coliform, which requires a 98% reduction for Peters Brook. Identifies primary source of bacterial contamination as "suburban stormwater"**
- **Implementation plan identifies implementation of the Phase II rules as the Specific measure to address the impairment**

Earlier Project

- Completed Spring 2005
- Previous study focused on lower Ross Brook Watershed only, not headwaters
- Utilized rain gardens as means of volume reduction
- Proved to not be cost-effective
- Poor assumptions

Earlier project

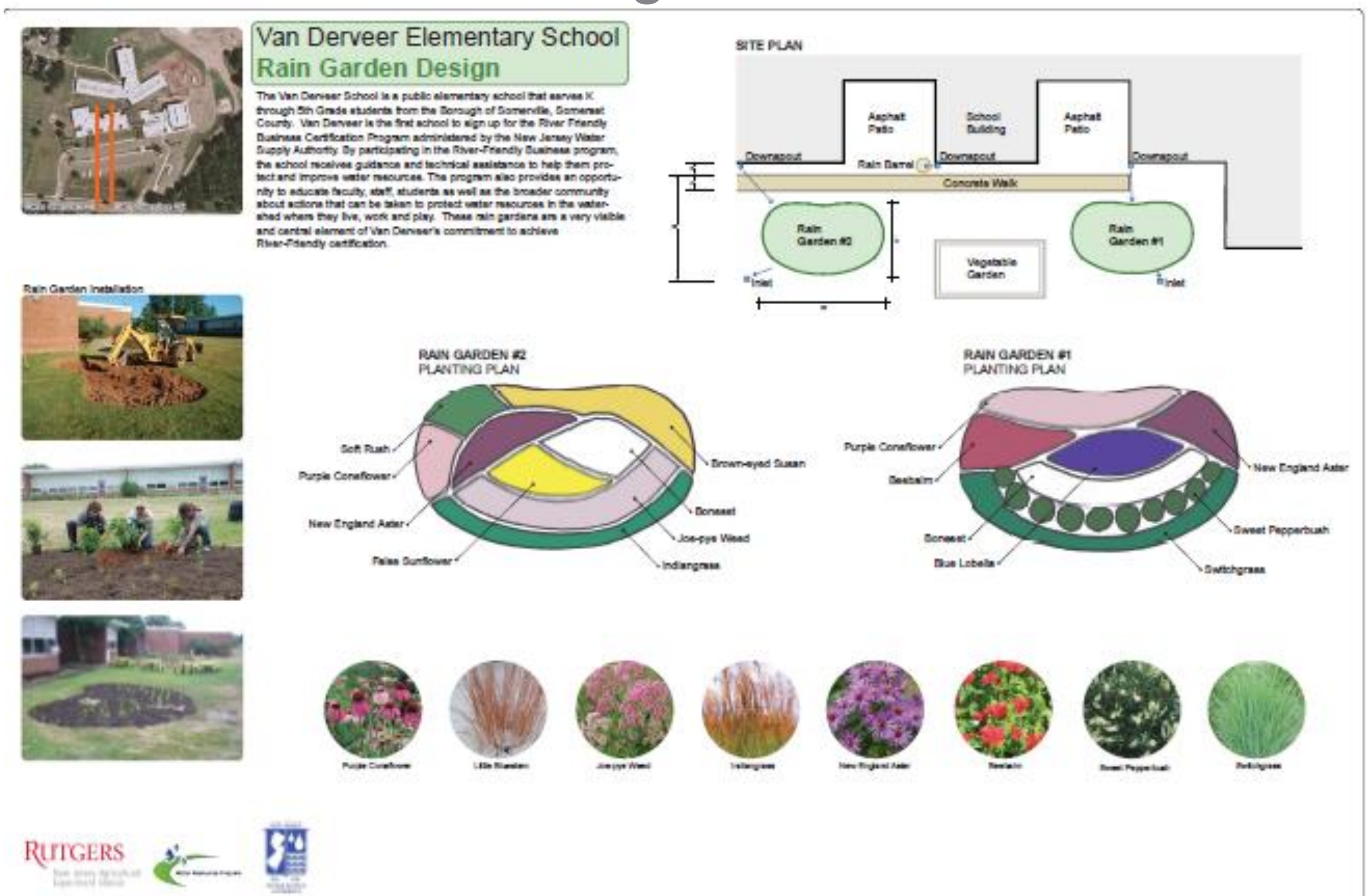
- Downfalls
  - Assumed that half of the roofs were connected
  - Assumed that rain gardens would receive runoff from driveways, roofs, and streets
  - Capturing driveway and street runoff might require re-grading and curb cuts
  - Too costly and requires large amount of homeowner effort

Earlier project

- Identified disconnection as a possible cost-efficient method of volume reduction
- Homeowner participation is key for any reductions to occur

Van Derveer Elementary School

NJWSA in the process of discussing rain gardens with VDV school; RCE and NJWSA together create school rain gardens.



To this

Partners included: NJWSA, Rutgers Water Resources Program,

AmeriCorps Ambassador Program

Somerset County Parks Dept.,

To this

To this

Photo by: Heather Barrett Assistant Watershed Protection Specialist NJ Water Supply Authority
Location: Van Derveer Elementary School Yard Rain Garden
Cover by: Ingrid Witty Rutgers Environmental Steward

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Van Derveer Elementary School Rain Garden Curriculum

Modified for students in grades 4-5

Topics Include:

1. **Watersheds**
2. **Stormwater, Nonpoint Source Pollution, and Storm Drains**
3. **Rain Gardens**
4. **Rain Garden Soils**
5. **Rain Garden Plants**
6. **Rain Garden Maintenance**

Lesson Example: Rain Gardens

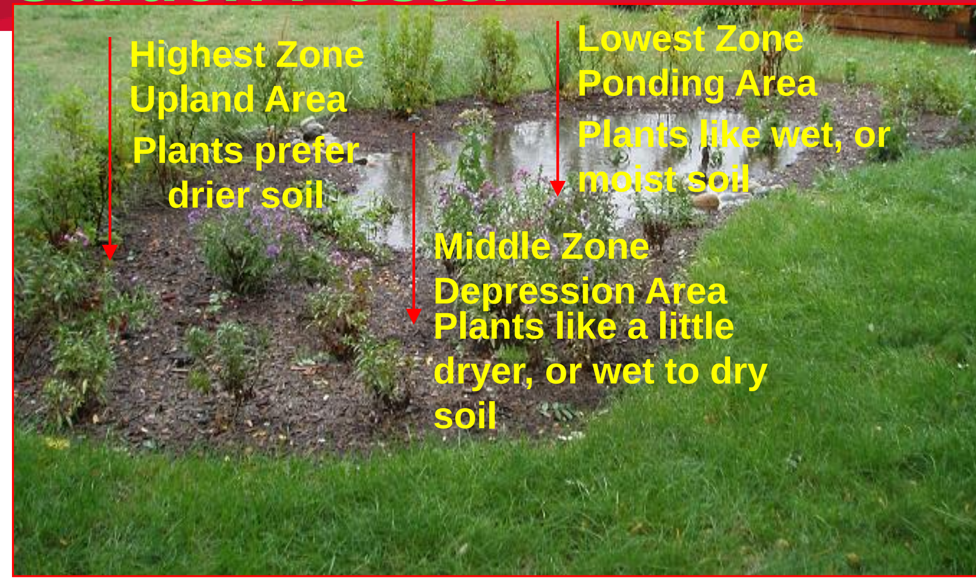
Van Derveer Elementary School Rain Garden Poster

Materials Teacher:

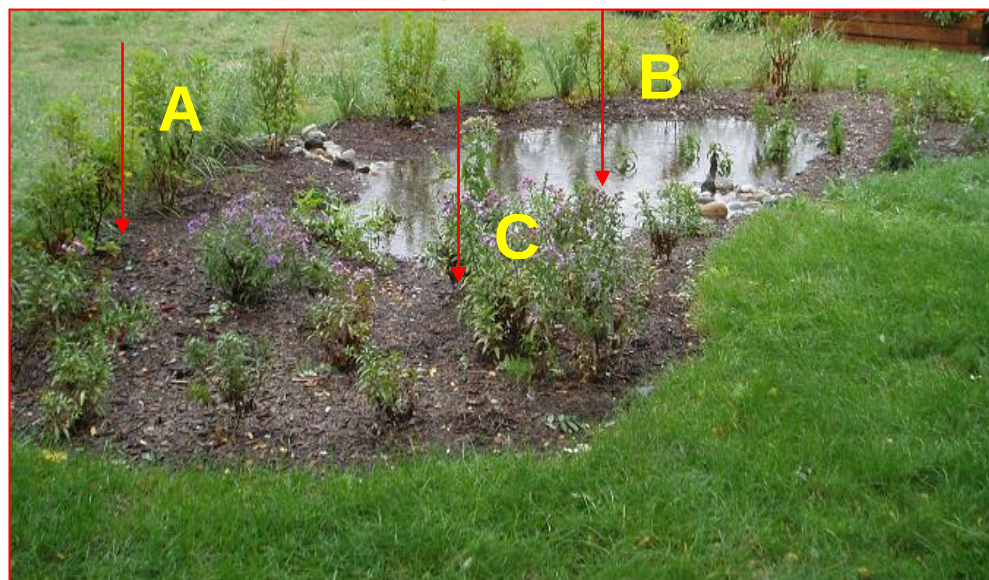
- Rutgers Rain Garden Manual
- Van Derveer School's Rain Garden Design Plan
- Van Derveer School's Rain Garden installation photographs on CD, and PowerPoint
- Van Derveer School's Rain Garden Poster

Materials Students:

- Van Derveer School's Rain Garden Worksheet



Van Derveer Elementary School Rain Garden Worksheet



Rain Barrel workshops

A partnership with New Jersey Water Supply Authority

NJWSA Peters Brook Project
Somerville Neighborhood Study Area

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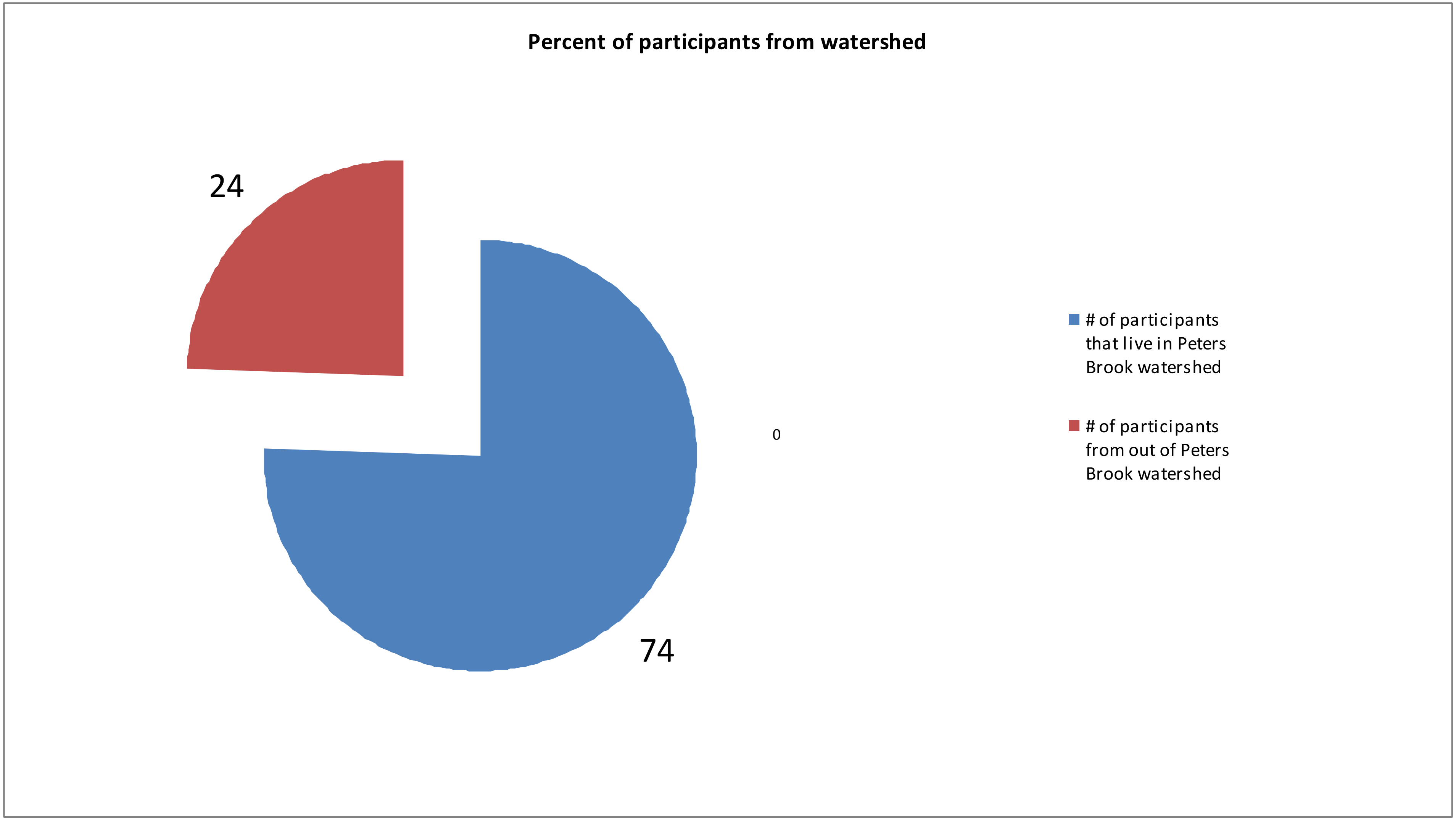
Rain Barrel workshop



Rain Barrel workshops- Making connections

- Back drop for the Somerville workshop

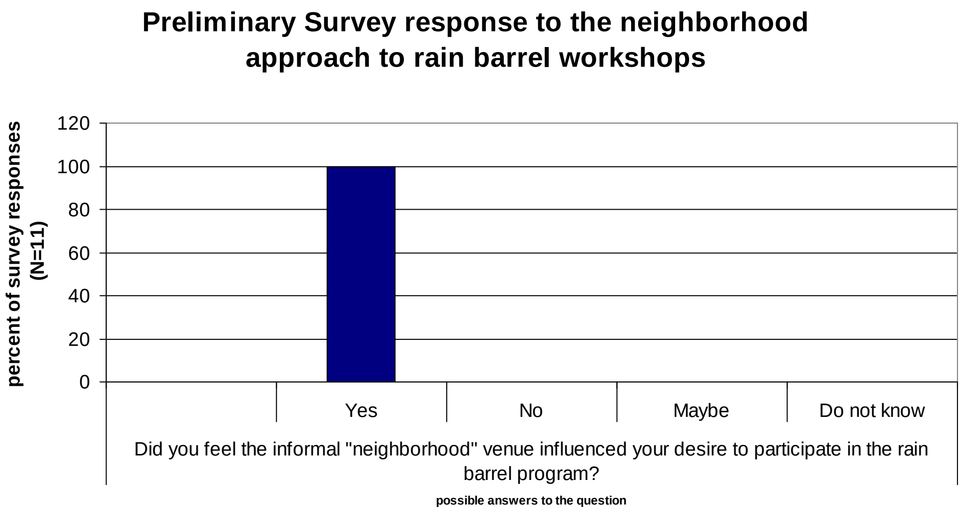
Making the connection between stormwater runoff and public water supplies

Rain water that falls in the Peters Brook Watershed flows to the Raritan River carrying with it, pollutants such as sediment, bacteria and hydrocarbons.

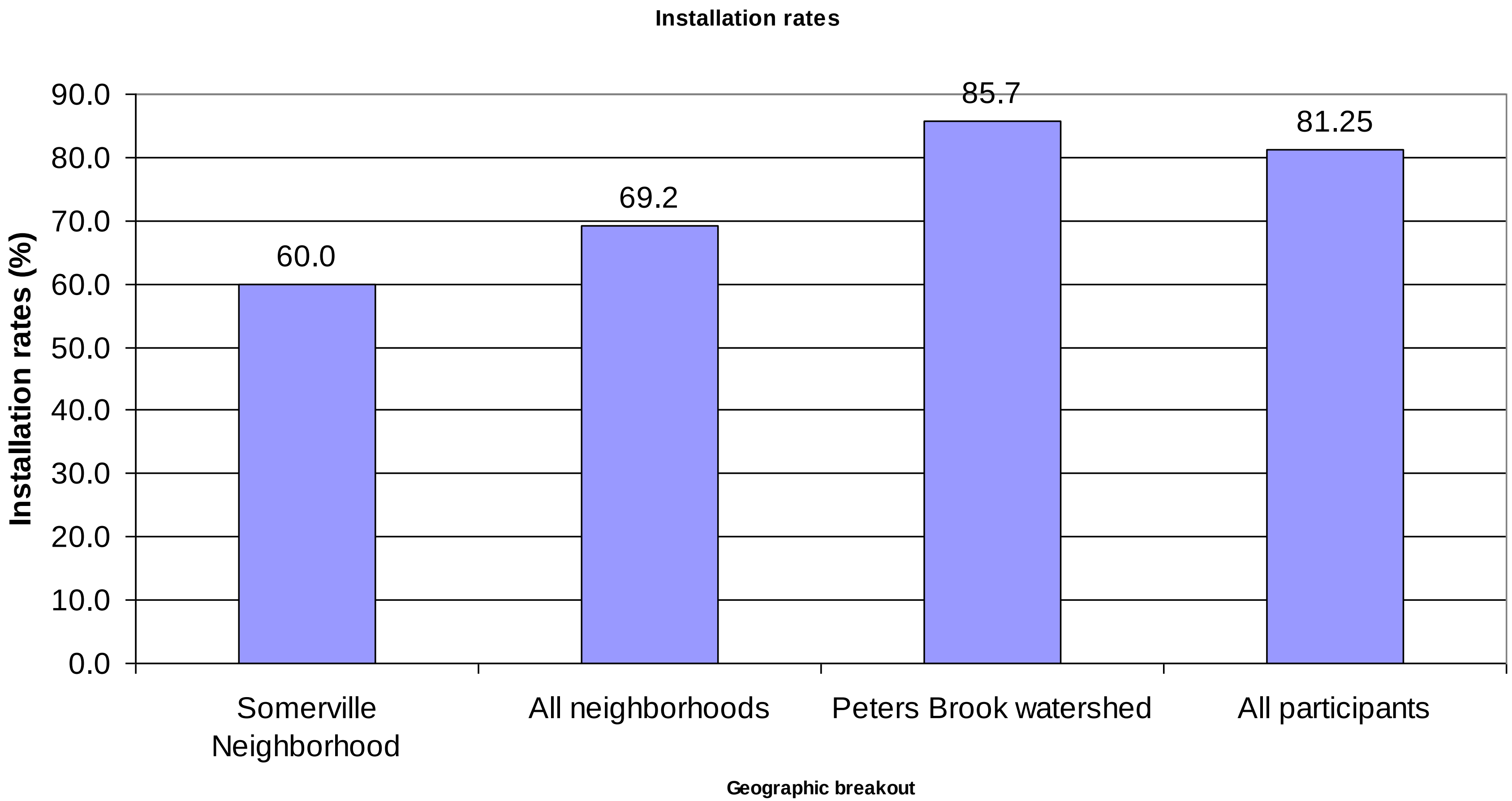
This "raw water" is processed and purified at the New Jersey American Water Treatment Plant, located at the confluence of the Raritan and Millstone Rivers.

Public drinking water is then distributed to Bridgewater, Raritan and Somerville as well as to communities throughout central New Jersey.

Neighborhood Venue

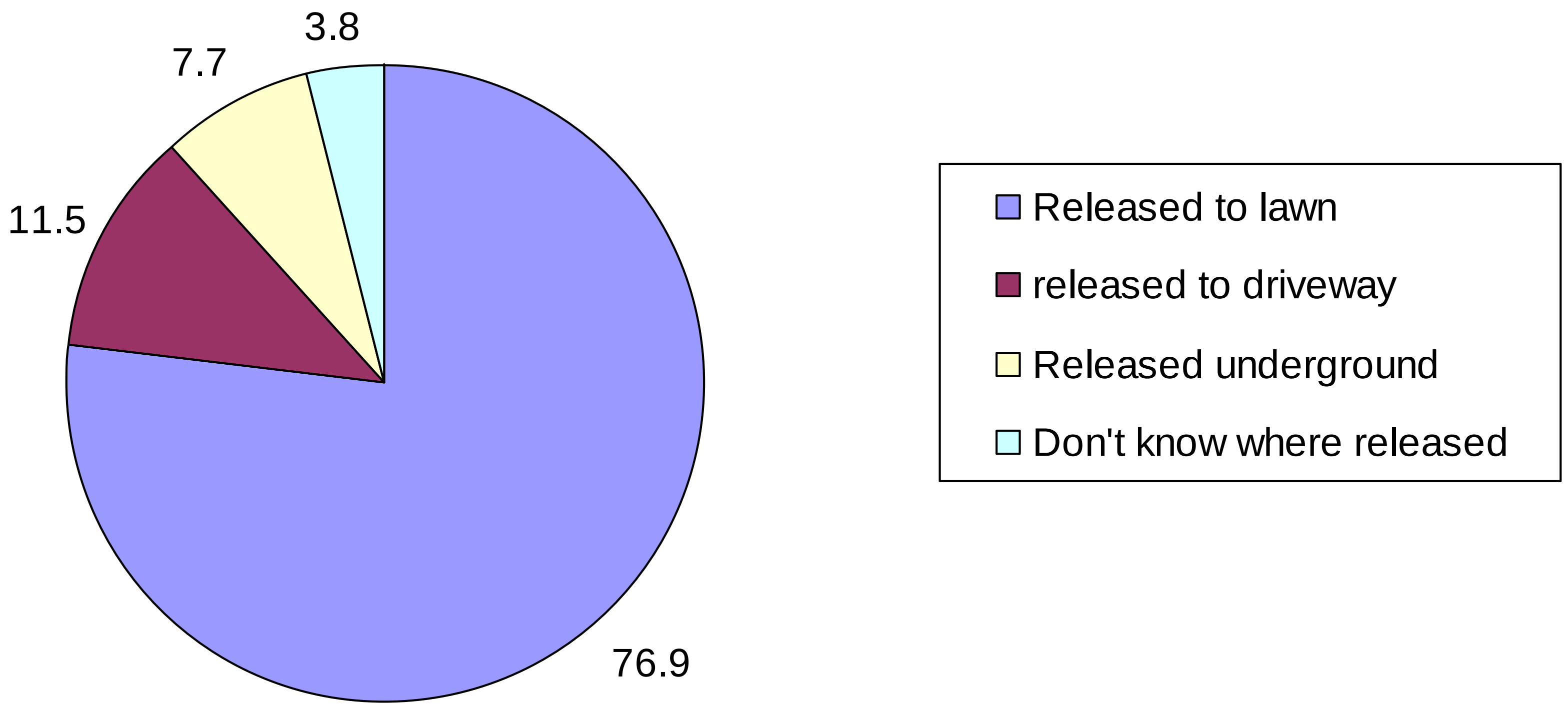


Installation Rates based on survey responses

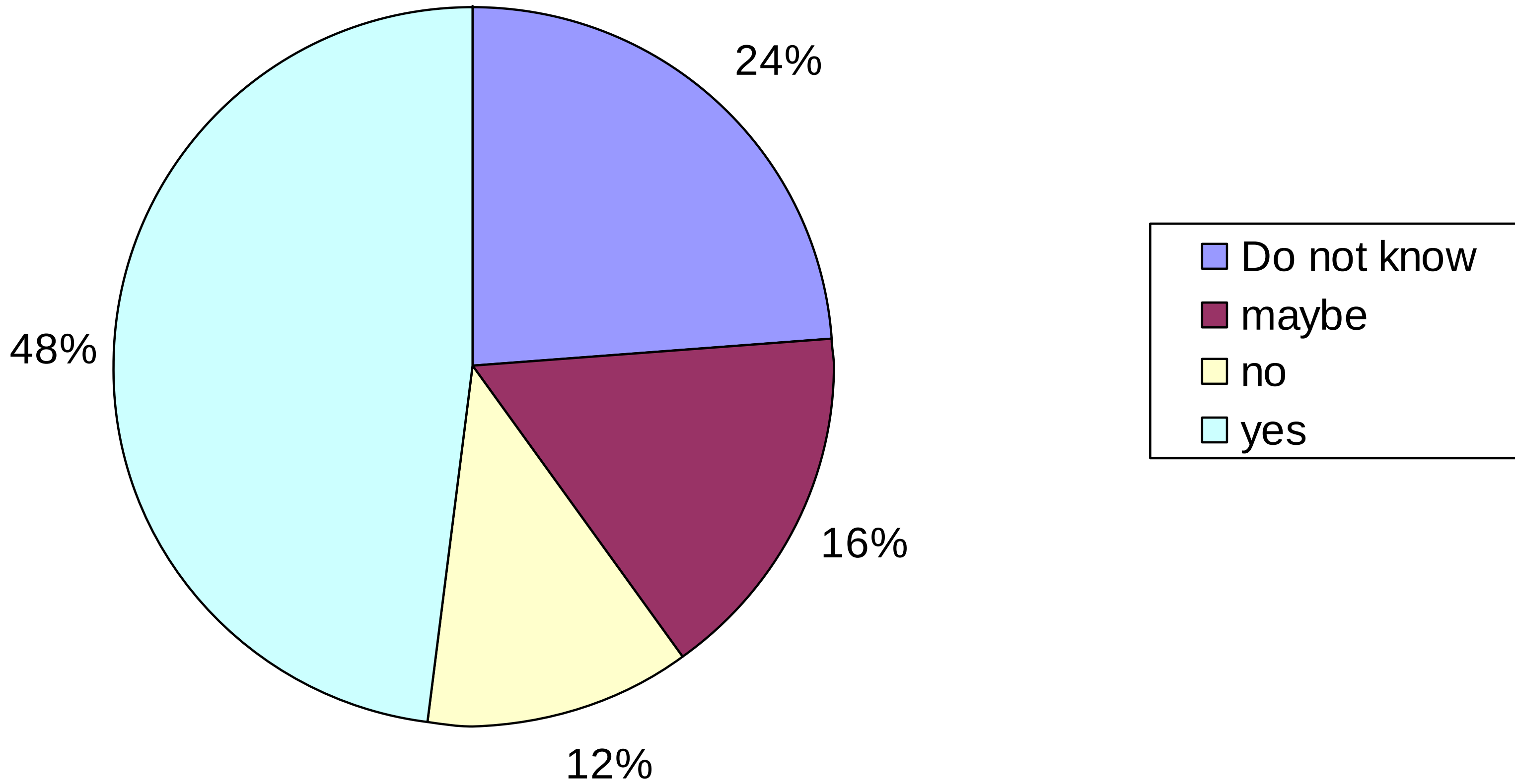


Statewide numbers 71% installation n=138

Type of downspout disconnection (%)



Interest to install rain garden



Flow Monitoring

- Pressure transducer or Ultra-sonic
- WRP had experience with Senix Gauge and Stingray
- Senix Gauge hangs above water and emits a small chirp and records the time it takes to bounce back to measure “depth”
- Stingray Gauge sits on the bottom of the pipe and uses to ultra-sonic emitters to measure depth and velocity

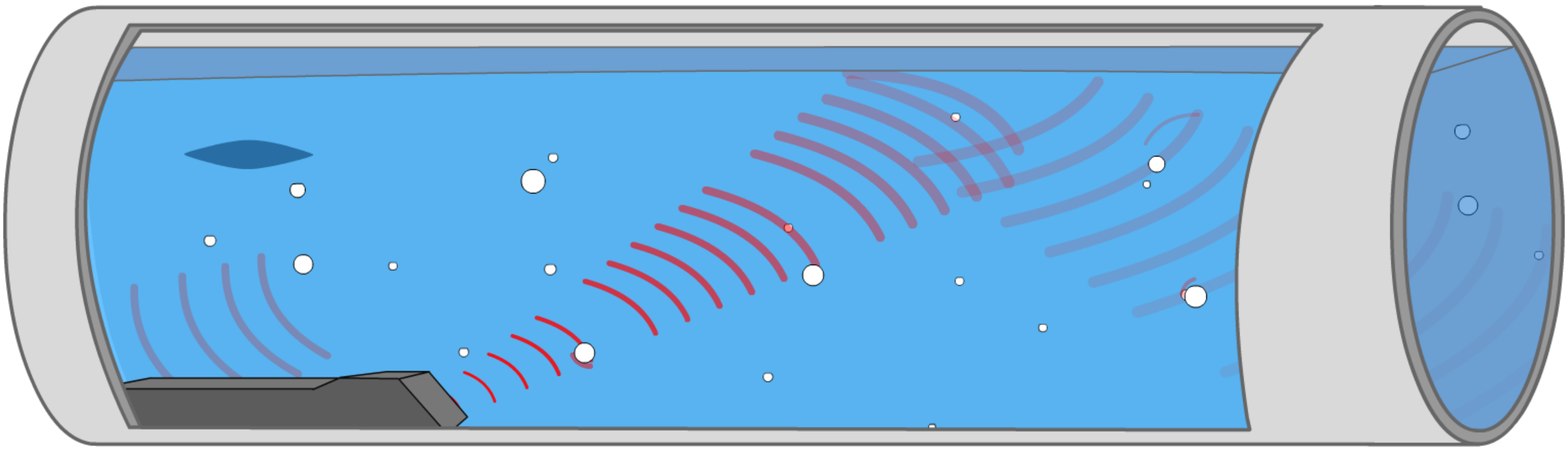
Flow Monitoring

- Greyline Instruments Stingray
  - Portable level-velocity data logger
  - Battery Powered and Compact
  - Ultrasonic Sensor
  - Mounting Band

- Instrument borrowed from WRP, grant paid for mounting band

Ultrasonic Sensor

- Sends an ultrasonic pulse and records the echo to determine depth and velocity



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Stingray Outfall Possibilities

- Red circle indicates outfall to Brook
- Expensive to put sensors in each outfall
- Walnut Avenue Outfall chosen as site to monitor

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Flow Monitoring

Storm Sewer on Sycamore Street

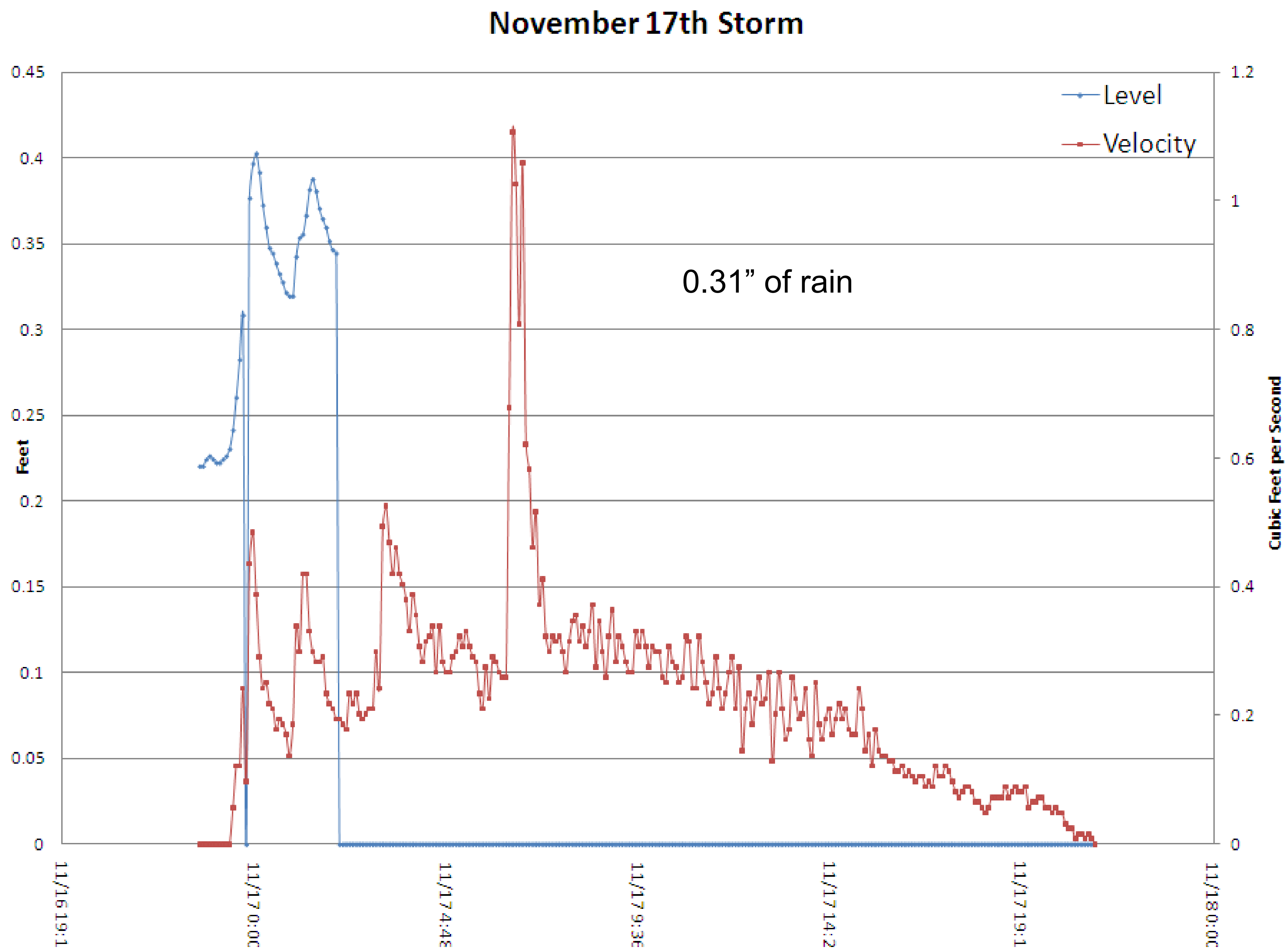
- Due to the excessive sediment build up at Walck Park outfalls, standing water was present from outfall to Sycamore Street

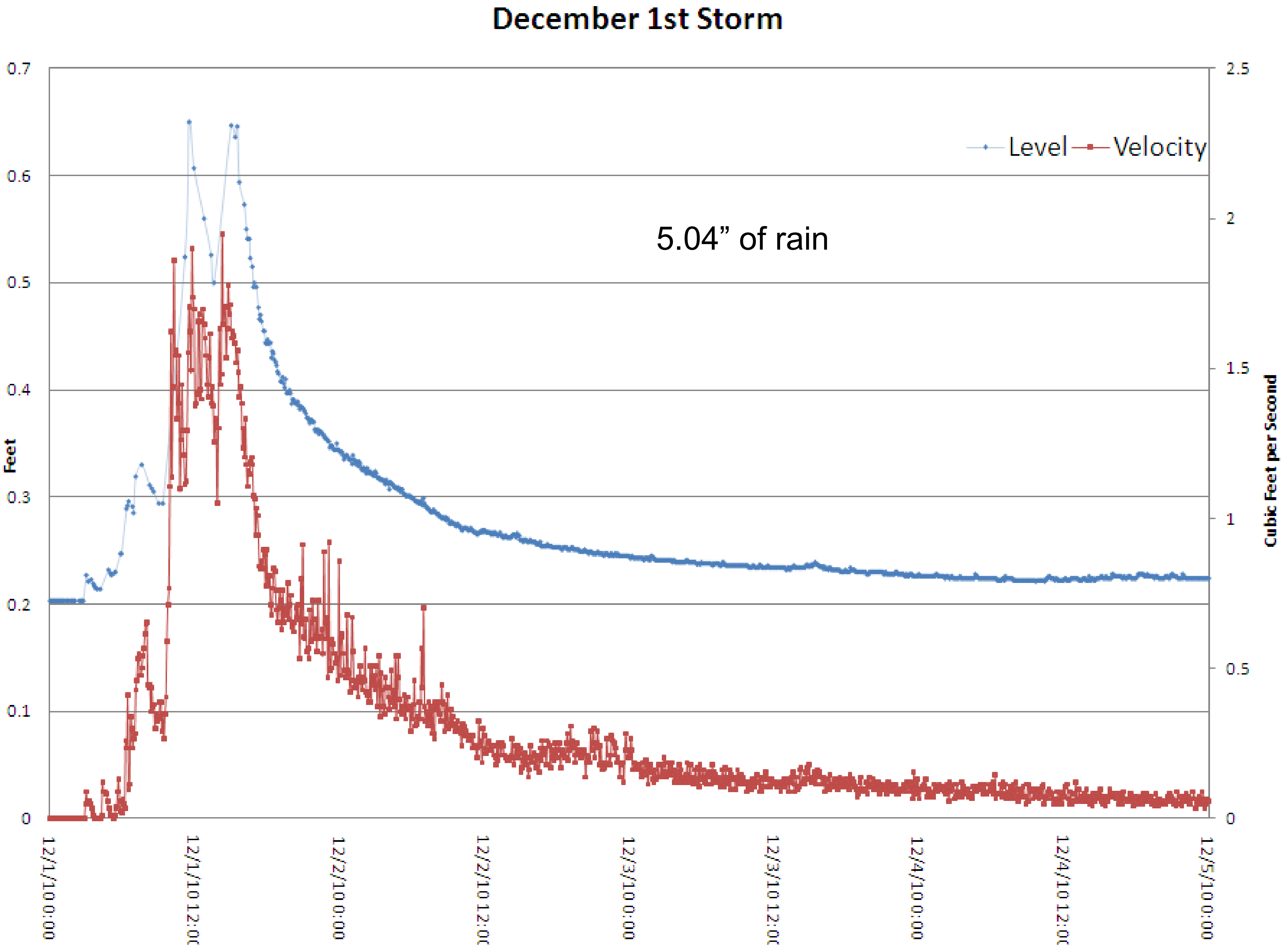
- Water deeper closest to Walck Park outfall

- Sycamore Street storm sewer had less than 2.5” of standing water

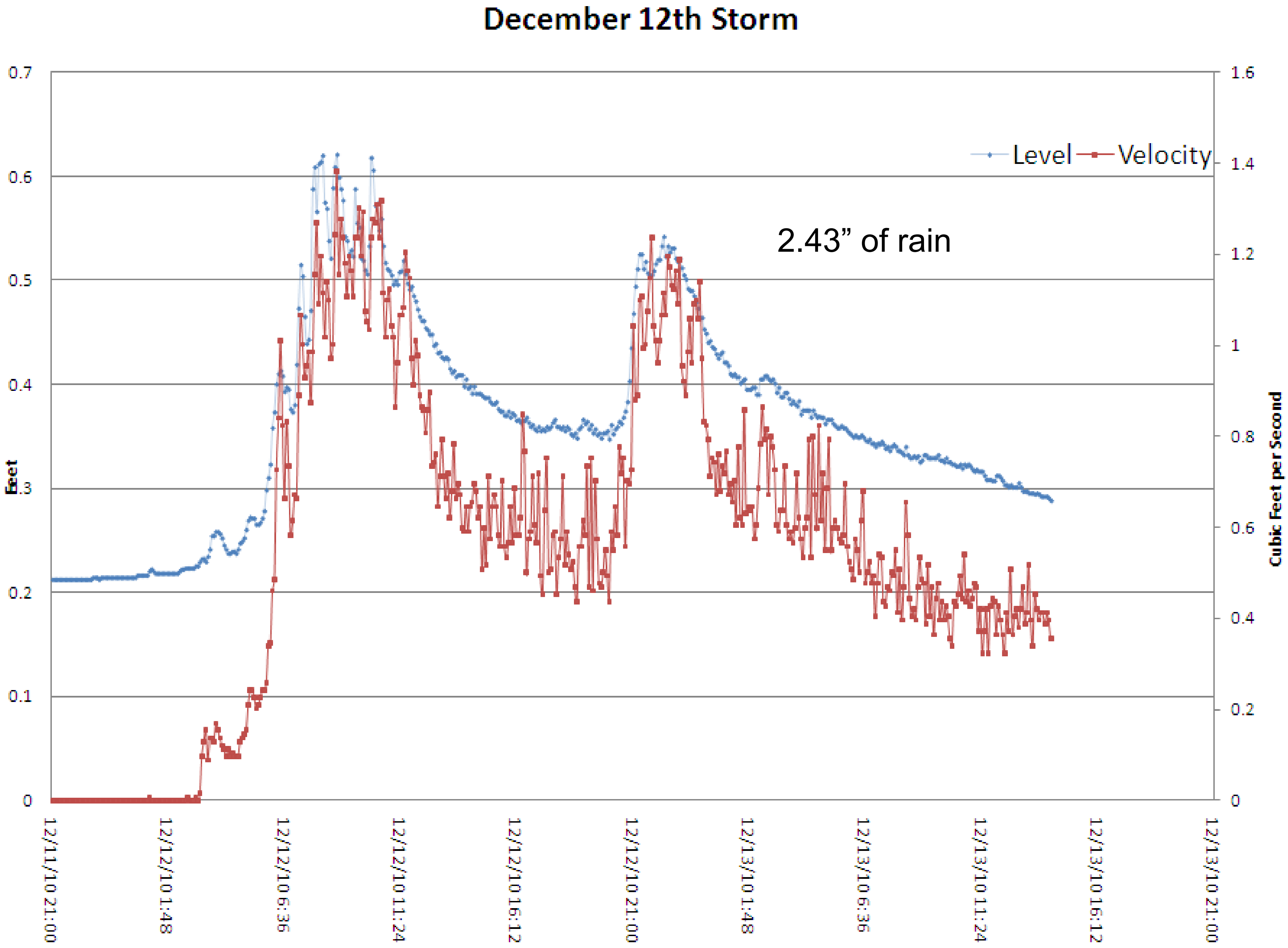
- Captures runoff from Demond and Sycamore Street

Neighborhood Connectivity


November 17th Storm
Level
Velocity
0.31" of rain
Feet
Cubic Feet per Second
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1.2
1
0.8
0.6
0.4
0.2
0
11/16 19:1
11/17 0:0C
11/17 4:48
11/17 9:36
11/17 14:2
11/17 19:1
11/18 0:0C



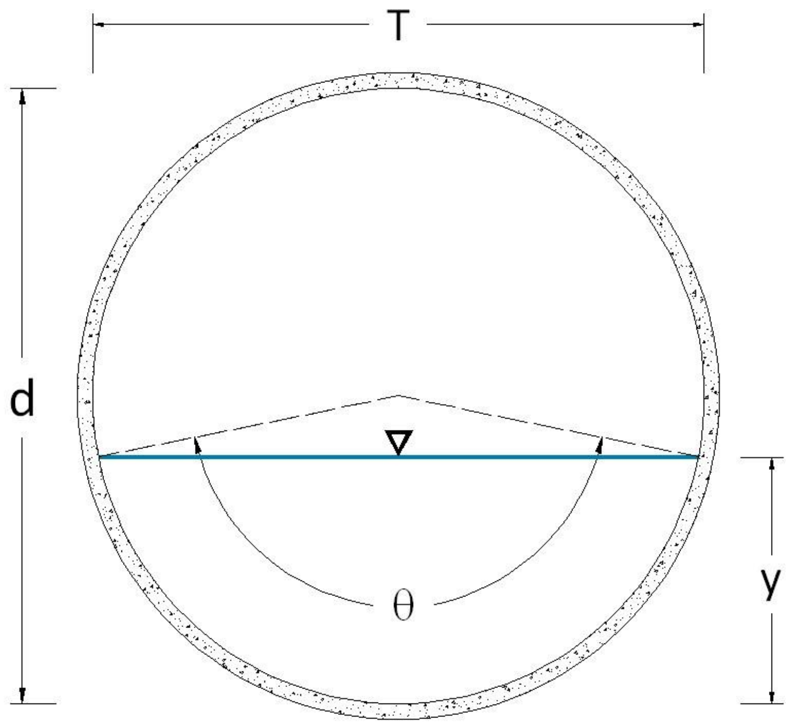
December 1st Storm
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Feet
2.5
2
1.5
1
0.5
0
Cubic Feet per Second
Level
Velocity
5.04” of rain
12/1/10 0:00
12/1/10 12:00
12/2/10 0:00
12/2/10 12:00
12/3/10 0:00
12/3/10 12:00
12/4/10 0:00
12/4/10 12:00
12/5/10 0:00


December 12th Storm
Level
Velocity
2.43” of rain
Feet
Cubic Feet per Second
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
12/11/10 21:00
12/12/10 1:48
12/12/10 6:36
12/12/10 11:24
12/12/10 16:12
12/12/10 21:00
12/13/10 1:48
12/13/10 6:36
12/13/10 11:24
12/13/10 16:12
12/13/10 21:00

Limitations

- Stingray collected measurable data for each storm
- Sensor constantly sits in 2.5″ of water, or 0.2′, measured and recorded for periods of dry weather
- Limited to non-turbulent water
- Turbulence causes zero data points, gaps in the hydrograph
- Data had to be filtered, any measurements below 0.2′ were removed

Volume Calculations



$$T = 2\sqrt{(y(d-y))}$$

$$\theta = 2\sin^{-1}\frac{T}{d}$$

$$A = \frac{d^2}{8}(\theta - \sin\theta)$$

Where:

T = *Top width of water surface (Feet)*

d = *Pipe diameter (Feet)*

y = *Water depth within pipe (Feet)*

θ = *Central Angle based on center point (Radians)*

Q = VA

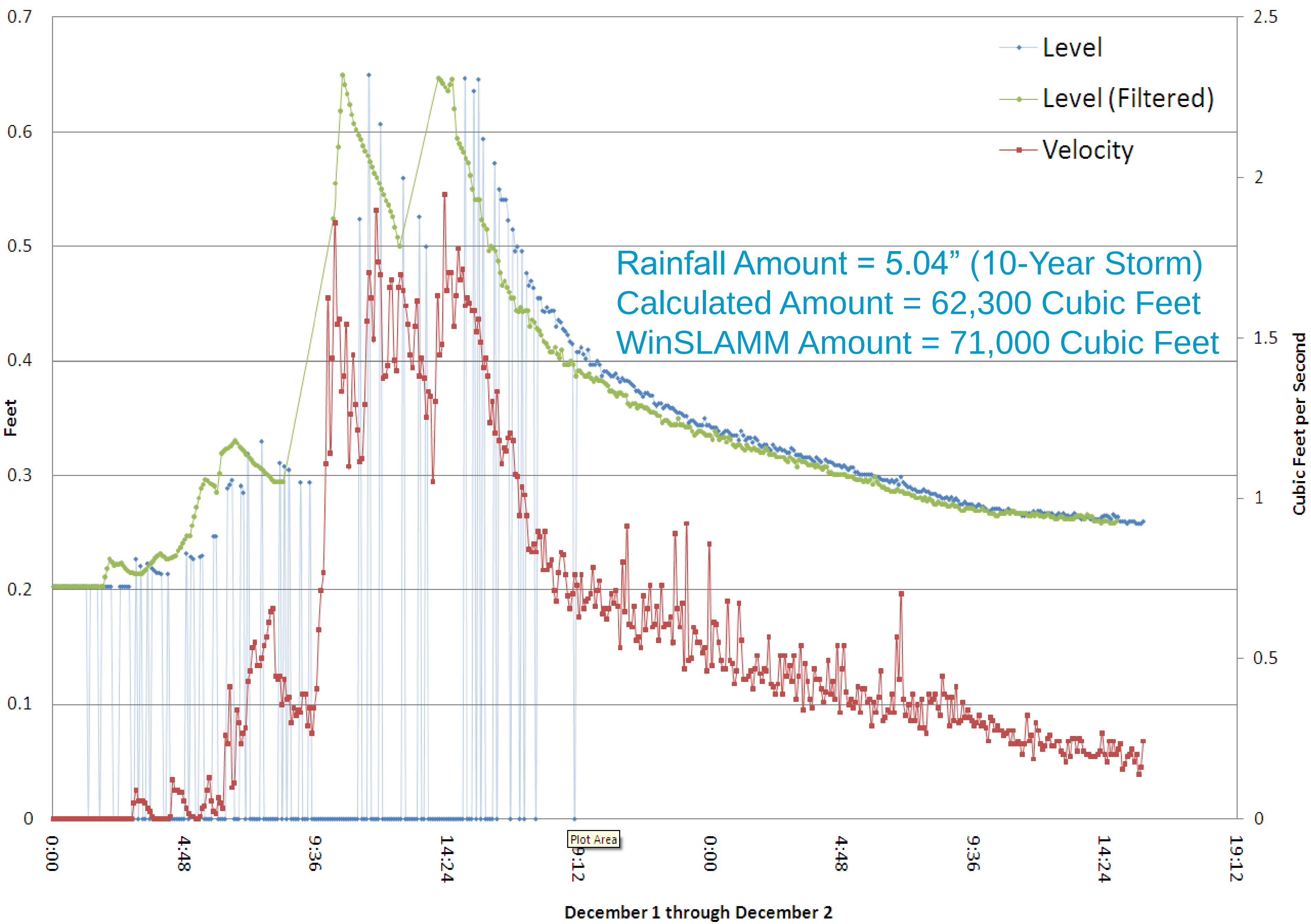
Where:

A = Area

V = Measured Velocity

To calculate total runoff volumes of each storm, a flow rate was calculated for each measurement and multiplied by the time of flow to calculate individual volumes.

December 1st Storm



Next Steps

- Collect data for a variety of storms to ensure accurate results
- Determine whether placement of sensor is affecting data collection
- Calibrate velocity data with depth data to fill in data gaps
- Try to calibrate or compare measured results to WinSLAMM results

WinSLAMM

- Windows Source Loading and Management Model
- Used to determine runoff from inputted land uses with the ability to implement Best Management Practices
- Modeled various scenarios of participation within the test neighborhoods based on certain assumptions about water use and rain barrel placement
- Models based on current conditions, participation, and gutter disconnection
- Runoff reduction was calculated

Test Neighborhoods

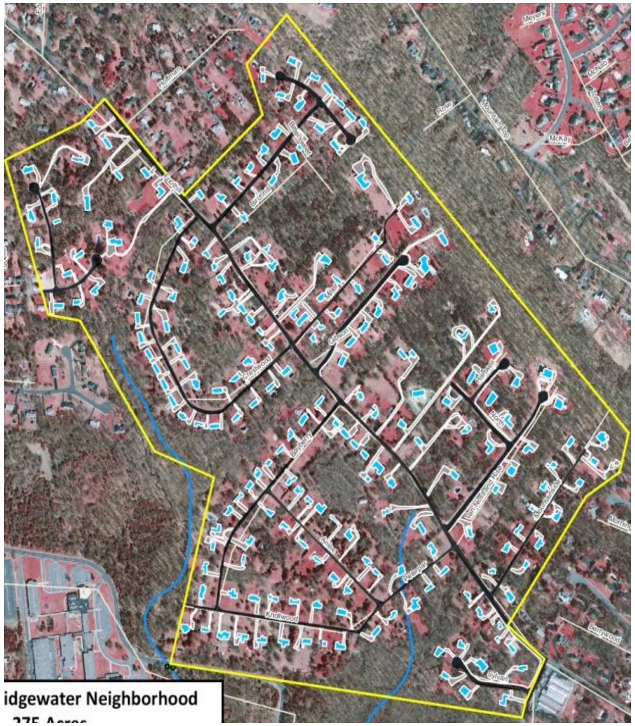
Bridgewater		
	Square Feet	Acres
Watershed	11,823,340.4	271.43
Roofs	512,644.68	11.77
Driveways	558,864,95	12.83
Streets	556,258.6	12.77
Sidewalks	22,068.9	0.51
Pervious	10,173,503.28	233.55
% Impervious		16

Houses and Average Roof Size

200
2500 ft^2

130
1000 ft^2

Somerville		
	Square Feet	Acres
Watershed	1,441,252.34	33.1
Roofs	126,157.52	2.89
Driveways	71,383	1.64
Streets	168,260	3.86
Sidewalks	42,268	0.97
Pervious	385,114.95	23.71
% Impervious		28



Roof Runoff Accounts for…

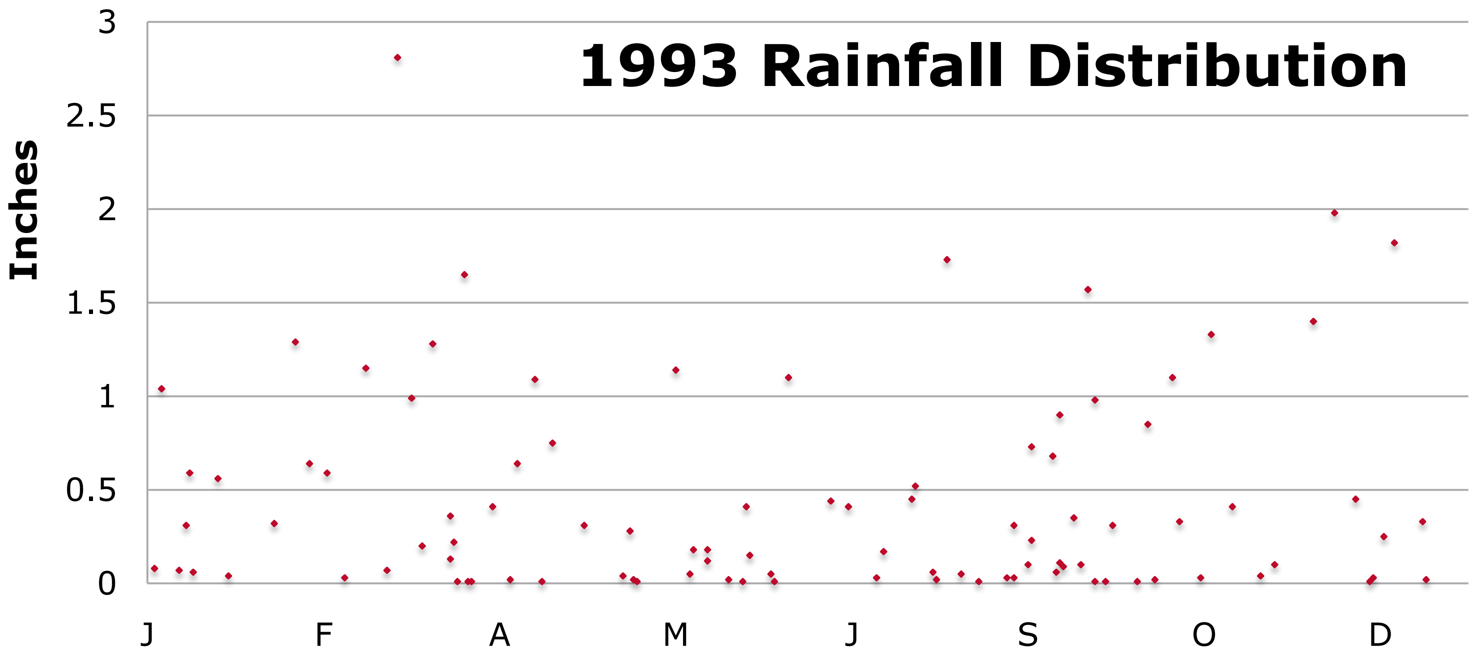
13% of Total Runoff

10% of Total Runoff

Scenarios

- Baseline conditions
  - Assumed all roofs were 25% connected, 75% disconnected drained to silty soil
- Participation based on survey results
  - Varying participation rates with participants using a rain barrel to disconnect a connected downspout 25% of the time
- Complete downspout disconnection
  - Varying participation rates for 100% downspout disconnection
- Downspout disconnection and rain barrels
  - Varying participation rates for 100% downspout disconnection with rain barrels

Rainfall Data



Average Storm = 0.43 Inches
85% of the storms less than 1.25 inches
Models ran data for April through October

Estimated Water Usage

Biofilter Cistern/Rain Barrel

Land Use: Residential
Source Area: Roofs 2
Biofiltration Device Number 1
Outlet Number 2

Month	Water Use Rate (gal/day)
January	0.00
February	0.00
March	0.00
April	6.67
May	3.23
June	3.33
July	5.00
August	3.23
September	10.00
October	6.45
November	0.00
December	0.00

Cancel | Continue | Delete

April

Time Start	Total Hours	Inches of Rain	Action
2:00	22	1.65	
17:00	1	0.01	
9:00	1	0.01	
23:00	19	0.41	Empty
20:00	2	0.02	
17:00	5	0.64	Empty
21:00	15	1.09	Empty
3:00	1	0.01	
12:00	8	0.75	Empty

Monthly Water Usage

200 gallons / 30 days 6.67 GPD

Results

Somerville – 130 total houses Scenario	Roof Runoff cu. Ft.	% Reduction
Baseline	75,300	-
10%	72,468	4
25%	68,254	9
50%	61,758	18
100%	39,807	**47**
100% Disconnection		
10%	70,360	7
25%	62,920	16
50%	50,558	33
100%	25,818	**66**
Disconnection and Barrels		
10%	68,787	9
25%	53,978	28
50%	43,114	43
100%	11,698	**84**

Bridgewater – 200 total houses Scenario	Roof Runoff cu. Ft.	% Reduction
Baseline	305,411	-
10%	294,780	3
25%	284,441	7
50%	266,923	13
100%	134,191	**56**
100% Disconnection		
10%	278,509	9
25%	248,420	19
50%	198,252	35
100%	104,798	**66**
Disconnection and Barrels		
10%	275,418	10
25%	243,187	20
50%	187,811	39
100%	84,059	**72**

Varied Results

- While results for each neighborhood are similar, some key characteristics vary the effectiveness

- Bridgewater has larger roofs and in turn more roof runoff but also larger lots, yet not large enough that soil saturation does not become a source of runoff

- Somerville has less roof runoff and a greater ability for high rain barrel participation to capture majority of runoff

Greatest Reductions

- Survey results determining planned usage was in favor of utilizing the barrel on a disconnected downspout (75%)
- Complete gutter disconnection is the least costly and yields the greatest results
- Installing a rain barrel at a location that is currently directly connected yields greatest reduction
- Encourage home owners first to disconnect any connected gutters and allow them to utilize the garden on any downspout`

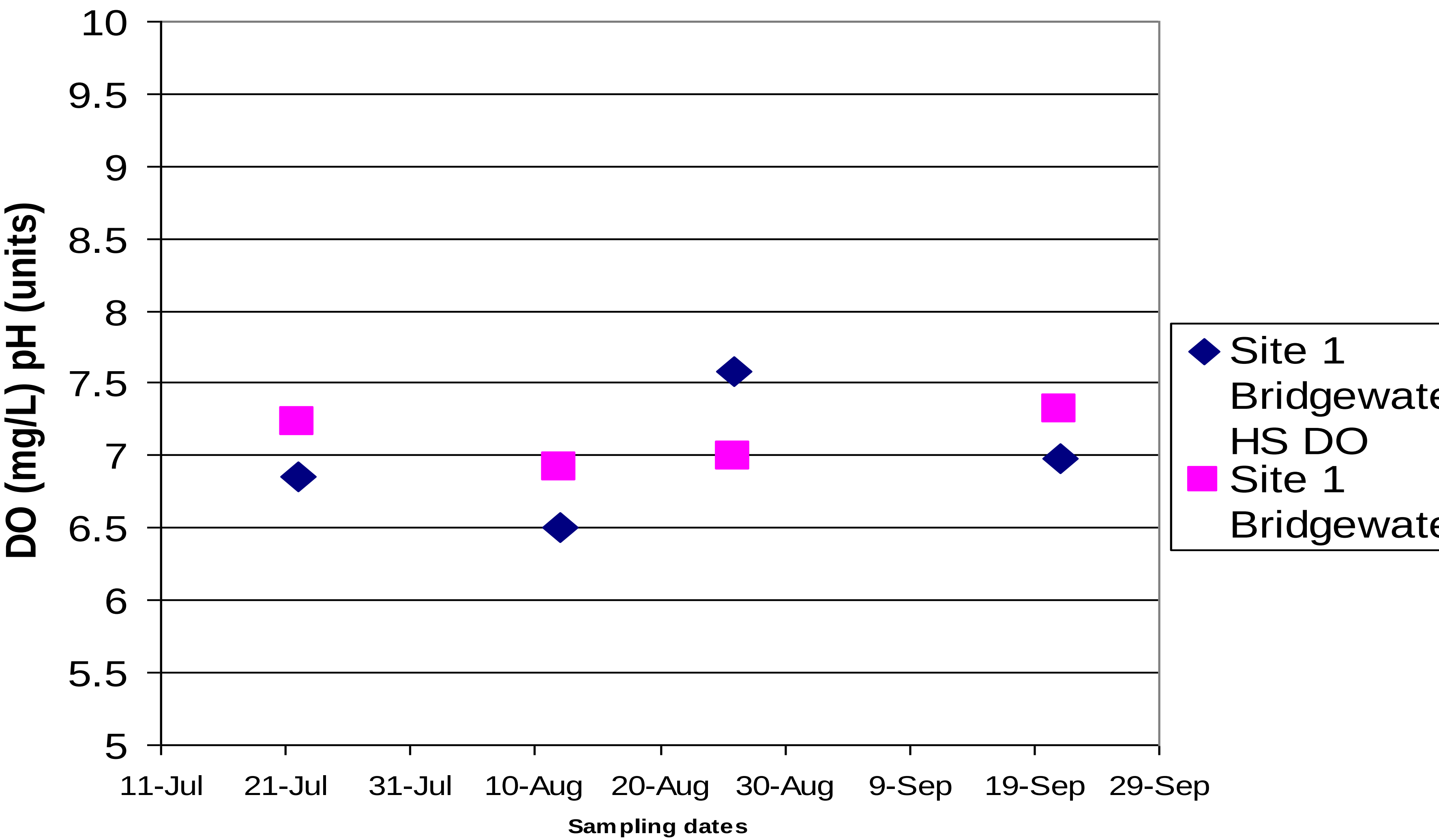
Next Steps

- Survey homeowners on rain barrel set up during the spring

- Determine how much water each homeowner uses from the rain barrel

- Make better assumptions based on above data

In-situ Bridgewater H.S..



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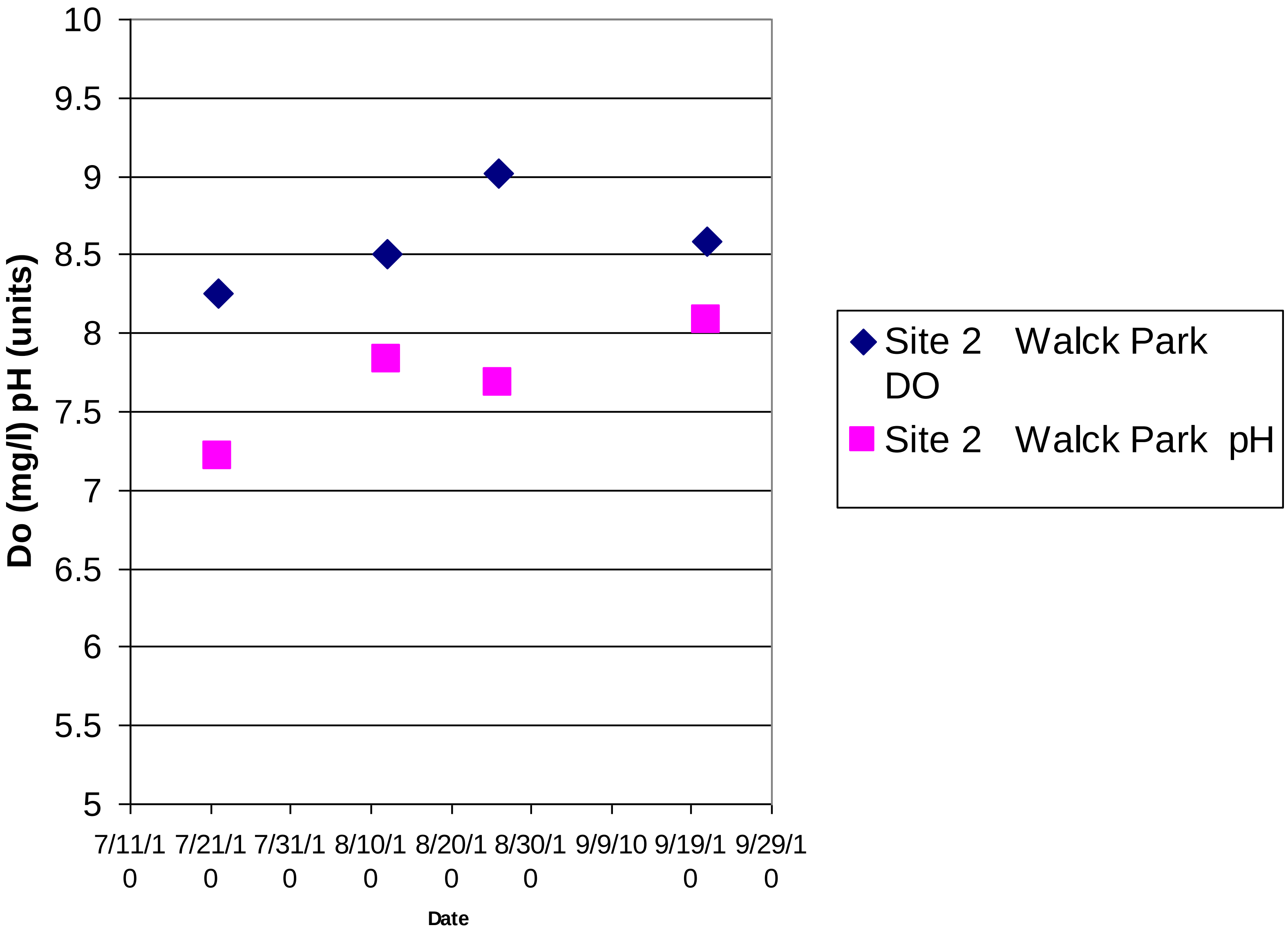
In-situ Walck Park



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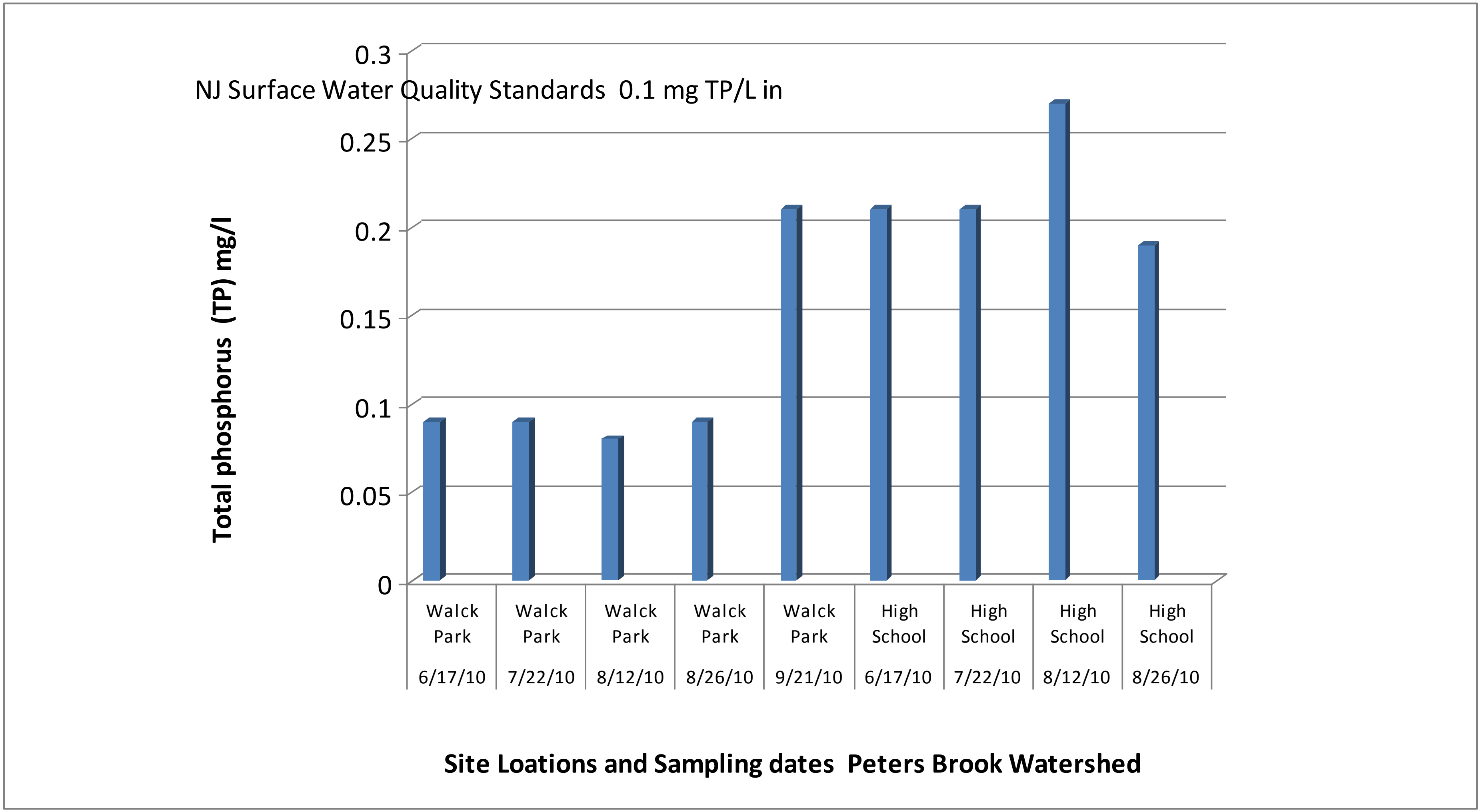
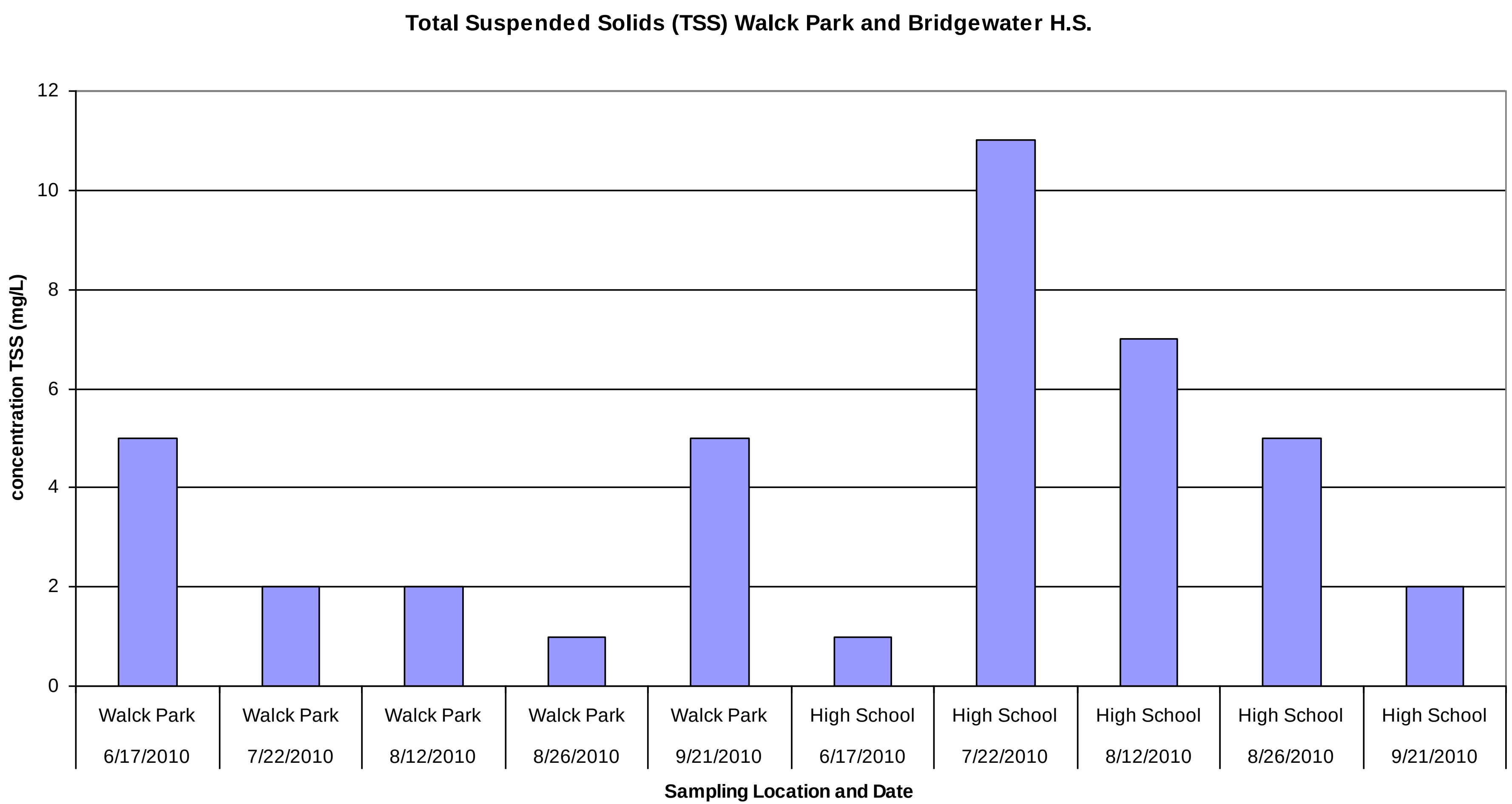
Total phosphorus (TP) Walck Park and Bridgewater H.S.



Total Suspended Solids (TSS) Walck Park and Bridgewater H.S.



Rutgers students taking flow measurements June 17, 2010

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Ross' Brook at Raritan (Bridgewater H.S.)

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Ross' Brook at Walck Park

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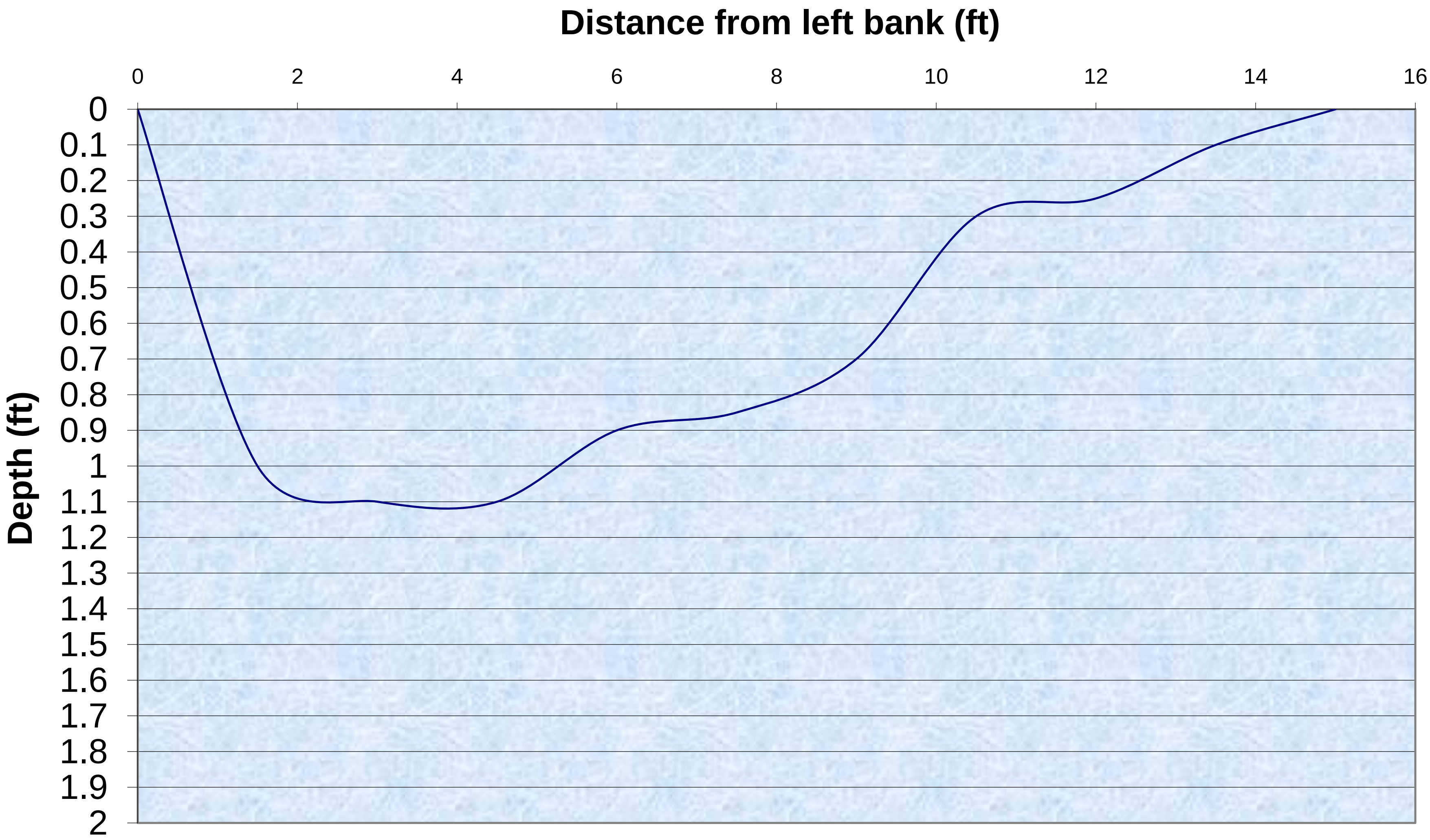
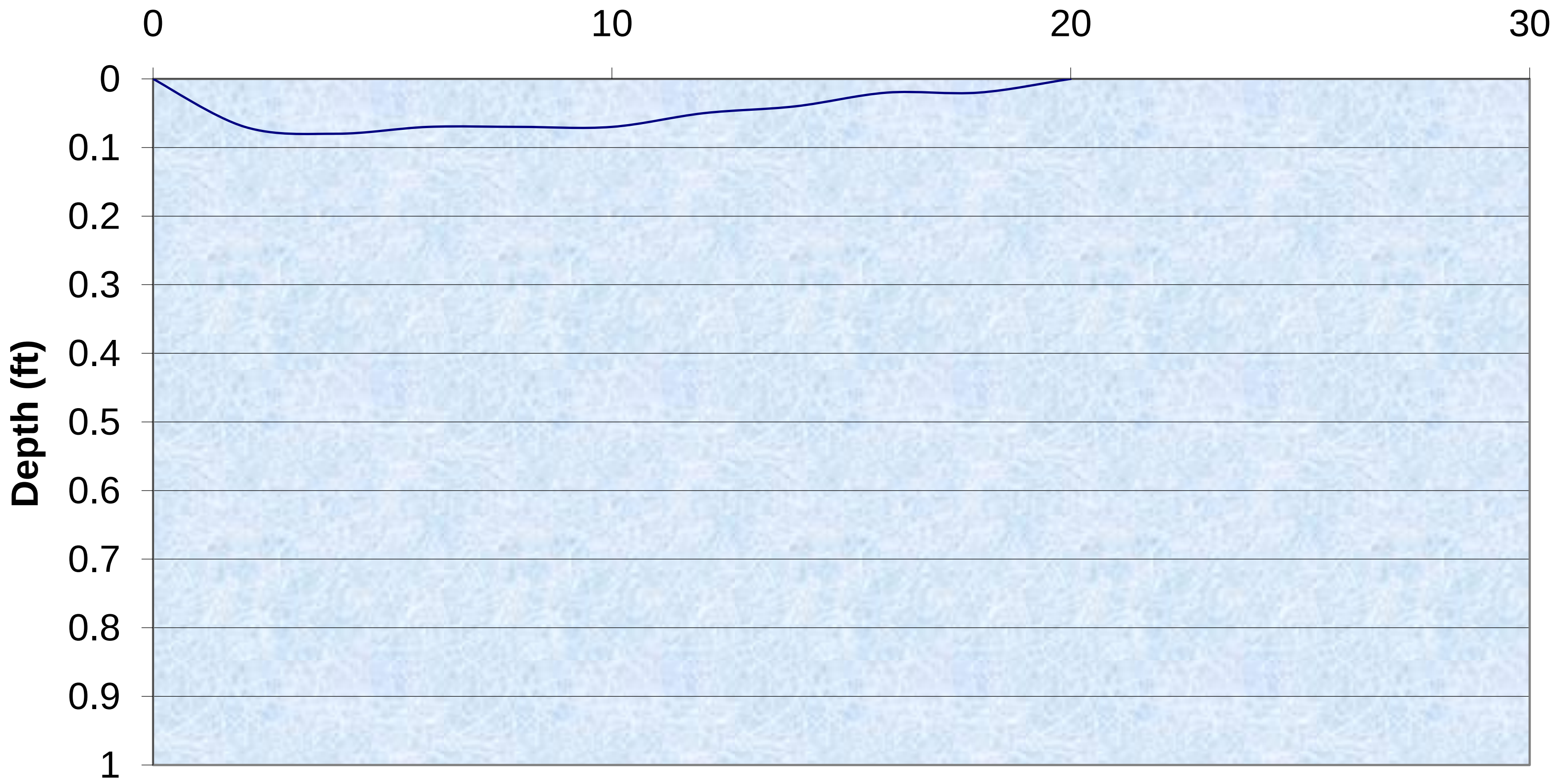
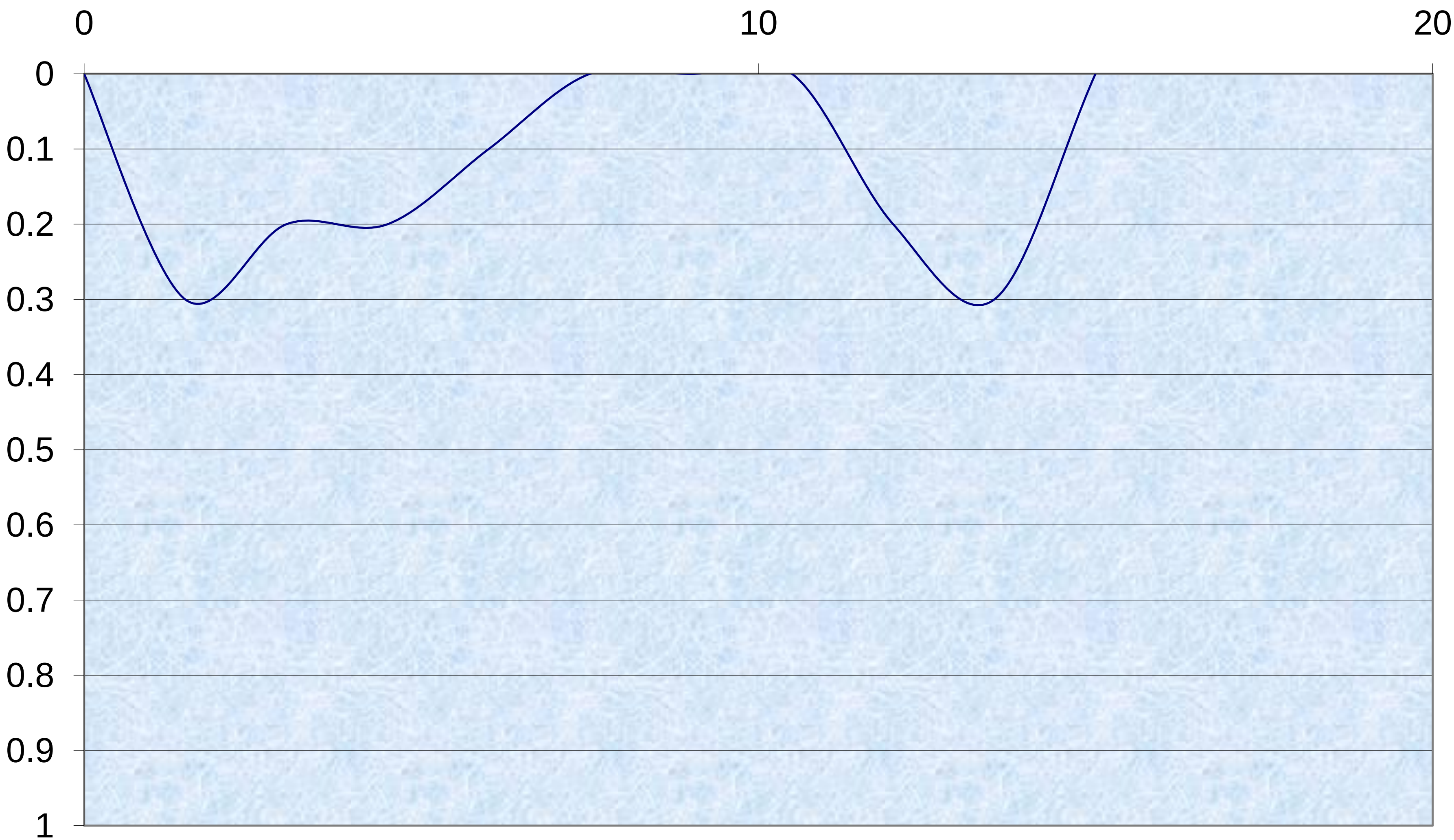
Stream bottom profile Site #1 (Bridgewater H.S.) Aug. 26, 2010



Stream bottom profile Site #1 (Bridgewater H.S.) Sept. 21, 2010



Bottom Profile Distance from Shroe versus Depth (ft) Site #2 (Walck Park
Sept. 21 2010



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Sampling Sheet provided courtesy Heather Barrett, Watershed Protection Specialist, New Jersey Water Supply Authority Sampling 2009

0376 H – Bridgewater Raritan HS

Rocky Bottom
Take three samples within a riffle area for best biodiversity. Record the percent of each substrate type present in riffles in the Macroinvertebrate Collection table below.

Muddy Bottom
Take a total of at least 20 scoops. The most scoops should be taken in the most represented habitat type present. Record the number of scoops from each habitat type and further description in the table below.

Habitat Type	# of Scoops	Description
Steep bank/vegetated margin		
Woody debris with organic matter		
Rock/gravel/sand substrate		
Silty bottom with organic matter		

Macroinvertebrate Collection
Separate the macroinvertebrates into the different categories listed bellow. Count the number of individuals present in each category and record those numbers in the cart. Count up the number of organism types there are in each sensitivity group and multiply by the indicated number to get an index value. Add all three index values tR rate yRur stream's water Tuality using the Water n uality Rating Chart.

Pollution Intolerant		Pollution Sensitive		Pollution Tolerant	
[3]	Mayfly	[100+]	Net Spinning Caddisfly	[17]	Black Fly
	Stonefly		Alderfly	[13]	Midge Fly
[6]	Caddisfly not net spinners	[1]	Damselfly		Lunged Snails
	Dobsonfly/Fish Fly		Dragonfly	[8]	Aquatic Worms
	Watersnipe Fly		Crane Fly	[11]	Leeches
[26]	Riffle Beetle		Sowbugs		
	Water Penny	[1]	Scud		
	Gilled Snails		Crayfish		
		[1]	Clams/Mussels		
[3] # of letters * 3 = [9]		[4] # of letters * 2= [8]		[4] # of letters * 1 = [4]	

Add the three calculated numbers together to find your total index value and rate your stream using the rating values below.

Total Index Value [21]

Water Quality Rating

___ Excellent (22>22) [✓] d ood (17-22) ___ Fair (11.16) ___ ᵐoor (<11)

Observations___________________________

PhRWs are aQways heGl uO- sGase aWch Wep wiW descrisWRGs.

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0376G – Walck Park

Rocky Bottom
Take three samples within a riffle area for best biodiversity. Record the percent of each substrate type present in riffles in the Macroinvertebrate Collection table below.

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Pollution Intolerant		Pollution Sensitive		Pollution Tolerant	
6	Mayfly	17	Net Spinning Caddisfly	2	Black Fly
	Stonefly		Alderfly	110	Midge Fly
2	Caddisfly not net spinners		Damselfly		Lunged Snails
	Dobsonfly/Fish Fly		Dragonfly	3	Aquatic Worms
4	Watersnipe Fly		Crane Fly		Leeches
5	Riffle Beetle		Sowbugs		
	Water Penny	1	Scud		
	Gilled Snails		Crayfish		
			Clams/Mussels		
4	# of letters * 3 = 12	2	# of letters * 2= 4	3	# of letters * 1 = 3

Add the three calculated numbers together to find your total index value and rate your stream using the rating values below.

Total Index Value 19

Water Quality Rating

___ Excellent (22>22) ✓ Good (17-22) ___ Fair (11.16) ___ Poor (<11)

Observations____________________

PhRWRs are aOways heOpfuO- pOease aWWach Whem wiWh descripWiRQs.

Sampling Sheet provided courtesy Heather Barrett, Watershed Protection Specialist, New Jersey Water Supply Authority Sampling 2009

Heather sampling August 4, 2010
Walck Park, Somerville, NJ

Habitat Types Present (check all that apply)

- ☐ Fine woody debris
- ☐ Submerged Logs
- ☐ Leaf Packs
- ☐ Cobble
- ☐ Boulders
- ☐ Coarse Gravel
- ☐ Vegetated Bank Margins
- ☐ Other

River Bottom Composition (must = 100)

- ____ % Sand
- ____ % Silt
- ____ % Organic
- ____ % Gravel
- ____ % Cobble
- ____ % Boulder
- ____ % Bedrock
- ____ % Other

Macroinvertebrate Collection

Separate the macroinvertebrates into the different groupings listed in the table below. Check the box to the left of each group present in your sample. Record the number of organisms present in each group on the line to the right (see example). Each column represents a different tolerance category (pollution intolerant, pollution sensitive, and pollution tolerant). Count the number of checks present in each column and record the total number of checks in the box below the column. Next, multiply the total number of checks in each column by the indicated value. Add the final numbers from each column to find the index value. Use this number to find the water quality rating of the site.

Pollution Intolerant		Pollution Sensitive		Pollution Tolerant	
Example: ☒ Mayfly	23	☐ Net Spinning Caddisfly	8	☐ Black Fly	
☐ Mayfly		☐ Alderfly		☐ Midge Fly	5
☐ Stonefly		☐ Damselfly		☐ Lunged Snails	
☐ Caddisfly not net spinners	7	☐ Dragonfly	1	☐ Aquatic Worms	3
☐ Dobsonfly/Fish Fly		☐ Crane Fly		☐ Leeches	53
☐ Watersnipe Fly	1	☐ Sowbugs			
☐ Riffle Beetle	4	☐ Scud	7		
☐ Water Penny		☐ Crayfish			
☐ Gilled Snails		☐ Clams/Mussels			
3 # of checks * 3 =	9	3 # of checks * 2=	6	3 # of checks * 1 =	3

Add the three calculated numbers together to find your total index value and rate your stream using the rating values below.

Total Index Value____

Water Quality Rating

____ Excellent (>22) 18 Good (17-22) ____ Fair (11.16) ____ Poor (<11)

Observations____

Photos are always helpful – please attach them with descriptions.

Power to discern a difference based on installation of small BMPs?

03716 H – Bridgewater Raritan HS

Rocky Bottom
Take three samples within a riffle area for best biodiversity. Record the percent of each substrate type present in riffles in the Macroinvertebrate Collection table below.

Muddy Bottom
Take a total of at least 20 scoops. The most scoops should be taken in the most represented habitat type present. Record the number of scoops from each habitat type and further description in the table below.

Habitat Type	# of Scoops	Description
Steep bank/vegetated margin		
Woody debris with organic matter		
Rock/gravel/sand substrate		
Silty bottom with organic matter		

Macroinvertebrate Collection
Separate the macroinvertebrates into the different categories listed below. Count the number of individuals present in each category and record those numbers in the cart. Count up the number of organism types there are in each sensitivity group and multiply by the indicated number to get an index value. Add all three index values to rate your stream's water quality using the Water Quality Rating Chart.

Pollution Intolerant		Pollution Sensitive		Pollution Tolerant	
3	Mayfly	100+	Net Spinning Caddisfly	17	Black Fly
	Stonefly		Alderfly	13	Midge Fly
6	Caddisfly not net spinners	1	Damselfly		Lunged Snails
	Dobsonfly/Fish Fly		Dragonfly	5	Aquatic Worms
	Watersnipe Fly		Crane Fly	11	Leeches
26	Riffle Beetle		Sowbugs		
	Water Penny	1	Scud		
	Gilled Snails		Crayfish		
		1	Clams/Mussels		
3 # of letters * 3 = 9		4 # of letters * 2 = 8		4 # of letters * 1 = 4	

Add the three calculated numbers together to find your total index value and rate your stream using the rating values below.
Total Index Value 21

Water Quality Rating
___ Excellent (22>22) ✓ Good (17-22) ___ Fair (11.16) ___ Poor (<11)

Observations___

Photos are always helpful. Please attach them with descriptions.

03716G – Walck Park

Rocky Bottom
Take three samples within a riffle area for best biodiversity. Record the percent of each substrate type present in riffles in the Macroinvertebrate Collection table below.

Muddy Bottom
Take a total of at least 20 scoops. The most scoops should be taken in the most represented habitat type present. Record the number of scoops from each habitat type and further description in the table below.

Habitat Type	# of Scoops	Description
Steep bank/vegetated margin		
Woody debris with organic matter		
Rock/gravel/sand substrate		
Silty bottom with organic matter		

Macroinvertebrate Collection
Separate the macroinvertebrates into the different categories listed below. Count the number of individuals present in each category and record those numbers in the cart. Count up the number of organism types there are in each sensitivity group and multiply by the indicated number to get an index value. Add all three index values to rate your stream's water quality using the Water Quality Rating Chart.

Pollution Intolerant		Pollution Sensitive		Pollution Tolerant	
6	Mayfly	17	Net Spinning Caddisfly	2	Black Fly
	Stonefly		Alderfly	10	Midge Fly
2	Caddisfly not net spinners		Damselfly		Lunged Snails
	Dobsonfly/Fish Fly		Dragonfly	3	Aquatic Worms
4	Watersnipe Fly		Crane Fly		Leeches
5	Riffle Beetle		Sowbugs		
	Water Penny	1	Scud		
	Gilled Snails		Crayfish		
			Clams/Mussels		
4 # of letters * 3 = 12		2 # of letters * 2 = 4		3 # of letters * 1 = 3	

Add the three calculated numbers together to find your total index value and rate your stream using the rating values below.
Total Index Value 19

Water Quality Rating
___ Excellent (22>22) ✓ Good (17-22) ___ Fair (11.16) ___ Poor (<11)

Observations___

Photos are always helpful. Please attach them with descriptions.

Habitat Types Present (check all that apply)		River Bottom Composition (must = 100)	
☐ Fine woody debris	☐ Submerged Logs	___ % Sand	___ % Silt
☐ Leaf Packs	☐ Cobble	___ % Organic	___ % Gravel
☐ Boulders	☐ Coarse Gravel	___ % Cobble	___ % Boulder
☐ Vegetated Bank Margins	☐ Other	___ % Bedrock	___ % Other

Macroinvertebrate Collection
Separate the macroinvertebrates into the different groupings listed in the table below. Check the box to the left of each group present in your sample. Record the number of organisms present in each group on the line to the right (see example). Each column represents a different tolerance category (pollution intolerant, pollution sensitive, and pollution tolerant). Count the number of checks present in each column and record the total number of checks in the box below the column. Next, multiply the total number of checks in each column by the indicated value. Add the final numbers from each column to find the index value. Use this number to find the water quality rating of the site.

Pollution Intolerant		Pollution Sensitive		Pollution Tolerant	
Example: ☒ Mayfly	23	☐ Net Spinning Caddisfly	8	☐ Black Fly	
☐ Mayfly		☐ Alderfly		☐ Midge Fly	5
☐ Stonefly		☐ Damselfly		☐ Lunged Snails	
☐ Caddisfly not net spinners	7	☐ Dragonfly	1	☐ Aquatic Worms	3
☐ Dobsonfly/Fish Fly		☐ Crane Fly		☐ Leeches	53
☐ Watersnipe Fly	1	☐ Sowbugs			
☐ Riffle Beetle	14	☐ Scud	7		
☐ Water Penny		☐ Crayfish			
☐ Gilled Snails		☐ Clams/Mussels			
3 # of checks * 3 = 9		3 # of checks * 2 = 6		3 # of checks * 1 = 3	

Add the three calculated numbers together to find your total index value and rate your stream using the rating values below.
Total Index Value ___

Water Quality Rating
___ Excellent (>22) 18 Good (17-22) ___ Fair (11.16) ___ Poor (<11)

Observations___

Photos are always helpful. Please attach them with descriptions.

I am not convinced that it will.

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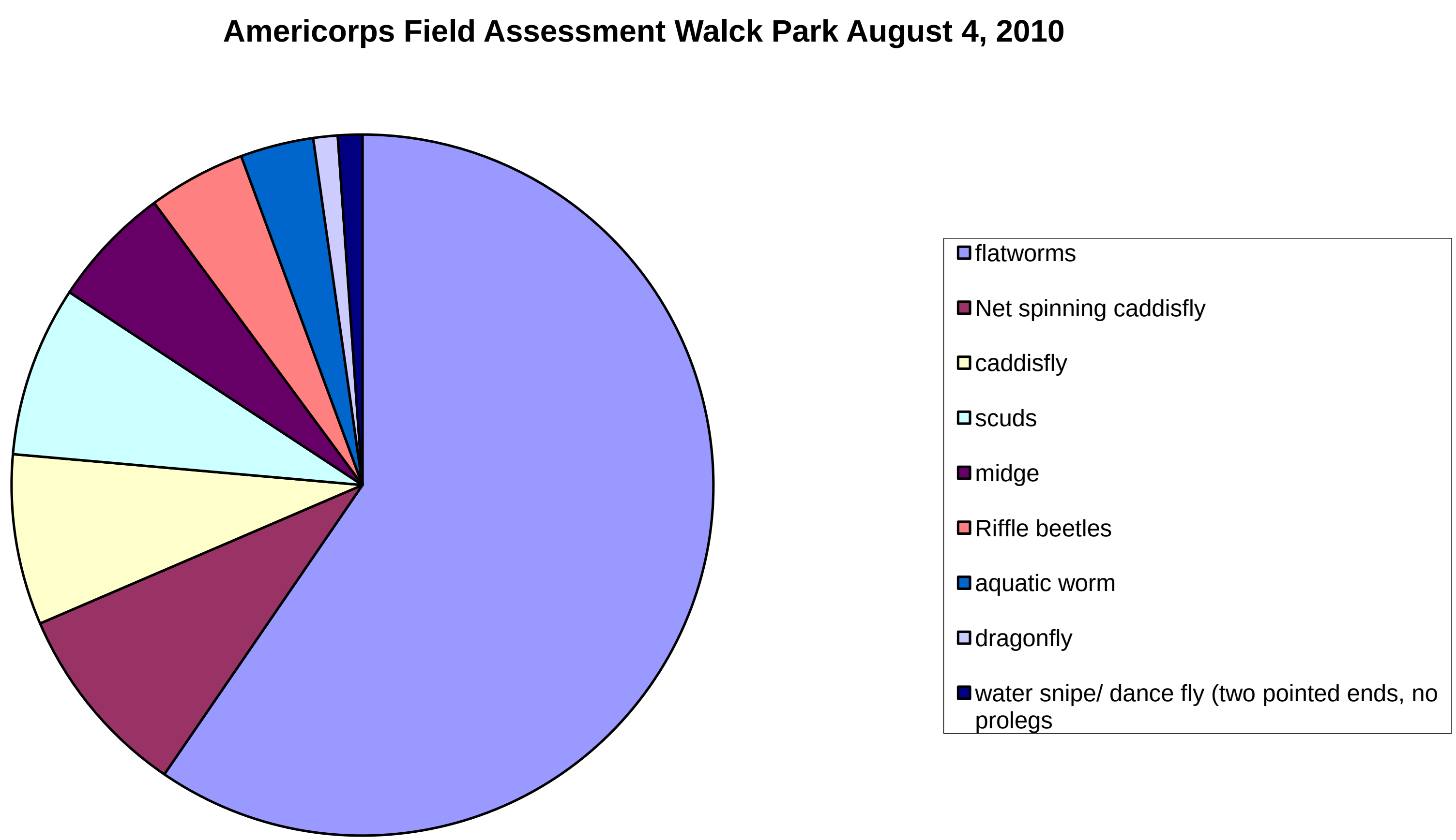
For example; looking at what was collected from a different angle



0376E – Facing upstream towards Mercer St.

0376E – Deposition under Mercer St. bridge

0376E (5-9/Fair) is located between the Davenport Street and Mercer Street bridges. This segment received the lowest total habitat assessment score range and the lowest average habitat assessment score of these 10 assessment sites in the Peters Brook.

The segment is considered within the Peters Brook Greenway (upstream-facing left bank is open space); however, the gravel path diverges away from this stream in this section. The right bank land use is single-family residential.

Six storm drain outfalls empty into this 500 foot stream segment. Large depositional bars have formed in this segment (see photo). The trees provide 65% canopy cover over the stream.

This segment received poor scores for riparian vegetation (<20 foot width), moderately unstable banks, extensive channelization (large segment of gabions on the left bank near the Davenport St. bridge), and greater than 50% covered by sediment on the stream bottom. This segment had dense algae coverage even in the winter.

A macroinvertebrate sample was collected in June 2009, and this segment received a score of 19 (good); however, the sample was dominated by black fly and midge fly larvae (pollution tolerant). Few individuals were observed from the pollution intolerant category; however, this resulted in a significant increase in the score.

Table III. Significant partial correlations (Spearman's *rho*) between the primary NMDS axis scores and reduced set of macroinvertebrate indices and chemical concentrations.

Metric abbreviation	Metric description	*rho*	*p*-Value
Macroinvertebrate metrics and indices ($n = 67$)			
NONINSRp	Percent of total richness as non-insect taxa	0·80	<0·0001
RichTOL	Average USEPA tolerance values based on richness	0·78	<0·0001
EPTR	EPT taxa richness	−0·72	<0·0001
ODIPNIRp	Percent richness as non-chironomid dipterans and non-insects	0·71	<0·0001
AbundTOL	Abundance-weighted USEPA tolerance value	0·70	<0·0001
NONINSR	Non-insect taxa richness	0·67	<0·0001
Dom5	Percent dominance top five taxa	0·66	<0·0001
ShanDiv	Shannon diversity	−0·65	<0·0001
RICH	Total taxa richness	−0·63	<0·0001
EPTRp	Percent richness as EPT taxa	−0·62	<0·0001
Dom3	Percent dominance of top three taxa	0·61	<0·0001
TRICHR	Trichoptera taxa richness	−0·51	<0·0001
pSC_Rich	Percent richness composed of shredder taxa	−0·41	0·0005
Chemical characteristics (units)			
DOC ($n = 33$)	Organic carbon, water, filtered (mg l^{-1})	0·67	<0·0001
NH4OD ($n = 45$)	Ammonia plus organic nitrogen, water, filtered (mg l^{-1} as nitrogen)	0·66	<0·0001
NH4OT ($n = 45$)	Ammonia plus organic nitrogen, water, unfiltered (mg l^{-1} as nitrogen)	0·63	<0·0001
Cl ($n = 42$)	Chloride, water, filtered (mg l^{-1})	0·52	0·0005
Sc ($n = 57$)	Specific conductance (uS cm^{-1})	0·43	0·0007
Ntot ($n = 45$)	Total nitrogen (mg l^{-1}; calculated as sum of NH4OT and NO_2NO_3)	0·42	0·0042
Ptot ($n = 45$)	Phosphorus, water, unfiltered (mg l^{-1})	0·37	0·0111

Macroinvertebrate and chemical metrics are listed in order of decreasing |*rho*|; USEPA, United States Environmental Protection Agency; EPT, Ephemeroptera, Plecoptera and Trichoptera.

Total Abundance

Average total abundance sites AMNET through I					148.4				
Site #0376 AMNET	Site #0376A	Site #0376 B	Site #0376 C	Site #0376D	Site #0376E	Site #0376 F	Site #0376G	Site #0376H	Site #0376I
191	12	41	311	301	98	169	56	187	118

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Family Biotic Index

organisms (i.e., those you think represent a single species or taxon). Use the general key in Chapter 20 to identify an individual from each group to the family level. Record the information on the data sheet provided (Table 35.2). Good general keys for more detailed identifications are available for all benthic macroinvertebrate groups (e.g., Pennak 1989, Thorp and Covich 1991, Smith 2001, Voshell 2003), specific groups such as the insects (e.g., Lehmkuhl 1979, Merritt and Cummins 1996), macroinvertebrates of specific regions (e.g., Clifford 1991), and insects of specific regions (e.g., Usinger 1956, Peckarsky *et al.* 1990). In addition, a video that demonstrates how to use a dichotomous identification key for benthic macroinvertebrates is available (Merritt 2002).

Macroinvertebrate Laboratory-Only Option

If a demonstration (e.g., to a class or volunteer monitoring group) is required because weather conditions or the size of the group do not allow a field visit, the following

TABLE 35.2 Form to Record Macroinvertebrate Data.

DATE: ______
NAME: ______
SITE: ______

	A Order/Family	B # of Organisms		C Tolerance Score		D Total
1.			×		=	
2.			×		=	
3.			×		=	
4.			×		=	
5.			×		=	
6.			×		=	
7.			×		=	
8.			×		=	
9.			×		=	
10.			×		=	
11.			×		=	
12.			×		=	
13.			×		=	
14.			×		=	
15.			×		=	
16.			×		=	
17.			×		=	
18.			×		=	
19.			×		=	
20.			×		=	

Family Biotic Index = Total of Column D divided by Total of Column B = ______

% EPT = Total Ephemeroptera, Trichoptera, and Plecoptera divided by total of Column B = ______

Taxa Richness = Total Number of Taxa = ______

TABLE 35.3 Water Quality Based on Family Biotic Index Values from Hilsenhoff (1988).

Family Biotic Index	Water Quality
0.00–3.75	Excellent
3.76–4.25	Very good
4.26–5.00	Good
5.01–5.75	Fair
5.76–6.50	Fairly poor
6.51–7.25	Poor
7.26–10.00	Very poor

TABLE 35.4 Sample Data Set for *t*-Test.

Group	Reference Site	Test Site
A	3.4	4.5
B	3.2	5.2
C	3.9	6.1
D	5.6	7.9
E	3.1	5.2
F	5.3	5.7
G	4.3	6.5
H	4.3	5.4
I	5.1	6.3
J	3.2	4.7

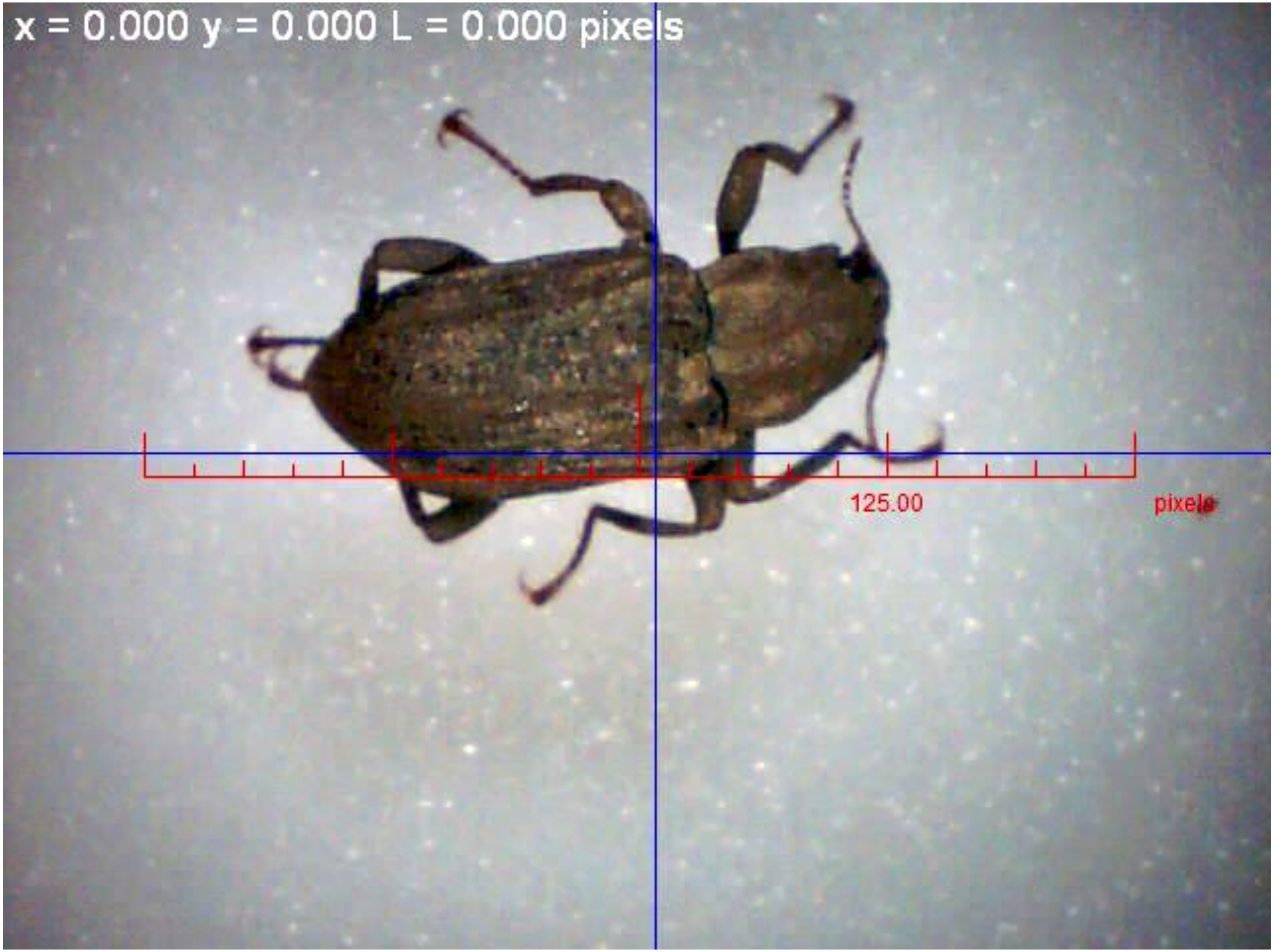
Summary statistics:

Reference site:
$n_1 = 10$ $\bar{x}_1 = 4.1$ $S_1^2 = 0.89$
$\sum x_1 = 41.4$ $\sum (x^2)_1 = 179.3$

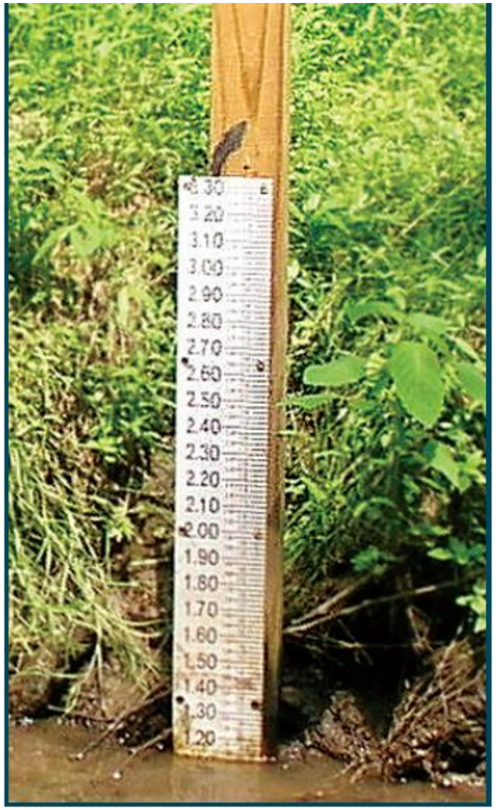
Test site:
$n_2 = 10$ $\bar{x}_2 = 5.8$ $S_2^2 = 1.00$
$\sum x_2 = 57.5$ $\sum (x^2)_2 = 339.6$

Hydropsychidae (Common net-spinning caddisfly)

Elmidae (Riffle Beetle)



Add Stage measurements to surveys



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Flow meters

- Potentially more costly than is warranted:
  - Equipment: meter approximately $6,000 (does include software)
  - Band approximately $400/band sized to the pipe
  - Need meter and band for "neighborhood" and also a "control neighborhood"
  - Specialized training for installation (Enclosed space training) engineers, and other specialized staff
- Physical
  - Some situations may not lend themselves to installation (sediment in outfall; manhole with continuous water)
  - Need for sufficient barrels to make measureable difference within the system
- Technical
  - Data may need to be adjusted based on accounting for turbulence and removal of measurements below 0.2" (in this case)
  - There may be other issues such as insufficient flow to obtain a reading, meter not working correctly etc.

Need to better study longer term with more barrels and control neighborhood to determine if this will be of value.

WinSLAMM

- Provides a more site specific model than STEP-L yet like STEP-L does not require an enormous amount of data.
- The data that is required is available through field visits and GIS, both of which are frequently available to users.
- WinSLAMM is able to be modified to provide various scenarios at the users discretion. Therefore it can be input with the actual data, and then include scenarios for 10% or 100% to provide specific information. It is on a site specific basis, yet can include the watershed level.

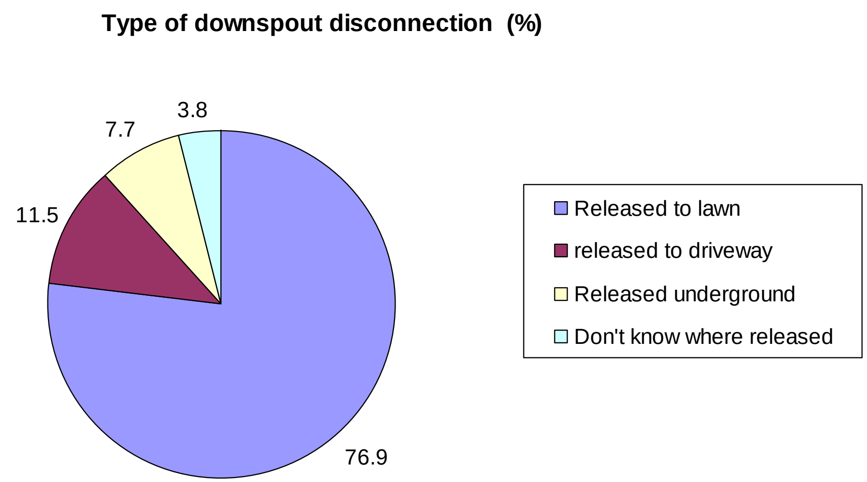
WinSLAMM

- COST:
- Initial Cost is approximately for the software for the program is $300
- It is possible to receive further training as opportunities are usually available. These run approximately $195
- Cost for staff to run model: Once the model is set up it is simply a matter to update or change scenarios. Time to set up the model is approximately 8-16 manhours for one neighborhood for the GIS component plus the field visit.

Although there is some initial costs many of these costs are one time only.

Why are follow up surveys important?

Figure 7. Backyard Stream: Rock Banks, Grass to Stream Edge, Straightened Channel, and Symmetrical Plantings Installed by Streamside Neighbors in the Name of "Stream Enhancement."



Conclusions

- Measuring flow may be an option with very defined system, comparative control system and means to assure very high participation rates.
- WinSLAMM can provide very specific estimates to guide planning and provide reasonable estimates as to the reduction in volume achieved through the use of rain barrels.
- Biological monitoring as conducted utilizing the Americorps Ambassador protocol is most likely not capable of discerning improvements from the installation of rain barrels on a neighborhood basis.

Conclusions

- Without an extraordinary cost or effort it may be possible for NJWSA to increase their biological capabilities and thus increase their ability to discern changes in the aquatic community. Whether these abilities would be of sufficient refinement to detect implementation of small BMPs (assuming a greater number than presently installed) is uncertain, but certainly possible.
- A continuing biological survey of Peters Brook/Ross' Brook will provide information for NJWSA in any case. A scheduled time (early summer perhaps) with steady sites would work best.

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Conclusions

- The Neighborhood Rain Barrel workshops were a success on many levels. The key will be to continue to build on the success in a manner that best utilizes all resources and aspects.
- NJWSA should continue with their effort to develop a pilot "Rain Barrel Rebate Program" in the Peters Brook Watershed. This will allow them to address the issue of disconnection (rebate upon installation and disconnection of impervious surface could be a requirement) while best utilizing staff resources. It is suggested that documentation be maintained and compared.
- Rutgers Cooperative Extension should continue to work with the municipalities to bring them the Rain Barrel workshop program as a package that the Environmental Commissions can take and run with. This will tap into that aspect of the program where enthusiasm was so high and the program was able to reach an audience hitherto untapped, while lessening the staff resources needed. The packaged program can be used by each Environmental Commission on their respective community days or the three towns could join together to have a Rain Barrel Day.
- As shown by the Rain Garden survey question beyond the Rain Barrel is the further disconnection and education that can be obtained. Also as discussed it is important to keep the momentum continuing. Dropping a good program may lead to a loss of credibility, as has occurred in watershed management areas previously. Better to continue with a small program and keep it going.

Thank you

- Ken Klipstein, New Jersey Water Supply Authority
- Robert O'Neil, New Jersey Water Supply Authority
- Heather Barrett, New Jersey Water Supply Authority
- Rick Anthes, New Jersey Water Supply Authority
- Kathy Hale, New Jersey Water Supply Authority
- A j Bozenmayer 2009/10 AmeriCorps Ambassador
- Lisa Dunne 2009/10 AmeriCorps Ambassador
- Jeff Vieser, 2010/11 AmeriCorps Ambassador
- Jeremiah Bergstrom, Rutgers Water Resources Program
- Ben Pearson, Rutgers Water Resources Program
- Sara Mellor, Rutgers Water Resources Program
- Caitrin Higgins , Rutgers Water Resources Program
- Ingrid Witty, Rutgers Cooperative Extension
- Somerville Borough
- Ron Czajkowski
- Raritan Borough
- Bridgewater Township
- Somerset County Parks
- Van Derveer Elementary School
- Somerset County Vocational Technical School

Questions?