Discover Your Streams:
Sing Sing Kill, Stewardship for a Small Hudson River Tributary and into the Tide.

Interim Status Report UPDATE for
DEC01-HRER16-2015-00032
Contract # DEC01-T00131GG-3350000

Updated 11/14/2017

Hudson Valley Arts and Science
53 Old Albany Post Road
Ossining, NY 10562
(914) 954-9447

Gareth Hougham, Ph.D.
Courtney Wieber,
Benjamin Zevola
John Waldman, Ph.D.
John Ladd, Ph.D.

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Summary:

Work on the Sing Sing Kill project began in June 2016, with field work commencing on July 1st and continuing essentially full time through the end of August into September. Two interns participated. Courtney Wieber, now a senior in environmental studies at SUNY Purchase College and Benjamin Zevola, a recent BA graduate of SUNY Cortland in Biology. The project components undertaken included culvert characterization for aquatic organism passage (AOP), the development of a stream gauge and carrying out associated hydrology studies, bacteriological measurements at 23 sites, a fish survey including electrofishing, and public outreach events. Every foot of 11 legs of the stream was walked. Most of the goals of the project have been achieved, although the stream gauge was destroyed by high waters in two storms sending us back to the drawing board for a more durable design. Follow up work in the spring of 2017 will include more bacteriological sampling including two new sites (where sewage leaks are suspected) and another round of electrofishing in the upper reaches hoping to confirm sightings of Brook Trout.

Fish passage barriers: Culverts, dams, bridges

Summary: G.Hougham and C.Wieber received culvert training from Andrew Meyer of the NYS DEC on 07/08/2016 and have since characterized and reported on 62 culverts and bridges. See figures 1a and 1b. Details can be found at www.streamcontinuity.org in the database link on the left margin and by searching for culverts input by C. Wieber and G. Hougham. Two high priority barriers have been identified in the lower portions of the Sing Sing Kill (SSK) and are candidates for mitigation proposals in the future.

Actions: A large culvert going under Route 9A that was being replaced was found to be getting installed with a freefall at the exit. The contractor was informed that this was incorrect, instructed in the proper design for fish passage and reminded of the new Town of Ossining law requiring culverts to be constructed as per NYS DEC guidelines for fish passage. The contractor complied and the culvert installation was corrected.

Another culvert in the SSK system is being newly constructed by the NYS DOT. They have been contacted and requested to comply with NYS DEC guidelines and Town of Ossining laws regarding fish passage. We will interact further with them as work commences.

Future action: The two most significant AOP barriers are at the Croton Aqueduct Double Arches, just below the stream gauge, and 200 meters farther downstream. Both could potentially be mitigated for fish passage by filling with rip rap or installation of fish ladders. We are considering writing a grant proposal for the design and permitting of these mitigations with the hope for construction in a future year as funding permits.

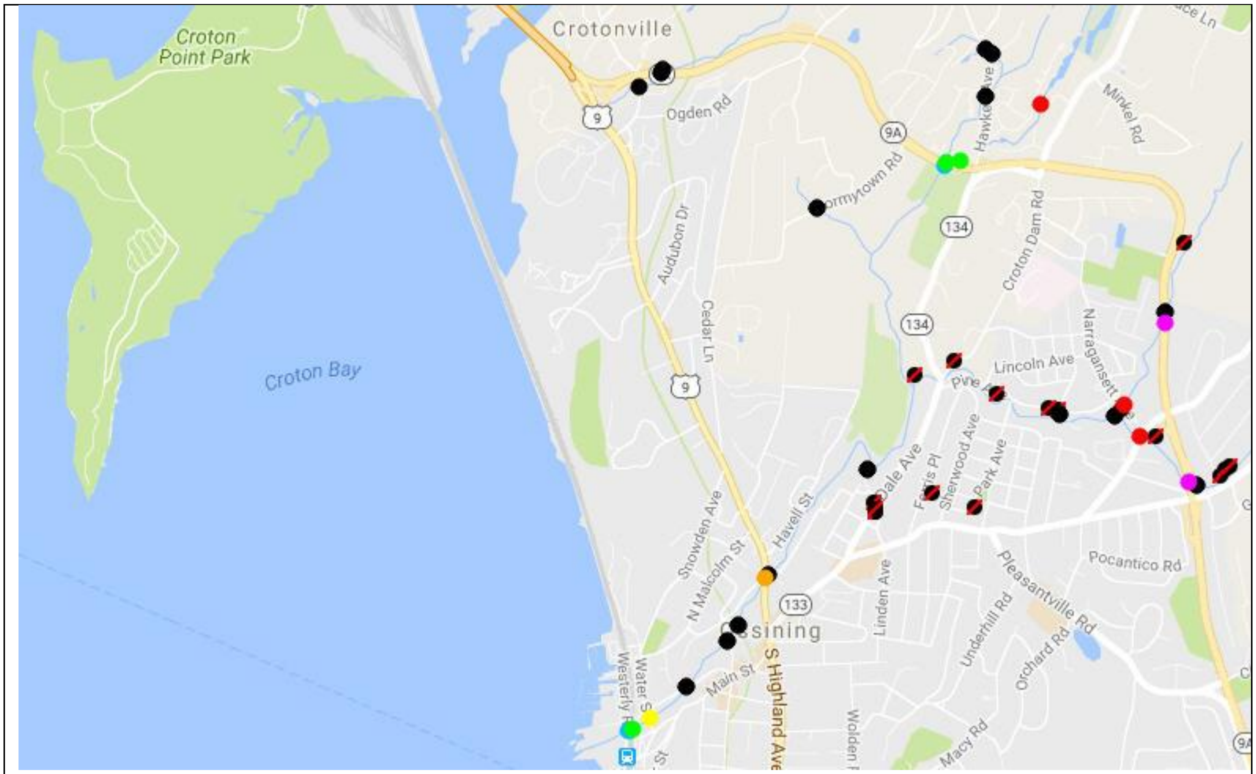

Figure 1a: Culverts input to www.streamcontinuity.org database by Courtney Wieber

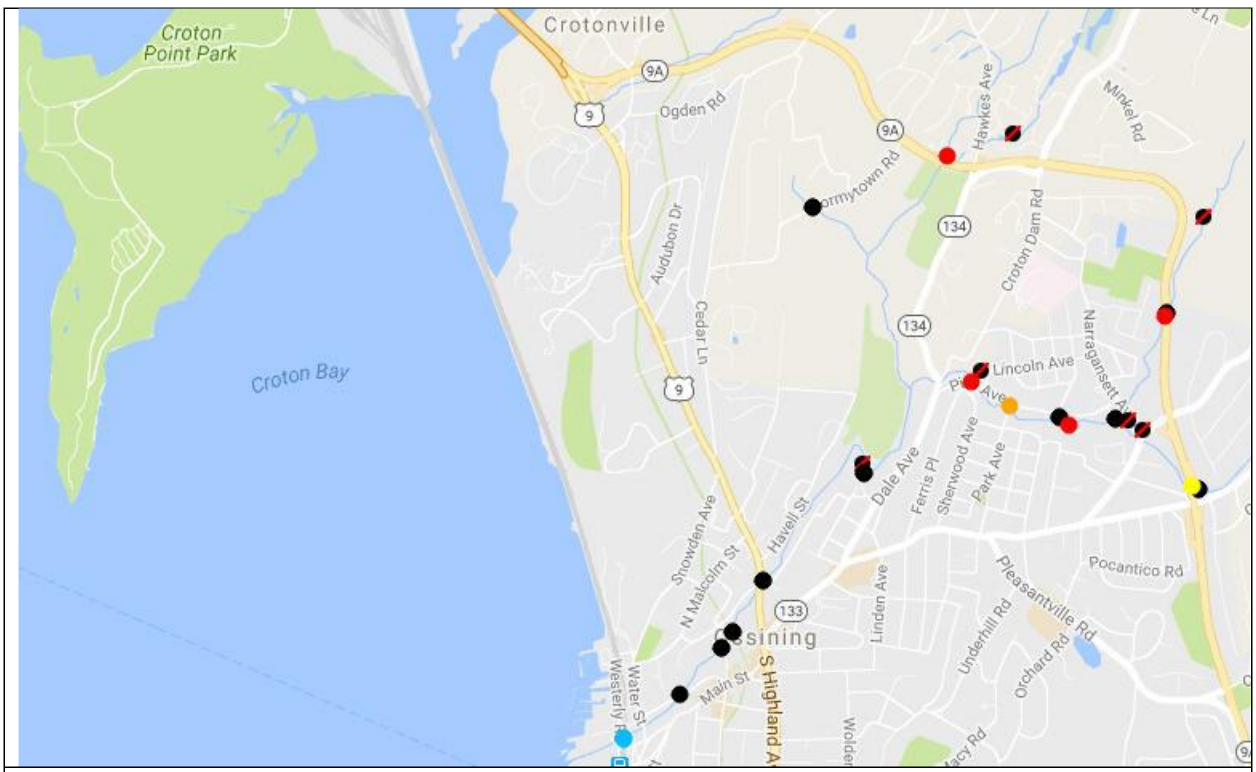

Figure 1b: Culverts input to www.streamcontinuity.org database by Gareth Hougham

Photos:

Figure 2: Fish migration barriers: Culvert characterization. Photos of all culverts entered into database.

Stream hydrology:

Summary:

Urban streams exhibit a much greater degree of "flashiness" than rural streams. This is a measure of how rapidly a stream rises and falls in response to rain events within its watershed and how often the rate of rise exceeds a mean value. Rural streams will respond more slowly because at the beginning of a rain event dry soils will absorb much of the water. After the rain event the soil will slowly release the stored water. Urban streams on the other hand have less soil to absorb the rain water and will also have extensive culvert infrastructure designed, specifically, to rapidly transfer the water from impervious surfaces into the stream bed. Flashy stream flows impact the quality of the benthic habitat by scouring.

As a first step in characterizing the flow characteristics of the Sing Sing Kill, an inexpensive stream gauge system was developed and used for preliminary hydrology measurements. It consists of three stream gauge signs and three wall mounted wildlife cameras located on the brick race directly under the Double Arch structure of the Croton Aqueduct in the Village of Ossining. See figure 3d. The cameras were set to take photographs of the signs at 15 minute intervals in order to capture the rise and fall of the stream. The measured depth of a stream is called the "stage" of the stream and is the most commonly used metric of stream hydrology. However, stage by itself is a poor indicator of the change in stream flow because the shape of the streambed profoundly effects the relationship between the stage and the volume discharge, (or flow, or flux) of water of the stream. For instance, a flat floodplain will have a small change in stage even with a large change in discharge whereas a deep gorge will have a large change in stage for the same change in discharge. Accordingly, we undertook to characterize the cross sectional geometry of the SSK streambed at the location of the gauge as well as the flow velocity at each stage level.

Ideally, non-contact measurements of stage are made to eliminate problems with instrument fouling. Systems based on radar and ultrasound are available. However, they are expensive to purchase and install and have some inherent limitations with minimum depth that make their implementation on very small streams difficult. Pressure based systems are most commonly used by the USGS. These too are expensive to install and they additionally require expensive recalibration every two weeks by a USGS field engineer. Thus, for an initial study of the Sing Sing Kill we sought to develop an inexpensive system based on gauge signs which show printed depth numbers with which the level of the water could be photographed on a timed interval.

A variety of sign arrangements and physical attachment methods were tried. Some failed and these led to improvements. Design changes are still being experimented with. The two main problems encountered were 1) leaf and debris entrapment against the sign making the depth numbers difficult to read in the photographs with accuracy because of excessive turbulence and spraying. This was significantly reduced by installing another sign six inches upstream to act as a debris deflector and catcher. This helped considerably but did not eliminate the problem. 2) Large debris including floating logs and rolling boulders were observed in heavy storm events which threaten to destroy mounted signs midstream. (Such may have contributed to the sign destruction during the 08/21/2016 storm. See figure 4.), and again in November.

Figure 3 shows photographs during construction of the gauge signs, camera setup and water race geometry measurements for cross sectional area and flow calibration. Figure 4 shows two signs; before during and after a major storm event. Clearly a new design will be needed to protect the signs from floating logs in high water. See also figure 5 showing sign damage before and after a storm in November.

A first step for making flow measurements from the stage data was to characterize the exact shape and dimensions of the brick water race. This was done by making careful measurements using a laser level as reference. Two measuring tapes were employed simultaneously: one to measure the distance from the wall in regular increments and the second to measure the depth from the laser level line to the brick. See figure 6 for graph of depth vs. position along a stream crossection.

As a backup plan in case the signs would be torn from their bolts (which they ultimately were) or became unreadable because of trapped floating debris, the depth of each brick, relative to the laser level, was carefully measured and documented. The idea was that the number of bricks showing in the photographs at any water height would be manually countable in the photos and could act as a proxy depth sign. (In fact, it was this brick data which allowed measurement of the rate of the falling water line after the 08/21/2016 storm because the signs had been destroyed. See figure 4.)

We had originally sought to have the photograph files automatically read and logged for the depth values, but this proved to be impossible due to the leaf and debris fouling. See figure 5

The next step was to calculate the cross sectional area as a function of depth. See figures 7 and 8.

Next, a curve representing the surface velocity as a function of depth was developed over several rain events. This was done by tossing a near-neutrally buoyant float (blueberries, grapes and tangerines) into the stream and timing the passage through a known distance. This was done at seven different stage heights to develop the curve shown in figure 9.

To convert the stage value (the depth read off the signs) into discharge rate values, two methods were used to determine the upper and lower limits.

The lower bound discharge rate was determined by multiplying the area of each 1 cm high cross section of the streambed by the velocity of the water measured, or estimated from best fit curve in figure 9, when it was at that same height. Then these discharge rates for each horizontal slice were added together cumulatively to create the lower bound curve in figure 10a and 10b. This approach assumes that a given horizontal layer moves at the same rate no matter how much water was above it.

The upper bound discharge rate assumes that the entire water column was moving at the same rate as the surface water. It was determined by multiplying the total cross sectional area of the water at a given height by the surface velocity.

During a storm event, the observed depth will change as a function of time. From before the storm to after the storm as the stream rises and then falls. One such storm that took place on 08/21/2016 was recorded by photographs every 15 minutes and a stage vs. time curve determined. See figure 11. This data was then used to calculate the discharge rate, at each time point. See figure 12 for the lower bound discharge of that storm. The upper bound for that storm will be calculated soon. Tables 1 and 2 show the data and results explicitly.

Flashiness:

The flashiness cannot be completely determined from a single recorded high rain event. Observations over many months are required which necessitates automatic data logging of stage. As described, this cannot be done at the present time but all the geometric and calibration factors are now known and installation of an appropriate automatic system, or further refinement of the current photographic system, would need to be completed first. Additional grant funding will be sought at a later time from any available source to purchase and install a non-contact stage measurement system. Such as the radar or ultrasound based instruments.

Figure 3: Building and calibrating the stream gauge. a) Measuring the geometry of the race in depth vs linear distance from the stone wall and separately, the depth vs. the brick row locations. b) A laser level was used to determine depth c) a third depth gauge sign was mounted on the north stone wall. d) Cameras are mounted on south side concrete wall pointing toward two depth measurement signs.

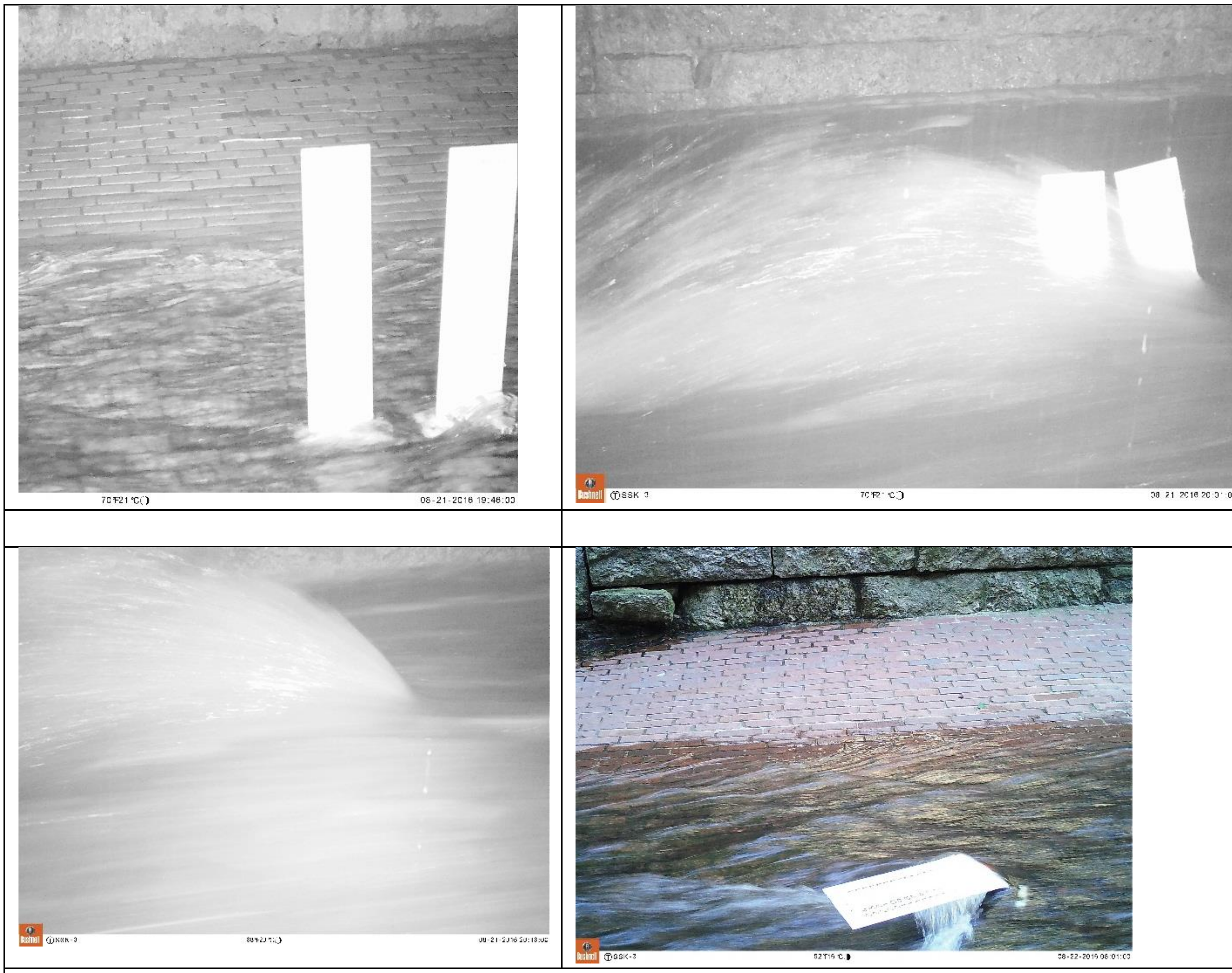

Figure 4: Stream gauge trial. Storm of 08/21/2016. Before, during and after storm. Upstream sign torn from bolts. Downstream sign bent.

Figure 5: photographs of debris fouling the stage signs. A) After some impact damage and debris fouling. B) After second time signs were destroyed by impact.

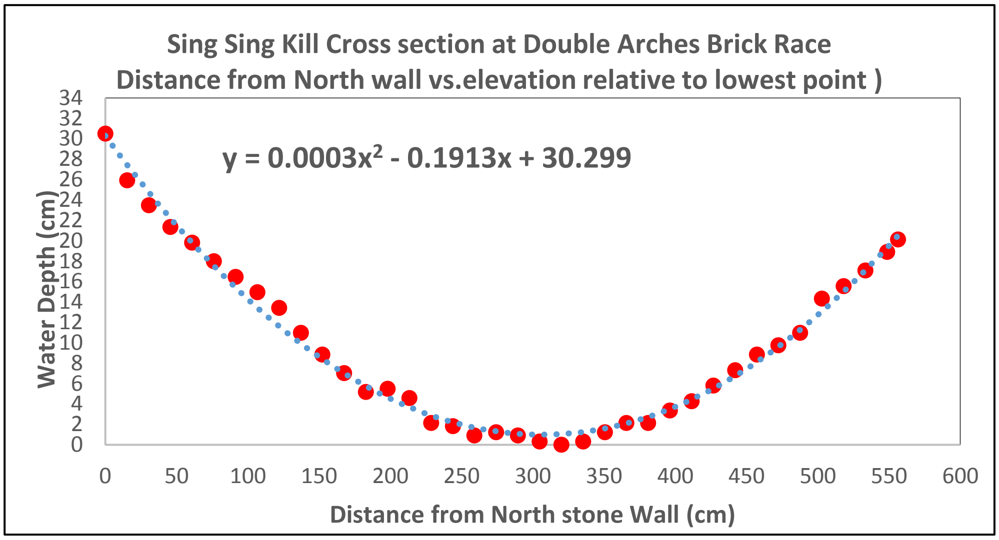

Figure 6: Cross section. Distance from north wall vs. depth relative to laser reference.

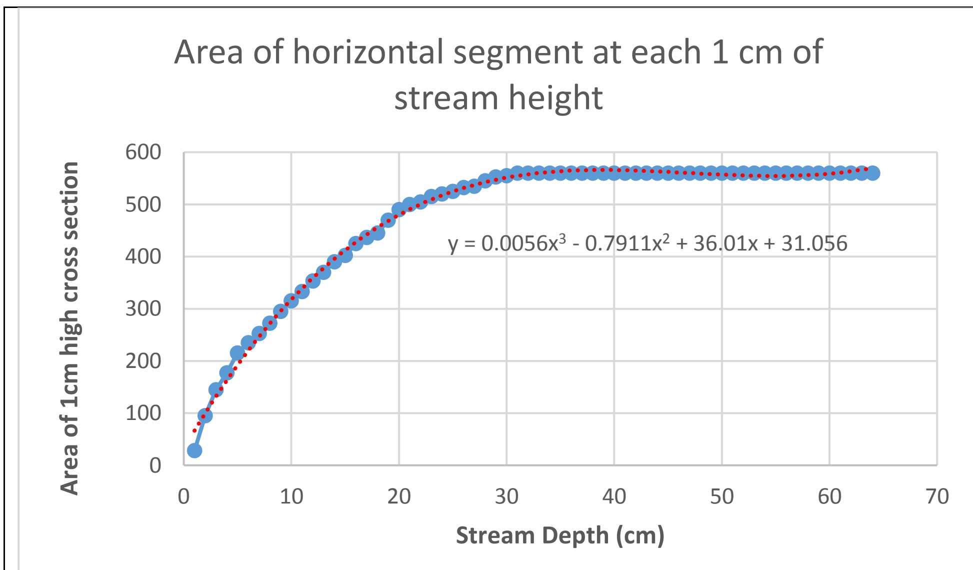

Figure 7: Area of each 1 cm horizontal segment of stream height.

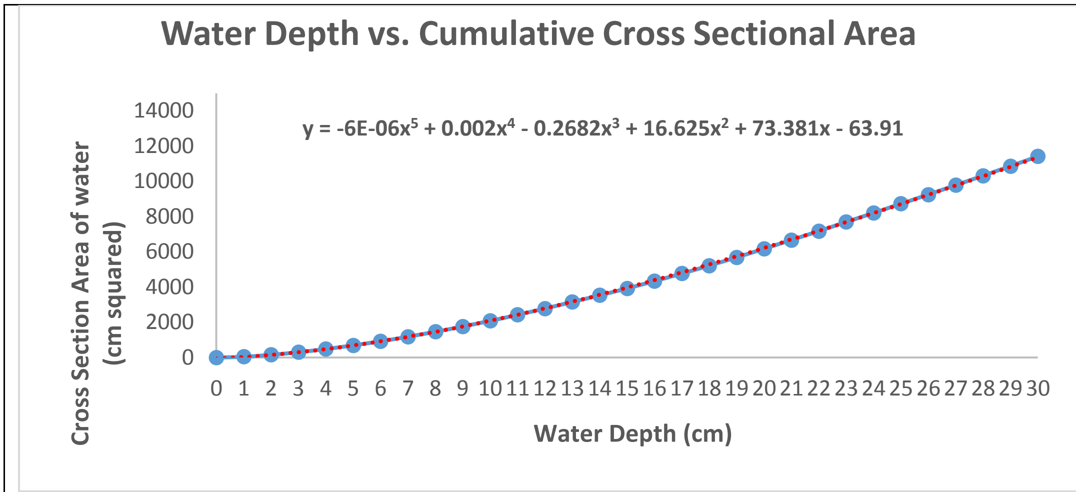

Figure 8: Water depth vs. Cumulative cross sectional area.

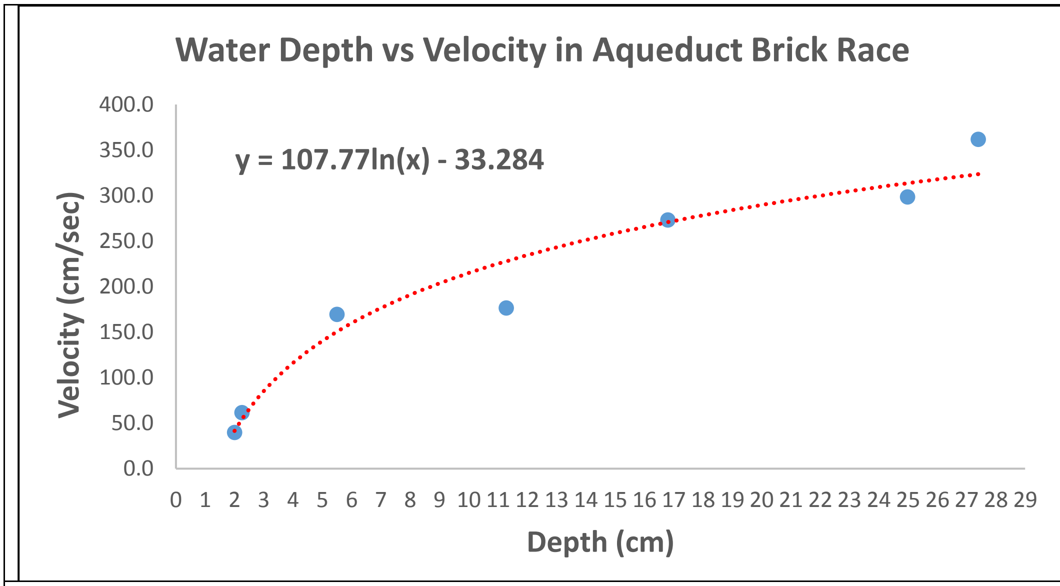

Figure 9: Water depth vs. water velocity at surface

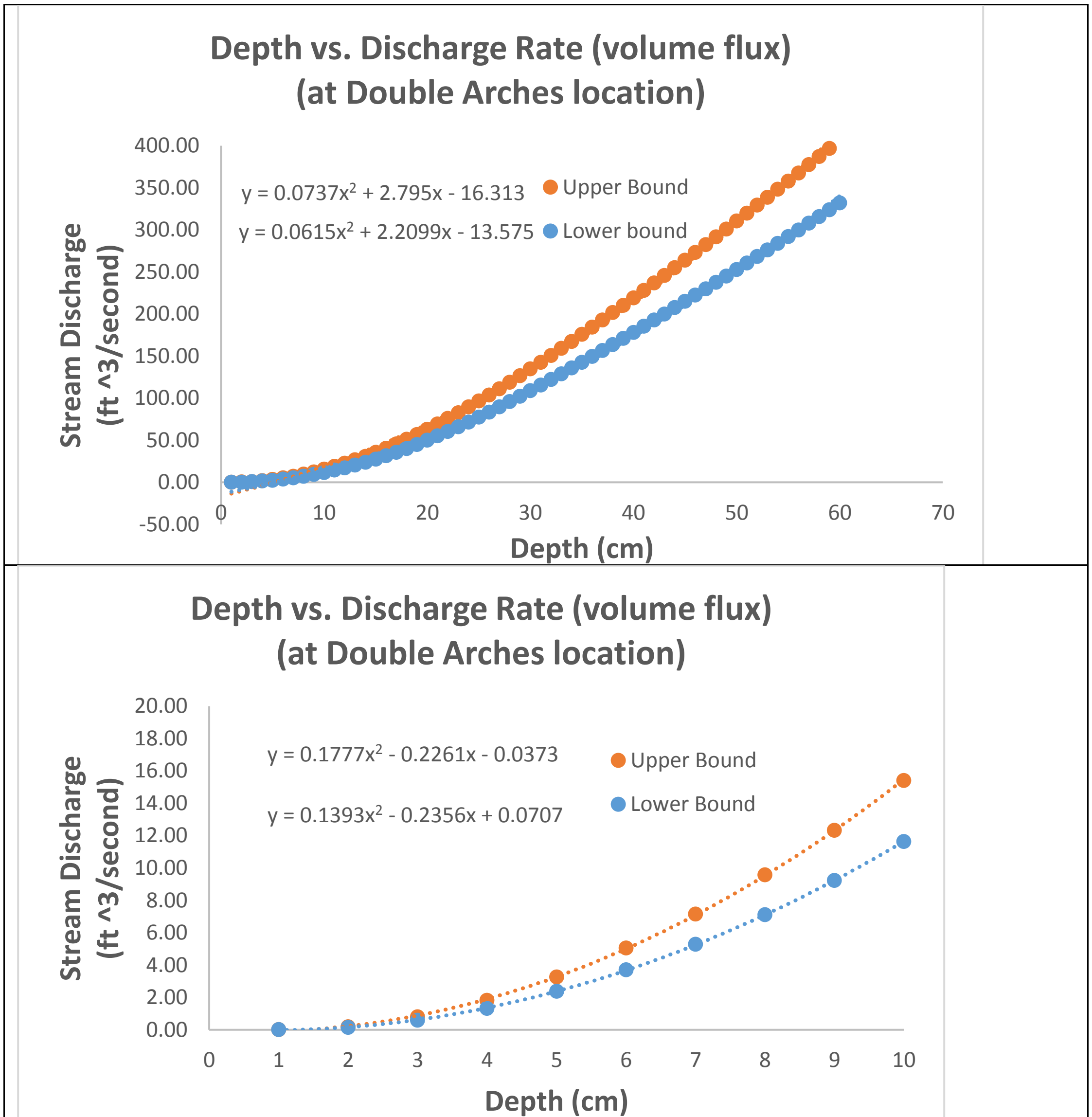

Figure 10: Water depth vs. discharge rate in cubic feet per second. A) Full scale to 60 cm depth. b) Blown up scale to show first 10 cm of depth

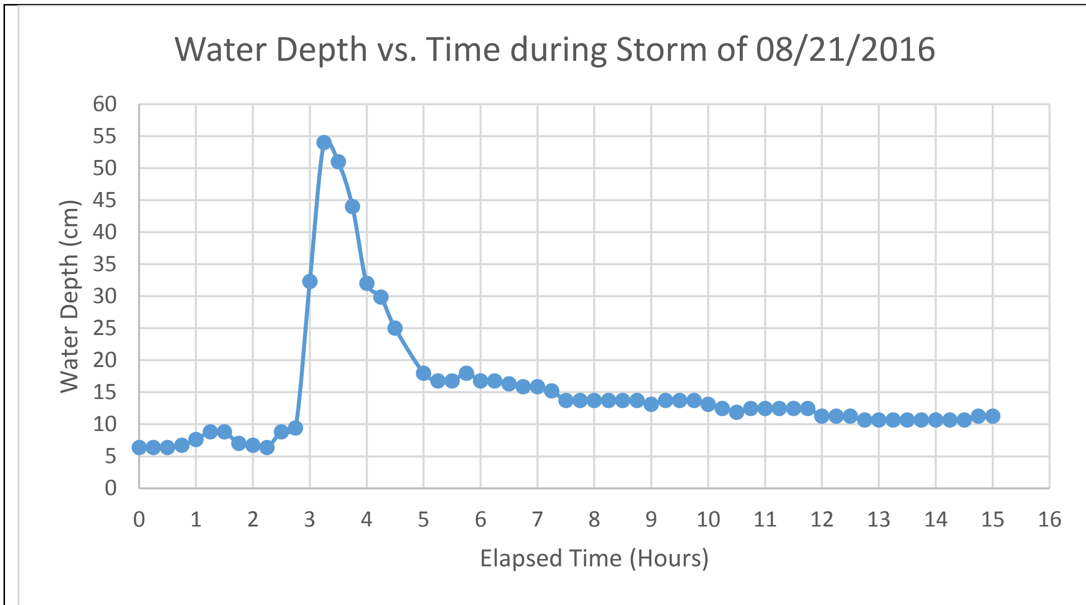

Figure 11: Stage (Water depth) vs. time for 08/21/2016 storm event.

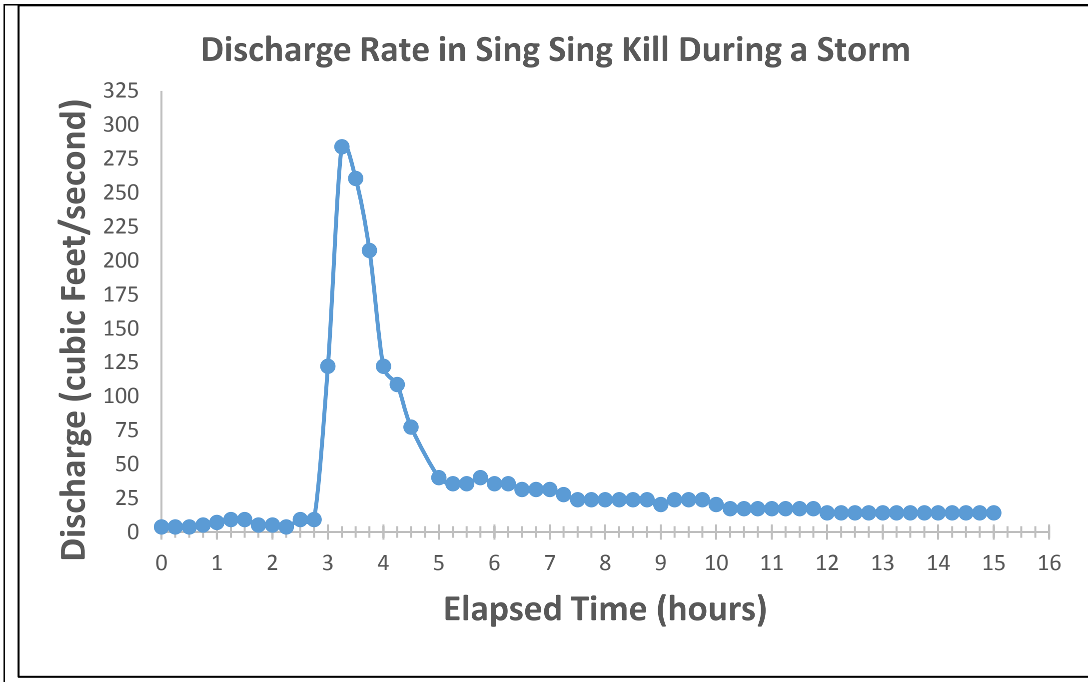

Figure 12: Discharge rate (lower bound) for 08/21/2016 storm event.

Depth (cm)	Cross Sectional Area (cm^2)	Velocity (cm/s)	Volume of horizontal slice (cm^3/s)	Cumulative Discharge (cm^3/s)	Cumulative Discharge (ft^3/s)
1	28.0	10.0	280	280	0.01
2	95.0	41.4	3935	4215	0.15
3	145.0	85.1	12341	16556	0.58
4	177.5	116.1	20611	37167	1.31
5	215.0	140.2	30136	67302	2.38
6	235.0	159.8	37556	104859	3.70
7	252.5	176.4	44548	149406	5.28
8	272.5	190.8	51998	201404	7.11
9	295.0	203.5	60036	261440	9.23
10	315.0	214.9	67683	329122	11.62
11	333.0	225.1	74971	404093	14.27
12	353.0	234.5	82784	486877	17.19
13	370.0	243.1	89962	576839	20.37
14	390.0	251.1	97940	674778	23.83
15	402.5	258.6	104071	778850	27.50
16	425.0	265.5	112845	891695	31.49
17	436.6	272.1	118778	1010472	35.68
18	445.0	278.2	123804	1134277	40.06
19	470.0	284.0	133498	1267774	44.77
20	490.0	289.6	141887	1409662	49.78
21	500.0	294.8	147412	1557074	54.99
22	505.0	299.8	151418	1708492	60.33
23	515.0	304.6	156884	1865375	65.88
24	520.0	309.2	160792	2026167	71.55
25	525.0	313.6	164647	2190815	77.37
26	532.5	317.8	169250	2360065	83.35
27	535.0	321.9	172221	2532286	89.43
28	545.0	325.8	177576	2709862	95.70
29	552.5	329.6	182109	2891971	102.13
30	555.0	333.3	184961	3076932	108.66
31	560.0	336.8	188606	3265539	115.32
32	560.0	340.2	190522	3456061	122.05
33	560.0	343.5	192379	3648440	128.84
34	560.0	346.8	194181	3842621	135.70
35	560.0	349.9	195930	4038552	142.62
36	560.0	352.9	197631	4236182	149.60
37	560.0	355.9	199284	4435467	156.64
38	560.0	358.7	200894	4636360	163.73
39	560.0	361.5	202461	4838822	170.88
40	560.0	364.3	203989	5042811	178.09

41	560.0	366.9	205479	5248290	185.34
42	560.0	369.5	206934	5455224	192.65
43	560.0	372.1	208354	5663578	200.01
44	560.0	374.5	209741	5873319	207.41
45	560.0	377.0	211098	6084417	214.87
46	560.0	379.3	212424	6296841	222.37
47	560.0	381.6	213722	6510563	229.92
48	560.0	383.9	214993	6725556	237.51
49	560.0	386.1	216237	6941793	245.15
50	560.0	388.3	217456	7159249	252.83
51	560.0	390.4	218651	7377900	260.55
52	560.0	392.5	219823	7597723	268.31
53	560.0	394.6	220973	7818696	276.12
54	560.0	396.6	222101	8040797	283.96
55	560.0	398.6	223208	8264006	291.84
56	560.0	400.5	224296	8488301	299.76
57	560.0	402.4	225364	8713665	307.72
58	560.0	404.3	226414	8940079	315.72
59	560.0	406.2	227445	9167524	323.75
60	560.0	408.0	228460	9395984	331.82

Table 1: Discharge Rate (Lower Bound) rate of SSK at the location of the Double Arches. Assumes each horizontal 1 cm high slice moves in the water colum at the velocity that it did when that height was the surface (during calibration runs).

Depth (cm)	Area (cm^2)	Velocity (cm/s)	Discharge Rate assuming total crossection is at velocity of surface (cm^3/s)	Cumulative Discharge Rate (ft^3/s)
1	28.0	10.0	280	0.01
2	95.0	41.4	5094	0.18
3	145.0	85.1	22810	0.81
4	177.5	116.1	51730	1.83
5	215.0	140.2	92579	3.27
6	235.0	159.8	143113	5.05
7	252.5	176.4	202538	7.15
8	272.5	190.8	271056	9.57
9	295.0	203.5	349123	12.33
10	315.0	214.9	436285	15.41
11	333.0	225.1	532112	18.79
12	353.0	234.5	637058	22.50
13	370.0	243.1	750453	26.50
14	390.0	251.1	873044	30.83
15	402.5	258.6	1002964	35.42
16	425.0	265.5	1142789	40.36
17	436.6	272.1	1289687	45.54
18	445.0	278.2	1442693	50.95
19	470.0	284.0	1606406	56.73
20	490.0	289.6	1779557	62.84
21	500.0	294.8	1959284	69.19
22	505.0	299.8	2144019	75.72
23	515.0	304.6	2335158	82.47
24	520.0	309.2	2531109	89.39
25	525.0	313.6	2731768	96.47
26	532.5	317.8	2937837	103.75
27	535.0	321.9	3147652	111.16
28	545.0	325.8	3363552	118.78
29	552.5	329.6	3584701	126.59
30	555.0	333.3	3809397	134.53
31	560.0	336.8	4038396	142.61
32	560.0	340.2	4269945	150.79
33	560.0	343.5	4503945	159.06
34	560.0	346.8	4740306	167.40
35	560.0	349.9	4978943	175.83

36	560.0	352.9	5219778	184.34
37	560.0	355.9	5462735	192.92
38	560.0	358.7	5707747	201.57
39	560.0	361.5	5954748	210.29
40	560.0	364.3	6203678	219.08
41	560.0	366.9	6454478	227.94
42	560.0	369.5	6707094	236.86
43	560.0	372.1	6961476	245.84
44	560.0	374.5	7217574	254.89
45	560.0	377.0	7475343	263.99
46	560.0	379.3	7734739	273.15
47	560.0	381.6	7995721	282.37
48	560.0	383.9	8258249	291.64
49	560.0	386.1	8522286	300.96
50	560.0	388.3	8787795	310.34
51	560.0	390.4	9054743	319.77
52	560.0	392.5	9323097	329.24
53	560.0	394.6	9592826	338.77
54	560.0	396.6	9863899	348.34
55	560.0	398.6	10136289	357.96
56	560.0	400.5	10409967	367.63
57	560.0	402.4	10684908	377.33
58	560.0	404.3	10961085	387.09
59	560.0	406.2	11238475	396.88
60	560.0	408.0	11517055	406.72

Table 2: Discharge Rate (upper bound). Assumes entire water column moves at velocity of the surface.

Fish survey:

Summary:

Before this year's work, it was thought that only three types of fish were in the SSK: Black Nose Dace, American Eel and Pumpkin Seed Sunfish. Of those, only one, Blacknose Dace had been confirmed despite considerable trapping effort in a prior year. On August 5th, 2016 Professor John Waldman of Queen's College led our team in electrofishing several locations along the SSK. See figure 13. As a result, many more species of fish were found to be in the stream. See tables 3 and 4. In addition to those shown in table 3 now known to live in the SSK, two sightings of what are believed to be Brook Trout were made in the upper reaches of the stream. This needs to be further investigated by additional electrofishing efforts. Permission for private property access for this has been obtained.

The elecrofishing was so successful that we feel this should be made a routine tool for the "Discover Your Streams" program. It would facilitate fish surveys in other Hudson Valley small streams. As shown in the financial sections of this report on page 35, we have approximately $4500. in grant funds remaining. We anticipate needing $2,000. For interns in the spring of 2017, leaving around $2500 that could be put toward and electrofishing backpack. Such equipment is estimated to cost around $6,000.

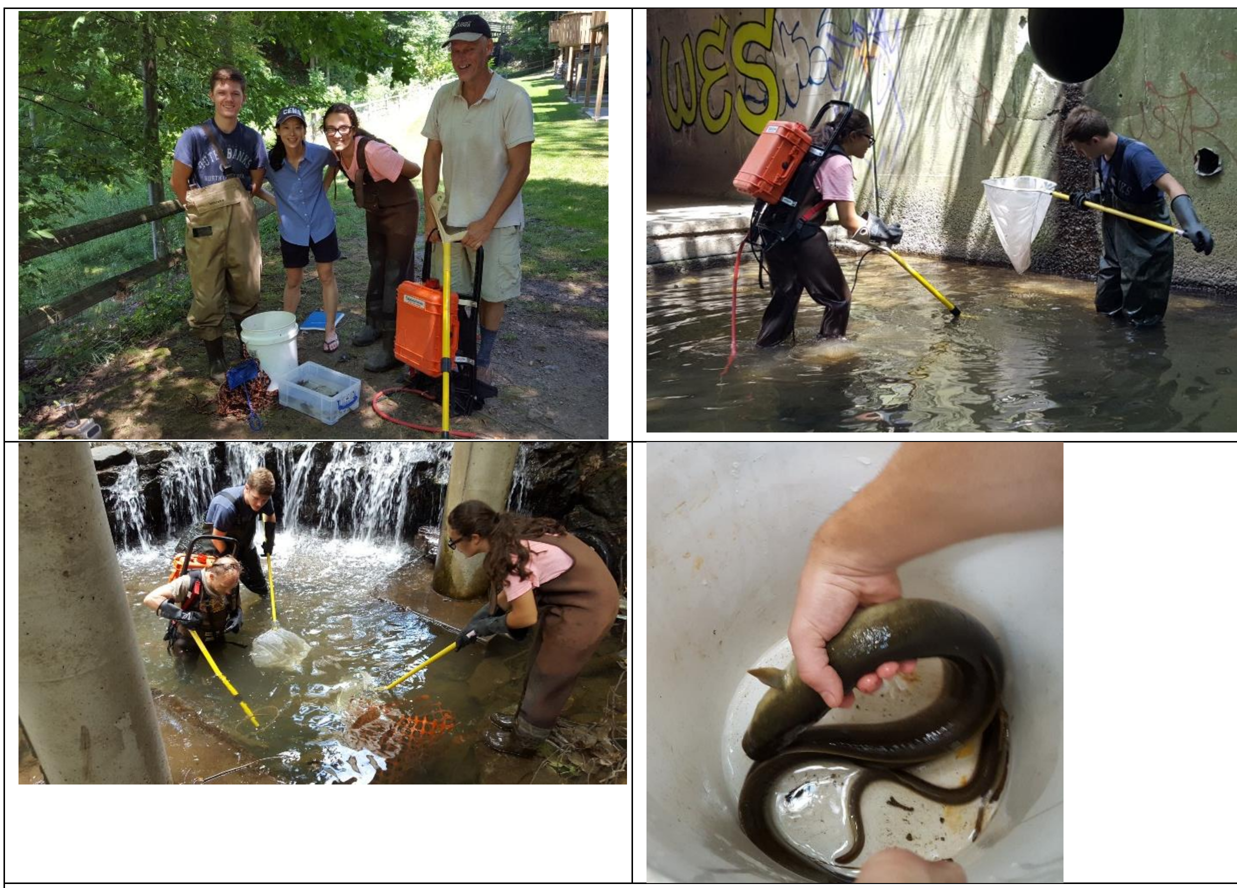

Figure 13: a)L to R: Ben Zevola, Elisa Chae, Courtney Wieber, John Waldman. B) C. Wieber and B. Zevola electrofishing. C) G.Hougham, B.Zevola, C.Weiber. D) Massive eel caught at site SSK-2.

Fish and other aquatics previously known or anecdotally reported in the SSK	**Fish and other aquatics now known to live in the SSK (Above the tide line).**
Blacknose Dace	Blacknose Dace
Pumkinseed sunfish (anecdotal)	Pumpkinseed Sunfish
American Eel (anecdotal)	Bluegill Sunfish
Crayfish (anecdotal)	American Eel
Spotted Salamander (anecdotal)	Golden Shiner
	Largemouth Bass
	Creek Chub
	Chain Pickerel
	Salamander (species not yet id'ed)
	Snapping Turtle
	Red Slider turtle
	Fresh Clam (Rangia cuneata, Wedge Clam, native)
	Green Frog
	Bullfrog
	Additionally, suspected but not yet confirmed Brook Trout in upper reaches. Based on two sightings but not caught. Also anecdotal from 30 yrs. ago.
Table 3: Fish and other aquatic animals in SSK before and after electrofishing survey.	

Fish Species	**Most Upstream Location: Lat/Long**	**Most Upstream Location: Stream leg**	**Most Upstream Location: rivermile (meters) from Hudson**	**Sample Site or Description**
Black nose Dace				Densely populated full freshwater range.
Pumpkinseed Sunfish	41.1852801/-73.846365	T10T9T5T3	4138.57	SSK-N8
Bluegill Sunfish	41.1852801/-73.846365	T10T9T5T3	4138.57	SSK-N8
American Eel	41.183218/-73.849061	T10T9T5T3	3900	The Pond at The Woods Condos
Golden Shiner	41.182873/-73.848232	T10T9T5T3	4000	Above Pond (past culverts) at The Woods Condos
Largemouth Bass	41.182873/-73.848232	T10T9T5T3	4000	Above Pond (past culverts) at The Woods Condos
Chain Pickerel	41.1852801/-73.846365	T10T9T5T3	4138.57	SSK-N8
Creek Chub	41.181976/-73.851948	T10T9T5	3526.44	Just before passing under Rt. 9A
Salamander (species not yet id'd)	41.173146/-73.853758	T10T9T5	2335.75	SSK-S5
Snapping Turtle	41.183218/-73.849061	T10T9T5T3	3900	The Pond at The Woods Condos
Red Eared Slider Turtle ("Stinky")	41.169498/-73.856072	T10T9	1818.31	SSK-3 "Turtle Pond"
Fresh Water Clam (Rangia cuneate), Wedge Clam, native)	41.173/-73.852	T10T9T7	2407	Inside culvert under Sassi's Deli. 5 m upstream of SSK2-4
Green Frog				Found over full freshwater range
Bullfrog	41.183218/-73.849061	T10T9T5T3	3900	The Pond at The Woods Condos
Crayfish				Found over full freshwater range
Brook trout (not confirmed)	41.1852801/-73.846365	T10T9T5T3	3800	SSK-N8 and another 300 meters downstream

Table 4: Locations of fish. Most upstream if caught at multiple sites.

Figure 14: Fresh Water Clam, Rangia cuneate, Wedge Clam, (native)

Figure 15: Red Slider Turtle (invasive)

Figure 16: Crayfish

Figure 17: Blacknose Dace

Figure 18: Bluegill Sunfish

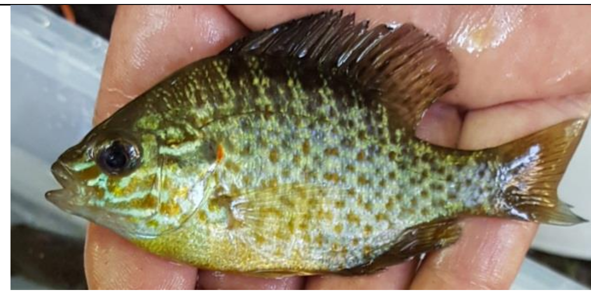

Figure 19: Pumpkinseed Sunfish

Figure 20: Salamander (top view)

Figure 21: Salamander (bottom view)

Figure 22: Large Mouth Bass

Figure 23: Golden Shiner

Figure 24: Chain Pickerel

Figure 25: Creek Chub

Bacterial sampling & Sewage source identification:

Summary:

Water sampling at 22 locations shown in figures 26 and 27 and in table 5 was carried out and analyzed for concentrations of E. coli, total coliforms, and Enterococcus. Results are shown in table 6. The concentrations of E. coli varied considerably, from 52/100ml to an indeterminate value greater than 24,196/ml. The 52/100 ml value was obtained within a few hundred feet of a wooded upstream source pond. The higher value spot was far downriver right next to a suspected sewage outflow. Total coliforms ranged from 602 to greater than 24,196. The concentrations of enterococcus varied from 10/100ml to greater than 24,196/100ml.

These sites will be sampled again. Additionally, several newly identified suspected outfalls will be sampled. Those will be analyzed at dilutions of 100x and 1000x in addition to our standard 10x dilution factor.

Thus far, several suspected sewage outfalls have been identified and will be reported to local authorities upon confirmation.

Methods:

IDEXX methodology was used which incorporates a fluorescent tag to growing bacteria by way of an enzyme reactant. Dilutions of 10x were used except in a few cases where both 10x and 100x were used because of suspected high bacterial concentrations.

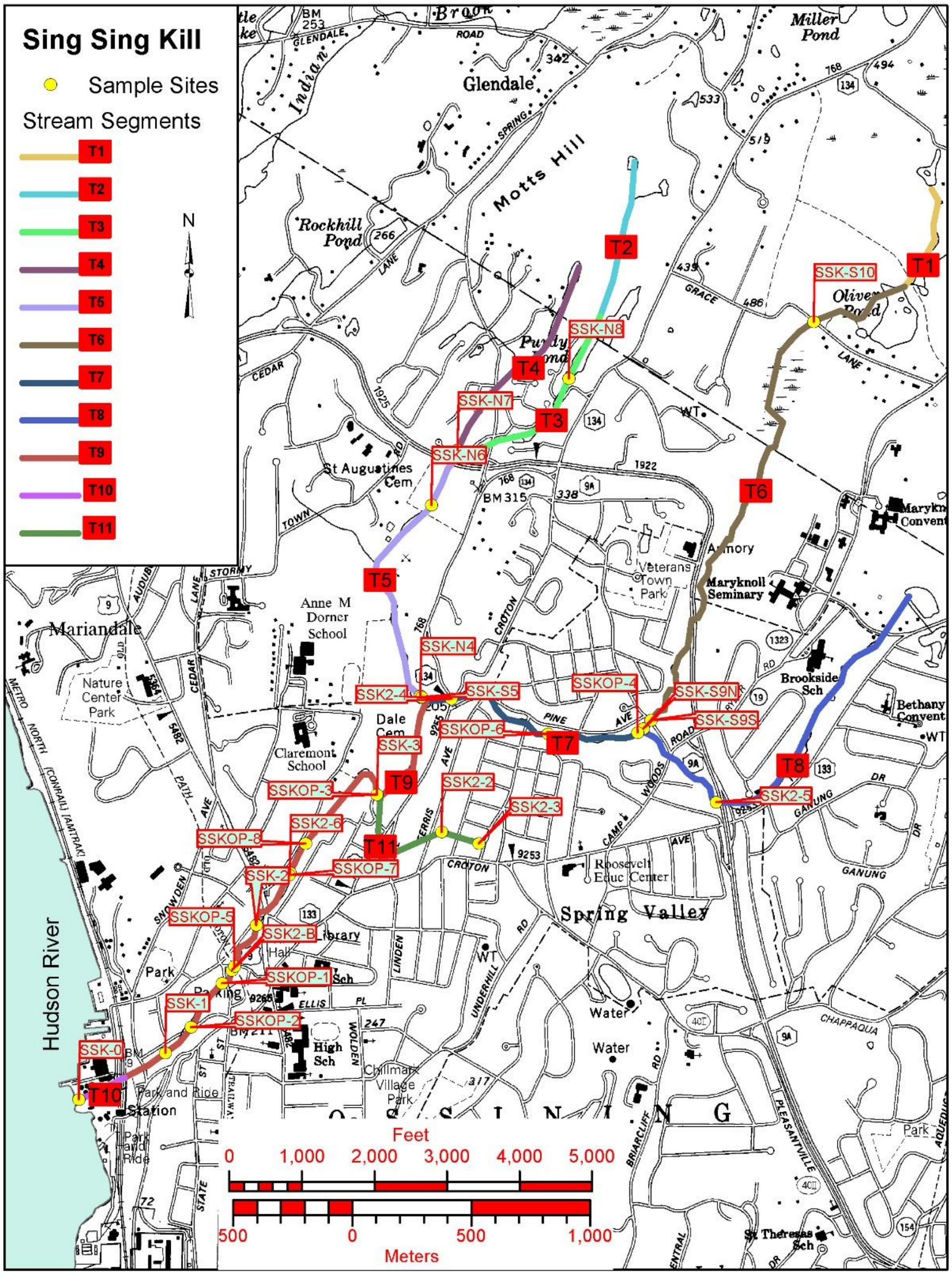

Figure 26: Map showing locations of bacterial sampling sites and tributary segments (T1, T2 etc.)

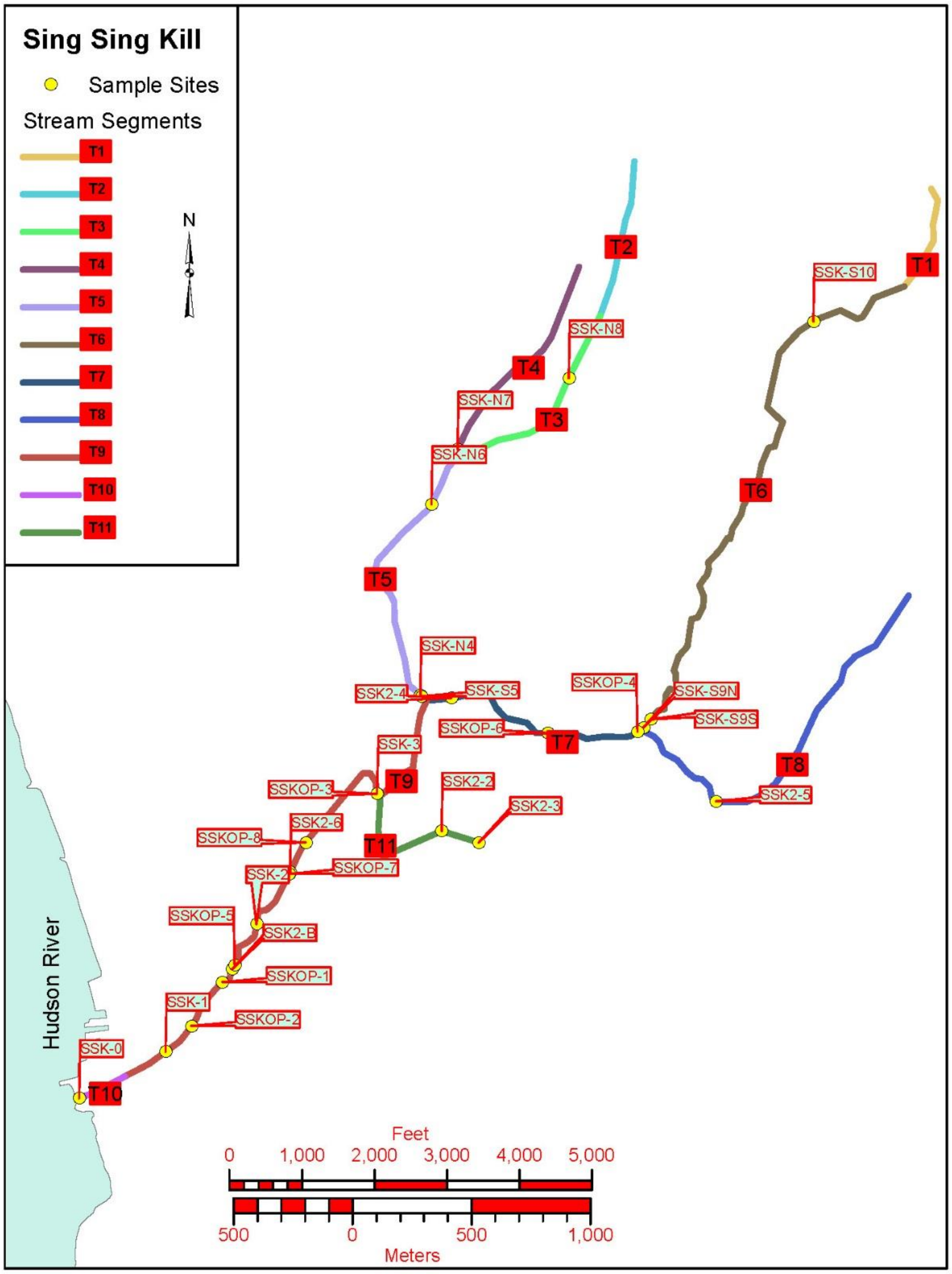

Figure 27: Map showing locations of bacterial sampling sites and tributary segments (T1, T2 etc.) Same as figure 26 but without street basemap for clarity.

Column1	Column2	Column3	Column4
Name	**Latitude**	**Longitude**	**Description**
SSK-0	41.157786	-73.871898	Mouth of Hudson (tidal)
SSK-1 (AbT)	41.159925	-73.866785	Above tidal line. 39-55 Central Ave.
SSK-2	41.164639	-73.861938	Just below Aqueduct St. "Eel pond." 46 Aqueduct St.
SSK-3	41.169498	-73.856072	"Turtle pond." 15ft upstream of "cockroach man" culvert outlet
SSK-N4	41.173195	-73.853821	North Branch of fork. 3 Hawks Ave. About 75ft from fork near white pipe, boulders, and Sickimore tree.
SSK-N6	41.180533	-73.853208	Saint Augustin's Cemetery. Vertical squashed culvert in poor condition. 75 Stormytown Rd.
SSK-N7	41.182568	-73.851795	Deerfield Condos across Route 9A. 96 Deerrun Lane.
SSK-N8	41.1852801	-73.846365	Spring Pond condos. 46 Spring Pond Dr. Pool at bottom of dam.
SSK-S10	41.187279	-73.833857	22 Grace Lane. Near Grace Lane Kennels. 3 round plastic culverts.
SSK-S5	41.173146	-73.853758	South side of branch. Upstream of the tree bridge. 3 Hawks Ave.
SSK-S9N	41.171934	-73.842633	11 Narragansett Ave. Branch by Narragansett culvert inside culvert. (North side)
SSK-S9S	41.172253	-73.842243	15ft upstream of branch (South side).
SSK2-2	41.168108	-73.852779	3 Park Ave. Blue in scour pool of outlet with rock/cement armoring.
SSK2-3	41.16764	-73.85092	8 Park Ave. Next to trolley car garage.
SSK2-4	41.173197	-73.852216	Culvert outlet by Sassi's Deli
SSK2-5	41.169103	-73.838987	Before Route 9A crossing. 33 Belle Ave.
SSK2-6	41.166745	-73.860685	23-25 Havel Street. Strong sewage smell, friendly pit bull.
SSK2-B	41.162974	-73.863409	Little upstream of our stream gauge boards on the bricks.
SSKOP-1	41.1625401	-73.863892	Orange outfall along walkway, downstream of SSKOP-2
SSKOP-2	41.161022	-73.8657701	15-99 Brandreth St. "Soapy" water from outpour (unkown source). Water flow is variable. Outpour along walway.
SSKOP-3	41.16948	-73.85612	"Cockroach man" culvert outlet. 10 Marble Place.
SSKOP-4	41.17183	-73.84295	Culvert inside culvert near Narragansett Ave.

SSKOP-5	41.163076	-73.863168	97 Broadway. Outpour from broken pipe and wall along walkway 50 feet upstream of stream gauge.
SSKOP-6	41.1712803	-73.847366	Culverts off of stream. Scour pool Pine Ave.
SSKOP-7	41.166547	-73.860418	26 Havell Street (but on Yale Ave. side of stream). Sewage leaking from concrete retaining wall next to sewer manhole.
SSKOP-8	41.168157	-73.860238	9 Sabrina Lane. Grey sludge just below sewer manhole tower.

Table 5: Water quality sampling sites, including new ones not yet sampled as of 09/03/2016. SSK-x is original series, SSK2-x is new series in stream, SSKOP-x is series of suspicious outpours (outfalls) along stream.

Site Name	Description	Enterococcus (/100 ml)	E. coli (/100 ml)	Total coliform (/100 ml)
Control		0	0	0
SSK-1 (abt)	Above Hudson tide	213	1043	9208
SSK-3	Turtle Pond	388	355	17329
SSK-2	Eel Pond	3654	>24196	>24196
SSKOP-6	Inaccessible culvert scour pool	667	874	15698
SSK2-3	Trolley car garage	1172	275	24196
SSK-S9N	Scour pool	243	84	5794
SSK2-2	Scour pool of heavily armored.	959	650	12033
SSK2-4	Under Sassie's deli	17329	3448	>24196
SSKOP-3	Cockroach man culvert	884	384	17329
SSK-N8	Spring Pond - pool at dam	450	145	17329
SSKOP-4	Culvert inside culvert	0	41	602
SSKOP-5	Outpour above stream gauge	1050	2142	6405
SSK-S9S	South branch of S branch	243	368	12033
SSK-0	Hudson River	10	119	>24196
SSK-S10	Grace Lane	435	52	5475
SSK-N4	North branch	272	272	8664
SSK-N7	Deerfield Condo	199	1145	11199
SSKOP-2	Downstream of stream gauge	135	243	14136
SSK-S5	Just upstream of tree bridge	435	1860	>24196
SSK-N6	St.Augustine Cemetery culvert	2098	857	15531
SSK2-5	Belle Ave. Just before 9A	521	480	9804
SSK2-B	At stream gauge	857	3076	>24196

Table 6: Bacterial analyses from sampling on 08/20/2016

Public Outreach and Education:

Summary:

HVAS and the two summer interns, Courtney Weiber and Ben Zevola participated in three public outreach events. See figure 28. These were the Hudson River Ramble on two dates and the annual Hudson River Fish Count.

Hudson River Ramble:

This was a Village and Town of Ossining event that invited the public to take part in a group walking tour scheduled for two different weekends. It was from the village center at the Old Croton Aqueduct, along the new Greenway path which winds through the dramatic Sing Sing Kill gorge, and down to the Hudson waterfront. HVAS was invited to set up a table along the Greenway to share the results of our Sing Sing Kill research.

On the first day, September 9, 2016 we set up a poster presentation of results to date, had a stereo microscope with aquatic macroinvertebrates under the light, and we had a very large (~two foot) mature female American Eel in an aquarium with circulating water. We also had Black Nose Dace in the aquarium. See figures 29-33. All of which were caught just an hour before the talk. The eel was the star of the show and afforded us the undivided attention of the audience for our poster talk. The talk was expertly and enthusiastically delivered by the interns. After the talk, member of the audience were invited to pet the eel and to admire it close up. The eel was hugely popular eliciting many wow's and only a few ick's and one running scream. (Try to imagine a retreating Doppler sound effect. That is exactly what it sounded like as this young mother fled running up the Greenway. But, the same mother allowed her toddler to reach in and touch the eel with the help of its father. See figure 29. So all was well and everyone left with a new appreciation for and understanding of the life cycle of the American eel.)

It should be pointed out that after only two hours, the water in the aquarium had warmed up to the point that one of the Blacknose Dace died suddenly and the eel became sluggish. We did our best to keep the water refreshed and cold, but it was hard to keep up with. When we released the eel, it remained sluggish and minimally responsive to poking and prodding for some minutes. It survived but in the end we felt that even with the oxygenating recirculator we had used, and the attempts to replace the water, that our set up could not responsibly display fish and eels again until we had an active cooling system in place. This is on our wish list for future acquisitions to enable dramatic educational demonstrations while remaining fair and humane to the participating fish.

I might add that on Saturday, August 13, 2016, we participated in the NYSDEC sponsored annual Hudson River fish count at Kingsland Park in Sleepy Hollow, NY. While not a part of the Sing Sing Kill project it provided an important learning opportunity for one intern who had never done seine netting before. And it gave us the opportunity to meet and work with the Teatown Lake Reservation staff who were overseeing the Sleepy Hollow site that day. It bears noting that the same cooling problem occurred there. The fish that were caught by all participants and put into aquariums for counting and teaching, did not fare well. The water temperature rose faster than the organizers were able to refresh it, despite their considerable efforts, and several of the fish died. The organizers released the surviving fish, stopped putting new fish into the tanks, and the centralized fish counting process became compromised. So, again we were reminded of the importance of an active cooling system in aquariums in a field setting. We are working on that.

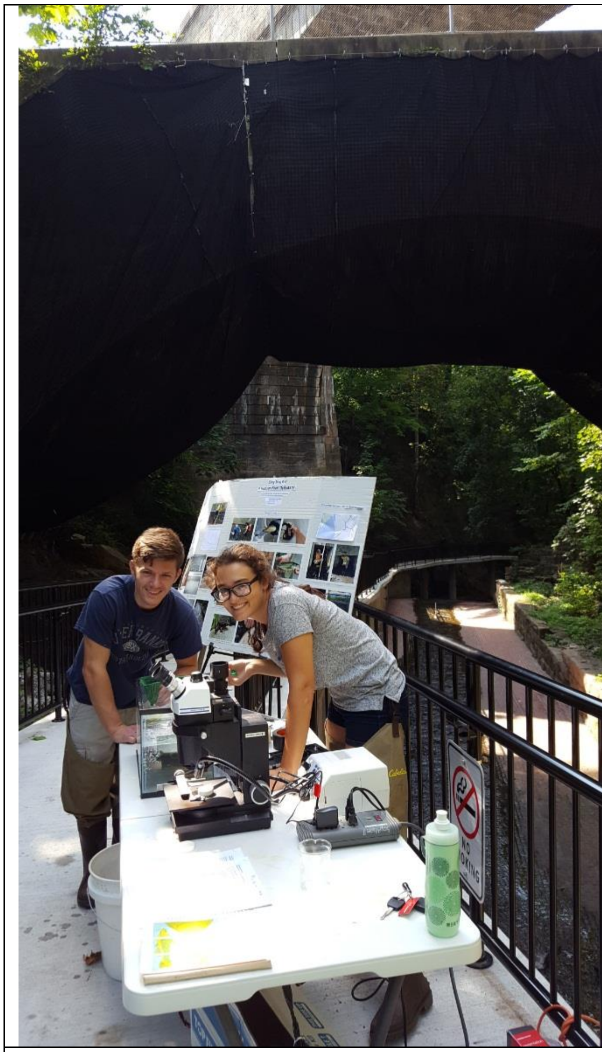

Figure 28: Interns Ben Zevola and Courtney Wieber setting up poster talk and stream science demo on Sing Sing Kill project 09/09/2016

Figure 29: The audience. 09/09/2016

Figure 30: The audience from kids to seniors. 09/09/2016

Figure 31:The audience from kids to seniors. 09/09/2016

Figure 32: American Eel from the Sing Sing Kill. 09/09/2016

Figure33: Courtney Wieber, intern, setting up poster. 09/09/2016

Update 2017

2017 was a slow year for the Sing Sing Kill project because our laboratory at SUNY College at Purchase was unexpectedly closed from the beginning of June to mid-September for a building wide asbestos removal project. The whole warm season when college interns are available was lost.

Village of Ossining Fair: Sing Sing Kill demo booth

We had a booth at the Ossining Village Fair featuring:

1. A poster showing the fish of the Sing Sing Kill, the results of the culvert analysis, the hydrological stream gauge results
2. An eel caught in the Sing Sing Kill that morning in an aquarium.

   We had planned to capture and display a very large eel known to reside in a particular pool of the SSK. To do so, we had arranged to borrow and use the electrofishing apparatus from Professor John Waldman of Queen's College. When in the stream at 6:00 AM, the electrofishing tool malfunctioned. Instead we were able to capture a small eel using nets alone. This small eel (elver) was successful in the booth by virtue of it's "cuteness" and to some extent made up for the loss of the bigger drama of a big, likely 25 year old eel.
   To display native fish in an aquarium on a hot summer day takes planning and effort. First, the water must be from the stream itself. Then, ideally, a recirculating cooling bath would be used to keep the water at a setpoint temperature equal to the temperature of the stream. We did not have a recirculating bath and so pre-froze more than 40 trays of Sing Sing Kill water into ice cubes. A thermometer in the aquarium was monitored and ice cubes were added every few minutes to keep the water temperature even. Almost all the ice cubes were used over the course of the day. It worked but was not a practical solution for future events. I plan to request permission to use some of the remaining grant funding to purchase a recirculating bath.

   Since we were planning a series of days on the SSK with the electrofishing gear to look for the Brook Trout that we thought we saw in the summer of 2016, we sent the tool for repair to the Halltech manufacturer for repair. They repaired the tool and we purchased two new batteries for it since the old batteries were no longer holding charge. We are being allowed now to use the tool by Queens College whenever we wish.

3. A working demonstration of culvert design for fish possibility.

   A pair of working model culverts was designed and built to illustrate both a good culvert design for fish passage and a bad one. Each was made starting with:
   - a plastic storage box (Walmart),
   - a short length of 3 inch diameter stove flu pipe to simulate a culvert pipe,
   - a formed concrete "road crossing",
   - a fish pond pump
   - simulated rocks to hide the pump

- plastic fish

The “good” culvert had the pipe located vertically such that the bottom of the culvert was under the streamgrade. In other words, that the bottom of the culvert was below the water level of the stream on both upstream and downstream sides of the crossining. Kids interacting with the models could push the plastic fish to “swim” upstream through the culvert to “have babies” upstream.

The “bad” culvert had the pipe elevated such that it had a waterfall at the end and did not allow the fish to swim through. So the fish could not get upstream to reproduce. Ie, no plastic fish were on the upstream side of this model.

These models proved very engaging to kids and adults alike and very effective conveying the message of the importance of “passable” culverts.

The models did not function perfectly though. Since the stream crossings were made of formed concrete they were very heavy. During transport the plastic boxes containing them distorted and broke the silicone seals separating the upstream and downstream sections. Thus, it was difficult to maintain water level differentials between the up and downstream sides and we had to resort to putting the pump tube directly in the culvert.

Following the Village Fair, these two models were discarded. But plans are underway to make new ones with the same design except for replacing the concrete with spray foam insulation. This material is lightweight, adhesive and impermeable.

<table>
<tr><td></td><td></td></tr>
<tr><td>Figure 34: Kids looking at Sing Sing Kill elver in aquarium.</td><td>Figure35: Talking to kids about eel lifecycles and the Sing Sing Kill / Atlantic Ocean connection. Sing Sing Kill research poster in back.</td></tr>
</table>

Figure 36: Demo of good culvert design. Culvert is below stream water level.

Figure37: Demo of bad culvert design. Culvert is above water level. Fish can't swim up waterfall. (Ice chest in back stored 40+ ice trays filled with Sing Sing Kill water ice cubes for aquarium).

Next Steps:

In the spring of 2017 (update-2018):

1) We will continue the bacteriological analysis of the stream's 23 sites and will add two new sites where suspected sewage was leaking directly into the stream.
2) Electrofishing will be carried out in the hope of confirming two sightings and anecdotal reporting of Brook Trout in the SSK. It is our hope to purchase eletrofishing gear. We would like to expand upon the success of this fish survey to other streams in the Hudson Valley and now consider this a key mission requirement. (update: we worked out an arrangement with Queens College whereby we repaired their electrofishing equipment and can now use it anytime we need)
3) Participation in public outreach events to share these results and try to bring about a greater awareness of the surprising biological diversity in small streams, the importance of stream connectivity, and the opportunities small streams bring for public recreation.
4) As part of our public outreach activities, we hope to further develop our demonstration table to be a one-of-a kind with dramatic aquaria displays of native fish including the American Eel. We now understand that to do this requires a portable cooling system for the aquariums to keep water temperatures AT the temperature of the local stream from which display fish will have

been obtained. (update: we did not have a portable cooling system so instead froze 40+ icetrays with Sing Sing Kill water and used the icecubes to imperfectly stabilize the aquarium temperature during the Village Fair).

5) Redesign SSK interpretive signage which HVAS installed several years ago. They do not accurately reflect the fish populations present in the stream.
6) To obtain two pieces of equipment we now believe are essential to our mission. Restated from above: 1) Electrofishing gear and an 2) Aquarium chiller unit. Remaining funds from the current grant are insufficient for these purchases. Other funding will be sought to augment what remains. (We need this aquarium chiller for effective public demos in 2018).
7) We are working with the Ossining High School science project and with NYSDEC's Sarah Mount and Chris Bowser to try to gain permission from the Village of Ossining to install and maintain an eel ladder on the SSK. We are seeking the Village's permission to install a gate for access to the prospective eel ladder site which is otherwise difficult to get to.

Acknowledgements:

HVAS would like to thank the NYSDEC and the Hudson River Foundation (HRF) for funding this project of the ***Discover Your Streams*** program. Of the NYS DEC we thank in particular Elisa Chae, Susan Pepe, Chris Bowser, Tom Lake, Andrew Meyer and Alene Onion. Of the HRF we thank in Helena Andreyko.

We also thank Riverkeeper's Dan Shapley, John Lipscomb, and Jennifer Epstein, The SUNY Purchase Environmental Studies Program and The Village of Ossining's Supervisor Paul Fraioli, Recreation Director Chris Soi, Mayor Victoria Gearity, and water superintendent Andy Tiess.