



October 25, 2013

NYSDOH  
Attn: Pamela Young  
Empire State Plaza  
Corning Tower Room 1110  
Albany, NY 12237

[fadcomments@health.state.ny.us](mailto:fadcomments@health.state.ny.us).

***Re: Comments submitted by Delaware Riverkeeper Network and Catskill Mountainkeeper on the proposed New York City Filtration Avoidance Determination Mid-Term Revisions (FAD) dated August 2013.***

Dear Ms. Young,

The Delaware Riverkeeper Network and Catskill Mountainkeeper offer the following comment on the proposed New York City Filtration Avoidance Determination Mid-Term Revisions (FAD) dated August 2013. The Delaware Riverkeeper Network and Catskill Mountainkeeper support the FAD and believes the program New York City has put in place and seeks to continue and strengthen with the Mid-Term Revisions should be approved, with a few areas of needed improvement, as the best way to protect drinking water for New York City and State residents as well as protect and enhance beautiful ecosystems that bring extended benefits for the environment, the economy and community quality of life. This program will also provide critical protections for all communities who live downstream of the reservoirs in the form of water quality and quantity protections and enhancements which benefit drinking water, recreation, ecotourism, local and regional economies, as well as health, safety and quality of life.

The FAD as proposed builds upon 20 years of work and success. It is important to protect the accomplishments put in place to date while at the same time continuing forward progress that will ensure changed conditions and actions in the future do not degrade the quality of New York City's drinking water.

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### **Community Wastewater Management Program**

While ensuring that wastewater management systems, including septic systems, are operating at their optimum so as to avoid unnecessary pollution of our waterways, is a valid concern and focus, we are concerned that the proposal to replace septic systems with connections to wastewater management plants will encourage increased development and therefore increased land disturbance and increased wastewater that is then treated and enters our waterways. To the extent that the FAD includes the tie in of septic system-reliant communities to wastewater management plants it needs to include a proactive program that will avoid this outcome (such as limiting the capacity of the wastewater plant to an amount no greater than the flow of the septic systems being replaced) – we don't want the FAD to replace one pollution source with a series of other pollution sources. There is a balance already in the FAD of providing support for the proper upkeep and operation of septic systems so there clearly is a recognition of their value in treating wastewater while keeping it in the natural hydrologic cycle in the sub-watershed where it was drawn from and created – we just want to ensure there continues to be this recognition and balance in the FAD program.

### **Stormwater Program**

Investment in addressing stormwater management can be wise given the water quality and water quantity ramifications of inappropriately addressed stormwater. But to be a truly wise investment it is important the strategies undertaken are about avoiding, reducing, treating and to the greatest degree possible infiltrating runoff. If the investment made is into traditional detention and pipe infrastructure then the outcome can be to make water quality (even if treated prior to discharge), flooding, erosion and water pollution worse. New York City's watershed rules have a solid focus on avoiding an increased volume of runoff and on use of infiltration and other practices designed to protect the natural hydrologic cycle. And so the Delaware Riverkeeper Network and Castkill Mountainkeeper support continuing investment in the FAD stormwater program.

### **Waterfowl Management Program**

The Delaware Riverkeeper Network and Castkill Mountainkeeper suggest including specific reference to the use of vegetation to prevent settlement and associated contamination by waterfowl in the reservoir system. Right now the FAD discusses and stresses "bird harassment practices". Planting trees and shrubs and other natural vegetative impediments to the water is a known deterrent for Canada Geese and other waterfowl. Including this strategy in the FAD provides important recognition of its value and creates additional incentive for ensuring that vegetated areas along waterways throughout the watershed are maintained in forested and similar well-grown vegetated habitats, whether by the City or others. Certainly, while the majority of lands surrounding the City's reservoirs are in vegetation, there are still areas where reforestation/revegetation can take place. This photo shows manicured grass lands along the Rondout Reservoir that is inviting to Geese. A natural vegetation restoration could provide an important deterrent in this area. The City should include this most effective, environmentally

friendly, and less labor intensive mechanism for waterfowl deterrence in the language of the FAD for its guidance as well as the guidance of others.

### **Land Acquisition**

The enhanced funding for the land acquisition program is important in order to continue the progress made to date. It has become increasingly clear that fee simple title of both the surface and subsurface rights of a property is the only way to ensure its permanent protection. Securing partial ownership of a property and/or securing protection of a parcel only through easement is fraught with peril as demonstrated by the current loss of property control to the gas drilling industry by those who fail to have fee simple title to the surface and subsurface of a parcel.

It is important that the FAD make clear that the land acquisition program should be targeted at parcels that can provide water quality, volume and flow benefits. The FAD does not currently include this important guidance. As such, present or future Administrations could easily lose their focus in a difficult political or economic climate. And therefore the FAD should explicitly state that the funds are to be targeted for purchases that will protect or enhance water quality, water volume and waterway health.

Considering the opportunity and success of the acquisition program to date it seems that an additional \$50 million is on the low side for this successful program. We would support an increased level of funding.

Allowing the land acquisition funds to supplement the City funded flood buyout program is a wise decision that the Delaware Riverkeeper Network and Catskill Mountainkeeper support and is well in keeping with the water quality goals of the FAD. There is a strong connection between natural land preservation, floodplain preservation and water quality protection.



Development and commercial operations in the floodplain continue to be all too common. Flooding that reaches developed landscapes pollutes rivers with accumulated chemicals and debris from the roadways, parking areas, lawns and buildings that it washes over and through. When high flows come, our waterways are polluted and the buildings, homes and businesses that are situated too close to the water, within the 500 year floodplain and any sort of rational buffer width, suffer damages that bring financial hardship to those impacted but also to state and federal



taxpayers who inevitably must commit substantial funds to aid in the emergency response during the flood and the recovery that happens after.

Because forested areas are the most beneficial for preventing and treating runoff and pollution, and forested areas can be a quick target for development or energy extraction projects we urge the City to focus greater attention and energy on accomplishing the goals of its Watershed Forest Conservation Easement Program.

We do not agree that two-for-one credit should be given Riparian or Flood Buy-Out acres solicited. The value in land acquisition and preservation for purposes of water quality protection is in the actual preservation of the land. An artificial 2 for 1 credit diminishes by 50% the value of the Riparian and Flood Buy-Out solicitations because each solicitation brings the City artificially closer to the 50,000 acres per year goal. The proposed FAD provides additional funds in recognition of the level of resources needed to achieve the 50,000 acre goal; it should not also now lower the 50,000 figure by giving 2 for 1 credit.

### **Funding for Flood Hazard Mitigation.**

The Delaware Riverkeeper Network and Catskill Mountainkeeper support the new funding to be provided for the Flood Hazard Mitigation component of the FAD and would support additional funds being committed to the program as we believe it to be so important to the protection of waterways and water quality.

While we wholeheartedly agree that wherever possible the City should leverage its dollars by using them as match for other existing programs, it is appropriate to allow flexibility that entitles the City to purchase a parcel outright in order to accomplish water quality goals that are best achieved through acquisition despite whether or not there are matching funds to accomplish the purchase. And having this buyout program complimented by the relocation program is a sound investment Delaware Riverkeeper Network and Catskill Mountainkeeper support.

It is important that the use of the Flood Mitigation funds be tied to protecting and improving water quality, preventing flood damages, and protecting stream channel integrity. Criteria should be developed to guide the use of these funds to achieve these specific goals. Given the increased level of flooding and flood flows climate change is expected to bring, at a minimum the program should focus on the 500-year floodplain rather than limit itself to the 100 year floodplain.

We do believe that the current stated goal of “flood mitigation” for the program needs to be clarified. On page 9, the FAD document reads: “the intent of this program is to acquire high-priority parcels that are important from a flood mitigation and water quality perspective, ...” The term “Flood mitigation” is often defined by efforts to control flood flows with structures. And so it is important to be clear that the buyouts that will be supported by this program are for

protection of lands in a natural state and not for securing lands for purposes of building structures that are intended to redirect, or channelize stream flows in any way.

Additionally, as written, it is not clear if the funds are solely for acquisition or include restoration as well. The Delaware Riverkeeper Network and Castkill Mountainkeeper believe restoration to a well vegetated habitat is an appropriate use of the funds to ensure maximum benefit from the lands purchased and so urges this addition/clarification be added to the FAD. A parcel purchased but left in a somewhat developed condition, e.g with the structure removed but with lawnscapes and/or paving remaining, does not provide the water quality and flood storage benefits that the program is designed to capture. And establishing a healthy naturally vegetated buffer with native species will help to suppress invasive species that can so easily takeover unmanaged lands.

From a water quality perspective, including funds targeted at removing structures from the floodplain and restoring healthy ecological habitat is important. Development along streams whether it be agriculture, housing, office buildings, or parkland dominated by manicured lawns, becomes a source of polluted runoff and prevents this important streamside and/or floodplain land from being vegetated by native trees, shrubs, and other plants that could otherwise filter pollution preventing it from entering the stream. Pollution from developed landscapes includes sediment, nutrients, pesticides, animal waste, hydrocarbons and more.

From a water quality perspective it also is important that the Flood Mitigation Funds not stop with acquisition. Restoring purchased lands with native trees, shrubs and herbaceous plants is important from a water quality perspective. Vegetation such as trees, shrubs, and deep rooted plants, filter pollution out of water runoff, protecting our streams from potential contamination and our communities from the cost of cleanup.

- ✓ Nitrogen, phosphorous, pesticides, sediment, sulfates, calcium, magnesium, and herbicides are among the many contaminants that healthy plant communities can remove from runoff before it is allowed to pollute our streams and water supplies.<sup>i</sup>
- ✓ Numerous studies have concluded that buffers, particularly forested varieties, provide significant removal of aquatic contaminants, including toxics. While site specific conditions dictate the effectiveness of such systems, many researchers have concluded that buffers can remove upwards of 80 to 90% of such contaminants when equal or greater to 100 feet in width. <sup>ii</sup>
- ✓ Study has shown that forested streams can process “two to 10 times the ammonia per unit length that a deforested stream can.”<sup>iii</sup>
- ✓ Vegetation on stream banks also prevent non-natural erosion resulting from increasing stormwater runoff levels upstream and introducing more sediment into the water column. Root systems of woody shrubs and trees do a better job of anchoring these soils – this is a function that turf grass simply cannot do effectively.<sup>iv</sup>
- ✓ Healthy forested buffers support pollution removal from stream channels. In a comprehensive review of scientific reports regarding the ability of forested buffers to

remove pollutants from entering streams, the Stroud Water Research Center found: on average, riparian buffers were 68% efficient in removing nitrogen from surface and subsurface flow; average removal efficiencies of over 80% for sediment; similarly high removal efficiencies for pesticides; removal efficiencies of over 50% for phosphorus were widely recorded.<sup>v</sup>

- ✓ When reaches of a stream with natural function are intersected with dysfunctional reaches there is a net loss in the ability of the stream to provide their water cleaning and protection benefits including processing of nutrients, pesticides, and organic matter;<sup>vi</sup> so protecting healthy function of all the waterways in the NYC Watershed ensures all waterways are able to maintain their healthy water quality and not be compromised by harm done elsewhere.

To the extent language is added to the FAD to state/clarify the use of funds for restoration upon acquisition, it would be valuable to give restoration of forested areas a high priority ranking.

- ✓ Increased nitrogen attenuation and pesticide degradation are particularly associated with forested stream buffers.<sup>vii</sup>
- ✓ Forested buffers have been shown to be 2 to 3 times wider than non-forested streams<sup>viii</sup>, thereby enhancing their ability to process point and nonpoint source pollution inputs.<sup>ix</sup>
- ✓ Forested reaches of streams support a greater number of macroinvertebrates and as such enhance the ability of the stream community to process organic matter and uptake nitrogen.<sup>x</sup> Forested streams are characterized by wider channels, lower average water velocity and higher bed roughness than deforested streams channels.<sup>xi</sup> Because forested streams have more width, there is more habitat and capacity for the uptake of nutrients like ammonium. Forested streams also slow down flows and that results in greater opportunity for uptake of nitrogen.<sup>xii</sup> The combination of increased contact time and wider channel possessed by forested streams play an important role in the ability of the stream to process nutrients and other natural and toxic substances.<sup>xiii</sup>
- ✓ Forested reaches of stream process significantly greater amounts of organic matter per unit of channel length than deforested reaches of stream.<sup>xiv</sup>
- ✓ Forested reaches of stream, per unit of channel length have a greater abundance of macroinvertebrates, including of pollution intolerant groups, they have an ability to degrade pesticides, and overall they tend to have a more natural ecosystem.<sup>xv</sup>
- ✓ Stream reaches that are forested “exhibit 20 - 33% slower channel migration and lower floodplain accretion rates of sediment and thereby provide more stability than deforested channels.”<sup>xvi</sup>
- ✓ Forested buffers help protect waterway carrying capacity. Forested streams tend to be wider with lower water velocity than deforested channels.<sup>xvii</sup> Streamside trees are well recognized for their ability to reduce flooding and flood damages<sup>xviii</sup> and are generally more effective at providing flood protection than either grass or shrubs.<sup>xix</sup>

These kinds of scientific findings advocate for a forested buffers requirement as opposed to simply vegetation in any restoration initiatives undertaken by the City. Restoration of forest ecosystems on purchased lands is well within keeping of the goals of the FAD Flood Hazard Mitigation Program.

### **Land Management Program**

The Delaware Riverkeeper Network and Catskill Mountainkeeper support adding the Invasive Species Management Strategy to the Land Management Program. As noted in the FAD, invasive species are having a significant impact on ecosystems and in turn on water quality. That impact will increase with the level of invasion. It is better to get a grip on this issue today when it is more manageable than tomorrow when it might be out of control.

### **Stream Management Program**

The Delaware Riverkeeper Network and Catskill Mountainkeeper support the addition of a new focus to the Stream Management Program giving attention to flooding in streamside communities while continuing to support and advance the historic efforts of the program. The additional funding for the Stream Management Program and its new focus are important investments for protecting water quality and helping communities.

### **Wetlands Protection Program**

The Delaware Riverkeeper Network and Catskill Mountainkeeper support the focus on enhanced wetlands mapping.

### **Riparian Buffer Protection Program**

We would like to suggest that the Mid-Term FAD include a special section on the Riparian Buffer Program and include work elements that would enhance that program. It is unclear looking at program materials what guidance or requirements for funding through the program are linked to buffer width. For both the Riparian Buffer program in place, the one to be created in this Mid-Term FAD and the restoration of riparian lands that may occur under the land acquisition and the flood buyout program, specific guidance should be provided on buffer widths. In order to be the most protective, buffers need to have a healthy width. And so it is important that any restoration guidance also stress the importance of maximum buffer widths with a minimum set at 100 ft width.

The Army Corps states, "that establishing or maintaining existing vegetated buffers to open waters is critical to overall protection of the nation's aquatic ecosystems".<sup>xx</sup> The Army Corps points out that the wider the buffer, the more protective of ecological functions they will be, which the Army Corps considers to be a mandated goal of the Clean Water Act.<sup>xxi</sup> The Natural Resources Conservation Service Planning & Design Manual recognizes that while there may be a range of buffers to choose from, "a minimum buffer of 100 ft (30 m) on both sides of the stream is recommended for sufficient protection of the stream."<sup>xxii</sup>

And so, while 100 feet is emerging as a minimum width that is needed for stream protection, it is also true that wider buffers, 300 feet or more, are often needed to protect stream health and water purity, and to give the animals in the stream and on the banks the habitat, food and protection they need for survival and reproduction. For nutrient removal 100 feet may not be enough, particularly if septic systems are not operating at full efficiency for the removal of nutrients.

Widths of 150 feet and more are often discussed for nutrients. Where 100 feet have been required for pollutant removal, in Massachusetts experience is demonstrating that this is increasingly too little. But in Connecticut the 100 foot minimum is used to accomplish a variety of objectives and it is believed that 100 feet will give a level of nutrient assimilation that is of value while achieving these other objectives, such as clarity for enforcement.<sup>xxiii</sup>

For nitrate removal, scientific study has shown that wider buffers are increasingly effective, with buffers in the 80 foot range providing about 58% removal as compared to buffers that were 85 to 164 feet providing 71% removal, and buffers over 164 feet providing 85%.<sup>xxiv</sup> And forested buffers were found to be more efficient at the nitrate removal by an average of 18% as compared to herbaceous buffers.<sup>xxv</sup> Also, while buffers slimmer than 164 feet had a wide range of nitrate removal efficiencies, those above 164 feet wide were consistently high, only occasionally dipping to no less than the 75% range.<sup>xxvi</sup> Likewise, sediment removal efficiencies increase with the width of the buffer.

### **Regulatory Authority over Floodplain/Streamside Development**

The Delaware Riverkeeper Network and Castkill Mountainkeeper recommend that the FAD include plans for a regulatory program which would prevent new development projects in the 500-year floodplain. With climate change, more extreme weather and flooding events are predicted and in fact already being experienced. It is important that there be no new development in the floodplain.

The City continues to rely heavily upon local government to manage construction within the floodplain. We believe it is time for the City to reconsider this shared decisionmaking. Development in the watershed's floodplain necessarily introduces new pollution inputs to waterways that serve NYC's drinking water supply, results in loss of the protective ecological systems natural floodplains provide, and puts new structures and facilities in the path of harm.

The City should either provide overlay criteria that prevents 500-year floodplain development and mandates minimum 100-foot buffers on all streams or should work with the DRBC to secure such regulation through the DRBC's authority. But a patchwork of regulation that allows floodplain development to continue is counterproductive to all the other measures NYC is implementing in this Mid-Term revision of the FAD.

### **Catskill Turbidity Control**

The Delaware Riverkeeper Network and Castkill Mountainkeeper urge that the planned Catskill Turbidity Control General Management Plan not be crafted with a goal of simply maintaining water quality from the Catskill system during the period the Rondout to West Branch Tunnel (RWBT) is shut down but that it have as a stated goal identifying the causes of the water quality impairment and turbidity issues and to craft and carry out permanent restorative solutions. There are many communities that rely upon the Delaware River in a variety of ways who are downstream from New York and as the community at the top it is incumbent on New York to



reduce its dependence on Delaware River water to the degree it can so the maximum level of water possible is available for those who are downstream on the Delaware. Providing permanent solutions for the Catskill system will allow the City to permanently reduce its reliance upon Delaware River water in a way that enhances the water security of those downstream but that also enhances the water security of New York City by expanding its array of water supply options. A plan focused on merely short term fixes which will only last the duration of the RWBT shut down is short sighted.

#### **Catskill and Delaware Aqueduct Connection at Shaft 4**

The Delaware Riverkeeper Network and Castkill Mountainkeeper oppose the new Catskill and Delaware Aqueduct Connection at Shaft 4. It is clear that this new connectivity will be used as a short cut to draw more clean Delaware River into the NYC drinking water system and alleviate the need to fully and permanently resolve the water quality and turbidity issues faced in the Catskill system.

#### **Reservoirs Should Not Be Used for Delaware River Flood Control**

There has been much pressure to rely upon the NYC reservoirs for managing flooding downstream, as far down as Bucks County, PA/Trenton, NJ. The Delaware Riverkeeper Network and Castkill Mountainkeeper cannot support this use of the reservoirs. DRBC analyses of major Delaware River flood events between 2004-2006 show that voids in the reservoirs cannot provide meaningful flood protection benefits in the downstream Watershed. Attempting to provide flood control through the New York City reservoir system is not feasible, beneficial, or environmentally or economically sound. The water supply reservoirs were not designed for that, they are not an effective means to accomplish a reduction in flooding and flood damages, and promising flood damage reduction via the NYC reservoir system will provide a false sense of security that supports, encourages and induces greater development in the downstream floodplain thus exacerbating, not alleviating, the problems associated with floodplain development and flooding.

Voids could jeopardize NYC's drinking water supply and downstream flows, it would compete with needed releases for protecting downstream drinking water for New Jersey and Pennsylvania, it competes with releases needed to manage the downstream salt line, and it would compete for releases needed to protect the fish populations and other stream dwelling species that are ecologically and economically vital to the River and dependent River communities and part of the recently approved Flexible Flow Management Plan.

Flood damages are best controlled by protecting floodplains and implementing policies and funding to remove structures from the path of floodwaters. It is the ultimate in hubris to think that through manmade structures we can or would prevent flooding and flood damages. And in fact, flooding in the floodplain is not just a given fact of life, but it makes a positive contribution to

the quality of our lives. Natural flooding ensures waterways continue to flow, provides ecological signals and changes critical for aquatic life, and is a natural, normal, and needed part of any waterway's life cycle. Rather than invest in false solutions for non-natural flooding, we need to invest in real solutions that provide positive contribution to all communities, including: reduce storm runoff by limiting land use changes; employ effective stormwater recharge systems; protect and restore healthy vegetated buffers along all waterways to allow storm flows to be absorbed and slowed; restore floodplains so they can provide their natural function of absorbing and attenuating flood flows and peaks, and remove structures out of the path of harm by preventing new development and removing existing development in the 500-year floodplain to avoid damages and catastrophic losses.

We recognize that in certain conditions such as storm flows, high water, and snow pack melt, spills from the reservoirs require management to avoid flooding directly below the reservoirs. But as for other downstream flooding, the Delaware Riverkeeper Network and Castkill Mountainkeeper state for the record that we do not support any efforts to add voids for flood flow storage to the reservoirs for flood control purposes in the downstream river.

We were disappointed to see that in the Ashokan Reservoir DEP has taken the position that reservoir voids are a valid tool for mitigating flooding.<sup>xxvii</sup> This sets a dangerous precedent for the NYC drinking water system that should be reversed. All NYC reservoirs should be managed in a way that does not inflict harm certainly, but to suggest that reservoir voids are an appropriate tool for flood damage reduction rather than other strategies such as voluntary buyouts and floodplain restoration places the City on a slippery slope and taking contradictory positions on the Delaware River reservoirs vis a vis the Ashokan. NYC needs to maintain a consistent position on this issue for all reservoir operations.

### **Shale Gas Development**

Given that the biggest new threat facing the Delaware River drinking water supply is the implementation of shale gas development with all the drilling, fracking, toxins, air emissions, infrastructure, land development, truck travel, etc that it brings, the FAD should include a position against shale gas development anywhere in the watershed and a plan for how NYC DEP will enforce such a ban. The ban should apply to horizontal drilling underneath the city's watershed lands to protect from potential contamination of ground and surface waters by hydraulic fracturing. This prohibition should include not only the drilling itself, but also withdrawal of water and discharge of gas drilling wastewater, and gas pipelines, compressors, etc that could be proposed to service gas drilling happening elsewhere.

## Wrap up

Overall with this Mid-Term FAD, New York City has set in place a strong program and precedent for others to admire and follow. We hope you will make the modifications recommended in this comment in order to ensure the program is as fully effective and model as possible for the benefit fo present and future generations.

Respectfully,



Maya K. van Rossum  
the Delaware Riverkeeper  
Delaware Riverkeeper Network

Wes Gillingham  
Program Director  
Catskill Mountainkeeper

<sup>i</sup> David Welsch, Forest Resources Management, USDA Forest Service, "Riparian Forest Buffers: Function and Design for Protection

### <sup>ii</sup> Summary of Select Studies Reporting Percentage of Pollutant Reductions Based on Buffer Size

Study	Year	% Reduction based on Buffer Size:											
		~15 ft (4.6 m)			~35 ft (10.7 m)			~100 ft (30.5 m)			> 100 ft (> 30.5 m)		
		N	P	S	N	P	S	N	P	S	N	P	S
Lowrance <i>et al.</i>	2001	5%	62%	60%	50%	65%	80%	80%	80%	90%	95%	90%	90%
Lowrance <i>et al.</i>	1995	4%	29%	61%	23%	24%	75%	80%	77%	97%			
Schwer & Clausen	1989							76%	78%	89%			
Magette <i>et al.</i>	1987	17%	41%	72%	51%	53%	86%						
Barker & Young	1984										99%		
Young <i>et al.</i>	1980							87%	88%				

<sup>iii</sup> Stroud Water Research Center, Protecting Headwaters: The Scientific Basis for Safeguarding Stream and River Ecosystems, 2008.

<sup>iv</sup> National Research Council. 2002. Riparian Areas: Functions and Strategies for Management. Water, Science, and Technology Board, Board of Environmental Studies and Technology, National Academy Press, Washington, DC. Also see Stroud Water Research Center, Protecting Headwaters: The Scientific Basis for Safeguarding Stream and River Ecosystems, 2008.

<sup>v</sup> Newbold & Sweeney, Stroud Water Research Center, "Removal of Nonpoint Source Pollutants by Riparian Buffers: A Short Summary of the Scientific Literature", June 2010.

<sup>vi</sup> B.W. Sweeney, Bott, Jackson, Kaplan, Newbold, Standley, Hession and Horwitz, Riparian deforestation, stream narrowing, and loss of stream ecosystem services, Proceedings of the National Academy of Sciences of the United States of American, Vol 101, No. 39, Sept 28, 2004.

<sup>vii</sup> Sweeney, B. W., et al. 2004. Riparian deforestation, stream narrowing, and loss of stream ecosystem services. PNAS, September 2004; 101: 14132-14137.

<sup>viii</sup> PA CREP Fact Sheet: Streamside Magicians, How Trees Help Streams, 2006, citing Stroud Water Research Center research.

<sup>ix</sup> Sweeney, et al, Riparian deforestation, stream narrowing, and loss of stream ecosystem services. 2003.

<sup>x</sup> B.W. Sweeney, Bott, Jackson, Kaplan, Newbold, Standley, Hession and Horwitz, Riparian deforestation, stream narrowing, and loss of stream ecosystem services, Proceedings of the National Academy of Sciences of the United States of American, Vol 101, No. 39, Sept 28, 2004.

<sup>xi</sup> B.W. Sweeney, Bott, Jackson, Kaplan, Newbold, Standley, Hession and Horwitz, Riparian deforestation, stream narrowing, and

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- loss of stream ecosystem services, Proceedings of the National Academy of Sciences of the United States of American, Vol 101, No. 39, Sept 28, 2004.
- <sup>xiii</sup> B.W. Sweeney, Bott, Jackson, Kaplan, Newbold, Standley, Hession and Horwitz, Riparian deforestation, stream narrowing, and loss of stream ecosystem services, Proceedings of the National Academy of Sciences of the United States of American, Vol 101, No. 39, Sept 28, 2004.
- <sup>xiii</sup> B.W. Sweeney, Bott, Jackson, Kaplan, Newbold, Standley, Hession and Horwitz, Riparian deforestation, stream narrowing, and loss of stream ecosystem services, Proceedings of the National Academy of Sciences of the United States of American, Vol 101, No. 39, Sept 28, 2004.
- <sup>xiv</sup> B.W. Sweeney, Bott, Jackson, Kaplan, Newbold, Standley, Hession and Horwitz, Riparian deforestation, stream narrowing, and loss of stream ecosystem services, Proceedings of the National Academy of Sciences of the United States of American, Vol 101, No. 39, Sept 28, 2004.
- <sup>xv</sup> B.W. Sweeney, Bott, Jackson, Kaplan, Newbold, Standley, Hession and Horwitz, Riparian deforestation, stream narrowing, and loss of stream ecosystem services, Proceedings of the National Academy of Sciences of the United States of American, Vol 101, No. 39, Sept 28, 2004.
- <sup>xvi</sup> Sweeney, et al, Riparian deforestation, stream narrowing, and loss of stream ecosystem services. 2003.
- <sup>xvii</sup> Sweeney, et al, Riparian deforestation, stream narrowing, and loss of stream ecosystem services. 2003.
- <sup>xviii</sup> See for example PA CREP Fact Sheet: Streamside Magicians, How Trees Help Streams, 2006, in which this powerful benefit of trees is affirmatively stated by the State program's fact sheet.
- <sup>xix</sup> Riparian Buffer Zone. NRCS Planning & Design Manual, NRCS.
- <sup>xx</sup> Army Corps of Engineers WRAP, "Technical and Scientific Considerations for Upland and Riparian Buffers Strips in the Section 404 Permit Process", ERDC-WRAP-01-6, May 2002 citing the Federal Register 67(10), p. 2065.
- <sup>xxi</sup> Army Corps of Engineers WRAP, "Technical and Scientific Considerations for Upland and Riparian Buffers Strips in the Section 404 Permit Process", ERDC-WRAP-01-6, May 2002.
- <sup>xxii</sup> Riparian Buffer Zone. NRCS Planning & Design Manual, NRCS.
- <sup>xxiii</sup> Position Statement, Inland Fisheries Division, Utilization of 100 Foot Buffer Zones to Protect Riparian Areas in Connecticut, Brian D. Murphy, Technical Assistance Biologist.
- <sup>xxiv</sup> Newbold & Sweeney, Stroud Water Research Center, "Removal of Nonpoint Source Pollutants by Riparian Buffers: A Short Summary of the Scientific Literature", June 2010.
- <sup>xxv</sup> Newbold & Sweeney, Stroud Water Research Center, "Removal of Nonpoint Source Pollutants by Riparian Buffers: A Short Summary of the Scientific Literature", June 2010.
- <sup>xxvi</sup> Newbold & Sweeney, Stroud Water Research Center, "Removal of Nonpoint Source Pollutants by Riparian Buffers: A Short Summary of the Scientific Literature", June 2010.
- <sup>xxvii</sup> January 22, 2012 Press Release, NYC DEP, DEP Reaches 10% Void in Ashokan Reservoir.