Bureau of Water Supply

Invasive Species Management Strategy

December 2016

Prepared in accordance with Section 4.3 of the NYSDOH Revised 2007 Filtration Avoidance Determination

Prepared by: DEP, Bureau of Water Supply

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1. Executive Summary

DEP's Invasive Species Program strives to protect water quality, watershed ecosystems and infrastructure from the negative impacts of invasive species through strategic activities to support five goals.

1. Preventing the introduction of new invasive species into the watershed by mitigating the risk associated with known pathways for introduction

   Prevention has proven to be a cost-effective first line of defense at the national, state, and regional level and is generally implemented through laws, regulations, and rules targeting activities that would promote the introduction and spread of invasive species via specific pathways. The risk of recreational boating on certain NYC reservoirs, for example, is mitigated by rules that require boats to be steam cleaned prior to use on the reservoir. It is also supported by outreach and education efforts.

2. Detecting new infestations early and responding to them rapidly

   Early Detection and Rapid Response (ED/RR) is the method by which new infestations of an invasive species to an area are identified, contained and potentially eradicated quickly to minimize the cost of control and impacts to water quality, the environment, human health and the economy. ED/RR efforts can be implemented at a variety of scales and require regional cooperation to make them most effective.

3. Control and management in order to support specific projects

   DEP selects invasive species management projects judiciously with attention to available resources. Aside from rapid responses to early detections, other criteria considered are the impacts to water quality, the threat from the invasive species to the successful outcome of other DEP land management projects and whether those management actions threaten to increase the impacts of invasive species to the surrounding area. Additionally, appropriate control strategies must be assessed based on their ability to successfully manage the target species.

4. Mitigate the impacts of any invasive species that cannot be effectively managed

   Other methods can be pursued to mitigate impacts in instances where there are no effective tools to eradicate or control an invasive species and it is causing a significant harm. This has been the case with the emerald ash borer, which was first detected in the West of Hudson watershed beginning in 2010.

5. Restoring sites to prevent further impacts from invasive species

   Restoration involves activities to promote natural succession through the intentional planting or stocking of desired native species. Some of the restoration projects currently underway include a tree planting project at the site of a tornado blowdown, planting of

native species along stream management projects after treating Japanese knotweed (*Fallopia japonica*) and the installation of deer fencing in areas undergoing forest management in the Ashokan Reservoir basin.

DEP coordinates among bureaus and directorates, and collaborates with partners regionally and statewide in order to achieve these goals. Many strategies to support these goals are already underway and will be adapted and improved by incorporating lessons learned over the coming years, while others are just coming online and may take some time to fully develop. This document includes strategies that are already being implementing and those that are planned for the next ten years to protect water quality, watershed ecosystems and infrastructure from invasive species.

2. Introduction

The New York City Department of Environmental Protection (DEP) strives to prevent and minimize impacts of invasive species on ecosystem functions and the infrastructure that delivers clean, high quality drinking water to over nine million New Yorkers. A species is considered invasive if it is non-native (or alien) to the ecosystem under consideration and its introduction causes or is likely to cause economic or environmental harm or harm to human health. Concern over the threat invasive species pose to the New York City Water Supply system has been growing since the arrival of the zebra mussel (*Dreissena polymorpha*) in the Great Lakes in 1988, and has expanded to include many terrestrial and other aquatic species as well. Invasive aquatic plants and animals, like the zebra mussel, can damage or disrupt water supply infrastructure and negatively impact water quality. Terrestrial invasive plants and pests make the landscape more susceptible to natural disturbances through increased soil erosion, sediment deposition and soil nitrogen loss in addition to decreased overall plant cover, diversity and forest regeneration.

Current Status of Invasive Species

The distribution and abundance of long-established populations of invasive species is variable across the NYC Water Supply watershed with a greater number of invasive species and broader distribution in the East of Hudson (EOH) watershed and fewer species with a higher concentration of many species in the eastern portion of the West of Hudson (WOH) watershed. New introductions are more likely to occur in the EOH watershed because of higher population density resulting in greater numbers of pathways for introduction as well as the proximity to ports of entry into the United States.

Nutrient rich EOH reservoirs support abundant aquatic plant growth, including the invasive species Eurasian water milfoil (*Myriophyllum spicatum*), curly-leaf pondweed (*Potamogeton crispus*), and water chestnut (*Trapa natans*). High numbers of deer, a land use history rich with human impacts, and proximity to roads and development EOH contribute to the greater distribution of established species like Japanese barberry (*Berberis thunbergii*), Oriental bittersweet (*Celastrus orbiculatus),* and garlic mustard (*Alliaria petiolata*). The hemlock woolly adelgid (*Adelges tsugae*) has been impacting the eastern hemlock (*Tsuga canadensis*) in most of

the EOH watershed for over two decades while the emerald ash borer (*Agrilus planipennis*) has just begun to spread into the region from its epicenter in Ulster County but will rapidly eliminate all ash (*Fraxinus*) species.

The six WOH reservoirs are much less nutrient rich and tend to only support low numbers of native aquatic plants. These reservoirs are also subject to large fluctuations in water level throughout the growing season which can prevent establishment of many invasive plants. Ongoing agricultural activities or those in the recent past have had a greater impact on the terrestrial invasive species present in the WOH watershed with multiflora rose (*Rosa multiflora*) and Japanese barberry found in abundance in abandoned farm fields. Japanese knotweed has also become widespread WOH as a result of frequent flooding and subsequent work that is done to restore stream bank stability and repair damaged roads. Emerald ash borer is spreading through the WOH watershed rapidly from east to west with satellite populations building in the west and hemlock woolly adelgid is moving through from southeast to northwest at a slow pace. Overall the WOH of watershed has lower numbers of many of the emerging invasive species that are commonly introduced to areas with greater human populations.

Mission

DEP's Invasive Species Program strives to protect water quality, watershed ecosystems and infrastructure from the negative impacts of invasive species through strategic activities to support five goals. First, preventing the introduction of new invasive species into the watershed by mitigating the risk associated with known pathways for introduction can stop a new invasion before it starts. Secondly, if prevention is not successful, detecting new infestations early and responding to them rapidly is the next best scenario. These two strategic goals have been recognized by the National Invasive Species Council in their 2016 - 2018 Management Plan as the most effective strategies for managing invasive species (National Invasive Species Council, 2016). Where these strategies fall short or established populations already exist, the third goal is to conduct control and management in order to support specific projects in accordance with the recommended practices such as in forest management activities (United States Forest Service, 2013) or wetland mitigation projects (US Army Corps of Engineers, 2005). The fourth goal is to mitigate the impacts of any invasive species that cannot be effectively managed. Lastly, when invasive species control work is not sufficient to maintain native ecosystem functions, restoration of sites that have been degraded may be necessary (National Invasive Species Council, 2016).

Accomplishment of all of these activities requires that efforts be coordinated between DEP bureaus and directorates and is greatly improved by collaborating with partners regionally and statewide. Many of these strategies are already underway and will be adapted and improved by incorporating lessons learned over the coming years, while others are just coming online and may take some time to fully develop.

The purpose of this document is to outline the strategies DEP is implementing and has planned for the next ten years to protect water quality, watershed ecosystems and infrastructure from invasive species. This covers work that has been accomplished through the efforts of DEP staff from across the Bureau of Water Supply that meet regularly as an Invasive Species Working

Group (Working Group), and working with regional and statewide partnerships such as the two Partnerships for Regional Invasive Species Management (PRISMs) that cover the watershed, Lower Hudson PRISM (LH PRISM) and the Catskill Regional Invasive Species Program (CRISP).

3. Prevention and Pathway Risk Mitigation

Preventing the introduction of new invasive species to an area by mitigating the risks associated with their known pathways, such as recreational boating, is an important first step to minimizing their impacts on City lands and waters. It has proven to be a cost-effective first line of defense at the national, state, and regional level and is generally implemented through laws, regulations, and rules targeting activities that would promote the introduction and spread of invasive species via specific pathways. The risk of recreational boating on certain NYC reservoirs, for example, is mitigated by rules that require boats to be steam cleaned prior to use on the reservoir. Education and outreach to audiences about the effects of certain behaviors is another strategy that is particularly suited to targeting those pathways with an audience that would also be impacted by invasive species, such as recreational boaters who may not be able to continue to enjoy a reservoir once it is invaded by water chestnut.

DEP has taken both approaches to preventing the introduction of new invasive species through high risk pathways. Federal and state regulations have increasingly been able to provide protection on a number of pathways but where these efforts fall short on targeting some of the greatest risks to the water supply, internal rules, procedures and practices have been implemented by DEP. DEP developed comprehensive communication plan to direct education and outreach efforts to target the highest priority audiences and supports national, state and regional education and outreach campaigns such as the *Don't Move Firewood* campaign, *Clean, Drain, and Dry* to stop aquatic hitchhikers, and a Eurasian Boar (*Sus scrofa*) awareness campaign for the Catskills.

Potential Pathways

Pathways are the means by which the introduction or movement of invasive species to a new area is facilitated either intentionally or unintentionally. Firewood is a known source of forest pests and could potentially be a pathway for the very damaging Asian long horned beetle (*Anoplophora glabripennis*), spreading it from nearby infestations in New York City or Worcester, Massachusetts into the watershed. Boat trailers are another top concern since aquatic plants can unknowingly be transported long distances within the structure of the trailer. Risk associated with each pathway varies depending on the species carried by the pathway, the frequency with which an introduction might occur, and the distance that a pathway could move a species. They can broadly be categorized into three areas: transportation, living industries, and miscellaneous which covers natural sources of movement or disturbance as well as anthropogenic processes. See Table 1.1 for many examples of each type of pathway.

Table 1.1 Potential pathways of invasive species introduction onto City lands or waters divided into three main categories: transportation, living industries, and miscellaneous natural and anthropogenic processes.

Transportation	Living Industries	Miscellaneous
Ballast water	Landscaping	Waterfowl
Recreational/fishing boats	Nurseries	Deer
Contractor and DEP boats	Soil and sod	Fire
Boat trailers	Hay and straw	Land clearing/mowing
Fishing equipment	Pet and aquarium trade	Logging
Dredge spoils	Bait/fish stocking	Utility ROW clearing
Cars, buses, and trucks	Aquaculture and seafood	Habitat restoration
Construction equipment	Hunting reserves	Waterways
ATVs	Firewood	Inter-basin transfers
Roadside maintenance		Aqueducts
Hikers/hunters		Wind

Current Pathway Risk Mitigation

Federal and state regulations have been developed to stem the tide of introductions over the years as pathways have been identified as bringing new, costly invasive species into the United States or New York.

Examples of federal regulations that target invasive species pathways include:

- The US Coast Guard's regulation, Ballast Water Management for Nonindigenous Species in Waters of the United States, targets the introduction of aquatic invasive species that could be carried into US waters through the shipping industry's ballast water.
- The Plant Protection Act allows the US Department of Agriculture Animal Plant Health Inspection Service (USDA APHIS) to regulate the movement of approximately 100 listed weeds including many invasive species.
- The Lacey Act grants the US Department of the Interior the ability to prohibit the importation or transportation of injurious wildlife that threaten humans or natural resources.
- The Plant Quarantine Act provides the USDA APHIS with the authority to regulate interstate movement of plants that are known to carry harmful pests including invasive insects or diseases.

Examples of New York State regulations that target invasive species pathways include:

- New York Environmental Conservation Law Article 11 Fish and Wildlife, Title 5 Fish and Wildlife Management 11-0507 prohibits the intentional liberation of zebra mussels

into any waters of the state and 11-0509 prohibits the planting, transport, transplanting or trafficking of water chestnut.

- Title 6 of the Department of Environmental Conservation (DEC) Codes, Rules, and Regulations, Part 180.12 prohibits the hunting or trapping of Eurasian boar since hunters are a known pathway for transporting boar to new locations.
- Title 6 of the Department of Environmental Conservation (DEC) Codes, Rules, and Regulations, Part 575 prohibits and regulates the sale, propagation, and importation of listed species that have been ranked highly for invasiveness.
- Title 6 of the Department of Environmental Conservation (DEC) Codes, Rules, and Regulations, Part 576 establishes reasonable precautions to prevent the spread of aquatic invasive species on watercraft into public waters.
- Title 6 of the Department of Environmental Conservation (DEC) Codes, Rules, and Regulations, Part 192.5 prohibits movement of untreated firewood more than 50 linear miles to prevent the spread of forest pests.

New York City Department of Environmental Protection

While these and other similar regulations help to reduce the spread of many species, there are some gaps that still leave City lands and waters vulnerable to invasion, particularly by species that may be common in nearby areas. The primary pathways that have been recognized as needing to be addressed by internal rules, procedures and practices are bait, fishing equipment, recreational and fishing boats, contractor and DEP boats and their trailers, logging, and construction equipment. They are currently managed through the following rules, strategies, plans, practices, policies and specifications.

Rules for the Recreational Use of Water Supply Lands and Waters

The Rules for the Recreational Use of Water Supply Lands and Waters are Chapter 16 of Title 15 of Rules of the City of New York and govern the recreational use of all New York City Water Supply lands, lakes and reservoirs. These rules apply to everyone who legally accesses these lands.

- §16-04 (g) Bait and Bait Disposal allows live aquatic bait, which may include, but is not limited to, alewives, shiners, leeches, and crawfish, to be used for fishing unless it has been taken from waters infested with zebra mussels, or other invasive species of mussels. Neither bait nor the water from aquatic bait containers shall be disposed of on City Property. DEP, at its sole discretion, may prohibit the use of specified bait.
- §16-04 (h) Fishing Equipment provides DEP the right to prohibit certain waders from use in the watershed due to the potential threat of invasive species being transferred from waders into the NYC water supply.
- §16-05 Boat Tag requires all anglers' boats used on City Property to be registered and steam cleaned by DEP, when available, as listed on the DEP website, and stored on-site in Boat Storage Areas designated by DEP due to the threat of Water Supply contamination by organisms such as zebra mussel larvae that may be introduced to City waters by boats previously used in contaminated waters.

- §16-07 (b) Recreational Boat Tags, governing the Recreational Boating Program, requires that all boats used in Recreational Boating Areas shall be registered and steam cleaned by DEP's designees, as listed on DEP's website due to the threat of Water Supply contamination by organisms such as zebra mussel larvae that may be introduced to City waters by boats previously used in contaminated waters.

  Zebra Mussel Prevention Strategy

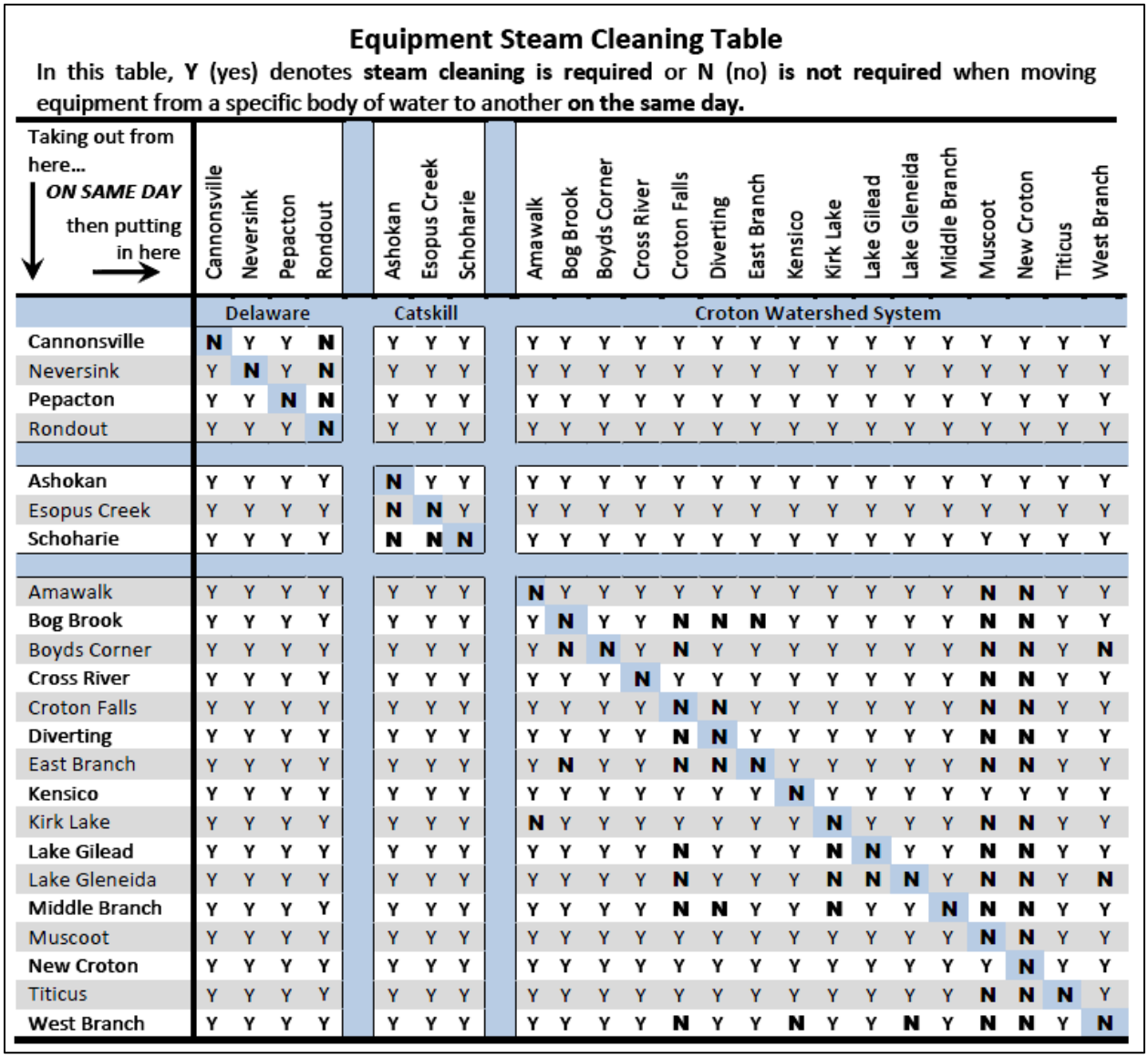
Since 1993, DEP has been implementing a strategy to prevent the introduction of zebra mussels through steam cleaning of contractor and DEP vessels and equipment that enter or move between reservoirs through operating procedures that have been established to prevent the inadvertent introduction or spread of zebra mussels or other small-bodied organisms:

- Small Boat Program Guide - Section 5 – Environmental, Health and Safety
  5.2 Equipment Steam Cleaning and Inspection is an internal procedure for steam cleaning and inspection of equipment that is used in the water by Bureau of Water Supply personnel and contractor vessels under 16 feet in length.

  - All water is drained from the vessels and their components including bilge water offsite
  - All parts of the vessel and equipment are visually inspected for adult mussels
  - If any suspect organisms are discovered they are collected, identified by trained staff, and verified by the zebra mussel contractor
  - If there are confirmed zebra or other invasive mussels attached to the vessel it will be quarantined for a minimum of two weeks
  - All vessels will be steam cleaned inside and out with high pressure steam spray
  - Steam cleaning must be done with a minimum of 160° F, 700 psi and 2 gallons per minute.
  - Interior areas that cannot be steam cleaned can be treated with 5% chlorine solution for at least 48 hours
  - Bureau of Water Supply vessels must be steam cleaned each day before a vessel is deployed all year around.
  - If visiting multiple reservoirs, the vessel must start at the most upstream reservoir in a given watershed (Figure 1.1)
  - If moving from one watershed system to another, that vessel must be steam cleaned again.
  - If moving to an upstream reservoir it must be steam cleaned again

- A specification is included in all contracts that requires contractor vessels 16 feet and longer and/or equipment to come into contact with the reservoirs to be steam cleaned by the contractor under DEP supervision. The specification prohibits all ballast exchanges in the reservoirs and details protocol for inspection and steam cleaning. Procedures and quarantine times for cases where organisms are found attached to any vessel or piece of equipment are also specified.

Figure 1.1 This figure indicates when boats must be steam cleaned based on the Small Boat Program Guide.



Equipment Steam Cleaning Table

In this table, **Y** (yes) denotes **steam cleaning is required** or **N** (no) **is not required** when moving equipment from a specific body of water to another **on the same day.**

Taking out from here… / *ON SAME DAY* then putting in here →	Cannonsville	Neversink	Pepacton	Rondout	Ashokan	Esopus Creek	Schoharie	Amawalk	Bog Brook	Boyds Corner	Cross River	Croton Falls	Diverting	East Branch	Kensico	Kirk Lake	Lake Gilead	Lake Gleneida	Middle Branch	Muscoot	New Croton	Titicus	West Branch
	Delaware				Catskill			Croton Watershed System															
Cannonsville	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Neversink	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Pepacton	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Rondout	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ashokan	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Esopus Creek	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Schoharie	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Amawalk	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y
Bog Brook	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	N	Y	Y	Y	Y	Y	N	N	Y	Y
Boyds Corner	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N
Cross River	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y
Croton Falls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	N	Y	Y
Diverting	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	N	Y	Y
East Branch	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	N	Y	Y	Y	Y	Y	N	N	Y	Y
Kensico	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
Kirk Lake	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	Y
Lake Gilead	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	Y	N	N	Y	Y
Lake Gleneida	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N
Middle Branch	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	N	Y	Y	N	N	N	Y	Y
Muscoot	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y
New Croton	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
Titicus	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y
West Branch	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	N	Y	N	N	Y	N

Gear Decontamination Policy for Didymo

In response to the discovery in 2009 of the diatom, Didymo (*Didymosphenia geminate)* in the Esopus Creek, DEP instituted a set of protocols to decontaminate field equipment to help prevent staff from spreading Didymo to other areas of the watershed during field work. The protocol requires sampling from upstream to downstream, inspection of equipment for Didymo, and provides several methods to decontaminate equipment after field work including bleach, salt solution, freezing or submersion in hot water (>45° C).

Conservation Practices and Process for DEP Forest Management Projects

This internal guidance document covers strategies to prevent the spread of existing terrestrial invasive plants throughout active forest management project sites and to stop the spread of seeds and other propagules from moving onto City lands on logging equipment.

- 4.7.3 Invasive Plant Best Management Practices specifies that:
  - Control of invasives in the log landing zone will be prioritized, as applicable to prevent their spread throughout the site
  - Existing roads, skid trails, and landings are used as much as possible to reduce soil disturbance which could promote invasive plant establishment
  - New roads, skid trails and landings are avoided in concentrated areas of invasive plants, if possible, to minimize soil disturbance and limit the unintentional transport of invasives into non-infested areas
  - Non-infested areas are harvested before infested areas to reduce the spread of invasive plants, if possible
  - Prior to moving equipment onto and off of a project area, soil, debris and vegetation and seeds will be broom-swept and/or scraped off from exterior surfaces of equipment, to the extent possible, to minimize the transport of invasive materials

Land Use Permits

DEP issues Land Use Permits to applicants that require access to City lands for a variety of purposes. Land Use Permit applications are reviewed for potential actions that may cause the introduction and spread of invasive species into the reservoirs or onto City lands. Any permitted activity that involves access to water requires the same steam cleaning protocols outlined in the Small Boat Program document or the contractor specification. Other permit conditions requiring actions to be taken to prevent the introduction or spread of invasive species and/or site restoration are added as needed by the particulars of the use.

Invasive Species Communication Plan

Where laws, regulations, rules, procedures and practices often fall short is the local spread of invasive species by routine activities. Spread prevention education and outreach can provide insight to specific audiences who may not realize that they are spreading invasive species and that these species might negatively affect their future activities.

DEP developed an internal document to generate targeted and consistent messaging to internal and external audiences to support existing national, state, and regional campaigns with messages relating to invasive species management. These messages are intended to increase capacity, efficiency and support for invasive species spread prevention among other management efforts.

The plan targets internal audiences, such as DEP units that engage in activities such as land clearing and mowing, that may provide pathways for invasive species messages like *Don't*

Spread Invasive Species. DEP staff have already received training on some invasive species spread prevention techniques as part of the implementation of this plan.

External audiences identified in the plan include loggers, construction contractors, design consultants and landscape architects, anglers, hunters, boaters, hikers, officials and policy makers, planning boards, planning professionals, and streamside landowners all of whom may spread invasive species within the watershed through their regular activities. To date the following elements of the plan have been implemented to reach external audiences: webpages on invasive species prevention techniques for hikers, hunters, anglers, and boaters on the DEP website; a Recreation Newsletter article on preventing the spread of invasive vines; distribution of print materials through booths at farmers' markets and fairs to address aquatic invasive species spread by boats and fishing equipment; and signs at boating areas regarding bait and fishing equipment.

Planned Pathway Risk Mitigation Strategies

Identify Gaps and Improve Messaging

The Invasive Species Working Group will continue to review programs and policies for their efficacy at preventing introductions through the various pathways and identify gaps in prevention. By bringing forward concerns from throughout the Bureau of Water Supply, Working Group members provide many perspectives on this issue and are exposed to a breadth of potential pathways.

One such pathway that has been brought up through the Working Group is soil disturbance from land clearing activities associated with construction projects, some land use permit activities, stream management projects, farming practices, and other work on infrastructure. The Working Group is considering the development of an internal policy or procedure to help address the opportunity for invasive species to become established when they are brought in on equipment since disturbed soil provides an optimal environment for them to become established.

Additionally, as spread prevention messages are developed for audiences such as hunters, anglers, or boaters, the response will be assessed and messaging will be adapted to achieve the desired behavior change. The response will be assessed by using surveys, observation at outreach events, and interviews with user groups.

Partnership Efforts

The New York State Invasive Species Advisory Committee, Lower Hudson Partnership for Regional Invasive Species Management and Catskill Regional Invasive Species Partnership have been working toward developing consistent invasive species messages and promoting specific themes statewide during the annual Invasive Species Awareness Week, in addition to other programming throughout the year. Much of this effort in recent years has focused on raising awareness of the 6 NYCRR Part 575 Prohibited and Regulated Invasive Species and Part 576 Aquatic Invasive Species Spread Prevention regulations. Supporting this effort through the implementation of the DEP communications plan to educate target audiences about the two new State regulations within the watershed

will help to increase compliance and reduce the risk of these important pathways. Continuing to support the annual statewide and regional outreach themes will help to amplify the efforts for all participating groups and prevent duplication of efforts. This will be done in conjunction with statewide efforts to develop a coordinated outreach program for invasive species in New York State. Two formal assessments to support regional and statewide outreach messages with published reports have been done to date by the Cornell University Human Dimensions Research Unit that cover the New York City watershed and can aid in the development of optimal messages, *Public Awareness of Invasive Plants and Insects in the Catskills and Lower Hudson Region,* (Connelly et al., 2007) and the two-part *New York Residents' Awareness of Invasive Species* (Connelly et al., 2015) and *New York Residents' Perspectives on Invasive Species* (Lauber et al., 2015).

4. Early Detection and Rapid Response

Early Detection and Rapid Response (ED/RR) is the method by which new infestations of an invasive species to an area are identified, contained and potentially eradicated quickly to minimize the costs of control and impacts to the environment, human health and the economy. ED/RR efforts can be implemented at a variety of scales and require regional cooperation to make them most effective.

The Working Group developed an Early Detection and Rapid Response Plan in 2011, which contains a broad strategic roadmap and a specific work plan to guide discussion of invasive species policy issues, allocation of budgetary resources, and decisions regarding appropriate actions necessary to achieve DEP goals with respect to monitoring, preventing and responding to invasive species threats. It calls for a focus on City-owned lands and reservoirs with active engagement in Lower Hudson PRISM's and CRISP's ED/RR efforts. The plan also specifies that implementation takes an adaptive management approach with regular evaluation and revision.

Current Early Detection and Rapid Response Strategies

The 2011 plan includes specific tasks that support the following objectives:

1. Ensure new invasive species are identified and their risks assessed promptly

    - Formal risk assessments have been developed by the DEP Invasive Species Working Group for over 50 species and are continuing to be developed as new species of concern emerge. The risk assessment process incorporated the New York State Invasiveness Ranking forms as well as a DEP-specific rapid assessment that specifically takes into consideration potential impacts to water quality, water supply infrastructure, watershed ecosystem function, or employee health and safety. The risk assessments were used to generate a priority list of species in order to focus ED/RR and other efforts.

    - A comprehensive survey of aquatic invasive species in all five terminal reservoirs (Rondout, Ashokan, West Branch, New Croton, and Kensico) was completed by staff from the State University of New York at Oneonta's Biological Field Station

in 2016. They used traditional survey techniques as well as piloting the use of environmental DNA (eDNA) to survey for traces of organisms in water samples collected in the reservoirs and analyzed in a laboratory. The results of the pilot indicated that traditional survey techniques are still superior to eDNA but noted that changes in technology in the next decade may make eDNA a feasible option. The traditional surveys indicated that the majority of the terminal reservoirs have a low abundance of very common invasive species such as Phragmites (*Phragmites australis)* and purple loosestrife (*Lythrum salicaria*). New Croton Reservoir had the greatest abundance and diversity of invasive species, including the early detection species hydrilla (*Hydrilla verticillata*).

- Early detection surveys have been conducted by DEP's Invasive Species Biologist and Fisheries Biologist at recreational boat launches to catch any inadvertent introductions that may result from the expansion of recreational boating opportunities since 2013. The only species of concern detected has been the rusty crayfish (*Orconectes rusticus*), which is very widespread and was likely been introduced through bait many years ago.

2. Ensure early reporting of new invasive species occurrences/infestation both internally within DEP and externally with watershed partners

    - The primary method employed for internal reporting of early detections has been the training of DEP field staff in the identification of priority early detection species. Trainings have been offered to staff from Bureau of Water Supply's Operations and Water Quality directorates and Bureau of Police and Security. Staff are directed to make a report of any suspect organisms to DEP's Invasive Species Biologist for verification.

    - Recreation users are encouraged to report suspicious species through informational pages on the website, a hotline, signage posted around reservoirs, and other activities outlined in the Invasive Species Communications Plan.

3. Define decision making responsibilities and response protocols

    - A rapid response protocol was established and staff was trained in the incident command system (ICS). Depending on the response required, decisions are made at varying levels within DEP.

    - DEP worked with US Department of Agriculture Animal Plant Health Inspection Service and New York State Department of Agriculture and Markets, Department of Environmental Conservation and the Office of Parks Recreation and Historic Preservation on a multi-phased State Plant Health Emergency Management training in 2015. This exercise illustrated what role DEP would play in a multi-

jurisdictional response to an invasive species of high economic significance such as the spotted lantern fly (*Lycorma delicatula*) or Asian long horned beetle.

4. Establish and maintain capacity to act

    - Funding is reserved for the procurement of invasive species control work East and West of Hudson annually that can be diverted to initiate a rapid response of limited scale. For a larger scale effort there would need to be collaboration with the New York State Department of Environmental Conservation (NYSDEC) and other partners in order to facilitate a rapid response.

5. Incorporate adaptive management in plan implementation.

    - The rapid response plan is a fluid document that can reflect changes and lessons learned through evaluation of responses.

Planned Early Detection and Rapid Response Strategies

Early detection survey work in both aquatic and terrestrial ecosystems will continue and expand as new threats are identified. Aquatic surveys targeting hydrilla may be needed in all EOH Reservoirs over the next ten years and will be critical to responding rapidly if it is detected in a new reservoir. Additionally, terrestrial survey efforts should be coordinated with the Lower Hudson PRISM and Catskill Regional Invasive Species Partnership as they build up their early detection programs and determine how best to increase the capacity to detect species across the landscape.

Coordinating response efforts across agencies and jurisdictions has proven to be challenging in the past. Response efforts will be guided, going forward, by the NYSDEC's DLF-16-1 Rapid Response for Invasive Species: Framework for Response (Framework), which was drafted in 2016 and promotes a collaborative approach among agencies and PRISMs. It is designed to be adapted for any number of response scenarios and draws from experience gained over the last decade by NYSDEC and their partners.

Evaluating several rapid response projects in which DEP is currently involved will also be instrumental to supplement the Framework and the ED/RR Plan to reflect the real-life hurdles to a rapid response:

Giant hogweed (*Heracleum mantegazzianum*) – NYSDEC has undertaken a statewide initiative to eradicate this species and is the lead in this effort. DEP works with NYSDEC and other partners to survey for new plants found on or adjacent to City lands so that they can be managed immediately. The number of plants detected each year continues to decrease as the seedbank is depleted.

Silver vine (*Actinidia polygama*) **–** An infestation that crosses over from City lands to private lands has been managed since it was detected in 2015 in partnership with the LH PRISM. This is only the second known infestation of this species in the state.

Hydrilla – DEP and NYSDEC have been working together closely to respond to this infestation that stretches from the New Croton Reservoir to the Hudson River in a multifaceted resource intensive response effort since 2014.

DEP will update the ED/RR plan based on the accomplishment of tasks identified in the plan and the efficacy of the prescribed actions if needed. This plan will continue to be adapted based on the experience and findings from response efforts to early detection occurrences.

5. Control and Management

DEP invests a great deal of consideration in the selection of invasive species control and management projects in the NYC water supply reservoirs and on City lands. Every infestation of every species cannot and should not be controlled over the 2,000 square mile watershed so projects must be selected judiciously with attention to available resources. Aside from rapid responses to early detections, other criteria considered are the impacts to water quality, the threat from the invasive species to the successful outcome of other DEP land management projects and whether those management actions threaten to increase the impacts of invasive species to the surrounding area. Additionally, appropriate control strategies must be assessed based on their and their ability to successfully manage the target species.

Control Strategies

Control projects are implemented using methods that have the least non-target impacts, are most appropriate for the species and site conditions that exist, are based on the latest scientific research and best management practices, and have a high likelihood of achieving the desired outcome. The following control strategies have been either implemented or considered for use in controlling invasive species:

<u>Manual and Mechanical Control</u>

Manual and mechanical control are strategies that involve using hands, hand tools or mechanized equipment to hand-pull, dig, mulch, cut, mow, destroy or otherwise remove invasive species.

This method works well over small areas and is preferable to other control strategies in sensitive environments where water quality or non-target impacts are considered unacceptable. Another benefit to these strategies is that they can generally be implemented without applying for permits or going through other lengthy approval processes. These strategies are currently being considered or implemented by staff, interns, and contractors along streams, wetlands, in and around reservoirs as well as for lower abundance invasive species.

Chemical Control

Chemical control strategies involve the use of approved pesticides for the control of invasive plants and insects in accordance with their labels and any special recommendations approved by New York State with Section 2 (ee) of the Federal Insecticide, Fungicide, and Rodenticide Act. All pesticide applications done on City lands are done by certified applicators who carry the proper licensing in the correct category for the work that they are conducting.

DEP's ecotoxicologist must review any chemical control project and issue an internal permit with the total amount of active ingredients to be used, formulation and other relevant information. Certain conditions for application can be placed on the applicator as well. Preference is given to the use of products with fewest known environmental impacts and lowest toxicity. A majority of projects over recent years have used the active ingredient glyphosate, due to its efficacy and low-toxicity, particularly in water.

Application technique varies based on the species being treated, with foliar application being the most common method. Stem injection for Japanese knotweed control and basal bark application for Japanese angelica tree control have also been used. Cut stump treatment has also been used for multiflora rose and Japanese barberry. Foliar application is generally favored because it requires the least amount of time and active ingredient, making it cost-effective and reducing the total amount of product applied to the site. Stem injection, basal bark application and cut stump treatments are less likely to have immediate non-target impacts but may require a greater total amount of chemical and longer persistence in the soil.

Herbicides for the control of aquatic invasive plants would be considered only when they are critical to a special project such as a rapid response effort or if the operations of the water supply were threatened. Commonly used aquatic herbicide products have been evaluated and ranked by the ecotoxicologist as a baseline for the selection of an acceptable chemical if the need is to arise.

Biological Control

Classical biological control is the use of co-evolved predator or herbivorous organisms for long-term control of an invasive plant or insect. Biological control agents that have received federal approval and are available for sale have minimal environmental impacts when compared to other control methods. The risk of non-target effects such as trophic disturbance, competition, or other abiotic and biotic factors that could harm native species and disturb ecological communities is lessened via an extensive screening protocol enforced by the federal government through the United States Department of Agriculture Animal Plant Health Inspection Service. Potential control agents are tested with no-choice feeding experiments to see if they will feed on closely

related native and economically valuable species present in the release region to ensure the control agent will not harm non-target species. Additionally, NYSDEC has a system of approval and licensing for the release of agents that have received a federal Finding of No Significant Impact (FONSI) within the state.

DEP views biological control as a tool to be used in tandem with other strategies as part of an integrated pest management program to suppress invasive species broadly over the region or to be released on a particular site in an inundative application to temporarily knock back a population. DEP uses a protocol for consideration of the use of biological control agents subsequent to federal and state licensing protocols. To introduce a biological control agent on City lands, the following criteria must be met:

1. The agent must target an invasive species that provides a serious threat to water quality, water quantity, ecological integrity and/or a threatened or endangered species
2. An integrated pest management plan must be developed or a justification provided for a biocontrol-only management plan
3. Other methods must have proven inadequate alone or presented an unnecessary human or ecological risk to the watershed
4. A monitoring program must be prepared and implemented before the control agent is released

Currently there are ten biological control agents for five invasive species that have been approved for release in New York State and are commercially available according to the New York Invasive Species Research Institute. *Rhinoncomimus latipes*, a weevil that targets mile-a-minute (*Persicaria perfoliata*) and *Galerucella calmariensis* and *pusilla,* which target purple loosestrife, are the only species that have been actively released on City lands. Field trials by researchers partnering with CRISP are currently underway in the WOH watershed for three species of parasitoid wasp biological control agents, *Spathius agrili, Tetrastichus plannipennisi, and Oobius agrili,* which target the emerald ash borer and have likely dispersed onto City lands.

Current Control Project Selection Priorities

Forest Management Projects

As part of the process outlined in the DEP Forest Conservation Practices, an assessment of potential impacts from invasive species on the success of forest regeneration and the potential for spread outside the project area is done for each forest management project. Control work is undertaken prior to the start of many forest management projects to minimize both of these potential outcomes once the canopy is opened, increasing light levels and soil disturbance.

Some of the species that have been controlled to prevent negative impacts from forest management projects include multiflora rose, Japanese barberry, Japanese knotweed, common buckthorn, and Oriental bittersweet. Species controlled to improve success of reforestation projects include Japanese angelica tree (*Aralia elata*), mile-a-minute vine, and porcelain berry.

Control work on these projects often includes a variety of strategies including manual or mechanical control, chemical control and biological control.

Wetland Mitigation Projects

There are currently five wetland mitigation sites on City lands to offset wetlands impacts from DEP-sponsored construction and other projects. Depending on the individual permit requirements, the mitigation sites may require a threshold of invasive species cover and/or native planting survival. In these instances, invasive species management is required to facilitate the growth of native plant species and maintain compliance with permit standards.

Purple loosestrife has been manually removed from one wetland mitigation site for several years in the Ashokan Basin to maintain compliance with percent cover requirements in a United States Army Corps of Engineers' permit. Additionally, chemical control has been undertaken at another mitigation site EOH to control phragmites and manual control was done for mile-a-minute. Plans are in place to do additional manual removal of common vetch (*Vicia sativa*) and mugwort (*Artemisia vulgaris*) at this site. It is anticipated that future wetland mitigation projects will require invasive species management.

Stream Restoration Projects

Invasive species can threaten the success of stream restoration projects by spreading rapidly in the project area ultimately decreasing stream bank stability. Native vegetation has more complex root structures that enhance bank stability more than invasive species. Preemptively controlling invasive plants to allow native vegetation to establish is an important component of stream restoration work.

Control strategies that have been employed include chemical and mechanical control work. Japanese knotweed, mugwort, Japanese barberry, and multiflora rose have been treated. These projects have been managed by the Soil and Water Conservation Districts working with DEP in all WOH basins.

Other Special Projects

Infrastructure and other large construction projects on City lands often include site restoration with native species. Permits often require restoration and include performance standards based on percent coverage by invasive species and survival of restoration plantings. Invasive plants can interfere with tree planting projects by outcompeting native plantings, and stormwater retention structures or roadside sightlines by rapidly becoming overgrown. By controlling invasive plants early in these construction projects there is a greater chance of native vegetation becoming established and suppressing the harmful impacts of invasive species.

Japanese barberry, Japanese angelica tree, Japanese knotweed, Oriental bittersweet, Japanese stiltgrass (*Microstegium vimineum*) and garlic mustard have been controlled through chemical and manual control strategies in the Kensico basin to support infrastructure projects on City lands.

Project Monitoring

Once a control project is complete, monitoring occurs over time through formal surveys and informal observation. If an area requires follow-up treatment, reports come into DEP's Invasive Species Biologist through foresters, wetland scientists, or others working on the management of the site. The current process is mainly focused on identifying areas where recolonization by the invasive species is becoming problematic.

A project monitoring framework is currently under development by a sub-committee of the Invasive Species Working Group. The purpose of this framework is to have a consistent and efficient method to assess which control strategies have proven effective at any given site in support of adaptive management, whereby strategies can be adjusted for greater success. The measure of an invasive species control project is how effective it is in reducing the presence of the invasive species, as well as measuring the recovery of the native plant community and fish and wildlife habitat.

Planned Project Selection Prioritization Strategies

Beyond the current priority control and management projects that are being implemented to support the success of DEP initiatives, there are other land management objectives that could be met through invasive species control work. New York State is currently working on an invasive species control project prioritization protocol that incorporates several existing resources that can rank invasive species impacts, conservation values of the site of the proposed project, and the likelihood of success of a project. It is anticipated that this will become available by 2017 and will be able to support consideration of additional types of control projects that can provide meaningful outcomes and provide the best use of available resources.

6. Mitigation of Impacts

In some instances where there are no effective tools to eradicate or control an invasive species and it is causing a significant harm, other methods may be pursued to mitigate impacts. This has been the case with the emerald ash borer, which was first detected in the West of Hudson watershed beginning in 2010. Impacts from the hemlock woolly adelgid, which has been in the EOH watershed since the 1990s, are being observed throughout the watershed and additional pests and pathogens may arrive at any time.

Current Mitigation Activities

Since 2002, authorities in Michigan have failed in attempts to eradicate emerald ash borer (EAB), an invasive wood-boring beetle. EAB has been in the watershed since 2010, is rapidly and completely killing all species of ash in the area and disperses up to three miles in a single year. There is typically near 100% mortality in an area within five years making it only possible to protect small numbers of trees through chemical insecticide control. DEP initially worked with NYSDEC and the United States Forest Service to implement a plan to slow ash mortality through strategic tree girdling and removal efforts. This effort was discontinued in 2013 due to loss of funding and extensive spread. Since then, the activities surrounding this pest have switched over to mitigation activities.

The major impacts that are anticipated from the loss of infested ash on City lands include development of hazard trees along roadways and the creation of gaps in the forest canopy. Once ash trees are infested they quickly dry out and become brittle and dangerous due to the potential for falling limbs. This poses a hazard to the motoring public, recreation users, and loggers removing the trees. Removing ash trees before they become a hazard is also important because dead ash does not retain any timber value so any work that is done once trees die would have a high cost associated with it as opposed to a traditional forestry project which can recover the cost of removal through the sale of timber.

To date, DEP has removed a significant number of potential hazard ash trees from City lands around the Ashokan Reservoir, working in concert with the NYS Department of Transportation along Route 28 and Ulster County Department of Public Works along Route 28A. Several hundred acres of ash dominated forest at Ashokan have been significantly thinned through forestry projects in order to promote regeneration.

Planned Mitigation Strategies

Hemlock woolly adelgid is another forest pest that has had a significant impact on the landscape through decline and mortality of the eastern hemlock. DEP is concerned with protecting hemlock trees in parts of the watershed that are not yet impacted but many areas of the watershed have long standing infestations and are transitioning into other forest types. As this problem becomes more widespread mitigation tools to preserve the ecosystem functions that hemlocks once provided for water quality may be necessary. This is an active area of research and a strategy that is currently being explored.

7. Restoration

When a site has been severely disturbed by a natural occurrence such as a hurricane or human activities, an infestation of invasive species may become firmly entrenched and an invasive species control project alone may not result in the establishment of a desirable native community. Often the seedbank is still dominated by invasive plants or the disruption of the soil from removal may provide the opportunity for another invasive species to move in. Restoration involves activities to promote natural succession or the intentional planting or stocking of desired native species. Some of the restoration projects currently underway include a tree planting project at the site of a tornado blowdown, planting of native species along stream management projects after treating Japanese knotweed, and the installation of deer fencing in areas undergoing forest management in the Ashokan Reservoir basin.

Current Status of Restoration Projects

In 2006, a tornado caused a 30 acre blowdown adjacent to Kensico Reservoir. The site quickly became dominated by Japanese stiltgrass and mile-a-minute to such an extent that native tree regeneration was unlikely given the high density of deer in the area and other invasive species that were poised to expand on the site. In 2014, DEP planted 5,000 native trees and shrubs and deer fences were installed with the intention of promoting regeneration and suppressing the expansion of invasive species on the site. DEP also released the biocontrol weevil *Rhinoncomimus latipes* to suppress mile-a-minute growth.

The DEP Stream Management Program regularly engages in restoration projects targeting disturbed stream banks that have been impacted by floods and have become invaded by Japanese knotweed. To stabilize the stream banks, Japanese knotweed is treated and native plantings are installed.

Deer fences have been installed as part of a study to assess the impacts of invasive vegetation and deer browse on the regeneration of forests after management around Ashokan Reservoir. The Nature Conservancy will assist DEP in determining what role Japanese stiltgrass plays in forest regeneration by comparing native plant diversity and tree seedling growth in the presence and absence of deer and invasive plant control over several growing seasons. The results will indicate how important deer management is as a restoration tool as well as assessing the benefits of invasive plant control.

Planned Restoration Projects

Further work is needed to streamline the process of selecting and completing restoration projects. Criteria will be developed to help determine when a threshold of damage has been reached and restoration may be warranted. When possible, DEP will collaborate with partners on restoration projects, both on design and implementation. Site restoration plans will be established for projects and will set a clear vision for the site as well as outlining long term management goals. Plant materials used to restore disturbed sites will be appropriate native species sourced from suppliers who can certify that they are "weed free". Monitoring will be done to determine which strategies are most successful.

Beyond monitoring implemented projects, field research on restoration strategies will help to facilitate the use of the most effective methods on future projects. DEP will continue to build on

partnerships with The Nature Conservancy and reach out to educational institutions to support research on City Lands that will aid in developing best management practices for restoration in order to maintain ecosystem functions. City lands provide a unique opportunity for researchers, students, and faculty to establish study plots and study the effects of a restoration activities that may not be afforded by private or State lands.

8. Intra-Agency Collaboration

Assessment and mitigation of the potential impacts of invasive species on the NYC Water Supply cuts across many groups and disciplines in DEP. A multi-group, interdisciplinary approach to invasive species is necessary to address the problem comprehensively. As the threat of invasive species on the water supply infrastructure and lands became more widely appreciated, DEP's response became more organized, cohesive and collaborative. DEP created an Invasive Species Biologist position, formalized an Invasive Species Program and allocated funds for program operations and constituted an interdisciplinary Invasive Species Working Group.

Invasive Species Biologist

The position of landscape ecologist was formally changed in 2008 to Invasive Species Coordinator and tasked with developing the Invasive Species Program and forming the Invasive Species Working Group. In 2007, DEP completed a white paper entitled *Invasive Species and the New York City Water Supply: Recommendations for Management* that summarized the literature to date on potential impacts of invasive species on water supplies, watersheds, reservoirs and water supply infrastructure, and recommended ten steps that DEP should take to manage invasive species in the watershed (DEP, 2007). The white paper was the impetus for formalizing the Invasive Species Biologist position, development of the Invasive Species Program and the formation of the Invasive Species Working Group. Since 2008, DEP has had a biologist dedicated to invasive species prevention and control.

Invasive Species Working Group

For years many groups worked independently on the issue and there was a need for a unified approach for effectively addressing invasive species. Acting on one of the white paper recommendations, BWS formed the Invasive Species Working Group in 2008 comprised of members from three BWS Directorates - Watershed Protection Programs, Water Quality and Operations - and DEP's Bureau of Police and Security. The purpose of the Working Group is to act as a coordinating body, meeting quarterly to develop recommendations to BWS management and staff on an overarching invasive species plan and related policy issues and to act as an advisory body on the prevention and management of new and emerging invasive species that may impact the water supply. Subcommittees are formed to work on specific tasks and issues to guide management and policy decisions with the ultimate goal of producing a comprehensive plan and guidance document on monitoring, prevention and responding to invasive species in the NYC water supply watershed.

Other Collaborative Efforts

In addition to the intra-agency work of the Working Group, the Invasive Species Biologist works with other bureaus and groups to reduce the introduction and spread of invasive species on City lands and in the watershed. Collaboration is typically through the development of guidelines to reduce the likelihood of introduction and spread by developing Best Management Practices (BMPs) for internal procedures, environmental reviews of projects sponsored by DEP to upgrade or maintain infrastructure and manage lands, and project reviews of projects proposed in the watershed. These projects are reviewed through the State Environmental Quality Review Act (SEQRA) and the City Environmental Quality Review (CEQR).

Many groups within DEP are responsible for activities that have the potential to introduce or spread invasive species on City Lands. BMPs have been developed through the Working Group and other ad-hoc committees to reduce the potential for introduction and spread of invasive species by normal job tasks including prevention of aquatic invasive species introductions by DEP and contractor vessels, spread of invasive species on maintenance and construction equipment, site restoration plans requiring the use of locally-sourced native plants and post-project management plans to help prevent the re-infestation by invasive species. Proposed DEP construction projects are reviewed through collaboration between the Bureau of Water Supply, Bureau of Engineering Design and Construction and Bureau of Environmental Planning and Analysis.

DEP reviews proposed construction projects designs, site restoration plans and invasive species management plans in the watershed through SEQRA for the potential of those projects to create conditions that promote the introduction and spread of invasive species. DEP recommends steps and design alterations that can be taken by the applicant to help reduce the likelihood of introducing and spreading invasive species during and after project construction.

9. Partnerships

By collaborating with other agencies and organizations working on invasive species management, DEP addresses emerging invasive species issues with greater efficiency. Partnerships allow for the sharing of knowledge and resources and have been identified by the National Invasive Species Council and others as critical to invasive species management at a regional scale. In 2005, the New York State Invasive Species Task Force recommended the formation of eight Partnerships for Regional Invasive Species Management (PRISMs) to coordinate partner efforts, recruit and train citizen volunteers, identify and deliver education and outreach, establish early detection monitoring networks and implement direct eradication and control efforts. DEP has been an active member in the two PRISMs that cover the geographic extent of the NYC watershed, the Lower Hudson PRISM (LH PRISM), and the Catskill Regional Invasive Species Partnership (CRISP) since their formation.

Beyond these regional partnerships, statewide collaboration is important to furthering policy changes and fostering dialogue on larger invasive species initiatives. As a result of the Invasive Species Task Force's findings, a New York Invasive Species Council and an Invasive Species Advisory Committee were established to assess the scope of all potential impacts caused by

invasive species in the state and to identify and coordinate actions to prevent, control, and manage invasive species. DEP has been a member of the Advisory Committee since 2008. NYSDEC has also partnered directly with DEP on several targeted invasive species projects.

Current Partnerships

Catskill Regional Invasive Species Partnership (CRISP)

CRISP's mission is to promote education, prevention, early detection and control of invasive species to limit their impact on the ecosystems and economies of the Catskills. DEP was a founding partner and holds a seat on the steering committee. DEP has been involved in CRISP partnership including:

- Asian Long horned Beetle Campground Surveys – DEP staff and interns worked with CRISP to survey approximately 20 private campgrounds for the Asian long horned beetle and distribute outreach materials on preventing the spread of forest pests in firewood in 2009 and 2013.
- Eradication of pale swallowwort (*Cynanchum louiseae*) – DEP and The Nature Conservancy worked with CRISP on eradicating pale swallowwort from a site next to the Pepacton Reservoir for five years as part of the NYSDEC Eradication Grant Program.
- Boat Stewardship – DEP staff and interns developed a program to educate recreational boaters at the Pepacton Reservoir on the importance of invasive species spread prevention techniques with CRISP 2013-2014.

Lower Hudson Partnership for Regional Invasive Species Management (LH PRISM)

LH PRISM strives to protect the rich biodiversity of the Hudson Valley by identifying conservation areas, likely areas of introduction and methods of early detection and response. DEP has been highly involved and is a member of the steering committee. Partnership projects with the LH PRISM include:

- Blockbuster Survey – DEP has participated in surveying 5 km squares as part of an effort to establish baseline presence and absence data for select invasive species across the entire region by surveying City lands that fall within assigned squares in 2015 and 2016.
- Giant Hogweed Eradication – DEP partners with NYSDEC and LH PRISM to identify and eradicate giant hogweed plants on City lands and the surrounding area. DEP conducts survey work while LH PRISM staff properly control the plant.
- Silver vine Eradication – DEP and LH PRISM staff are working together to eradicate the second known population of silver vine in the state from City lands and the neighboring private lands.

New York State Invasive Species Advisory Committee

The Invasive Species Advisory Committee (ISAC) is a statutory body created in 2008 by Title 17, Section 9 of the Environmental Conservation Law (ECL) to provide information, advice and

guidance to the Invasive Species Council, which is comprised of nine state agencies that play a role in managing invasive species, including providing assistance with the development of invasive species regulations. Up to 25 members from stakeholder organizations described or specified in the law constitute the Committee, including DEP which represents all New York water utilities. Since 2015, DEP has chaired the committee. To date, the accomplishments of the ISAC include:

- Prohibited and Regulated Species – ISAC worked with NYSDEC to develop the 6 NYCRR Part 575 Prohibited and Regulated Invasive Species regulations.
- Aquatic Invasive Species Spread Prevention – ISAC supported the formation of the part 6NYCRR 576 Aquatic Invasive Species Spread Prevention regulations.
- Invasive Species Awareness Week – ISAC sponsored a statewide education and outreach initiative which included the declaration of a formal Invasive Species Awareness Week to concentrate and cross-promote events for a single week to broadly raise awareness of the issue.

New York State Department of Environment Conservation

The NYSDEC takes on the leadership in management actions for certain invasive species that are deemed to be a high level threat. DEP has partnered with NYSDEC to support two such efforts. In 2011, DEP supported the NYCDEC Slow Ash Mortality project to create trap trees to slow the westward expansion of EAB in the Catskills, and in 2014, DEP and NYSDEC began working jointly on a response to hydrilla in the New Croton Reservoir and the Croton River.

References

Connelly, N.A., T.L. Brown, and P.J. Smallidge. 2007. Public Awareness of Invasive Plants and Insects in the Catskills and Lower Hudson Region. HDRU Publ. Series 07-7. Dept. of Nat. Resour., Coll. of Ag. and Life Sci., Cornell Univ., Ithaca, NY. 46 p. https://ecommons.cornell.edu/bitstream/handle/1813/40417/HDRUReport07-7.pdf?sequence=1&isAllowed=y

Connelly, N. A., T.B. Lauber, and R.C. Stedman. 2015. New York Residents' Awareness of Invasive Species. HDRU Publ. Series 15-2. Dept. of Nat. Resour., Coll. Agric. and Life Sci., Cornell Univ., Ithaca, NY. 32 p. https://ecommons.cornell.edu/bitstream/handle/1813/40334/HDRUReport15-2.pdf?sequence=2&isAllowed=y

DEP, 2007. Invasive Species and the New York City Water Supply: Recommendations for Management. Kingston, NY, 45 p.

Lauber, T.B., N.A. Connelly, and R.C. Stedman. 2015. New York Residents' Perspectives on Invasive Species. HDRU Publ. Series 15-6. Dept. of Nat. Resour., Coll. Agric. and Life Sci., Cornell Univ., Ithaca, NY. 38 p. https://ecommons.cornell.edu/bitstream/handle/1813/40347/HDRUReport15-6.pdf?sequence=2&isAllowed=y

United States Department of the Interior. 2016. National Invasive Species Council. Management Plan: 2016–2018. Washington, D.C., 40 p. https://www.doi.gov/sites/doi.gov/files/uploads/pre-release_copy_niscmanagement_plan_adopted11july2016.pdf

United States Forest Service. 2013. National Strategic Framework for Invasive Species Management. 36 p. http://www.fs.fed.us/foresthealth/publications/Framework_for_Invasive_Species_FS-1017.pdf

United States Army Corps of Engineers, New York District. 2005. Compensatory Mitigation Plan Guidelines.

Appendix A

Early Detection/Rapid Response Plan

NYCDEP Invasive Species Working Group
Proposed Early Detection & Rapid Response Plan Recommendations

BACKGROUND

In October 2008, DEP's Bureau of Water Supply formed the Invasive Species Working Group (ISWG) comprised of staff members from three Directorates: Watershed Protection Programs, Water Quality, and Operations. The purpose of the ISWG is to form a coordinating body that develops and makes recommendations to Bureau management staff regarding an overarching invasive species plan and related policy issues. The ISWG is also charged with staying abreast of emerging issues and serving as a forum for information exchange, rapid response needs, and budget prioritization. Subcommittees were formed to work on specific tasks with the ultimate product being a comprehensive plan and guidance document on monitoring, preventing, and responding to invasive species threats in the New York City Water Supply Watersheds.

During 2009-2010, the ISWG developed, followed, and updated a long-term workplan that included among its goals and deliverables the creation of recommendations for early detection and rapid response (ED/RR) plans for invasive species. In late 2010, an ISWG subcommittee began to address this task and in January 2011 a scoping memo was submitted that recommended DEP develop and support an ED/RR strategy that focuses primarily on City-owned lands (including water bodies) but includes the ability to collaborate with watershed partners. The recommendation was endorsed and the subcommittee began to research ED/RR plans from across the country and especially those related to watershed programs. The subcommittee created an ED/RR plan outline along with draft recommendations and a proposed timeline that were shared and discussed with the full ISWG in March 2011. The ISWG agreed that the document was ready for submission with a few minor edits.

Therefore, this guidance document – **Proposed ED/RR Plan Recommendations** – is submitted by the ISWG in fulfillment of the second deliverable of Task 5 in the ISWG Workplan: *Create recommendations for ED/RR plans for land and water*. This document is intended to serve as a broad strategic roadmap and practical workplan for use by Bureau management staff when discussing invasive species policy issues, allocating budget resources, and deciding upon appropriate actions necessary to achieve DEP goals with respect to monitoring, preventing, and responding to invasive species threats in the New York City watersheds. Two prominent themes that are critical components of this ED/RR plan will be the importance of clear and timely internal communication and the need for external coordination with partners.

INTRODUCTION & OVERVIEW

An effective invasive species management program includes five strategic elements: (1) prevention; (2) early detection and rapid response; (3) control and management; (4) rehabilitation and restoration; and (5) organizational collaboration. These key elements are supported by the National Invasive Species Council's *2008-2012 National Invasive Species Management Plan* (2008), the USDA Forest Service's *National Strategy and Implementation Plan for Invasive Species Management* (2004), the *Final Report of the New York State Invasive Species Task Force* (2005), and many other local, state and national experts.

The first line of defense against invasive species is to prevent their introductions in the first place. However, since it is virtually impossible to prevent all introductions, early detection & rapid response (ED/RR) is considered the second line of defense and one of the most critical components of any invasive species strategy. Early detection requires vigilance and regular monitoring to detect a species at the earliest possible time after an introduction is known or believed to occur. If or when an invasive species is detected, a rapid response is initiated to determine the environmental (and potentially economic or financial) risks, extent of its establishment and distribution, potential for spread, and to evaluate response options.

According to experts, the hallmarks of successful ED/RR efforts typically include:

a) Potential new threats are identified in time to allow efficient and practical risk mitigation measures to be taken;
b) Institutional mechanisms are in place to support ED/RR decisions and ensure effective deployment of resources;
c) Responses to invasions are effective, environmentally sound, and prevent the spread and/or permanent establishment of invasive species;
d) Adequate and timely information is provided to decision-makers, the broader public, partners, and to affected/interested parties; and
e) Lessons learned from past efforts are used to guide current and future efforts.

Ideally, eradication of a newly detected invasive species is both practical and achievable. More frequently, however, invasive species are managed to contain or slow their spread. In some cases, ED/RR may trigger no response because the invasive species is determined to be too widespread, potential threats are not considered high priority, and/or the necessary resources are unavailable to ensure successful mitigation. Regardless of the scenario, any delay in supporting ED/RR favors the target pest and significantly increases the costs of implementing a longer-term mitigation program for an established population. With particular respect to the New York City watersheds, lack of an ED/RR plan could negatively impact water quality, threaten or damage water supply infrastructure, disrupt DEP's Long-term Watershed Protection Program, or potentially result in legal or liability issues not to mention a tarnished reputation if DEP's response to a serious new infestation is deemed slow or ineffectual.

PLAN SUMMARY: GOAL, OBJECTIVES & METRICS

This ED/RR Plan focuses on City-owned lands and reservoirs but includes the ability to coordinate and collaborate with other stakeholders and especially the Catskill Regional Invasive Species Partnership (CRISP), of which DEP is an active member and serves on the Executive Steering Committee. CRISP is a fully functioning and state-funded entity that is coordinated locally by the Catskill Center for Conservation & Development through a five-year contract with the New York State Department of Environmental Conservation (DEC). With respect to the East of Hudson watershed, DEP should also be involved with the Lower Hudson PRISM (Partnership for Regional Invasive Species Management) which is similar in purpose and function to CRISP but not quite as organized and also not yet funded by the DEC.

Although water supply reservoirs and City-owned lands are clearly the highest priority for DEP in terms of ED/RR efforts, it is important to recognize that the CRISP and Lower Hudson PRISM framework provides DEP with the opportunity to build and enhance internal ED/RR capacity through staff training opportunities, secure access to reliable and up-to-date scientific information (including early notification of new detections or approaching species of concern that are not already known by DEP), potentially gain access to state or federal funding, leverage regional efforts and ensure widespread public participation in watershed activities pertaining to invasive species.

The **overarching goal** of this ED/RR Plan is to prioritize and then minimize both potential and direct threats to water quality, water supply infrastructure, and the watershed's green infrastructure, as well as to reduce budgetary impacts and potential liability issues on City-owned watershed lands, that could result from the establishment and spread of non-native invasive species within the Catskill/Delaware and Croton Water Supply Systems.

To achieve its overarching goal, this ED/RR Plan is divided into three main components – (1) Risk Assessment, (2) Early Detection, and (3) Rapid Response – and it comprises the following **primary objectives** that are embedded within the three plan components:

1. Ensure new invasive species are identified and their risks assessed promptly.
2. Ensure early reporting of new invasive species occurrences/infestations both internally within DEP and externally with watershed partners.
3. Define decision-making responsibilities and response protocols.
4. Establish and maintain capacity to act.
5. Incorporate adaptive management in plan implementation.

In addition, it will be necessary for the ISWG to identify potential qualitative and quantitative metrics that are tied to the various objectives and actions/tasks so that the performance and success of this ED/RR Plan can be measured, tracked and evaluated on a regular basis. Initial metrics for consideration as part of this plan might include:

- New occurrences of invasive species are detected promptly
- No new infestations (established populations) on City-owned watershed

lands Known infestations on City-owned lands are contained (slow the spread) Number of rapid assessments performed/completed

- Actions/outcomes are achieved as per rapid assessments
- Number of times an invasive species has been reported to DEP via specific methods (phone, email, website, personal contact, other)
- Number of DEP staff trained to support ED/RR (also number of trainings held)
- Percentage/acreage/miles of City-owned lands actively monitored and/or treated for invasive species control each year
- Number of boats steamed cleaned on water supply reservoirs annually
- Extent of DEP's outreach and communication message regarding invasive species
- Increased knowledge about invasive species as measured in specific target audiences Timely completion of ED/RR actions and tasks based on established deadlines

PLAN COMPONENT #1: RISK ASSESSMENT

Objective # 1 – Ensure new invasive species are identified and their risks assessed.

Proposed Actions/Tasks:

1. Compile and maintain a prioritized DEP-specific "unwanted invaders" list that includes a list of invasive species already known to occur in the watershed and species that are not yet known to exist in the watershed but are considered an imminent threat to water quality or the water supply. This "unwanted invaders" list should be widely publicized at all DEP facilities/locations in order to promote and facilitate public awareness.

   NOTE: The ISWG has developed an invasive species threat matrix that will be utilized along with other existing priority species list developed by CRISP, Lower Hudson PRISM, and other entities.

   - Timeframe: 1-3 months for initial completion, ongoing thereafter
   - Proposed Deadline: June 30, 2011

2. Establish a centralized reporting system and accompanying set of procedures for reporting suspicious species found on City-owned lands and to facilitate tracking and documentation of confirmed sightings. If necessary, compile an "on-call expert" list of taxonomy specialists who are willing to make positive identifications inside their areas of expertise, as well as taxonomic generalists who can assist the ISWG with rapid assessments. Establish a central ISWG contact person through which external sightings are reported and documented, requests are submitted to experts (when necessary), and responses are received/confirmed.

NOTE: The ISWG represents the core DEP team of internal invasive species experts, with DEP also having access to external expertise through participatory involvement with CRISP, Lower Hudson PRISM, and the NYS Invasive Species Advisory Council.

- Timeframe: 1-3 months for initial completion, ongoing thereafter
- Proposed Deadline: June 30, 2011

3. Develop and utilize a risk assessment methodology, including a set of general guidelines and protocols to be used in assessing potential risks/threats.
   NOTE: The ISWG is already conducting rapid risk assessments on several priority species of concern to DEP and will continue to conduct rapid risk assessments for new species detected on City-owned lands as well as those located on non-City watershed lands or in proximity to the New York City watersheds and representing a likely future invasion.

- Timeframe: 1-3 months for initial completion, ongoing thereafter
- Proposed Deadline: June 30, 2011

PLAN COMPONENT #2: EARLY DETECTION

Objective #2 – Ensure early reporting of new invasive species occurrences/infestations.

Proposed Actions/Tasks:

1. Design an active DEP monitoring plan/network for those invasive species of highest concern/threat/risk to water quality and water supply/green infrastructure. Active monitoring should initially focus on likely points of entry and other high risk locations, such as reservoir boat launches, popular recreational areas, and City-owned lands that are in proximity to known infestations. This task will require internal training of DEP field staff regarding highest priority species (top 5-10) that may be encountered during the course of routine watershed field work (see #5 below). This task will also require clear and direct channels of internal communication to ensure timely reporting and documentation of invasive species detections.

NOTE: DEP's ongoing response to the current Emerald Ash Borer infestation (and related collaboration with DEC regarding monitoring/tracking activities) should be reviewed and assessed for its efficacy and strengths/weaknesses as part of this task.

- Timeframe: 3-6 months for initial completion, ongoing thereafter
- Proposed Deadline: December 31, 2011

2. Design and implement a passive monitoring plan/network for specific invasive species of particular concern to water supply reservoirs and City-owned lands in order to supplement DEP's active monitoring plan/network. This task will require active coordination and collaboration with CRISP and Lower Hudson PRISM (re: potential volunteer support and other forms of capacity-building) as well as a broad public education and outreach component that allows DEP to utilize external audiences (boaters, hikers, loggers, contractors, etc.) to capitalize on additional chance discoveries on DEP's wide portfolio of properties. This task will also require clear and direct channels of internal and external communication to ensure timely reporting and documentation of invasive species detections.

- Timeframe: 6-10 months for initial completion, ongoing thereafter
- Proposed Deadline: April 30, 2012

3. Develop WaLIS database tools for documenting/tracking known infestations on City-owned lands and recording/tracking the status, progress and efficacy of DEP management actions. It will be important for DEP's reporting system to be linked with CRISP, Lower Hudson PRISM, and other state/federal databases and also include an around-the-clock (24/7) invasive species reporting hotline.

- Timeframe: 4-6 months for initial completion, ongoing thereafter
- Proposed Deadline: January 31, 2012

4. Work with BCIA to modify existing DEP Watershed Protection website to include a special webpage and/or hot links for invasive species reporting (especially early detection efforts). Any DEP website reporting mechanism should be linked to the ED/RR centralized reporting system established pursuant to this workplan.

- Timeframe: 1-3 months for initial completion, ongoing thereafter
- Proposed Deadline: June 30, 2011

5. Identify appropriate staff and develop and begin to implement an internal training program for DEP watershed field staff, including necessary training materials for both office and field use, to raise their awareness of priority invasive species they may encounter during their routine field work and to solicit their assistance with ED/RR efforts where appropriate (in order to increase the likelihood of early detections).

    - Timeframe: 4-8 months for initial completion, ongoing thereafter
    - Proposed Deadline: February 28, 2012

6. Develop an invasive species outreach and communication strategy that educates watershed constituents and targeted stakeholders (especially recreational users of City- owned lands) about the importance of ED/RR and who they should contact/where they should turn for immediate reporting purposes. This task will incorporate the use of CWC reservoir kiosks, appropriate signage at key recreational areas, DEP recreation newsletters, DEP website, displays/exhibits at public events (county fairs, watershed festivals, etc.), DEP press releases, and other modes of communication.

    NOTE: This task dovetails with the efforts of the WPP Outreach Working Group and as such should be incorporated into that group's workplan, if appropriate.

    - Timeframe: 3-6 months for initial completion, ongoing thereafter
    - Proposed Deadline: December 31, 2011

PLAN COMPONENT #3: RAPID RESPONSE

Objective #3 – Define internal decision-making responsibilities and response protocols.

Proposed Actions/Tasks:

1. Utilize the ISWG to develop rapid response action protocols that provide clear direction, internal accountability, points of contact, and proper chain of command, including necessary decision-making, actions, and reporting requirements both internally and with external agencies/partners (CRISP, Lower Hudson PRISM, DEC, USDA, etc.). These protocols should minimally address the following:
    a. Mandatory training and emergency response drills for DEP staff with invasive species monitoring and control responsibilities, including any necessary certifications or permits for capture, possession, or destruction/disposal of nuisance invasive species.

b. Guidelines for proper destruction/disposal of nuisance invasive species.
c. Approved formats for any/all reports that are required to be submitted.
d. Appropriate feedback loop that keeps ISWG and DEP management well-informed about key external decisions made locally by watershed partners (CRISP, Lower Hudson PRISM) and regionally by state and federal agencies (especially those with regulatory and/or enforcement responsibilities).
e. Potential capacity for dispute resolutions.

Note: DEP should explore utilizing or adapting the Incident Command System (ICS) that is available to all levels of government as well as not-for-profit and private organizations. ICS is a standardized, flexible, on-scene, all-hazards incident management approach that is applicable to all disciplines and facilitates coordinated activities in five functional areas: Command, Operations, Planning, Logistics, and Finance/Administration. The DEC has used ICS for responding to Oak Wilt in Albany County as well as the recent Emerald Ash Borer outbreak in the Hudson Valley.

- Timeframe: 6-10 months for initial completion, ongoing thereafter
- Proposed Deadline: April 30, 2012

Objective #4 – Establish and maintain capacity to act.

Proposed Actions/Tasks:

1. Establish a stable internal fund to support annual rapid response efforts, including the possible designation of a DEP emergency fund to be accessed under specific high priority conditions and a regular fund to be requested annually for certain ongoing invasive species management projects. Another key task will be to work closely with CRISP and Lower Hudson PRISM to pursue DEC grant funding (especially monitoring and eradication funding) and other non-City grant opportunities as they arise.

NOTE: One potential model to explore for DEP emergency funding is the $5,000 reserved each year through Natural Resources Management/Fisheries for responding to fish kills.

- Timeframe: ongoing
- Proposed Deadline: ongoing (via annual expense budgeting cycle)

2. Develop a rapid response checklist of regulatory constraints, permitting obligations, preferred management implementation tasks, and jurisdictional boundaries and ensure that any barriers or constraints are identified and removed, if possible (i.e., pesticide application on City lands). In particular, the SEQRA process and other internal permitting processes should be examined to avoid potential disruption of short-term emergency responses should a particular invasive species infestation warrant immediate and/or drastic DEP management or control action.

   NOTE: DEP should also consider potential watershed-specific regulatory actions to be implemented if/when necessary, such as the potential banning of felt-soled hip waders to help control the spread of Didymo (rock snot) from currently infested streams, or the requirements for steam cleaning boats to prevent the introduction of zebra mussels.

   - Timeframe: 4-6 months for initial completion, ongoing thereafter
   - Proposed Deadline: December 31, 2011

3. Develop model response plans for specific invasive species that include defined protocols, response procedures, long-term action planning, and generic monitoring and assessment requirements to be incorporated into control projects. Potential response options to be considered based on degree of infestation and threats/risks might include: (1) eradication, (2) slow the spread, (3) continued monitoring, or (4) no response.

   NOTE: This task will produce potential response scenarios tailored to individual priority species and as such will require advanced discussions with Bureau management staff about policy and potential funding implications should certain scenarios occur.

   - Timeframe: 6-10 months for initial completion, ongoing thereafter
   - Proposed Deadline: April 30, 2012

4. Develop and conduct regular training for rapid responders to ensure they understand reporting procedures and are familiar with highest priority threats.

   NOTE: In 2010, the DEC conducted an Asian Long-horned Beetle case study (emergency response exercise) to simulate local response to a potential (fictitious) infestation. This exercise could be replicated by DEP for other invasive species.

   - Timeframe: 6-10 months for initial completion, ongoing thereafter
   - Proposed Deadline: April 30, 2012

5. Compile eradication and control libraries that can be shared with watershed partners (CRISP, Lower Hudson PRISM) and necessary state/federal regulatory agencies.

    - Timeframe: 2-4 months for initial completion, ongoing thereafter
    - Proposed Deadline: June 30, 2011

Objective #5 – Incorporate adaptive management into ED/RR plan implementation.

Proposed Actions/Tasks:

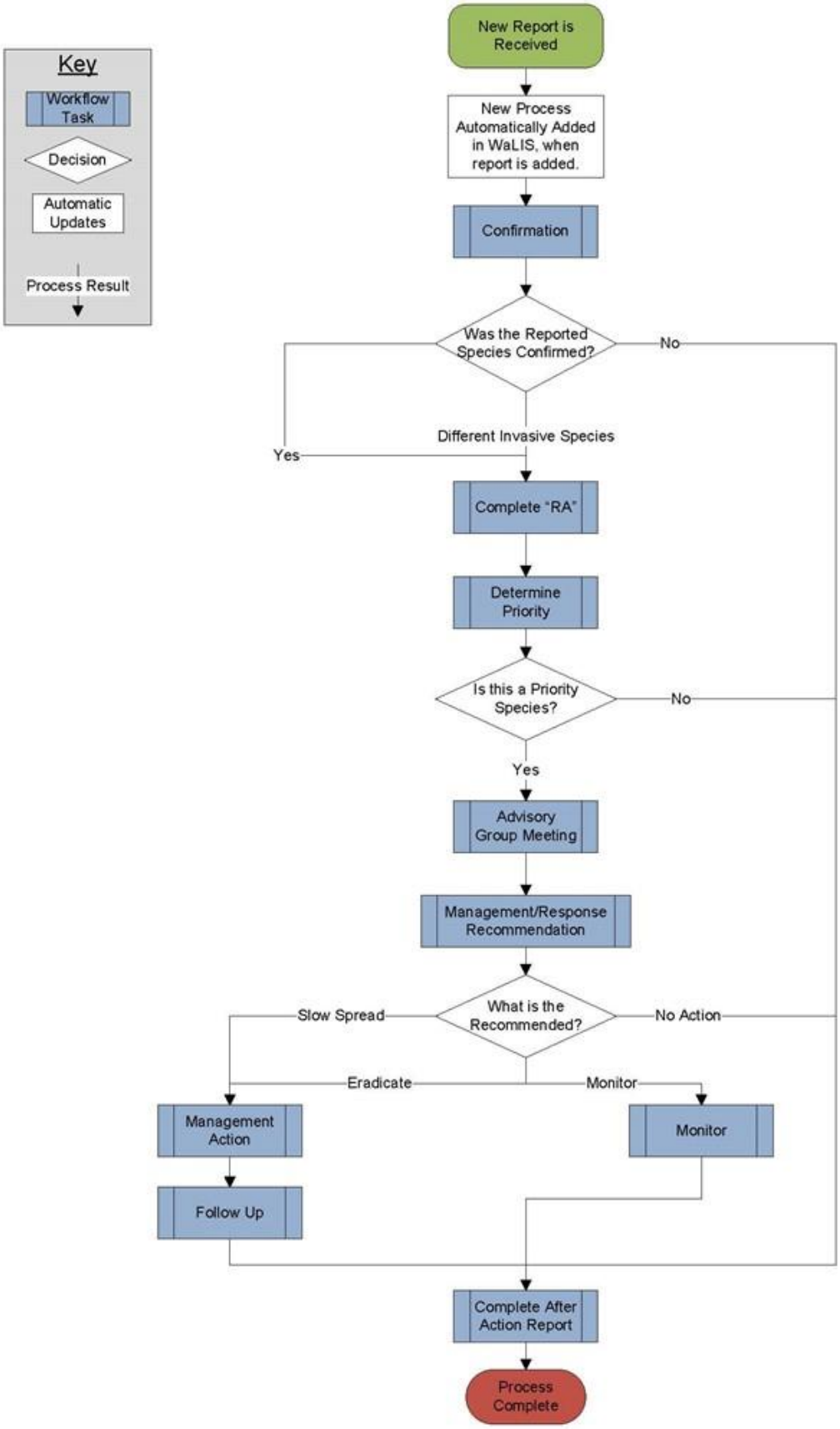
1. Review plan implementation and associated procedures at least annually to evaluate and improve both policy decisions and on-the-ground management activities. Measure success based on achievable and realistic metrics that will also be evaluated.

    - Timeframe: annually
    - Proposed Deadline: January of each year

2. Amend ED/RR plan and metrics/procedures to reflect new technologies and lessons learned and to continually define/refine measures of success.

    - Timeframe: ongoing
    - Proposed Deadline: ongoing

Invasive Species Report Workflow



Appendix B

Invasive Species Communication Plan

Invasive Species Communication Plan

Meredith Taylor
NYC DEP Bureau of Water Supply
WPP NRD City Lands Stewardship
Ecological Research and Assessment
April 2013
Introduction

Effectively communicating priority messages to internal and external audiences regarding the threats associated with invasive species, and the importance of preventing, detecting and controlling them is critical to the success of an invasive species management program in the NYC watershed and on city-owned lands. Invasive species threaten the NYC water supply through their alteration of terrestrial environments with changes to soil and water chemistry and impacts such as erosion, increased herbicide and pesticide use. Aquatic invasive species (AIS) can degrade infrastructure, impede recreation, impact water quality, and threaten human health.

The purpose of this plan is to lay out a strategy for reaching target audiences within the Agency and within the watershed with priority messages in order to promote efficient collaboration among all internal outreach efforts and outside initiatives including national and statewide invasive species programs. Cultivating informed audiences will empower these groups to play a greater role in minimizing the risk associated with certain key vectors for introduction, identify new detections of species that can be eradicated if detected early, and take measures that are the most effective in controlling some of the more widespread and/or threatening invasive species.

Background

Internal audiences (DEP staff) have been targeted with bureau-wide efforts to raise awareness of invasive species issues since the establishment of the Invasive Species Working Group (ISWG) and the creation of the Invasive Species Coordinator position within the Bureau of Water Supply in 2007. The charge of ISWG is to be proactive in dealing with invasive species issues by bringing together DEP staff that have knowledge and experience to coordinate the development of plans and policies that address emerging invasive species issues. Prior to the establishment of ISWG, awareness levels varied among staff and tended to center around a single species such as zebra mussels or Japanese knotweed. Baseline information on ISWG members' knowledge and attitudes is available from an initial survey that was completed in early 2009 and in an evaluation completed in mid-2010. The members' knowledge and attitudes represent a cross-section of bureau divisions; however they provide a slightly skewed response given that they were selected to participate in the Working Group due to interest and experience with invasive species.

The Catskill Regional Invasive Species Partnership (CRISP) and the Lower Hudson Partnership for Regional Invasive Species Management (PRISM), as part of the statewide PRISM network have been targeting external audiences throughout the watershed with invasive species messages since their establishment in the mid 2000's. Baseline information on knowledge and attitudes of several key external audience groups, large forest landowners, local government officials, and foresters and loggers operating in the watershed was gathered as of December 2007 in a study by Cornell University's Human Dimensions Research Unit (Connelly, 2007). This study, commissioned by the Watershed Agricultural Council (WAC), also looked at the most effective vehicles to reach these target audiences with communications.

Intent

This plan serves as a guidance document to shape DEP's invasive species communication priorities for internal and external audiences. It is critical to take a strategic approach in capitalizing on all existing outreach mechanisms that are already employed to reach each target audience such as the recreation newsletter, existing staff trainings, regular invasive species partnership meetings, and special workshops to promote specific messages (communication vehicles listed under each message are in no particular

order). These messages can be layered for each audience over the course of several years in order to achieve desired outcomes.

By explicitly identifying concurrent programs, duplication of effort, time and resources can be minimized and DEP can be a better partner to the organizations that are involved in existing invasive species outreach programs. This plan can also be used to help advocate for partner support on outreach specific to species we are most concerned about (i.e. zebra and quagga mussels). Taking advantage of the expertise and networks already established by partners will help maximize the message.

For each priority message, specific outreach outcomes and measures will need to be identified to help monitor implementation of the plan and to identify successes and challenges. New invasive species outreach initiatives are being put into place across the state and it is important that effectiveness is tracked so that the most successful programs can be replicated by interested partners and less successful programs can be adapted to better meet audience needs.

Goals

The four priority messages outlined in this plan are designed to achieve changes in the various audiences in order to achieve the following goals:

1. To increase internal knowledge and capacity to respond to the threat of invasive species through prevention, early detection and rapid response on city lands and within the watershed;

2. To increase the efficiency with which invasive species infestations are controlled on city lands and within the watershed; and

3. To garner support for prevention, early detection/rapid response, and control of invasive species.

Target Audiences

This plan is intended to guide communication to targeted internal and external audience groups that have the potential to introduce, spread, detect or control invasive species on city lands and within the watershed. The methods used to reach each audience group will vary depending on their receptiveness to various outreach vehicles and many will be complemented by concurrent state and national efforts. Initially, focus will be given to internal audiences so that they are able to assist to greater degree in reaching out to external audiences. Audience groups are broken out below.

Internal DEP staff

- Operations – This directorate should be engaged in preventing the introduction of invasive species by taking measures to limit the spread of invasive species through equipment use and transport, especially when equipment is shared or used throughout the five operational regions – east and west of the Hudson River- and the City itself. Operations personnel should be planting native species in road and other maintenance projects and when possible replacing non-native species in key landscaped locations with native ones. Watershed maintainers and supervisors, through ongoing City land and conservation easement inspections, could also provide a strong network for early detection of low abundance species throughout East and West of Hudson lands if they were trained in how to identify early detection species and had a communication protocol to follow. Operations staff is also at the front line for steam cleaning boats providing an excellent opportunity for detecting AIS and educating recreational users.

- Water Quality – Field staff collecting water samples from streams and reservoirs are the first line of defense for the detection of many early detection aquatic invasive species. While performing their regular duties they could be looking for new, potentially damaging species with proper training and support. Additionally, lab staff should be trained and supported in identifying invasive organisms that can be detected in water samples.

- Watershed Protection & Planning - WPP Outreach Working Group – This group is comprised of staff from throughout the directorate that interacts with the public through fairs, the development of outreach materials and work with partners that do outreach in the watershed. They are a good means of personal communications and distributing print materials to landowners and external natural resources professionals.

- Natural Resources Division
  - Forestry - The foresters already have a strong skill set in invasive plant and insect identification and could benefit from training in early detection species identification and reporting as well as the use of best practices for control projects.

  - Recreation – As the internal interface for an important external audience, staff in this program should be informed and supportive of the messages that are directed at recreation users and identify opportunities for reaching this audience.
  - Wetlands & Fisheries – The wetlands and fisheries scientists have a high level of awareness of common wetland and aquatic invasive species and could be engaged at a higher level in early detection given their strong skill sets in plant/fish identification and in best practices for control projects at wetland mitigation and forest management sites.

  - Property Management – When conducting easement monitoring, pre-closing inspections, land use permit assessments and other field work, staff can be looking for early detection species and reporting them. This could be made a regular part of each property monitoring visit after some initial training. Staff interacting with landowners is also an important vehicle for communicating information regarding best management practices (BMPs) for control to easement grantors.

- Regulatory Engineering - The engineering field inspection staff are regularly visiting sites on private properties interacting with contractors and landowners. With increased training, field staff could provide early detection of easily identified species. Field staff may also act as a vehicle for conveying information to these external audiences on both early detection species and spread prevention best management practices. Project review staff currently review site development and stormwater management plans within the watershed, and through increased training can be prepared to suggest BMPs to consultant engineers and developers. Through the SEQRA Compliance Section's interaction with local Planning Boards and the public hearings related to development projects in the watershed, DEP will be able to spread the various Invasive Species Priority messages both directly and indirectly to local planning officials, professional consultants, and the public.

- Watershed Lands & Community Planning
  - Stream Management – The stream staff spends time working in stream channels and has done work to inventory and control Japanese knotweed. With additional support they could be doing more early detection reporting. They also have the potential to prevent spread of

species and use best practices through their work with contractors that are hired to complete projects in the streams.

- DEP Police – DEP Police will be assisting Natural Resources Division staff in an expanded AIS monitoring as part of the recreational boating program. This effort will build AIS identification and detection skills which can be utilized when Police are performing other diving activities. They can then report suspected AIS to the Invasive Species Coordinator. Incoming recruits should be trained in early detection as part of the DEP Police Academy.

- Policy Makers – By enacting policies that would both prevent the spread of invasive species and implement best practices in invasive species management work to combat invasive species at the agency level would be much more efficient and DEP would be a model for other land managers in the watershed.

- Bureau of Environmental Design and Construction (BEDC) – Integrating spread prevention measures, including not planting non-native species, and BMPs for control into the design phase of projects and contract specifications can help to eliminate the need to remediate or restore sites later. The design staff needs to be more aware of the elements that are most important for invasive species control in their work and the work of their contractors.

External

- Contractors
    - Logging – When logging operations take place on DEP owned lands, there is the potential to require contracted loggers to take prevention measures to keep them from bringing in invasive species on equipment or from disturbing areas where invasive plants have gone to seed to prevent the spread. Information (e.g. fact sheets, DEP Forester interactions) on best management practices to be engaged on the project could be used to reach this audience. Contract specifications could also be included to require certain BMPs (i.e. washing equipment before being deployed on City land). Work via partners in the watershed and the PRISMs to educate loggers and other contractors working in the watershed on best management practices should also continue. The Watershed Agricultural Council (WAC) provides trainings that reach nearly all of the loggers operating in the watershed.

    - Construction – Work that is being done by construction crews on infrastructure in the reservoirs and in streams has great potential for the spread of invasive species on equipment or in fill. Contracts can also be used to engage this audience in activities to prevent spread and to control invasive species on projects.

    - Design Consultants and Landscape Architects – When designing construction projects, land clearing and grubbing and site restoration consultants should be considering invasive species spread prevention and engaging in best management practices.

- Recreation users
    - Anglers – Fishing activities pose a risk of spread of invasive species by gear and contaminated bait or release of invasive bait species making it essential to communicate the threats associated with these activities. Anglers could also provide early detection information for a number of aquatic species and many already have a skill set in species

identification. Existing groups, such as Trout Unlimited and Rod and Gun clubs provide a good opportunity to reach large numbers of anglers at once.

- Hunters – Hunters visiting multiple parcels could spread invasive plant seeds in their boots or on their clothing or they could be a source of early detection information, particularly for feral swine. Communicating the threats associated with invasive species and the skills needed to identify them and prevent their spread would benefit the relationship with this audience.

- Boaters – With the recent opening of four reservoirs to recreational boating, the risk of spread of invasive species by this audience has greatly increased. Boats have the potential to contain plant propagules or small organisms that can persist in moist environments for long periods of time. The increase in activity at boat launch sites also has the potential for emergent or terrestrial plants to be introduced and become established. With adequate outreach, the risk associated with this vector can be greatly decreased and boaters can become a source of early detection reports for aquatic species that are easily observed from the surface.

- Hikers – Invasive plant seeds can be transported in hiking boot treads or on clothing. Reaching hikers with messaging on the threats associated with invasive species and spread prevention techniques could help to minimize the risk of spread and they could also be trained to be a source of early detection reporting. This is an audience that could potentially be skilled in plant identification and can cover a large amount of land in a given season.

- Natural Resource Professionals
    - Land Managers – Watershed lands that are not owned by the city and are managed by natural resource professionals such as Frost Valley YMCA, The Ashokan Center, or land trusts could be engaging in best management practices for controlling invasive species. Additionally, they likely have skills to engage in early detection identification and reporting. The vehicles identified by the 2007 Cornell Human Dimensions Research Unit to best reach this audience were printed materials and personal communications (Connelly, 2007). WAC and PRISMs are great avenues for communicating with this audience.

    - Scientists – University and state agency scientists that are involved in research in the watershed could be a great source of early detection reporting. This audience could also be critical to establishing new best practices for control of invasive species and helping to get this message out to other groups.

    - Officials and Policy Makers – Local, state and federal policy makers have the ability to make changes to or develop new laws that can prevent the introduction or spread of invasive species. This audience can also influence the use of BMPs when a species that poses a significant threat arrives. We will be looking for opportunities to support legislation by providing comments and going through the proper channels to support new legislation. Outreach to these groups may be best conducted through partners.

        - Building inspectors – When conducting inspections on properties in the watershed, building inspectors could be looking for and reporting early

detection species. They could also pass information along to landowners on BMPs and spread prevention tips.

- Planning boards – In reviewing site plans, planning boards have the ability to provide information to landowners and developers regarding invasive species spread prevention.

- Planning Professionals – Invasive species issues spread prevention and BMPs can be addressed in planning documents such as Comprehensive and Master Plans, which in turn will elevate awareness of this issue.

- Media
  - Newspapers – In addition to acting as a vehicle to get out messages, newspapers can be an audience to reach with the message that invasive species pose a significant threat. Having primed, receptive local newspapers could be vital in an early detection crisis situation.

  - Radio Stations – Establishing relationships with local radio stations can also be critical to getting the word out quickly in an invasive species crisis situation. It is important that this audience is aware that invasive species pose a significant threat. Local stations in the Catskills like WIOX already work with partners like WAC and other PRISM partners.

  - Web-based Media – Social media and online news outlets are an additional vehicle and audience group. Establishing a relationship with groups that have large Facebook or local online news followings, (e.g., Watershed Post), is important. They can reach many people at a moment's notice.

- Landowners
  - Large landowners – Similar to land managers, landowners who are responsible for greater than 5 acres could be engaging in best management practices for invasive species. This audience is generally less engaged in active management so it is more challenging to achieve this behavior change. Landowners also may serve as a source for early detection reports for easier to identify species. The vehicles identified to best reach this audience by the 2007 Cornell Human Dimensions Research Unit study were printed materials (brochures and fact sheets), websites, and personal communications (Connelly, 2007). WAC reaches many farmers through the agriculture program trainings and the PRISMs, DEP Stream Management and Land Acquisition Programs will also be critical in reaching this audience.

  - Small landowners – While smaller landowners' activities have minimal impacts individually, if a best management practice is undertaken by many small landowners it could be a positive impact for the watershed. This audience also may serve as a source for early detection reports for easy to identify species. PRISMs will be critical in reaching this audience.

  - Streamside landowners – This subset of landowners also has unique abilities to impact water quality and the spread of invasive species. Many terrestrial plant species spread downstream and can rapidly colonize many miles of stream banks. Having educated streamside landowners that are able to report new populations of invasive species can

help to prevent large infestations from occurring. This is also an audience that receives outreach on a number of other issues from a variety of sources, including the DEP's Stream Program.

- Land Use Permittees
    - DEP issues revocable land use permits to entities using City land. Conditions will be incorporated into permits requesting permittees to utilize BMPs, report possible invasive species and/or perform removal of certain invasive species. For example, we have required permittees for hiking trails to monitor and remove invasive species. We should continue to expand this. Special groups such as Boy Scout troops could be recruited and trained to identify early detection species.

Priority Messages

1. Invasive Species Pose a Significant Threat

The first step in achieving desired behavior changes in nearly every audience is to communicate the threat that invasive species pose to the water supply, environment, economy or human health. Identifying direct threats to a constituency's interest (i.e. Didymo and trout fisherman) can be an important tool and spur those groups to action. Without understanding the risk of inaction, it is much less likely that they will be receptive to any message that is attempting to change their knowledge, awareness, skills, attitudes, and behaviors regarding invasive species. This message has been conveyed in the past through a number of efforts including an invasive species health and safety training for staff, personal communications, PRISM programs, DEP-funded watershed programs and the establishment of prevention policies.

Working collaboratively with concurrent state and national efforts to convey this message will help elevate the importance of invasive species to the audiences targeted in this plan. Resources can be shared among agencies and organizations and the audience acceptance of this message will only be increased by the number of sources. Unfortunately, invasive species issues will only be increasing with the expansion of global trade and climate change making it all the more important to get this message out now, while small actions can still help to prevent or alleviate larger problems.

Supporting Facts and Statistics

- Invasive species are non-native organisms that harm the environment, economy or human health and threaten public water supplies.
- There have been 50,000 non-native species introductions to U.S since the beginning of colonization.
- 4,300 of those are considered 'invasive'
- Invasive species cost $120 billion/yr. in damages and pest control costs (Pimentel, 2005)
- Invasive species are a threat to 49% of all endangered & threatened species in US (Simberloff, 2000)
- Invasive species have caused 68% of U.S. fish extinctions (Miller, 1989)

Vehicles for conveying this message to internal audiences –

- Pipeline / Tributaries newsletter articles
- Weekly Bullets

- Establishment of policies for prevention and management
- Personal communications
- Trainings
- Conferences and workshops
- Demonstration projects

Vehicles for conveying this message to external audiences –

- Websites – (DEP and others such as catskillstreams.org)
- Recreation newsletter article
- Press releases
- Policies for contracts
- DEP branded invasive species giveaway
- DEP invasive species logo
- DEP booth at festivals
- CWC reservoir kiosks
- PRISM efforts
- Participation in the NYS Invasive Species Advisory Committee
- Land use permits
- Vendors for recreational boating and DEP staff for boat steam cleaning
- Conservation easement landowners
- Direct email communication to recreation users and conservation easement property owners
- Green social messaging

Concurrent State and National Efforts

- New York State Invasive Species Unit
- New York State Invasive Species Council
- United States Invasive Species Council
- PRISMs
- NYIS (Cornell Clearinghouse)
- Hungry Pests (USDA)

2. Look For & Report Priority Early Detection Species

It is imperative to the success of DEP's Early Detection and Rapid Response Program that new species to an area are reported by any and all potential observers. Agency personnel are regularly out on DEP lands and waters and could provide an excellent source for observation data. Recreation users on publicly accessible properties could also be reporting observations of several easy-to-identify species. Without extensive outreach to these groups, limited success at getting new reports can be expected.

As new methods for reporting invasive species become available, such as an invasive species hotline, email listserv, WaLIS report form, and website report form, information on how to use them will need to be distributed in order to facilitate their use. This message has been conveyed solely by personal communications in the past. A much broader messaging campaign will be required to get the desired response.

Supporting Facts and Statistics

- Every new detection of Asian long horned beetle has been found by a member of the public
- By finding and treating invasive plant populations while they are small, we have a better chance of controlling the population.
- The larger the infestation the greater the control costs in time and money.
- Support for ED&RR efforts by a wide-range of stakeholders is essential. (National Invasive Species Council)
- EDRR requires collaboration among federal, tribal, state, local governments, nongovernment organizations (NGOs) and the private sector. (National Invasive Species Council)

Vehicles for conveying the message to internal audiences

- Trainings
- WaLIS reporting form
- Print materials
- Personal Communications
- Email list
- Bullets, Pipeline, Tributaries

Vehicles for conveying the message to external audiences

- Website
- Summits
- Select print materials
- PRISM efforts
- Watershed Agricultural Council outreach
- Cornell Invasive Species In-Service
- Recreation permit holder newsletter
- Fishing boat permit renewal notices
- Direct email communication to recreation users and conservation easement property owners
- Press releases
- CWC reservoir kiosks and boat launch kiosks
- Trailhead kiosks
- DEP Booth at festivals
- County tourism boards

Concurrent State and National Efforts

- New York State Invasive Species Unit
- PRISMs
- NYIS (Cornell Clearinghouse)
- iMapinvasives
- Hungry Pests (USDA)
- Beetle Busters (USDA)

3. Don't Spread Invasive Species

Spread prevention is critical to slowing the rate of introduction of new species to a given area. With Asian long horned beetles, hydrilla, snakehead fish, zebra mussels and other invasive species within close proximity to the New York City watershed, promoting messages such as *don't move firewood*, *don't dump aquaria*, and *clean, check, and dry* can help to keep them out. Impacts of the species present within small parts of the watershed, such as emerald ash borer, mile-a-minute vine and swallow-wort, can be minimized by slowing the rate with which they move to un-invaded areas. Simple actions can be taken by internal and external groups that will greatly reduce the chance of a new introduction or the spread of invasive species within the watershed.

There are several national campaigns that aim to combat the vectors of spread for invasive species that can be incorporated into existing communication efforts. These should be targeted to both internal audiences that may inadvertently spread invasive species through regular work activities that move equipment and materials throughout the watershed and external audiences that also have the potential to transport species into the region from great distances. Education and policies regarding steam cleaning boats for staff and recreation users as well as practices to use gear and cleaning techniques to avoid spreading Didymo have already been implemented. Continued efforts should be made to formalize these practices and expand on them to exemplify the DEP as a leader in spread prevention and convey a stronger message to all audiences.

Supporting Facts and Statistics

- Tree-killing insects and diseases lurking in firewood can't move far on their own, but when people move firewood they can jump hundreds of miles. New infestations destroy our forests, property values, and cost huge sums of money to control. (Don'tMoveFirewood.org)

- Over the past 10-15 years, exotic insects like Asian long horned beetle, emerald ash borer and hemlock wooly adelgid have killed millions of trees in cities and woodlots from Long Island, New York to upper Michigan. (NYSDEC)

- Virtually no native tree species in New York are free from potential attack by one or more invasive exotic insect or disease. (NYSDEC)

- Costs to Federal, State and local budgets have exceeded $100 million for eradication efforts, tree removals and disposal and replacement of city street trees. (NYSDEC)

- Many invasive tree and forest pests are difficult, to impossible, to detect early enough in their infestation to be able to eliminate them or control their spread. (NYSDEC)

- History has shown that many invasive forest pests have been spread long distances, inadvertently assisted by humans, through our movement of plants and wood not known to be infested. (NYSDEC)

- Aquatic invaders brought in on boats and equipment or released by the dumping of aquaria can:
    - Reduce game fish populations

- Ruin boat engines and jam steering equipment
- Make lakes/rivers unusable by boaters and swimmers
- Dramatically increase the operating costs of drinking water plants, power plants, dam maintenance, and industrial processes
- Reduce native species
- Degrade ecosystems
- Affect human health
- Reduce property values
- Affect economy of water dependent communities (ProtectYourWaters.net)

Vehicles for conveying the message to internal audiences

- Trainings
- Time-lapse maps showing spread over time
- Implementation of policies
- Print materials
- Personal Communications
- Email list
- Bullets, Pipeline, Tributaries

Vehicles for conveying the message to external audiences

- Implementation of policies
- Website
- Use of the SEQRA process
- Time-lapse maps showing spread over time
- Print materials
- PRISM efforts
- Recreation permit holder newsletter
- Press releases
- CWC reservoir kiosks
- DEP Booths at festivals

Concurrent State and National Efforts

- iMapInvasives
- Habitatitude (National Partnership)
- Clean, Check, Dry -Stop Aquatic Hitchhikers
- Don't Move Firewood (TNC and National Partners)
- NYIS (Cornell Clearinghouse)
- Hungry Pests (USDA)
- Beetlebusters
- NYSDEC

4. Use Best Management Practices to Control Invasive Species

Once invasive species become established, even at a small-scale, they become very challenging to successfully control. Site specific conditions will often warrant different control techniques for the same species and ongoing research frequently results in new recommendations for best practices making it

difficult for managers to select the best technique for a problem area. Additionally, control projects take a high level of patience and commitment since they are rarely effective overnight and it can take several years before significant progress can be seen. Thoughtful planning is also critical given that pesticides and herbicides can be an important element in effective management and must be used judiciously. Managers can easily become overwhelmed by the degree of involvement needed to mount a successful control project and may not attempt it without support or they may use inappropriate techniques that can waste time and resources.

By promoting best management practices (BMPs) for controlling invasive species within the watershed the entire process will be simplified allowing for more efficient management. Best practices can guide project selection to favor projects that have a higher chance of success. Communicating the details of BMPs to both internal and external audiences has occurred to a limited extent primarily through personal communications. The implementation of BMPs should be encouraged through a more comprehensive communication campaign in order to maximize the efficiency of control efforts within the watershed.

Supporting Facts and Statistics

- The National Invasive Species Council's Implementation Task P.3.5 provides support for efforts by non-federal stakeholders to develop/enhance codes of conduct and Best Management Practices and to publish codes of conduct and BMPs on the Web. (National Invasive Species Council)

- Effective implementation of BMPs will be a process of continuous learning. Over time, training programs for foresters, landowners, and loggers will be necessary to ensure a successful BMP effort. (Wisconsin's Forestry Best Management Practices for Invasive Species)

- Without Best Management Practices it is expected that rates of implementation of control projects will not increase and the issues associated with invasive species will continue to worsen.

Vehicles for conveying the message to internal audiences

- Trainings (Tool-box Talks)
- Species summits
- Shared resource server folder
- Implementation of policies (Forestry Conservation Practices)
- Print materials
- Personal communications
- Email list
- PRISM efforts

Vehicles for conveying the message to external audiences

- Implementation of policies
- Use of the SEQRA process
- Website
- Select print materials
- PRISM efforts
- Species summits
- Demonstration projects
- Recreation permit holder newsletter
- Press releases
- CWC reservoir kiosks
- DEP Booth at festivals

Concurrent State and National Efforts

- New York State Invasive Species Unit
- NYIS (Cornell Clearinghouse)
- New York State Invasive Species Council
- PRISMs
- National Invasive Species Council
- US Department of the Interior
- US Department of Agriculture

Appendix C

Aquatic Herbicide Information

Reference for review of aquatic invasive species control projects

Prepared April 2015 by David Quentin, DEP Ecotoxicologist – Subject to regular updates

Active Ingredient of Herbicide	Trade Name(s)	USEPA Reg. No.	% Active Ingredient	Emergent/ Submergent Control	Eradication/ Suppression	Restrictions (Yes/ No)	Exposure Concerns *2*3	USEPA	NYSAWQS(ppb)
Copper (Chelated)	Komeen Komeen Crystal Nautique	67690-25 67690-60 67690-10	22.9 50 9.1	Both Both Both	Eradication same same	Yes* Yes*	No No	1300	200
2,4-D	Navigate Weedstroy AM-40	71368-4-8959 228-145	27.6 46.8	Emergent(Floating) same	both based on species	No No	Yes Yes	70 70	50 50
Diquat	Reward	100-1091	37.3	Both	Suppression	Yes SLN NY-030001	Yes	20	20 (Surface water)
Endothall	Aquathol K	70506-176	40.3	Submergent	Suppression	No	Yes	100	N/A
Fluridone	Avast! Sonar SRP Sonar A.S.	67690-30 67690-3 67690-4	41.7 5.0 41.7	Submergent Same Same	Eradication same same	No	No	N/A	N/A
Glyphosate	AquaPro Rodeo	62719-324-67690 62719-324	53.8 53.8	Emergent same	Eradication same	No No	No	700	N/A
Imazomox	Clearcast	241-437	12.1	Both	Eradication	No	No	N/A	N/A
Triclopyr	Renovate	62719-37-67690	44.4	Both	Eradication	Yes SLN NY-060001	Yes	N/A	N/A

Appendix D

Timeline of Invasive Species Highlights

Invasive Species Timeline - DEP Accomplishments

1988		Zebra mussels first detected in Great Lakes
1993	to now	Zebra mussel prevention program: monitoring, steam-cleaning and outreach
1996		Asian long horned beetle (ALB) found in NYC
1999	to now	Invasive species monitoring in forest health plots and continuous forest inventory plots
2000		ALB workshop-Liberty, NY
2000	to 2001	ALB information mailed to DEP hiking permit holders
2002	to now	Begin Japanese knotweed control/outreach
2003		Fund literature review on Japanese knotweed and management
2003	to 2006	Japanese knotweed mapping and management study
2004		Japanese knotweed study
2004	to 2006	Participate in and co-lead Japanese Knotweed Initiative
2004	to 2007	DEP literature review/ white paper on invasive species
2005		The Nature Conservancy (TNC)conducts invasive plant inventory project
2005		Trees New York holds invasive species workshops (Poughkeepsie & Kingston, NY)
2005	to 2009	Sponsor Japanese knotweed demonstration sites
2005		Forest health/invasive species stakeholder meetings & outreach workplan (pre-CRISP)
2005		DEP comments to DEC on NYS Invasive Species Task Force report
2006		DEP active in founding CRISP (Catskill Region Invasive Species Partnership)
2006		ALB-awareness-Upstate/downstate bus tour
2006		Lower Hudson PRISM forms
2006		DEP representative appointed to NYS Urban & Community Forestry Council
2006		Contract specs for barge work (bridge construction/repair) in streams, lakes or reservoirs
2006		Japanese knotweed Conference
2006	to 2007	Public Awareness Survey of Invasive Plants and Insects in the Catskill and Lower Hudson Region
2006		Giant Hogweed first detected on City Land (Croton Falls)
2006		Met with Cary Institute for Ecosystem Studies & DEC to formulate plans for invasive species management in Catskill Preserve
2006		TNC Catskill Invasive Survey finds Swallow-wort found on City Land (Pepacton)
2007		Summer Firewood Education/Outreach Pilot Program
2007		Begin control of swallow-wort control on City Land
2007	to 2010	Bait sales analysis and lobby for regulation to reduce risk of ZM introduction
2007		Fisherman reports Rock snot (Didymo) to WQ samplers
2007		DEP Invasive Species white paper completed
2007		Training on Invasive Species Health & Safety Issues developed
2007		NYS Invasive Species Legislation enacted to form a Council, Advisory Committee and PRISM's
2008		Terrestrial Eradication Grant funding to DEP-TNC for swallow-wort (Pepacton) (2008-2010)
2008		Brazilian elodea (Egeria densa), first reported in Westchester County - Lake Waccabuc
2008		Ballast (Small Boat) Administrative Operating Procedure revised (begun in 2004)
2008		DEP attends Regional Firewood Forum in New Jersey
2008		Northern Snakehead found and eradicated in Orange County, NY
2008		ALB found in Worcester MA
2008		NYS issues Emergency Regulations on firewood transport & treatment
2008		Begin control of Japanese barberry, mile-a-minute weed and giant hogweed on City land
2008		DEP representative appointed to NY IS Advisory Committee
2008		Organize DEP Invasive Species Working Group (ISWG)

2009		DEP partners with CRISP and TNC to do a ALB survey of campgrounds in the Catskills
2009		DEP participates in regional ALB training with USDA-APHIS
2009	to 2010	ISWG begins to do risk assessments and rank species
2010		Emerald ash borer (EAB) found in Ulster County, NY
2010		Invasive species surveys conducted for giant hogweed, mile-a-minute and swallow-wort
2010		Attended Cornell Cooperative Extension training on EAB
2010		Updated zebra mussel steam-cleaning and quarantine protocols
2010		Presented on the ISWG at the Watershed Science and Technical Conference
2011		NYS issues Invasive Species Management Strategy
2011		ISWG Finalized an Early Detection and Rapid Response Plan
2012	to 2016	Contracted SUNY Oneonta Biological Field Station to survey terminal reservoirs for aquatic invasive species
2012		EAB surveys conducted around Ashokan Reservoir
2013		Invasive Species Communication Plan Drafted
2013		Presented on swallow-wort eradication project at the Watershed Science and Technical Conference
2013		Presented on EAB at the New England Society of American Foresters annual meeting
2013		Training on early detection species given to field Operations staff throughout the watershed
2013	to 2015	Pilot boat steward program developed with CRISP at Pepacton Reservoir
2013		Training by USDA APHIS held for DEP Police on feral swine
2013	to 2014	Recreation users surveyed on invasive species awareness
2014		Hydrilla is detected in New Croton Reservoir
2014		NYS prohibits and regulates the sale of many invasive species (NYCRR Part 575)
2014	to 2015	*Rhinoncomimus latipes*, biocontrol for mile-a-minute released near Kensico Reservoir
2015	to now	DEP participates in the Lower Hudson PRISM blockbuster survey for focal species EOH
2015	to now	Benthic barriers installed to control hydrilla around the boat launch in New Croton Reservoir
2015		Presented on hydrilla at the Watershed Science and Technical Conference
2015	to 2016	Worked with TNC to develop a deer exclosure study of invasive species in the Ashokan Basin
2015		DEP representative named chair of the NY IS Advisory Committee
2016		NYS Aquatic Invasive Species Spread Prevention regulations are enacted (NYCRR Part 576)
2016		Extensive survey for hydrilla conducted in New Croton Reservoir by Solitude Lake Management
2016		DEP participates in Hemlock Conservation priority setting with CRISP
2016		DEP comments to DEC on the proposed Rapid Response Framework

Appendix E

2003 Establishment of NYS Invasive Species Task Force

Chapter 324 of NYS Law

AN ACT creating the New York state invasive species task force Became a law August 5, 2003, with the approval of the Governor. Passed by a majority vote, three-fifths being present. The People of the State of New York, represented in Senate and Assembly, do enact as follows:

§ 1. Legislative intent. The Legislature finds that invasive plant and animal species pose an unacceptable risk to New York State's environment and economy and that this risk is increasing through time as more invasive species become established within the state. The Legislature additionally finds that invasive species are having a detrimental effect upon the state's fresh and tidal wetlands, water bodies and waterways, forests, meadows and grasslands, and other natural communities and systems by out-competing native species, diminishing biological diversity, altering community structure and, in some cases, changing ecosystem processes. Moreover, the Legislature recognizes that the ecological integrity of an increasing number of publicly and privately-owned parks and preserves is being adversely affected by invasive plants and animals, challenging the ability of land management agencies to effectively manage these sites. The Legislature further recognizes that nearly half (forty-six percent; fifty-seven percent of the plants, thirty-nine percent of the animals) of the species on the federal list of endangered species are declining, at least in part, due to invasive species. The Legislature additionally finds that invasive species have an adverse impact on the New York State economy. Particularly affected by these species are the water supply, agricultural, and recreational sectors of the state economy. The economic impact to the national economy has been estimated to be as high as one hundred thirty-seven billion dollars annually.

§ 2. The New York state invasive species task force is hereby established. The role of the task force includes, but is not limited to:

(a) assess the nature, scope and magnitude of the environmental, ecological,

agricultural, economic, recreational, and social impacts caused by invasive species in the state;

(b) identify actions taken by members of the task force, state and local governments and the public to: prevent the introduction of invasive species; detect and respond rapidly to and control populations of invasive species in a cost-effective and environmentally sound manner; monitor invasive species populations accurately and reliably; provide for restoration of native species and habitat conditions in ecosystems that have been invaded; conduct research on invasive species and develop technologies to prevent introduction; provide for environmentally sound control of invasive species; promote public education on invasive species; and the means to address invasive species;

(c) prepare a report to the governor and the legislature that provides specific recommendations regarding: existing state laws, regulations, programs, policies, practices, and resources available to prevent the introduction of invasive species; the detection and rapid response to and control of populations of such species in a cost-effective and environmentally sound manner; the monitoring of invasive species populations accurately and reliably; the restoration of native species and habitat conditions in ecosystems that have been invaded; research on invasive species and development of technologies to prevent introduction and provide for environmentally sound control of invasive species; the promotion of public education on invasive species; and the means to foster greater coordination between state agencies, and the public.

§ 3. The task force shall issue its findings, in the form of a report, no later than November 30, 2005.

§ 4. The task force shall consist of a total of 17 members and shall include the commissioners of environmental conservation, agriculture and markets, transportation, the office of parks, recreation and historic preservation, secretary of state, the chairperson of the New York state thruway authority, the director of the New York state canal corporation, the chairperson of the Adirondack Park agency, and the program manager of the New York natural heritage program, or

a designee of such agencies, public authorities or programs. The commissioners of environmental conservation and agriculture and markets shall select the task force's 8 at-large members from each of the following: New York biodiversity research institute, New York state's land grant university, New York sea grant, a statewide organization formed to address invasive species, a statewide land conservation organization, a statewide agricultural organization, a nursery business and a boating organization.

§ 5. The commissioner of agriculture and markets and the commissioner of environmental conservation or their designees shall serve as joint chairs of the task force.

§ 6. The task force may consult with any organization, educational institution, governmental agency, or person including, but not limited to, the United States Department of Agriculture, the United States Coast Guard, the Port Authority of New York and New Jersey, and the National Invasive Species Council.

§ 7. The commissioners of environmental conservation and agriculture and markets may reconvene the task force, with the same or different members, after issuance of the report, to address any invasive species issues.

§ 8. The members of the task force shall serve without compensation, except that at-large members shall be allowed their necessary and actual expenses incurred in the performance of their duties under this act.

§ 9. This act shall take effect immediately.

The Legislature of the STATE OF NEW YORK

Pursuant to the authority vested in us by section 70-b of the Public Officers Law, we hereby jointly certify that this slip copy of this session law was printed under our direction and, in accordance with such section, is entitled to be read into evidence.

JOSEPH L. BRUNO, Temporary President of the Senate

SHELDON SILVER, Speaker of the Assembly

Appendix F

2007 NYS Invasive Species Legislation

Title: An act to amend the environmental conservation law in relation to creating the New York invasive species council.

Purpose: The purpose of this bill is to address environmental, ecological, agricultural, economic, recreational, and social impacts caused by invasive species in the State.

History: In June 2007, this NYS Invasive Species Legislation was passed by the Senate and Assembly. Governor Spitzer signed the legislation in the fall of 2007. The legislation is based on the recommendations of the 2005 New York State Invasive Species Task Force Report to the Governor and Legislature: http://www.dec.ny.gov/docs/istfreport1105(1).pdf. It amends the state environmental conservation law to create a New York state invasive species council.

Highlights:

1. Creates an Invasive Species Council made up of state agencies

2. Creates an Invasive Species Advisory Committee made up of NGOs, local municipalities, and other non-state agencies.

3. Calls for development of a NYS Invasive Species Management Plan

4. Calls for a biennial invasive species conference

5. Formalizes the relationship between PRISMs (Partnerships for Regional Invasive Species Management), the Council, and the Advisory Committee

6. Creates a four tier classification (prohibited from distribution, species of concern that should not be allowed to escape into natural areas, non-native species that are not invasive, and unevaluated non-native species). Species within each category and recommended penalties are to be submitted to Legislature by 2010.

7. Once list is created, all state funded projects shall not use species on the prohibited list. The four-tier classification will be voluntary for all other sectors unless the Legislature amends this bill at some future date after 2010.

Summary of Specific Provisions: This bill would create an invasive species council and an advisory board on which a DEP representative would serve. The membership of the New York Invasive Species Council would be consistent with the Task Force established under Chapter 324 of the Laws of 2003 (Appendix D). The Council would be responsible for the development of a comprehensive plan for invasive species management, providing input on funding for invasive species control and management, and developing a four-tier classification list for non-native wildlife and plant species which would be the basis for recommendations of the Council for restrictions on the introduction of such species and penalties for such violations. The bill would also give DEC additional powers and duties for the implementation of the act and prohibit the State from purchasing or intentionally distributing species identified as prohibited in the recommendations of the Council.

Justification:: “Invasive plant and animal species pose an unacceptable risk to New York State's environment and economy and this risk is increasing through time as more invasive species become established within the State. Invasive species are having a detrimental effect upon the State's fresh and tidal wetlands, water bodies and waterways, forests, meadows and grasslands, and other natural communities and systems by out-competing native species, diminishing biological diversity, altering community structure and, in some cases, changing ecosystem processes. Moreover, the ecological integrity of an increasing number of publicly and privately-owned parks and preserves is being adversely affected by invasive plants and animals, challenging the ability of land management agencies to effectively manage these sites. Nearly half (forty-six percent; fifty-seven percent of the plants, thirty-nine percent of the animals) of the species on the federal list of endangered species are declining, at least in part, due to invasive species. Particularly affected by these species are the water supply, agricultural, and recreational sectors of the state economy (italics added-BD).The economic impact to the national economy has been estimated to be as high as one hundred thirty-seven billion dollars annually. The council and program established by this bill will help to address this problem.”

For the full bill (S6117A or A9027A) see http://public.leginfo.state.ny.us/menugetf.cgi

Appendix G

Small Boat Program Invasive Species Protocols

1.0 Purpose

The movement of Bureau and Contractor boats is controlled to prevent the introduction or spread of organisms (non-native and/or invasive plant or animal species). This Appendix provides direction when invasive species are discovered during equipment inspection and cleaning activities addressed in section 5 of the SBP Guide.

2.0 Discussion

It is imperative that Bureau boating activities on New York City reservoirs contribute minimal negative impacts to water quality. The spread of non-native, invasive species must be prevented. To this end, controls have been put into place as described in the SBP Guide. When boats are inspected and invasive species are discovered, they must be quickly processed so that adequate measures can be taken to prevent their spread in the water supply.

3.0 Invasive Species Control

1. Procedure 5.2 *Equipment Steam Cleaning and Inspection* requires vessels to be inspected for invasive species and cleaned. Procedure 5.2 should be reviewed in conjunction with this Appendix when needed.

2. If any suspected zebra mussels or other organisms are discovered on the vessel or any equipment attached to the vessel during inspection, the SBP Operator or Contractor will be responsible for removing the zebra mussels or other organisms and placing them in a secure container. DEP staff present to inspect/steam clean the boat, equipment etc., shall place the suspected zebra mussel(s) in a secure non-breakable container and preserve this in ethyl or isopropyl alcohol (final solution should be 25-50% alcohol by volume).

3. Both the Zebra Mussel Project Manager and the Fisheries Biologist shall be contacted by telephone and email at the time the possible zebra mussel(s) are found by DEP staff. The Fisheries Biologist shall go directly to the site within six hours of the sighting, for first level identification. If he is unable to visit the site within six hours, the Zebra Mussel Project Manager shall direct the DEP staff person who found the mussel (or that person's supervisor) to ship the mussel in the solution described above for identification by DEP's zebra mussel monitoring consultant.

4. If the Fisheries Biologist is able to visit the site within six hours, he should then contact the Zebra Mussel Project Manager by phone and e-mail to report if the mussel(s) found appear to be zebra mussels. He will then ship the mussel(s) to

the zebra mussel contractor for positive identification, as per the instructions of the Zebra Mussel Project Manager. The mussels should be shipped in a secure non-breakable container and preserved in ethyl or isopropyl alcohol (final solution should be 25-50% alcohol by volume as described above.)

5. If the samples are identified by the Fisheries Biologist as not being zebra mussels, the vessel will be allowed into the reservoir after the organisms are removed and another steam cleaning is performed.

6. If the samples are identified as zebra mussels, they are shipped (as mentioned above) to the zebra mussel consultant for identification. While waiting for positive identification of the organisms and recommendations for further action, the vessel is not to be placed into the NYC reservoir. **If the organisms are found to be zebra mussels, there will be a mandatory two-week quarantine of the vessel** during which time the vessel needs to be completely dry. Cool, damp weather or rain may extend the quarantine.

7. If the organisms are confirmed not to be zebra mussels the vessel will be allowed into the reservoir after another steam cleaning. At any point during the process DEP staff shall quarantine for two weeks or disallow a vessel from entering the NYC reservoir if DEP staff is not highly confident that all zebra mussels or other organisms have been removed. The vessel is not to be put into the NYC reservoir until it is deemed safe by DEP staff. After proper removal of these organisms, the vessel must be carefully steam cleaned and carefully re-inspected by DEP Operations staff to be sure that all identifiable zebra mussels or other organisms are gone.

4.0 Further Information

Zebra Mussel Project Manager – (718) 595-5356

Invasive Species Coordinator – (845) 340-7856

Fisheries Biologist – (845) 340-7857