SUMMARY OF, AND RESPONSES TO, COMMENTS RECEIVED ON DCR'S DIVISION OF WATER SUPPLY PROTECTION'S SCIENCE AND TECHNICAL ADVISORY COMMITTEE'S REPORT AND DCR'S "FROM HERE FORWARD" RESPONSE DOCUMENT

The DCR Division of Water Supply Protection's Science and Technical Advisory Committee released its report, "Review of the Massachusetts DWSP Watershed Forestry Program", on December 10, 2012 at a joint meeting of the Quabbin and Ware River Watershed Advisory Committees. The document was posted on the DCR website and comments were accepted through January 2013.

The Division of Water Supply Protection's response to the STAC report, entitled "From Here Forward", was distributed at the February 12, 2013 joint meeting of the Quabbin and Ware River Watershed Advisory Committees. The document was posted on the DCR website and comments were accepted through March 2013.

The following table aggregates many of the common themes presented in the individual and organizational comments received by DCR and also provides the agency's response to these concerns.

Acronyms

DCR: Department of Conservation and Recreation
DEP: MA Department of Environmental Protection
DFG: MA Department of Fish and Game
DFW: DFG's Division of Fisheries and Wildlife (MassWildlife)
DWSP: DCR's Division of Water Supply Protection
EEA: MA Executive Office of Energy and Environmental Affairs
FSC: Forest Stewardship Council
MEPA: MA Environmental Policy Act
MWRA: Massachusetts Water Resources Authority
NHESP: MA Natural Heritage and Environmental Species Program

1. DWSP must do the research to prove beyond doubt that logging and active management of the forest are improving its ability to function as the biological filter for this water supply and that these purported improvements are in fact improvements in the filtration provided by an unmanaged forest.

The Quabbin and Wachusett Reservoirs contain some of the highest quality source drinking water in the world. DWSP and MWRA conduct extensive water quality monitoring (see the annual water quality reports posted on the DWSP website at www.mass.gov/eea/agencies/dcr/water-res-protection/water-quality-monitoring/). As a result of the STAC process, DCR is committing to increased monitoring in order to more specifically verify that DWSP silvicultural practices are not negatively affecting adjacent tributary waters.

DWSP's watershed forest management is guided by conclusions published in watershed forestry research and many other disciplines, as reviewed in the Principles section of the Land Management Plan for each watershed (found at www.mass.gov/eea/agencies/dcr/water-res-protection/watershed-mgmt/plans.html). The watershed forest management literature suggests that working to deliberately diversify the structure and composition of forests that have been made relatively homogenous by past land use practices is the most prudent, conservative approach to maintaining the water supply protection provided by this biological filter, especially in the face of ever-increasing disturbances such as ice and heavy snow, winds from microbursts or hurricanes, insect pests, or intensely dry or wet periods (see Principles section of the LMPs, and the cited literature within these sections).

The recently completed STAC report concluded that forest cover of any kind provides far superior protection to that provided by any other land use, that an unmanaged forest will maintain water supply protection until catastrophic disturbance reduces its ability to serve this function, and that a forest managed deliberately to maintain diverse structure and composition should resist and recover from these disturbances better than a forest that develops homogenous structure and/or composition.

There are clear examples in the literature of water supply benefits from managing protection forests for diversity. For example, the hydrology literature verifies that snowmelt from a watershed with homogeneous forest cover is synchronized and will occur within a very short time period, achieving a significantly higher hydrologic peak than a mixed composition forest, on which snowmelt is desynchronized by the variable land cover. Diverse forest cover reduces the hydrologic peak and the associated transport of sediments and nutrients compared to a homogeneous forest cover (Satterlund and Adams, 1992. Wildland Watershed Management; p.249).

Both Boston and New York City rely upon biological filtration to protect and maintain their drinking water supplies. The water supply system for each of these cities is treated, but not artificially filtered. Both watershed systems are heavily forested and the water supply protection agencies responsible for both of these systems rely upon active management of their watershed forests to optimize the function of the forest filter over the long term. Much like the routine replacement of the elements of an engineered filtration system, watershed forest management functions to 'tune-up' the filter by deliberately rejuvenating some components and building redundancy that stabilizes the filtration function during periods of stress.

DWSP's review of the past and current research on the subject as well as the agency's more than 60 years of experience and extensive monitoring and the recent review by the Science and Technical Advisory Committee all support the desirability of continuing the active management approach.

2. Mature forests better maintain their ecological integrity than managed forests in the face of severe weather events, and forests and wildlife benefit from the impacts of natural disturbances. Logging does NOT mimic natural disturbances and often degrades forest health and water quality.

DWSP's silvicultural approach is designed to regenerate less than 1% of the actively managed watershed forest cover each year. This is within the well-researched natural rate of disturbance in these Northeastern forests of 0.5 to 2.0% per year, but is more deliberately distributed across the forest. These forests are first and foremost tasked with providing stable biological filtration of the drinking water supply for 2.2 million people. The Science and Technical Advisory Committee concluded that achieving this stability can best be accomplished through active management designed to deliberately diversify structure and composition where the forest is currently less diverse than desired.

These silvicultural objectives have been actively pursued without either long-term or short-term degradation of the water supply and with the research-based expectation (again, see the Principles section of the Land Management Plan for each watershed) of achieving greater stability in the face of natural disturbances. Change agents, such as storms or pests, often are fairly specific in the sizes and/or species of trees they affect. Therefore, by acting now to deliberately diversify species and sizes, the agency believes it is increasing the stability of this biological filter by reducing its susceptibility to disturbance. While DWSP is engaged in considerable work related to wildlife and has set aside more than 20% of each watershed forest as unmanaged reserve, protection of the drinking water supply remains the agency's primary mandate.

3. There is no reason or credible science to support the claims that that logging will "help" forest health and water quality and that trees should be cut down to protect against some theoretical future hurricane.

The fundamental responsibility for the Division of Water Supply Protection's Office of Watershed Management is the long range planning for a water supply that must deliver clean drinking water to 2.2 million users, every day, in perpetuity. This supply is biologically filtered by the forests that dominate its land cover. These forests are subjected to an increasingly wide array and frequency of natural disturbances, some of which are catastrophic. While the relationship between diversity and stability is heavily debated in ecology, as applied to watershed protection it is as simple as, for instance, reducing the impact of an insect that attacks oaks by managing to regenerate a mix of species within an oak-dominated stand. Redundancy in engineering is defined as the duplication of critical components or functions of a system with the intention of increasing the reliability of the system. Diversity in structure and species composition, whereby the overstory forest is backed up by vigorous understory vegetation is a conservative component of redundancy in maintaining a forest-filtered drinking water supply.

The objective of management within the watershed forests under the care and control of DWSP is to maintain the diversity, and therefore the stability, of this biological filter, by deliberately restructuring it where diversity, in age classes or species composition, is inadequate. DWSP has reviewed and carefully assembled the well-researched science behind this objective, as detailed in the lengthy Principles section of each Land Management Plan. These are not spurious excuses; they are carefully assembled objectives built upon a very wide body of credible science. The components of these plans were reviewed by the original Quabbin Science and Technical Advisory Committee, and the re-convened STAC confirmed these principles.

4. The only possible motivation for DWSP forest management appears to be to raise revenue. Furthermore, the primary beneficiaries are private logging companies, most of whom ship the logs they harvest on DWSP lands to Canada. If timber harvesting is to occur on DWSP properties, it should be handled by the agency, not by commercial interests.

The motivation for DWSP's long-standing active watershed forest management program is to protect the water supply for 2.2 million people. DWSP employs professional foresters and wildlife biologists, and other natural resources professionals to provide vigilance over and recommend appropriate management of the biological filter that protects these surface drinking water supplies. The primary product of the agency is drinking water and the value of the drinking water delivered each year to metropolitan Boston and other users exceeds $100 million. The agency employs more than 100 other professional staff responsible for engineering, watershed and water quality monitoring, land acquisition, recreational management, and watershed maintenance. The revenue that supports all of these staff derived from the production of sufficient quantities of extremely high quality drinking water to meet the needs of 2.2 million users, every day, in perpetuity.

DWSP does rely on professional timber harvesters/loggers to implement the agency's silvicultural objectives. When DWSP requires trees to be cut to refine the structure of the forest filter, the agency marks these trees, sells the marked trees in a competitive bidding process, lays out paths for the harvesters to access and remove them, and then very carefully monitors the implementation of the cutting. Projects are clearly not designed to maximize profits; in fact the requirements for specific and extremely expensive equipment, best management practices, retention trees, and seasonal constraints

makes these projects particularly difficult to bid. Only a small number of contractors with specific equipment, skills, and knowledge end up bidding on DWSP watershed forestry projects. To stay in business, the loggers must realize a value that meets or exceeds their costs, but they have no say over what trees are to be cut. DWSP foresters make this determination based on the desired changes to the forest, such as thinning to improve the vigor of the remaining trees or harvesting overstory trees to bring light to the forest floor and establish a new age class through regeneration.

Once the trees are sold, DWSP has no control over where the logs or pulpwood or firewood are marketed by the logger. The wood processing industry used to be much more viable in Massachusetts and these wood products from state lands were primarily processed in-state. Global changes in trade and wood markets have made this increasingly challenging, and sawmills and other processing facilities have been drastically reduced in Massachusetts over the past 30 years. Today, 98% of the wood used in Massachusetts is imported from elsewhere. The Canadian government has provided generous incentives to maintain their wood processing industry, and consequently, significant volumes of wood generated in Massachusetts, including from state lands, are profitably shipped to Canada by Massachusetts timber harvesters. While the loss of local sawmills and other wood processing facilities limits opportunities for retaining the value of these wood products in Massachusetts, some of the DWSP wood is used locally. Most of the firewood is sold locally and companies such as Northern Lights Log Homes in Orange, MA specifically purchase logs from DWSP watersheds and use their origin in marketing their products.

5. DWSP failed the FSC certification process because its logging practices violated standards.

In 1997, Commonwealth lands on the Quabbin watershed were the first public lands in North America to be FSC certified. In 2004, this certification was expanded to cover DCR-Bureau of Forestry, Department of Fish and Game, and the remaining DCR-DWSP lands. As the joint certification approached expiration, the agencies sought recertification, but the costs associated with meeting the conditions of certification coincided with significant budget cuts that made paying for the additional required audits not feasible, and so the agencies chose not to continue to pursue recertification. It was the costs of an additional audit, not a violation of standards, which brought the agencies to agree not to pursue recertification after it expired in 2009. DWSP may pursue third-party forestry certification in the future.

6. The Science and Technical Advisory Committee is deliberately composed only of individuals who are biased toward the continuation of logging on DWSP properties.

STAC was formed for the purpose of evaluating the scientific and technical principles on which DWSP's land management plans are based, and for informing the revision of such plans with state-of-the-science reviews of research directly relevant to management issues and concerns. Its original format (in 1996) was a direct conversation between the DWSP field managers and academics from throughout the Northeast.

STAC was reconvened in 2010 to address the requirements of former EOEEA Secretary Ian Bowles' Forest Heritage Plan, which included reviewing the principles and practices of the DWSP forest management program. With this task in mind, 22 scientists were invited to sit on the committee representing the fields of forest management and silviculture, wildlife management, watershed/water supply management, civil and environmental engineering, wetland ecology, rare and endangered species, conservation biology, invasive species, biometrics, environmental economics, sustainable forest policy, forest ecosystem science, forest carbon management, disturbance/restoration ecology, forest resource planning, and environmental science; 16 agreed to participate. Advisors were invited from Mass Audubon,

The Nature Conservancy, the University of Massachusetts (Departments of Economics, Mathematics and Statistics, Environmental and Water Resources Engineering, and Environmental Conservation), Mt Holyoke College, Yale University, Harvard University, the University of Vermont, the USDA Forest Service (UMass Northern Research Station and Hubbard Brook, NH), American Water Works Association, and the Global Institute of Sustainable Forestry. The participants and their affiliations are listed on the DWSP website at: www.mass.gov/eea/agencies/dcr/water-res-protection/watershed-mgmt/science-and-technical-advisory-committee.html.

7. DWSP logging amounts to destructive deforestation that will cause massive losses of nutrients and sediments to the reservoir.

"Deforestation" refers to the conversion of forest land to another use, such as the loss of tropical forests to agriculture via "slash and burn" conversions, or the conversion of forested properties to residential properties, with concurrent changes in water, soil, and nutrient dynamics. Forest management maintains the land in forest use. The vast majority of DWSP properties are permanently in forest cover. DWSP is in fact preventing deforestation of central Massachusetts through its purchase of land and conservation easements. Since 1985, DWSP has spent over $130 million with MWRA ratepayer funding to purchase in excess of 22,000 primarily forested acres to permanently protect them from development.

While overstory trees are harvested through the DWSP forest management program (on less than 1% of the watershed forests each year), this does not result in a change of land use. In addition, strict adherence to both Massachusetts and DWSP performance standards prevents losses of nutrients and sediments. The understory in harvested areas regenerates forest cover very quickly, either because regeneration is already established prior to the removal of overstory trees, or because the abundant sources of tree, shrub, and herb seed respond to the available soil, water, and light in the growing season following the harvest. A combination of deep organic soils, the adjacent overstory surrounding these small openings and the vegetation that remains following overstory removal protect against losses of nutrients or sediments during the regeneration period. Decomposition rates and conversion of organic materials to more mobile inorganic nutrients do increase following both natural and deliberate disturbances of the overstory, however these increases are unlikely to impact the reservoir or the adjacent streams because the natural systems in these forests are nutrient-limited and therefore rapidly capture available nutrients in biomass accumulation.

8. The DCR has violated the MA Environmental Policy Act regulations, 301 CMR 11.00, and circumvented the requirements of MEPA for disclosure of environmental impacts associated with its proposed forest management plan for its watersheds.

The MEPA regulations, 301 CMR 11.00, seek to limit damage to the environment through a detailed review process. However, operations that alter less than 25 acres of land and are considered to be practices "for which performance standards have been developed that avoid, minimize, or mitigate potential environmental impacts to the maximum extent practicable" are exempt from review. Projects that are consistent with an approved Forest Cutting Plan and involve generally accepted forestry practices are not subject to MEPA review (www.env.state.ma.us/mepa/downloads/forestcutting.pdf).

The forestry practices on the DWSP watershed properties are conducted as part of a carefully designed forest management plan. They are performed under a Chapter 132 Forest Cutting Plan, and within strict performance standards. Therefore, they are not subject to MEPA review.

9. The patch openings DWSP has made within 50 feet of the reservoir edge are illegal because 350 CMR 11.04(1)(a) prohibits activities which could degrade the quality of the water within 400 feet of the Reservoirs.

350 CMR 11.04 prohibits "activity which could degrade the quality of the water in the Watersheds as determined by the Division [DWSP] after consultation with the Department [DEP]". This work falls under two exemptions of these watershed protection regulations: any work of DCR's Division of Water Supply Protection done to maintain, operate, and improve the Waterworks System is exempted from these provisions by 350 CMR 11.05(6); Forestry work done under an approved Forest Cutting Plan is considered an agricultural use, which is exempted by 350 CMR 11.05(7) and (9).

DEP has reviewed DWSP harvesting operations regularly and has repeatedly determined that because they are conducted within the restrictions of the MA Forest Cutting Practices Act (Chapter 132) and its regulations and recommended Best Management Practices, they do not threaten to degrade the quality of water in the DWSP watersheds. With the addition of self-imposed DWSP standards to protect water quality and forest health, such as bridging all flowing streams and requiring onboard spill protection supplies, the forestry projects are not considered to be activities that threaten to degrade the quality of water in adjacent sources.

Chapter 132 requires a variable width (depending on slope) filter strip that is a minimum of 50 feet, and allows harvesting of up to 50% of the stocking within that filter strip, so long as equipment does not pass within that strip. DWSP's objective for managing these areas is to enhance the structural and compositional diversity of riparian forests. The agency has always done so within the constraints of all laws, regulations, and recommended practices, and no degradation of water quality related to these practices has been discovered despite extensive routine monitoring.

10. Cutting is done within the priority habitats of the protected populations of endangered loons and bald eagles.

The DFW Natural Heritage and Endangered Species Program, which is responsible for regulating critical habitats, has delineated priority loon and eagle habitats to include the entire border where the reservoirs meet the forest because these birds alter their nesting sites from time to time within this broad habitat. Whenever DWSP proposes to harvest within these habitats, the agency first submits proposals to NHESP, which then determines whether active nesting is occurring within a critical distance of the proposed lot. If nesting is occurring, there are very tight restrictions placed on the harvest; DWSP has always adhered to these restrictions. When no nesting is occurring within critical distances of the proposed lots, or when the lot can be completed during a season that does not include nesting, the operation is allowed to proceed.

Common loons were first discovered nesting on Quabbin Reservoir in 1975 after being extirpated from the state in the late 1800s. Since this first nest was discovered, loons have made a strong comeback in Massachusetts, and DWSP reservoirs (Quabbin, Wachusett, and Hycrest Pond) are the core of the state's breeding population. In 2012, there were 35 breeding pairs in MA, 24 of which were on DWSP reservoirs. DWSP biologists conduct weekly loon monitoring during the nesting season and to date have banded 68 loons as part of a long-term monitoring study. DWSP biologists are keenly aware of active loon breeding sites and keep detailed GIS information about their nesting locations, which may shift from year to year. DWSP has anchored artificial loon nesting rafts within the reservoirs to encourage nesting and to compensate for the fluctuations of the water level due to withdrawals. Although Natural Heritage has

identified the complete shoreline of each DWSP reservoir as "potential" loon habitat, specific decisions about the potential impacts of forestry operations on loon breeding are made through discussions between DSWP biologists and Natural Heritage. If proposed forestry operations are in proximity to known loon nesting sites, then appropriate protective measures are enacted to provide consistent protection of these birds.

Bald eagles, like loons, have made a strong comeback in Massachusetts and are no longer federally listed, but are still protected under state regulations. DWSP biologists, in concert with biologists from DFW, conduct routine surveys for nesting eagles on both Quabbin and Wachusett Reservoirs, and a large portion of the state's nesting population is found near these water bodies. Active nests are identified and recorded in GIS layers. As with loons, the entire shoreline of each reservoir is classified as "potential" eagle habitat. When forestry operations are proposed in areas with active nesting eagles, appropriate protective measures are initiated with guidance from NHESP. In addition, all known eagle nesting trees are protected from harvesting, and when possible, DWSP foresters carefully manage existing nesting areas to improve conditions (e.g., providing better flight lines in and out of nesting trees, encouraging "super-canopy" trees for future nests, etc.).

11. DWSP logging causes the overabundance of deer, thus requiring a hunting program to control the population at Quabbin. If logging were stopped, the deer population would achieve a balance with available food sources and allow the forest to regenerate following natural disturbances.

For most of the history of Quabbin, forestry was focused on stand improvements and thinnings, which do not create regeneration openings that would provide additional food for deer. The biggest contributors to the high, sustained deer populations at Quabbin are the absence of natural predators (wolves, mountain lions) that can regulate deer populations (note that although coyotes may take a few young deer, it is not their primary food source) coupled with no hunting, which can substitute for natural predation. This results in very high annual survival of females (studies have estimated at least 80-90% annual survival in areas with no hunting and no predators). Deer, in the absence of regular mortality, can experience exponential growth rates. In other studied systems (often on islands), these "irruptions" are often followed by dramatic declines in deer population as they exhaust their food supply. The population then typically explodes again until some equilibrium is reached between deer populations and habitat.

At Quabbin, however, there was little evidence that the deer population ever experienced these dramatic declines. Bill Healy, a distinguished wildlife researcher for the US Forest Service gave this very credible explanation: "Annual fluctuations in acorn crops may be the most important factor preventing an equilibrium relationship between deer and vegetation on the sanctuary (Quabbin). Acorn crops are independent of deer density and carrying capacity varies with the size of the acorn crop. Competition for food acts to regulate deer populations, and deer populations adjust to a constantly changing carrying capacity determined by mast crops rather than a relatively stable point determined by winter forage availability…Acorn crops on the sanctuary seem to be sufficient to maintain deer populations that can consume most of the growth of palatable woody species during the growing season or in winters when acorns are unavailable". Healy, W. M. 1997. Influence of deer on the structure and composition of oak forests in central Massachusetts. The Science of Overabundance: Deer Ecology and Population Management. Smithsonian Institution Press. pp. 249-266.

Deer populations have remained, and would continue to remain, high in the absence of predators, supported by regular and abundant acorn crops. Prior to 1991, deer populations on Quabbin Reservation were estimated to include 40-60 deer/mi^2. These densities are 4-6 times higher than is typically found in traditionally hunted areas and densities sustained at this level had dramatic ecological impacts. Not only

was tree regeneration nearly impossible under these high deer densities, deer also impacted a variety of other important forest communities including both common and rare wildflowers, shrubs, and herbs. These altered conditions meant a more simplified forest, which in turn affects the faunal community.

Since 1991, the Quabbin Reservation Controlled Deer Management Program has reduced and maintained deer densities at or below the 10-15 deer/mi^2 that is necessary to support forest regeneration. With the reduction of deer densities across the whole Reservation, wildflowers have returned, understory vegetation has increased dramatically, and successful tree regeneration following canopy openings now takes place vigorously throughout the area. This deer management program, in combination with active forest management has been responsible for arguably the most important positive change in biological diversity in the Quabbin forest in the past 100 years. The deer program continues, with the goal to maintain deer densities at levels that allow these conditions to persist.

12. The pattern of invasive plant populations on the watersheds is related to the pattern of logging; logging causes the invasive plant problems that occur everywhere on DWSP properties.

Harvard researchers tested this hypothesis on the Prescott Peninsula at Quabbin and came to the opposite conclusion: "recent forest harvesting did not influence the occurrence or abundance of B. thunbergii [Japanese barberry]" (DeGasperis and Motzkin, Ecology. 2007 Dec; 88(12):3115-25). The initial establishment of invasive plants was often for the deliberate purpose of landscaping, wildlife conservation, or other objectives. From the establishment point, these species then move to fill gaps, such as abandoned fields, or natural or deliberate disturbances of the forest. In this sense, logging, like any disturbance of the overstory, can accelerate the spread of invasives if they occur nearby or within the harvest area.

While logging can accelerate the spread of invasive plants, so will any disturbance, natural or intentional, unless and until the presence of these plants in the watersheds is successfully reduced. Based on inventories at Quabbin, invasive plants are present on approximately 16% of that watershed. Although this is certainly a troublesome level of occurrence that is overdue for aggressive attention, these terrestrial invasive plants are not "everywhere".

DWSP is working to reduce the likelihood of this spread by requiring logging equipment to be cleaned before moving from an infested area onto DWSP watershed forests and by not disturbing areas that have become deeply infested. The agency has inventoried and studied the problem and continues to experiment with control options. A DWSP Terrestrial Invasives Management Strategy is posted on the agency's website.

13. DWSP harvesting will result in a massive loss of carbon sequestration and massive soil carbon release. The STAC should have done a full accounting of the carbon sequestration values lost and the carbon emissions associated with the commercial harvesting of trees from DWSP watershed forests, and that loss should have been reconciled with the mandates of the Global Warming Solutions Act, the economy-wide reduction of greenhouse gas (GHG) emissions from the 1990 baseline to between 10 and 25% less by 2020 and 80% less by 2050.

Table 2.6 on page 21 of the STAC report shows an increase of more than 16 million cubic feet across the Quabbin forest from 2000 to 2010, confirming that the Quabbin forest continues to grow and accumulate biomass (and therefore sequester carbon) far beyond tree mortality and regeneration removals. Across New England, however, forests are maturing and growth is slowing after 150+ years of

recovery from the mid-1800s height of agricultural clearing, and so the opportunity for large increases in carbon sequestration in these forests is diminishing.

The creation of new age classes in the DWSP watershed forests is planned to occur on less than 1 percent of these forests per year, a rate similar to the natural disturbance rate of 0.5 to 2.0. This is not "massive disturbance" but a very slow transition, especially given the speed with which harvested areas regenerate and begin rapidly accumulating carbon and capturing available inorganic nutrients.

DWSP's primary objective is to ensure that the watershed forest provides stable biological filtration of the water supply. Through DWSP's long-term forest management activities the forest can be left less vulnerable to catastrophic disturbances that harm source and tap water quality and still sequester substantial amounts of carbon in a mix of older and younger trees. The watershed forest's natural filtration functions can be maintained following various disturbances by maintaining diversity in tree ages and species. The forest as a whole continues to grow older and all trees help sequester carbon.

The Department of Environmental Protection (DEP) has generated tables for calculating the 1990 baseline from which progress on GWSA will be measured. DEP has chosen not to use the "biogenic" emissions related to forest growth and sequestration as part of the baseline because the required level of inventory for emissions and sequestration for forests is not available. It would therefore be impossible to show how any DWSP forestry practices compare to the objectives of the GWSA because the DEP is not tracking this sector.

The largest estimated biogenic emission by DEP is from land clearing for development – about 400-600 tons per acre cleared, totaling about 2.2 million tons per year currently. This includes emissions from the wood cleared (conservatively assuming most is burned or otherwise emitted quickly), the soil emissions from the disturbances associated with development, and the lost sequestration all the way to (and beyond) 2050, since the forest is gone from these areas. From this perspective, in reverse, every acre of land that DWSP has removed from potential development through its land and conservation restriction purchases prevents a loss of about 500 tons of carbon emission per acre. Since 1985, the State and MWRA have invested over $131 million to acquire watershed land and conservation restrictions, removing more than 22,000 acres from potential development, thus preventing 11,000,000 tons of carbon emissions.

Furthermore, one of the main outcomes of active forest management is to shift growing resources onto the most vigorous and best formed trees, which enhances the likelihood that if harvested, these trees will be used for long-lasting products, such as furniture or building materials, rather than short-cycle products such as pulp or firewood. As a result, the carbon in these products is sequestered much longer, an additional offset associated with active forest management.

14. Timber harvesting is devastating to many wildlife species in the forests, including uncommon amphibians and mountain lions.

DWSP takes its statutory responsibility to protect rare and endangered species, including amphibians, very seriously. DWSP staff includes highly trained wildlife biologists who work with NHESP to assure that performance standards are in place to protect critical habitats and populations. All proposed timber harvesting areas are examined for overlaps with priority habitats for rare and endangered species. When there are overlaps, DWSP works with the Natural Heritage program to determine if special restrictions are required to protect the species of concern. This may lead to requirements for additional buffers or for restricting harvests to periods when the ground is frozen. DWSP adheres strictly to these requirements and has worked closely with Natural Heritage and other wildlife and conservation biologists to refine the protection provided during harvesting operations. Rare and common amphibians continue to thrive in

these undeveloped watershed forests.

While sightings of what are most likely individual, dispersing young male mountain lions throughout New England (including one that was killed on the road in CT) are confirmed, the nearest viable, reproducing population is hundreds of miles away and the road and residential density of most of New England, including in the area surrounding Quabbin, alone will likely continue to prevent the development of a breeding population. Active forest management on less than 1% of the watershed forest per year is unlikely to have had any impact on mountain lion population viability in the area.

15. Watershed forestry is spreading Lyme disease due to the fragmentation of the forest and consequent changes in the abundance of host species, including the white-footed mouse population.

Although Allen et al., is cited as a source of this conclusion, it is important to note that "fragmentation" is clearly defined in this research as human activity that involves "a reduction in the average size of remaining forest patches, increasing the distance between patches and increasing the ratio of edge to interior." This fragmentation is created by development that removes forest cover, leaving islands of forest in a sea of residential or other development. Allen selected forest patches that were "*a minimum of 1.6 kilometers from the nearest forested site"*. This is not the land pattern that is created when small patches are regenerated by forestry within a large, contiguous forest such as Quabbin. The reduction in white-footed mouse competitors and predators that is caused by the fragmentation of forest by development does not occur within large contiguous forests, whether they are managed or un-managed.

16. What evidence is there that watershed forestry over the past several decades has led to forest regeneration with diverse species?

DWSP has collected a great deal of evidence. Since 1988, DWSP has conducted a wide array of extensive regeneration surveys in the watershed forests. These surveys have demonstrated statistically and visibly significant changes in the understory of DWSP forests in response to not only the controlled deer hunting that began in 1991 but also to the regeneration silviculture that followed once deer numbers came under control.

All tree species have become more abundant in the understory than they were prior to the control of the deer population. In the preliminary regeneration surveys, taken before hunting began in order to demonstrate the problems with regeneration, all tree species were significantly suppressed with the exception of black birch (this species tolerates shade and is not preferred by deer due to oils that make it unpalatable). In the most recent surveys, black birch numbers remain strong, but the averages for white pine, maples, and oaks and many minor tree species, as well as the presence and abundance of wildflowers and herbaceous species, have all increased dramatically. What was once a park-like forest with minimal understory is now a sea of green from the forest floor to the tallest trees. Summary reports on regeneration are available by contacting the Forestry or Natural Resources sections in the agency.

17. How was the threshold determined that total cutting will not exceed 25% of the watershed within 10 years? There is no figure on total number of acres to be cut in the Quabbin watershed, but with some 85,538 acres of forested land and a 25% threshold, it appears that 21,000 acres will be cut over the next 10 years.

As cited in the STAC report and in the Principles section of DWSP Land Management Plans, long term paired watershed experiments throughout North America have demonstrated that holding harvesting rates below 25% of any given subwatershed, within any given 5-10 year period, will not result in an increase in water yield or in the yield-related increases in movement of sediments and nutrients. This is summarized in Hornbeck and Kochenderfer, 2004. *A century of lessons about water resources in northeastern forests* and in Figure 3.2, page 26 of the STAC report. DWSP uses this finding as a guideline threshold in the annual Lot Review process. It is NOT a target; it is a maximum allowable amount for any harvesting on any given subwatershed.

For example, within the Quabbin watershed, as detailed in the Land Management Plan, DWSP controls 58,412 acres. Of this area, more than 12,000 acres are not actively managed, leaving approximately 46,000 that can be managed. DCR's target for annual regeneration cuts, to diversify age structure, is 400 acres per year, less than 1% of the managed forest. In ten years time, this would total 4,000 acres, not 21,000. Furthermore, this harvested acreage is dispersed across the landscape, predominantly in openings ranging from single trees to two acres, with an average of less than one acre, and any opening that exceeds 0.5 acres will include retained live trees that are either dispersed or aggregated within the opening.

18. More than 44,000 acres out of a total of almost 188,000 acres of the Quabbin, Ware, Wachusett and Sudbury watershed forests have been harvested from 1980 to 2009, an amount that may be greater than any single natural disturbance, or combination of them. Although the reports are vague about the numbers, an equal amount, as much as 47,000 acres more is being planned for harvesting over the next ten years.

44,000 acres is the total area which has been included in silvicultural treatments during the thirty year period from 1980 to present. It is NOT the acreage that was cut. On any given treatment area, approximately one third is regenerated by cutting overstory trees, although some of these treatment areas received only thinnings. An average of less than 500 acres per year were cut and regenerated in each of the last 30 years. This figure represents less than 1% of the acreage across all four watersheds that is considered to be in active management and less than 0.27% of the total forested watershed area. This is well within the annual range of naturally-caused forest overstory disturbance (0.5% to 2.0%).

According to the agency's plans, approximately 5,000 acres, *not* 47,000 acres, would be cut across all four watersheds over the next ten years, and as stated above, this cutting is in well-dispersed openings ranging from a single tree to 2 acres and averaging an acre, with green retention within any opening that exceeds 0.5 acre.

19. There was no consideration of forest "reserves" where no forestry activities would occur or ways to encourage and increase both late successional and old growth forests.

As reported in the DWSP response to the STAC report in Table 3 on page 9, nearly 23,000 acres of the forests under DWSP care and control are not managed and therefore are developing late successional forest habitat, provided they are not naturally disrupted. Development of this habitat is not the priority for the remaining, actively managed watershed protection forest, but nearly 25% of the watershed forests under DWSP care and control will continue to approach late successional forest habitat conditions over time.

By definition, true "old growth" is forest that has not been harvested or converted to agricultural uses. Harvesting and conversion to agriculture was ubiquitous across New England following European settlement, peaking around 1850. Simply reserving areas of second growth forest does not overcome this definitional limitation. As a result, there are very few acres of true old growth in Massachusetts and none have been identified on DWSP watersheds.

20. Active harvesting sites visible to the public should have interpretative signage. Also, public field trips to harvesting sites should be held either before the operation begins or after it is completed, but not during active harvesting.

DWSP has committed to providing more information about its forestry activities via increased signage on each site and also on the agency's website, as part of a commitment to greater transparency of these practices to the public. In the DWSP Response to STAC Report document, DWSP committed (section 4.1) to "regular field trips to forestry sites in coordination with other state agencies and stakeholder groups." To address comments received in writing and at joint advisory committee meetings regarding public safety if these trips happened during active operations, DWSP is further clarifying this commitment. DWSP will schedule regular, well-advertised public field trips to view a selection of proposed or completed harvests before these operations commence and/or after they are completed. This scheduling will occur during the annual presentation of proposed harvesting projects.

21. Resources available for oversight of loggers is shrinking every year due to budget cuts.

DWSP has received ample and increasing funding for all watershed protection operations through the Water Supply Protection Trust and MWRA funding since its creation nine years ago (see www.mass.gov/eea/agencies/dcr/water-res-protection/watershed-mgmt/water-supply-protection-trust.html). Planning and oversight of all forestry projects is a high priority for a team of watershed professionals and is fully incorporated into the DEP-approved Watershed Protection Plan and the Trust's Annual Work Plans.

22. DWSP should retain a significant amount of mature age and size trees at Quabbin.

Across the watersheds, 23,000 acres will be retained in an unmanaged condition, allowing some 4-5 million trees to grow to biological maturity, dying of natural causes. Some of these trees, especially where they are sheltered from high winds, will achieve very large size during their lives. Based on current plans to regenerate less than 1% of the managed forest per year, at least one third of the actively managed stocking will have exceeded 125 years of age before it is harvested, assuming no intervening catastrophic storm or pest. In addition, on the vast majority of actively managed sites, "legacy trees" are commonly left behind by foresters. These are exceptionally large or vigorous specimens that are valued for their aesthetic contribution or their ability to produce seed and will not be harvested.

23. Contrary to DWSP statements that forestry focused on improvement thinnings during the first 30 years [1960-1990], thousands of acres of older forest had cuts that caused regeneration of pine and birch on much of Quabbin Reservation. It was not regeneration harvesting, but DWSP's disregard for forest aesthetics, especially by employing geometric, "cookie cutter" 1-2 acre openings, that brought them to this current difficulty.

Regeneration of shade tolerant species and species that were not preferred browse certainly did occur as a result of some of the past management, especially in areas that were thinned to lower than normal densities in an effort to increase water yields. However, in the 1972 Quabbin Watershed Management Plan written by Bruce Spencer (Chief Forester on DWSP lands for more than 30 years) and Forester Charles Walker, on page 16, is a description of the condition of the forest at the time, including the statement that "large scale regeneration is not needed at the present time, for the following reasons: 1) Practically all timber sale areas are adequately stocked with a forest and any regeneration occurring in forest openings would be premature…" The plan goes on to state that as of the 1971 re-measurement of Continuous Forest Inventory plots, there were only 320 acres of seedling stands and that the 17,920 acres of pole timber were the result of regeneration that had occurred from 1936 to 1946, not the result of forest harvesting from 1960 to 1970.

In the 1986 Forest and Wildlife Management Plan for the Quabbin Watershed, written by Bruce Spencer and Wildlife Biologist Paul Lyons, the Quabbin Forest is again described as being composed of sawtimber-sized, 60-100+ year old stands (66%) and pole stands originating with the plantings in the 1930s and 1940s and the hurricane of 1938 (33%), while only "a few hundred scattered acres" that were "too insignificant to classify" were occupied by seedlings and saplings (page 14). Furthermore, the 1986 plan states that although balanced age classes should be the goal of forest management, that "it is not possible at Quabbin at this time" because "deer browsing has destroyed the development of new regeneration", and finally that "due to the older maximum age classes desired for this type of multiple use watershed management, forest regeneration is not a pressing problem." The agency's forest management program at the time was focused on maintaining water *yield* at adequate levels to meet demand. Regeneration was considered a deterrent to enhancing yield, so forestry was focused on improving the vigor of stands grown at low densities, not on regeneration.

As water quality regulations became tighter while conservation efforts reduced the focus on water yield, and as the watershed forests approached maturity, the absence of regeneration was identified as a critical problem, leading eventually to both the establishment of a controlled deer hunting program and the subsequent deliberate regeneration of less than 1% of the managed forest each year. Increased harvesting in the past decade reflects this change in management approach.

Regarding the "cookie cutter" approach, DWSP's response to the STAC report includes changes to opening shape and distribution (section 4.4.2, page 8). In addition, in regeneration harvests, designed to create new age classes in the treated forest area, a new distribution standard will be applied in an effort to reduce the unnatural appearance caused by geometric layouts of the past. Based on STAC recommendations and DWSP commitments to apply these recommendations, the primary approach to regeneration silviculture on DWSP lands will follow the site-adapted irregular shelterwood approach. Openings will be irregular in shape, following the variations in landscape and overstory and understory composition, with live trees retained within the openings as required by the green retention standard. Openings will be visually well-separated from each other, with a minimum physical separation of 100 feet of retained overstory forest. The only exceptions to this rule will be areas in which restoration practices, as detailed in section 4.4.1.2 of the DWSP Response to STAC Report document, prevent its practical application. For example, red pine plantations were frequently planted geometrically, so that regeneration of these stands to restore native forest may also create geometric regeneration openings.

24. Creating openings without first thinning the whole forest to establish regeneration ignores the long process required to bring about this regeneration and will result in regeneration failures.

Cutting cycles (the number of years between silvicultural entries into a stand) are necessarily long on DWSP watersheds, given the deliberately slow pace of harvesting. As a result, regeneration established by thinnings often is not released soon enough to prevent its stagnation, depending on the species. This approach to establishing regeneration also favors the shade tolerant species, which includes black birch, a prolific seeder that can dominate the regeneration response. Furthermore, thinning the whole stand in order to establish regeneration in advance of the next harvest requires putting heavy equipment throughout the stand, rather than focusing it on the openings to be made.

In DWSP's experience, openings made with only minimal regeneration will still rapidly regenerate, and with a diversity that reflects the range of light brought to the forest floor, from partial to full sunlight. The minimum size of opening for this response depends on such conditions as aspect, slope, soil depth and moisture, and competition from other species (e.g., hay-scented fern or mountain laurel). Natural Resources staff has documented regeneration development in experimental openings ranging from 0.1 acres to 6.0 acres in size, near Thurston Brook, on the Prescott Peninsula. These areas were all cut with no advance regeneration other than very young seedlings under one foot tall. 2-3 years after harvesting, openings 0.5 acre or larger had the strongest diversity, density, and size of regeneration, and 10 years after harvesting, there were, on average, 5,406 stems per acre that were over 10 feet tall in the largest opening, including 1,974 stems of red oak, 1,425 of paper birch, 1,030 of black birch, 686 of red maple, 172 of black cherry, and just under 50 each of white pine, grey birch, and pin cherry. While results vary, achieving the DWSP objective for rapid regeneration of diverse species, without unnecessary compaction of soil, has been successful without requiring additional thinnings.

25. Quabbin Reservoir is the largest reservoir of surface drinking water in the world, and thus merits great attention and care.

Quabbin is one of the largest forest-filtered, single-purposed surface drinking water supply reservoirs in the world; however it isn't the largest of these and falls far down the line of all surface drinking water reservoirs. For example, Lake Tahoe is a reservoir of surface drinking water (among many other purposes), and holds ten times as much water as Quabbin Reservoir. DCR agrees, however, with the latter part of this statement. The DCR Watershed Management Program is an international model for a water supply

successfully maintained without artificial filtration, recognized by the American Water Works Association in 2010 with an Exemplary Source Water Protection Award for Large Systems (see www.mass.gov/eea/docs/dcr/watersupply/watershed/dcrawwaaward.pdf).

26. DCR logging operations have violated set-backs and buffer zones around vernal pools, wetlands, and other highly sensitive ecological areas, and logging equipment has caused destruction when it is repeatedly driven directly through active functioning vernal pools, wetlands, and other highly sensitive ecological areas.

DWSP staff go to great lengths to identify potential vernal pools from aerial photography interpretations and then to ground-check this information to determine if they are in fact functioning pools (some are too shallow and dry up too quickly to support successful reproduction of amphibians). All verified vernal pools are treated as though they are Certified and subsequently avoided utilizing DWSP's Conservation Management Practices. Likewise, DWSP maintains and/or accesses extensive databases and GIS coverages delineating wetlands and other critical habitats within the watersheds and protects these in full compliance with the laws and regulations that govern their protection, as well as through additional DWSP in-house policies (see Timber Harvesting Guidelines near Vernal Pools, a figure in recent Land Management Plans).

Timber harvesting operations are reviewed for the presence of these habitats at the beginning of the harvest planning process, and DWSP strictly follows regulatory and recommended performance standards for protecting them and the buffers around them. In the highly unlikely event that a functioning vernal pool or a wetland or other critical habitat within DWSP watersheds is found to have been compromised by timber harvesting, DWSP would appreciate being notified immediately. The agency takes the obligation to protect these habitats very seriously, has implemented or supported extensive inventory and research over the past several decades, and has painstakingly supervised their protection during timber harvesting operations.

27. While DWSP has committed to a maximum opening size of 2 acres in regular regeneration silviculture across the watersheds, the agency also describes "restorative silviculture", in which openings may exceed 2 acres in size. Given the attention focused on opening sizes, there needs to be additional review and approval of larger regeneration openings.

DWSP has a very comprehensive internal project review process in place which is followed by a presentation of all proposed harvesting in open public meetings and online. Section 4.3 of the "From Here Forward" document clarifies specific additional oversight by the Director of Natural Resources and the Regional Directors that has been added since the STAC report and in response to comments that followed that report. In addition to the above, and reflecting the policy in place within the DCR Bureau of Forestry, the infrequent proposed regeneration openings that exceed 5 acres in size must be justified in a detailed report to the Commissioner, who will review and then must approve these openings before they can be presented to the public.