NHTOA
NH TIMBERLAND OWNERS ASSOCIATION

Date: April 15, 2010

To: Karen Bennett

From: Jasen A. Stock

Re: Good Forestry in the Granite State – Dan Cyr Comments

Attached are Dan's comments to the latest revision of "Good Forestry in the Granite State". He dropped these off at the NHTOA Office and requested I pass them along to you.

If you have any questions please feel free to contact me or Dan directly.

Jasen

CC; Dan Cyr

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Growing Leadership for New Hampshire's Forests

Good Forestry in the Granite State
Draft Water Resources - Water Quality

x.x WATER QUALITY

BACKGROUND

Human uses of surface waters, the survival of fish and other aquatic organisms, and the quality of groundwater supplies all depend on cle surface water.

The most important aspect of protecting water quality is maintaining the integrity of wetlands, instream and riparian areas (see other chapters in the water resources section). Guidelines for conducting forest management in a adjacent to wetlands and surface waters are known as best management practices, or BMPs. They are designed to protect water quality. These guidelines, some of which are law, are found in *Best Management Practic for Erosion Control on Timber Harvesting in New Hampshire*. Some oth water quality topics are addressed in more detailed in other water resource chapters.

OBJECTIVE

Protect water quality during and following harvesting and road-building.

CONSIDERATIONS

- The N.H. Department of Environmental Services (NHDES) regulates wetlands (RSA 482-A: Fill and Dredge in Wetlands). The N.H. Department of Resources and Economic Development regulates, amo other things, basal area and slash (RSA 227-J).
- Forest management is exempt from RSA 483-B, the Comprehensive Shoreland Protection Act (CSPA) as long as it isn't associated with shoreland development or land conversion and is conducted in

compliance with RSA 227-J:9. Forestry conducted by or under the direction of a water supplier for the purpose of managing a water supp is also exempt from the CSPA.

- Timber harvesting near surface water drinking supplies may be gover by specific statutes. Some water supply watersheds are protected by st rules establishing setbacks and/or requiring the water supplier's appro prior to timber harvesting.
- A majority of timber harvests will encounter wetlands or surface wate Crossing wetlands or surface waters (x.x wetlands, x.x stream crossing may require notification to the NHDES prior to the start of the operati NHDES requires that all wetland and stream crossings follow BMPs.
- Regularly maintaining permanent culverts and other stream crossings could save a substantial amount of money in repairs in the long run.
- Aquifers, wells and municipal and public water supply reservoirs may impacted by timber harvesting. These resources may be beyond your property boundary and are vulnerable if downstream. GIS data layers showing the location of some stratified drift aquifers, wellhead protect zones, and public water supplies are available at UNH GRANIT (http://www.granit.unh.edu/) .
- Vegetable-based bar and chain oils biodegrade rapidly and are virtuall non-toxic to fish and algae, but they are more expensive than petroleum-based products and may not be covered under equipment warranties.
- Water quality is affected by activities throughout a watershed, many o which may be beyond the control of the landowner or land manager.

RECOMMENDED PRACTICES

- Layout timber harvests on bare ground (without snow) to identify wat and other natural resources. Locate landings, roads and skid trails to minimize stream and wetlands crossings.
- Minimize soil disturbance near surface waters and wetlands. Harvesting within certain distances of surface waters and wetlands is regulated.
- Apply BMPs according to guidelines in *Best Management Practices Erosion Control on Timber Harvesting Operations in New Hampsh*

- When stream crossings are necessary, follow BMPs and regularly insp and maintain crossings to make sure they function properly. Temporai stream crossing structures shouldn't impede streamflow and should handle increased flow that could occur in a storm during a harvest operation (x.x Streams Crossings and Habitat).
- Monitor sites before, during and after harvesting, and preferably durin rain, for visible signs of erosion and sedimentation. Signs may include
  - cloudy or muddy water
  - increased growth of algae in streams or ponds (green slime)
  - deposits of silt or muck on rocky or gravel streambeds
  - new runoff channels or gullies
- After the timber harvest water bar skid trails, remove temporary strea crossing structures and seed and mulch embankments, and apply othe soil-stabilizing techniques as needed. If the ground is too frozen, you may have to come back later.
- In watersheds containing brooks or streams draining directly into a wa supply reservoir, consult with a water company or municipal water supply representative. The water supplier may have specific recommendations to avoid or minimize water quality impacts. To determine whether a watershed is covered by special rules, consult NH Administrative Rules Env-Ws 386 (http://des.nh.gov/organization/commissioner/legal/rules/documents/env-ws386.pdf) or contact NHDES's Drinking Water Source Water Protection Program.
- Fill and maintain equipment well away from open water or wetlands. Park equipment and oil tanks where they won't leak into water. Keep sawdust or other absorbent material (a spill kit) on the site to soak up accidental spills or leaks. Report spills to NHDES unless:
  - the spill is less than the amount listed in the regulations as reporta for that chemical (25 gallons for oil)
  - is immediately contained
  - doesn't threaten surface or groundwater
  - and all discharge and contamination is removed within 24 hours.

  If a spill occurs, contact the NHDES for information at 271-3899 or, after hours or on weekends, the State Police at 271-3636.

- Consider using vegetable-based bar and chain oil as an alternative to petroleum-based bar and chain oil. Check equipment manufacturer

warranties to ensure that biodegradable oils and lubricants won't dama equipment or invalidate the warranty.

CROSS REFERENCE

Erosion and Soil Damage; Soil Nutrients; Wetlands; Riparian Areas; Strea and Stream Crossings; Beaver-Created Openings; Truck Roads and Skid Trails; Landings.

ADDITIONAL INFORMATION

Cullen, J.B. 2004. Best Management Practices for Erosion Control on Tim Harvesting Operations in New Hampshire (2nd ed.). New Hampshire Department of Resources & Economic Development, Division of Forests a Lands, Concord, NH.

NH Administrative Rules Env-Ws 386 http://des.nh.gov/organization /commissioner/legal/rules/documents/env-ws386.pdf (http://des.nh.gov /organization/commissioner/legal/rules/documents/env-ws386.pdf) Accessed on February 1, 2010.

New Hampshire Department of Environmental Services. 2007. Reporting Spills, Hazardous Waste Spills and Groundwater Contamination http://des.nh.gov/organization/commissioner/pip/factsheets/rem/documents /rem-13.pdf (http://des.nh.gov/organization/commissioner/pip/factsheets /rem/documents/rem-13.pdf) Accessed on February 1, 2010.

New Hampshire Department of Environmental Services. Drinking Water Source Water Protection Program. http://des.nh.gov/organization/divisions /water/dwgb/dwspp/index.htm (http://des.nh.gov/organization/divisions/water /dwgb/dwspp/index.htm) Accessed on February 1, 2010.

Smith, S. Ed. 2005. Best Management Practices for Forestry: Protecting N Hampshire's Water Quality. UNH Cooperative Extension, Durham NH. 9 pp. http://extension.unh.edu/resources/files/Resource000248_Rep267.pdf (http://extension.unh.edu/resources/files/Resource000248_Rep267.pdf) Accessed on February 1, 2010.

Smith, Sarah. 2009. Guide to New Hampshire Timber Harvesting Laws. UNH Cooperative Extension, Durham, NH. 37 p.

UNH GRANIT http://www.granit.unh.edu/ (http://www.granit.unh.edu/) Accessed on February 1, 2010.

Good Forestry in the Granite State
Draft Water Resources - Wetlands

2.1 WETLANDS

BACKGROUND

Wetlands are ecologically important and should receive special consideration in order to protect water quality, wildlife habitat, and aesthetic values.

Wetlands protect water quality, help control floods, recharge groundwater, and provide recreational and scenic opportunities. Wetlands are among the most critical parts of any forest ecosystem. Forested wetlands can include economically important trees as well as rare plants and natural communitie There are 47 rare plants that grow in forested wetlands in New Hampshire, including 31 listed as endangered. Riparian areas and wetlands are used by over 90% of the region's wildlife species and are the preferred habitat for c 40% of them.

Wetlands are identified using hydrology, soils, and vegetation. Hydrology the presence of water at or near the soil surface. Some signs of wetland hydrology include swollen tree trunks, drift lines, and water or silt-stained leaves or plant stems. All wetlands have saturated soil for at least part of th growing season, and all support vegetation adapted to wet conditions.

Wetlands may be forested (such as red maple or cedar swamps) or non-forested (such as marshes, wet meadows, scrub-shrub wetlands, peatla or beaver-created meadows). They can have open water. Shrub wetlands a dominated by shrubs and saplings and may be in a transitional state betwee an open wetland and a forested one, or they may remain shrubby. They include small or ephemeral areas such as seeps and vernal pools (see xx vernal pools and xx seeps). Riparian areas are associated with wetlands an surface waters (xx riparian areas). *Best Management Practices for Erosio Control on Timber Harvesting in New Hampshire* includes a basic guide

wetland identification.

Wetlands and the adjacent upland have a long history of use and alteration humans. Combined pressures along with their ecological significance, underscores the importance of properly managing those that aren't yet heav impacted and restoring those that are currently degraded. Wetlands protect begins with careful road and skid trail layout to minimize wetland and surf water crossings. The timing and silvicultural methods used in wetlands anc adjacent uplands are also key.

Good!

OBJECTIVE

Maintain the important functions and values of wetlands.

CONSIDERATIONS

- The N.H. Department of Environmental Services (NHDES), pursuant RSA 482-A, regulates activities in wetlands and the N.H. Department Resources and Economic Development, pursuant to RSA 227-J, regulates timber trespass, basal area and slash. Together they regulate forestry practices in wetlands.
- Cities and towns may have adopted their own wetland ordinance. Municipalities may further identify wetlands of significant value wort of extra protection because of their uniqueness, fragility, or unspoiled character. These wetlands, and the 100 foot buffer adjacent to the wetland, are designated as "prime wetlands" and are afforded special protection under RSA 482-A.
- Guidelines for harvesting in and adjacent to wetlands and surface wat are known as best management practices, or BMPs. These guidelines, some of which are law, are found in *Best Management Practices for Erosion Control on Timber Harvesting in New Hampshire*.
- Proper planning reduces the number, width, and length of surface wat and wetland crossings and saves money.
- Use of corduroy or tree tops minimizes impact to the ground. These materials are considered fill in wetlands and require a permit from NHDES. However, corduroy can be left in place where there is no defined stream channel.

- Excessive rutting in wetlands affects the surface hydrology, severs pla root and can cause erosion.
- Identification of forested wetland boundaries may be difficult.
- The integrity of wetlands may be affected by activities of others throughout the watershed.
- Forested wetlands may be highly productive so that limiting harvestin wetlands and upland areas bordering them will entail an economic los
- Some wetlands are rare, some are designated exemplary natural communities, and some wetlands are more sensitive to disturbance tha other wetlands. The N.H. Natural Heritage Bureau (NHNHB) is the b source for determining if a wetland is rare, an exemplary natural community, or susceptible to disturbance.
- Wetlands can be surrounded by productive upland forests and may be affected by cutting along the wetland edge. Uplands bordering wetlan filter runoff, capture pollutants before they enter the wetland, and are critical to the survival of wetland-dependent wildlife. A wetland buffe as used in this chapter, is this vegetated upland area adjacent to a wetland. Deciding on the width and management actions in wetland buffers depends on what functions and values you want to preserve. It difficult to generalize about wetland buffer widths because of the man types of wetlands and the diversity of wildlife. Different species requir different widths for breeding, nesting, and overwintering. Leaving the understory adjacent to wetlands intact will provide many wildlife and water quality services. Timber harvesting within a wetland buffer can provide benefits to wildlife habitat (x.x Beaver). The size of a buffer is influenced by, among other things, the type of wetland, steepness of sl surrounding the wetland, the erodibility of soils, the size and type of vegetation within the wetland, and the landowner's objectives.
- There can be wildlife-related, ecological and silvicultural reasons to harvest in wetlands.

RECOMMENDED PRACTICES

- Survey the property (ideally in early spring) and identify important hydrologic features such as streams, ponds and wetlands including see and vernal pools.

- Consult a natural resource professional to help identify wetlands and t determine what permit(s) may be needed.
- Check with the NHDES or the city or town before timber harvesting i or within 100 feet of prime wetlands.
- Protect surface waters and wetlands by appropriately locating roads before harvesting begins and appplying other BMPs.
- When logging in and near forested wetlands, avoid rutting and other damage by cutting when the ground is frozen or sufficiently dry to support the type of equipment used.
- Before harvesting within or near rare or highly sensitive wetlands, consult with the NHNHB for suggested management recommendation specific to the wetland type and landscape context.
- Designate a wetland buffer adjacent to forested and non-forested wetlands. Include steep slopes, highly erodible soils, known endangere species habitat, rare plants and exemplary natural communities, and heron, eagle or osprey nests. The effectiveness of the buffer increases with width. Sensitive wetlands will require larger areas of upland to reduce the risk of disturbance.
- Leave the area closest to the stream, pond or wetland unharvested to provide increased protection to aquatic habitats and allow a reliable long-term supply of cavity trees, snags, and downed woody material. Larger zones will increase the protection of non-timber values, howev no-harvest zones may not always be consistent with ecological or silvicultural objectives.
- Retain trees with cavities, standing dead trees, downed logs, and large supra-canopy trees.

CROSS REFERENCE

Erosion and Soil Damage 1.1; Beaver-Created Openings 3.3; Deer Winter Areas 3.5; Rare Plants and Natural Communities 4.1; Vernal Pools 4.2; Seeps 4.3; Heron Colonies 4.5; Bald Eagle and Osprey Nests 4.6; Bald Ea Winter Roosts 4.7. Riparian, Water Quality, Rare Wildlife,

ADDITIONAL INFORMATION

Chase, V., L. Deming, and F. Latawiec. 1995. Buffers for Wetlands and Surface Waters: A Guidebook for New Hampshire Municipalities. Audubo Society of New Hampshire, Concord, NH. 80 pp.

Cullen, J.B. 2004 Best Management Practices for Erosion Control on Timl Harvesting Operations in New Hampshire (4th ed.). New Hampshire Department of Resources & Economic Development, Division of Forests & Lands, Concord, NH.

Elliott, C.A. 1988. A Forester's Guide to Managing Wildlife Habitats in Maine. University of Maine Cooperative Extension Service, Orono, ME.

Smith, S. Ed. 2005. Best Management Practices for Forestry: Protecting N Hampshire's Water Quality. UNH Cooperative Extension, Durham NH. 9 pp. http://extension.unh.edu/resources/representation /Resource000248_Rep267.pdf (http://extension.unh.edu/resources /representation/Resource000248_Rep267.pdf) Accessed February 8, 2010.

Smith, Sarah. 2009. Guide to New Hampshire Timber Harvesting Laws, UNH Cooperative Extension, Durham, NH. 37 p.

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Good Forestry in the Granite State
Draft Water Resources - Riparian Areas

2.1 FOREST MANAGEMENT IN RIPARIAN AREAS

BACKGROUND

Riparian areas should be managed to protect water quality, streamflows, fish and wildlife habitat, and scenic values.

A riparian area is land adjacent to and directly influenced by streams, river ponds, lakes, and associated non-forested wetlands. It forms a transition fro aquatic to terrestrial ecosystems. Soils and growing conditions are often moister, more nutrient rich, and more productive than those in surrounding uplands, resulting in considerable species diversity and productivity. Becau of their proximity to surface waters, these areas are vital for maintaining water quality and aquatic resources.

Riparian areas have a long history of use and alteration by humans, includi urbanization, road-building, agriculture, dam-building, and timber harvesti The combined pressures, along with their documented ecological significar underscore the importance of properly managing the riparian forest.

The Functions and Values of Riparian Areas

Riparian areas provide many ecosystem services and benefits such as:

- Flood control and stream flow regulation especially where the riparian area includes a river's floodplain
- Water quality protection by filtering and retaining sediment, nutrients, and other pollutants from upslope areas, and through bank stabilizatio
- Aquatic habitat protection including:
    - Regulating temperatures by shading streams, which is particularly important for lower order streams that support coldwater fish (e.g brook trout). Increases in water temperature can have negative effects on stream chemistry, aquatic insects, stream flora, and fish

    - Large woody material (e.g., fallen trees and large branches) whic creates pools, riffles, debris jams, and related aquatic habitat including necessary spawning habitat for brook trout.
    - Leaves, twigs, fruit and insects contributing energy to drive aquat food webs. Headwater streams and small rivers derive most of the energy this way.
    - Fish habitat during high flow periods.
- Rare natural communities (e.g., calcareous riverside seeps, swamp wh oak floodplain forest) and many rare plants. More than 1/3 of all New Hampshire vascular plants occur in riparian natural communities, including 93 rare species.
- Habitat for feeding, cover and travel for many amphibians, birds, furbearers, and reptiles. Deer-wintering areas are often associated with riparian softwood forest. Large trees in these areas are the primary nesting sites for bald eagles, osprey, and colonial waterbirds.
- Recreational and scenic opportunities, such as hiking, fishing, hunting boating, bird-watching, and wildlife viewing.

Identifying Riparian Areas and Designing Riparian Management Zo
Riparian areas are defined by their location adjacent to lakes, ponds, strean and rivers, by their characteristic vegetation, and by the function they serve Vegetation can vary from a narrow band of shrubs to floodplain forests hundreds of yards wide. The size depends on what function is being considered and may include upland forest as well as truly riparian communities.

Riparian management zones (RMZs) are linear zones along the shores of lakes, ponds, rivers, streams, and associated wetlands, within which specia forest management practices are used.

Just how wide should the RMZ be? Unique combinations of ecological functions, physical characteristics, and landscape context, make it difficult arrive at a one-size-fits-all width. An important first step is to identify what you wish to protect – the width needed to provide shade to a stream, for example, may be one tree height or less, whereas riparian wildlife habitat n extend several hundred feet into upland forests adjacent to a river or lake.

Foresters and landowners are in the best position to consider and apply localized factors.

Variable, tailor-made RMZs reflect localized site conditions, but are gener more complicated to consistently define, apply, and monitor. Fixed-width RMZs have the practical benefit of being clear, consistent, relatively simpl apply and monitor, and provide reasonable confidence that RMZ values an goals will be attained. We suggest a tiered approach that provides the practical benefits of a fixed-width, but includes key modifiers offering som added benefits of a variable-width approach.

The following widths are recommended as general guidelines. The RMZ extends upland from the top of the streambank or from the upland edge of stream-, pond-, or lake-side wetlands (see illustration). For additional information about establishing RMZs, see chapter 2 in *Riparian Management in Forests of the Continental Eastern United States*.

Guidelines for Riparian Management Zones

	Legally Required1		Recommended	
	Riparian Management Zone	No Harvest Zone2	Riparian Management Zone	No Harvest Zone2
Intermittent streams	none	none	75 ft.	none
1st and 2nd order streams	50 ft.	none	100 ft.	25 ft.
3rd order streams5	50 ft.	none	300 ft. 4	50 ft.3
4th order and larger streams5	150 ft.	none	300 ft.4	25 ft.
Pond <10acres (see footnote 1)	50 ft.	none	100 ft.	none
Lake or Great Pond (>10 acres)	150 ft.	none	300 ft.	25 ft.

1 Width required under RSA 227-J:9 (basal area law). Within a 12-month period, no more than 50% of the basal area may be cut in th areas. Includes ponds less than 10 acres associated with a stream or brook that flows throughout the year.

2 Portion directly adjacent to the water body in which no cutting is recommended. It may be desirable to expand if there are steep slopes (>25%), unstable soils, sensitive wetlands, or exemplary natural communities. Increasing the width of the no-harvest zone will provide greater protection of non-timber values, but will also encumber a large amount of timber. There may be valid ecological and silvicultural reasons to harvest in the no-harvest zone.

3 A 50' no-harvest zone is recommended for 3rd order streams becaus of the importance of large woody material on streams of this size.

4 RMZ width on 3rd & 4th order and larger streams and rivers may expand to encompass known wildlife travel corridors, drinking water supply considerations, and the full extent of the 100-year floodplain.

5 For a list of fourth-order and higher streams (http://des.nh.gov /organization/divisions/water/wetlands/cspa/documents/consolidated_list.pdf) see NHDES Consolidated List of Waterbodies Subject to RSA 483-B.

OBJECTIVE

Maintain the important ecological functions and values of forested riparian areas.

CONSIDERATIONS

- Wetland permits (RSA 482-A) or other legal requirements (RSA 227- may apply to forestry operations in riparian areas (x.x wetlands). Timl harvesting is exempt from RSA 483-B, the Comprehensive Shoreland Protection Act, so long as it isn't associated with shoreland developme or land conversion, and is conducted in compliance with RSA 227-J:9
- Landowner objectives, water body size, landscape context, vegetative

composition, slope and other factors helps determine the appropriate width and management of RMZs.

- There are benefits to managing riparian areas with a long-term perspective (>100 yrs). Some potential effects of harvesting in riparian areas may be short-lived while others, such as reduced input of large woody material, are much longer lasting. Trees retained today will be source of key terrestrial and in-stream habitat structure many decades into the future.
- Active forest management can be compatible with maintaining riparia functions and values. Trees regenerated today will be the future sourc cover, cavity trees, woody material, and snags. Some silvicultural and wildlife habitat objectives can conflict with no-harvest or limited harv RMZs. For example, maintaining beavers at an active flowage within particular stream reach may require active tree harvesting within these zones (x.x Beaver-Created Openings). Soil scarification improves the likelihood of regenerating white pine, red oak, or red spruce and may conflict with the recommendation to minimize ground disturbance.
- Riparian forests may be highly productive. Limiting harvesting in RM will entail some financial loss to riparian landowners.
- The integrity of aquatic, and riparian ecosystems may be affected by activities of others throughout the watershed.

RECOMMENDED PRACTICES

- Survey the property (ideally in early spring) and identify important hydrologic features such as rivers, streams, lakes and ponds.
- Establish RMZs along streams, rivers, ponds, and lakes. Recommende minimum zone widths and key considerations are described above.
- Include maintaining or restoring riparian functions and values as a silvicultural objective in RMZs.
    - Retain trees with cavities, standing dead trees, downed logs, and large supra-canopy trees (especially white pine).
    - Leave windfirm trees that are well-distributed. Leave other vegetation, including existing groundcover.
    - Choose a regeneration system most likely to maintain riparian functions and values and rapidly regenerate the site with the desir

trees. Choosing a method is complicated by wet soils and the desi to maintain forest structure that contributes to wildlife habitat anc other ecological values.

  - Use uneven-aged techniques such as single tree or small grou selection, maintaining 60-70% crown closure or full stockin recommended in silvicultural guides. (To convert crown clos percentages to basal area, see Leak and Tubbs 1983).
  - Use even-aged techniques such as shelterwood or patch cuts achieve regeneration goals when rapid regeneration is likely (x.x silviculture).

- Locate new truck roads and log landings outside RMZs, except where doing so would result in greater overall adverse environmental impact
- Design roads and skid trails within RMZs to minimize the long-term impacts on water quality and wildlife habitat. Put roads to bed at the e of the harvest operation.
- Minimize ground disturbance. Operate ground-based equipment when the ground is dry or frozen.
- Time harvesting to avoid disturbance to nesting birds (x.x woodland raptors) and other sensitive species (x.x wetlands).
- Leave the area closest to the stream, pond or wetland unharvested to provide increased protection to aquatic habitats and allow a reliable long-term supply of cavity trees, snags, and downed woody material. Refer to the table for guidance. Larger zones will increase the protecti of non-timber values, however, no-harvest zones may not always be consistent with ecological or silvicultural objectives.
- Keep trees along banks to stabilize shorelines.
- Avoid leaving isolated riparian management zones with long distance abrupt edge. Riparian forests next to heavy cuts, agricultural, or urbar land uses may be subject to increased edge effects (e.g., invasives, nes predation) and risk of blowdown. Practices that minimize these risks include limiting harvest within the riparian management zone, increas the width of the zone, or feathering the edges of the heavy cut.
- Refer to the x.x wetlands for recommended practices specific to wetlar

CROSS REFERENCE

Erosion and Soil Damage 1.1; Beaver-Created Openings 3.3; Deer Winter

Areas 3.5; Rare Plants and Natural Communities 4.1; Rare Wildlife X.X; Vernal Pools 4.2; Heron Colonies 4.5; Bald Eagle and Osprey Nests 4.6; Bald Eagle Winter Roosts 4.7; Wetlands X.X; Floodplain Forests X.X.

ADDITIONAL INFORMATION

Chase, V., L. Deming, and F. Latawiec. 1995. Buffers for Wetlands and Surface Waters: A Guidebook for New Hampshire Municipalities. Audubo Society of New Hampshire, Concord, NH. 80 pp.

Leak, W.B. and C.H. Tubbs.1983. Percent crown cover tables for applying the shelterwood system in New England. U.S.D.A. Forest Service Northeastern Forest Experiment Station Research Note NE-313.

NH Department of Environmental Services. 2010. DES Consolidated List Waterbodies Subject to RSA 483-B, the Comprehensive Shoreland Protect Act. http://des.nh.gov/organization/divisions/water/wetlands/cspa/documer /consolidated_list.pdf (http://des.nh.gov/organization/divisions/water/wetlands /cspa/documents/consolidated_list.pdf) Accessed February 8, 2010.

Verry, E.S., J.W. Hornbeck, and C.A. Doloff. 2000. Riparian Managemen Forests of the Continental Eastern United States. Lewis Publishers.

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Good Forestry in the Granite State
Draft Water Resources - Stream Crossings and Habitat

x.x STREAM CROSSINGS AND HABITAT

BACKGROUND

Roads are necessary for forest management and allow access for outdoor activities such as hunting, fishing, hiking, wildlife watching a snowmobiling. Roads that cross streams can impact stream habitat a impede stream-flow.

This chapter addresses the needs of fish and other aquatic organisms. The importance of intermittent streams is also addressed. Best management practices (BMPs) to prevent erosion can be found in *Best Management Practices for Erosion Control on Timber Harvesting Operations in New Hampshire* and additional practices in *Best Management Practices for Forestry: Protecting New Hampshire's Water Quality*. Using BMPs minimizes the impact of crossings on streams and stream habitat during timber harvesting.

Aquatic organisms move upstream and downstream throughout their life cycles. The survival of a population depends on access to spawning habitat feeding areas, shelter, and the dispersal and colonization of available habit by juveniles. A healthy population also depends on unrestricted gene flow crossings may isolate populations, making them vulnerable to extirpation. Many species of amphibians, reptiles, and mammals use riparian zones as travel corridors, and their movement may be impacted by certain crossings

Instream wood (trees and branches), sediment and ice transport are import Trunks and branches (1) retain nutrients within the stream and keep excess nutrients from going into waterbodies downstream, (2) create pools for fish and other aquatic animals, and (3) are used by fish as refuges to avoid predators and high water velocities that occur during floods. Downed trees

a natural component of streams, and they are often transported long distanc from where they initially entered the stream channel. It is important to not create conditions that cause downed wood from upstream to block the strea crossing. Sediment and ice are also integral parts of stream systems, and lik branches, can plug undersized stream crossings. Erosion can cause an increase in nutrients which reduces water quality especially in downstream waterbodies. (see x.x riparian areas).

These same processes occur in intermittent streams and perennial (year-round) streams. The surrounding forest provides leaves and coarse woody material critical to the food web along the entire stream course. These materials are carried downstream, as are the invertebrates that feed on then Crossings on intermittent streams should also allow for aquatic organism passage, as aquatic invertebrates, some unique to intermittent streams, occu these streams year-round.

The following is a brief discussion of the more common types of crossing most often used in timber harvesting operations:

Bridges

Bridges span streams entirely, and can be the best way to protect the strean and the crossing structure itself. They can be permanent or temporary, and made out of wood, metal or a combination. Permanent bridges are often us for truck roads, while temporary bridges may be used for skid trails. Sited properly, bridges won't affect water flow, and the erosion of the bank is mu reduced or eliminated. Improperly constructed abutments can cause bank erosion.

Culverts

A culvert is a corrugated pipe, well casing, or other type of pipe placed unc a truck road or a major skid trail to permit the crossing of an intermittent o perennial stream. A culvert can either be temporary or permanent. (Culvert used as cross drainage in truck roads aren't covered in this chapter, see Cullen, 2004). In general, culverts installed within truck roads are perman crossings.

A culvert can block fish, other animals and natural materials from moving downstream. Culverts can lead to streambed and bank erosion on the

downstream side of the culvert due to the increased water velocities exiting the pipe. The result is a perched culvert with its downstream end above the water. The resulting waterfall can prevent aquatic animal passage.

Fords

Poled Fords: A poled ford is a temporary stream crossing in which natura materials are used to fill a defined channel to allow for the passage of vehicles. Per RSA 482-A, poled fords are a BMP and must be removed as soon as the site is closed out. Leaving them in place after the permit expire considered fill and a violation of state law. Leaving them in place can also lead to streambed and bank erosion and reduced aquatic animal passage. Corduroy, used to fill wet places that aren't streams, aren't considered pole fords and may be left in place.

Stone Ford: Stone fords use the stable stream bottom or stone fill as the ro bed. They are intended as permanent crossings since their removal can cau erosion and turbidity. On roads where the wide width and shallow water combine to make a bridge or culvert unworkable, a stone ford combined w a culvert sized to accommodate fish and other aquatic organism passage is option.

OBJECTIVE

Provide safe stream crossings which allow passage of aquatic animals up and down the stream as well as protecting water quality.

CONSIDERATIONS

- The N.H. Department of Environmental Services regulates the design and installation of temporary and permanent stream crossings. A wetlands permit may be required prior to the installation of a tempora or a permanent stream crossing, including bridges that don't run bank bank. Bridges running bank to bank may not need a permit.
- Streams are inherently dynamic, and natural processes in stream morphology can have dramatic impacts on stream crossings and associated roads. Undersized crossings can become plugged with dow wood and sediment, leading to increased maintenance costs and sometimes to the failure of the stream crossing.
- Watershed size and topography will affect the amount of water and

flashiness of flood events.

- Planning road, landing and skid trail layout without snow cover make easier to see intermittent and perennial streams.
- Limiting stream crossings can reduce costs.
- The type and size of crossing will affect both cost and permitting requirements. Appropriate designs can minimize installation costs and reduce cost over the expected life of the crossing. Costs depend on the structure, site conditions and expected lifespan.
- A permanent crossing is generally installed within a truck road. Temporary crossings are generally installed within a skid trail.
- Portable bridges are an option for skid trails that are expected to be us for a short period of time.
- The installation cost of a permanent bridge may be more than that of a culvert, but the savings over the course of its life may be less due to reduced maintenance needs and costs. There may be increased liabilit you don't maintain the bridge.
- Although a temporary crossing can remain for the life of the wetlands permit (two years), removing it as soon as the harvest is complete and ground conditions allow minimizes the impact to aquatic animals.
- Culvert size, placement and bottom substrate are all important considerations.
  - Sizing guidelines are available in *Best Management Practices fo Forestry: Protecting New Hampshire's Water Quality*.
  - Continuing the natural substrate of the stream through the culvert ensures aquatic animal passage. Open bottom culverts maximizes aquatic organism passage by maintaining a natural streambed.
  - The practice of laying two or more small culverts side by side blo flow and can require higher maintenance due to the blockage of natural material that floats downstream.
- While fords are appropriate for maintaining water quality, they block stream channel, even when used in combination with a culvert.
- Bridges and culverts are preferred over stone fords for permanent crossings to accommodate aquatic animal passage.

RECOMMENDED PRACTICES

- Consult your natural resource professional for permitting requirement and to determine which type of crossing is best suited for your particul situation.
- Per RSA 482-A:3, use BMPs as detailed in *Best Management Practic for Erosion Control on Timber Harvesting Operations in New Hampshire*. Also refer to *The Guide to New Hampshire Timber Harvesting Laws*.
- Locate landings, roads and skid trails to minimize the number of strea crossings.
- Construct during periods of no- or low-flow and in as short a period of time as possible.
- Design the crossing to fit the stream channel. Locate crossings where:
  - Stream alignment is straight and has a uniform profile so as not to obstruct the flow of water. Avoid bends in the stream.
  - Banks are firm and level.
  - Road and trail approaches are reasonably level for a distance of 5 feet on each side of the crossing, avoiding sharp curves in the roa
- Crossings shouldn't be sited where there is an accumulation of instrear downed wood or sediment. This is a sign that it is likely instream woo will clog the inlet of the crossing.
- Design crossings to handle the largest stream flows.
  - Design temporary crossings for a 10 year flood.
  - Design permanent crossings for at least a 25 year flood.
  - See *Best Management Practices for Forestry: Protecting New Hampshire's Water Quality* pages 45-47 for easy calculations.
- Minimize water from the road entering the stream by:
  - Constructing the road so the grades approaching the crossings div water from the stream.
  - Directing roadside ditches away from the stream well before the crossing.
  - Using water bars to divert road runoff from streams.
  - Using brush, slash and tops to stabilize skid trail approaches.
- For temporary crossings:
  - Consider using a portable skidder bridge. See *A Guide for Constructing and Using Portable Skidder Bridges*.
  - Site the approach to the ford as carefully as for other crossings.

- Remove the structure and stabilize the bank as soon after the harv as ground conditions permit.
- Use bridges and culverts as the preferred method over stone fords, whe possible. Span streams with a bridge in which the abutments are beyor the top of the stream banks.
- When installing stone fords with a culvert:
  - Size the culvert wide enough to accommodate fish and other aqua organism passage.
  - Place the culvert at the deepest point of the stream.
  - Choose ford material that allows water to flow through it, so the f does not act as a dam. Use a minimum 6 inch angular stone anchored by large boulders on the downstream side.
  - Design the ford to minimize the risk that the addition of stone material will direct the stream, during low or high flows, around t ford, causing erosion.
  - Make the ford at the same elevation as the natural substrate at the ford location.
  - Protect entry points at the streambank from erosion due to the tra of equipment.
- Culvert Recommendations:
  - Avoid side by side culverts.
  - Size culverts to provide uninterrupted flow of water, sediment, downed wood and ice. There are two suggested methods to determine the minimum size of a round culvert. See pages 45-49 *Best Management Practices for Forestry: Protecting New Hampshire's Water Quality* or consult with the Natural Resource Conservation Service for assistance with using the watershed drainage method or visit NH StreamStats (http://water.usgs.gov/osw/streamstats/new_hampshire.html) (see additional information).
  - When conditions permit, install an emergency spillway adjacent t culvert by making one section of the road lower in elevation so fl water goes over the road at that point instead of around the crossi This spillway should have a stable base.
  - Protect the upstream end of the fill around the culvert from erosio by placing rock headers.
  - Install the culvert so it is in line with the existing stream. A

• Use 3-4 foot diameter boulders on the out flow side to 4 inch in the stone Road.

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maximum of 15 degree skew is acceptable as an exception where approach conditions are difficult.
- Align the approach and exit of the road with the culvert crossing center line with as little curvature as possible.
- To maximize aquatic organism passage, consider several options maintain a natural streambed. Techniques vary in effectiveness ar cost and include:
  - Placing culverts in the natural channel.
  - Digging culverts into the stream bed so that the inside of the culvert has the same substrate as the natural streambed.
  - Using open bottom culverts.

CROSS REFERENCES

Riparian, Water Quality, Wetlands

ADDITIONAL INFORMATION

Cullen, J.B. 2004. Best Management Practices for Erosion Control on Tim Harvesting Operations in New Hampshire. New Hampshire Department of Resources & Economic Development, Division of Forests & Lands, Conco NH.

Smith, S., Ed. 2005. Best Management Practices for Forestry: Protecting N Hampshire's Water Quality. University of New Hampshire Cooperative Extension. Durham, NH. 92 pp.

Smith, Sarah. 2009. Guide to New Hampshire Timber Harvesting Laws. University of New Hampshire Cooperative Extension, Durham, NH. 37 p.

US Geological Survey. NH StreamStats.http://water.usgs.gov /osw/streamstats/new_hampshire.html (http://water.usgs.gov/osw/streamstats /new_hampshire.html) Accessed February 8, 2010.

Vermont Division of Forestry. 2008. A Guide for Constructing and Using Portable Skidder Bridges.
http://www.vtfpr.org/watershed/portbridgebroc.cfm (http://www.vtfpr.org

/watershed/portbridgebroc.cfm) Accessed on January 21, 2009.
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Good Forestry in the Granite State
Draft Sensitive Areas - Vernal Pools

x.x VERNAL POOLS AND THE SURROUNDING FOREST

BACKGROUND

Vernal pools and the adjacent forest provide critical habitat for numerous wildlife species, but vernal pools are easily overlooked because they are small and dry seasonally.
Vernal pools form in shallow depressions or basins, and may appear as sim pools of water, with little or no vegetation growing in them. To be consider a vernal pool, the pool can't have a permanently flowing outlet and it must hold water for at least two months after spring ice-out (See NH Administrative Rule Env-Wt 101 for the official state definition).

Vernal pools differ from other wetlands in that they have a seasonal cycle c flooding and drying - this cycle determines what wildlife use vernal pools. Many flood then dry each year, though some pools may hold water for sev years between drying.

Vernal pools are unique wetlands that provide critical habitat for several amphibian and reptile species. Fish are major predators in wetlands, but th are unable to maintain viable populations in vernal pools (because they dry As a result, vernal pools provide critical breeding habitat for amphibians whose tadpoles and larvae are especially vulnerable to fish predation. Thes species include spotted salamanders, blue-spotted/Jefferson's salamanders, state-endangered marbled salamanders, and wood frogs.

Other species besides amphibians use vernal pools. Fairy shrimp are small crustaceans that require vernal pools for all life stages. State-endangered

Blanding's turtles and state-threatened spotted turtles feed on amphibian eg in vernal pools and use them for basking, mating, and overwintering. Thes turtles also use vernal pools as stop-over habitat when migrating, because pools provide moist refuge and abundant food. Many mammals, birds and snakes also forage at vernal pools, including song birds, wood ducks, ribbc snakes, bats, and raccoons.

While vernal pools are essential habitat for many wildlife species, the fores surrounding the pools is equally important. For example, wood frogs and tl salamanders that breed in vernal pools spend over 11 months in the forest.

OBJECTIVE

Manage vernal pools and the surrounding forest to provide amphibi invertebrate, and turtle habitat, by maintaining pool hydrology, wate quality, forest floor integrity, and sufficient canopy cover.

CONSIDERATIONS

- Many vernal pools meet the statutory definition of wetland and are subject to state wetlands regulations pertaining to timber harvesting.
- Marbled salamanders and Blanding's turtles are listed as endangered, and spotted turtles as threatened species by the state of New Hampshir and are protected under the NH Endangered Species Conservation Ac The NH Natural Heritage Bureau can tell you if these or other listed species have been documented on or near your property.
- In preparation of a timber harvest, it may be necessary to mark the perimeter of vernal pools when they contain water in the spring, so the can be identified during the dry season or during winter.
- When a vernal pool fills with water, how long it holds water, and the t and abundance of amphibians and invertebrates it supports can all change dramatically from year to year. Animals that use the pools are adapted to this variation. Though some species may not be present at a particular pool in a given year, that pool and its surrounding forest ma still be high-quality habitat.
- Although reptiles and amphibians are small, they travel long distances

Juvenile wood frogs and salamanders may disperse to vernal pools as as 1/2 to several miles from the pool in which they were born. These movements maintain genetic variability within amphibian populations and recolonize sites where local amphibian populations are gone.

- Both the vernal pool and the surrounding forests are part of the functional vernal pool system, but each serves different functions. Breeding habitat includes the vernal pool basin and a forested buffer extending 200 feet from the pool edge. The pool basin is the physical breeding location for vernal pool-dependent species and is a nursery fc their eggs and larvae. The buffer helps protect pool water quality by filtering sediment and pollutants, providing shade, and slowing surfac runoff. The buffer also provides leaf litter, which is the foundation of t vernal pool food chain, and shelter for adult and metamorphic amphibians immediately after they emerge from the pool. Core habitat extends from the breeding habitat out to 950 feet from the pool edge. I provides critical habitat for amphibians of all ages during the non-breeding season, and provides aestivating and basking habitat for spotted and Blanding's turtles.
- The lack of long-term studies in the northeast means that much is still unknown about the specific effects of timber harvesting on vernal pool-dependent reptiles and amphibians. Available research suggests t within the core habitat:
    - Excessive compaction or scarification of the soil during timber harvesting may reduce leaf litter and burrows, and reduce the amount of suitable upland habitat available to wood frogs and mc salamanders. Maintaining natural topography maintains the volu and timing of water reaching vernal pools.
    - Vernal pool-dependant amphibians and reptiles are most sensitive disturbances that alter water quality or temperature within the po alter the length of time the pools hold water, or alter the air and sc temperature in the forest surrounding vernal pools.
    - Wetland buffers intended to protect water quality may be too nar to allow amphibians to complete all of their life-history.
    - Negative effects of temporary openings are less in a forested landscape than in a developed one.
    - As forest opening size increases, the negative effects of habitat

drying and increased soil and air temperature also increases. However, it is unclear how specifically these impacts change as tl disturbance increases from a single-tree opening, to a small group opening, to a large clearcut of many acres. In most cases, the negative effects of timber harvesting on vernal pool-dependant species are temporary and decrease with time as the forest regenerates.

- Canopy cover reduced below 55%, will probably have at least a temporary negative affect on vernal pool-dependent amphibians - until the canopy or understory cover fill in.
- Openings such as wildlife food plots, pastures, fields and landings create barriers to reptile and amphibian dispersal because they are often hot and dry. These openings are most likely to create barrier when they are located directly between adjacent wetlands.
- Vehicle ruts can reduce the length of time a pool holds water by directing water away from the pool. Ruts at any distance from a p can create breeding "traps" for amphibians, since wood frogs and salamanders will often deposit eggs in ruts. Most ruts dry too quickly to allow the eggs to develop completely.

RECOMMENDATIONS

- Mark the locations of vernal pools before harvest. Alert equipment operators. Locations and management recommendations could be included in the forest stewardship plan.
- Locate openings such as landings, main skid trails, roads, wildlife foo plots, pastures, and fields as far as reasonably possible from vernal po Avoid locating permanent, non-forest openings directly between two adjacent vernal pools.
- The vernal pool basin:
  - Avoid running machinery through vernal pool basins, even durin dry periods, to avoid changing the pool's ability to hold water.
  - Avoid adding slash (woody material) to vernal pools. Where significant amounts of slash fall into the pool, remove it by hand some other low-impact method. If the pool contains water, leave t slash until the dry season. Removing it when the pool holds water

can disrupt amphibian egg and larval development.
    - Avoid removing trees that have crowns immediately overtopping any portion of the pool in order to maintain water temperature an nutrient inputs.

- Within 200 feet of a vernal pool:
    - Limit tree removal to individual trees or small groups of trees. Locate groups where there is established advanced regeneration o shrub cover which can help to maintain shady conditions after the overstory is removed.
    - Avoid removing stumps, stones, or other large cover objects.
    - Maintain as much of the existing understory vegetation (i.e., smal trees, shrubs, herbaceous ground cover) as possible.
    - Limit the activity of heavy equipment.
    - Locate main skidder roads outside of this buffer.
    - Avoid applying herbicides or insecticides.
- Beyond 200 feet:
    - Limit the area that is scarified, stumped or regraded to that necessary to accomplish silvicultural or wildlife objectives.
    - Retain as much existing dead and down woody material, stumps, stones and leaf litter as possible.
    - Avoid or minimize rutting by following best management practic (BMPs). When possible, harvest on frozen ground (preferable) or dry summer conditions.
    - Retain as much understory vegetation as possible where its remov isn't required to meet other objectives.

CROSS REFERENCE

Harvesting Systems; Water Quality; Wetlands

ADDITIONAL INFORMATION

Calhoun, A.J.K. and P.deMaynadier.2004. Forestry Habitat Management Guidelines for Vernal Pool Wildlife. MCA Technical Paper No. 6, Metropolitan Conservation Alliance. Wildlife Conservation Society, Bron

New York.

Marchand M. Ed. 2004. Identification and Documentation of Vernal Pools New Hampshire. New Hampshire Fish and Game Department.

Tarr, M. and K. Babbitt. 2009. The Importance of Hydroperiod in Wetland Assessment: A guide for community officials, planners, and natural resour professionals. UNH Cooperative Extension. 23 pp.

Good Forestry in the Granite State
Draft Non-Timber Forest Products - Ecosystem Services

x.x ECOSYSTEM SERVICES

BACKGROUND

Forests provide a myriad of services that are beneficial to human welfare- wildlife habitat, water quality, storage and regulation of stor flows, erosion control and sediment retention, recreation, aesthetics a carbon storage. These public benefits, known as ecosystem services, a provided by the forests of thousands of private landowners who keep their forest as forest.

Historically, ecosystem services haven't been given a dollar value in the market, but that is changing. Programs to compensate landowners for the services their lands provide are emerging. The intention of these programs to provide an incentive to landowners to keep their land in forest.

Although there are regional projects where landowners are compensated fo the services their land provides, carbon is currently the only ecosystem serv that has a global market. Work and research continues on the valuation of other services. New markets for ecosystem services may emerge as the pub becomes more aware of their importance. Wetlands banking, conservation banking, and other landscape-level efforts to protect the values and service provided by natural landscapes are already established in regions around th country. Private landowners stand to benefit from growing markets for ecosystem services. Compensation for services provided by the forest may some day provide an income stream and thus an incentive to participate in ecosystem services markets.

Carbon Sequestration Markets (Carbon Offset Markets)

All forests store carbon. The rate and quantity of carbon stored varies by forest type, age and structure. Carbon markets, which provide credible standards by which carbon storage is measured and verified, are developin and give forest landowners an opportunity to measure and monitor the carb stored in their forests and sell credits on an open market. Carbon credits ar purchased by carbon emitters seeking to offset their carbon emissions. Currently these markets within the United States are entirely voluntary, though the development of a mandatory national carbon "cap-and-trade" system would change this situation considerably.

The Regional Greenhouse Gas Initiative (RGGI), a consortium of 11 easte states that creates mandatory emission reduction targets for large electric generation facilities, is currently the nation's only regulated carbon cap-and-trade system. However, managed forest projects are not currently eligible for offset credits under RGGI.

Carbon credit transactions may be private transactions between parties or coordinated through centralized registries or exchanges. The primary regis for forest carbon offset credits that has emerged is the Climate Action Rese (CAR).

Developing a carbon offset project is complex and expensive, involving inventory, monitoring and verification costs above and beyond what is necessary for a normal forest management plan. Currently, participation in these markets is only feasible for large landowners, though Congress is considering proposals that would make these markets more accessible to smaller landowners. Some carbon offset project development companies ar developing programs to aggregate multiple smaller landowners. Participati in these markets also imposes long-term commitments and expenses.

These markets have reached the point where they currently provide a viabl source of income for at least some landowners, though because the field is changing rapidly, the long-term prospects for participation by a range of landowners, as well as the financial value of these markets, is difficult to predict.

Other Markets

There are other models of compensating landowners for their good stewardship to ensure their forests continue to provide ecosystem services. Wetland mitigation banking and conservation banking for endangered spec mitigate unavoidable impacts on aquatic resources and endangered species from development or other activity. The "bank" is a restored, enhanced or conserved area maintained to specific contractual standards by the bank owners. The banks are subject to regulatory review. Mitigation or conservation credits, which provide a specific ecosystem function, are sold companies whose projects have an unavoidable impact on a similar resour For example, if a project impacts a specific endangered species habitat the purchased credit must support that same species habitat in the bank. These mitigation banks aren't currently in New Hampshire but have been used in other states, such as California and Florida, for decades.

CONSIDERATIONS

- Forest ecosystems converted to other land uses cease to provide ecosystem services.
- Protecting forest land in perpetuity with a conservation easement is on way to ensure that forests continue to provide ecosystem services.
- Human-engineered systems that replace ecosystem services lost throug forest conversion generally are expensive, require technology not yet developed or perfected, and aren't as efficient or cost-effective as what natural ecosystem provide.
- Voluntary carbon markets and standards by which carbon is measured and traded continues to develop and change.
- Carbon markets and carbon trading are in their infancy. It has yet to b proven whether participation in carbon exchange programs will be successful at providing an income stream and an incentive for landowners to participate in this market.
- Landowners interested in participating in carbon markets will need to establish a baseline inventory of their woodlot. Protocals for carbon inventories are being developed.
- The Farm Bill of 2008 authorizes the U.S. Secretary of Agriculture to "establish technical guidelines that outline science-based methods to measure the environmental services benefits from conservation and lar

management activities in order to facilitate the participation of farmers, ranchers, and forest landowners in emerging environmental services markets.

RECOMMENDED PRACTICES

- Discuss your interest with your forester.
- Establishing a baseline inventory of their woodlot.
- Participate in a forest certification system, such as the American Tree Farm System, Forest Stewardship Council, or the Sustainable Forestry Initiative. This may be required to participate in carbon markets and is likely to be required as markets for other ecosystem services are create
- Identify aggregators, or organizations that put together the carbon stoc from several landowners, in their state or region. Private forest landowners will need to work with aggregators to participate in carbon trading.

CROSS REFERENCE

x.x Setting Objectives, x.x Forest Management Planning

ADDITIONAL INFORMATION

Chicago Climate Exchange. 2009. http://www.chicagoclimateexchange.co (http://www.chicagoclimateexchange.com/) Accessed March 11, 2010.

RGGI. 2008. Regional Greenhouse Gas Initiative. http://www.rggi.org/ho (http://www.rggi.org/home) Accessed March 11, 2010.

USDA Forest Service. Ecosystem Services. http://www.fs.fed.us /ecosystemservices/index.shtml (http://www.fs.fed.us/ecosystemservices /index.shtml) Accessed March 11, 2010.

USDA Forest Service- Northern Research Station. Carbon Tools. http://nrs.fs.fed.us/carbon/tools/ (http://nrs.fs.fed.us/carbon/tools/) Accessed March 11, 2010.

U.S. Environmental Protection Agency Mitigation Banking Fact Sheet
http://www.epa.gov/owow/wetlands/facts/fact16.html (http://www.epa.gov/owow/wetlands/facts/fact16.html)
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