

Forest Management Plan for the Property of the City of Bangor

City of Bangor
530 Maine Avenue
Bangor, Maine 04401

Property is located in the Town of Winterport, Maine

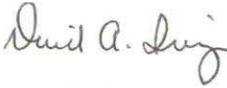
Property Acreage Summary										
Tax Map	Lot	Forestland Classified in Tree Growth Tax			Non Classified Forestland	Open Land	Gravel Pit	Class 2 Roads	Wetlands	Total
		Softwood Forestland	Mixedwood Forestland	Hardwood Forestland						
R-09	167	0	0	0	22	0	7	1	0	30
R-09	173	14	75	11	28	1	5	1	5	140
Total		14	75	11	31	1	12	2	5	170

Plan Drafted by: David Irving, Maine LF 3249, TSP 12-8087
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Plan Drafted: February 16, 2021
Plan Expires: February 15, 2031

Certification Statement

This forest management plan complies with all applicable federal, state, and local laws and meets applicable standards, specifications, statements of work, and requirements of the Maine Tree Growth Tax Program. I certify that this forest management plan also meets the requirements to participate with the American Tree Farm System.

David A Irving		3249 / 12-8087	2/16/2021
Name	Signature	Maine LF # / TSP	Date



Summary of Recommendations

The following table provides an executive summary of the findings and recommendations made as part of this forest management plan. It is provided at this point for ease of access. Detailed discussion as to data and rationale for the recommendations will be found throughout the many following pages.

<i>Summary of Recommended Activities for the Property of the City of Bangor in Winterport, Maine</i>						
<i>Location</i>	<i>Time Period</i>	<i>Units</i>	<i>Activity Description</i>	<i>Expense</i>	<i>Income</i>	<i>Priority Level</i>
Boundaries which bisect forestland	2021-2025	4,850 feet	Clear and Mark Boundary Lines	x		1
Stand 01	Winter 2022-2024	21 acres	Commercial Thinning		x	1
Stand 02	Winter 2021	9 acres	Single Tree Selection Harvest		x	2
Stand 03	Winter 2022	22 acres	Patch Cut Harvest to Promote Woodcock Habitat		x	2
Stand 04	Winter 2022	12 acres	Patch Cut Harvest to Promote Woodcock Habitat		x	2
Entire Property	2019-2029	1x/2years	Semi-annual monitoring of property lines and insect/disease concerns	-	-	2
Entire Property	February 16, 2031	170 acres	Update Forest Management Plan Contact Licensed Forester in July of 2030	x	-	1



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Forestry Terms

The following list of forestry terms and table at the bottom are provided to offer a better understanding of the information provided in the following pages.

- **Basal Area (BA):** The cross section area of the stem or stems of a plant or of all plants in a stand, generally expressed as square units per unit area. Tree basal is used to determine percent stocking.
- **Cord:** A stand unit of wood volume measurement measuring 128 cubic feet.
- **Crop Trees:** Trees to be grown to the end of the rotation.
- **Diameter at Breast Height (DBH):** Outside bark diameter at breast height. Breast height is defined as 4.5 feet above the forest floor on the uphill side of the tree.
- **Even-aged Management:** Timber management that produces a stand of two or one distinct age classes. Harvesting methods include shelterwood, seed tree, and clearcutting.
- **Maturity:** Expressed in two ways: 1. financial maturity occurs when a tree has reached the point where it has maximized value growth from the prospective market place; 2. Biological maturity occurs when a tree has reached the point where the energy costs of maintaining itself exceeds the energy input from photosynthesis. Financial maturity is reached long before biological maturity.
- **Quadratic Mean Diameter (QMD):** The average DBH of a sample of trees.
- **Regeneration:** Renewal of a tree crop by natural or artificial means.
- **Shelterwood:** An even-aged silvicultural system in which the mature trees are removed in a series of partial cuts that take place over a small portion of the rotation. The residual trees are left as a seed source and to provide shade and protection for the new seedlings. Three types of cuttings are used in this method: The preparatory cut, in which the least desirable trees are removed to improve the quality and growth of the stand, the seed cut, in which the regeneration is established, the removal cut (or cuts) in which the mature trees are cut to release the regeneration.
- **Stand:** A community of trees possessing sufficient uniformity in regards to composition, constitution, age, spatial arrangement or condition to be distinguishable from adjacent communities.
- **Stocking Level:** Stocking levels are calculated by comparing either the basal area or the number of trees the site could support, if the growth potential of the land was fully utilized, to the basal area or number of trees actually on the site.
- **Trees Per Acre (TPA):** The density of trees growing on the space of an acre per the forest inventory sample.
- **Uneven-aged Management:** Timber management that produces a stand composed of a variety of age classes. Harvesting methods used in uneven-aged management include individual tree and group selection.

Tree Species and Stand Type Codes

Common Name	Scientific Name	Common Name	Scientific Name
Red Spruce	Picea rubens	Black Spruce	Picea nigra
Balsam Fir	Abies balsamea	Eastern Hemlock	Tsuga canadensis
White Pine	Pinus strobus	Northern White Cedar	Thuja occidentalis
Trembling Aspen	Populus tremuloides	White Birch	Betula papyrifera
Red Maple	Acer rubrum	Sugar Maple	Acer saccharum
Yellow Birch	Betula allegheniensis	Tamarack (Larch)	Larix laricina
Brown Ash	Fraxinus nigra	White Ash	Fraxinus americana

Overstory Height	Code
15-35 feet	1
36-55 feet	2
56-75 feet	3
>75 feet	4
Canopy Closure	Code
76-100%	A
51-75%	B
26-50%	C
0-25%	D

Example and Explanation of Stand Abbreviation

Overstory Type	Species Codes	Height Code	Canopy Closure Code
Mixedwood 3C	Mixedwood = Mixed	3 = 56-75 feet	B = 26-50%
Hardwood and Softwood			

Introduction

This forest management plan is drafted for the 170-acre property owned by the City of Bangor in the Town of Winterport, Waldo County, Maine.

Much of the property was found to have some type of agricultural history, whether as pasture for livestock, fields for hay, or tillage for annual crops; it is estimated that 70% of the property area was once used for agriculture. Since the farm and other farms were abandoned many decades ago, the open fields and pastures have slowly been succeeding back to forest, resulting in a diverse mosaic of a wide gamut of species at differing stages of growth, stocking, and density. Timber harvest on approximately 60% of the property occurring approximately 20 years ago added to this diversity as a flush of new growth occupies the lower strata. The forest is dominated by aspen, but many other species are present. The property provides habitat to a variety of species, including moose, deer, bear, grouse, woodcock, various songbirds, and small mammals such as squirrels, snowshoe hare, pine marten, and fisher.

The property also once had a large area devoted to gravel pits, totaling 20% (35 acres) of the property's footprint. As of today, only 12 acres are devoted to open gravel pits. The City mines gravel and sand from the pits for use on City construction projects.

The objective of the City is to promote a diverse and healthy property, one which will provide continual and multiple benefits to society. They would like to utilize low impact and conservative timber management to generate revenue to assist with paying taxes and other carrying costs. More specifically, their goals for timber management are as follows:

1. Sustainable timber harvest is the fundamental priority for management.
 - a. They wish to utilize a broad spectrum of silvicultural practices to mimic natural stand dynamics.
 - b. Focus will be placed on promoting quality of the timber resources.
 - c. Mitigation practices to control invasive and non-native species will be utilized as much as practical.
2. Promotion of wildlife habitat is a secondary priority.
 - a. Biodiversity is important to them, so both vertical and horizontal structure will be improved so that the property is useful to a wide variety of animal species.

In both narrative and technical form, this plan is provided and intended to serve as a historical, reference, and practical document. The plan may be best viewed in two sections. First, a baseline of current forest conditions was established to provide an understanding of the cultural, sociological, ecological, operational, and silvicultural variables which must be considered while pursuing the landowner's objective. The second part of the plan, while utilizing the baseline conditions, management activity recommendations are presented, which are balanced according to the broad objective and specific management goals and criteria. It is worth noting that activities and practices recommended as part of this plan are only suggestions, and are not requirements of management. Decisions whether to move forward with recommendations found within this plan may ultimately be made by the landowner, particularly when practices are dependent on financial investment. In the process of forest management on such a significant ownership, it would not be uncommon that some forest stand treatments may not be implemented in whole or in part with any forest management plan due to operational or financial constraints. Modifications to this plan, on strategic and tactical levels may be required due to potential changes in forest stand dynamics (e.g. insect and disease outbreaks), local culture, policy, forest product markets, and operational realities such as contractor availability or technology. Or if the objectives are altered, the plan should be effectively updated in order to maintain consistency.

Mapping Procedures

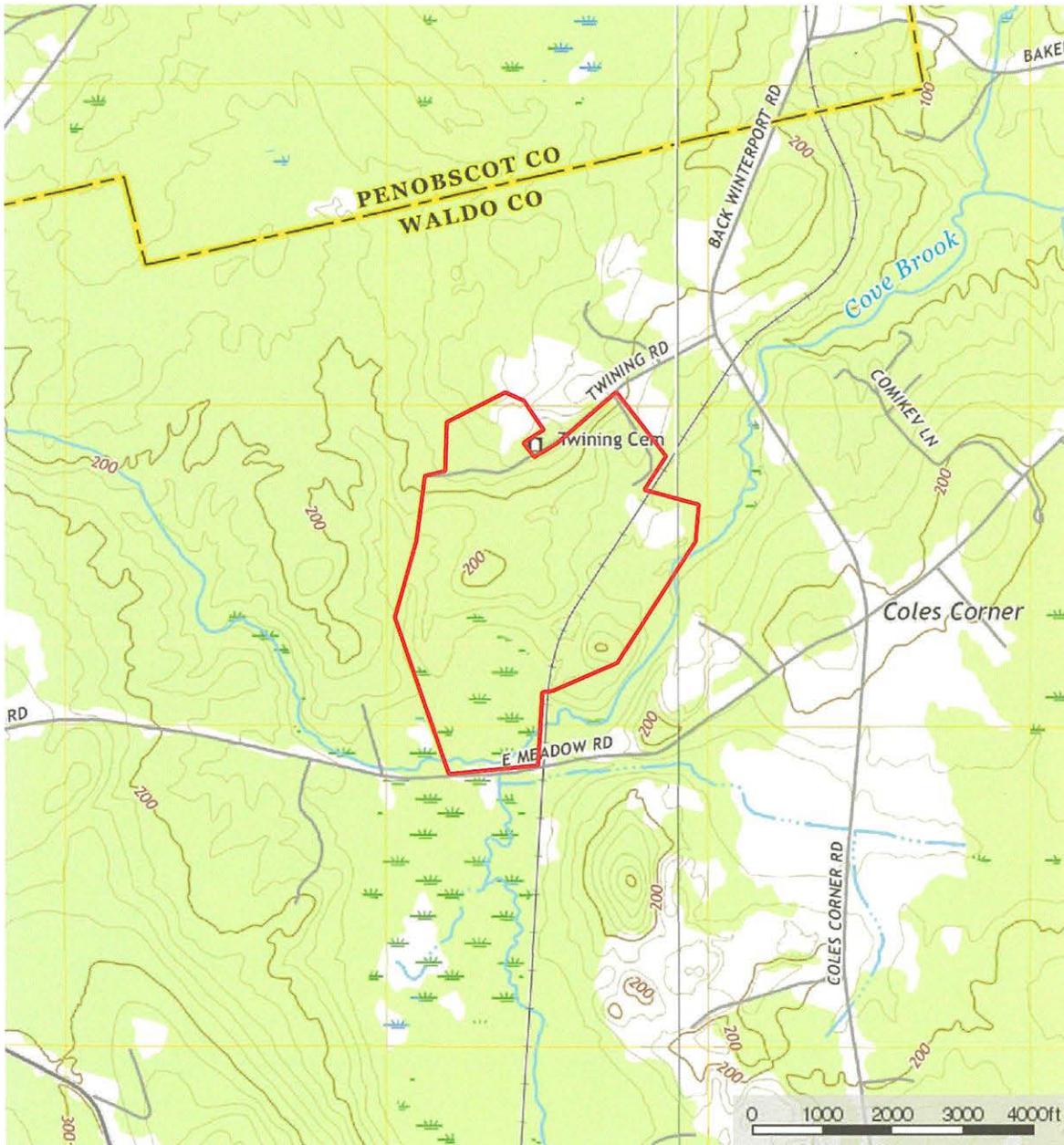
Utilizing the Geographic Information System (GIS), boundaries of the property were drawn to provide reference to roads, trails, watershed, forest stands, soil types, significant habitat, and special sites. Data used to create the GIS was compiled from maps and data provided by the landowner, Town of Winterport, GPS data collected in the field, and data obtained from the Maine Office of GIS. **Please note property boundaries and acreage figures are informal estimates and maps are not presented or intended to be used as a legal survey.**

Forest Inventory Procedures

The subject property was traversed in its entirety on December 24, 2020. Estimates of tree species composition, including basal area, density, and volume are the result of visual observations made while traversing the property.

Property Location

The subject property consists of two tax lots, separated by the Railroad line. Lot 173 lies westerly of the railroad whereas Lot 167 is easterly. The property has frontage along Twining Road on the north, and Cove Road / East Meadow Road to the south.

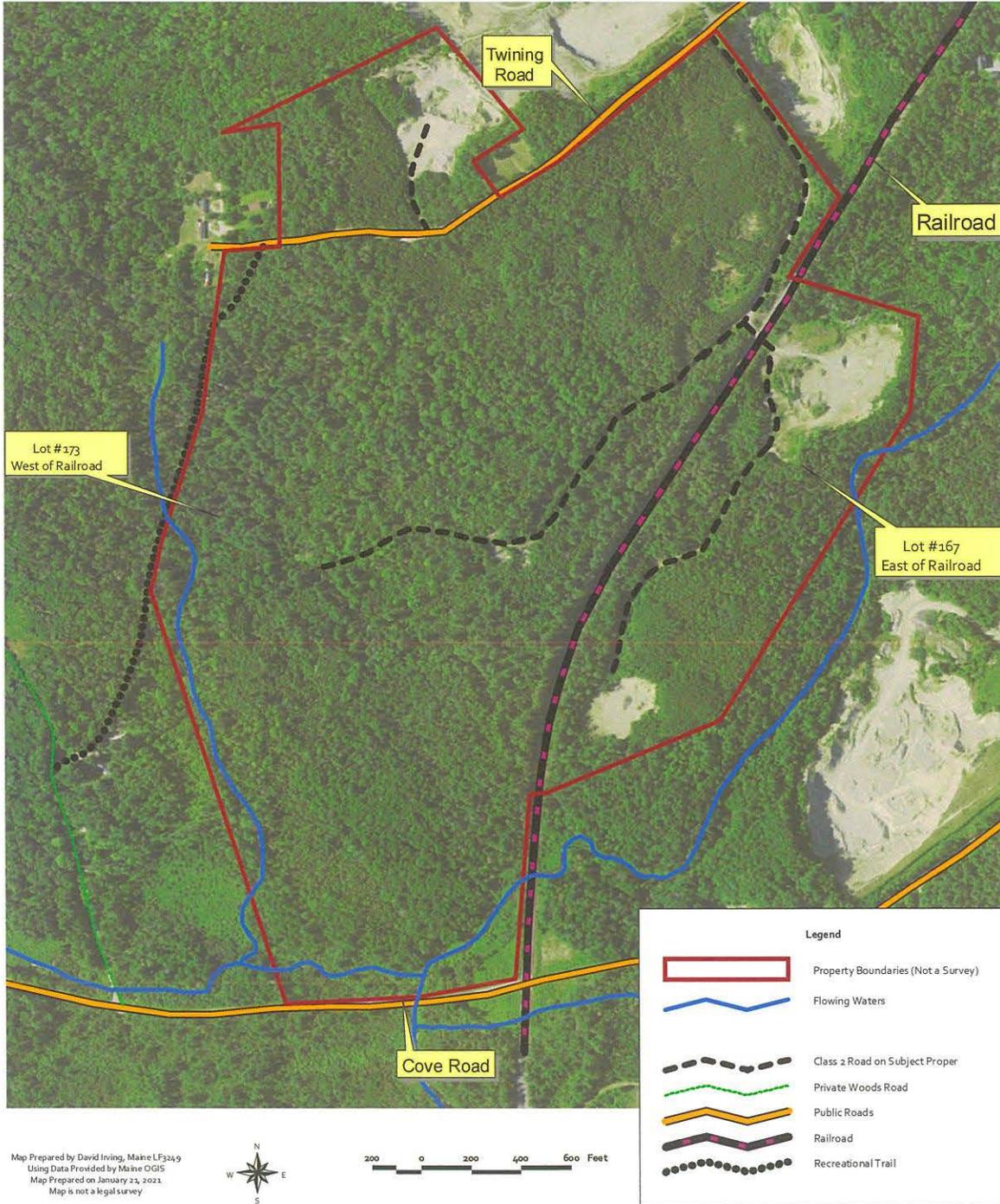


Base Maps

Several maps are provided below and on the following pages to provide a historical reference of the vegetative changes which have naturally occurred on the property, as well as an opportunity to view changes occurring on the surrounding landscape such as timber harvest or development.

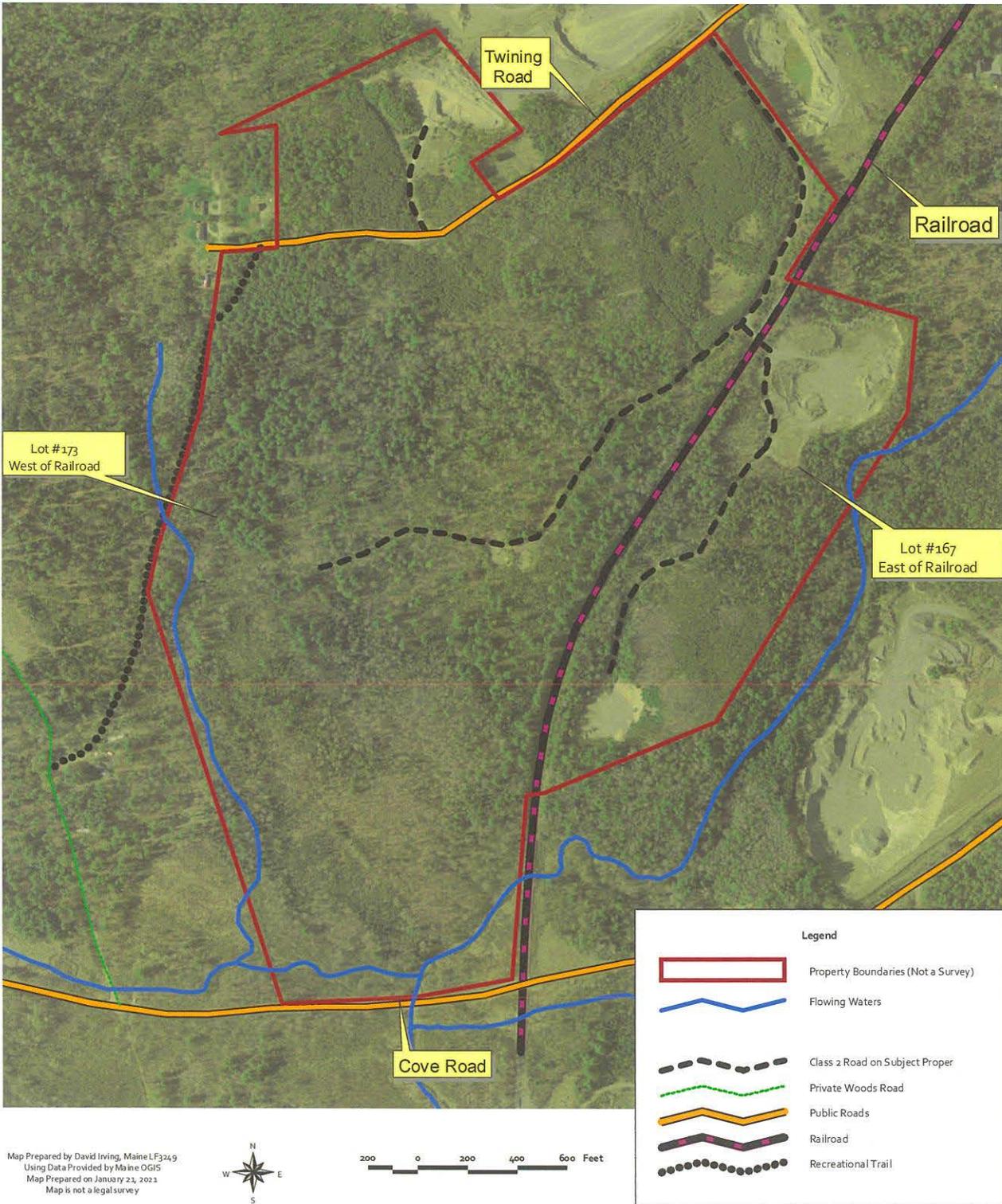
Property of the City of Bangor
Town of Winterport, Waldo County, Maine
Tax Map Rog Lots 167 & 173

Base Map
2018 Aerial Photo



Property of the City of Bangor
 Town of Winterport, Waldo County, Maine
 Tax Map R09 Lots 167 & 173

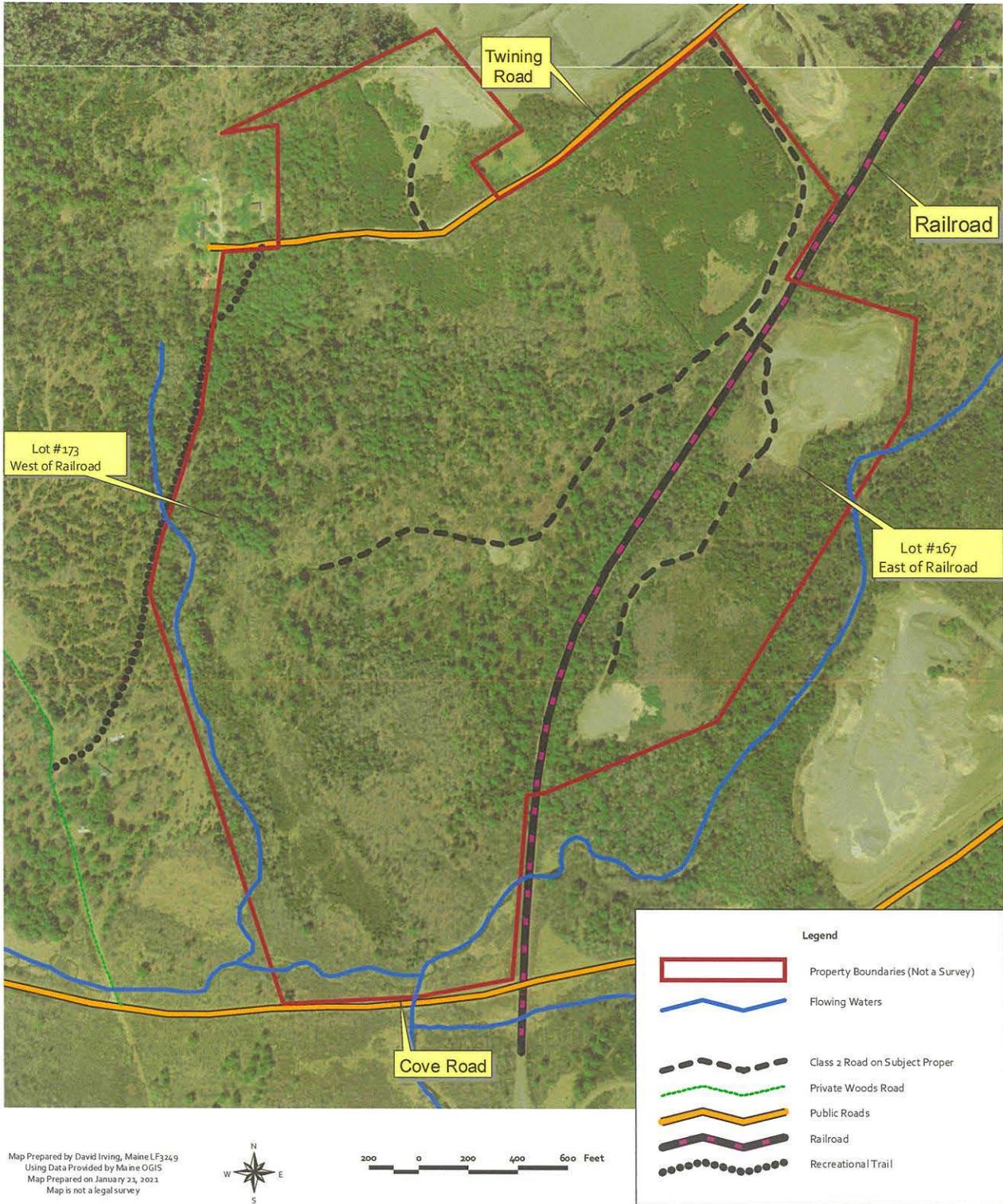
**Base Map
 2015 Aerial Photo**



Map Prepared by David Irving, Maine LF3249
 Using Data Provided by Maine OGIS
 Map Prepared on January 21, 2021
 Map is not a legal survey

Property of the City of Bangor
Town of Winterport, Waldo County, Maine
Tax Map R09 Lots 167 & 173

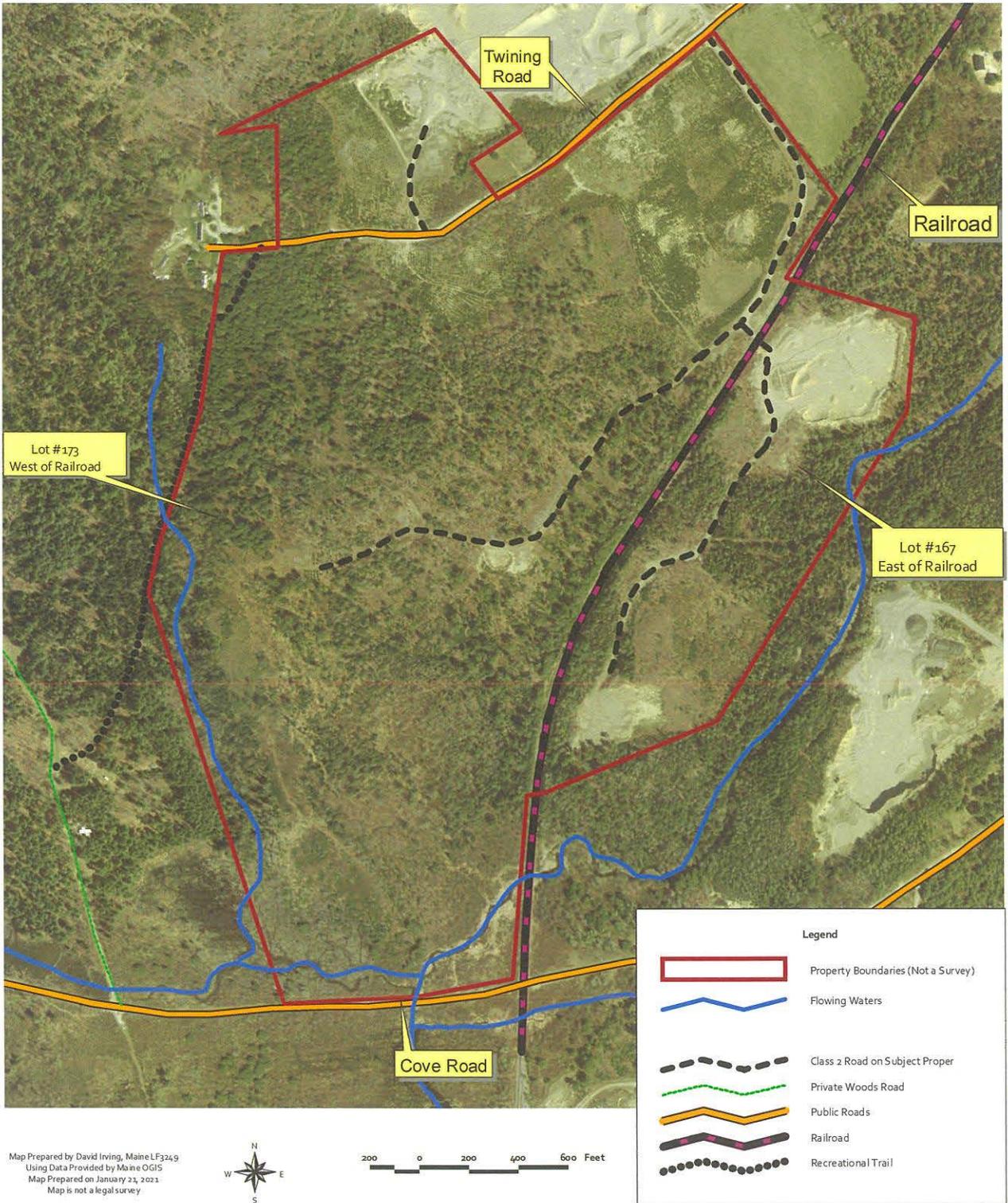
Base Map
2014 Aerial Photo



Map Prepared by David Irving, Maine L.F.3249
Using Data Provided by Maine OGIS
Map Prepared on January 21, 2021
Map is not a legal survey

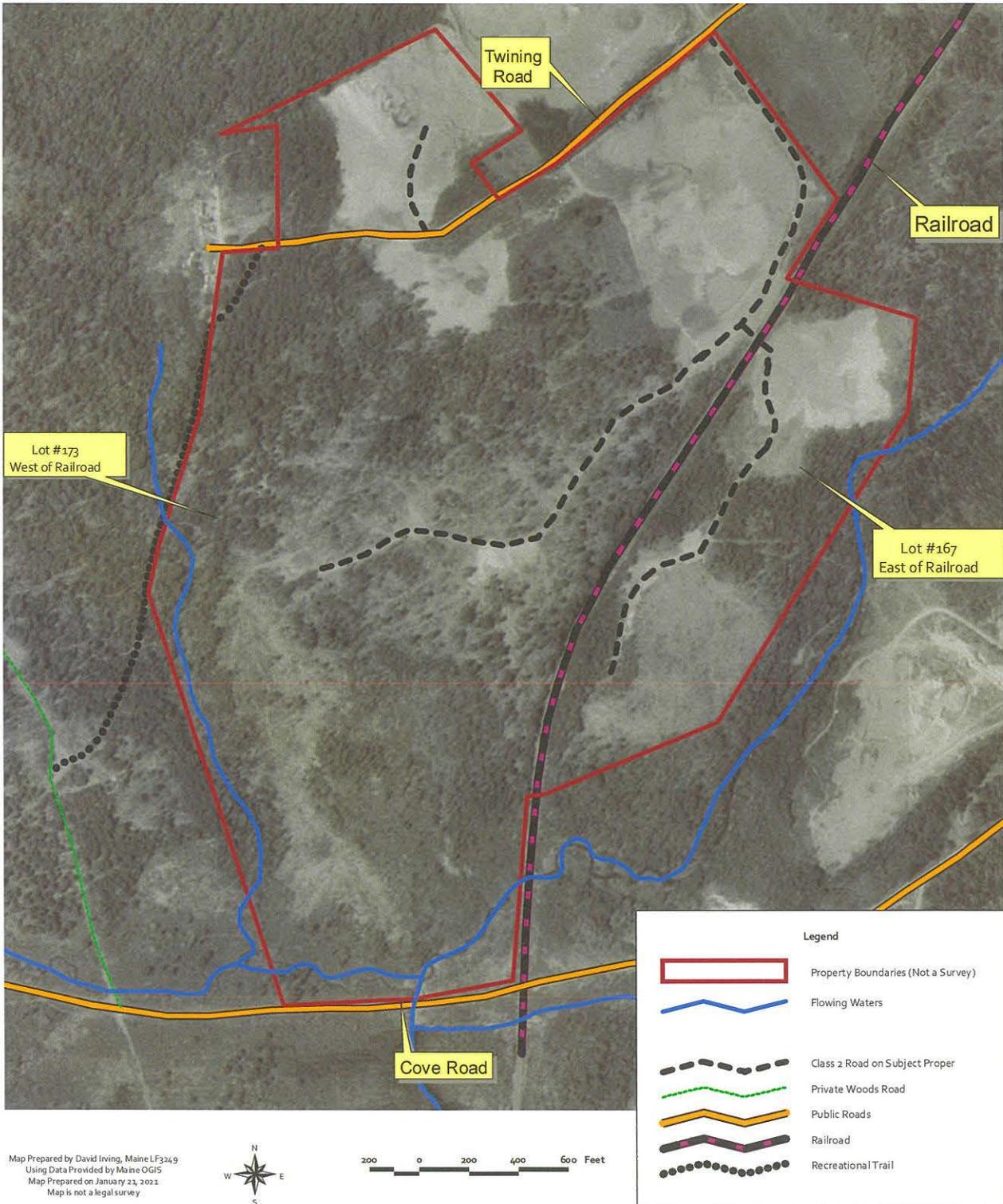
Property of the City of Bangor
Town of Winterport, Waldo County, Maine
Tax Map Rog Lots 167 & 173

Base Map
2005 Aerial Photo



Property of the City of Bangor
Town of Winterport, Waldo County, Maine
Tax Map Rog Lots 167 & 173

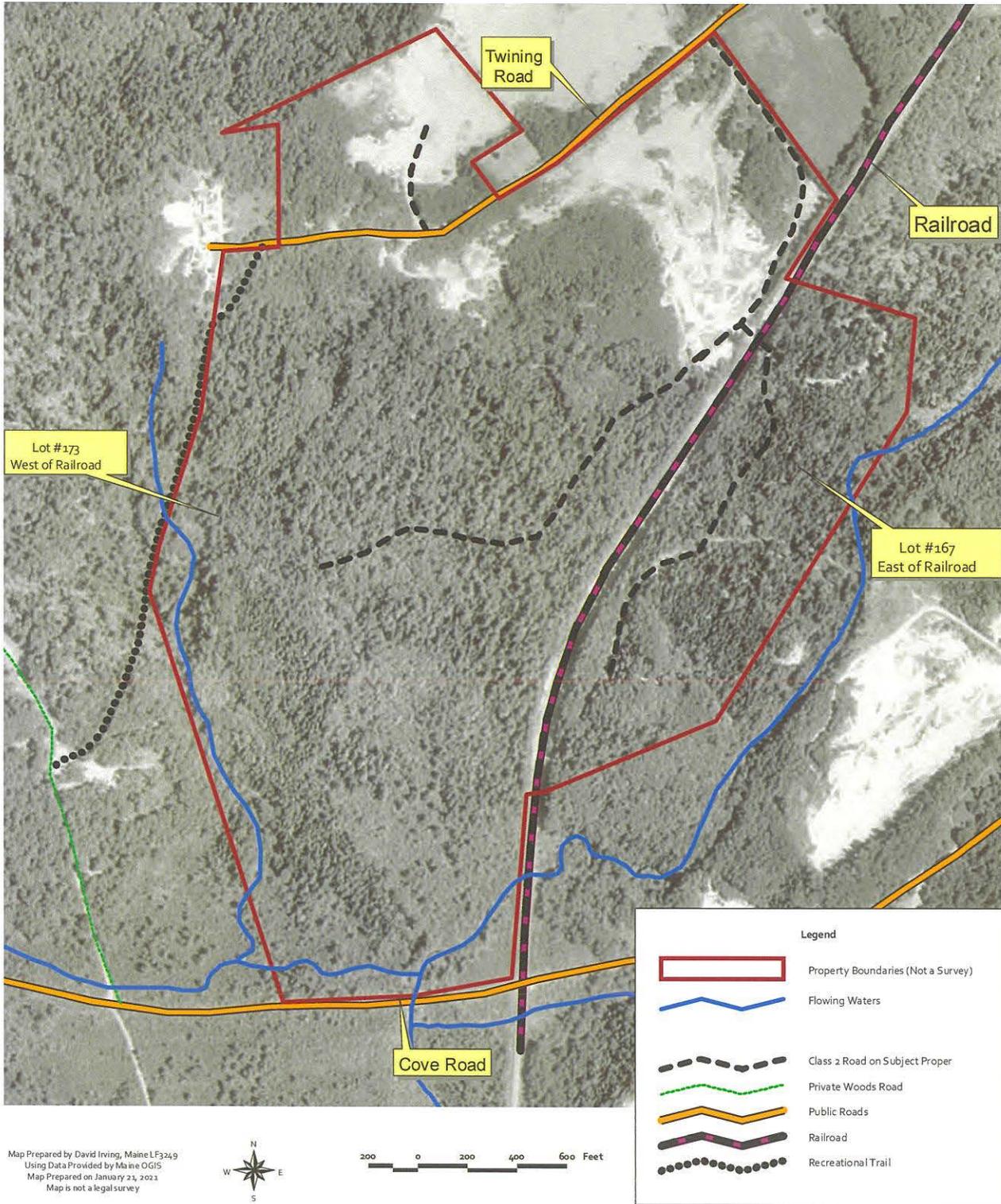
Base Map
1997 Aerial Photo



Map Prepared by David Inving, Maine LFP3249
Using Data Provided by Maine OGIS
Map Prepared on January 23, 2021
Map is not a legal survey

Property of the City of Bangor
 Town of Winterport, Waldo County, Maine
 Tax Map R09 Lots 167 & 173

Base Map
 1991 Aerial Photo



Legal Information

Current Use Tax

Much of the forestland on the subject property is currently classified in the Maine Tree Growth Tax Program. As a result of this Plan, the property is eligible for re-certification in the Tree Growth Tax Program for the next ten years. The property may also be transferred to the Open Space Tax Program without penalty if the owners would prefer. The Open Space Tax Program does not provide a tax shelter as large as Tree Growth Tax, but it has more flexibility regarding commercial forest management for conservative-minded forestland owners whom do not want to feel the pressure of managing for commercial purposes. Property Tax Bulletins #19 (Tree Growth Tax) and #21 (Open Space Tax) are attached to provide more information regarding these programs.

Easements & Leases

There are no known leases or easements on this property.

Forest Management Rules & Regulations

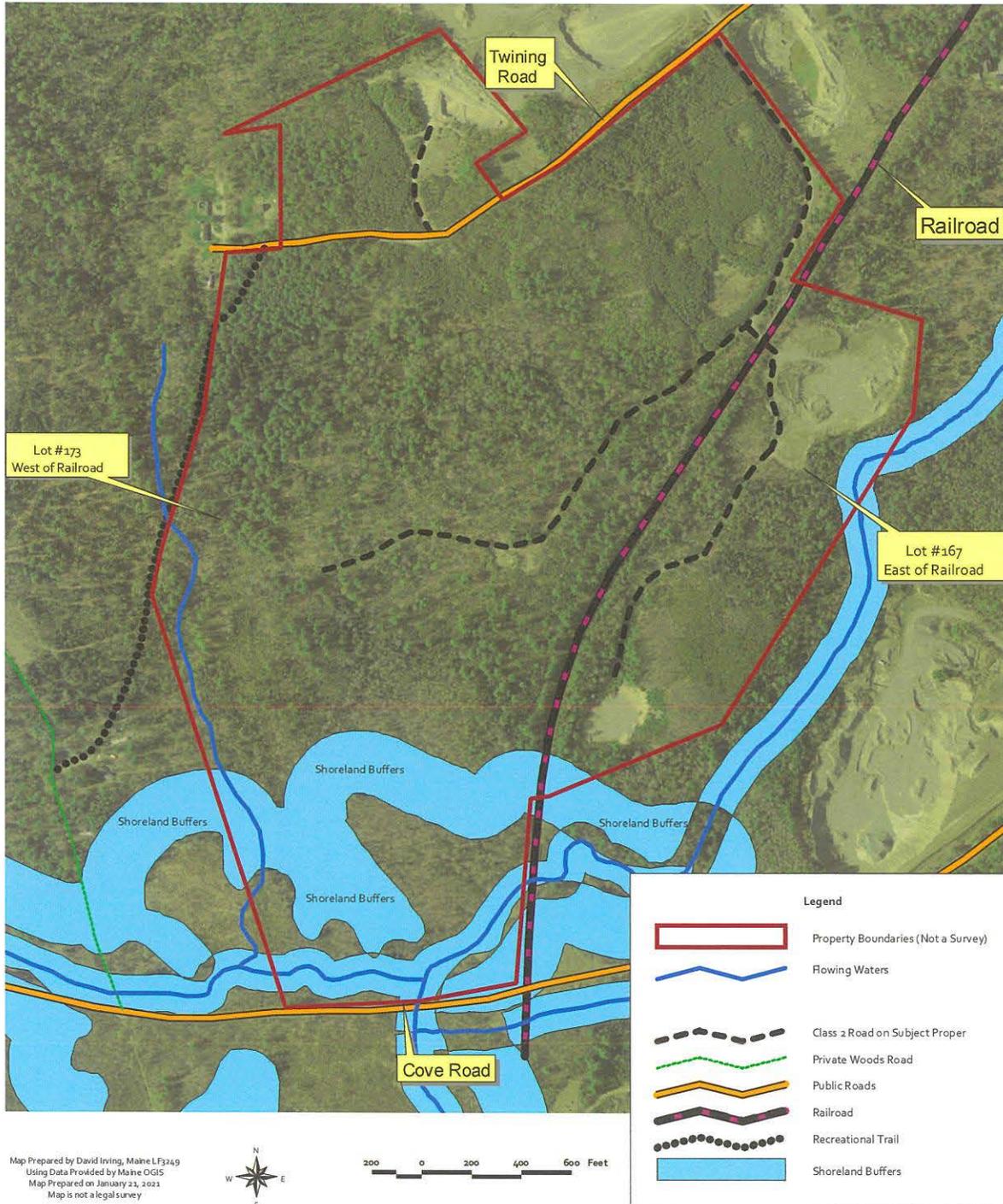
The following information is a summary of rules and regulations which pertain to forest management of this property. Regulations may change and they often do, but it is the responsibility of the owner to comply with the regulations in effect at the time forest management activities are conducted.

- **Slash & Brush:** Specific set-backs are required for brush and slash disposal from management activities which may occur near boundary lines and public roadways. The purpose of the law is to minimize fire hazard and aesthetic concerns. Road frontage along all Town roads, and property boundaries which bisect forest are subject to this law.
- **Forest Operations Notifications (FON) and Landowner Report:** Maine Forest Service (MFS) Rules Chapter 26. These rules require that landowners notify the Maine Forest Service of planned timber harvesting. A Landowner Report must be filed at the conclusion of each year which a FON is on file. The consulting forester will take care of this requirement before a harvest commences.
- There are not any local ordinances or deed restrictions which affect forest management of the property.
- The property is NOT subject to the Liquidation Harvesting Rule since the property has been owned for more than 5 years.
- **Clearcutting Rules Chapter 20.** These rules regulate the establishment, arrangement and regeneration of clearcuts. Clearcuts are harvests which leave an area 5 acres or greater with less than a minimum stocking of trees. This will not be a concern as clearcuts this size are not planned, nor is it the objective of the owners to create large openings like clearcuts.
- **Essential or Significant Wildlife Habitats (EWH, SWH)** as designated by the Maine Department of Inland Fisheries and Wildlife (DIF&W). EWH or SWH may or may not have regulatory impacts on forest management activities, depending on whether they have been legislatively adopted and mapped. See pages 28-29 for more information.
- **Threatened or Endangered Species:** Federal and/or State Endangered or Threatened Species are designated by the US Department of the Interior and/or the Maine DIF&W, and may have protections regarding their habitats and/or restrictions on certain activities near these habitats. See pages 28-29 for more information.
- The property is **not** located within jurisdiction of the Maine Land Use Planning Commission.
- **Wetlands, water bodies and water quality:** Protection of wetlands, water bodies and water quality occurs through different rules which vary with location and type of activity. This property is located within a Town whom governs water quality protection and land use policy according to the local ordinance which is based on Maine DEP rules. The Regulatory Zone Map is provided on the following page.

Regulatory Zone Map

Property of the City of Bangor
Town of Winterport, Waldo County, Maine
Tax Map Rog Lots 167 & 173

Shoreland Regulatory Map 2015 Aerial Photo



Property & Management History

As described earlier, it is estimated that 50% of the property was once cleared land used for sustenance agriculture by the Smart family for generations. Several items of past farm use of the property were observed such as apple trees, stone walls, and wire fencing along the boundaries.

The Maine Historic Preservation Commission offers complimentary map reviews of woodlots and provided a very nice report presented below. They identified no special historical sites or features on the property.

As for forest management, much of the property was harvested at different stages during a time window between 20 and 30 years ago. Harvests were very conservative and administered very well under the watchful eyes of the prudent landowners and their careful forester. Additionally, an estimated 21 acres of the property was planted to red pine in the late 1990's on sites which were closed-out gravel pits.



JANET T. MILLS
GOVERNOR

MAINE HISTORIC PRESERVATION COMMISSION
55 CAPITOL STREET
65 STATE HOUSE STATION
AUGUSTA, MAINE
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KIRK F. MOHNEY
DIRECTOR

ARCHAEOLOGY AND HISTORIC RESOURCES REVIEW FORESTRY PLAN

MHPC # F118-20 Date Received 12/14/2020
Forester DAVID IRVING Township WINTERPORT
Parcel CITY OF BANGOR

*****This worksheet was completed for informational purposes only*****

Prehistoric (Native American) Archaeology (for further information: arthur.spieess@maine.gov)

- No prehistoric archaeological sites known. Based on location, soils and topography, none are expected.
- No prehistoric archaeological sites known because no survey has been conducted. However, the following area is archaeologically sensitive. _____
- The property includes known sites of archaeological importance. (See attached info)

Historic Archaeology (e.g. 1800s farms, etc.) (for further information: leith.smith@maine.gov)

- No sites are known, and none are expected (based on historic maps and documents).
- There are possible sites from former houses, barns, and outbuildings shown on maps from 1850 to 1920, now possibly recognizable as foundations or cellar holes. (See attached map.)
- The property contains known sites of archaeological importance. (See attached info)

Historic Buildings or Structures (for further information: megan.m.rideout@maine.gov)

- No historic buildings or structures are known or expected on the property (based on 7.5' USGS topographic maps and MHPC records).
- Buildings or structures may exist on the property that have not been evaluated for National Register eligibility. Our office will provide an assessment if a request letter, photos of any buildings over fifty years of age that are on the subject parcel, and a 7.5' USGS topographic map with all photos keyed to it are submitted to our office.
- Buildings or structures exist on the property that are either listed in or eligible for nomination to the National Register of Historic Places. (See attached info)

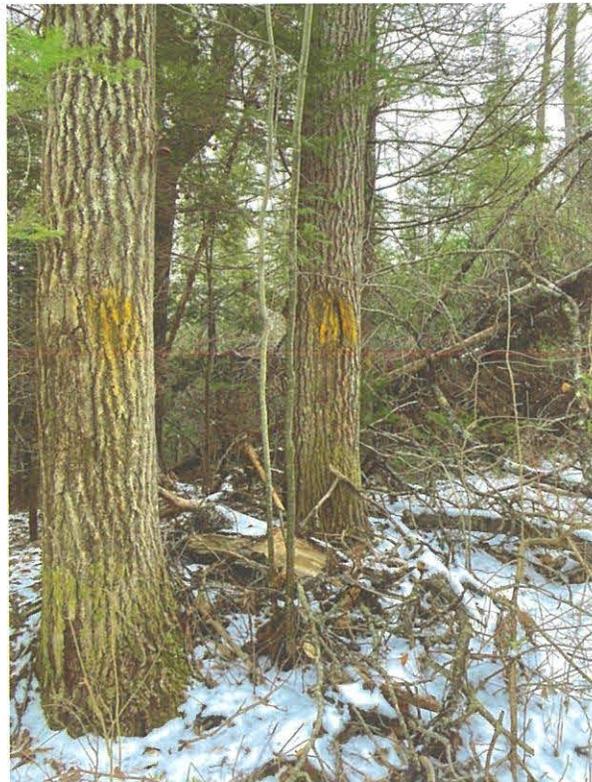
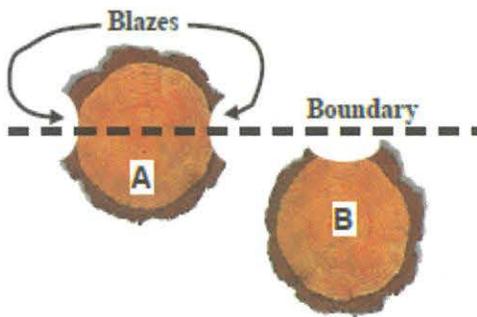
The information on this worksheet is being provided for Forestry Management Planning purposes only.

If any construction or ground disturbing activities on these properties will utilize federal funding, permitting or licensing, initiation of Section 106 review with the Maine Historic Preservation Commission is required pursuant to the National Historic Preservation Act of 1966.

Property Boundaries

The parcel boundaries are a mix of stone walls, painted trees bisecting forestland (with various colors), public roads, and frontage along the Railroad. There is a total of 17,650 feet of property boundaries; this is 3.34 miles. Evidence of the lines was identified along most of the perimeter of each parcel. I found that 4,850 feet of lines will need maintenance in the next 3 years. The following table provides the distance of property lines. For reference purposes, the estimated expense of brush and blazing boundary lines is \$150 per 1,000 feet.

Map	Lot	North Line		East Line		South Line		West Line		Total
		Distance (feet)	Description	Distance (feet)	Description	Distance (feet)	Description	Distance (feet)	Description	
R-09	167	510 feet	Through Forestland	1,820 feet	Through Forestland	760 feet	Through Forestland	2,310 feet	Frontage Along Railroad	5,400 feet
R-09	173	1,310 feet	Frontage Along Twining Road	3,460 feet	Frontage Along Railroad	915 feet	Frontage Along Cove Road	1,400 feet	Along Side of ATV Trail	12,250 feet
R-09	173	2,550 feet	Boundaries North Of Twining Road	855 feet	Edge of Access Road			1,760 feet	Through Forestland	
Total										17,650 feet



This is the westerly boundary of Lot 173

Recreation

At the moment, the property is open to courteous use by the general public, although the landowners hope that permission is sought by recreationists before hunting just so they are aware in case there is work being implemented by loggers or foresters. One hunter's tree stand was found, and it was properly tagged with the owner's name as required by Maine law.

Access Network

Access from public road is excellent. The parcels each have excellent public road frontage, with very good interior roads present. Additional interior roads were found which were installed for past harvest projects; the roads are now overgrown and considered forestland. Improving the old tote roads will be a simple process and should occur when the particular parcel is planned for management. Some gravel, ditching, tree cutting, and culvert replacement may be needed, but the expense to do this will be minimal compared to value of timber which will be removed. Additionally, the expense to do so is typically included in the stumpage rates. A photo of the primary access road leading into the properties is provided below. As shown in this photo, this road and others are gated to prevent illegal use of the property and its gravel pits.



Maine Water Quality BMP's

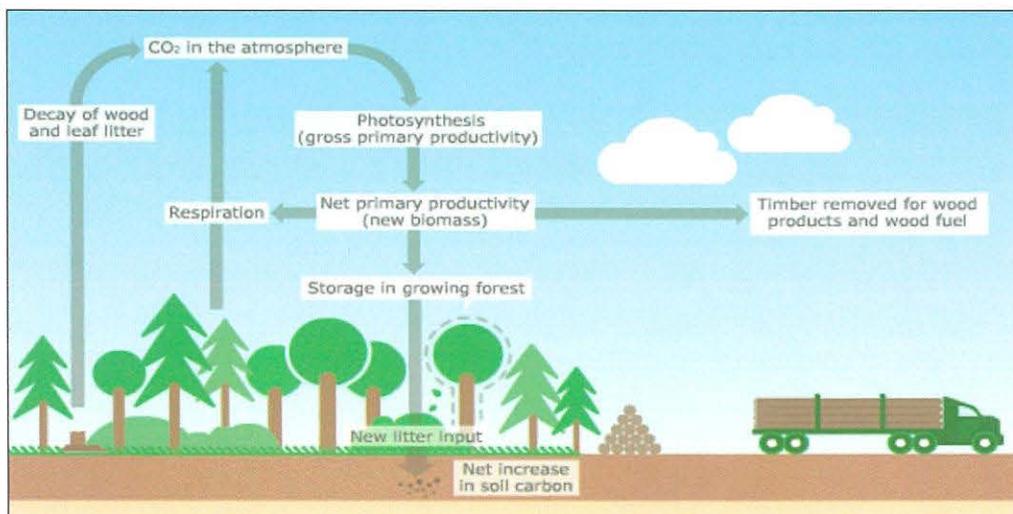
All work on the subject property shall adhere to Maine's Best Management Practices (BMP's) for soil protection and water quality. Working with a licensed forester is advised to assure this is achieved particularly because there are seeps and hydric soils present. The Maine Forest Service provides an excellent manual which provides information and procedures for implementation of best management practices to prevent, minimize, or mitigate soil loss, erosion, and water quality concerns. This manual is made available as an attachment to this plan in electronic format.

Aesthetics

Recommended management activities will sometimes occur within view of public roads. In the process of activity implementation and typically for a time period after it occurs, some amounts of visually unappealing slash (branches, leaves, and tops of trees cut) will be generated. Prior to all activity implementation, all options for mitigation of visual aesthetics concerns shall be addressed. Options may include hauling the slash away, chipping, mulching, or cutting it down to height deemed as acceptable levels.

Forest Carbon and Climate Change

With continuous increase in global population and respective use of fossil fuels and resultant carbon dioxide emissions, it will be important to consider the effect which forest practices on this property will have on climate change. The diagram below provides a good description of the carbon cycle in forests, and the important role which trees play in carbon storage. In summary, the goal of growing and managing trees or stand of trees sustainably as described in the landowner's objective, management will promote significant carbon storage potential of this property.



Forest Fire Protection

Forest fires are relatively rare in Maine in comparison with western States, especially considering the extent of forestland in Maine. However, when it does occur, it can be very devastating. All opportunities shall be utilized to minimize the risk of wildfire on this property; management of a thrifty, vigorous forestland is one way to minimize this risk. Sometimes, dry conditions exist so that even the healthiest forest is susceptible. In the event a forest fire were to occur, it is important to incorporate firefighting & control measures within the property. This includes maintaining both fire breaks and fuel breaks. Fire Breaks, which can also be roads, are exposed strips of mineral soil measuring at least one tree length in width. Good fire breaks are especially oriented in a north-south alignment, with the goal to stop a fire which may be in the process of being spread by westerly prevailing winds common in Maine. Fuel Breaks are strips of land which fuels (dead trees, tree residue, woody trees, etc.) have been removed and primarily herbaceous growth of plants (clover, raspberries, etc.) dominates the site. Width of a good fuel break is twelve feet.

Forest Product Markets

The subject property is very well situated with respect to commodity forest product manufacturing facilities. The SAPPi paper mill in Skowhegan will be the primary market for sale of hardwood pulpwood, and occasionally for spruce/fir pulpwood. Some hardwood may be better utilized as firewood through sale at the roadside. In addition, the firewood market would allow trees to be cut and utilized down to a smaller top, thereby improving utilization and less visually displeasing waste material.

Markets exist for premium hardwood and softwood timber. Most feasible market for spruce and fir sawlogs is at the Pleasant River sawmill in Dover Foxcroft, although smaller, portable homeowner/hobby mills may also be a consideration. Pleasant River will also buy white pine sawlogs, but Robbins Lumber in Searsmont has been found to pay the better prices and have better scale. Hardwood sawlogs may be sold to Kennebec Lumber in the Waterville area. Hardwood veneer buyers will also buy veneer logs directly at the property. Hemlock pulpwood and studwood may be sold in Chester, while hemlock sawlogs may be sold to Parker Lumber in Bradford. Most current stumpage prices accounted for by research implemented by the Maine Forest Service may be found at <http://www.maine.gov/doc/mfs/pubs/pdf/stumpage>. Caution should be used when using these numbers as forest product markets have been quite volatile over the past several years. Consulting with a licensed professional forester is always a good idea.



Management Tools

A variety of timber harvest systems are being used in the Maine woods. Three systems are compared in the following table. Other systems such as horse and tractor logging are sometimes available. A combination of systems is also a possibility in order to properly match the equipment mix to the harvest goals and site conditions. An example of equipment combination is felling with a whole tree harvester and then following with a processor, forwarder or cable skidder. Whole Tree and conventional systems have been used on the property in the past, with fantastic results. I feel the whole tree harvest system will be the best choice for this property moving forward to match best price and best operational quality. The Cut to Length System may also be utilized in some areas.

	Cut To Length System	Whole Tree System	Conventional System
Stumpage Price	Receive 10% less price than Whole Tree System	Best Price	Slightly less than Whole Tree System
Tree Damage	Very Good	Good but need to have a good skidder operator	Average
Production	150 cords/week	400 cords/week	25-50 cords/week
Brush Management	Brush left in Trail System	Brush left in Trails OR skidded to landing and chipped	Brush left at the stump
Landing Size	Small (1/2 acre or less)	Large (2 acres or more)	Small – less than ¼ acre
Product Utilization	Excellent	Good – If Brush is chipped, landowner receives extra bonus at \$5cord	Very Good
Ground Impact	Minimal Since Brush is left in Trails	Average but poor if brush is chipped and cut in the summer	Moderate as long as timing is sufficient



Photo of a cable skidder used in the conventional harvest system

Non-Timber Forest Foods & Products

The forest traverse was performed late during the growing season, so soft fleshy mushrooms and other foods were not readily observed. Chaga mushrooms (*Inonotus obliquus*), known in Siberia as “the mushroom of immortality” were seen growing on yellow birch trees, a species which is well known for its antioxidant properties. Due to the habitat, several other softer flesh mushrooms are likely on the property, including oyster (*Pleurotus ostreatus*), lobster (*Hypomyces lactiflorum*), and chanterelles (*Cantharellus cibarius*).

Brown ash was found growing on the wetter sites. This species is sought after by basket makers as the wood properties are conducive to peeling and bending. Unfortunately the size not quantity of brown ash is not currently suitable for an economic revenue at this time, but it may be a consideration as a species to foster along.

Several other native forest foods were observed and available on the ownership, including, wild apples, hazelnuts and blackberries. However, like the mushrooms and ash, these products were not observed in sufficient quantities to promote their economic importance.



Forest Soils

An official soil report was generated utilizing the web soil survey, an online service made available by the United States Department of Agriculture. The reports provide valuable information regarding soil substance and other variables. Soils are grouped together by the color, texture, structure and other properties present in their layers, or their soil profile. Soils may be grouped into soil series depending mainly on their parent materials and the appearance of their profiles. Difference between the types is soil depth, with some variability in substance. Utmost care should be taken while operating equipment on deep soils to prevent erosion and rutting, especially in the more hydric (poorly drained) soil areas. Many forestry companies in the northeast have recently discovered the value of knowing not only the drainage class of their soils, but since this is a great determinant of the potential rooting depth of trees, and therefore their potential growth rates. If depth to water table is shallow, then trees will lack sufficient oxygen and grow slowly. If a soil is too well-drained, however, trees may suffer from a lack of water. This is why trees growing in moderately drained soils with depth to water table of more than 12 inches generally exhibit superior growth rates. The majority of tree roots occur within the upper 24" of the soil profile. The soil drainage table is provided below and soil type map is provided on the following pages. The soil report is attached to this plan in hard copy and electronic format.

Rutting, and resultant soil loss should be a continual concern while working on this property as soils are deep and fertile. Winter harvesting is recommended in order to utilize frozen ground conditions and to use snow and ice to build bridges over wet areas.

Table—Drainage Class (Property of The City of Bangor in the Town of Winterport, Maine)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BaC	Bangor silt loam, 8 to 15 percent slopes	Well drained	0.8	0.4%
BoB	Boothbay silt loam, 3 to 8 percent slopes	Somewhat poorly drained	6.8	3.8%
BoC	Boothbay silt loam, 8 to 15 percent slopes	Moderately well drained	34.4	19.4%
DxB	Dixmont silt loam, 3 to 8 percent slopes	Somewhat poorly drained	5.3	3.0%
DxC	Dixmont silt loam, 8 to 15 percent slopes	Moderately well drained	7.4	4.2%
MkC	Masardis fine sandy loam, 8 to 15 percent slopes	Somewhat excessively drained	38.7	21.8%
MkE	Masardis fine sandy loam, 15 to 45 percent slopes	Somewhat excessively drained	12.3	7.0%
Pg	Pits, gravel and sand	Excessively drained	10.9	6.2%
RmC	Rock outcrop-Lyman complex, 3 to 15 percent slopes		3.2	1.8%
Sw	Swanville silt loam, 0 to 3 percent slopes	Poorly drained	43.3	24.4%
ThC	Thordike-Winnecook complex, 8 to 15 percent slopes, rocky	Somewhat excessively drained	9.6	5.4%
ThD	Thordike-Winnecook complex, 15 to 35 percent slopes, very rocky	Somewhat excessively drained	1.2	0.7%
TrE	Thordike-Rock outcrop complex, 15 to 45 percent slopes, very stony	Somewhat excessively drained	3.2	1.8%
Totals for Area of Interest			177.2	100.0%

Forest Topography

No other topography constraints were identified, although some steep sites present. The surface is free of boulders, ledge, or other geologic formations. Highest elevation of the property is on the northerly portion of Lot 173, north of Twining Road, approximately 240 feet above sea level. The lowest elevation is along the easterly line of Lot 167 where Cove Brook is in the proximity, an estimated 130 feet above sea level.

Table—Representative Slope (Property of The City of Bangor in the Town of Winterport, Maine)

Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
BaC	Bangor silt loam, 8 to 15 percent slopes	12.0	0.8	0.4%
BoB	Boothbay silt loam, 3 to 8 percent slopes	6.0	6.8	3.8%
BoC	Boothbay silt loam, 8 to 15 percent slopes	12.0	34.4	19.4%
DxB	Dixmont silt loam, 3 to 8 percent slopes	6.0	5.3	3.0%
DxC	Dixmont silt loam, 8 to 15 percent slopes	12.0	7.4	4.2%
MkC	Masardis fine sandy loam, 8 to 15 percent slopes	12.0	38.7	21.8%
MkE	Masardis fine sandy loam, 15 to 45 percent slopes	30.0	12.3	7.0%
Pg	Pits, gravel and sand	2.0	10.9	6.2%
RmC	Rock outcrop-Lyman complex, 3 to 15 percent slopes	9.0	3.2	1.8%
Sw	Swanville silt loam, 0 to 3 percent slopes	2.0	43.3	24.4%
ThC	Thomdike-Winnecook complex, 8 to 15 percent slopes, rocky	10.0	9.6	5.4%
ThD	Thomdike-Winnecook complex, 15 to 35 percent slopes, very rocky	20.0	1.2	0.7%
TRE	Thomdike-Rock outcrop complex, 15 to 45 percent slopes, very stony	30.0	3.2	1.8%
Totals for Area of Interest			177.2	100.0%

BMPs

- 1 Install water bars, skid humps, or other diversions to move water off the trail, preferably before it reaches the filter area.
- 2 Locate waterbars and other diversions frequently enough to prevent water from accumulating, based on Table E. On some sites, choosing appropriate locations for diversions may be more important than their spacing.

Table E
Waterbar Spacing Guidelines

Slope (%)	Spacing (ft)
1-2	250-400
3-5	135-250
6-10	80-135
11-15	60-80
16-20	45-60
21+	<45

This diagram and chart was copied from the Maine BMP manual to provide guidance on water control for skid trails on steep slopes. As long as the ground is snow covered and frozen when harvesting is implemented, these techniques will not be necessary.

Custom Soil Resource Report
Map—Drainage Class (Property of The City of Bangor in the Town of Winterport, Maine)



Forest Health

Poor health was identified with balsam fir and white pine. There will inevitably be a significant health concern with red pine in the coming decade if the planted red pines are left untreated (without thinning).

Balsam Fir

A significant component of the woodlot is comprised of balsam fir (*Abies balsamea*) and is in general poor health. The reason for the poor health is due to a combination of age, insect, and disease factors. As fir ages, particularly more than 35 years on the site quality of this forest, a root disease, *Armillaria spp.* initiates root decay, and then travels into the stem. The stress causes defense mechanisms in the foliage to decline. As foliage defense declines, the tree becomes susceptible to insects, such as the wooly adelgid and spruce budworm. In effect, a rotation age of 30-40 years is recommended for fir.

Invasive Species

Invasive honeysuckle is a significant on this woodlot. Dutch elm disease was also observed but is not a significant problem due to low density of American elm.

Invasive Species Potentially on the Forest in the Future

Invasive insects such as the Hemlock Looper, Emerald Ash Borer, and Hemlock Gypsy Moth are non-native insect species that pose a threat to the property. Each insect has now been documented at some location in New England, and all seem to be spreading.

Vertebrate Pests on the Property

Porcupine damage to sapling and pole stems was noted throughout the property. The rodent species has girdled several pole sized trees, mostly being eastern hemlock. However, control is not warranted since damage is generally insignificant.

Insect & Disease Monitoring

Due to the potential of invasive insect species being transported by tourists to the area, the property should be monitored on a semi-annual basis to assess any potential insect or disease problems.

Forest Growth Analysis

Based on measurement of a random sample of increment borings, as well as observation of terminal leader growth of saplings, it is estimated that the forest has an average growth rate higher than expected for average timberland. This rate, 0.450 cords per acre per year, is being dispersed among all age classes.

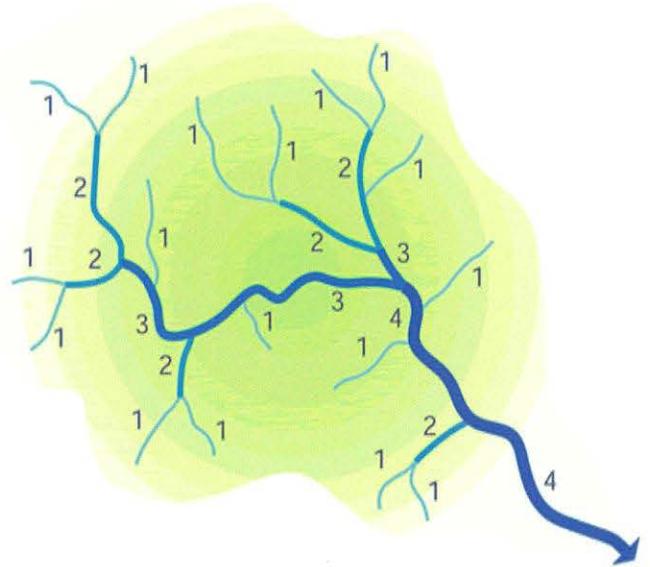
Watershed

Water from the property flows into Cove Brook, and then directly into the Penobscot River just a couple miles to the southeast.

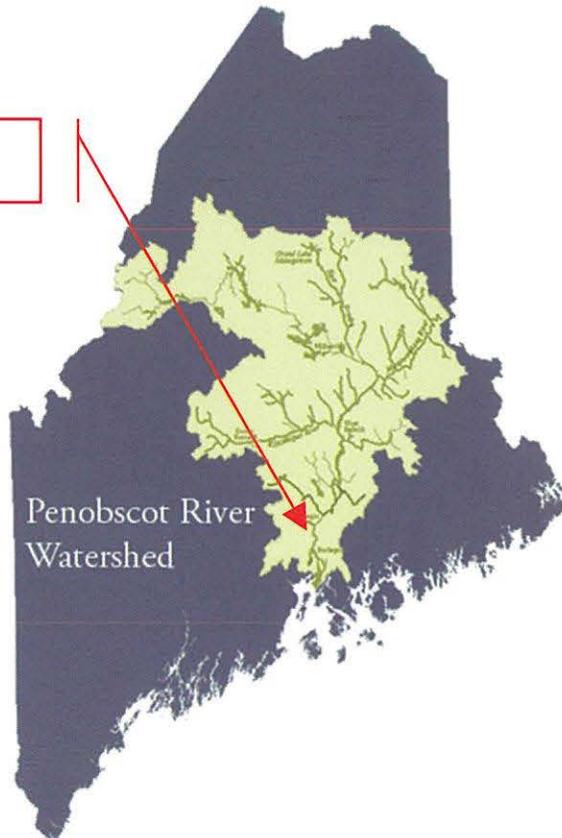
Site specific hydrography of a forest property is important to discuss, as not only are on-site decisions, conditions, and operations governed by water, the effect of management felt further downstream through the watershed. As mentioned earlier, Cove Brook cuts through the southerly portion of the property. According to the diagram at right, this waterway is a second order watershed (shown as #2 on the diagram). In addition, other smaller brooks and seeps were found flowing into Cove Brook from the north and west sides.

Feeder brooks, as well as Cove Brook require 75 foot setbacks.

The smaller seeps were found on all lots which are not mapped should be identified and buffered appropriately during the operational planning and layout prior to timber harvesting.

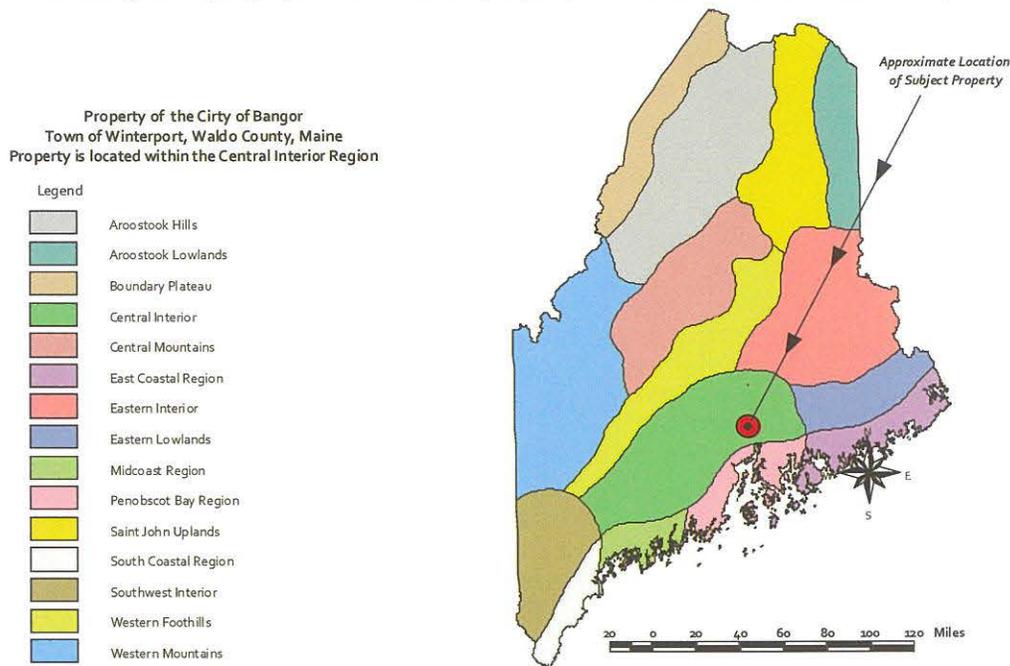


Approximate Property Location



Biophysical Considerations

Understanding the physical condition of forestland is an integral part to sound forest management. One tool in identifying important attributes to be considered while managing a forest is to review characteristics of the biophysical region which the ownership lays. A document titled "The biophysical regions of Maine: Patterns in the Landscape and vegetation". (McMahon, J.S. 1990) provides a resource to do this. A map of the biophysical regions of Maine is provided below with the property plotted according to its geographic location. The property lies within the Central Interior Region.



Central Interior Region

Physiography: The Central Interior Region extends from the foothills of the White Mountains near Buckfield in a northeasterly direction to the Penobscot River near Alton. From here the boundary swings south along the eastern shore of the Penobscot to Graham Lake. The region, which includes the lower drainages of the Kennebec and Penobscot Rivers, is characterized by flat to gently rolling terrain. Elevations average between 200' and 400', with the highest elevations occurring east of the Penobscot River in the Lucerne area. Bedrock geology of the region is complex. Igneous rocks include a large granitic pluton that underlies the Belgrade Lakes and smaller intrusions near Augusta and Athens. Bedrock is primarily composed of alternating bands of metasedimentary and metavolcanic rocks which strike northeast-southwest. Metamorphic grade generally increases from east to west across the region. Small pockets of metamorphosed calcareous rocks occur in the southwest.

Climate: Compared to other inland regions, the climate is moderate. Summers are warm and the frost-free season of 140 to 160 days is comparable to that of the coastal zone. Mean maximum July temperature is 80° F. Winter temperatures are relatively mild with a mean minimum January temperature of 10° F. Average annual precipitation (42") and snowfall (80") are intermediate between coastal and northern regions. The region's inland boundary roughly follows the 22" isopleth for potential evapotranspiration. Water surplus is typically less south of this line. This phenomenon is attributed to high summer temperatures and favorable wind movements, which increase evaporation and therefore the likelihood of summer drought.

Surficial Geology and Soils: Much of the region, particularly the Penobscot Valley, is covered with glaciomarine clays and silts. Extensive coarse-grained ice-contact deposits occur near Madison and Hinckley. Eskers and stream alluvium occur throughout the region, although these are more abundant to the southwest and northeast.

Soils in the region tend to be deep, well to moderately drained, coarse loams. Dixfield and Marlow fine-sandy loams are common on ridge slopes and somewhat poorly drained Colonel soils fill the valleys. Bangor silt loams and Thorndike soils predominate in the eastern portion of the region. In western sections, where glacial outwash is most abundant, Skerry and Becket sandy loams occur.

Vegetation and Flora: The flora of this region reflects its comparatively moderate climate. The region's northern and eastern boundaries occur in the center of the vegetational transition zone described in the Southwest Interior Region. Among forest ecosystems, there is a transition from a northern Appalachian forest of oak, pine, and mixed hardwoods in southern Maine to a spruce-fir-northern hardwood forest in northern and eastern Maine. Floristic changes further define this transition zone. Northern range limits of at least 60 woody and more than 250 herbaceous species are concentrated along the inland boundary of the region.

Rare, Threatened, and Endangered Species

Evidence of State or federal rare, threatened, or endangered species on the woodlot was not observed during the resource inventory. The property was reviewed by the Maine Natural Areas Program. Their review produced linkage of the property to critical habitat for Atlantic salmon and brook trout. Association to sensitive riparian habitats emphasizes the importance of protecting water quality and riparian habitat on the property. The generous complimentary report and map generated as part of this review is provided below and on the following page.

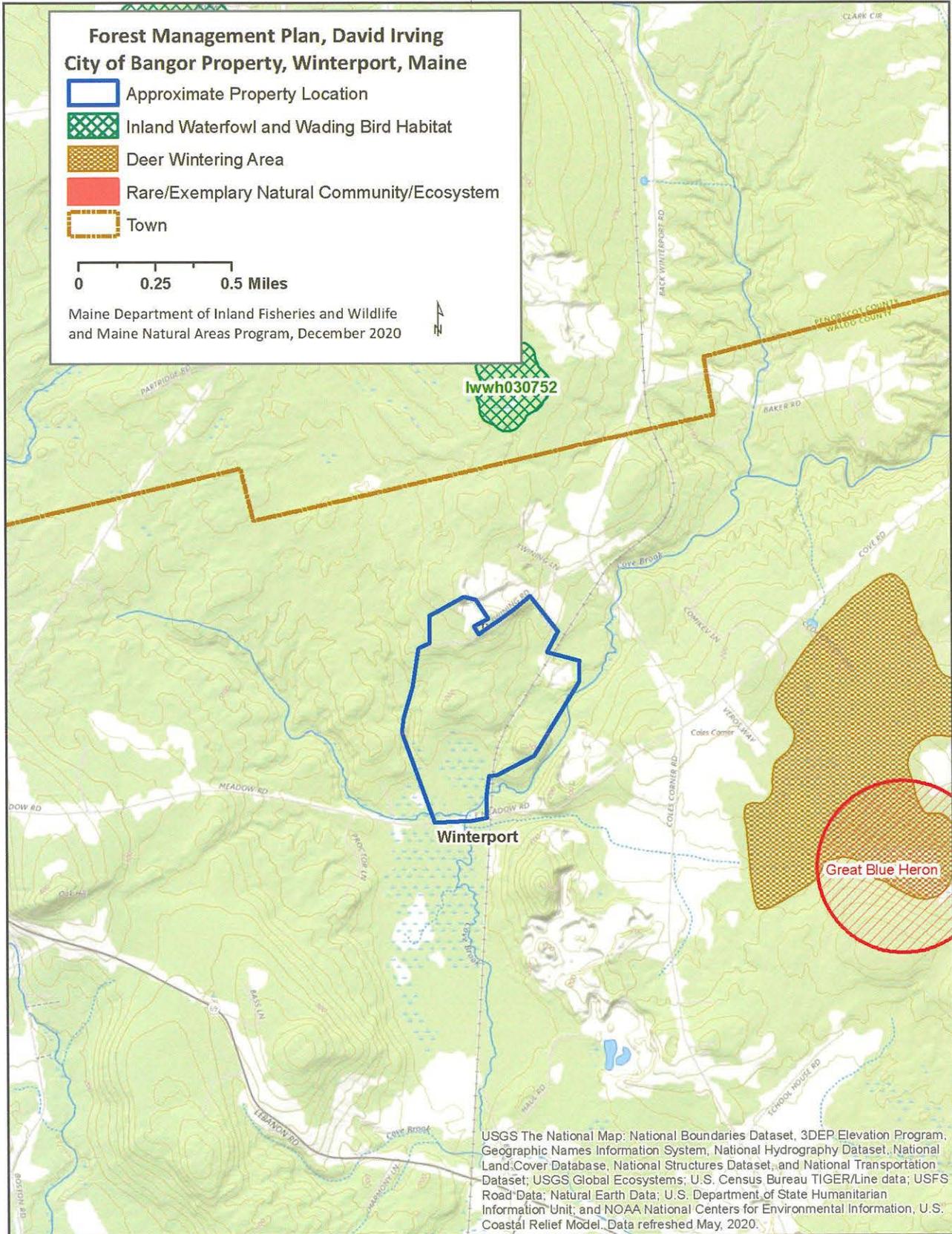
MAINE NATURAL AREAS PROGRAM
(207)287-8044 or maine.nap@maine.gov

Forest Management Plan Review

Forester: *David Irving* Landowner: *City of Bangor* Lot Name: *Map R9 Lots*
Date Received: *12.09.2020* Town: *Winterport* County: *Waldo* MDIFW Region: *B*

PLANT, ANIMAL, AND HABITATS	Documented to occur at the site?		Contact the following biologist to discuss conservation considerations
	YES	NO	
Plants: rare, threatened and/or endangered <i>If yes, see attached summary table.</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Natural Communities: rare and/or exemplary <i>If yes, see attached summary table.</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Animals: rare, threatened, or endangered <i>If yes, see attached summary table.</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Mapped Essential Wildlife Habitats: Roseate tern Piping plover and Least tern	<input type="checkbox"/> <input type="checkbox"/>	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	
Mapped Significant Wildlife Habitats: Deer wintering area Inland waterfowl and wading bird habitat Tidal waterfowl and wading bird habitat Significant vernal pool Shorebird feeding/roosting area	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	
Wild brook trout habitat	Yes <input checked="" type="checkbox"/>	Unknown <input type="checkbox"/>	MDIFW Assistant Regional Fisheries Biologist Wes Ashe, 287-5363
Atlantic Salmon: Salmon critical habitat Salmon stream habitat	Yes <input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/> Unknown <input type="checkbox"/>	USFWS Biologist Wende Mahaney, 902-1569 For more information: www.fws.gov/mainefieldoffice/Atlantic_salmon.html
Canada lynx: The town & parcel may provide habitat for lynx	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
LANDSCAPE CONTEXT	YES	NO	
Does parcel intersect with a Beginning with Habitat Focus Area? Focus Area Name: Additional information on this focus area may be available at www.maine.gov/dacf/mnap/focusarea	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Is the parcel adjacent to or on Conservation Lands? Owner: Ownership type: <input type="checkbox"/> Fee <input type="checkbox"/> Easement Area Name:	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Is the parcel within an area identified by MNAP as a potential inventory site for undocumented rare plants or exemplary natural communities? If so, MNAP will contact the landowner for permission prior to any inventory work.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

Review completed by: RJ
Date: 12/11/2020
MNAP #: 2020_12_11_RJ_06



Biodiversity Considerations

Maintenance and improvement of biodiversity shall be a consideration of management. Biodiversity is defined as the diversity of life in all its forms and at all levels of organization. This means biodiversity includes plants, invertebrates, fungi, bacteria, and of course the vertebrates which get most of the attention. Biodiversity is measured at many scales, and may be quantitative and qualitative. However, simply saying you want to have biodiversity doesn't just make it happen. Instead, you need to manage for it, at the differing scales such as at the individual tree, the forest stand, and at the overall landscape.

Tree Level

Three types of "wildlife" trees were formally assessed; (1) cavity/den (2) dead/down and (3) mast producing trees and shrubs. Overall density of these assessed wildlife trees is generally satisfactory.

- Cavity/den trees are all living, partially living and dead standing trees that may provide nesting, den, or roosting habitat. Species which may utilize cavity trees include red squirrels, barred owls, wood ducks, porcupine, and pine marten. Both quantity (stems/acre) and quality (species and size) are important factors for management.
- Dead/down trees are those dead and lying on the ground that now and in the future will provide ground habitat and food and nutrient sources to wildlife and plant species. There is special importance of downed trees to small mammals during the winter months with heavy snowfall. This combination of 2 or 3 downed trees provides a canopy of shelter from the snow, providing an "insulated" area for species such as the deer mouse and chipmunk. In addition, the areas under downed trees in winter provide valuable foraging and cover habitat for the pine marten. In summer, these cool moist areas under logs provide habitat for amphibian species like the red backed salamander.
- Mast is any nut, seed or fruit produced by woody plants and eaten by wildlife. Mast is nutritious, containing more fat and protein than other plant foods. Seeds such as beechnuts from beech trees, acorns from red oaks, hazelnuts from woody shrubs, and blackberries growing in the open areas are examples of mast on this property.

Stand Level

Vertical and horizontal forest stratification (i.e. structure) on the stand and property scale is another consideration. Horizontal structure is measured by the variety of vegetation types within the stands, and within the property. On the stand scale, due to past land management practices, the property has some degree of horizontal diversity with patches of mature or semi mature trees interspersed with sapling and pole sized stems. These void areas are especially important as they provide small patch habitat to a variety of species. Vertical structure is measured by the amount of layers or groups of different sized trees within a stand. It occurs naturally (or artificially through harvesting), increasing as stands develop (or are harvested); some trees inevitably succumb to environmental stress causing them to fall down (or are cut down), creating a hole in the forest canopy allowing new trees to fill the open growing space. This mixing of old, mature and young, regenerating trees with their differing respective heights and foliage characteristics throughout a stand creates vertical structure. And generally speaking, the amount of vertical structure determines the stands wildlife diversity; as structure increases, diversity increases.

Landscape Level

Although you do not have control over your neighbor's forest practices, you do have the ability to monitor activities on their lands utilizing aerial photography. With it, you can determine how well your management style fits with the overall landscape. The surrounding landscape is a mix of land uses very similar to this property, forestland and wetlands.

Forests of Recognized Importance (FORI):

FORI are globally, regionally and nationally significant large landscape areas of exceptional ecological, social, cultural or biological values. These forests are evaluated at the landscape level, rather than the stand level and are recognized for a combination of unique values, rather than a single attribute. Most FORI in the U.S. that are globally, nationally or regionally significant have already been identified and protected by state or federal government or have been put under a conservation easement by an environmental nonprofit organization. FORI were not identified as part of the MNAP review.

Forest Types

The following pages provide a discussion of the various forest types found on the property and will include management recommendations which may be utilized to achieve the landowner's objective for the next planning period of ten years. As previously discussed, the forest inventory consisted of ocular estimates. Analysis of notes taken from ocular estimates along with aerial photo interpretation yielded the stratification of six forest stand types, gravel pits, a meadow, and wetlands. A summary of the forest stand types, and their respective acreage is provided in the tables below. A Forest Stand Type Map is provided on the following page, with the forest type data summaries on the page thereafter.

<i>Tax Map</i>	<i>Lot Number</i>	<i>Land Use Type</i>	<i>Tree Growth Tax Status</i>	<i>Forest Type Number</i>	<i>Forest Type Code</i>	<i>Acres</i>
R-09	167	Forest	NOT Classified	4	SH3A	12
R-09	167	Forest	NOT Classified	5	M1A	2
R-09	167	Forest	NOT Classified	5	M1A	8
R-09	167	Gravel Pit	NOT Classified			7
R-09	167	Class II Road	NOT Classified			1
					Total	30

<i>Tax Map</i>	<i>Lot Number</i>	<i>Land Use Type</i>	<i>Tree Growth Tax Status</i>	<i>Forest Type Number</i>	<i>Forest Type Code</i>	<i>Acres</i>
R-09	173	Forest	Classified	1	Red Pine 2A	14
R-09	173	Forest	NOT Classified	1	Red Pine 2A	7
R-09	173	Forest	Classified	2	HS3A	3
R-09	173	Forest	NOT Classified	2	HS3A	6
R-09	173	Forest	Classified	3	SH3A	40
R-09	173	Forest	NOT Classified	3	SH3A	10
R-09	173	Forest	Classified	4	WP4D/HS2A	32
R-09	173	Forest	NOT Classified	4	WP4D/HS2A	5
R-09	173	Forest	Classified	6	H2B	11
R-09	173	Gravel Pit	NOT Classified			5
R-09	173	Class II Road	NOT Classified			1
R-09	173	Meadow	NOT Classified			1
R-09	173	Wetland	NOT Classified			5
					Total	140

<i>Forest Type Number</i>	<i>Forest Type Code</i>	<i>Acres</i>
1	Red Pine 2A	21
2	HS3A	9
3	SH3A	62
4	WP4D/HS2A	37
5	M1A	10
6	H2B	11
Total		150

Forest Stand Type Summaries

Stand 01 – Red Pine 2A – 21 acres

Location: This stand is entirely located on Lot 173.

Stand History: This stand was planted in 1995 after the gravel pits were decommissioned and “reclaimed”.

Current Stand Condition: A well-stocked semi-mature monoculture stand which reflects an even-aged structure; there is one age class. There is an estimated 120 square feet of basal area per acre of timber sized trees and fewer than 100 stems per acre in the regenerating class. Red pine is the dominant species in the overstory aspen and red maple dominant in the understory. There is an estimated 20 cords per acre, all of which is designated as pulpwood. Vertical structure of the stand is assessed as low. Cavity/den trees are stocked at low levels. Dead/down trees are poorly stocked. Mast trees are poorly stocked but hazelnuts shrubs are present.

Identified Resources of Concern & Considerations: Monoculture red pines susceptible to fungal agents such as Diplopia Tip Blight and/or Sirococcus Shoot Blight. Honeysuckle was found sporadically. Visual aesthetics near the public roads.

Recommended Management Activities:

I feel the stand should be surgically thinned using a cut to length logging system sometime within the next 2 years. This harvest would be called a commercial thinning. The goal would be to select single trees for removal while promoting health of residual stems. I feel that removing between 25% and 33% of the basal area would be desirable in order to promote regeneration and to meet the owner’s objective. The harvest would be best implemented during the winter, as this timing would minimize site damage. I feel a net stumpage revenue of \$50 per acre is a reasonable expectation due to the low grade pine pulpwood that would be harvested. After this harvest is implemented, a future thinning harvest would occur in 15 years.



A photo of Stand 01 exhibiting the monoculture red pine.

Stand 02 – Hardwood – Softwood 3A (HS3A) – 9 acres

Location: Found at the northerly portion of Lot 173 in a few separate polygons.

Stand History: Most trees are at least 50 years of age. The stand seems to have originated from old fields / pastures.

Current Stand Condition: A well-stocked semi-mature mixedwood stand which reflects an even-aged structure. There is an estimated 120 square feet of basal area per acre. Overstory trees are dominated by a quaking aspen, red maple, white birch, and balsam fir. Estimated standing volume of 20 cords/acre is 75% pulpwood, with the remaining being Sawtimber. Regeneration is stocked with an estimated 300 to 500 stems per acre, dominated by balsam fir, red maple, and aspen. Vertical structure is moderate. Cavity/den trees are moderately stocked. Dead/down trees are poorly stocked. Mast trees are poorly stocked.

Identified Resources of Concern & Considerations: Balsam fir in the overstory and understory. Public road frontage.

Recommended Management Activities:

I feel the stand should be surgically thinned using a cut to length logging system sometime within the next 5 years. This harvest would be called a single tree selection harvest. The goal would be to select single trees for removal while promoting an uneven-aged stand structure. I feel that removing between 33% and 40% of the basal area would be desirable in order to promote regeneration and to meet the owner's objective. Balsam fir and aspen would be the target for removals. The harvest would be best implemented during the winter, as this timing would minimize site damage. Best results would be achieved if a licensed forester marked trees for cutting. I feel a net stumpage revenue of \$200 per acre is a reasonable expectation. After this harvest is implemented, a future selection harvest would occur in 15 years.



A photo of Stand 02.

Stand 03 – Softwood – Hardwood 3A (SH3A) – 62 acres

Location: Found throughout both lots.

Stand History: Dominant trees are at least 80 years of age. The stand seems to have originated from old fields / pastures. Harvest last occurred an estimated 25 years ago.

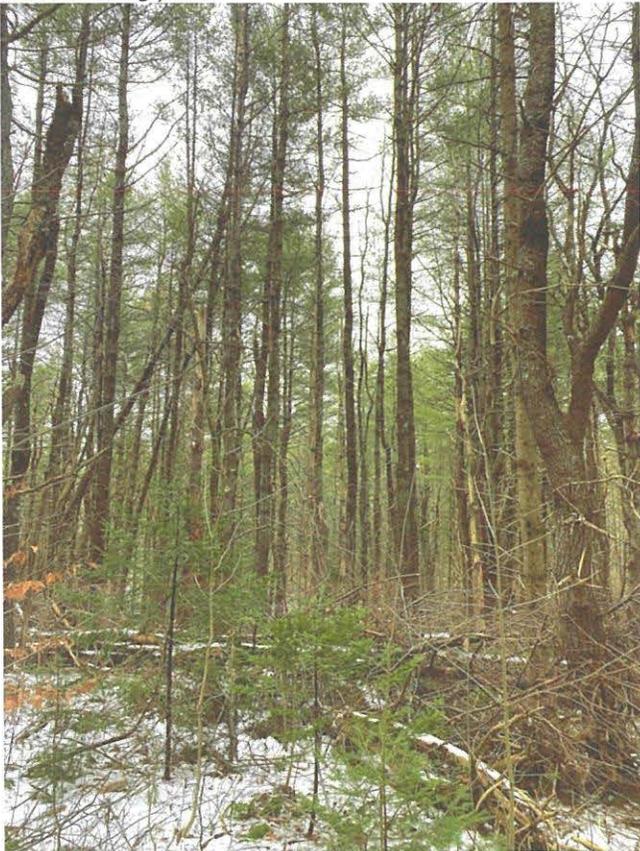
Current Stand Condition: A well-stocked semi-mature mixedwood stand which reflects an uneven-aged structure. There is an estimated 120 square feet of basal area per acre. Overstory trees are dominated by a variety of species such as white spruce, white pine, quaking aspen, red maple, white birch, and balsam fir. Estimated standing volume of 25 cords/acre is 80% pulpwood, with the remaining being studwood and sawtimber. Regeneration is stocked with an estimated 1000 to 2000 stems per acre, dominated by balsam fir, red maple, and aspen. Vertical structure is high. Cavity/den trees are well stocked. Dead/down trees are poorly stocked. Mast trees are poorly stocked.

Identified Resources of Concern & Considerations: Balsam fir in the overstory and understory. Public road frontage.

Recommended Management Activities:

I feel this stand should be managed to provide habitat for American woodcock and ruffed grouse. My rationale for the patch cut habitat strategy is due to the significant component of quaking aspen, in addition to the soils of the stand. It lends itself very well to a woodcock habitat project. I have provided an American woodcock habitat management guide attached to the Plan for reference. I feel that 33% of this stand should be patch cut within the next 5 years (20 acres total, between 8 and 10 patches).

Patch clearcuts of 2 to 3 acres in size should be flagged by a forester, and cleared by a logger with whole tree harvest and chipping capabilities. All stems taller than 4 feet in height should be cut. I feel a net stumpage revenue of \$600 per acre is a reasonable expectation. After this harvest is implemented, a future patch cut harvest of 33% of the stand area would occur in 10-15 years.



A photo of Stand 03

Stand 04 – White Pine 4D / Hardwood-Softwood 2A (WP4D/HS2A) – 37 acres

Location: Found on the central and southerly portions of lot 173.

Stand History: Dominant trees are at least 80 years of age. The stand seems to have originated from old fields / pastures. Harvest last occurred an estimated 25 years ago.

Current Stand Condition: A well-stocked mature conifer dominated stand which reflects an uneven-aged structure. There is an estimated 120 square feet of basal area per acre. Overstory trees are dominated by a superstory of white pine and a second story of red maple, red oak, aspen, paper birch, and balsam fir. Estimated standing volume of 25 cords/acre is 85% pulpwood, with the remaining being high quality white pine sawtimber. Regeneration is stocked with more than 5,000 stems per acre, dominated by balsam fir, red maple, and aspen. Vertical structure is high. Cavity/den trees are well stocked. Dead/down trees are well stocked. Mast trees are well stocked with red oak.

Identified Resources of Concern & Considerations: Balsam fir in the overstory and understory. Stand lies adjacent to wetlands and with seeps within.

Recommended Management Activities:

Similar to Stand 03, I feel this stand should be managed to provide habitat for American woodcock and ruffed grouse. My rationale for the patch cut habitat strategy is due to the significant component of quaking aspen, in addition to the soils of the stand. It lends itself very well to a woodcock habitat project. I have provided an American woodcock habitat management guide attached to the Plan for reference. I feel that 33% of this stand should be patch cut within the next 5 years (12 acres total, between 4 and 6 patches).

Patch clearcuts of 2 to 3 acres in size should be flagged by a forester, and cleared by a logger with whole tree harvest and chipping capabilities. All stems taller than 4 feet in height should be cut. I feel a net stumpage revenue of \$700 per acre is a reasonable expectation. After this harvest is implemented, a future patch cut harvest of 33% of stand area would occur in 10-15 years.



A photo of Stand 04.

Stand 05 – Mixedwood 1A (M1A) – 10 acres

Location: Found in two polygons on Lot 167.

Stand History: The site was clearcut in anticipation of using the land as gravel pits and estimated 20 years ago.

Current Stand Condition: A well-stocked mixedwood stand which reflects an even-aged structure. There is an estimated 0 square feet of basal area per acre; the stand is in a regenerating condition with no standing volume, aside from biomass. Regeneration is stocked with more than 4,000 stems per acre with a true mix of species such as aspen, red maple, balsam fir, and paper birch. Vertical structure is low. Cavity/den trees are poorly stocked. Dead/down trees are poorly stocked. Mast trees are poorly stocked but some red oak saplings were observed.

Identified Resources of Concern & Considerations: None.

Recommended Management Activities:

The stand should be left to grow. It is likely a commercial thinning will be available in 15 to 20 years.

Stand 06 – Hardwood 2B (H2B) – 11 acres

Location: The southerly portion of Lot 173.

Stand History: The site has been forested for at least 4 decades. Mature trees are approximately 40 years. The stand originated from old field abandonment. It has not been thinned since reverting to forest.

Current Stand Condition: A well-stocked hardwood stand which reflects an even-aged structure. There is an estimated 100 square feet of basal area per acre. Overstory trees are dominated by black cherry, red maple, and white ash. Red oak was observed but not significant. Estimated standing volume of 15 cords/acre is 90% pulpwood, and 10% sawlogs, a very nice balance of products for an unmanaged stand. Regeneration is stocked with more than 1,000 stems per acre with a true mix of species. Vertical structure is moderate. Cavity/den trees are poorly stocked. Dead/down trees are poorly stocked. Mast trees are poorly stocked.

Identified Resources of Concern & Considerations: Frontage along wetland associated with Cove Brook.

Recommended Management Activities:

The stand should be left to grow. It is likely a commercial thinning will be available in 15 to 20 years.

Gravel Pits– 12 acres

There are 12 acres of open gravel pits. Most of the area designated as gravel pits is actively being mined by the City of Bangor. A small area of land designated as pit along the easterly portion of Lot 173 may be considered to be transferred to forestland acreage at some point, as it is grown over almost entirely with forest vegetation. Additionally, as pits are discontinued and closed out, this land too may be considered to be converted to forestland, much like the former pits were planted to red pines 25 years ago. The photo below is of the pit located north of Twining Road on Lot 173.



Meadow Area – 1 acres

Located along the easterly portion of Lot 173, this is a site which had been planted to red pines in 1995, but being poorly drained, the pines did not grow. Instead it is a small grassy meadow sitting amongst the planted red pines (Stand 01). Installation of two nesting boxes for eastern bluebirds is recommended. I have attached literature regarding construction and installation specifications for the bluebird boxes. No other treatment is recommended.

Wetland Area – 5 acres

Located along the southerly portion of Lot 173 along Cove Road, and associated with Cove Brook, the wetland area is dominated by alders, dwarfed spruce and birches, and a variety of herbaceous and woody wetland shrubs as shown in the photo below. Installation of two nesting boxes for wood ducks is recommended. I have attached literature regarding construction and installation specifications for the duck boxes. No other treatment is recommended.



Recommended Management Summary

The table below provides a summary of the recommended management activities made throughout this plan.

<i>Summary of Recommended Activities for the Property of the City of Bangor in Winterport, Maine</i>						
<i>Location</i>	<i>Time Period</i>	<i>Units</i>	<i>Activity Description</i>	<i>Expense</i>	<i>Income</i>	<i>Priority Level</i>
Boundaries which bisect forestland	2021-2025	4,850 feet	Clear and Mark Boundary Lines	x		1
Stand 01	Winter 2022-2024	21 acres	Commercial Thinning		x	1
Stand 02	Winter 2021	9 acres	Single Tree Selection Harvest		x	2
Stand 03	Winter 2022	20 acres	Patch Cut Harvest to Promote Woodcock Habitat		x	2
Stand 04	Winter 2022	12 acres	Patch Cut Harvest to Promote Woodcock Habitat		x	2
Entire Property	2019-2029	1x/2years	Semi-annual monitoring of property lines and insect/disease concerns	-	-	2
Entire Property	February 16, 2031	170 acres	Update Forest Management Plan Contact Licensed Forester in July of 2030	x	-	1

Stumpage Value Discussion

Stumpage is defined as the price which is paid to the owner of the land for the right to harvest timber from that land. It can be a lump sum price or unit price broken down by species and products. The stumpage price includes considerations such as access, operability, harvest level, market conditions, regulations, and location. Stumpage values may be adversely impacted by the following considerations:

1. The landowner's objective for the property; the harvest would need to be conducted in the best manner possible in order to maintain and/or improve visual aesthetics. Quality comes with a price.

For the purpose of this report, approximate potential stumpage prices were drawn from current working knowledge of the business. Stumpage price data may also be found with the Maine Forest Service at <http://www.maine.gov/doc/mfs/pubs/pdf/stumpage>.

It shall be noted the market condition has been volatile during recent years, and that potential stumpage prices used in this analysis are a snapshot of a brief time during this period. Prior to harvesting and selling timber from this property, it is advised that a current market analysis should be performed to identify any abrupt changes which may adversely impact the stumpage value.

Operational Planning Checklist

Prior to negotiating with service providers for work to be implemented on the property, it is recommended that an operational plan is completed.

- This includes drafting short, concise prescriptions for treatments discussed in this Plan, in addition to a limited but complete discussion of all other site specific protection or management considerations located on the property.
- Operations are also expected to conform to all current forest regulations and all other site-specific conditions set forth in this management plan and future operational plans and contracts between the landowner and contractors.
- All timber harvest operations must comply with guidelines set by Maine's Best Management Practices. (BMP's). To minimize impact of harvest to soils, all operations with heavy equipment should occur during winter months.
- Placement of wood processing and staging sites should be completed in coordination between all parties.
- The contractor selected to perform the service should ensure compliance with the operations plan, forest regulations, and all conditions formally implied by the landowner.
- The operational plan and conditions for harvesting should be in a contract.
- The logger must be insured and licensed to operate the equipment to harvest, process, and transport wood.

To ensure compliance with regulations and all contract conditions, it is suggested that operations are supervised and monitored by a licensed forester. The forester should inspect the operation weekly and prepare audit reports.

Certification Systems

The specifications which this plan is drafted meet and exceed those required of a plan for eligibility in the American Tree Farm System.

Benefits of enrollment in the Tree Farm System include certification of wood sold from the property, access to better markets, and local recognition. More information may be found at: <http://www.treefarmssystem.org>.

All of the work as discussed is substantially dependent on the ability to make it happen in a manner which is financially acceptable to the landowner. Thorough analysis shall be made in the future in partnership with a forester and service providers (loggers) to determine if the landowner deems the investments worthwhile.

Conclusion

The preceding 39 pages have provided a detailed report of the current condition of the subject property, including general background information of the ownership, ecological and timber management analysis. This analysis was utilized to then prepare recommended management activities to attain the forest management goals for the next ten years. In conclusion, this plan is presented to the owner as a working document, one which may be administered immediately, but also one which most likely will be modified periodically in order to reflect the ever-changing variables that encompass forestland ownership. It is inevitable that timber markets will shift, new literature will arise, and forest conditions will evolve not exactly as planned. Forest management and ownership goals may even be altered over time, and this is perfectly acceptable and even expected. If or when these goals or other variables change, it will be important to update this plan accordingly.



MAINE REVENUE SERVICES PROPERTY TAX DIVISION PROPERTY TAX BULLETIN NO. 19

MAINE TREE GROWTH TAX LAW

REFERENCE: 36 M.R.S.A. §§571 - 584-A.
Issued May 19 2016; Replaces May, 2013 revision

1. General Information

The Maine Tree Growth Tax Law provides for the valuation of land that has been classified as forest land on the basis of productivity value, rather than on just value. The law is based on Article IX, Section 8 of the Maine Constitution that permits such valuation of forest land for property tax purposes. The purpose of this bulletin is to explain the more important features of the law.

2. Definitions

- A. Commercial Harvesting or Harvesting for Commercial Use. “Commercial harvesting” or “harvesting for commercial use” means the harvesting of forest products that have commercial value.
- B. Forest Land. “Forest land” means land used primarily for growth of trees to be harvested for commercial use; may be either seedling, pole timber, or saw log stands. Forest land does not include ledge, marsh, open swamp, bog, water and similar areas that are unsuitable for growing a forest product or for harvesting for commercial use even though these areas may exist within forest land.

Land, which would otherwise be included in this definition, shall not be excluded because of:

- (1) Multiple uses for public recreation;
- (2) Statutory or governmental restrictions which prevent commercial harvesting of trees or require a primary use of the land other than commercial harvesting;
- (3) Deed restrictions, restrictive covenants, or organizational charters that prevent commercial harvesting of trees or require a primary use of land other than commercial harvesting and that were effective prior to January 1, 1982; or

(4) Past or present multiple use for mineral exploration.

- C. Forest Management and Harvest Plan. “Forest management and harvest plan” means a written document that outlines activities to regenerate, improve and harvest a standing crop of timber. The plan must include the location of water bodies and wildlife habitat identified by the Department of Inland Fisheries and Wildlife. A plan may include, but is not limited to, schedules and recommendations for timber stand improvement, harvesting plans and recommendations for regeneration activities. The plan must be prepared by a licensed professional forester or a landowner and be reviewed and certified by a licensed professional forester as consistent with this subsection and with sound silvicultural practices.
- D. Forest Products that Have Commercial Value. “Forest products that have commercial value” means logs, pulpwood, veneer, bolt wood, wood chips, stud wood, poles, pilings, biomass, fuel wood, Christmas trees, maple syrup, nursery products used for ornamental purposes, wreaths, bough material or cones, or other seed products.
- E. Parcel. “Parcel” means a unit of real estate, even if it is divided by a road, way, railroad or pipeline, or by a municipal or county line.
- F. Forest Type. “Forest Type” means the general classification of forest land as softwood, hardwood or mixed wood.
- G. Residential Structure. “Residential structure” means a building used for human habitation as a seasonal or year-round residence. It does not include structures that are ancillary to the residential structure, such as a garage or storage shed.
- H. Shoreland Area. “Shoreland area” means land within 250 feet of the normal high-water line of any great pond, river or saltwater body, within 250 feet of the upland edge of a coastal wetland, within 250 feet of the upland edge of a freshwater wetland except as otherwise provided in 38 M.R.S. § 438-A(2) or within 75 feet of the high-water line of a stream. (38 M.R.S. § 435).

3. Determination of Valuation

The State Tax Assessor determines the 100% valuation per acre for each forest type by region each year. These valuations are adopted through rulemaking and are made public by April 1.

Municipal assessors are required to adjust the State Tax Assessor's 100% valuation for each forest type of their county by the municipality's certified ratio.

4. Requirements for Classification

- A. Minimum Size. Parcels must contain at least ten acres of forest land. Parcels of less than ten

forested acres resulting from a conveyance of classified land must be withdrawn from classification (See section 10). The size of the exclusion from classification under this subchapter for each structure located on the parcel and for each residential structure located on the parcel in shoreland areas is determined pursuant to 36 M.R.S. § 574-C.

- B. Use. The land must be used primarily for the growth of trees to be harvested for commercial use. Owners must manage tree growth classified parcels according to accepted forestry practices designed to produce trees having commercial value. In considering this option owners may be guided by – but are not limited to – the following accepted forestry practices: timber harvesting, tree planting, direct seeding, site preparation, thinning, cleaning, weeding, pruning, inventory of standing timber, forest protection measures (insect, fire, wind, etc.), and boundary line work.
- C. Forest Management and Harvest Plan. A forest management and harvest plan must be prepared for the parcel and updated every ten years. On the initial application and every ten years thereafter, the landowner must file a sworn statement with the municipality where the parcel is located (or the state, if located in the unorganized territory) stating that a forest management and harvest plan has been prepared for the parcel. The landowner must comply with the plan and every ten years submit a sworn statement from a licensed professional forester stating that the landowner is complying with the plan.
- D. Attestation. A landowner must provide an attestation that the landowner's primary use for the classified forest land is to grow trees to be harvested for commercial use or that the classified forest land is land described in 36 M.R.S. § 573(3). The attestation must be provided when one of two situations applies: 1) When a landowner is required to provide to the assessor evidence that a forest management and harvest plan has been prepared or updated; or 2) When a landowner is required to provide evidence of compliance.

The existence of multiple uses on forest land does not render it inapplicable for tax treatment under the Tree growth Tax Law, as long as the parcel remains primarily used for the growth of trees to be harvested for commercial use.

- E. Unanimous consent. Unanimous written consent of all owners of a parcel is required to apply for classification in the Tree Growth Tax Law program.

5. General Provisions

- A. Filing. Owners must file an application with the assessor of the jurisdiction where the parcel is located by April 1 of the year in which classification is first requested. Assessors may request the filing of a new application at any time by giving the land owner 120 days written notice of the request.

(1) Separate applications must be filed for: 1) Each non-contiguous parcel; and 2) Each part

of a parcel, if that parcel is located in more than one municipality or county. If filing an application for classification of less than ten forested acres in a municipality with the remaining forest land in the parcel located in an adjacent municipality, the owner of the parcel must provide copies of both applications to each town.

(2) The application must be accompanied by a map showing the location of the different forest types for land being classified (softwood, hardwood, mixed wood) as well as a description and location of land not classified in the parcel.

B. Review. Proof may be required by the assessor to confirm the landowner's sworn statement. However, certain proprietary detail that is included in a particular plan must be held as confidential. After reviewing a plan, the assessor must return it to the owner or the owner's agent.

Information for evaluating the suitability of a plan, harvest, or other activity conducted on classified forest land and other general information regarding forest management and harvest plans and licensed foresters may be obtained by contacting the Maine Forest Service at 1-800-367-0223, <http://www.maine.gov/dacf/mfs/index.shtml>, or forestinfo@maine.gov.

C. Reclassification. An owner of classified forest land is responsible for reporting changes in forest type or use of classified land. If an owner fails to give notice of a change, the assessor must reclassify the parcel where the facts justify a change in classification or use. If a change results in the land no longer qualifying for the Tree Growth Tax Law program, the reclassification will result in a withdrawal penalty and an additional 25% penalty. The additional penalty may be waived for cause.

D. Tax Rate. Classified forest land is assessed at the same property tax rate applicable to other property in the municipality.

E. Valuation of Land Other than Forest Land. Areas other than classified forest land within a parcel must be valued on the basis of just value.

F. Reduced Valuation. Upon written request a landowner may seek a reduced valuation if fire, disease, or other natural disaster reduces stocking to less than three cords per acre of merchantable wood on classified forest land. The reduced valuation is equal to 25% of the otherwise applicable value for the first ten years following the loss.

G. Recreational Lease. When the consideration received for a recreational use lease of forest land exceeds the established forest land value for a parcel of 100 acres or more, the land is no longer primarily used for the continuous growth of forest products. When an assessor determines the recreational lease value exceeds the forest land value, the landowner must terminate the lease, adjust the lease terms to reduce the value to an acceptable level or withdraw the forest land from the Tree Growth Tax Law program.

H. Exclusion of Structures and Shoreland Areas. In addition to other exclusions from classified forest land, if a parcel of forest land for which an owner seeks classification under this subchapter, on or after August 1, 2012, contains a structure for which a minimum lot size is required under state law or municipal ordinance, the following exclusions apply:

- (1) Structures. The owner of classified forest land must exclude the land on which a structure is located. The excluded land must not be less than 0.5 acres.
- (2) Shoreland areas. For each residential structure located within a shoreland area, the landowner must exclude the area of land in the parcel containing the structure or structures, which may not be less than 0.5 acres, and the excluded parcel must include 100 feet of shoreland frontage or the minimum shoreland frontage required by the applicable minimum requirements of the zoning ordinance for the area in which the land is located, whichever is larger. If the parcel has less than 100 feet of shoreland frontage, the entire shoreland frontage must be excluded. This subsection does not apply to a structure that is used principally for commercial activities related to forest products that have commercial value as long as any residential use of the structure is nonrecreational, temporary in duration and purely incidental to the commercial use.

6. Transfer of Classified Forest Land

When an owner sells or transfers classified forest land to another person, the new owner must, within one year of the date of transfer, file with the municipal assessor one of the following:

- A. A sworn statement that a new forest management and harvest plan has been prepared; or
- B. A statement from a licensed professional forester that the land is being managed in accordance with the plan prepared for the previous landowner. This option requires that the new owner complete the required ten-year compliance inspection and recertification within ten years from the date that previous owner's plan was certified or revised, rather than ten years from the date of transfer.

Failure to timely file one of the above statements may result in a notification for non-compliance from the assessor and the assessment of penalties (See section 9).

A new owner of classified forest land may not harvest or authorize the harvest of forest products for commercial use until a statement under A or B is filed with the assessor.

7. Appeal from Determination of Valuations

Any person aggrieved by the 100% valuation per acre determined by the State Tax Assessor, may petition the State Tax Assessor for reconsideration within 60 days of the adoption of the valuation.

If a reconsideration request is denied, appeal may be made to the Maine Board of Tax Appeals or to the Superior Court pursuant to 36 M.R.S. § 151.

8. Appeal from the Assessor

Assessments on classified forest land are subject to the abatement procedures provided by § 841. The assessor, on written application filed within 185 days from date of commitment, or on his or her own initiative, within one year from date of commitment, may make an appropriate abatement r, provided the taxpayer has complied with § 706. § 706 requires that taxpayers submit a list of property owned on April 1 if the assessor requested a list in writing. If a taxpayer fails to file a list when properly requested, he or she may be barred of the right to apply for an abatement of taxes for that tax year.

- A. Notice of Decision. If an assessor fails to give written notice of his or her decision on an application for abatement within 60 days from the date the application is filed, the application is deemed to have been denied and the taxpayer may appeal to the State Board of Property Tax Review, 49 State House Station, Augusta, Maine 04333, Telephone: 207-624-7410, email: Prop.Tax@maine.gov.
- B. State Board of Property Tax Review. An appeal must be filed within 60 days from receipt of the assessor's decision or within 60 days from the date the application for abatement was deemed to have been denied.
- C. Superior Court. Any party dissatisfied with the decision of the State Board of Property Tax Review may further appeal, within 30 days of that decision, to Superior Court in the county where the property is located.

Bulletin No. 10 provides a more thorough explanation of the abatement and appeals process.

9. Notice of Noncompliance.

- A. Notice. No earlier than 185 days prior to the ten-year filing deadline for an updated Tree Growth Application Schedule and accompanying map, established by § 574-B, if the landowner has not yet complied with the requirements of that section, the assessor must provide the landowner with written notice by certified mail informing the landowner of the following:
 - (1) The statutory requirements that need to be met to comply with the filing of an updated Tree Growth Application Schedule and accompanying map and the date of the deadline for compliance, or the deadline by which the parcel may be transferred to open space classification;
 - (2) Failure to meet the deadline for filing an updated Tree Growth Application Schedule and

accompanying map or transferring the parcel to open space classification, results in a supplemental assessment of \$500; and

(3) Continued noncompliance will lead to a subsequent supplemental assessment of \$500.

If the assessor issues the notice of compliance less than 120 days before the compliance deadline, the owner has 120 days from the date of the notice to provide the assessor with the documentation to achieve compliance with § 574-B. The notice must specify the date by which the owner must comply.

- B. Administrative Penalty. If the landowner fails to provide the assessor with the documentation to achieve compliance with § 574-B or transfer the parcel to open space classification by the deadline specified in the notice, the assessor shall impose a \$500 penalty to be assessed and collected as a supplemental assessment in accordance with § 713-B.
- C. Second Administrative Penalty. At the expiration of six months, if the landowner has not complied with § 574-B or transferred the parcel to open space classification, the assessor shall impose an additional \$500 supplemental assessment in accordance with § 713-B.

The assessor shall send notification of the second supplemental assessment by certified mail and notify the landowner that, no later than six months from the date of the notice, the landowner must comply with the requirements of § 574-B or transfer the parcel to open space classification or the land will be withdrawn from the Tree Growth Tax Law program.

- D. Withdrawal. If the landowner has not complied within six months from the date of the second supplemental assessment, the assessor must remove the parcel from the Tree Growth Tax Law program and assess a penalty for the parcel's withdrawal.
- E. Other Notices. The assessor is not limited from issuing other notices or compliance reminders to property owners at any time in addition to the notices described in this section.

10. Withdrawal of Classification; Penalty

A. Forest land may be withdrawn from Tree Growth Taxation in one of two ways.

- (1) Withdrawal by Landowner. Classified forest land that is no longer used primarily for the growth of trees to be harvested for commercial use must be reported by the landowner to the assessor and must be removed from tree growth classification. (36 M.R.S. § 581(1)).

The landowner may, at any time, request in writing withdrawal of any parcel or portion of a. In the case of a portion of a parcel, a plan showing the area withdrawn must be filed. The resulting portions must thereafter be treated as separate parcels.

(2) Withdrawal by Assessor. If, after all applicable notification, the assessor determines that classified forest land no longer qualifies as forest land, the assessor must withdraw the parcel from tree growth classification. (36 M.R.S. § 581(1)).

B. Penalty. A penalty is imposed when forest land is withdrawn from classification under the Tree Growth Tax Law, except where the forest land is withdrawn by the exercise or threatened exercise of eminent domain. The penalty applies to the real estate that is withdrawn. Penalties must be assessed and collected as supplemental assessments in accordance with 36 M.R.S. § 713-B.

C. Farm and Open Space Tax Law. No penalty shall be assessed upon the withdrawal of forest land from the Tree Growth Tax Law if the same forest land is accepted for classification as Farm Land or Open Space Land under 36 M.R.S. § 1109.

D. Calculation of Penalty. The penalty will be an amount equal to 30% of the difference between the 100% valuation (of the classified forest land on the assessment date immediately preceding withdrawal) and the just value of the property on the date of withdrawal. If the land has been classified for more than 10 years, the following percentages shall apply:

11 years	29%
12 years	28%
13 years	27%
14 years	26%
15 years	25%
16 years	24%
17 years	23%
18 years	22%
19 years	21%
20 years or more	20%

E. IMPORTANT. Pursuant to the Constitution of Maine, Article IX, section 8, the withdrawal penalty imposed may not be less than “the tax which would have been imposed over the 5 years preceding that change of use had that real estate been assessed at its highest and best use, less all taxes paid on that real estate over the preceding 5 years, and interest.”

11. Financial Assistance.

Financial assistance for preparation of forest management and harvest plans may be available from federal and state sources. Ask your forester about cost-share programs, contact a Natural Resources Conservation Service Center or call Maine Forest Service at 207-287-2791.

NOTE: This bulletin is intended solely as advice to assist persons in determining, exercising or complying with their legal rights, duties or privileges. If further information is needed, contact the Property Tax Division of Maine Revenue Services.

MAINE REVENUE SERVICES
PROPERTY TAX DIVISION
PO BOX 9106
AUGUSTA, MAINE 04332-9106
TEL: (207) 624-5600

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(Published under Appropriation No. 1037.1)



Boundary Line Information

Maine Forest Service, DEPARTMENT OF CONSERVATION, 22 State House Station, Augusta, ME 04333

Robert Frost's observation "**good fences make good neighbors**" is as true today as when he wrote it. With more expensive land and higher timber values, good boundaries are even more important today than they were in the past. The following information will help landowners avoid boundary problems:

Establishing boundaries:

1. An **"established property line"** means a line demarcated by monuments, signs, markings, pins, reference points or other markers that denotes a change in ownership between abutting properties. **These established property line markers must have been placed upon mutual agreement of the abutting landowners**, based on historical physical evidence of a preexisting boundary line or by a licensed professional surveyor.

Only a licensed surveyor can establish a property line if there are no existing blazes or monuments. Surveyors are licensed in the State of Maine under 32 MRSA § 13901 et. Seq. Copies of the law and a roster of land surveyors licensed to practice in Maine are available from the:

State Board of Licensure for
Professional Land Surveyors
35 State House Station
Augusta, ME 04333
(207) 624-8603.

2. The landowner or a licensed forester may maintain a line or reestablish one where some monuments or blazes still exist. If you cannot sight from one blaze to another, you should probably get the line surveyed by a licensed surveyor. Previously marked lines may be incorrect and will be relocated after an accurate survey.

3. Monuments are relatively permanent features like stone posts, iron bars, etc., that are established by the surveyor. Tree blazes are not monuments, they are only an approximate location of where the line

lies. A cap listing the surveyor's license number must be placed on the lots corner posts.

4. Line trees are those trees where the actual boundary intersects any part of the tree, such that part of the tree is on either side of the boundary (17 MRSA § 2511.1.D. See Tree A on the back of this sheet). Because they may be evidence of a line, blazed trees on a property line serve as witness trees and should not be cut. They generally have little value for timber since the blaze provides an avenue for bacteria and fungi to invade the tree and cause rot. These trees may also have fencing tacked to them, this will cause them to be rejected at the sawmill. **Line trees may only be cut with the permission of the abutting landowner** (17 MRSA §2511.2.B).

5. Before permanently marking the boundary by either blazing or painting, the line should be walked with the adjoining landowner to ensure its location is mutually agreeable. When there is a disagreement about a line, it should be surveyed. The landowners may agree to share the costs; however this should be agreed to or otherwise determined before proceeding with the survey.

Maintaining boundaries:

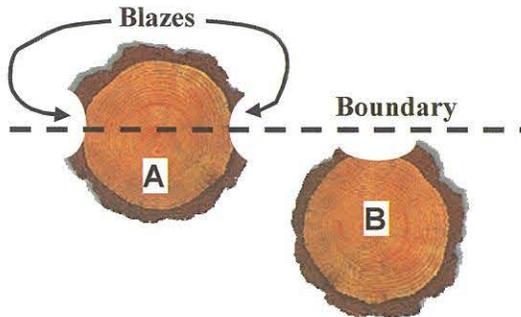
1. Boundaries should be painted with high grade, durable paint. Use a color such as red, yellow, orange or blue, these colors are easily seen and visible for long distances. Paints specifically formulated for marking boundaries are available from forestry supply companies. Paint trees only when the bark is warm and dry. Paint witness trees at the point where the boundary line intersects the tree.

2. In blazing and painting trees along the boundary line, the following rule is used:

A. If the boundary line passes through the middle of a tree, blaze and paint on both sides of that tree where the line passes through it (Tree A).

B. Where the line passes adjacent to the tree, blaze and paint one point only, immediately adjacent to the line (Tree B).

C. Be sure to blaze and paint both sides of the line so that it can be seen from either side. This will help prevent accidental trespass.



3. Avoid blazing well-formed, large or valuable trees as blazing the tree may allow the entrance of bacteria and fungi causing decay. Blazes should be about 4 to 5 inches in diameter and located about five feet above the ground. Blaze often enough so that it is possible to see the next blaze easily.

4. Boundary lines should be cleaned/brushed out for easy traveling and locating. Pruning limbs to head height and cutting small trees along the line will help. Cutting any vegetation on another's property requires permission. Check with the adjoining landowner before proceeding.

5. Corner posts should be of some permanent material, with the adjoining trees (witnesses) marked for easy locating. Wood, with the exception of cedar, makes a poor corner post as in a few years it will rot and fall to the ground. Iron pipe is long lasting, easily transported and inexpensive, and is easily driven into the ground. Where available, pile small stones around any corner post. Paint the stones and the corner post.

6. High quality paint, properly applied, should last at least ten years in the woods; axe blazes should last longer. Lines should be checked and maintained annually or periodically. Lines and corners should be shown to family members so they can locate them in the future.

Timber Harvesting and Boundaries:

Maine law is careful to protect adjoining landowners from timber trespass and damages that occur during any logging or wood harvesting operations. If you are considering harvesting timber, you should know and observe state and local timber harvesting regulations near property lines, trespass and slash disposal laws.

1. Anyone who authorizes timber harvesting, or in fact harvests timber shall **clearly mark with flagging or other temporary and visible means any established property lines within 200 feet of an area to be harvested.** The marking of property lines must be completed prior to commencing timber harvesting. Parcels less than 5 acres are exempt. (17 MRSA § 2511). Failure to clearly mark property lines may also make the person who authorized the cutting liable for double damages to an abutter if a timber trespass occurs (14 MRSA § 7552-A).

2. Slash left from any cutting operations of forest growth must be disposed of according to the following regulations: (12 MRSA § 9331-9336).

A. Along highways, slash must not be left in the right-of-way or within 50 feet of the nearer side of the right-of-way of a public highway.

B. Along railroads and utility lines (pipeline, electric, telephone, telegraph, or cable) slash must be removed from in the right-of-way or within 25 feet of the nearer side of the right-of-way.

C. Slash that might constitute a fire hazard shall not be allowed to remain on the ground within 25 feet of the property line of land belonging to another.

For more information, please contact:

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American Woodcock: Habitat Best Management Practices for the Northeast



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American Woodcock: Habitat Best Management Practices for the Northeast

Introduction

The American woodcock (*Scolopax minor*) is a migratory shorebird that has adapted to forested habitats. Its distinctive features include a stocky body, cryptic feather coloration and a long prehensile bill used to probe moist soils for earthworms, the primary food.

American woodcock populations have steadily decreased over the last quarter century at a rate of 1 to 2 percent per year (fig. 1). The decline is attributed to forest succession, the loss of young forest and shrubland habitat in the eastern and central United States due to forest succession, human development,

absence of wildfires, and changing forest management practices.

The Northern Forest Woodcock Initiative was created to document best management practices for the Northern Forest region, develop a regional system of demonstration areas, and monitor the response of woodcock to habitat treatments.

Fifty-nine other species have been identified by New England States that require young forest and shrubland habitats of both deciduous and coniferous forest types for survival. All State Wildlife Action Plans can be accessed at <http://www.wildlifeactionplans.org>.

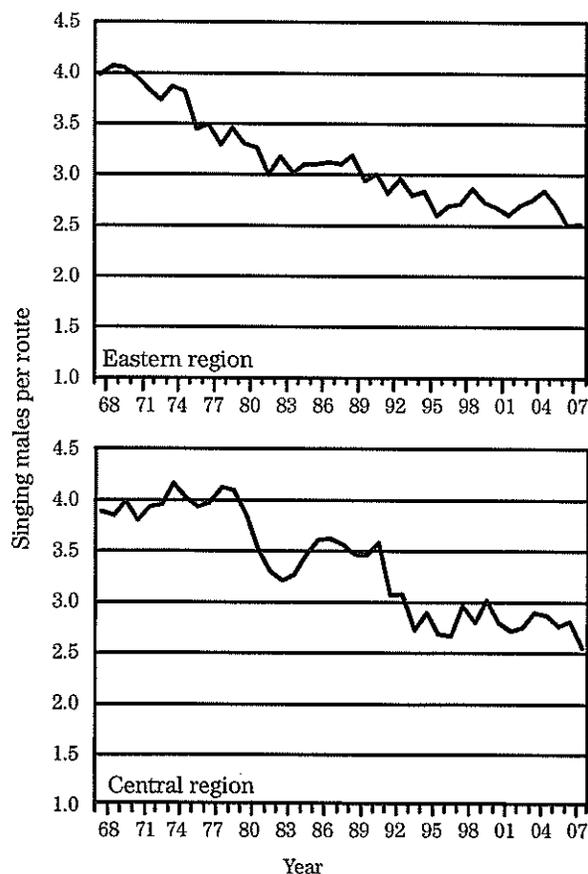
Cutting trees to create young forest and shrubland habitats is necessary for the recovery of woodcock. However, woodcock habitat management is not suitable in some situations and in some forests. It is critical to know where and where not to help woodcock by creating young forest. Another resource value that may supersede woodcock habitat creation includes threatened and endangered (T & E) species and associated habitats that must be protected so the listed species or its habitat is not harmed. The best source for understanding if there are T & E species in the area is the State wildlife agency, or Natural Heritage Program.

This Wildlife Insight summarizes work to date in Maine, New Hampshire, Vermont, New York, and Massachusetts. Information contained within applies to these States but may be applicable elsewhere.

Woodcock habitat needs

Woodcock need diverse habitats to survive, including small clearings for courtship, dense shrubland or young forest thickets for diurnal (i.e., daytime) foraging for earthworms, early successional forests for nesting and brood rearing, and clearings for summer roosting (fig. 2).

Figure 1 Long-term trends of the number of woodcock heard on the Singing Ground Survey, 1968 to 2008 (Cooper, Parker, and Rau 2008)



Courtship areas

Male woodcock return to breeding ranges in early spring and immediately occupy courtship territories, usually referred to as singing grounds. Male woodcock perform courtship activities in a variety of openings such as clearcuts, natural openings, roads, pastures, cultivated fields, and reverting agricultural fields. The quality of singing grounds is influenced by the proximity of nesting and brood-rearing habitat. Singing grounds are usually close to diurnal foraging cover. Things to look for:

- Forest openings with sparse ground cover (snowpacks may knock down and flatten tall herbaceous vegetation allowing woodcock to display) (fig. 3).
- Log landings and forest roadsides.
- Pastures.
- Hayfields, especially close to wet areas.

Figure 2 Diverse woodcock habitat



Figure 3 Forest openings used as woodcock singing grounds



- Reverting farmland.

Characteristics:

- Open herbaceous ground cover.
- Openings with scattered small shrubs and trees.
- Openings with ground cover flattened by winter snowpacks.
- Generally, singing grounds are a half acre in size or larger.

Feeding areas and diurnal habitat

A wide variety of plant species may comprise suitable diurnal habitat, but important indicators of good habitat are a preponderance of shade intolerant hardwoods (e.g., alder and aspen) or have growth forms that provide adequate protection for birds. The abundance of earthworms is a critical determinant of woodcock use of a site. Moist, rich soils high in organic matter produced by decomposition of leaf litter support highest densities of earthworms (fig. 4). Birds may sometimes use more mature forests if there is a dense understory. Use of coniferous stands is minimal in northern breeding areas, but can be critical for survival during droughts and dry conditions. Things to look for:

- Abandoned farmland: especially abandoned apple orchards overtopped by young forests, when located within one-half mile of forested or scrub/shrub wetlands.
- Riparian habitats: rich moist habitats located adjacent to streams and waterbodies. Riparian stream habitats should be along second order and higher streams (at least one upstream branch). To be considered as high potential for woodcock habitat, stream courses should be low

Figure 4 Woodcock feeding



gradient, slow flowing, with flat topography (fig. 5).

- Lower benches: young forest or shrubland habitats located adjacent to riparian habitats and extending up to two benches or terraces uphill from the wetland edge. Also, in general, any young forest habitat within a half mile of a stream, wetland, pond, or waterbody. See the preferred forest types mentioned below for a more specific picture of woodcock preferred feeding areas.
 - Within the National Wetlands Inventory (NWI) (www.fws.gov/wetlands/), important woodcock habitats may be included in the following NWI wetland types: palustrine scrub-shrub and palustrine forested. To view the locations of these wetlands, use the wetland mapper tool on the NWI Web site (<http://www.fws.gov/wetlands/data/WebMapServices.html>).

Characteristics of feeding areas:

- Moist, rich soils with abundant earthworms.
- Preferred forest types for woodcock feeding include those generally labeled as shade intolerant hardwoods, including aspen, alder/willow, gray or paper birch, and pin cherry. Secondary forest types include young forest (with associated shrub layers) in the following forest types: northern hardwood, red spruce/balsam fir/hardwood mixtures, eastern red cedar/red maple mixtures, and elm/ash/red maple.
- In young forest and shrubland habitats, feeding areas should have greater than 10,000 stems per acre of young trees or shrubs. Typically, these habitats are regenerating hardwood clearcuts between 3 and 15 years of age.

Figure 5 Riparian areas provide a consistent source of earthworms



- In general, most preferred forest types are prone to root suckering or stump sprouting.

Nesting cover

Most woodcock nests are in young second-growth (forest that was recently cut) hardwood stands that are near feeding areas and/or singing grounds (fig. 6). Nesting cover may also serve as diurnal feeding cover. The woody stem density of nesting areas should be at least 6,000 stems per acre. Preferred brood habitat is characterized by protective dense hardwood cover on fertile soils that support an abundance of earthworms. Things to look for:

- Forest sites somewhat drier than feeding areas with sapling to small pole sized trees (>4.5 ft tall, with a diameter at breast height (DBH) of 6 in or less). These areas may include young forest or shrubland habitats on uplands adjacent to riparian areas or 10- to 15-foot-tall alder on drier sites.
- Young, open, second-growth hardwood—seedling/sapling size class (DBH <4 inches) from 2 to 15 years following clearcutting if there is no dense ground cover. Bare ground is necessary for brood rearing.
- Nesting habitats may include large sapling/small pole-sized hardwoods (15 to 25 years post-cut) with a dense shrub layer (aspen with a hazelnut, dogwood, and/or viburnum understory, alder, tamarack, and aspen with fir).

Characteristics of nesting cover:

- Areas as small as one acre can be used, although 5-acre units are better from a management perspective.
- Preferences for forest types for nesting are the same as preferences for feeding areas.

Figure 6 Typical woodcock nesting cover



Roosting areas

Woodcock often leave diurnal areas at dusk and fly to openings such as clearcuts, abandoned agricultural fields, and pastures to spend the night. Use of roosting fields generally begins in July and continues up to time of migration. In northern areas, woodcock generally do not feed on roosting habitats, seeking out instead protection from predators at night. In general, the structure of roosting habitats should be open enough for woodcock to detect ground predators while affording scattered overhead protection from avian predators. On smaller openings it is advantageous to have a tapered (feathered) edge of small trees and shrubs rather than an abrupt edge. Things to look for:

- Naturally regenerating recent clearcuts and log landings.
- Revegetated gravel pits.
- Lowbush blueberry barrens or fields.
- Recently abandoned farmland.
- Newly established or herbicide-released tree plantations
- Pastures with light to moderate grazing.

Characteristics of roosting areas:

- Barren, light herbaceous ground cover.
- Some bare ground.
- Occasional weed or shrub cover for overhead protection.
- Clump grasses are preferred over sod grasses.
- Scattered small shrubs and trees less than 4 feet in height.
- Grazed pastures with some areas of short (4 to 6-in) grass.

Woodcock habitat mosaics

Quality woodcock habitat mosaics are a combination of dense hardwood cover on fertile soils, with an abundance of earthworms, interspersed with both large and small openings. Farmland/hardwood forest mix is an ideal location to consider managing for woodcock. Birch, bigtooth aspen, quaking aspen, speckled alder (hereafter alder), hawthorn, and dogwood provide the cover densities preferred by this species (table 1).

Woodcock populations thrive when all habitat components are located close to each other. To create a mosaic of quality habitat capable of supporting 500 woodcock (adults and chicks just after hatching) is

Table 1 Scientific and common names of trees referenced in this document

Common Name	Scientific Name
alder	<i>Alnus</i> spp.
alder, speckled	<i>Alnus incana</i> spp. <i>rugosa</i>
ash	<i>Fraxinus</i> spp.
aspen	<i>Populus</i> spp.
aspen, bigtooth	<i>Populus grandidentata</i>
aspen, quaking	<i>Populus tremuloides</i>
birch, gray	<i>Betula populifolia</i>
birch, paper	<i>Betula papyrifera</i>
blueberry, lowbush	<i>Vaccinium angustifolium</i>
cedar, eastern white	<i>Thuja occidentalis</i>
cherry, pin	<i>Prunus pennsylvanica</i>
dogwood	<i>Cornus</i> spp.
elm	<i>Ulmus</i> spp.
fir, balsam	<i>Abies balsamea</i>
hawthorn	<i>Crataegus</i> spp.
hazelnut	<i>Corylus</i> spp.
tamarack	<i>Larix laricina</i>
maple, red	<i>Acer rubrum</i>
spruce, red	<i>Picea rubens</i>
viburnum	<i>Viburnum</i> spp.
willow	<i>Salix</i> spp.

an ultimate goal of woodcock experts. By looking at some examples of areas intensively managed for woodcock, it is clear that an intensively managed unit of 500 to 1,000 acres should support approximately 500 woodcock. Densities from the Moosehorn National Wildlife Refuge, Ethan Allen Firing Range (EAFR), and American Woodcock Singing Ground Survey are contrasted (figs. 7 and 8).

As a hedge against adverse impacts to populations caused by climatic events, disease, predation, etc., it is advantageous to position several habitat mosaics within 1 to 2 miles of each other. This way, if one population declines, there are suitable source populations nearby to allow for recolonization of the area. Undoubtedly, the preceding landscape-scaled goals

Figure 7 Densities of woodcock on intensively managed demonstration areas

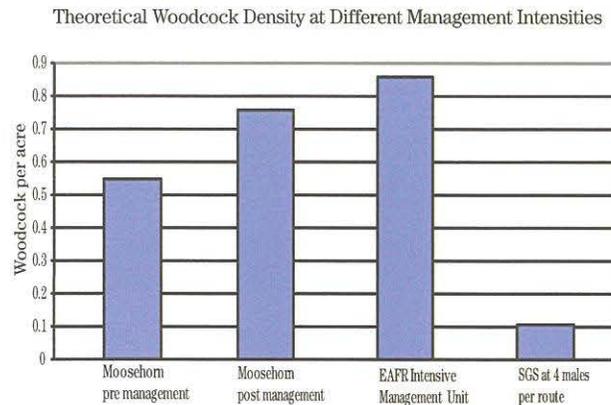
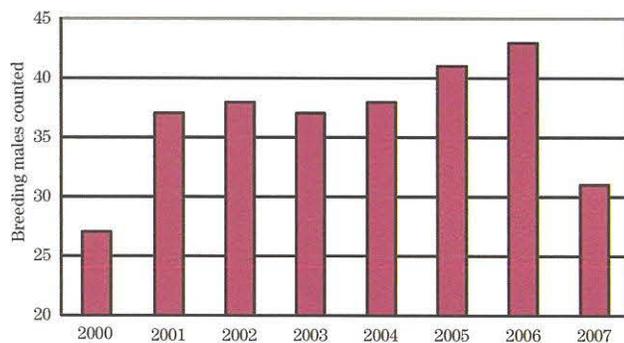


Figure 8 Breeding male population on EAFR



for woodcock populations and habitat mosaics can be daunting for those working primarily with owners of smaller forested parcels common to the Northeast. However, it is recognized that a shifting mosaic of suitable woodcock habitat can be maintained on small parcels across the landscape. Cumulatively smaller-scale efforts will benefit the species and will contribute toward landscape-level goals.

Landowners and land managers can use this guide to help provide some or all of the four habitat components required by woodcock on small parcels and at smaller scales. It should be noted that adjacent lands and or landowners may need to be involved to meet all the habitat needs of woodcock where smaller ownerships are involved. For instance, a landowner with a 50-acre forested parcel may have good site condi-

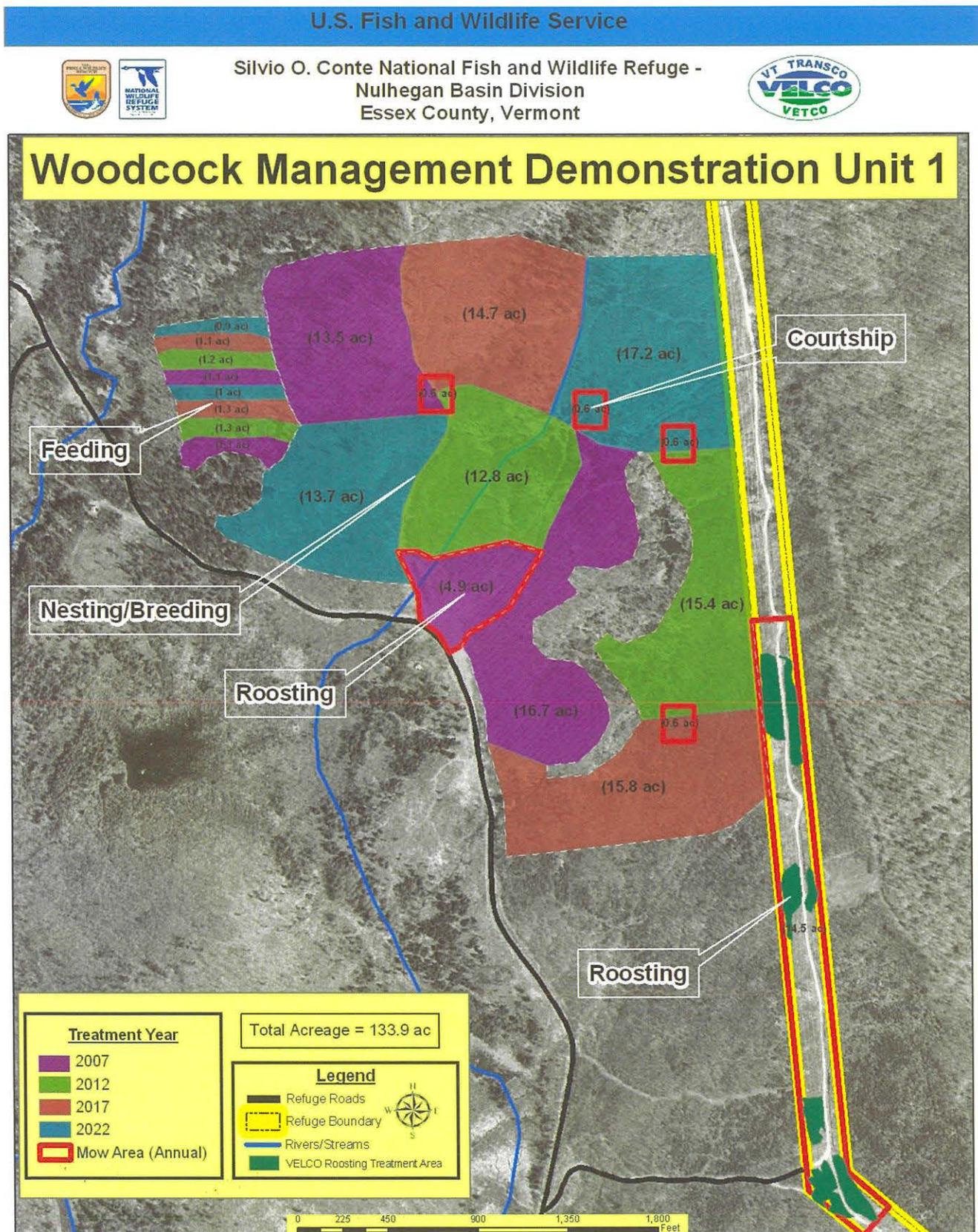
tions to provide nesting and feeding habitat but may have to rely on nearby agricultural lands for long-term courtship and roosting areas for local woodcock. A Landowner's Guide to Woodcock Management in the Northeast (Sepik, Owen, and Coulter 1981) contains examples of smaller-scale woodcock habitat projects.

Composition of habitat mosaics

In the ideal woodcock management unit, the following habitat configuration should result in the highest densities of woodcock (fig. 9):

- Locate the unit so that its center or core is an alder swale or other forested wetland (on the National Wetlands Inventory (<http://www.fws.gov/wetlands/>), look for palustrine scrub-shrub and palustrine forested wetlands).
- More than 80 percent of the management unit should be dedicated to providing diurnal foraging areas. An important component of this diurnal habitat area is the core scrub-shrub or forested wetland that is used to define the center of the management unit. Here, the structure of the scrub-shrub or forested wetland should be managed so that it provides dense sapling growth. Because these areas are most likely to feature moist soils high in organic matter (important for earthworms) regardless of drought conditions, the core feeding area will be the most reliable habitat to support woodcock populations through time.
- Diurnal habitat surrounding or adjacent to the core alder swale or other forested wetland will be created by even-aged forest cuttings of greater than 5 acres in size located on adjacent uplands. These cuts will stimulate sprouting of shade-intolerant species such as aspen to create ideal woodcock feeding habitat.
- Alder diurnal habitat areas will grow out of usefulness when the canopy opens and allows grasses and forbs to thrive in the understory or the process of stem exclusion in the developing stand has evolved to less than 10,000 stems per acre. Plan to regenerate 25 percent of the core alder feeding habitat every 5 years so that the entire area is rotated through a cutting cycle within 20 years. This way, woodcock will always have a choice of different aged feeding areas.
- In preferred forest types (defined in the feeding areas section), this important mosaic of feeding areas can be structured so that 25 percent of the unit is in one of four age classes: 0 to 10, 11 to 20, 21 to 30, and 31 to 40 years since cutting. One efficient method is to create new young forest habi-

Figure 9 Woodcock habitat mosaic implemented on the ground at the Silvio O. Conte National Fish and Wildlife Refuge, Nulhegan Basin Division, Essex County, VT



tats in 5-acre or larger blocks on a 40-year rotation on a 10-year entry period. This management approach would also provide nesting and brood rearing habitat over time. In secondary forest types, lengthen rotation and/or age class distribution to achieve commercial forest products.

- When diurnal habitat areas have been identified or delineated, the remainder of the management unit should be dedicated to roosting field and singing ground habitats. Generally, these two components require open habitats. Strive to create:
 - One roosting field per 100 acres: Roosting fields should be at least 5 acres in size (fig. 10).
 - Eight singing grounds per 100 acres: singing grounds should be at least one-half acre in size.

Woodcock conservation plan and habitat goals

How much is enough? Is one 500- to 1,000-acre habitat mosaic per county enough? The Woodcock Conservation Plan (<http://www.timberdoodle.org>) has quantified habitat and population goals by region and state to increase woodcock populations to 1970 levels. The Woodcock Conservation Plan emerged from the efforts of the United States Fish and Wildlife Service (USFWS), State wildlife management agencies and nongovernmental organizations to galvanize action to reverse the decline of woodcock.

The Woodcock Task Force recognized that bird interest groups dedicated generally to conservation of

waterfowl, shorebirds, neotropical migrant songbirds and waterbirds had developed strategic plans to set population objectives, rank the level of risk, define amounts or types of critical habitat, and outline funding deficiencies. Goals from those plans would drive agency funding and priorities. Woodcock, however, had not received similar attention. To allow woodcock needs to compete with other bird needs, a conservation plan was needed.

The Woodcock Conservation Plan assessed current levels of woodcock habitat and woodcock populations and calculated the amount of new habitat needed to return woodcock to 1970s population levels. Goals for each region of woodcock range can be found by downloading the plan from <http://www.timberdoodle.org>. Within each specific initiative's (e.g. Northern Forest Initiative) page on the web site, there are links to step down plans that provide planning goals for states and counties within each region.

Woodcock habitat management practices

Aspen management

- Aspen responds to cutting by sending up thousands of spouts from underground roots. This develops into dense sapling growth that makes aspen a preferred species to manage for woodcock (fig. 11).
- Even if aspen is scarce in a forest stand, it can regain dominance if correctly managed. As little as 30 square feet of basal area per acre of aspen makes a stand suitable for management as an aspen stand.

Figure 10 Roosting field



Figure 11 Aspen is preferred forest type for woodcock



- In old or decadent stands, a greater percentage of the area may need to be cut in the first two cutting cycles to prevent the death of aspen clones from the lack of viable root sprouting.
- In stands with aspen, position 5-acre patch cuts so that they include existing aspen trees. Roots from the cut trees will sprout and revegetate in the opening around the stump.
- To maximize sprout growth, time the cutting to occur after leaf-fall. Whenever possible, operate on frozen ground.
- Cutting aspen on a 40- to 60-year rotation should result in commercial timber revenue. Landowners may get the habitat work paid for and perhaps even make money while improving woodcock habitat.

Alder management

- Alder is an important habitat type for woodcock when young alder stands exhibit high stem density with little understory so that woodcock can feed freely without the threat of predation. Like aspen, alder sprouts vigorously when cut, although most alder sprouting is directly from the stump, not from roots. Alder will also grow naturally from seed.
- When alder stands become old, stem density decreases substantially and understories are overtaken by grasses and other ground covers. Woodcock cannot feed freely in old alder stands.
- To determine the suitability of the age of a stand of alder, observe the growth form of alder stems. When old, alder frequently grows horizontally instead of vertically. Alder stands with horizontal growth are good candidates for regeneration (fig. 12).
- A widely practiced way to manage alder is to cut strips that are 50- to 100-foot wide through the alder stand. Strips are positioned so that every 5 years, an adjacent strip can be cut. By doing so, all alder strips will be revisited once every 20 years. As with aspen, the percentage of the area cut can be accelerated in decadent stands with substantial horizontal growth.
- Not all alder is suitable for woodcock. Stands with standing water, saturated soils or heavy sedge growth are likely too wet to support earthworms.
- Depending on site conditions, alder management can be accomplished using a brush hog, a

hydroaxe, an excavator equipped with a mowing head (brontosaurus), or by shearing off stems with a skidder or bulldozer blade in winter at or near ground level after the ground has frozen.

- Generally, there is no commercial use for alder, but local habitat management programs (e.g., Farm Bill) may provide financial assistance to private landowners.

Roosting area management

- In forested areas, woodcock may have difficulty finding open areas in which to roost. In some cases, when open areas are not close by, woodcock may remain in diurnal habitats through the night. Scientists speculate that mammalian predation may be higher at night in these habitats. In other cases, when open areas are not abundant, woodcock may fly long distances to roosting fields. Research suggests that mortality increases when habitat components are scattered.
- In heavily forested areas with active forest management, newly created cuttings (especially softwood and mixed-wood sites) serve as roosting fields for at least several years after the time of cutting (fig. 13).
- In heavily forested areas without active annual management, or where management is not even-aged, roosting fields must be created and managed. Generally accepted guidelines for creating roosting fields are:
 - Cut and maintain openings of 5 acres or larger with sparse ground cover.
 - Do not plant or revegetate, especially with sod-forming grasses. The objective is to

Figure 12 Alder growing horizontally not suitable for woodcock habitat



allow the site to revegetate with patchy, naturally occurring weeds, forbs, and native clump grasses. Do not fertilize.

- Sites should be maintained in this condition through mowing, prescribed burning, herbicides, or grazing.
- Allow a 100-foot border of the opening to regenerate into dense sapling-sized deciduous shrubs and trees for woodcock nesting habitat.
- Manage for one roosting field per 100 acres of habitat.
- In areas with pastures, hayfields or blueberry fields close by (within a half mile of feeding areas).
 - Pastures with light to moderate grazing pressure are maintained in cover suitable for use by roosting woodcock. These areas serve the needs for woodcock roosting and, therefore, eliminate the need for the landowner to manage other areas as roosting fields.
 - Because dense grass and weed growth prevent the use of roosting fields by woodcock, hayfields and blueberry openings must be managed to allow use by woodcock.
 - Mowing strips in hayfields is an effective management tool in some areas. To encourage woodcock use, strips from 6 to 8 feet wide should be mowed in hayfields during late summer. Up to 25 percent of a field can be strip mowed to maintain roosting habitat. In hayfields that provide suitable habi-

tat for grassland nesting birds, the NRCS recommends mowing be conducted after the locally established breeding bird season dates.

- Managed blueberry barrens provide good habitat structure for woodcock. Barrens should regularly be mowed or burned, usually on an annual or biannual treatment schedule depending on fuel load or rank growth.
- Other landscape components that serve as roosting fields include barrens, airstrips, military training grounds, topsoil mined areas, regenerating gravel pits, and newly established forest plantations.

Log landing management

Log landings can serve as both singing grounds and roosting fields and in a forested environment can serve as an efficient way to maintain some open habitat important for woodcock (fig. 14).

- Landings should be as large as possible, usually 1 to 3 acres in size is practical. The larger the landing area, the more likely the landing will be used as a roosting field. Large landings are also more likely to support multiple male courtship territories.
- Landings should be smoothed with dense slash removed or piled but little else in the way of site treatment is necessary.
- Landings should not be planted if woodcock use is desired. Landings with erosion problems may be planted to annual grasses.

Figure 13 Woodcock select areas with sparse vegetation to use as roosting fields including clearcuts



Figure 14 Log landings provide important habitat for woodcock



Commercial forest management

Commercial forestry can be an excellent way to improve woodcock habitat at no cost to the landowner. There are various forestry guides available, but forest managers should refer to the habitat composition goals listed in DeGraaf et al. (2005) as an excellent approach to integrating early successional habitat needs into forest management.

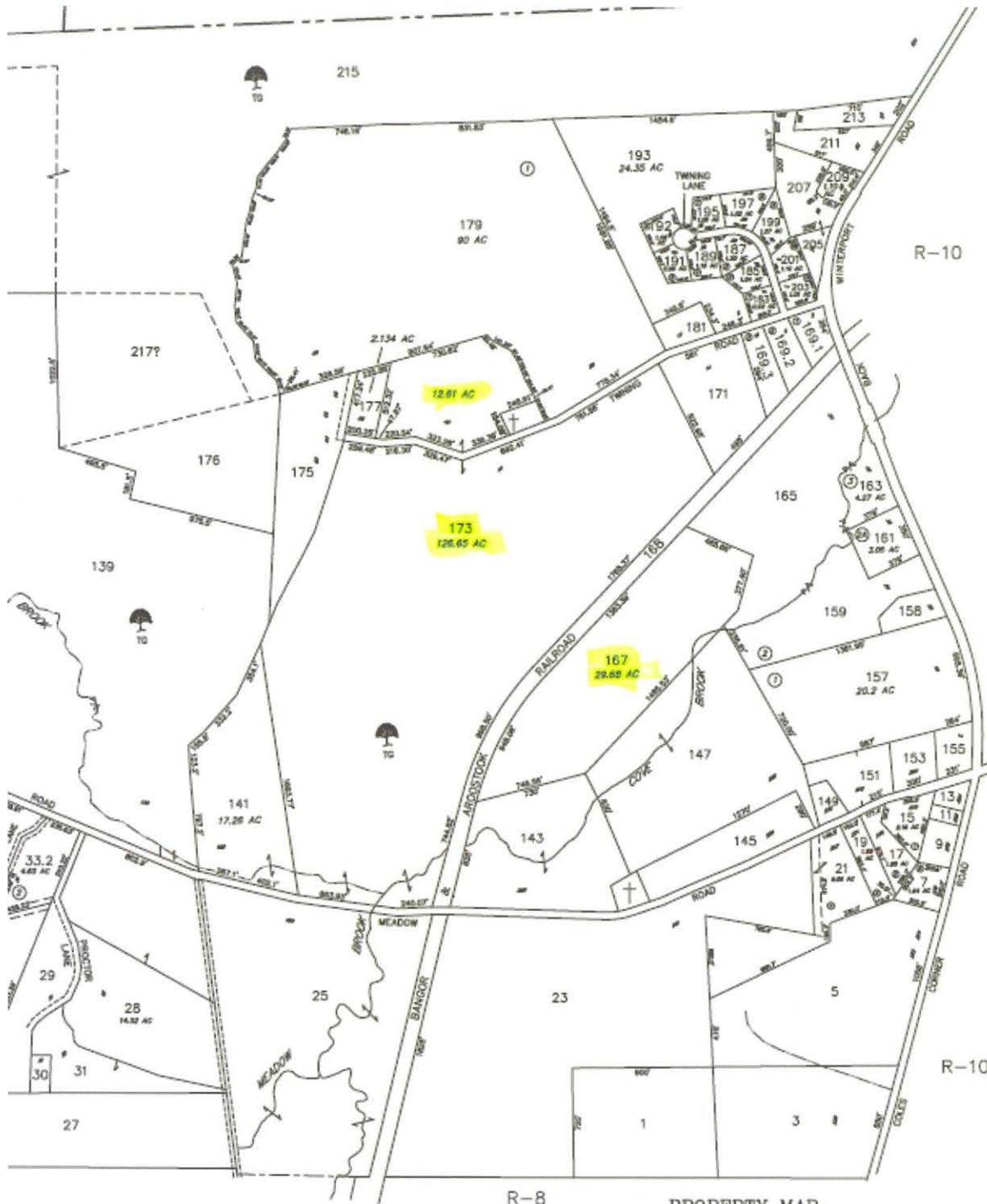
Summary

American woodcock respond favorably to habitat improvement, usually within one year or so. In fact, many private landowners witness the aerial acrobatics of displaying males the first spring after the creation of singing grounds. So the discussion and implementation of Best Management Practices for woodcock habitat provides quick rewards to both the landowner and the technical assistance provider.

Woodcock populations were highest when working farms and forestlands dotted the landscape. Brushy field edges, streambanks, orchards, fallow fields, pastures, reverting agricultural fields, and managed woodlots provided the mosaic of habitats that woodcock depended upon. Many of those habitats are gone today, replaced by either mature forests or human developments. Woodcock can recover to 1970 population levels if the right steps are taken to create and maintain better habitats. This relies in large part to the NRCS because working farm and forestlands provide the best opportunity to recreate the habitat mosaics of the past.

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 TOWN OF WINTERPORT
 WALDO COUNTY, MAINE



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Maine Forest Service

10-2020

Sirococcus Shoot Blight of Red Pine (*Sirococcus conigenus*)

Forest Health and Monitoring Division

Maine Forest Service

Department of Agriculture, Conservation and Forestry

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Sirococcus shoot blight of red pine (*Sirococcus conigenus*)

Hosts: Red Pine (*Pinus resinosa*)

General Information: Sirococcus shoot blight of red pines has become increasingly common in Maine and other New England states over the past decade. Many red pine plantations were established throughout Maine and northern New England after harvesting of spruce and fir stands damaged by the spruce budworm during the 1970s and 1980s. These plantations are now showing a high susceptibility to injury and mortality due to *S. conigenus*. The disease is also found in native red pine stands where similar damage has been seen.

Infection potential is largely driven by favorable weather conditions for the fungus of cool, wet springs and prolonged wet periods in summer, conditions which have been common in most of the Northeast for the past decade. These weather conditions and the high concentration of suitable host material (plantations) can result in a rapid build-up of the pathogen representing high infection potential. Growth reduction, dieback of lower limbs and reduced live crown size result from chronic infection and in some cases tree mortality can occur after several years of high disease incidence and severity.

Symptoms and Signs: The disease infects current-year needles soon after they emerge from the buds during the spring and early summer. *S. conigenus* then has the ability to grow from the needles into the current-season shoots, and can kill the new shoots. Symptoms of infection include the browning and wilting of recently infected needles and later, the death infected shoot tips (Figure 1). Often, as tips die, lateral buds below the infection take over apical dominance and subsequently die from infection. If this happens repeatedly, the outer portions of branches take on a bushy appearance referred to as 'lion's tailing.' Spores of the fungus are produced in pycnidia that appear as small black dots on the needles (often also found under the needle sheath at the base of needle fascicles) and on shoots of infected trees. Branches die when terminal buds and shoots can no longer support new growth. As the infections progress over a period of several years, from the lower branches to the upper branches, tree mortality may eventually occur. Additional stress-related pest issues may also cause further damage in infected stands.

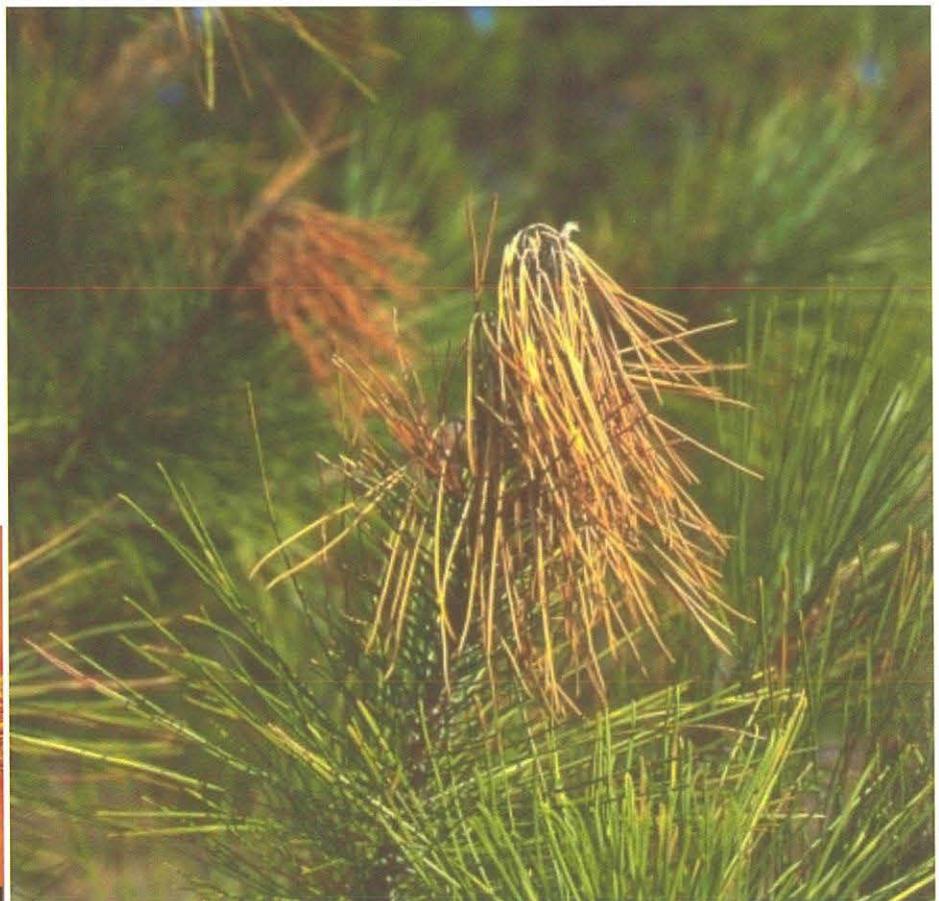


Figure 1: (left) Spore-producing structures of *S. conigenus* on a needle; (right) Characteristic wilted appearance of needles of a red pine shoot infected by *S. conigenus*. Images: USFS and Joseph O'Brien, Bugwood.

Management: Frequent and regular monitoring of stands is critical, as early detection of *S. conigenus* infection will allow flexibility in management. While fungicide application is seldom practical in larger and older plantings and stands, thinning stands to maximize air circulation and surface-drying of needles can help to reduce infections.

Thinning is a suggested management strategy, even in stands with trees that would not ordinarily be considered large enough for a thinning treatment. However, thinning stands with an average live crown ratio of 30% or less must be carefully considered, as the stress caused by the thinning operation may cause large-scale mortality in already stressed stands. Heavily infected trees and dead trees will decrease in quality rapidly, and will need to be salvaged quickly to recover whatever value they have. Management activities should be limited to wintertime to avoid the risk of Heterobasidion root disease (formerly Annosus root disease) establishment (See "Heterobasidion root disease" MFS fact sheet) and minimize other stressors like root compaction. In landscape settings, options for management include hand pruning infected branch tips and applications of protective fungicides in spring and early summer to prevent the infection of new growing shoots. Supporting tree vigor and preventing water stress are important, as vigorous trees are more resilient in response to infections.

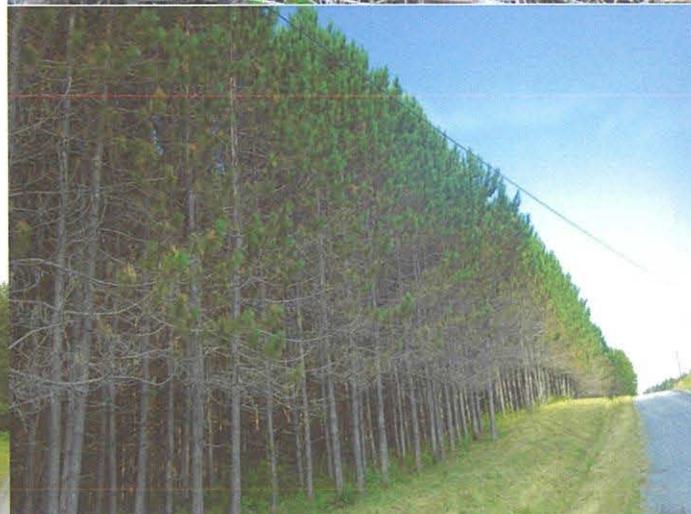


Figure 2: (above right) A red pine tree with *S. conigenus*-blighted tips at various stages of infection (orange arrows) and associated lower limb dieback; (lower left) A red pine plantation with fairly healthy, full crowns with high live crown ratios; (lower right) A plantation showing blighted tips and dead lower branches due to *Sirococcus* shoot blight with low live crown ratios. This plantation also was also impacted by *Diplodia* tip blight fungal infection (see "Diplodia tip blight of pines" fact sheet). Images: Maine Forest Service.



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1-2021

Diplodia tip blight of pines (*Diplodia sapinea*)

Department of Agriculture, Conservation and Forestry

Maine Forest Service
Forest Health and Monitoring Division

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Recommended Citation

Department of Agriculture, Conservation and Forestry and Maine Forest Service, "Diplodia tip blight of pines (*Diplodia sapinea*)" (2021). *Forest Service Documents*. 271.
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Diplodia tip blight of pines (*Diplodia sapinea*)

Hosts: Austrian (*Pinus nigra*), mugo (*P. mugo*), ponderosa (*P. ponderosa*), red (*P. resinosa*), Scots (*P. sylvestris*) pines.

General Information: Diplodia tip blight is commonly found in Maine and is often associated with red pine (*Pinus resinosa*) plantations; however, it is also found in the natural forest and ornamental settings. The fungus causes cankers and kills new growth in spring/early summer. Symptomology includes new growth that is partially elongated, brown and brittle, scattered throughout the lower crown and branch dieback that may be traced back to stem cankers further back on the branch. Infection severity tends to increase in response to longer-term stress events like drought or inundation of roots and especially acute stress events like hail injury. Spores are spread by rain splash during prolonged periods of high relative humidity. There is also indication that insects, especially those that feed on cones, may vector the fungus from one tree to the next.

Symptoms and Signs: Symptoms begin to appear in May/June as new shoots are attacked. Blighted shoots often are stunted (indicating that they were infected soon after shoot elongation) or wilted. Vascular tissues (inner bark) may be stained a brownish color. Repeated years of blighted shoots cause the branch ends to appear crooked as new shoots are killed, and adjacent lateral shoots take over as terminals. This buildup of dead branch tips at the ends of branches is referred to as 'lion's tailing' and can often be observed from the ground looking up at the fringes of canopies. While cankers are sometimes difficult to locate and confirm as being caused by *D. sapinea*, it is often fairly easy to find spore-producing structures (pycnidia) growing on cone scales, as the fungus readily invades the cones after infecting branches. Spore-producing structures are also found less often/less easily beneath the papery sheath that holds together the base of bunches of needles (the fascicle). When *D. sapinea* pycnidia are squashed on a glass slide and viewed under magnification, very characteristic large (for spores), dark-brown oval spores can be seen. Branches chronically infected by *D. sapinea* in the lower crown typically die due to the infection or secondary reasons. This leads to low live crown ratios, which may have management implications.

Management: Avoid injuring trees during management. In plantation situations, removing suppressed trees may be beneficial to overall stand health and improve airflow in the stand (increased airflow improves drying conditions and can lower infection). Do not plant susceptible species near already infested trees. Management activities should be limited to wintertime to avoid the risk of Annosus root disease establishment (see MFS fact sheet, [Heterobasidion Root Disease](#)) and minimize other stressors like root compaction. Diplodia tip blight may be mistaken for Sirococcus shoot blight (and vice versa) and therefore proper identification of the causal agent is important (see MFS fact sheet, [Sirococcus Shoot Blight of Red Pine](#)). However, both diseases can be found in the same stand, and even on the same tree. Stands where both diseases are present may decline more rapidly than stands where only one of the diseases is present. In landscape situations, support tree vigor and prevent water stress, as vigorous trees are more resilient in response to infections. Also, protective fungicides can be applied in spring and early summer to prevent the infection of new growing shoots. Although this may be beneficial in landscape settings, fungicide application is seldom practical in larger and older plantings and stands. Since heavily infected trees can become attractive to mass attack by bark beetles, it is recommended to remove the worst infected trees. Finally, trees with lower live crown ratios may not respond positively to management. Thinning of such health-compromised stands may lead to subsequent high mortality. In these cases, stand replacement may be the preferred management option.



Left Panel Images: (top) Thin crowns with low percent of live crown due to chronic and severe *Diplodia* tip blight infestation as seen from the ground in a planted red pine stand; (bottom) *Diplodia* tip blight on mugo pine in a landscape setting causing blighted, discolored branch tips.

Middle Panel Images: (top) A dead branch tip due to infection by *D. Sapinea*. The shoots were killed not long after shoot elongation, early in the growing season. Also note the multiple dead ends on this branch tip. This symptom, called lion's tailing, results from serial episodes of new-shoot infection and mortality. The tree's response to the tip death is to initiate new shoots below the dead tip; (bottom) A side-by-side comparison of a cone from an uninfected branch (left) and an infected branch. The latter shows small black spore-producing structures erupting through the cone scale surface (pycnidia).

Right Panel Image: Naturally regenerated red pine trees weakened by chronic *Diplodia* tip blight infection. Trees impacted by this primary chronic disease stressor often are more susceptible to damage from other agents of decline.

All images: Maine Forest Service



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United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for **Waldo County, Maine**

**Property of The City of Bangor in
the Town of Winterport, Maine**



Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

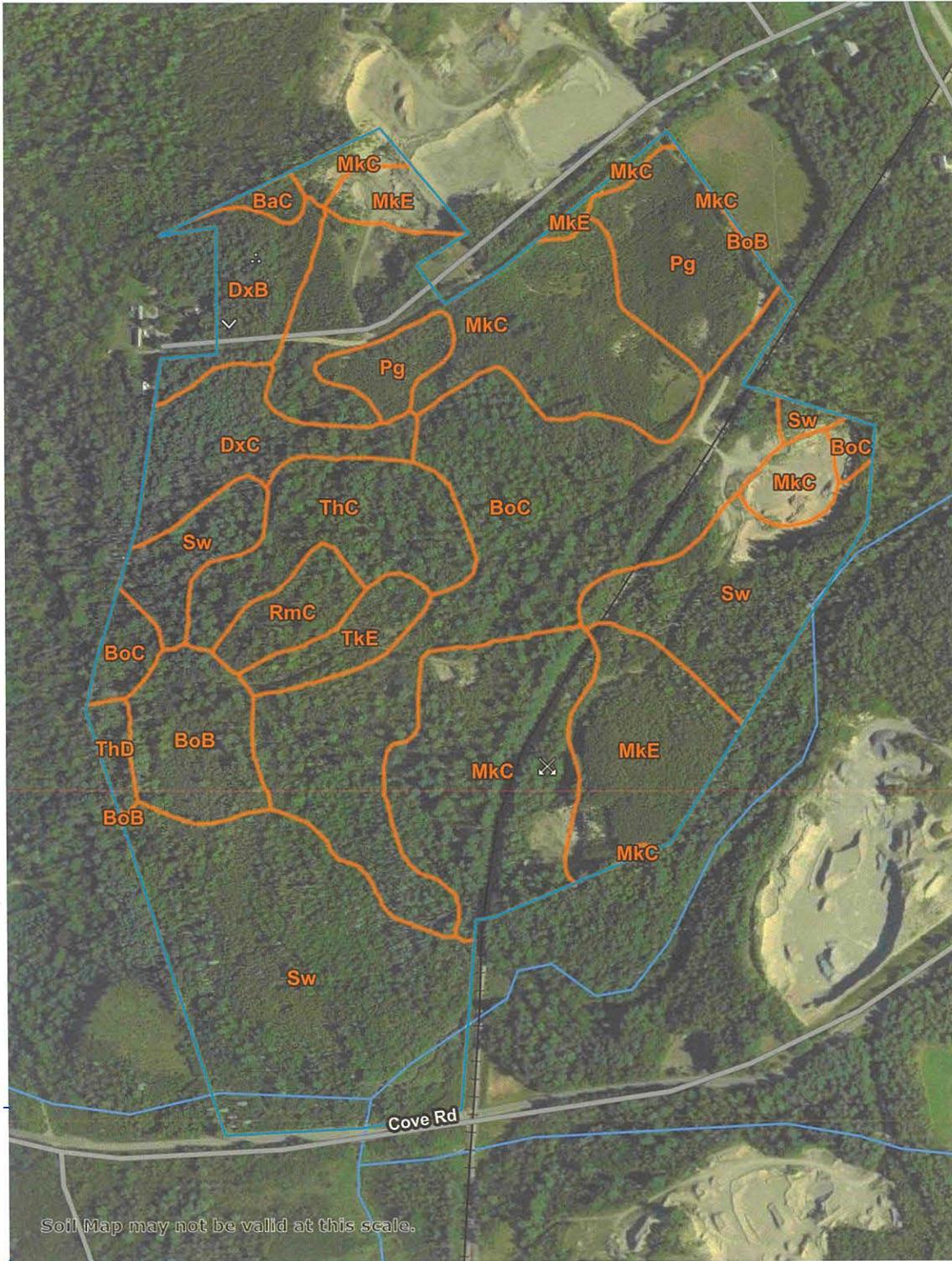
Custom Soil Resource Report
Soil Map (Property of The City of Bangor in the Town of Winterport, Maine)

68° 53' 14" W

68° 52' 22" W

44° 41' 13" N

44° 41' 13" N



44° 40' 24" N

44° 40' 24" N

68° 53' 14" W



Map Scale: 1:7,280 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84

68° 52' 22" W

Custom Soil Resource Report

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features

 Blowout

 Borrow Pit

 Clay Spot

 Closed Depression

 Gravel Pit

 Gravelly Spot

 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry

 Miscellaneous Water

 Perennial Water

 Rock Outcrop

 Saline Spot

 Sandy Spot

 Severely Eroded Spot

 Sinkhole

 Slide or Slip

 Sodic Spot

 Spoil Area

 Stony Spot

 Very Stony Spot

 Wet Spot

 Other

 Special Line Features

Water Features

 Streams and Canals

Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Waldo County, Maine
Survey Area Data: Version 20, May 29, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 27, 2010—Aug 31, 2010

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend (Property of The City of Bangor in the Town of Winterport, Maine)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BaC	Bangor silt loam, 8 to 15 percent slopes	0.8	0.4%
BoB	Boothbay silt loam, 3 to 8 percent slopes	6.8	3.8%
BoC	Boothbay silt loam, 8 to 15 percent slopes	34.4	19.4%
DxB	Dixmont silt loam, 3 to 8 percent slopes	5.3	3.0%
DxC	Dixmont silt loam, 8 to 15 percent slopes	7.4	4.2%
MkC	Masardis fine sandy loam, 8 to 15 percent slopes	38.7	21.8%
MkE	Masardis fine sandy loam, 15 to 45 percent slopes	12.3	7.0%
Pg	Pits, gravel and sand	10.9	6.2%
RmC	Rock outcrop-Lyman complex, 3 to 15 percent slopes	3.2	1.8%
Sw	Swanville silt loam, 0 to 3 percent slopes	43.3	24.4%
ThC	Thorndike-Winnecook complex, 8 to 15 percent slopes, rocky	9.6	5.4%
ThD	Thorndike-Winnecook complex, 15 to 35 percent slopes, very rocky	1.2	0.7%
TkE	Thorndike-Rock outcrop complex, 15 to 45 percent slopes, very stony	3.2	1.8%
Totals for Area of Interest		177.2	100.0%

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Drainage Class (Property of The City of Bangor in the Town of Winterport, Maine)

"Drainage class (natural)" refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized-excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained. These classes are defined in the "Soil Survey Manual."

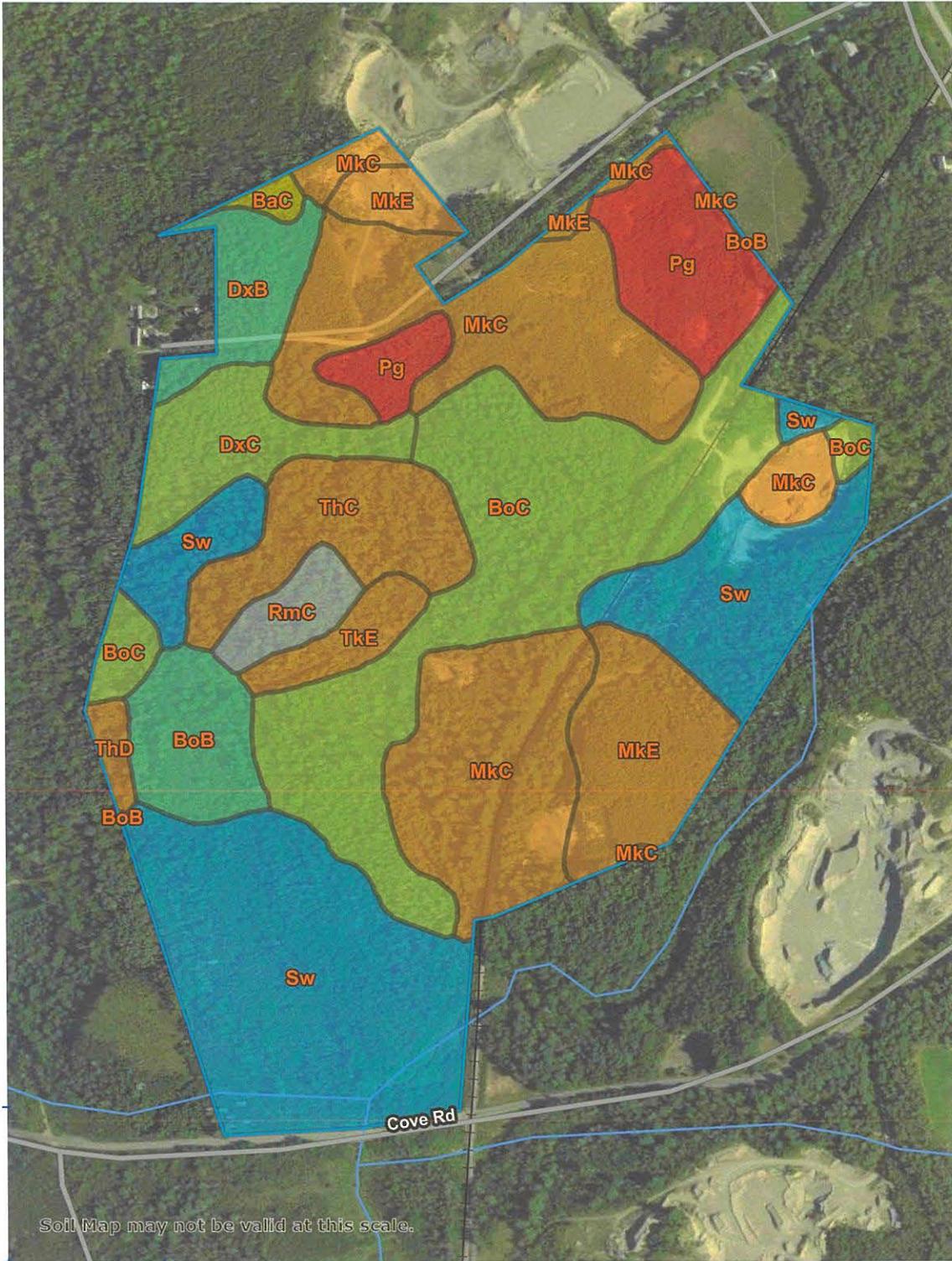
Custom Soil Resource Report
 Map—Drainage Class (Property of The City of Bangor in the Town of Winterport, Maine)

68° 53' 14" W

68° 52' 22" W

44° 41' 13" N

44° 41' 13" N



44° 40' 24" N

44° 40' 24" N

68° 53' 14" W

68° 52' 22" W



Map Scale: 1:7,280 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

-  Excessively drained
-  Somewhat excessively drained
-  Well drained
-  Moderately well drained
-  Somewhat poorly drained
-  Poorly drained
-  Very poorly drained
-  Subaqueous
-  Not rated or not available

Soil Rating Lines

-  Excessively drained
-  Somewhat excessively drained
-  Well drained
-  Moderately well drained
-  Somewhat poorly drained
-  Poorly drained
-  Very poorly drained
-  Subaqueous
-  Not rated or not available

Soil Rating Points

-  Excessively drained
-  Somewhat excessively drained
-  Well drained
-  Moderately well drained
-  Somewhat poorly drained
-  Poorly drained
-  Very poorly drained
-  Subaqueous
-  Not rated or not available

Water Features

 Streams and Canals

Transportation

-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL:
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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Soil Survey Area: Waldo County, Maine
 Survey Area Data: Version 20, May 29, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 27, 2010—Aug 31, 2010

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Drainage Class (Property of The City of Bangor in the Town of Winterport, Maine)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BaC	Bangor silt loam, 8 to 15 percent slopes	Well drained	0.8	0.4%
BoB	Boothbay silt loam, 3 to 8 percent slopes	Somewhat poorly drained	6.8	3.8%
BoC	Boothbay silt loam, 8 to 15 percent slopes	Moderately well drained	34.4	19.4%
DxB	Dixmont silt loam, 3 to 8 percent slopes	Somewhat poorly drained	5.3	3.0%
DxC	Dixmont silt loam, 8 to 15 percent slopes	Moderately well drained	7.4	4.2%
MkC	Masardis fine sandy loam, 8 to 15 percent slopes	Somewhat excessively drained	38.7	21.8%
MkE	Masardis fine sandy loam, 15 to 45 percent slopes	Somewhat excessively drained	12.3	7.0%
Pg	Pits, gravel and sand	Excessively drained	10.9	6.2%
RmC	Rock outcrop-Lyman complex, 3 to 15 percent slopes		3.2	1.8%
Sw	Swanville silt loam, 0 to 3 percent slopes	Poorly drained	43.3	24.4%
ThC	Thorndike-Winnecook complex, 8 to 15 percent slopes, rocky	Somewhat excessively drained	9.6	5.4%
ThD	Thorndike-Winnecook complex, 15 to 35 percent slopes, very rocky	Somewhat excessively drained	1.2	0.7%
TkE	Thorndike-Rock outcrop complex, 15 to 45 percent slopes, very stony	Somewhat excessively drained	3.2	1.8%
Totals for Area of Interest			177.2	100.0%

Rating Options—Drainage Class (Property of The City of Bangor in the Town of Winterport, Maine)

Aggregation Method: Dominant Condition
Component Percent Cutoff: None Specified
Tie-break Rule: Higher

Representative Slope (Property of The City of Bangor in the Town of Winterport, Maine)

Slope gradient is the difference in elevation between two points, expressed as a percentage of the distance between those points.

The slope gradient is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

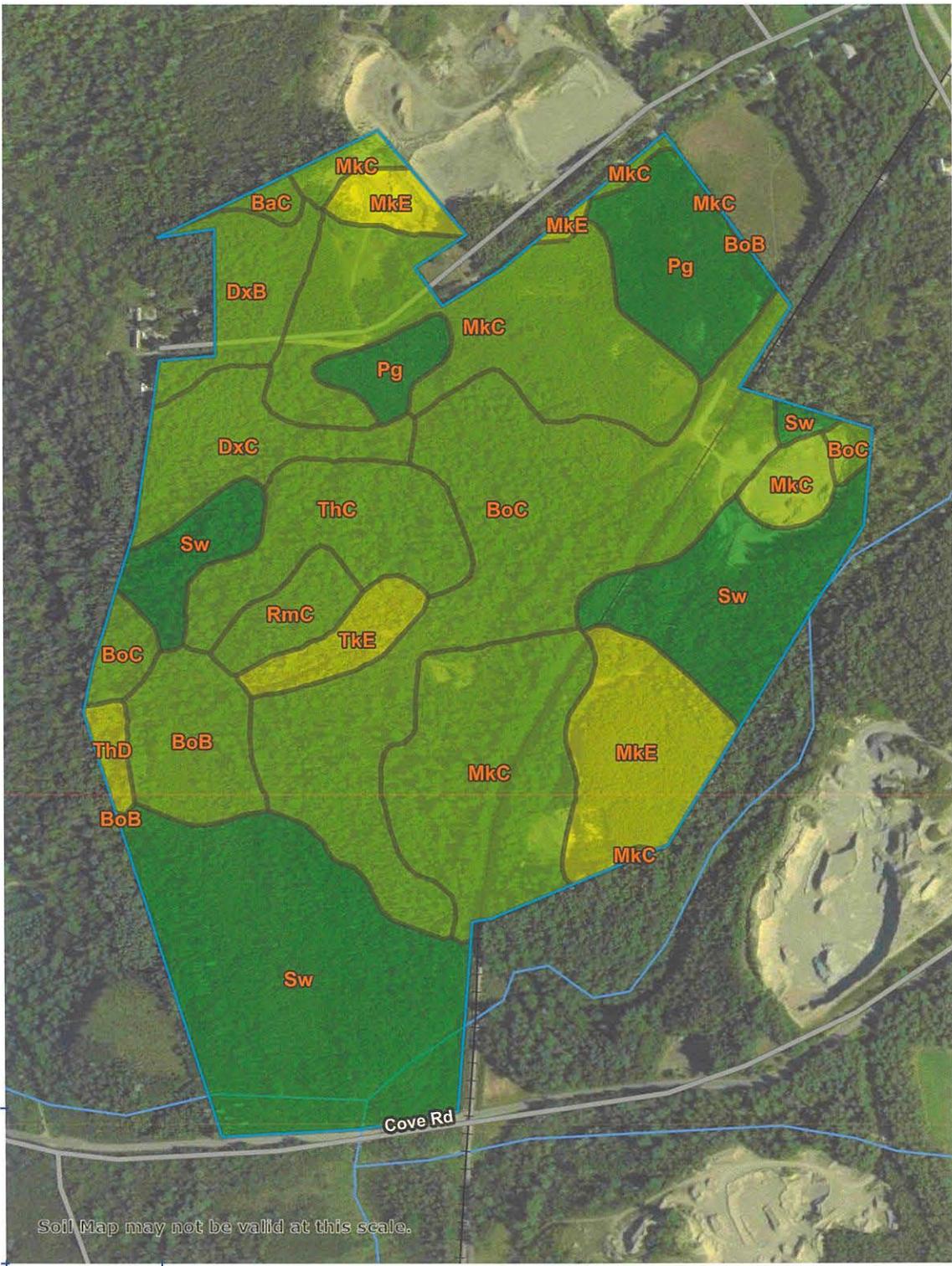
Custom Soil Resource Report
 Map—Representative Slope (Property of The City of Bangor in the Town of Winterport, ...)

68° 53' 14" W

68° 52' 22" W

44° 41' 13" N

44° 41' 13" N



Soil Map may not be valid at this scale.

44° 40' 24" N

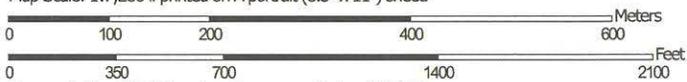
44° 40' 24" N

68° 53' 14" W

68° 52' 22" W



Map Scale: 1:7,280 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84

MAP LEGEND

- Area of Interest (AOI)**
 -  Area of Interest (AOI)
- Soils**
 - Soil Rating Polygons**
 -  0 - 5
 -  5 - 15
 -  15 - 45
 -  45 - 60
 -  60 - 100
 -  Not rated or not available
 - Soil Rating Lines**
 -  0 - 5
 -  5 - 15
 -  15 - 45
 -  45 - 60
 -  60 - 100
 -  Not rated or not available
 - Soil Rating Points**
 -  0 - 5
 -  5 - 15
 -  15 - 45
 -  45 - 60
 -  60 - 100
 -  Not rated or not available
- Water Features**
 -  Streams and Canals

- Transportation**
 -  Rails
 -  Interstate Highways
 -  US Routes
 -  Major Roads
 -  Local Roads
- Background**
 -  Aerial Photography

MAP INFORMATION

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Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL:
 Coordinate System: Web Mercator (EPSG:3857)

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Custom Soil Resource Report

Table—Representative Slope (Property of The City of Bangor in the Town of Winterport, Maine)

Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
BaC	Bangor silt loam, 8 to 15 percent slopes	12.0	0.8	0.4%
BoB	Boothbay silt loam, 3 to 8 percent slopes	6.0	6.8	3.8%
BoC	Boothbay silt loam, 8 to 15 percent slopes	12.0	34.4	19.4%
DxB	Dixmont silt loam, 3 to 8 percent slopes	6.0	5.3	3.0%
DxC	Dixmont silt loam, 8 to 15 percent slopes	12.0	7.4	4.2%
MkC	Masardis fine sandy loam, 8 to 15 percent slopes	12.0	38.7	21.8%
MkE	Masardis fine sandy loam, 15 to 45 percent slopes	30.0	12.3	7.0%
Pg	Pits, gravel and sand	2.0	10.9	6.2%
RmC	Rock outcrop-Lyman complex, 3 to 15 percent slopes	9.0	3.2	1.8%
Sw	Swanville silt loam, 0 to 3 percent slopes	2.0	43.3	24.4%
ThC	Thorndike-Winnecook complex, 8 to 15 percent slopes, rocky	10.0	9.6	5.4%
ThD	Thorndike-Winnecook complex, 15 to 35 percent slopes, very rocky	20.0	1.2	0.7%
TkE	Thorndike-Rock outcrop complex, 15 to 45 percent slopes, very stony	30.0	3.2	1.8%
Totals for Area of Interest			177.2	100.0%

Rating Options—Representative Slope (Property of The City of Bangor in the Town of Winterport, Maine)

Units of Measure: percent

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Interpret Nulls as Zero: No

Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

Land Management

This folder contains a collection of tabular reports that present soil interpretations related to land management. The reports (tables) include all selected map units and components for each map unit, limiting features and interpretive ratings. Land management interpretations are tools designed to guide the user in evaluating existing conditions in planning and predicting the soil response to various land management practices, for a variety of land uses, including cropland, forestland, hayland, pastureland, horticulture, and rangeland. Example interpretations include suitability for a variety of irrigation practices, log landings, haul roads and major skid trails, equipment operability, site preparation, suitability for hand and mechanical planting, potential erosion hazard associated with various practices, and ratings for fencing and waterline installation.

Forestland Harvesting (ME) (Property of The City of Bangor in the Town of Winterport, Maine)

This table can help forestland owners or managers plan the use of soils for wood crops. Interpretive ratings are given for the soils according to the limitations that affect harvesting on forestland. The ratings are both verbal and numerical.

Rating class terms for suitability for use of harvesting equipment and for log landings indicate the degree to which the soils are suited to that specified aspect of forestland management. *Well suited* indicates that the soil has features that are favorable for the specified management aspect and has no limitations. Good performance can be expected, and little or no maintenance is needed. *Moderately suited* indicates that the soil has features that are moderately favorable for the specified management aspect. One or more soil properties are less than desirable, and fair performance can be expected. Some maintenance is needed. *Poorly suited* indicates that the soil has one or more properties that are unfavorable for the specified management aspect. Overcoming the unfavorable properties requires special design, extra maintenance, and costly alteration. *Unsuited* indicates that the expected performance of the soil is unacceptable for the specified management aspect or that extreme measures are needed to overcome the undesirable soil properties.

Numerical ratings in the table indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative

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impact on the specified aspect of forestland management (1.00) and the point at which the soil feature is not a limitation (0.00).

The paragraphs that follow indicate the soil properties considered in rating the soils. More detailed information about the criteria used in the ratings is provided in the "National Forestry Manual," which is available in local offices of the Natural Resources Conservation Service or on the Internet.

Ratings in the column *Suitability for use of harvesting equipment (ME)* are based on slope, rock fragments on the surface, plasticity index, content of sand, the Unified classification, depth to a water table, and ponding. The soils are described as well suited, moderately suited, or poorly suited to this use.

Ratings in the column *Suitability for log landings (ME)* are based on slope, rock fragments on the surface, plasticity index, content of sand, the Unified classification, depth to a water table, ponding, flooding, and the hazard of soil slippage. The soils are described as well suited, moderately suited, or poorly suited to use as log landings.

Ratings in the column *General harvest season (ME)* are for the period during the year when mechanized timber harvesting or thinning causes the least amount of soil damage. This period is generally when the soil is not too wet or when the ground is frozen or has adequate snow cover. The ratings are based on depth and duration of the seasonal high water table and the parent material as it relates to soil texture. Starting with the driest sites, map units that are rated *Year Round* are generally suited for forest management activities in all but the wettest periods of the year. These soils formed in sandy and gravelly glacial outwash parent material and have a seasonal high water at a depth of more than 6 feet. Map units that are rated *Except Spring* are generally suited for forest management activities throughout the year except for periods in the spring when the soil is saturated due to snowmelt and seasonal runoff. The soils formed in a variety of parent materials and have a seasonal high water at a depth of more than 6 feet. Map units that are rated *Summer and Winter* are generally suited for forest management activities in the dry summer period and during winter when the ground is frozen or snow covered. The soils formed in a variety of parent materials and have a seasonal high water table at a moderate depth within the soil. Map units that are rated *Winter Only* are limited to forest management activities in the winter when the ground is frozen or when there is sufficient snow depth to prevent soil rutting and compaction. The soils formed in a variety of parent materials, have a seasonal high water table at a shallow depth within the soil, and are all classified as hydric soils. Map units that are *Not Rated* are generally not used for woodland and have very limited potential for commercial forest management.

Reference:

United States Department of Agriculture, Natural Resources Conservation Service, National Forestry Manual.

Report—Forestland Harvesting (ME) (Property of The City of Bangor in the Town of Winterport, Maine)

[Onsite investigation may be needed to validate the interpretations in this table and to confirm the identity of the soil on a given site. The numbers in the value columns range from 0.01 to 1.00. In the suitability for use of harvesting equipment and log landing columns, the larger the value, the greater the potential limitation. In the

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general harvest season column the value will always be 1.00. The table shows only the top five limitations for any given soil. The soil may have additional limitations]

Forestland Harvesting (ME)—Waldo County, Maine							
Map symbol and soil name	Pct. of map unit	General harvest season (ME)		Suitability for use of harvesting equipment (ME)		Suitability for log landings (ME)	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
MkC—Masardis fine sandy loam, 8 to 15 percent slopes							
Masardis	89	Year round		Well suited		Moderately suited	
		Year Round	1.00			Slope	0.50
DxC—Dixmont silt loam, 8 to 15 percent slopes							
Dixmont	88	Summer & winter		Moderately suited		Moderately suited	
		Seasonal soil wetness	1.00	Wetness	0.50	Slope	0.50
						Wetness	0.50
MkE—Masardis fine sandy loam, 15 to 45 percent slopes							
Masardis	88	Year round		Moderately suited		Poorly suited	
		Year Round	1.00	Slope	0.50	Slope	1.00
BoB—Boothbay silt loam, 3 to 8 percent slopes							
Boothbay	86	Summer & winter		Moderately suited		Poorly suited	
		Seasonal soil wetness	1.00	Wetness	0.58	Wetness	1.00
						Slope	0.50
DxB—Dixmont silt loam, 3 to 8 percent slopes							
Dixmont	86	Summer & winter		Moderately suited		Moderately suited	
		Seasonal soil wetness	1.00	Wetness	0.50	Wetness	0.50
						Slope	0.50
BoC—Boothbay silt loam, 8 to 15 percent slopes							
Boothbay	85	Summer & winter		Moderately suited		Moderately suited	
		Seasonal soil wetness	1.00	Wetness	0.50	Slope	0.50
						Wetness	0.50
Sw—Swanville silt loam, 0 to 3 percent slopes							
Swanville	85	Winter only		Moderately suited		Poorly suited	
		Long term soil wetness	1.00	Wetness	0.83	Wetness	1.00

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Forestland Harvesting (ME)—Waldo County, Maine							
Map symbol and soil name	Pct. of map unit	General harvest season (ME)		Suitability for use of harvesting equipment (ME)		Suitability for log landings (ME)	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
BaC—Bangor silt loam, 8 to 15 percent slopes							
Bangor	84	Except spring		Well suited		Moderately suited	
		Seasonal soil wetness	1.00			Slope	0.50
Pg—Pits, gravel and sand							
Pits	83	Not Rated		Not rated		Not rated	
TkE—Thorndike-Rock outcrop complex, 15 to 45 percent slopes, very stony							
Thorndike	60	Except spring		Moderately suited		Poorly suited	
		Seasonal soil wetness	1.00	Slope	0.50	Slope	1.00
RmC—Rock outcrop-Lyman complex, 3 to 15 percent slopes							
Rock outcrop	59	Not Rated		Not rated		Not rated	
ThD—Thorndike-Winnecook complex, 15 to 35 percent slopes, very rocky							
Thorndike	55	Except spring		Moderately suited		Poorly suited	
		Seasonal soil wetness	1.00	Slope	0.50	Slope	1.00
ThC—Thorndike-Winnecook complex, 8 to 15 percent slopes, rocky							
Thorndike	55	Except spring		Well suited		Moderately suited	
		Seasonal soil wetness	1.00			Slope	0.50
ThD—Thorndike-Winnecook complex, 15 to 35 percent slopes, very rocky							
Winnecook	30	Except spring		Moderately suited		Poorly suited	
		Seasonal soil wetness	1.00	Slope	0.50	Slope	1.00
ThC—Thorndike-Winnecook complex, 8 to 15 percent slopes, rocky							
Winnecook	30	Except spring		Well suited		Moderately suited	
		Seasonal soil wetness	1.00			Slope	0.50

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Forestland Harvesting (ME)–Waldo County, Maine							
Map symbol and soil name	Pct. of map unit	General harvest season (ME)		Suitability for use of harvesting equipment (ME)		Suitability for log landings (ME)	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
RmC—Rock outcrop-Lyman complex, 3 to 15 percent slopes							
Lyman, very stony	23	Except spring		Moderately suited		Moderately suited	
		Seasonal soil wetness	1.00	Rock fragments	0.50	Slope	0.50
						Rock fragments	0.50
TkE—Thorndike-Rock outcrop complex, 15 to 45 percent slopes, very stony							
Rock outcrop	20	Not Rated		Not rated		Not rated	

Vegetative Productivity

This folder contains a collection of tabular reports that present vegetative productivity data. The reports (tables) include all selected map units and components for each map unit. Vegetative productivity includes estimates of potential vegetative production for a variety of land uses, including cropland, forestland, hayland, pastureland, horticulture and rangeland. In the underlying database, some states maintain crop yield data by individual map unit component. Other states maintain the data at the map unit level. Attributes are included for both, although only one or the other is likely to contain data for any given geographic area. For other land uses, productivity data is shown only at the map unit component level. Examples include potential crop yields under irrigated and nonirrigated conditions, forest productivity, forest site index, and total rangeland production under of normal, favorable and unfavorable conditions.

Forestland Productivity (Property of The City of Bangor in the Town of Winterport, Maine)

This table can help forestland owners or managers plan the use of soils for wood crops. It shows the potential productivity of the soils for wood crops.

Potential productivity of merchantable or *common trees* on a soil is expressed as a site index and as a volume number. The *site index* is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that forestland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability. More detailed information regarding site index is available in the "National Forestry Manual," which is available in local offices of the Natural Resources Conservation Service or on the Internet.

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The *volume of wood fiber*, a number, is the yield likely to be produced by the most important tree species. This number, expressed as cubic feet per acre per year and calculated at the age of culmination of the mean annual increment (CMAI), indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

Trees to manage are those that are preferred for planting, seeding, or natural regeneration and those that remain in the stand after thinning or partial harvest.

Reference:

United States Department of Agriculture, Natural Resources Conservation Service, National Forestry Manual.

Report—Forestland Productivity (Property of The City of Bangor in the Town of Winterport, Maine)

Forestland Productivity—Waldo County, Maine				
Map unit symbol and soil name	Potential productivity			Trees to manage
	Common trees	Site Index	Volume of wood fiber <i>Cu ft/ac/yr</i>	
BaC—Bangor silt loam, 8 to 15 percent slopes				
Bangor	Balsam fir	56	114.00	Eastern white pine, European larch, Red pine, Tamarack, White spruce
	Eastern white pine	75	143.00	
	Red spruce	57	129.00	
	White spruce	64	143.00	
BoB—Boothbay silt loam, 3 to 8 percent slopes				
Boothbay	Balsam fir	55	114.00	Eastern white pine, White spruce
	Eastern hemlock	—	0.00	
	Eastern white pine	62	114.00	
	Paper birch	56	57.00	
	Red maple	56	29.00	
	Red spruce	—	0.00	
	White spruce	55	129.00	
BoC—Boothbay silt loam, 8 to 15 percent slopes				
Boothbay	Balsam fir	55	114.00	Eastern white pine, White spruce
	Eastern hemlock	—	0.00	
	Eastern white pine	62	114.00	
	Paper birch	56	57.00	
	Red maple	56	29.00	
	Red spruce	—	0.00	
	White spruce	55	129.00	

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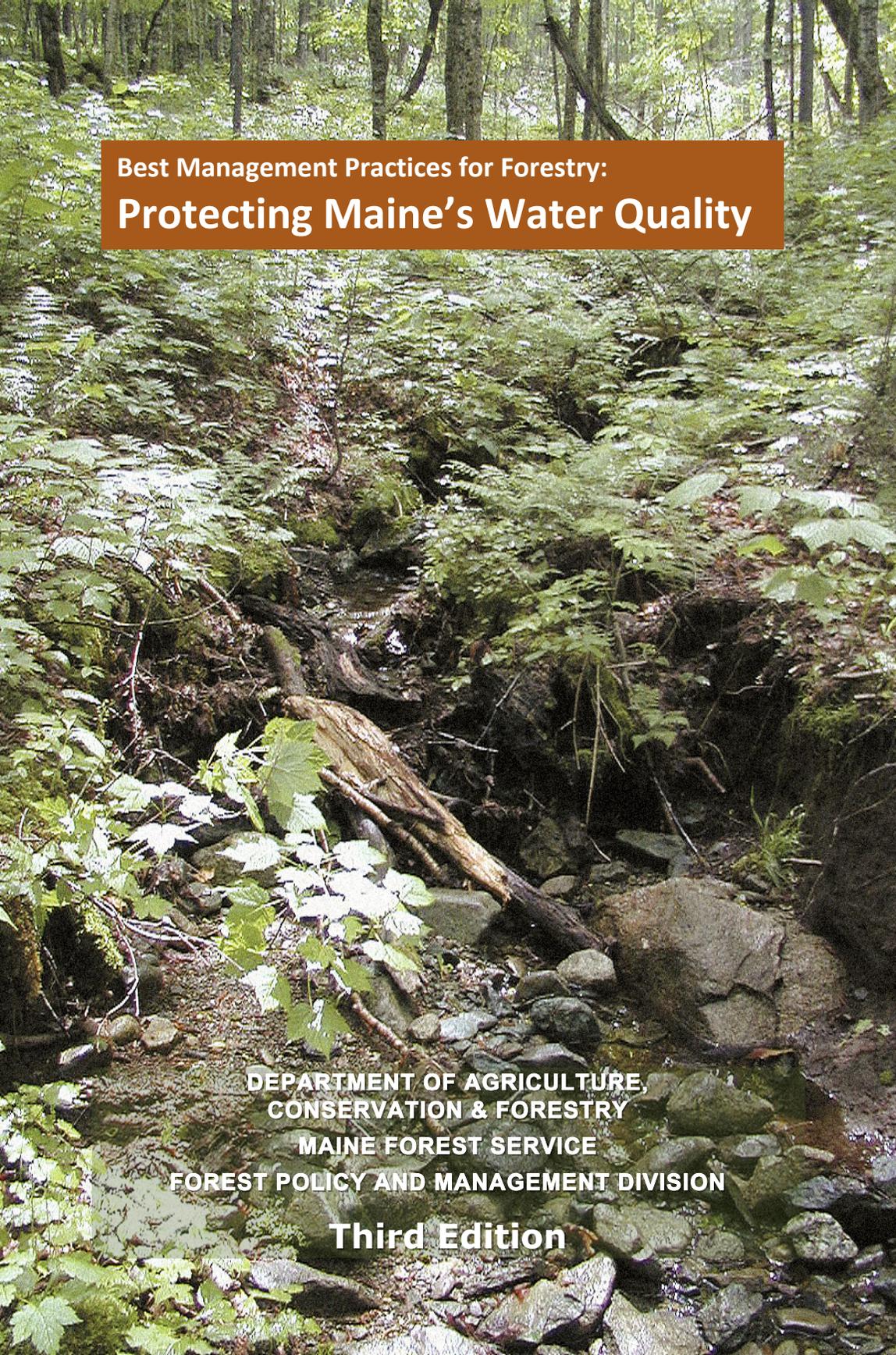
Forestland Productivity—Waldo County, Maine				
Map unit symbol and soil name	Potential productivity			Trees to manage
	Common trees	Site Index	Volume of wood fiber	
			<i>Cu ft/ac/yr</i>	
DxB—Dixmont silt loam, 3 to 8 percent slopes				
Dixmont	Balsam fir	54	100.00	Eastern white cedar, Eastern white pine, European larch, White spruce
	Eastern white pine	70	129.00	
	Paper birch	63	72.00	
	Red spruce	49	100.00	
	White spruce	51	114.00	
DxC—Dixmont silt loam, 8 to 15 percent slopes				
Dixmont	Balsam fir	54	100.00	Eastern white cedar, Eastern white pine, European larch, White spruce
	Eastern white pine	70	129.00	
	Paper birch	63	72.00	
	Red spruce	49	100.00	
	White spruce	51	114.00	
MkC—Masardis fine sandy loam, 8 to 15 percent slopes				
Masardis	Balsam fir	55	114.00	Eastern white pine, Red pine, White spruce
	Eastern white cedar	55	86.00	
	Eastern white pine	60	100.00	
	Paper birch	55	57.00	
	Red pine	52	86.00	
	Red spruce	45	100.00	
	Sugar maple	55	29.00	
	White spruce	48	100.00	
	Yellow birch	55	29.00	
MkE—Masardis fine sandy loam, 15 to 45 percent slopes				
Masardis	Balsam fir	55	114.00	Eastern white pine, Red pine, White spruce
	Eastern white cedar	55	86.00	
	Eastern white pine	60	100.00	
	Paper birch	55	57.00	
	Red pine	52	86.00	
	Red spruce	45	100.00	
	Sugar maple	55	29.00	
	White spruce	48	100.00	
	Yellow birch	55	29.00	
Pg—Pits, gravel and sand				
Pits	—	—	—	—

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Forestland Productivity—Waldo County, Maine				
Map unit symbol and soil name	Potential productivity			Trees to manage
	Common trees	Site Index	Volume of wood fiber	
			<i>Cu ft/ac/yr</i>	
RmC—Rock outcrop-Lyman complex, 3 to 15 percent slopes				
Rock outcrop	—	—	—	—
Lyman, very stony	Balsam fir	48	114.00	—
	Eastern white pine	56	—	
	Northern red oak	53	—	
	Red spruce	41	86.00	
	Sugar maple	50	29.00	
	White ash	56	—	
	White spruce	55	129.00	
Sw—Swanville silt loam, 0 to 3 percent slopes				
Swanville	—	—	—	—
ThC—Thorndike-Winnecook complex, 8 to 15 percent slopes, rocky				
Thorndike	Eastern white pine	62	114.00	Balsam fir, Red spruce, White spruce
	Paper birch	56	57.00	
	Red spruce	46	100.00	
	White spruce	56	129.00	
Winnecook	Balsam fir	55	114.00	American beech, Balsam fir, Eastern white pine, Northern white cedar, Red pine, Red spruce, Sugar maple, White ash, White spruce, Yellow birch
	Eastern white cedar	57	86.00	
	Eastern white pine	63	114.00	
	Northern white-cedar	57	86.00	
	Paper birch	57	57.00	
	Red spruce	44	86.00	
	Sugar maple	57	29.00	
	White spruce	48	100.00	
	Yellow birch	57	29.00	

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Forestland Productivity—Waldo County, Maine				
Map unit symbol and soil name	Potential productivity			Trees to manage
	Common trees	Site Index	Volume of wood fiber	
			<i>Cu ft/ac/yr</i>	
ThD—Thorndike-Winnecook complex, 15 to 35 percent slopes, very rocky				
Thorndike	Eastern white pine	62	114.00	Balsam fir, Red spruce, White spruce
	Paper birch	56	57.00	
	Red spruce	46	100.00	
	White spruce	56	129.00	
Winnecook	Balsam fir	55	114.00	American beech, Balsam fir, Eastern white pine, Northern white cedar, Red pine, Red spruce, Sugar maple, White ash, White spruce, Yellow birch
	Eastern white cedar	57	86.00	
	Eastern white pine	63	114.00	
	Northern white-cedar	57	86.00	
	Paper birch	57	57.00	
	Red spruce	44	86.00	
	Sugar maple	57	29.00	
	White spruce	48	100.00	
	Yellow birch	57	29.00	
TkE—Thorndike-Rock outcrop complex, 15 to 45 percent slopes, very stony				
Thorndike	Eastern white pine	62	114.00	Balsam fir, Red spruce, White spruce
	Paper birch	56	57.00	
	Red spruce	46	100.00	
	White spruce	56	129.00	
Rock outcrop	—	—	—	—



**Best Management Practices for Forestry:
Protecting Maine's Water Quality**

**DEPARTMENT OF AGRICULTURE,
CONSERVATION & FORESTRY
MAINE FOREST SERVICE
FOREST POLICY AND MANAGEMENT DIVISION**

Third Edition

The Maine Forest Service

The Maine Forest Service was established in 1891 to ensure Maine's citizens the greatest economic and social benefits from the trees and forestlands of the state.

The primary responsibilities of the Maine Forest Service include:

To develop through information, education and formal publications a greater public awareness and appreciation of forests as Maine's basic economy and renewable resource;

To provide advice and assistance in forest management to woodland owners;

To maintain and improve the scenic beauty, wildlife habitat and recreational values of Maine;

To encourage and promote appropriate forestland management practices;

To protect Maine's forests from fire, insects, diseases, and other natural enemies; and

To enforce Maine's forestry laws and rules by preventing violations, intervening with potential problems and, as a last resort, take enforcement action.



3rd Edition
January 2017

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This document was developed by the Maine Forest Service's Forest Policy and Management Division, with the assistance of FORAT (Forestry Advisory Team), an advisory group with broad representation from Maine's forestry community.

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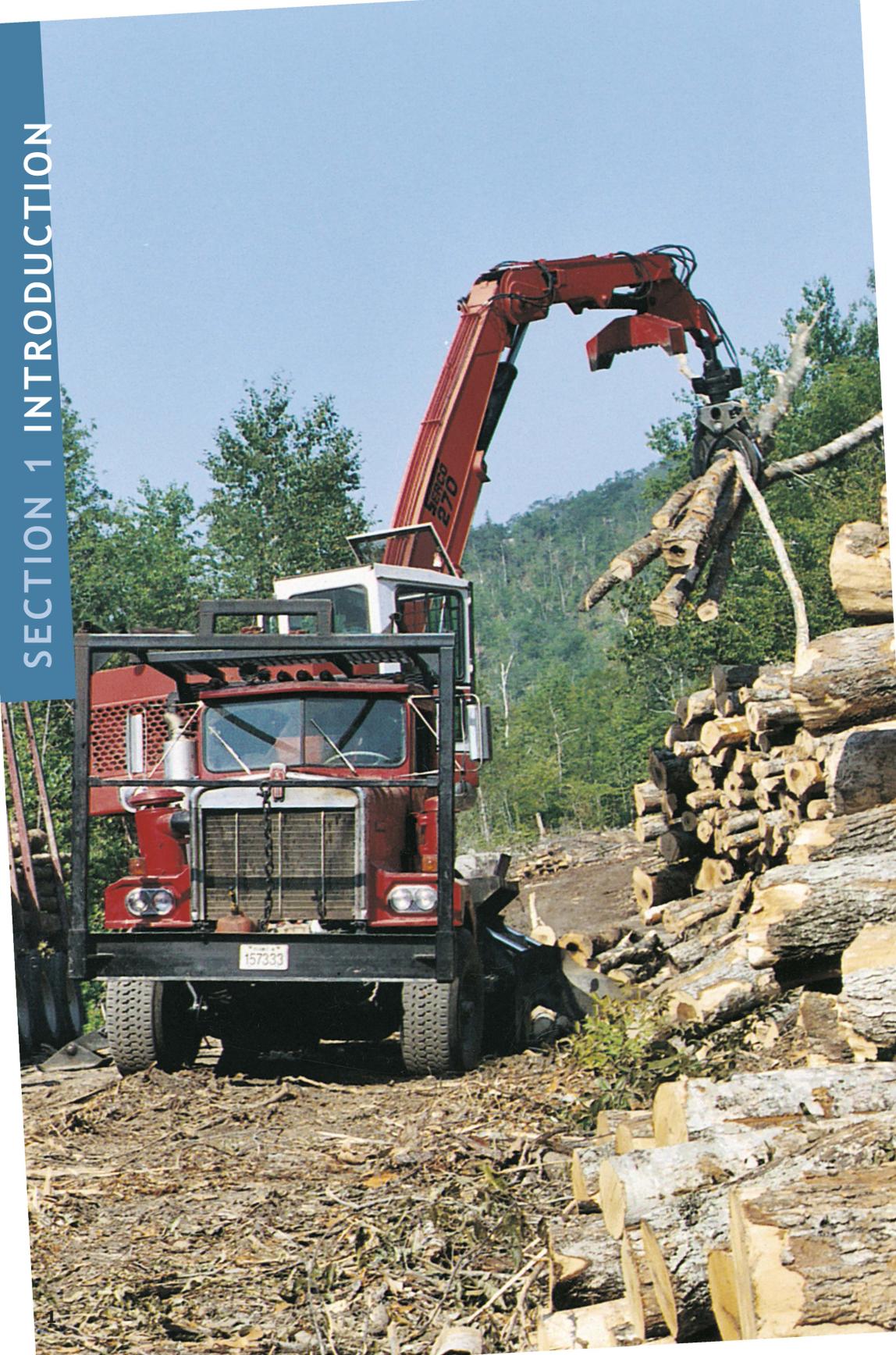
The Maine Forest Service would like to thank the hundreds of loggers, foresters, and landowners whose work in forest management and harvesting helped shape this manual. They demonstrate their professionalism every day.

3RD EDITION EDITS: Rondi Doiron, Greg Miller, Dan Jacobs, Don Mansius and Tom Gilbert.

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SECTION 1 INTRODUCTION



INTRODUCTION

WHAT THIS HANDBOOK IS

This handbook describes Best Management Practices, or BMPs, for protecting water quality during forest harvests. The BMPs include a wide range of recommended techniques that can be used before, during, and after logging operations. Loggers, foresters, and scientists from Maine and other states have developed these techniques from their own practical experience and research.

This handbook is for woodlot owners, loggers, foresters, and others involved in harvest operations. The handbook will help you understand, identify, design, and implement water quality protection measures while meeting other harvest objectives.

This book will help you to:

- Understand how BMPs work. It is more effective, cheaper, and easier to prevent pollution than to fix problems after they occur. When you understand the principles behind BMP techniques, you will be able to anticipate and prevent problems before they end up costing you time and money.
- Decide which BMPs to use. Harvest sites can vary significantly, and different techniques are appropriate to different sites. By applying BMP principles, you will be able to use your own judgment and this handbook to select the most appropriate and effective BMPs for a particular site.

WHAT THIS HANDBOOK IS NOT

BMPs are not the same as regulations. Best Management Practices are recommended procedures that, when used appropriately, will result in the greatest protection of the environment over the course of the operation. Regulations prescribe required, minimally acceptable practices. Some BMPs may be mandatory in some situations; others may be voluntary, depending on the site and local and state laws.

This handbook is not a complete how-to manual for installing BMPs. Please see "Section 4: For More Information" for titles of other documents that provide technical details on BMP installation.

This handbook focuses on water quality BMPs. There are BMPs that protect wildlife habitat, soil integrity and productivity, aesthetics, and other aspects of the forests. Although these values are important, they are not the focus of this manual.

HOW TO USE THIS MANUAL

In order to decide how and when to use BMPs, it's important to understand how they work to protect water quality. "Section 1: What is Water Quality?" explains different characteristics of water quality, how harvesting practices can affect them, and where it is most critical to use BMPs.

"Section 2: Fundamental BMPs" discusses fundamental BMP principles and key steps toward the overall goal of protecting water quality. These principles give you an overview of the most important things to keep in mind before, during, and after a harvest.

"Section 3: BMPs for Every Stage" lists specific BMPs for stream crossings, truck roads, log landings, skid trails, and harvesting areas. Under each of these headings is a discussion of the planning, construction, maintenance, and closeout BMPs applicable to that topic.

Throughout the manual, you will also find  signs that will alert you to potential legal requirements.  signs will point out important topics that shouldn't be overlooked. Each section is color-coded on the edge of the page to make it easier for you to find information about a specific topic.

SECTION 3 BMPs FOR EVERY STAGE

BMPs

BUILD IT RIGHT

PERMANENT CROSSINGS

 Permanent crossings may require permits, especially if water must be diverted during installation.

- 1 If possible, build crossings when streams are dry or at low water. If considerable excavation is necessary during periods of regular or high flow, temporarily divert the water while installing the crossings.
- 2 Install crossings and approaches using a "no-grub zone" at least the width of the filter area, wherever possible.
 - Minimize excavation on stream banks and approaches.
 - Construct road approaches using fill (instead of grubbing), leaving the forest floor undisturbed, especially outside the road profile. Consider surfacing with clean gravel or stone. This will stabilize the road surface, prevent it from eroding directly into the stream, and keep mud from being tracked onto the crossing structure.
 - Use geotextile and fill on unstable soils or during wet weather.
 - Set abutments back from the stream's edge.
- 3 Design bridges using solid decking or other features to minimize the amount of material that falls through the deck and into the stream.




Two types of permanent crossings.

HOW BMPs PROTECT WATER QUALITY

WHAT IS WATER QUALITY?

Forest areas in and around waterbodies are complex systems and provide habitat for a wide range of plants and animals. These forest areas, and the waterbodies in them, are the setting for different processes that provide food, water, shelter, breeding space, and other needs. For our purposes, “water quality” refers to the characteristics of water in nature that support life. These include the natural chemical, physical, and biological aspects of streams, rivers, ponds, lakes, and non-forested wetlands. The chemical properties of water include pH, dissolved oxygen, nutrients, and the presence of chemical pollutants. The physical properties of water include such things as turbidity (how clear or cloudy the water is) and temperature. In addition, the physical characteristics and natural processes of waterbodies are important aspects of water quality. Examples include stable channels, the transport of nutrients, the volume and speed of the water, the streambed material, and sticks and logs that have fallen into streams naturally.

Forest streams, lakes, and wetlands typically have excellent water quality. Forestry operations that use best management practices can protect these waterbodies’ natural ability to support life. By preventing stream sedimentation, such operations can maintain streambed properties and the clean water that allows fish—and the aquatic insects they depend on—to feed and spawn. Leaving trees that shade and provide leaf litter to waterbodies limits changes in water temperature and chemical characteristics that could reduce the ability of some species to survive and reproduce. These are just the most commonly understood examples of how maintaining the properties of water in forests can protect aquatic habitats.

Although water quality is a complex subject, BMPs are intended as relatively simple, practical steps that protect water quality. Most BMPs in this manual address turbidity by keeping sediment out of streams. Several other BMPs preserve the physical integrity of waterbodies and their natural processes. If these issues are addressed, most other aspects of water quality will be protected, too.

KEY ISSUE

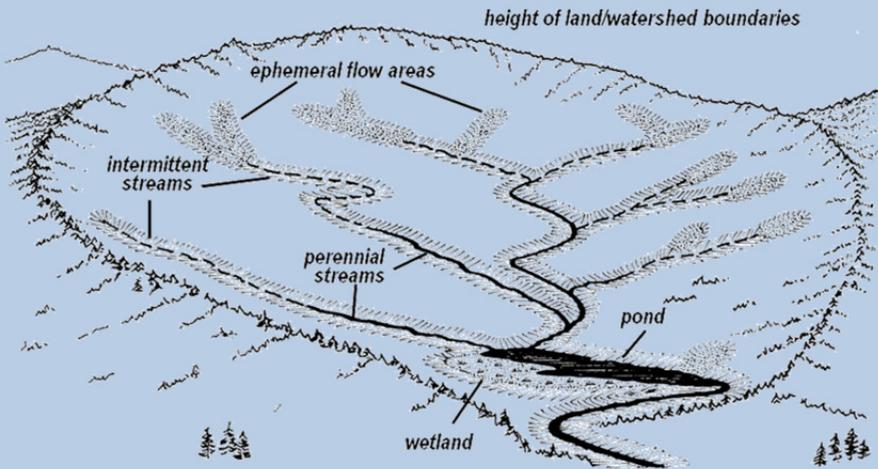
Water Movement

Maine has thousands of lakes and ponds, large areas of forested and non-forested wetland, and thousands of miles of streams and rivers. All these forest waterbodies, and the areas that drain to them, are connected by moving water. Most of the water in the forest comes from rain or snowmelt which is either absorbed into the soil, flows over the ground, or enters stream channels, flowing downhill.

WATERSHED

A **watershed** is all the land and waterbodies from which water drains to a given point. You can define a watershed for an entire lake, for a stream at a crossing site, or for a river where it reaches the ocean. Watersheds range in size from just a few acres (for a small stream), to thousands of acres (for a large river). All land is part of some watershed.

It is critical to understand where water is coming from and draining to in the watershed where logging is planned. The amount of cutting or road construction at higher elevations can affect the amount and timing of runoff at lower elevations within the same watershed. When you know where, when, and how much water flows in the harvest area, you will be able to determine the best locations for roads and trails, and what types of BMPs you will need to control water movement.



The watershed of a pond.

In this manual, “waterbodies” includes streams, rivers, lakes, ponds, and wetlands, as well as coastal areas. BMPs are recommended primarily for those areas where water is at or near the surface (streams, lakes, or wetlands), and where runoff can move directly into surface waterbodies. These waterbodies and related areas are defined and illustrated below.

EPHEMERAL FLOW AREAS

Ephemeral flow areas are small drainage areas that flow into streams, but have no defined, continuous channel. Examples are low-lying depressions, or swales with an intact forest floor. Soils in these areas may quickly become saturated during rainy periods, storms, or snowmelt. Surface water flows in these low areas over saturated soil without forming a channel. Water from ephemeral flow areas may carry sediment or other materials directly into streams. Ephemeral flow areas change in size in response to the soil and weather conditions, and are the proximate source of much of the water that enters small streams.



Ephemeral flow areas are small drainages, with no defined channel, where water flows into streams during wet periods.

STREAMS

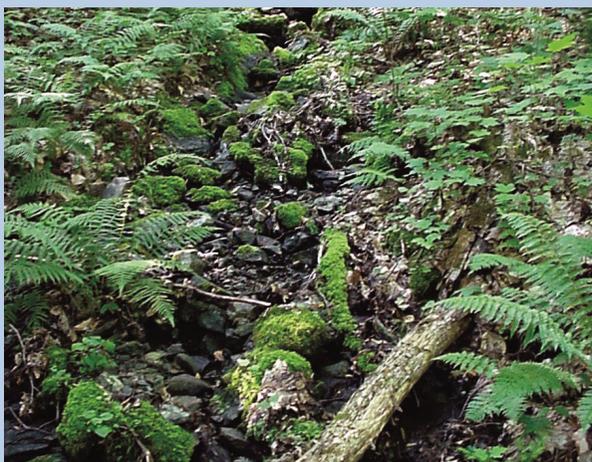
Streams are natural water channels that:

- may flow year-round or only part of the year;
- have a defined channel and banks;
- are relatively continuous and connected with larger surface waters; and
- have a streambed where flowing water has exposed the mineral bottom of soil, sand, gravel, ledge, or rock.

Forest streams in Maine vary widely in how much water they carry, how steep they are, the shape of the streambed or channel, how much area they drain, and when they flow. **Perennial streams** flow year-round and range from small brooks to large rivers; **intermittent streams** flow only a few months of the year, and/or during wet seasons.



Streams can vary widely, but all have a defined, continuous channel, a streambed with exposed soil, and carry water at least part of the year.



The **normal high water mark** is the place on the stream bank where the highest water levels typically occur, often during spring runoff. You can identify it from features like undercutting of the bank; a change in the type of vegetation; exposed roots that do not penetrate beyond a certain level; root scars; and water stains on stems, roots, or other vegetation.



One indication of the normal high water mark is undercutting or scouring of the bank.

WETLANDS

Wetlands are areas where soils are saturated or flooded a significant part of the year, and where water-loving plants are often found. Wetland soils usually have developed special characteristics, and often have a significant amount of water moving below the surface.

Forested wetlands are dominated (or potentially dominated) by trees taller than 20 feet. Forested wetlands vary widely in their characteristics, often have relatively little water directly at the surface, and have indistinct borders. They may require considerable expertise to identify. Forested wetlands are often managed for timber, with roads and trails crossing them.

Non-forested or **open wetlands** are not dominated by trees, though they may have some scattered trees, mostly less than 20 feet tall. They have water at or near the surface at least part of the year, and may have a more or less distinct border defined by the surrounding forest. The high water and organic content of wetland soils make them considerably weaker than upland soils and difficult to work in. Non-forested wetlands are not managed for timber, and should be crossed only when they cannot be avoided.

Vernal pools are a type of wetland, typically forested, which provide specialized habitat and deserve special attention. Separate guidelines for protecting vernal pool habitat are available from the Maine Forest Service.



forested wetlands



non-forested wetlands



vernal pools

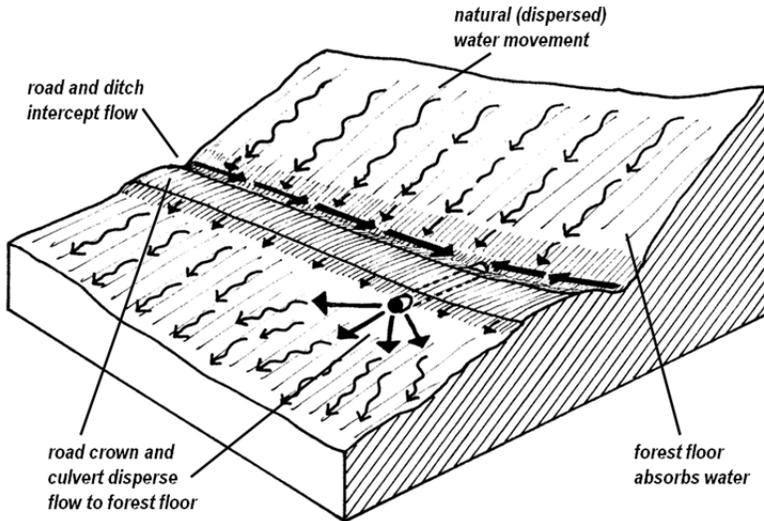
HOW HARVESTING AFFECTS WATER QUALITY

HOW HARVESTING CHANGES WATER FLOW

Forest harvests can directly impact water quality by affecting how water flows through an area. In particular, constructing roads, trails, landings, or drainage systems can:

- **Reduce the soil's absorbency.** This can occur any time the forest floor is disturbed, removed, compacted, or otherwise damaged.
- **Increase soil erosion.** The opportunity for soil to be carried away by runoff increases greatly when mineral soil is exposed or fill is used.
- **Divert water flows.** Roads and trails can block or intercept water moving over or through the soil. The more water that accumulates, the greater the chance that it will form a channel and start eroding soil. Sometimes harvesting can cause streams to erode a new channel by blocking the stream's flow with logs or debris.
- **Concentrate water flows.** Roads, trails, landings, and their associated drainage structures can collect and funnel runoff, creating rills or gullies. In these situations, water erodes and transports exposed soil in its path.
- **Diminish the benefits of vegetation next to waterbodies.** Harvesting may reduce shade on the water's surface, reduce the amount of natural woody debris, or eliminate leaf litter that is an important food source for aquatic life. In addition, timber harvests that remove a significant percentage of the trees in a watershed can increase the amount of water moving through the soil into streams, and in some instances, increase flooding.

Usually, it is impossible to avoid disturbing some soil or concentrating some flowing water during a harvest. The important point to remember is to avoid these disturbances as much as possible, and to use BMPs to prevent them from resulting in sedimentation or erosion.



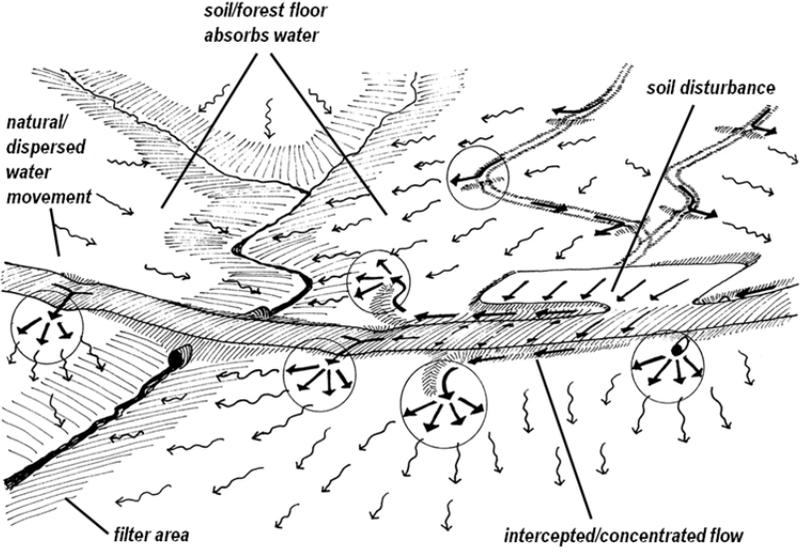
Harvesting operations intercept natural water movement and concentrate it in ditches or on the road/trail surface.

DRAINAGE SYSTEMS OR STRUCTURES are techniques used to get water off the road, trails, or landing. These can include the road crown, ditches, turnouts, cross-drainage culverts, water bars, etc.

WHAT DO BMPs DO?

BMPs are designed to mimic or protect the natural functions of forests. BMPs can absorb or disperse runoff, retain soil nutrients, filter sediment, prevent large changes in water temperature, and contribute organic material to surface waters.

- **BMPs minimize the risk of sediment and other pollutants getting into waterbodies.** Sediment—soil, dirt, silt, sand, mud—is the primary type of water pollution from forestry operations.
- **BMPs maintain the natural flow of water in streams and wetlands.** They avoid blockages, keep water flowing in its natural path, and prevent damage to the streambed and banks.
- **BMPs protect shoreland vegetation.** Some practices simply preserve enough of the forest so that it continues to function normally: shading the waterbody and stabilizing water temperatures, maintaining the soil’s natural functions, and contributing organic matter that serves as habitat and a food source to aquatic plants and animals.



One way BMPs minimize impacts to water quality is by dispersing concentrated water flow. Circles indicate where BMPs disperse flow to the undisturbed forest floor.

SECTION 2 FUNDAMENTAL BMPs



FUNDAMENTAL BMPs

Most BMP techniques are based on a few basic principles. This section provides an overview of these fundamental BMPs and how they protect water quality.



Understanding these principles will enable you to select or adapt the BMPs

that are the most appropriate and effective. Think of these principles as goals. Any single practice or combination of practices that effectively achieves one or more of these key goals could be considered an appropriate BMP.

1. DEFINE OBJECTIVES AND RESPONSIBILITIES

- **Determine the harvest objectives with the landowner, forester, and logger.** The first step in planning, prior to beginning work, is to communicate with everyone involved what the harvest objectives are. Discuss what's going to be cut, where, and the desired condition of the remaining forest.
- **Decide who is responsible for BMPs.** You will want to agree in advance (and in a written contract) who is responsible for implementing the BMPs, including deciding when to operate, locating streams, laying out the operation, and planning and maintaining the BMPs.
- **Find out what legal requirements apply to waterbodies in the harvest area.** The basic legal requirement in Maine is to keep pollution—including mud, silt, rock, soil, brush, or chemicals—out of the water. When working near waterbodies, find out what town, state, or federal standards apply, and if permits are needed.

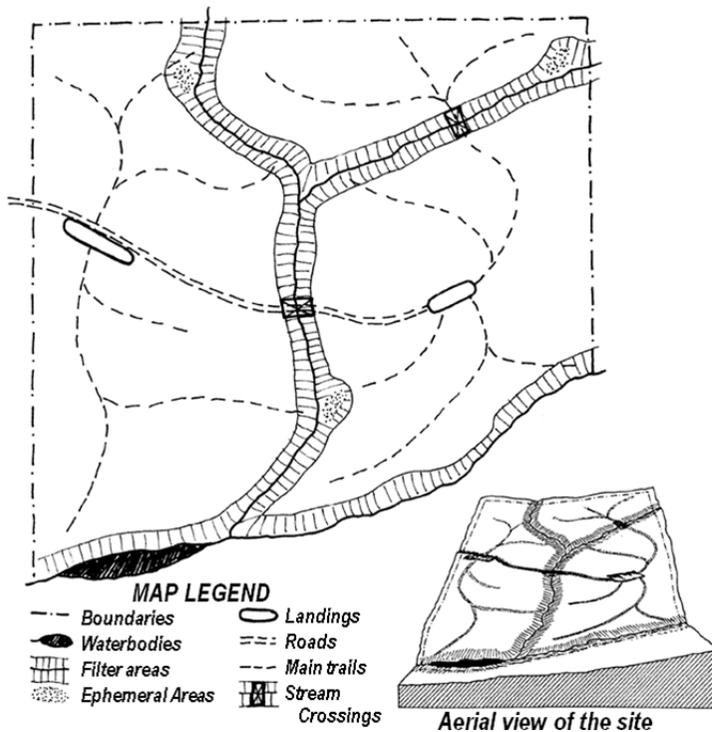


Know the laws! Landowners, foresters, and loggers should determine what laws apply on a particular job. However, it is Maine landowners who are responsible by state law for preventing mud, sediment, and other pollutants from entering waterbodies. This manual does not replace legal standards, and reading it is not a substitute for

2. PRE-HARVEST PLANNING

Pre-harvest planning is a good business practice and avoids many problems. Planning will help reduce costs, make the job more efficient, protect roads and trails that will stay in place after the job, leave the job looking better, *and* protect water quality.

- Determine the harvest area limits and property boundaries on the ground. Know whose responsibility it is to identify the property boundaries correctly.** While not essential to protecting water quality, locating property boundaries is common sense and good planning. There may be survey pins, blazes, wire fences, or stone walls that mark boundaries or property corners. Forest type maps, soil or topographic maps, or aerial photos help, too.



Example of a map showing planning and layout on a large lot.

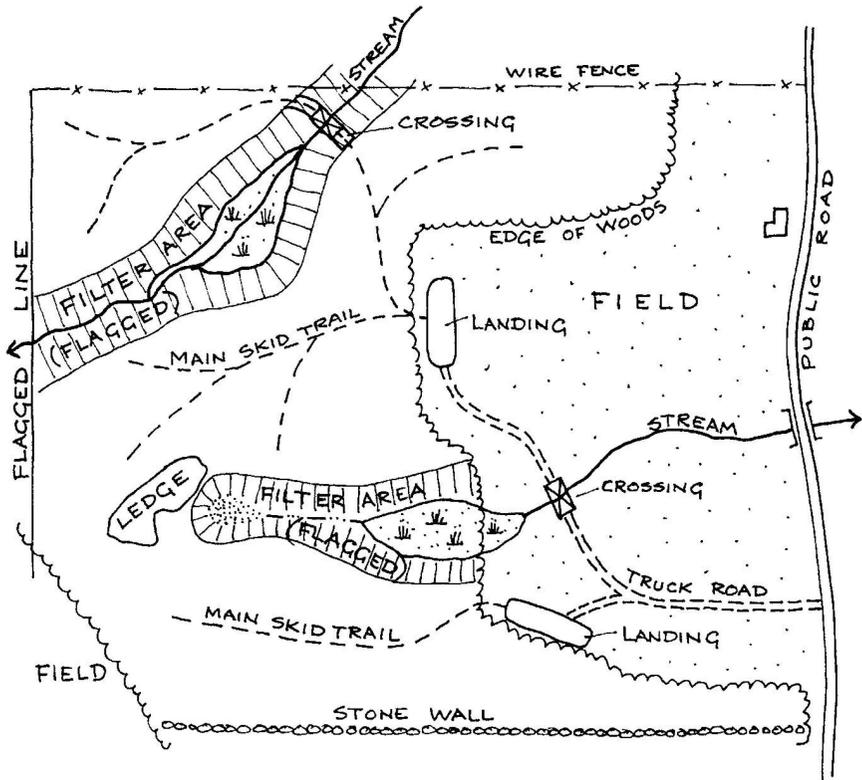


When in doubt, stop! Get more information or professional advice. Call The Maine Forest Service at (800) 367-0223 (in-state only) or (207) 287-2791 for answers and referrals to professionals who can help.

- **Identify streams, lakes or ponds, wetlands, and other features on maps and on the ground.** Maps and aerial photographs can help identify features like waterbodies, steep slopes, or poorly drained soils. Walking the property to locate important features on the ground is essential. If possible, do your planning on bare ground in wet seasons when surface water is visible.
- **Identify the areas where you need BMPs.** Forest harvesting BMPs are most critical in and immediately next to waterbodies including intermittent and perennial streams, lakes or ponds, wetlands and coastal areas—wherever direct impacts to surface water may occur. You may also need to use BMPs in other areas of the watershed where flowing water could be substantially altered or carry sediment into these waterbodies.
- **Lay out the harvest operation on the ground.** Harvest planning includes determining where operational features such as roads, stream crossings, landings, cut-and-fill areas, main skid trails, and particular BMPs will be needed. While on-site, make sure everyone involved in the harvest operation is aware of the layout—especially roads, skid trails, and filter areas next to waterbodies.



There is no substitute for laying out the harvest operation on the ground.



Example of a map showing planning and layout on a small lot.

- **Choose BMPs that are appropriate to the site conditions.** Most sedimentation occurs during short periods of heavy rain or snowmelt. How much rain falls during a storm, how much water streams carry, how stable the soils are, and what type of vegetation is present are all conditions that vary. BMPs that are sited, designed, and installed to anticipate adverse conditions work best.
- **Decide on BMPs for the entire harvest area and for closeout before beginning work.** BMP systems need not be complicated, but they require planning across the entire harvest area and over the entire duration of the operation, including closeout. Applying BMPs in one location can sometimes solve problems elsewhere on the site, or prevent problems after the operation is complete. When you understand the natural drainage system in the watershed, often you can use a combination of simple BMPs that are more effective— and cheaper—than more complex or expensive techniques.

- **Consider the needs of future operations on the same** property. Will roads, trails and landings be used again in five years, 15 years, or longer? Are there other areas of the property that can be accessed using the same roads? If you need to access the lot in the future, plan roads and trails accordingly. Otherwise, consider restricting vehicle access after the harvest. Because of the possibility of extreme weather conditions, it is important to design and close out roads properly. Identify which structures—such as culverts—will be left in place, and which will be removed. Considering the future can avoid problems and costly solutions.

3. ANTICIPATE SITE CONDITIONS

- **Time operations appropriately.** Harvesting under frozen, snow-covered, or dry conditions can minimize the need for additional BMPs. At the same time, a range of BMPs that are appropriately chosen, installed, and maintained can extend the harvest season. Use extra caution during fall and spring when streams are high and the ground is typically wetter—you may need to use additional BMPs to control the larger volume of water.



BMPs may extend the harvest season, reduce equipment wear and the amount of mud on logs, increase skidding efficiency, and protect your investment in roads and stream crossings.



Site conditions both during and after the harvest are likely to change.

- **Determine whether previous operations in the harvest area created conditions that are impacting—or could impact—water quality.** Old roads, log landings, and skid trails can be reused or upgraded. However, in some situations, avoiding or retiring them is a better choice. Using old roads, landings, and trails may be cheaper in the short run, but may be more costly to fix or maintain later. Pre-existing conditions may also influence your choice of BMPs.
- **Plan to monitor, maintain, and adjust BMPs as needed, especially to deal with seasonal or weather-related changes.** After installation, many BMPs require maintenance or modification. Conditions—such as the amount of water flowing in streams, soil moisture, or the depth of frost—can change quickly, even with one storm. Take into account how conditions may change, and maintain or install additional BMPs as needed. Determine who will be responsible for this work. In many instances, the landowner will want to periodically check and maintain BMPs that have been installed after harvesting is done. This often prevents washouts and a loss of access while protecting water quality at the same time.

4. CONTROL WATER FLOW

- **Understand how water moves within and around the harvest area, and decide how water flow will be controlled.** Concentrated flows of water on roads, skid trails, landings, and in drainage systems develop more force and a greater ability to erode soil and carry sediment. It is easiest and most effective to control small volumes of water, before they converge and accumulate into concentrated flows.
- **Slow down runoff and spread it out.** Many BMPs work by directing small amounts of water into areas of undisturbed forest floor where it can be absorbed.



Properly sized ditches capture and slow down runoff.

- **Protect the natural movement of water through wetlands.** Wetlands play an important role in the environment by storing water in wet periods and slowly releasing it back into the surrounding ground and streams. Logging roads and trail crossings can affect the flow of water within or through a wetland. This changes how much water the wetland stores, the degree of flooding that occurs, and the rate at which water leaves the wetland. Such impacts can affect the health of the wetland and waterbodies downstream.

5. MINIMIZE AND STABILIZE EXPOSED SOIL

Limiting soil disturbance and stabilizing areas where mineral soil is exposed are among the most important BMPs for preventing erosion. These practices are most critical in and around filter areas—forest areas bordering waterbodies. A detailed discussion of filter areas, how best to work in them, and soil stabilization starts on page 22. Generally speaking, there are two major objectives:

- **Minimize disturbance of the forest floor, especially in filter areas.** The forest floor absorbs water and filters out sediment and other pollutants. Exposed soil, on the other hand, can erode very rapidly. Most of the sediment that ends up in streams near managed forests comes from exposed soil on roads, landings, and skid trails. Know where the filter areas are and how to protect their capacity to absorb and filter runoff.
- **Stabilize areas of exposed soil within filter areas and in other locations where runoff has the potential to reach filter areas.** Use BMPs during or immediately after the harvest to prevent exposed soil or fill from eroding. These techniques and materials can be used near waterbodies, at stream crossings, road cut-and-fills, ditches, landings, and skid trails. In some situations, you may need to seed and/or plant vegetation in order to stabilize the soil.

6. PROTECT THE INTEGRITY OF WATERBODIES

- **Protect stream channels and banks.** Blocking or altering streams (with slash, for instance) may keep fish from swimming past the blockage. Damaged stream banks erode quickly, causing sedimentation and siltation. By protecting the physical integrity of streams, BMPs prevent these problems.
- **Leave enough shoreland vegetation to maintain water quality.** BMPs maintain the benefits that nearby trees and plants provide waterbodies. Streamside vegetation shades the water, minimizing temperature changes. Live roots stabilize the banks and maintain the soil's physical and chemical properties. Trees along the banks drop leaf litter and woody debris that supply nutrients and become habitat for plants and animals in the stream. Shoreland vegetation plays an important role in maintaining water quality.

7. HANDLE HAZARDOUS MATERIALS SAFELY



For assistance with spills of hazardous materials, call the Department of Environmental Protection's Division of Response Services office nearest you:

**Augusta (207) 287-7688
Bangor (207) 941-4570
Presque Isle (207) 764-0477
Portland (207) 822-6300**

**In an emergency, call
(800) 482-0777 (oils/fuels)
(800) 452-4664 (other chemicals)**

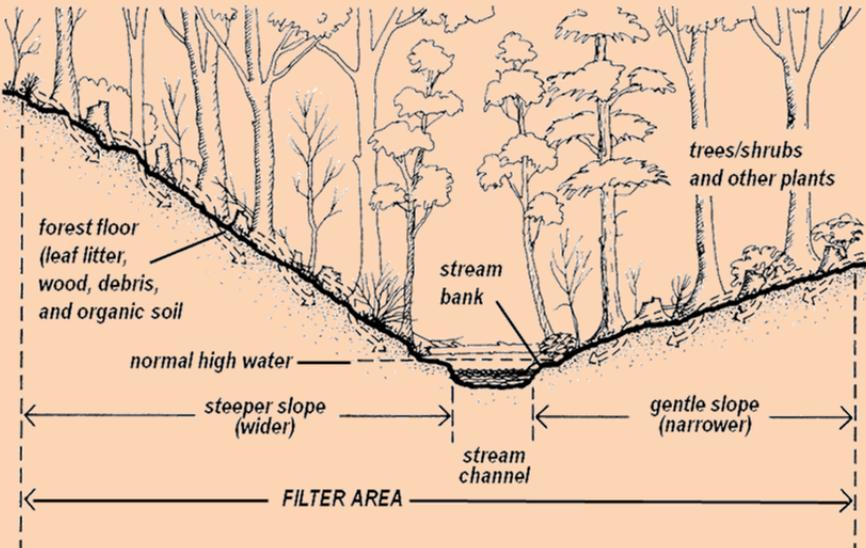
- **Be prepared for any emergency.** Keep an emergency response kit and contact information at the site for fuel, oil, or chemical spills. Remember that fertilizers, herbicides, pesticides, and road chemicals (calcium chloride, road salt, etc.) are hazardous materials, too. Know whom to call for help with unexpected erosion, accidents, or other emergencies. Having a backup plan and being prepared for unexpected and special situations can help avoid or minimize negative impacts to water quality. Industry groups, equipment suppliers, and local and state government agencies all have specialists available to help. Refer to "Section 4. For More Information" on page 94 for agency names, addresses, and telephone numbers.
- **Use and store hazardous materials properly.** The best way to avoid accidental spills of hazardous materials is to store and handle them so that the chance of these types of emergencies occurring is minimized. You'll find several BMPs in this manual that describe how to do this, starting on page 90.

KEY ISSUE
Filter Areas

Filter areas, broadly speaking, are forested areas bordering waterbodies that provide important functions, especially filtering sediment and debris from runoff and preventing pollutants from reaching waterbodies. Filter areas have several components.

- The **banks** of streams (or other waterbodies) protect and contain the water channel.
- The **forest floor**—especially the leaf litter, woody debris, and organic soil layer—absorbs and filters water as it moves over and through the soil.
- **Trees and other vegetation** shade the water (minimizing changes in water temperature), stabilize the banks, and add woody debris and organic matter to the water and forest floor.

Limiting impacts to these components within a minimum distance from the waterbody (depending on slope) typically maintains these benefits and protects water quality.



WORKING IN FILTER AREAS

Forested filter areas are not “no-harvest” zones; you can often cut within them. You can also use logging equipment in filter areas if the forest floor is protected. However, it is important that you take extra precautions within filter areas to prevent water pollution.

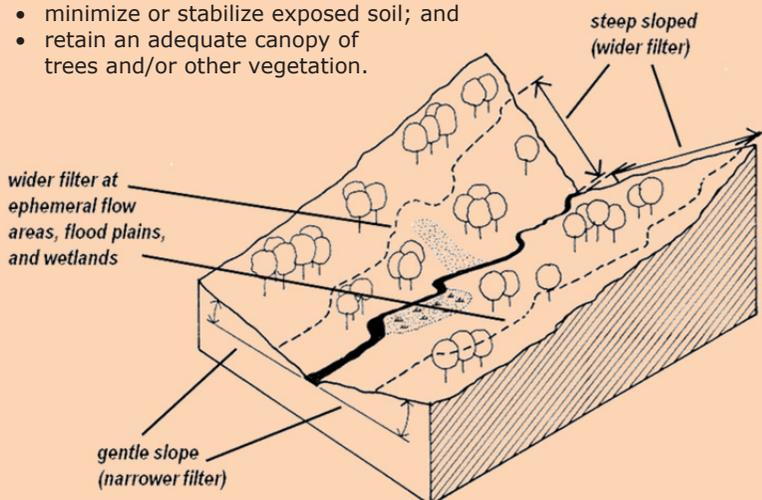
Note that the filter areas described here may be wider or narrower than regulatory requirements for forestry activities.

Table A
Minimum Filter Area Width

Slope (%)	Width from High Water Mark (ft.)
0	25
10	45
20	65
30	85
40	105
50	125
60	145
70+	165

BMPs

- Determine what legal requirements you must meet when working near waterbodies.**
- Delineate filter areas next to streams, lakes and ponds, and non-forested wetlands.** Minimum recommended widths (from the normal high water mark) for filter areas appear in Table A.
- Apply BMP techniques for roads, landings and skid trails (described in later sections) when working in filter areas to:**
 - minimize damage to the stream channel and stream banks;
 - protect the forest floor next to streams and other waterbodies from disturbance;
 - disperse concentrated flows of water through the area;
 - minimize or stabilize exposed soil; and
 - retain an adequate canopy of trees and/or other vegetation.



The minimum filter width varies with slope and site conditions.

4 Increase the width of the filter area and install more BMPs when local conditions call for it. The recommended minimum filter area widths are based on the ability of the undisturbed forest floor to absorb water and filter sediment. The actual width needed for the filter area to be effective may be greater than the minimums listed in Table A, depending on the site conditions and planned activity. Examples of situations where it is best to designate a filter area wider than that stated in Table A include:

- **Ephemeral flow areas next to waterbodies.** Water from ephemeral flow areas may carry sediment or other materials directly into streams (especially during wetter seasons).
- **Forested wetlands and floodplains next to waterbodies.** Typically, these are wetter, weaker soils. They are more likely to develop ruts and produce rapid runoff into nearby waterbodies.
- **Water diversions that concentrate flow.** Culverts, ditches, and other drainage structures may increase the amount of water flowing into the filter area. They could also create a new channel through the filter area, reducing its effectiveness. In these cases, increasing the filter area width and making sure the drainage structures and BMPs are properly installed will help disperse the water.
- **Some stand conditions.** Some sites may warrant wider filter areas to maintain the wind-firmness of the stand or provide adequate shade on the waterbody.



Forest harvesting operations in both non-forested and forested wetlands may have legal requirements. However, the definitions of forested and non-forested wetlands vary in different federal, state, and local laws. Forestry activities may be exempt in some cases, but not in all. Know which law applies to your situation.

KEY ISSUE

Stabilization

STABILIZING EXPOSED SOIL

Stabilizing exposed soil is most important where sediment can be carried to waterbodies. Different materials may be used to reduce erosion on exposed soils. Temporary materials are often ones that will rot and/or that will be replaced by natural vegetation. Permanent stabilization is provided by long-lasting, sturdy vegetation, stone or artificial materials designed to withstand the force of moving water. Often, stabilization materials are used in combination with each other, providing both immediate, temporary stabilization and permanent revegetation.

TEMPORARY MATERIALS

Hay or **straw mulch** can help minimize soil movement, and usually lasts one or two seasons, holding the soil until the natural vegetation grows back. Mulch is often used after seeding exposed soil. Hay and straw are not effective in areas of concentrated flows. Be aware that hay mulch typically contains non-native grass seed, while straw does not.

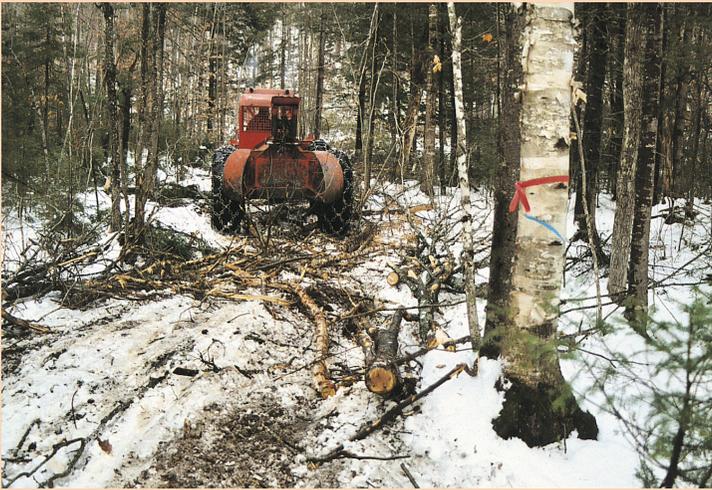
- When mulching exposed soil with hay or straw, use enough mulch to cover the soil completely or nearly completely. A common guide is approximately 90 lbs of mulch per 1,000 square feet (or about 2 square bales for a 30 x 30 foot area). On steep slopes (greater than 4:1 or 25%) or exposed windy sites, it may be necessary to anchor the mulch with staples, netting, or twine.



Hay mulch on a landing.

Brush, slash, and tops from harvesting are often readily available, and are an excellent means of stabilizing exposed soils until the area revegetates naturally. Brush typically does not need to be removed except if it falls below the normal high water mark of waterbodies.

- Use brush on trails that could erode and deliver sediment to streams. Wherever possible, put brush down before the soil becomes disturbed and the soil exposed. The more brush, the better.
- Use brush as a berm on the lower shoulder of roads running across slopes to help stabilize exposed soil and disperse water being shed off the road.
- Use brush on landings or similar high traffic areas (if it will not present a hazard to equipment).
- Use brush at the outfall of road culverts, dips, water bars, and other drainage structures to help hold the soil and disperse concentrated runoff.



Harvesting during frozen winter conditions and putting slash in the skid trails are both excellent ways to limit soil disturbance.

Seeding grasses that will establish themselves quickly can help minimize erosion of exposed soil. Temporary seeding works best on slopes less than 4:1 (25%). The recommended grasses for temporary seeding include winter rye (110 lbs/acre), oats (80 lbs/acre), or annual ryegrass (40 lbs/acre). See "Seeding," page 29, for instructions on how to sow seed.

Temporary erosion control blankets are available in rolls and are made of a wide variety of materials. Usually they are biodegradable. They are often used with grass seed to establish vegetation as the blankets rot. Erosion control blankets must be in contact with the soil to prevent water flowing between the blanket and the soil. On slopes greater than 4:1, blankets may need to be anchored with staples or by other means. Blankets work best in ditch and swale sections (where there is concentrated runoff) when the slopes are gentle.

PERMANENT MATERIALS

Wood chips, waste wood, or bark mulch may last several seasons, depending on the material and its depth. Occasionally, these materials are combined with soil in an erosion control mix. Spread the material to a depth of 2–6 inches, primarily on slopes less than 4:1 (25%). Wood chips, waste wood, and bark mulch are not recommended in areas of concentrated water flow or where they may be subject to wind erosion.

Permanent erosion control blankets are usually made of synthetic materials and are used in high-flow areas such as ditches.

Gravel can provide adequate stabilization, especially on travel surfaces with low slopes and little concentrated flow. Ideally, gravel used in critical areas is screened and/or washed to remove the fines.

Riprap or cobbles are larger stones used to stabilize ditches, heavily traveled areas, and areas of high flow. They are also used to armor steep slopes (up to 1.5:1 or 67%) and culvert inlets and outlets. You can use riprap in combination with erosion control blankets to prevent flowing water from undercutting steep slopes. Use very large stone in combination with smaller cobbles and/or blankets.

Permanent vegetation or revegetation is commonly used to permanently stabilize disturbed areas. Permanent vegetation may include grasses, shrubs, and/or trees. Seeding is recommended on exposed soils within filter areas, at waterbody crossings, and at similar critical sites that are not stabilized by other means. Most other areas will reseed naturally within two years, provided BMPs have been used to control the water flow.



Hay mulch holds exposed soil while grass becomes established.

Wide varieties of seed mixtures for permanent revegetation are available. Usually, they contain combinations of creeping red fescue, annual ryegrass, tall fescue, flatpea, switchgrass, bluestem, deertongue, and other species. Commercially available “Conservation Mix” is often appropriate. A typical mix consists of: creeping red fescue (40%); annual ryegrass (31%); Dutch white clover (20%); birdsfoot trefoil (5%); and hairy vetch (4%). Select a seed mixture based on:

- the site conditions;
- how quickly the soil needs to be stabilized to avoid sedimentation;
- the time of year and predictable weather conditions;
- the soil’s moisture and fertility; and
- shade conditions.

Native, non-invasive grass species are preferable if they are available and affordable.



For more detailed and site-specific recommendations, see the USDA Natural Resource Conservation Service’s guidelines for Critical Area Planting, Section IV of their Field Office Technical Guide, referenced on the inside back cover.

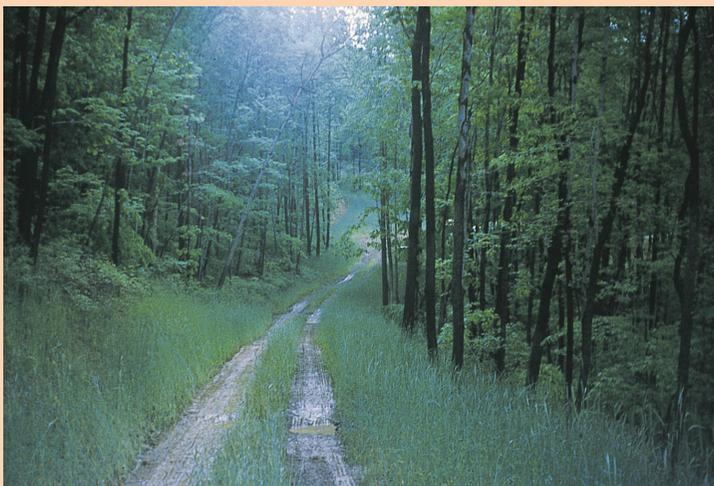
SEEDING

Whether you are seeding for temporary or permanent vegetation, the sowing process is the same.



Use fertilizer with care near waterbodies, and never put it directly in any waterbody.

- Prepare the seedbed (if necessary) by raking, grading, removing debris, and/or smoothing the exposed topsoil.
- Apply the seed mix immediately after preparing the seedbed, at the supplier's recommended rate (generally from 20–50 pounds per acre) by hand, seed spreader, or hydro-seeder.
- If possible, apply seed in the spring, fall, or after rain to help ensure germination.
- Consider liming and fertilizing the site before seeding, based on soil conditions, or if it is recommended by the seed supplier. Fertilizer-coated seed mixtures may also be available. A few seed types, such as legumes, require inoculants (available from the supplier) in order to become established.
- On critical areas (near waterbodies), dry soils, highly erodible sites, or sites seeded during the summer, mulch the seeded area with hay or straw.
- Do not allow vehicles or heavy foot traffic in areas that have been seeded until the cover is well established.



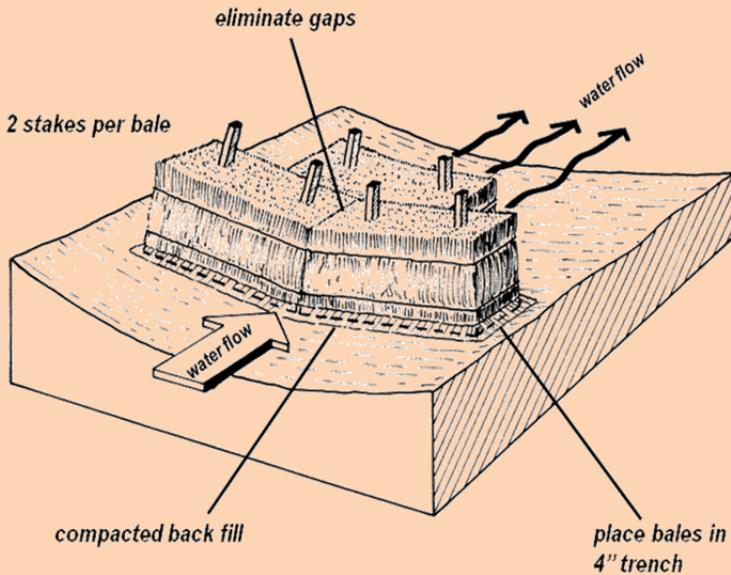
Seeding with grass seed will help stabilize exposed soil, often within a single growing season.

TEMPORARY SEDIMENT BARRIERS

Temporary sediment barriers such as hay bales and filter fences are used to trap sediment during the construction of roads, ditches, and BMPs until other measures, especially permanent vegetation, can be installed. Hay bales and silt fences are not intended as permanent structures and should be removed during closeout or after the site has stabilized.

HAY BALE INSTALLATION

- Excavate a trench 4 inches deep and the width of the bale;
- position the hay bales in a single row or stagger them, making sure there are no gaps between the bales where water could flow through;
- place the bales in the trench and stake with at least two stakes per bale; and
- backfill with soil on the uphill side to keep water from flowing underneath the bale.

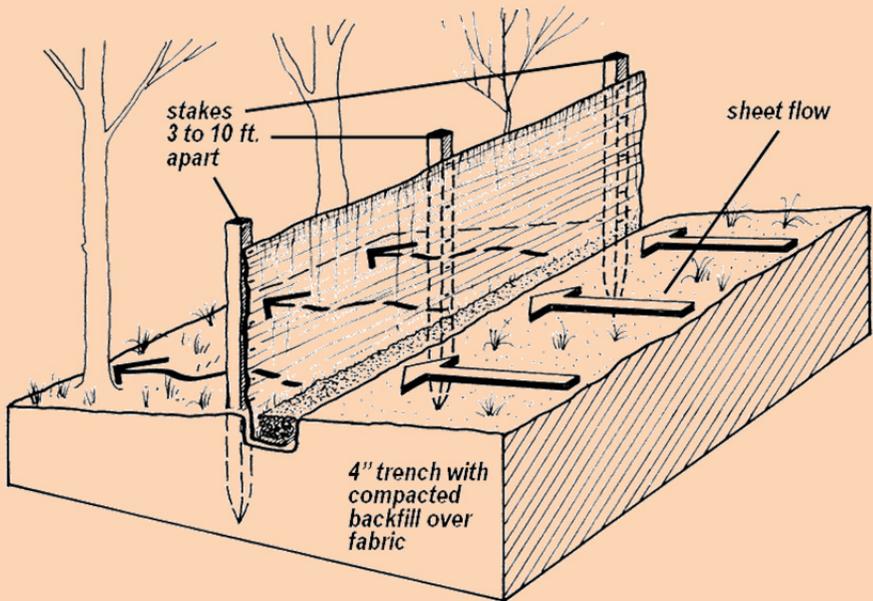


FILTER FENCE INSTALLATION

- Install a synthetic filter fence by first setting stakes at least every 3–10 feet. Three feet is needed for light fabric, while 10 feet is adequate when using extra strength fabric and/or a wire mesh support fence.
- Follow the manufacturer's recommendations and choose a filter fabric capable of handling the expected water flow. The fabric may be 15-36 inches high.
- Excavate a 4-inch deep trench upslope, along the line of stakes.
- Place an 8-inch skirt of fabric in the trench; staple the other side of the fabric to the stakes; then backfill and compact the soil.



Hay bales and filter fences are temporary measures. Remember to remove them after the harvest, or when the site has stabilized.



BMPs FOR EVERY STAGE OF THE HARVEST

The remaining sections of this manual cover specific Best Management Practices that are appropriate for a variety of situations or stages of a harvest operation. All are techniques that are intended as steps toward achieving one or more of the Fundamental BMPs listed in the previous section.

The specific BMPs you select in any given situation will depend on a range of factors: the site itself—including terrain, slope, soils, and location in the watershed—as well as the forest stand type, equipment, materials, and experience. The following guidelines are applicable in many situations. However, specific practices may need to be implemented in unique combinations, modified for particular circumstances or incorporate new technology or research in order to meet the objectives of the Fundamental BMPs.





HIGHEST PRIORITIES

- Minimize damage to the streambed and banks.
- Avoid altering the channel or restricting the flow of water.
- Maintain fish passage.
- Minimize and stabilize exposed soil on crossing approaches.
- Control runoff on approaches.
- Close out the crossing properly.

STREAM CROSSINGS

Stream crossings can have a significant negative impact on water quality. However, these impacts can be minimized by making sure your temporary and permanent crossings are properly installed.

Stream crossings encompass the entire section of a road or skid trail as it crosses the filter area on both sides of the stream, including:

- the channel itself;
- the stream banks; and
- the road or trail approaches (at a minimum, a length equal to the recommended width of the filter area at that point).



Some laws limit the use of “temporary” crossings to a few months, require permits, and/or require certain measures or design features.

road or trail should cross stream at appropriate location and in the shortest possible distance

minimize disturbance of stream channel and banks

install water diverting and dispersing mechanisms outside the filter area

build approaches inside the filter area that minimize disturbance

Stream crossings typically require consideration of several factors.

There are two types of crossings, temporary and permanent:

Temporary crossings are generally in place for up to several months. Stream crossings on trails used by skidders, forwarders, and other yarding and felling equipment are usually temporary.

Permanent stream crossings are intended to be in place for many years. Truck road crossings, for example, are often permanent and require careful design, installation, and long-term periodic maintenance. Permanent crossings are occasionally used for skidding or forwarding, but usually only if there are other access needs for the crossing.



A temporary bridge on a winter skid trail.



A permanent bridge.

PLAN AHEAD

Plan stream crossings before road construction, trail layout, and harvesting begin.



Crossings on streams with fish may be required to allow fish passage. See page 41 for general fish passage guidelines. Call the Maine Department of Inland Fisheries and Wildlife for help identifying streams with fish habitat at (207) 287-8000.

BMPs

- 1 Determine if a temporary or permanent crossing is needed. Select the type of crossing that best matches the site and stream characteristics, and the need for access.** If you don't need permanent access, properly installed temporary crossings may have less of an impact on water quality.

Temporary stream crossings include:

- portable bridges,
- temporary culverts or pipe arches,
- logs or pole fords, or
- brush.

Use temporary structures to keep equipment out of flowing water, to prevent sediment from entering the water, and/or to protect the banks and stream bottom. Portable, removable structures such as bridges, mats, and culverts (when they are installed without additional fill) have the advantage of being reusable.



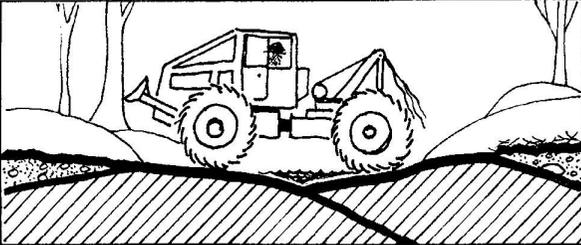
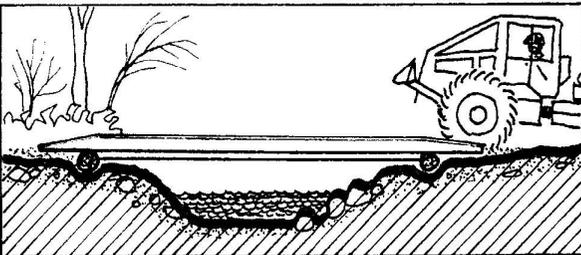
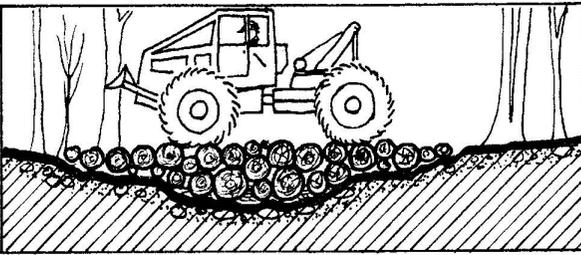
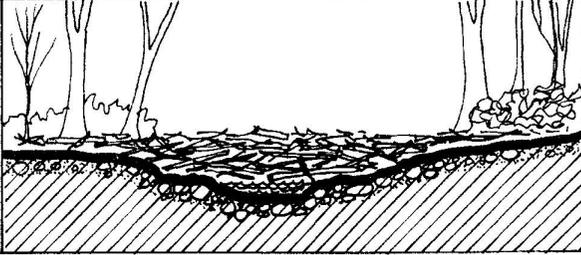
Temporary culvert crossing of a small intermittent stream using slash.

PLAN AHEAD

You may not need to use a structure at a temporary stream crossing if sedimentation can be avoided and the stream bottom and banks will not be disturbed. For example, you can use:

- natural fords—locations where the banks and stream bottom are ledge or rocky; or
- winter crossings when frozen conditions prevent sedimentation and stream channel disturbance.

Types of temporary crossings

<p>NATURAL FORD — stream flows over rock or ledge</p>	 A black and white line drawing showing a tractor with large, treaded tires crossing a stream. The stream is shallow and flows over a rocky or ledge-like bottom. The tractor is positioned in the middle of the stream, and the water level is low enough for it to pass without submerging its wheels.
<p>TEMPORARY/ PORTABLE BRIDGE — protect/stabilize stream bank</p>	 A black and white line drawing showing a tractor crossing a stream using a temporary bridge. The bridge is a long, flat structure supported by logs or poles, spanning across the stream. The tractor is on the bridge, and the stream banks are visible on either side.
<p>LOG OR POLE FORD — protect bank and channel — maintain water flow — remove at closeout</p>	 A black and white line drawing showing a tractor crossing a stream using a log or pole ford. The stream is shallow, and the tractor is crossing over a bed of logs or poles that have been laid across the stream. The water level is low, and the logs/poles are arranged to support the tractor's weight.
<p>SLASH/BRUSH — protect bank and channel — maintain stream flow — remove at closeout</p>	 A black and white line drawing showing a tractor crossing a stream using slash or brush. The stream is shallow, and the tractor is crossing over a bed of slash or brush that has been laid across the stream. The water level is low, and the slash/brush is arranged to support the tractor's weight.

PLAN AHEAD

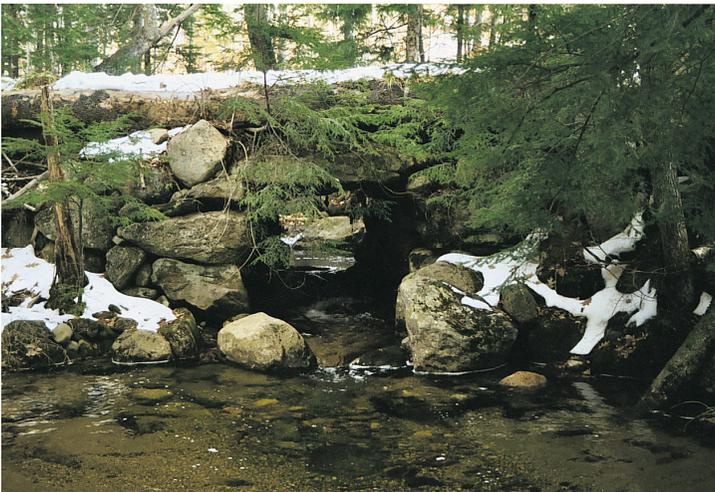
Permanent stream crossings are most often used on haul roads, and include:

- bridges,
- culverts,
- pipe arches, or
- stone fords.

Types of permanent crossings



A permanent bridge on a truck road.



An old stone culvert still functioning.

PLAN AHEAD

BMPs

- 2 Select appropriate crossing locations, based on site and stream conditions.**
- Minimize the number of stream crossings needed and maximize the harvest area accessed by each crossing. By locating all of the crossings during the planning stage, you may be able to reduce the number of crossings needed. Decide whether the amount of wood you gain access to justifies a crossing.
 - Identify the best available sites for stream crossings. Look for:
 - relatively straight, narrow channels, and stable stream sections;
 - level or gently sloping banks and approaches (on both sides) that are stable;
 - approaches that are more or less at right angles to the channel;
 - hard stream bottom (for crossings where the structure rests on the stream bottom, e.g., pole fords or slash); and
 - areas away from important fish spawning habitat.
 - Install crossings when the soil is dry or frozen and the water level is low.
 - Minimize impacts to gravel or cobble streambeds where fish may spawn (especially from late fall to spring when you could harm incubating fish eggs).



See the section on “How to Size and Install Bridges and Culverts” on page 47.

PLAN AHEAD



Know what legal requirements, minimum opening sizes, and permits apply for each location and stream crossing type.

BMPs

- 3 Select a type of crossing structure that is appropriate for the stream and the adjacent terrain.** Is there a floodplain or wide, flat wetland next to the stream? These are evidence that the stream floods frequently, and you will need to plan the crossing accordingly. Install additional overflow pipes, dips, or other structures to prevent the crossing from washing out at high flows. Also, keep in mind that the type of crossing structure will affect the efficiency of water flow. Culverts may be preferred in narrow, deep gullies or on V-shaped, steep-sided channels. Bridges or box culverts are suited for wider streams with low, flat banks.
- 4 Base the opening size on the highest expected stream flows.** Size stream crossings appropriately to reduce the chance that high water levels will undermine or wash out the crossing. Washouts cause erosion and damage the stream. Moreover, repairing or replacing a bridge or culvert is a significant cost, and one that can usually be avoided (see the section on “How to Size and Install Bridges and Culverts,” page 47).
- 5 Determine the maintenance and closeout needs, and who will be responsible for these tasks.** A well-built stream crossing is an investment that minimizes your risk of causing sedimentation and can assure long-term access. Protect that investment by knowing in advance how it will be maintained and closed out.

KEY ISSUE

Fish Passage**Stream Smart Crossing**

Designing and installing stream crossings that function effectively for road infrastructure while maintaining fish passage is becoming increasingly important. Crossings designed using the **4 “Stream Smart” principles** allow for adequate capacity for high flows, minimize sedimentation of the stream and provide passage for fish and other aquatic life.



Crossings on streams with fish are required by law to allow fish passage. Call the Maine Dept. of Inland Fisheries and Wildlife for help identifying streams with fish habitat at (207) 287-8000.

Principle #1 – Span the Stream Channel

A crossing that is narrower than the natural stream channel can “pinch” the stream, causing water flow to accelerate through the crossing. This can create a barrier to fish movement, as water may move faster than a fish can swim. In addition, when accelerated water flow exits a culvert that is too narrow, it will create a scour hole. This will cause the culvert to become perched above the streambed, which also limits fish passage. Crossings that are at least as wide as the stream channel allow natural flows to be maintained through the crossing, minimizing velocity problems. In *most* cases a crossing sized to be as wide as the stream channel will also accommodate at least a 50 year flood.



A culvert that is spanning the stream channel.

Principle #2 – Set the Crossing at the Correct Elevation

Stream crossings, including closed bottom culverts and footers of open bottom structures, should be set below the elevation of the **ORIGINAL** stream channel. This is particularly important to be aware of when replacing a stream crossing, since old crossings are often set at too high an elevation. A stream crossing that has not been set at the correct elevation limits fish passage and may pond water on the upstream side, which in time may compromise the road.



Water ponded upstream of an old crossing is a good indication that the crossing is set too high.

Principle #3 – Slope Matches the Stream

Crossings should be set at the same gradient as the natural stream channel. This allows the stream to maintain its natural velocity and minimizes problems such as scour holes below the crossing.

Principle #4 – Substrate in the Crossing

Open bottom crossings such as bridges and arch culverts are open to the natural stream bottom. Properly sized and embedded closed bottom culverts can have a stream bottom redevelop in the crossing as stream bed material accumulates. Material may need to be added to culverts, particularly on steeper streams.



A culvert installed to stream smart principles that is accumulating substrate



Tip: The width of the opening for a bridge or culvert should be at least as wide as the stream channel at the normal high water mark. Sizing a crossing only based on the 10 or 25 year flood (see page 48-49) may not always accomplish this goal.

BMPs

- 1 **Minimize “velocity barriers” by maintaining natural rates of stream flow.** Culverts that constrict flows can increase water speeds beyond the swimming ability of some fish species. Design a culvert’s shape, slope, size, and outlet so that the stream’s natural rate of flow is preserved and fish can swim upstream through the culvert.
- 2 **Minimize “low-flow barriers” by maintaining adequate flows in culverts.** Multiple culverts or other designs that spread out flow or broaden the channel may result in water that is too shallow for fish to pass through, especially during summer.
- 3 **Minimize “exhaustion barriers” to fish.** Culverts that are long, steep, or provide no resting areas may tire fish enough to prevent them from passing through.
- 4 **Minimize “jump barriers”.** Culvert outlets that are set too high (“hanging culverts”) can prevent fish from entering the culvert. In addition, outlets that scour the stream channel can create fish barriers over time as the streambed is washed out and lowered.
- 5 **Minimize “debris barriers”.** Woody material that accumulates at the inlet of undersized culverts can sometimes obstruct passage. Adequately sized crossings may allow debris to pass through, but culverts require regular maintenance to prevent obstructions.
- 6 **Consider possible “behavioral barriers” when choosing the culvert type and material.** The type of culvert bottom may discourage some species of fish from passing over or near them because of specific behavioral traits.

Incorporating these principles into the design of stream crossings can reduce the likelihood of creating barriers to fish. For most stream crossing situations, fish passage can be provided by making sure that:

- structures (bridges and culverts) are at least as wide as the stream channel at normal high water mark;
- culverts are embedded slightly (5-25% of their diameter) in the stream substrate; and
- a natural stream bottom is retained or redevelops within the structure after installation.



Tip: Sediment can collect up stream of undersized stream crossings raising the stream bed elevation. When replacing existing crossings, the new culvert or footings should usually be embedded below the original stream bed elevation. See references (back cover) for more information.

BUILD IT RIGHT

Properly installed water crossings preserve water quality, protect your investment in the crossing, and reduce future maintenance costs.

ALL STREAM CROSSINGS

BMPS

- 1 **Minimize disturbance to the stream banks, channel, and streambed during installation, use, and removal.**
- 2 **Minimize and stabilize exposed soils on the approaches within the filter area.** During operations, you can stabilize the approaches with brush or other materials.
- 3 **Install diversions on the approaches to prevent channeled runoff from entering the stream from the trail or road, and to disperse it into adequate filter areas.**
- 4 **Build the narrowest roads and trails possible in the filter area and at the crossing.**
- 5 **Do not obstruct water flow or fish passage in the stream. See the guidelines for fish passage on page 41. Install culverts with the bottom resting on or below the stream bed at the inlet and outlet.**
- 6 **Minimize work during wet weather or when the soil is saturated.**

STREAM CROSSINGS

TEMPORARY CROSSINGS

BMPS

- 1 **Stabilize crossing approaches with brush or similar materials, before and during operations.**
- 2 **Protect the approaches by extending temporary bridges well beyond the stream bank.**
- 3 **Install any temporary, portable bridges so that all portions of the bridge are above the stream's normal high water mark. Keep abutments back from the banks, if possible.**



A pole ford.



A temporary bridge.

BUILD IT RIGHT

PERMANENT CROSSINGS

BMPs

1 If possible, build crossings when streams are dry or at low water. If considerable excavation is necessary during periods of regular or high flow, temporarily divert the water while installing the crossings.



Permanent crossings may require permits, especially if water must be diverted during installation.

2 Install crossings and approaches using a “no-grub zone” at least the width of the filter area, wherever possible.

- Minimize excavation on stream banks and approaches.
- Construct road approaches using fill (instead of grubbing), leaving the forest floor undisturbed, especially outside the road profile. Consider surfacing with clean gravel or stone. This will stabilize the road surface, prevent it from eroding directly into the stream, and keep mud from being tracked onto the crossing structure.
- Use geotextile and fill on unstable soils or during wet weather.
- Set abutments back from the stream’s edge.

3 Design bridges using solid decking or other features to minimize the amount of material that falls through the deck and into the stream.

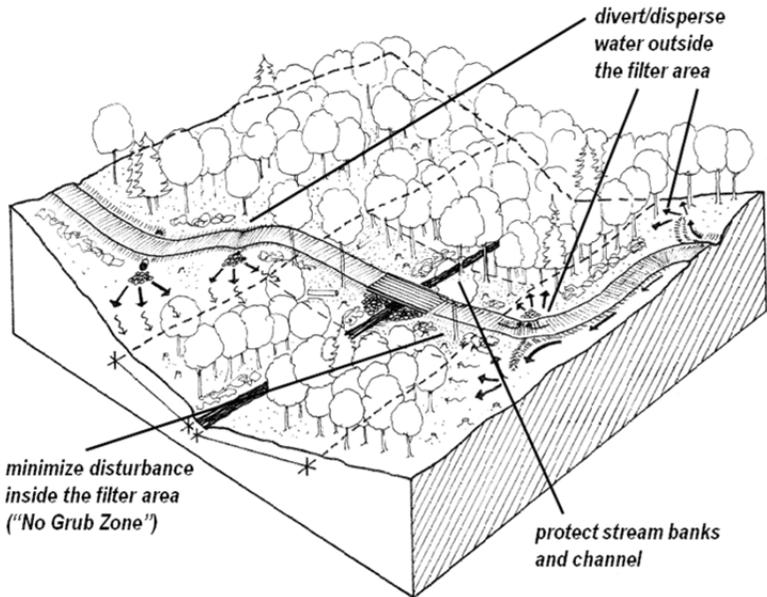


Two types of permanent crossings.

BUILD IT RIGHT

BMPs

- 4 Road ditches should not terminate in the stream. Use a broad-based drainage dip or similar structure to divert and disperse water off the road just outside the filter area to the undisturbed forest floor.
- 5 Seed and mulch exposed soil on approaches within the filter area (outside the roadbed). This should be done during or immediately after the road installation, in spring, or in early fall—follow the recommendation of the seed supplier. See p. 29 for more information on seeding.



A permanent stream crossing that minimizes water quality impacts.

KEY ISSUE: HOW TO SIZE AND INSTALL *Bridges and Culverts*

Properly sizing and installing bridges and culverts in stream crossings is very important. Doing so will prevent these structures from failing or washing out, requiring expensive repairs or rebuilding. Moreover, washouts can significantly impact a stream's water quality.



Before designing bridges or culverts, know which legal standards apply and what permits may be required.

Planning a stream crossing involves selecting the best crossing location and type of crossing structure. The size of the bridge or culvert will be based on the opening size needed for the size of the stream you are crossing.

STEP 1:

Determine the degree of flooding the crossing must handle without being damaged or washed out. This will depend on what type of crossing you want and how long you anticipate the crossing to be in place. The longer a crossing is in place, the larger the flood that is likely to occur at any particular location.

Design the crossing opening to handle at least normal high water (a 1–3 year flood) for:

- temporary trail crossings in place during summer, fall, and/or winter seasons (but not during spring runoff).

Design for at least a 10-year flood event for:

- temporary trail crossings that will remain in place during spring runoff;
- temporary road crossings; and
- permanent trail or road crossings that will be regularly maintained.

A 10-YEAR FLOOD EVENT: the highest flood level a stream is likely to reach, on average, in any 10 year period.

Design for at least a 25-year flood event for:

- permanent road crossings that will not be maintained; or
- roads that will be put to bed without removing the crossing.

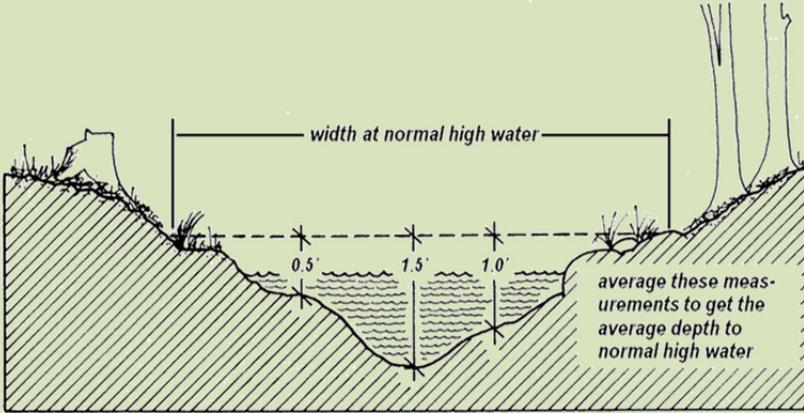
EXAMPLE: You need to install a crossing that will be temporary, but you won't be able to remove it until after the spring runoff. You are planning to use a round culvert.

SOLUTION: You need to design the crossing for a 10-year flood event.

STEP 2:

Determine the opening size needed to accommodate the expected flood event. The field method described here calculates opening size based on the actual stream dimensions at the crossing location.

Be sure to use streambank evidence to measure at the normal high water mark – not just the existing water level.



- To accommodate **normal high water** (a 1–3 year flood), multiply (width) x (the average depth at normal high water), or keep all temporary bridge components above the normal high water mark.
- For a **10-year flood event**, use Table B1, or multiply (2.5) x (width of the stream at the crossing location at normal high water) x (average depth of the stream at normal high water).

Table B1
10-year Flood
Crossing Opening Size
(sq. ft.)

Stream Width*	Average stream depth*			
	(ft.)			
ft.	0.5	1	1.5	2
1	1.25	2.5	3.75	5.0
2	2.5	5.0	7.5	10
3	3.75	7.5	11.3	15
4	5.0	10	15	20
5	6.25	12.5	18.8	25
6	7.5	15	22.5	30

* at normal high water mark

Bold: bridge or arch may be preferred on these larger streams

- For a **25-year flood event**, use Table B2, or multiply (3.5) x (width of the stream at the crossing location at normal high water) x (average depth of the stream at normal high water).

EXAMPLE: The average depth of the stream at your chosen crossing site is (1 ft. + 1.5 ft. + 0.5 ft.) / 3 = 1 ft. You determine the width is 5 feet.

SOLUTION: You use Table B1 because you are designing for a 10-year flood. That table shows that the opening size at the stream crossing should be 12.5 sq. ft.

STEP 3:

Design the bridge or culvert to meet or exceed the minimum opening size.

- **For bridges or box culverts**, determine a width and height that, multiplied together, produce a result that is at least as great as the square footage you determined you needed in Step 2. Bridges should be installed above the normal high water mark or higher.
- **For round culverts**, select a culvert size using Table C.
 - Find the opening size in the first column that is equal to, or the next size up from the opening size you determined in Step 2.
 - Find the culvert diameter for that opening size in the second column.
 - If you plan to use more than one culvert, be sure the total opening size of all culverts adds up to the minimum opening size you determined in Step 2.

Table B2
25-year Flood
Crossing Opening Size
(sq. ft.)

Stream Width*	Average stream depth* (ft.)			
	0.5	1	1.5	2
1	1.75	3.5	5.25	7.0
2	3.5	7.0	10.5	14
3	5.25	10.5	15.8	21
4	7.0	14	21	28
5	8.75	17.5	26.3	35
6	10.5	21	31.5	42

* at normal high water mark
Bold: bridge or arch may be preferred on these larger streams

Table C
Culvert Diameter
And Opening Sizes

Opening size (sq. ft.)	Diameter (inches)
0.20	6
0.80	12
1.25	15
1.75	18
2.40	21
3.15	24
4.90	30
7.05	36
9.60	42
12.55	48
15.90	54
19.65	60
23.75	66
28.26	72



Tip: To provide adequate fish passage the width of the opening for a bridge or culvert should be at least as wide as the stream channel at the normal high water mark (see page 41). Sizing a crossing only based on the 10 or 25 year flood may not always accomplish this goal.

- **For pipe arches**

- calculate the required opening size as in Step 2;
- double the opening size; and
- use Table C to find the pipe arch diameter for that opening size. (The opening of pipe arches is approximately half that of round culverts of the same diameter). Make sure the diameter is wide enough to install bottomless/half circle arch footings above the normal high water mark.

EXAMPLE: You plan to install a round culvert, so you look for your required opening size of 12.5 sq. ft. in the left column of Table C.

SOLUTION: 12.5 isn't listed, but the next highest number is 12.55. The diameter size listed opposite 12.55 in the right column is 48 inches. This is the size culvert you need.

STEP 4:

Adjust the bridge or culvert size as necessary to:

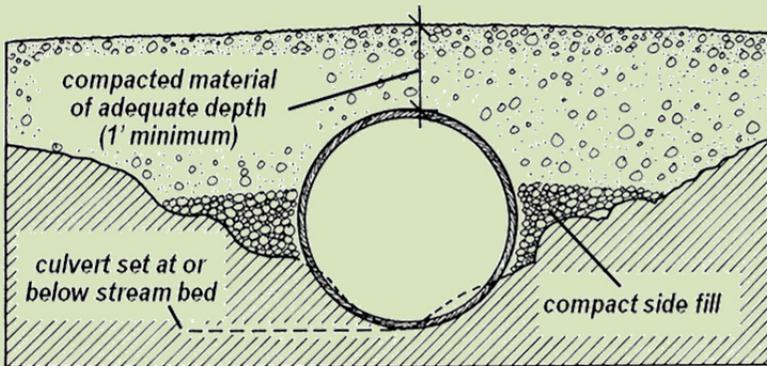
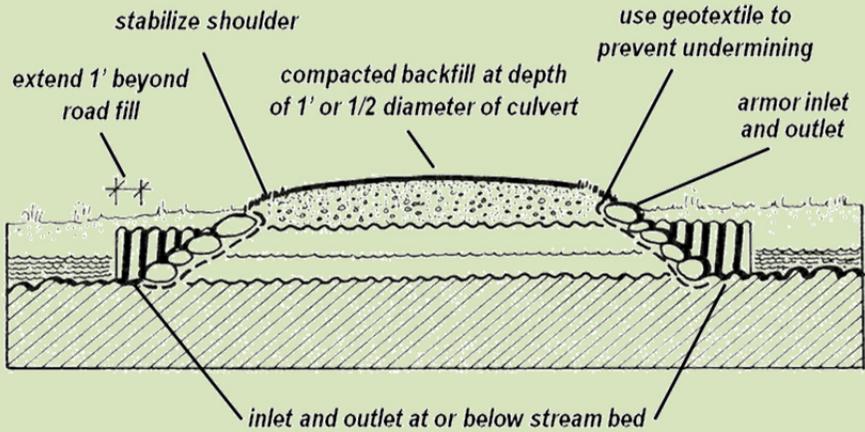
- minimize disturbance to the stream channel and banks;
- allow for unrestricted normal flows; and
- allow fish to pass when water is present.

EXAMPLE: This stream has fish in it, and fish passage is required by law. To provide adequate fish passage, the culvert must span the stream.

SOLUTION: The stream was measured at 5 ft. in width. Therefore, a 60 inch culvert would be adequate to provide fish passage.

When installing permanent culverts:

- Set the culverts with the bottoms slightly below the bed of the stream, and at a 2-3% slope. Avoid "hanging" culverts where the bottom of the culvert outlet is above the low water level.
- Extend the culvert inlet and outlet 1 foot or more beyond the fill or roadbed.
- Cover with compacted backfill to a depth equal to half the culvert diameter, or at least 1 foot deep.
- Stabilize the inlet and outlet of culverts and bridges using cobbles, timber abutments, or other armoring.



AS AN ALTERNATIVE to this field method, consider using a hydrological analysis model and/or assistance from a professional engineer, especially for permanent crossings. See the "References" section for more information.

MAINTAIN IT

ON ALL CROSSINGS

BMPs

- 1 **Do not allow ditches to terminate directly into the stream or the filter area.** Runoff should be dispersed onto the undisturbed forest floor before it reaches the filter area.
- 2 **Make sure the approaches within the filter area are stabilized**
- 3 (see "Stabilizing Exposed Soil" on page 25).
- 4 **When grading or rock-raking approaches, do not drag material onto the crossing.**

TEMPORARY CROSSINGS

BMPs

- 1 **Stabilize the soil on stream crossing approaches in the filter area by using slash, brush, or log corduroy.**
- 2 **If there is rutting or channeling on the crossing approaches, disperse the water flow to an undisturbed, stable filter area using water bars or similar structures.**

PERMANENT CROSSINGS

BMPs

- 1 **Establish a regular monitoring and maintenance schedule for permanent stream crossings.**
- 2 **Make sure the crossing approaches are not carrying sediment to the stream.** Maintain and restabilize them as needed.
- 3 **See if the abutments, armoring, and bank stabilization measures are being undermined or damaged, and replace or repair them as necessary.** Severe undermining may indicate a poor location for the crossing, improper sizing, or incorrect installation, and can only be corrected by relocating or redesigning the crossing.
- 4 **Periodically remove debris and other materials that may block or constrict the culvert or bridge opening.** Using 15"-18" minimum diameter culverts greatly reduces the need for this maintenance work.

CLOSE IT OUT CORRECTLY

Closeout BMPs will help minimize future damage at both permanent and temporary crossing sites.

BMPs

- 1 As a first step, identify the long-term monitoring and maintenance needs appropriate to the harvest site and communicate these to the landowner, forester, and logger.** Determine who will be responsible for these tasks.
- 2 Remove temporary structures, slash, and/or other materials from below the normal high water mark when the crossing is no longer used.** Do not remove debris that has fallen into the stream naturally.
- 3 Leave brush in place on the approaches and banks (above the normal high water mark) to ensure ongoing stabilization when you closeout.**
- 4 Remove bed logs used for temporary bridges unless doing so may cause more disturbance.**
- 5 After the harvest, stabilize the remaining exposed soil on the approaches in the filter area.** Use additional brush, hay, or other materials. If large areas are disturbed, spread grass seed and mulch.



Closeout of a temporary stream crossing.



HIGHEST PRIORITIES

- **Avoid crossing wetlands whenever possible.**
- **Minimize soil disturbance, soil movement, and sedimentation.**
- **Maintain water movement, especially in the top 12 inches of soil.**

WETLAND CROSSINGS

Wetlands are areas where soils are saturated or flooded for a significant part of the year, where water-loving plants are found, and where soils have taken on special characteristics (see page 9 for more discussion and examples of wetlands). The large amount of water and organic matter in wetland soils make them difficult to work in. Wetland soils have low weight-bearing capacity and therefore are weaker than upland soils. In addition, it is common for water to be moving through the soil near the surface.

BMPs in wetlands help minimize two primary impacts: sedimentation and the alteration of water flow through the wetland soils. Sedimentation is primarily a concern for non-forested wetlands. Sedimentation in forested wetlands is somewhat less of an issue when there are no other waterbodies flowing through them. Several wetland BMPs provide ways to increase the strength, or bearing capacity, of the soil (minimizing rutting) and to maintain water movement through the wetland soil.

PLAN AHEAD

BMPs

- 1 **Construct permanent wetland crossings only if there is no reasonable alternative.** Can the wetland crossing be avoided by rerouting the road or trail?
- 2 **Get assistance from a professional engineer or licensed forester if you need to construct permanent roads in non-forested wetlands.** These professionals can minimize your costs as well as the impacts on water quality.
- 3 **Avoid building winter crossings in areas with moving water that does not freeze well.**
- 4 **Design wetland crossings that will remain stable and will not restrict water flow during wet periods, especially at spring high water.**
- 5 **Determine the maintenance and closeout needs, and who will be responsible for these tasks.**

BUILD IT RIGHT

BMPS

1 Minimize the length and width of the road or trail within the wetland.

2 Temporary crossings are preferred. Use wooden mats, log corduroy, or similar structures to cross wetlands.

3 Stabilize the approaches to non-forested wetland crossings, and the road and trail surfaces within the wetland itself. The approaches should be stabilized out to the edge of the filter area. Filter areas around non-forested

wetlands begin at the border between non-forested and forested areas (to the degree that it can be identified). See page 25 for more information on soil stabilization.

4 Filter areas within forested wetlands need to be stabilized too. In these cases, the filter area is based on the location of streams that flow through the wetlands.



Soil disturbance, fill, and other alterations in wetlands (both forested and non-forested) may require permits from one or more government agencies. Call the Maine Forest Service first at (800) 367-0223 (in state only), or (207) 287-2791. They can refer you to the appropriate agencies.



Wetland culverts allow for cross drainage if the road fill does not.

BUILD IT RIGHT

TEMPORARY CROSSINGS

BMPs

- 1 Cross wetlands on frozen ground if possible.
- 2 Use brush, if necessary, to increase the soil's bearing capacity.
- 3 Avoid rutting as much as possible.



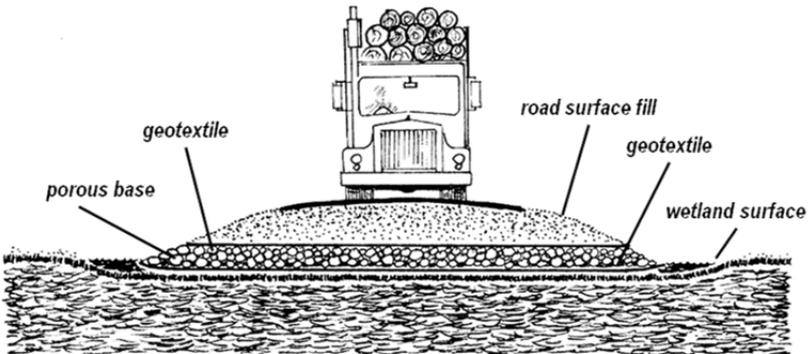
Log corduroy used for a skid trail across a wet area.

BUILD IT RIGHT

PERMANENT CROSSINGS

BMPs

- 1 Use road base materials such as waste wood, poles, corduroy, or large stone that permit water to flow through the road's sub-base.** If necessary, use these materials in combination with geotextiles to keep the different layers of road material separate or to isolate the wet soils. This will increase the bearing capacity of the road so it can stand up to heavier loads and traffic.



Use geotextile to keep fill from mixing with the wetland soil

BMPs

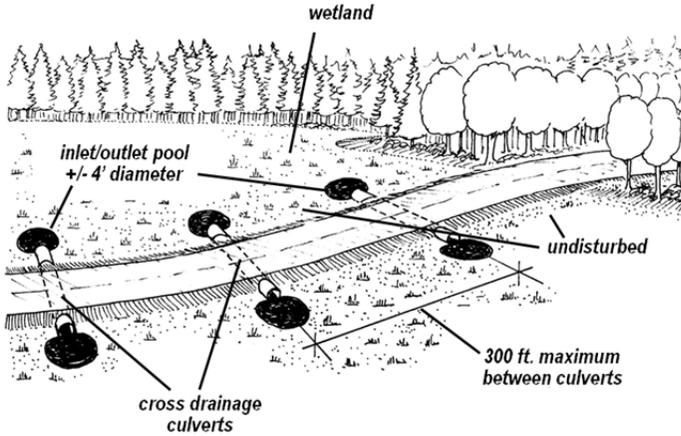
- 2 Limit excavation and other disturbances to the organic mat and the soil.** If you can maintain the natural water flow without ditching, do so.

WETLAND CROSSINGS

BUILD IT RIGHT

BMPs

- 3 If the drainage through the road base is not adequate (if the road is damming water), install cross-draining culverts or other structures to allow water to flow through.



BMPs

- 4 Use side ditches, parallel to the road, only when they are needed to collect flowing surface and subsurface water. Disperse the water to undisturbed areas.

MAINTAIN IT

BMPs

- 1 Use temporary crossings when the ground is frozen. Pack or plow the snow to help freeze the ground.
- 2 Keep cross drainage structures functioning by clearing debris that can plug them.
- 3 Whenever possible, use equipment with wide tires, tracks, or other features that distribute the weight.

CLOSE IT OUT CORRECTLY

BMPs

- 1 Identify the long-term monitoring and maintenance needs appropriate to the harvest site and communicate these to the landowner, forester, and logger.
- 2 After harvesting, remove wooden mats, log corduroy, or similar temporary structures used to cross non-forested wetlands.



HIGHEST PRIORITIES

- **Construct new roads outside of filter areas, except at stream and wetland crossings.**
- **Where you must cross filter areas or wetlands, minimize the length of road.**
- **Keep water off the road with drainage systems that are well designed and maintained.**
- **Divert and disperse runoff onto undisturbed forest floor outside filter areas.**

TRUCK ROADS

This section contains BMPs for roads used primarily for hauling wood from the landing by truck. The design, materials, specifications, and use of these roads vary widely, but they are all referred to as “truck roads” in this section, whether it is a short 100-foot spur, or an extensive road system.



BMPs for truck roads are critical for protecting water quality in and around filter areas, and for minimizing runoff.

The construction and use of truck roads can sometimes cause significant water quality problems. Road construction may alter the flow of water over and through the ground. Truck roads expose soil over a large area and get heavy use. They often require permanent stream crossings. All of these factors pose risks to the quality of nearby waterbodies.

However, most negative impacts on water quality can be avoided if truck roads are designed, constructed, and maintained properly.

Well-planned and well-built roads make sense both economically, and environmentally. Road BMPs:

- extend the seasons the road can be used;
- reduce road wear and maintenance costs;
- enable trucks to haul heavier loads;
- lower truck maintenance costs;
- reduce travel time; and
- protect water quality during and after harvests.



ALL TRUCK ROADS

BMPs

- 1 Determine the size and type of road needed.** Plan roads that are appropriate to the immediate harvest needs and the long-term forest management objectives. Consider the harvest characteristics (the volume and types of products, terrain and soils), all current uses of the road, and other features of the property (the shape of the lot, proximity to neighboring lots, and long-term management plans).
- 2 Identify the future forest management uses of the road, after the current operation is closed out.** Is the road likely to be used for precommercial operations like pruning? Is access for fire suppression important? How often will the road be used for harvesting?
- 3 Determine the maintenance and closeout needs, and who will be responsible for these tasks.**
- 4 Know the legal requirements for roads.** Are local or state permits required?

NEW ROADS

BMPs

- 1 Plan and design new roads that will meet your harvest needs.**
 - What size truck will be used?
 - During what season will you be cutting, and how long will the harvest last?
 - What are the safety considerations?
 - What are the long-term road uses:
 - permanent or temporary access?
 - recreation or other road uses?
 - future harvests?
- 2 Think about how you want the road to fit into the access system for the entire property. Elements to consider are:**
 - the direction of travel;
 - turnarounds;
 - entrances;
 - total road length; and
 - connections to other roads.

PLAN AHEAD

OLD ROADS

BMPs

- 1 Determine if old roads can be reused or upgraded with minimal impacts to water quality.** Consider the road's location, the existing drainage (i.e., where does the water flow?), the potential for additional drainage, and intended uses.
- 2 Consider relocating roads that:**
 - encroach on a filter area unnecessarily;
 - have poorly placed or unnecessary stream crossings;
 - have poor drainage; and/or
 - have unstable soils that cannot be improved (especially gullied roads, roads in ravines, or roads that collect and hold water).



In some situations, there may be laws that govern when, where, and how old roads can be upgraded. Contact the Maine Forest Service, the Maine Department of Environmental Protection, the Land Use Planning Commission, and/or the town Code Enforcement Officer for more information.

PLAN AHEAD

LOCATING AND LAYING OUT NEW ROADS

Lay out new roads so that they fit the terrain, ground conditions, and equipment you will be using. It is often helpful to use topographic maps and aerial photos for this.

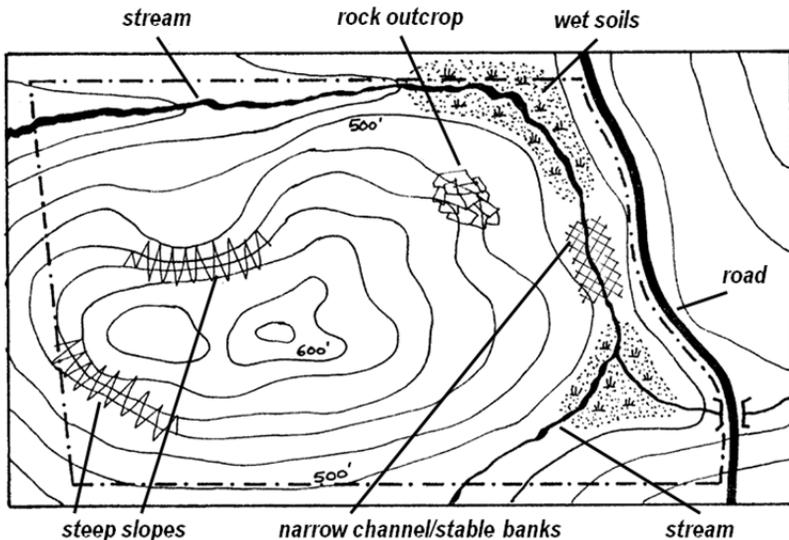


These recommendations are not intended to substitute for obtaining engineering advice or abiding by regulations in the appropriate circumstances.

BMPs

1 Identify important features on maps, aerial photos, and in the field. Be sure to include:

- the boundaries of the property and the area to be harvested;
- water bodies and filter areas;
- ephemeral, wet, or poorly drained areas next to water bodies;
- existing roads, entrances, landings;
- stands; and
- terrain features such as steep slopes, flat benches, rock outcrops, gullies, bowls, and ridges.

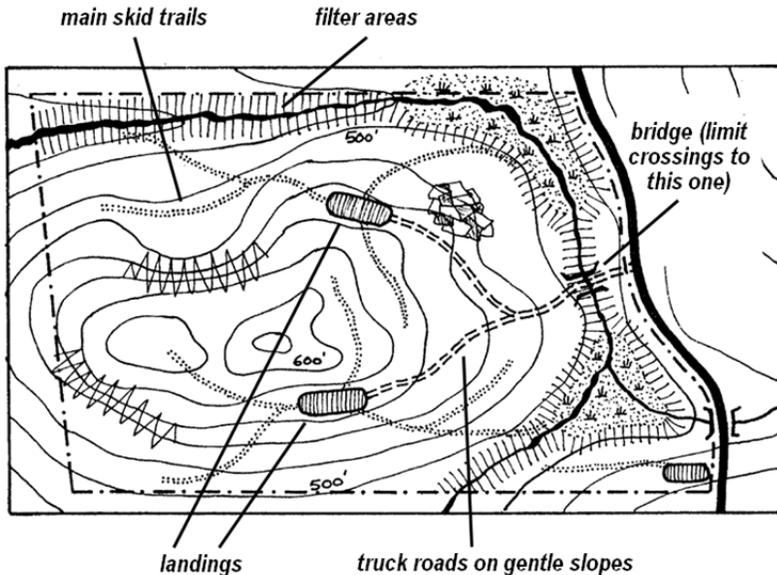


Map out important features on the ground first...

PLAN AHEAD

BMPs

- 2 Mark the harvest boundaries, water bodies, new road locations, stream crossings, and filter areas on-site.**
- 3 Lay out roads where there are better-drained soils, gentle slopes (ideally 2–5%), and good stream crossing locations.**
- 4 Minimize the overall road length, while still meeting operational objectives, including preferred log landing locations.**
- 5 Minimize road sections where water may be difficult to drain or divert.** Pay special attention to:
 - road grades greater than 10% (over 15% in mountainous terrain);
 - long, unbroken grades;
 - long, flat stretches; and
 - roads laid out straight uphill or downhill that still require ditches.
- 6 Avoid filter areas (except at appropriate stream crossing locations); ephemeral, wet, or poorly drained areas; floodplains; and steep slopes, outcrops, gullies, or ravines.**



...then lay out the roads, trails, etc.

BUILD IT RIGHT

BMPs protect water quality when building new roads or upgrading old ones. Using BMPs protects the condition of, and investment in, the road.

TIMING

BMPs

- 1 **Whenever possible, construct roads during dry periods or when the ground is frozen.**
- 2 **Minimize work during heavy rains and/or wet periods.**
- 3 **Plan how and when roads built during the winter will be stabilized.**
- 4 **If possible, build roads before you intend to use them heavily so that they have time to settle and stabilize.**

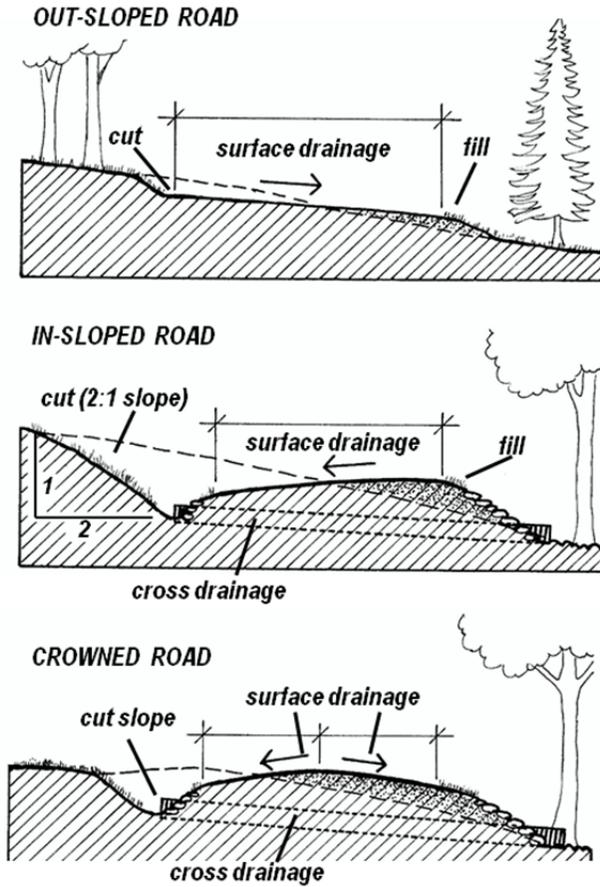


CONSTRUCTION

BMPs

- 1 **Shape roads to move water off the road surface using a crown, an out-slope (this may present a safety hazard in icy conditions or on curves), or an in-slope (this will often require ditches and cross-drainage structures).**
- 2 **Use gravel, crushed stone, or other surface material (with or without geotextile) to stabilize roads, shed water, and increase the weight-bearing capacity.**
- 3 **Maintain cut and fill slopes at a natural angle of repose or less (2:1 for average soils) wherever possible.**

BUILD IT RIGHT



BMPs

- 4 As the construction progresses, stabilize areas of exposed soil that will receive road runoff such as cut-and-fill slopes, steep road shoulders, and erosion-prone soils in filter areas.
- 5 Use temporary sediment barriers to slow flowing water and trap sediment during construction.



Controlling the Water

DRAINAGE AND DIVERSION STRUCTURES

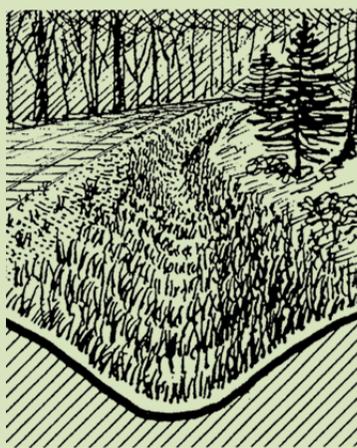
Water diversions minimize the amount of run-off that reaches waterbodies. These diversions can include cross-drainage structures, ditches, turnouts, and other structures that divert water away from the road and disperse it into areas of undisturbed forest floor.

BMPs

- 1 Construct roadside ditches to carry runoff from the road surface and uphill areas. Ditches with a flattened U-shape (a broad, rounded bottom and sloping sides) are preferred—avoid straight-sided ditches.



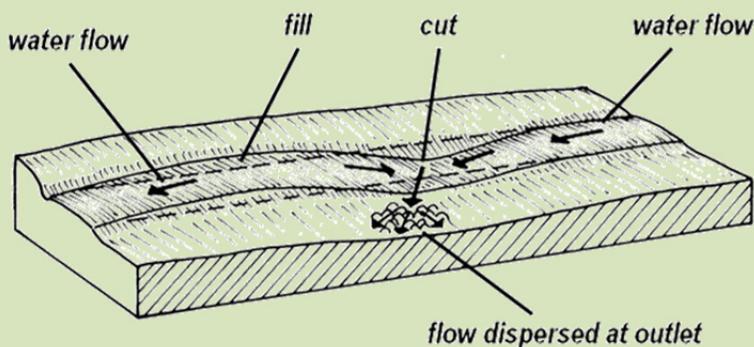
Grass and stone stabilized ditch



U-shaped, grass stabilized ditch

BMPs

- 2 Divert water off the road surface and away from the road using natural dips (or grade breaks), broad-based dips, culverts, turnouts, or similar techniques.

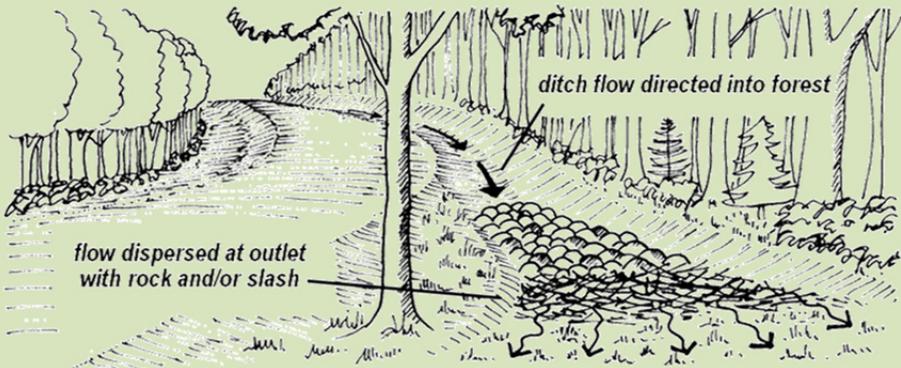


BMPs

- 3 Space water diversions close enough together to control the volume and speed of water.** The recommended spacing varies widely, depending on the grade (steeper grades require closer spacing). Refer to Table D for the spacing most appropriate for the slope at hand. Choosing appropriate locations for the diversions may be more important than spacing on some sites.
- 4 The location and spacing of culverts is often more important than their diameter.** For round culverts, use at least a 15- to 18-inch diameter size to minimize plugging and maintenance.
- 5 Disperse water flowing from the outlets of diversion structures or from downhill road shoulders using brush berms, riprap aprons, or other methods—before it enters the filter area.**
- 6 Construct settling basins outside the filter area if water from ditches cannot be diverted off the road onto undisturbed forest floor.** Settling basins will require periodic maintenance and cleaning.

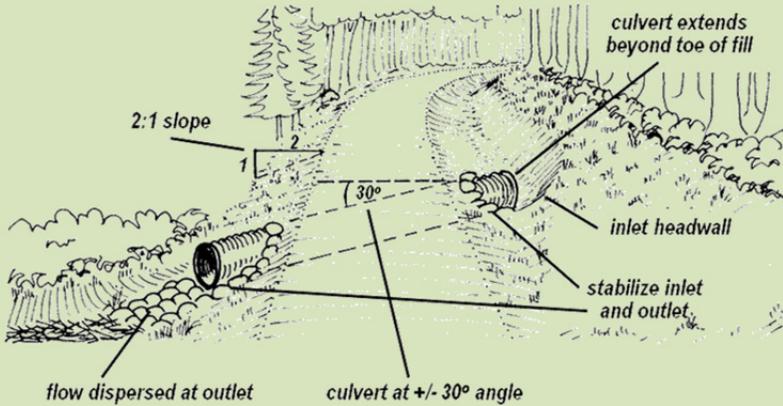
Table D
Spacing for Water Diversion

Road Grade (%)	Spacing (ft.)
0-2	250-500
3-5	165-250
6-10	140-165
11-15	125-140
16-20	100-125
21+	<100



CROSS-DRAINAGE CULVERTS

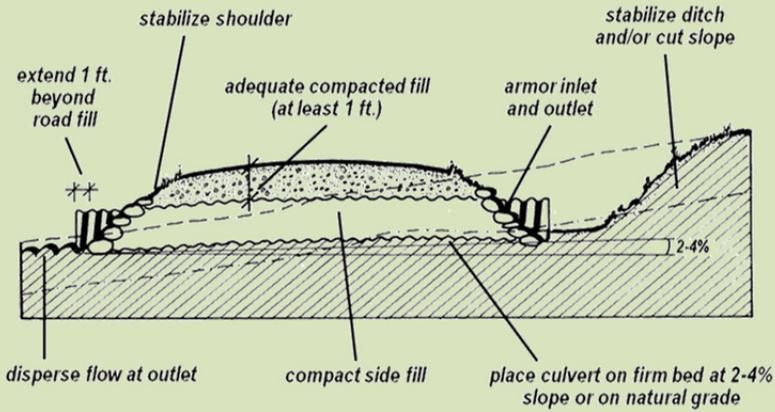
Cross-drainage culverts may be metal, plastic, concrete, or wood (box culverts). Permanent or temporary culverts are most effective when installed according to the following specifications.



BMPS

- 1 **Install a berm or diversion headwall that directs ditch water into the culvert and protects the culvert end.** Ideally, the berm is left in place during the excavation of the ditch.





BMPs

- 2 **Install culverts at a 2–4% slope and at a 30° angle to the road.**
- 3 **Stabilize areas around the inlet and outlet with riprap or other material, and extend the culvert at least 1 foot from the road fill on either end.**
- 4 **Install culverts on top of adequate bedding material (native soil or, if necessary, added fill) that is free of branches or large rocks.**
- 5 **Cover the culvert with compacted material to a depth of half the culvert diameter (or a minimum of 1 foot) or to the manufacturer’s recommended specifications.**



MAINTAIN IT

Proper road maintenance protects water quality and the road by keeping the BMPs functioning. If these structures fail, significant water pollution can result, most often during severe rainfall or snowmelt. Many of the structures used to divert water from road and trail surfaces should be maintained both during and after the harvest (unless the road is closed out). Periodically removing accumulated sediment in these structures will keep them operating as they were designed to.



BMPs

- 1 Avoid using roads during wet seasons or after heavy rains.** Let wet roads dry out or freeze before reusing them.
- 2 Regrade the road surface if the crown is lost from heavy use.** This prevents water from running in the wheel ruts. Don't leave material at the road's edge. Such "false ditches" can carry water along the road edge, bypass the BMPs, and channel the water into filter areas or crossings.
- 3 Inspect ditches to make sure they have not begun to fill in, slump, or develop channels. Clear blocked ditches.**
- 4 Reshape and/or stabilize ditches as needed with erosion control mats, or by other methods.**
- 5 Stabilize exposed soils within filter areas and areas that drain directly to waterbodies. Where your original stabilization techniques are no longer effective, restabilize using additional materials (mulch, brush, and/or seeding) or other techniques.**
- 6 Keep cross-drainage culverts free of debris and accumulated sediment at their inlet and outlet. Repair the outfall protection if water is eroding the soil around it.**
- 7 Maintain the riprap or other armoring at culvert ends to prevent erosion around the pipe and to protect the ends from physical damage.**
- 8 Replace culverts that have been undermined or crushed, before they fail.**
- 9 Clean out settling basins, ponds, and check dams well before they fill up with sediment.**

CLOSE IT OUT CORRECTLY

Most erosion and sedimentation from roads happens *within two years of the operation*. Road closeout BMPs are best used before leaving the site for any extended period, or after the harvest is completed—even if you expect to use the road again. These BMPs prevent damage, ensuring that the road can be used again in the future. Of course, they also prevent water pollution.

BMPs

- 1 **As a first step, identify the long-term monitoring and maintenance needs appropriate to the harvest site, communicate these to the landowner, forester, and logger, and decide who will be responsible for each task.**
- 2 **Close out road sections as portions of the harvest are completed.**
- 3 **Make sure drainage structures are functioning correctly, are free of debris and accumulated sediment at their inlet and outlet, and are adequately sized for storm events.**
- 4 **Stabilize and seed exposed soils outside the travel surface, within filter areas, and in areas that drain to waterbodies.**
- 5 **Reshape and stabilize the road surface and ditches as needed.**
- 6 **Remove temporary sediment barriers such as hay bales and filter fences.**
- 7 **Divert water entering the road from skid trails, log landings, or other roads.**
- 8 **If necessary, limit or block vehicle access to prevent damage or rutting** (if this is compatible with the landowner's objectives).



If you are planning to close access roads permanently, notify the Maine Forest Service at (800) 367-0223 (instate) or (207) 287-2791.



Revegetated road ditches carry water without eroding.



HIGHEST PRIORITIES

- **Locate landings on sites with well-drained soils and gentle slopes whenever possible.**
- **Avoid locating landings in or near waterbodies (including wetlands) and filter areas.**
- **Minimize the amount of water entering the landing from roads or skid trails.**
- **Stabilize and maintain the landing surface.**

LOG LANDINGS

Log landings are the cleared areas in the harvest area where logs and other products are brought from the woods and piled, sorted, or stored before being loaded onto trucks. Log landings are sometimes referred to as log yards or decks. Landings are also where hazardous materials often are stored or used to maintain and repair equipment and roads. Please refer to the “Hazardous Materials” section on page 90 for BMPs that deal with these substances.

BMPs will help prevent negative impacts to water quality and can extend the use of log landings during—and long after—the harvest. Landings are often the most visible part of the operation. BMPs may help maintain or improve the landing’s appearance while demonstrating conscientious work to the public.

PLAN AHEAD

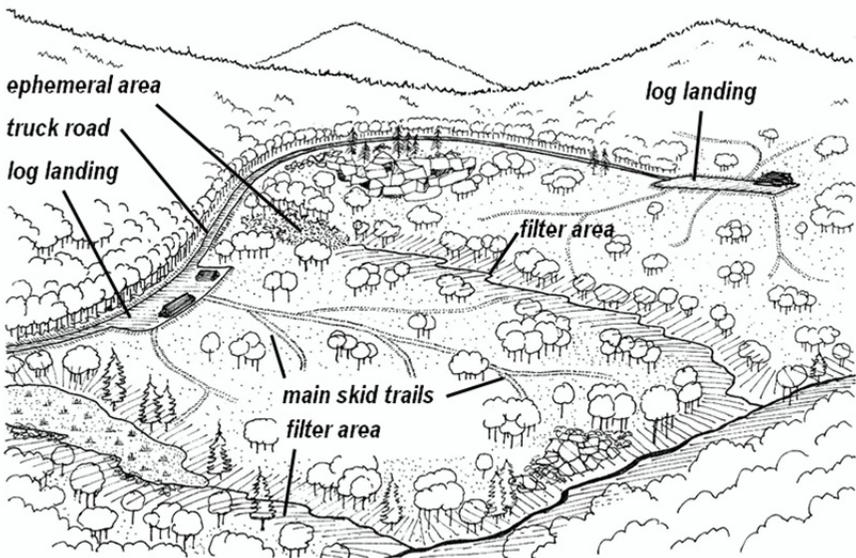
Log landings are busy places where a relatively large amount of soil may be exposed or disturbed. It is therefore important to locate landings away from water and maintain erosion controls.



PLAN AHEAD

BMPS

- 1 Use maps and field information to decide the best location for log landings.** Preferred sites are:
 - on well-drained soils;
 - on gently sloping (not flat) ground; and
 - outside filter areas.
- 2 Keep the landing as small as possible and still meet the requirements of the equipment, the quantity and type of products, and safety.**
- 3 Mark the landing boundaries before construction begins.**
- 4 Lay out skid trails and roads so that water cannot flow into or out of the landing where they enter.**
- 5 Plan how you will stabilize exposed soil on the landing after the job.**
- 6 If landings already exist, determine if they can be reused with adequate erosion controls. If not, relocate them.**



Select landing locations carefully.

BUILD IT RIGHT**BMPs**

- 1 Minimize the area of the landing that is stumped or grubbed.** Logs may sometimes be piled on relatively undisturbed soil or forest floor, within reach of loading equipment.
- 2 Install drainage ditches, water bars, or berms to drain the landing to areas of undisturbed forest floor, or to road drainage systems that can handle the amount of water coming off the landing.**
- 3 Surface the landing with wood chips, stone, or aggregate if it will help stabilize the surface and shed water.** Use these materials on top of geotextiles, if necessary.
- 4 During construction, install temporary sediment barriers (such as hay bales or silt fences) to keep newly exposed soil from entering flowing water and filter areas.** See page 30 for more information on temporary sediment barriers.



Slash and logging debris can help stabilize exposed soil on log landings.

MAINTAIN IT

BMPs

- 1 Maintain the landing surface to keep water from collecting or channeling.
- 2 Maintain drainage structures on roads and trails to keep water from entering the landing.
- 3 Install temporary or short-term measures (e.g., water bars) on skid trails if significant rain is likely during operations.
- 4 Allow landings to dry out after significant rainfall.



A well-maintained, well-drained landing.

CLOSE IT OUT CORRECTLY

BMPs

- 1 As a first step, identify the long-term monitoring and maintenance needs, decide who is responsible for these tasks, and make sure everyone involved in the operation is notified.**
- 2 Prevent water from entering or exiting the landing via roads or skid trails.** If necessary, install water bars or similar diversions to divert flowing water to the undisturbed forest floor.
- 3 Seed, mulch, or otherwise stabilize the landing to establish a vegetative cover.** This is particularly important near waterbodies and filter areas. If the soils in the landing are severely compacted, some site preparation may be necessary before vegetation can take root.
- 4 Limit vehicle access to the landing** (if this is compatible with the landowner's objectives).
- 5 Remove any temporary erosion control structures such as stacked hay bales or silt fences. Make sure that permanent measures are in place.**



Seeded and mulched landing area.



HIGHEST PRIORITIES

- Minimize water channeling in trails and entering filter areas.
- Limit the amount of exposed soil.
- Leave enough vegetation to provide important natural functions within filter areas.
- Close out trails appropriately.

TRAILS AND HARVESTING

Much of the activity on a harvest operation happens on logging trails, away from truck roads and log landings. Trails may be cut for skidders, forwarders, felling machinery, and other equipment. Logging trails often require little or no excavation, and are usually temporary.

PLAN AHEAD

WORKING IN FILTER AREAS

Clearing trails and cutting trees, by themselves, may have a limited or temporary impact on water quality. However, when trails and trees are cut within a filter area, the potential for negative impacts on water quality increases.

BMPs

- 1 **Determine how much and where to cut within the filter area first; then plan your trail layout.** Limiting the harvest activity within the filter area is an important practice for protecting water quality during harvesting.
- 2 **Delineate filter areas in the field that are of appropriate width around waterbodies** (including non-forested wetlands). The size of the filter area should be based on site and stand conditions, but at least the width shown in Table A on page 23.



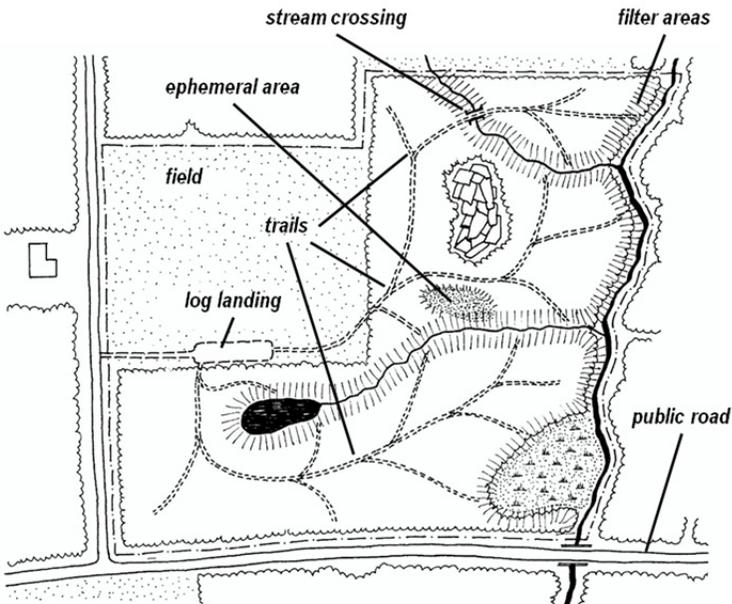
PLAN AHEAD

TRAIL LAYOUT

Locating and laying out skidding or forwarding trails in advance, especially main trails, can prevent problems. Consider the terrain, where the wood is, the lean of the timber, available equipment, the grade, soil conditions, skidding distance, filter areas along streams, and stream crossings. Good planning may reduce the skidding costs, and can reduce or eliminate the need for additional BMPs and structures.

BMPs

- 1 **If possible, lay out trails for winter harvests in advance when there is no snow on the ground. Ideally, lay out trails on bare ground during wet seasons.**
- 2 **Whenever possible, lay out main trails to avoid waterbodies and their associated filter areas, wet spots, seeps, and the bases of slopes.**
- 3 **Keep trails out of stream channels and off the banks of waterbodies.**
- 4 **Construct trails on the contour, if it is safe to do so.** Avoid skidding straight up and down hills. Remember that trail systems that run downhill to the landing tend to concentrate runoff.

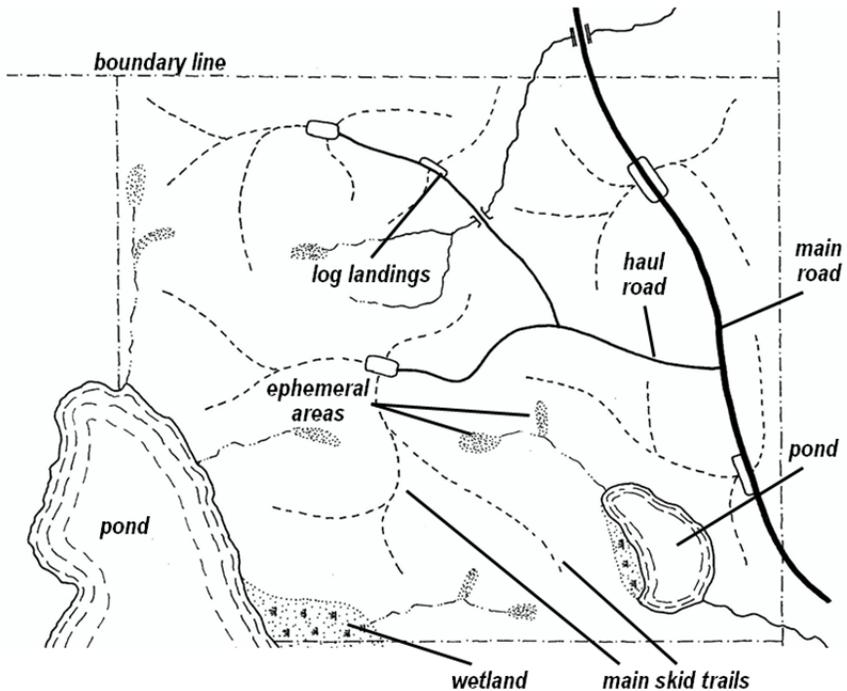


Example of small lot layout.

PLAN AHEAD

BMPs

- 5 **Plan to divert water from the trails to the undisturbed forest floor.**
- 6 **Minimize trail sections on steep slopes (>15%) wherever possible.**
- 7 **Plan to harvest during appropriate soil and weather conditions** (preferably on dry or frozen ground).
- 8 **Before you use old trails in the harvest area, consider whether water will run in them and where this water goes.**
Use existing trails only if runoff can be kept out of waterbodies by:
 - diverting water from the trail (for example, by using water bars); and
 - using brush or other materials to prevent ruts from developing or deepening.
 - If old trails are deeply rutted and the site cannot be harvested without additional rutting, consider harvesting on frozen ground and/or relocating the skid trails.



Example of large lot layout.

BUILD IT RIGHT

BMPs

- 1 Construct trails using simple structures that divert water.** Keeping water out of the trail not only prevents erosion, but also reduces equipment wear and extends the period that the trail is usable (both during and after wet weather).
- 2 If possible, limit the use of equipment in filter areas, or harvest only on frozen ground.**
- 3 Limit the amount of disturbed soil in filter areas and make sure that any sediment is filtered out before it reaches surface water.** This reduces the impact of skidding and forwarding.
- 4 Use brush to reduce the amount of ground compaction the equipment causes, to prevent soil disturbance, and to stabilize areas of exposed soil in filter areas.**



Brush on skid trails, as well as frozen ground, helps minimize soil disturbance and rutting.

KEY ISSUE

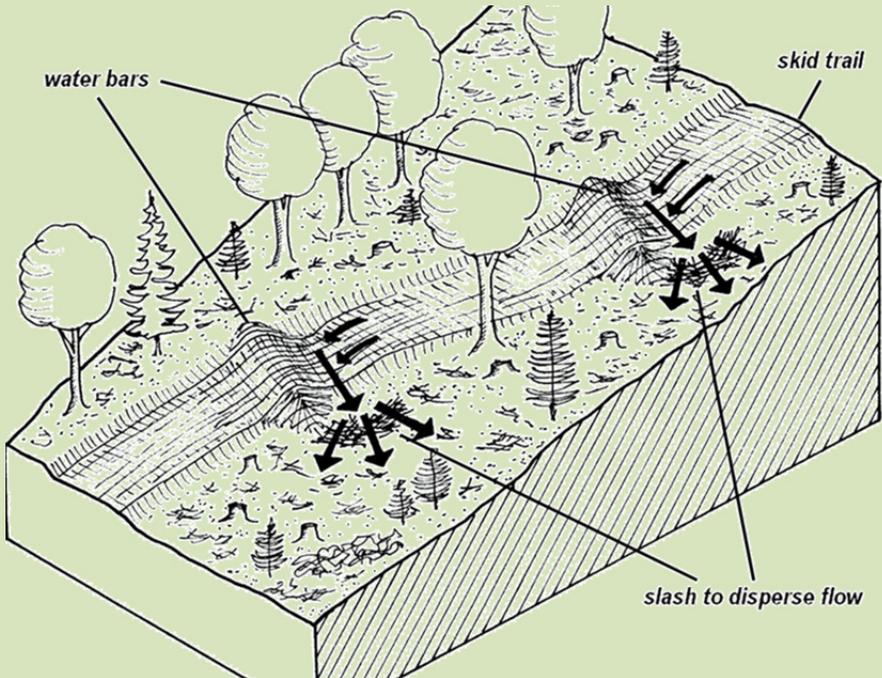
Water Diversions for Trails

BMPs

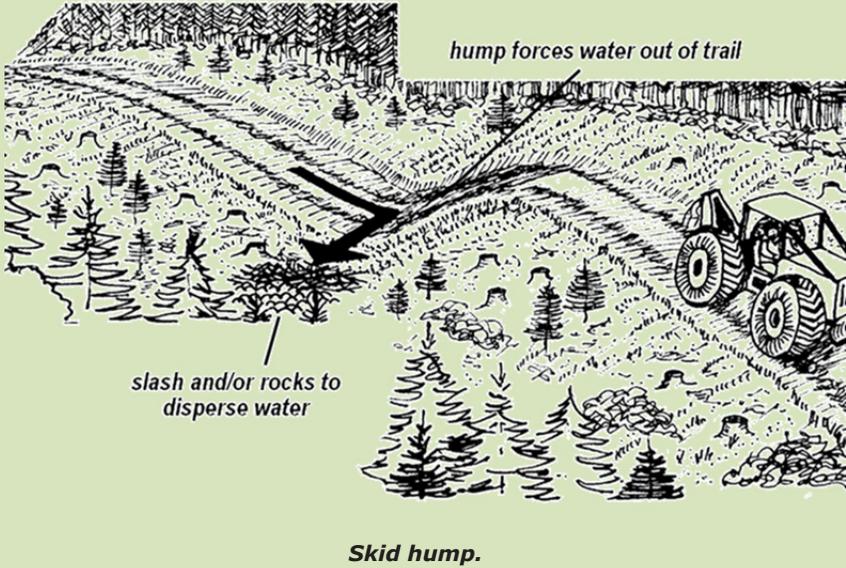
- 1 Install water bars, skid humps, or other diversions to move water off the trail, preferably before it reaches the filter area.
- 2 Locate water bars and other diversions frequently enough to prevent water from accumulating, based on Table E. On some sites, choosing appropriate locations for diversions may be more important than their spacing.

Table E
Water Bar Spacing Guidelines

Slope (%)	Spacing (ft.)
1-2	250-400
3-5	135-250
6-10	80-135
11-15	60-80
16-20	45-60
21+	<45



- 3 Make water bars at least 6-12 inches deep, 6-12 inches high, and install them at a 30-degree angle to the trail.
- 4 Extend the water bar inlet and outlet 1 foot or more beyond the trail to keep the diverted water from re-entering the trail.
- 5 Use the terrain to incorporate natural skid humps into the trail layout, to help divert water from the trail.
- 6 Put brush in the trail, as needed, to help disperse water.



HARVEST IT RIGHT

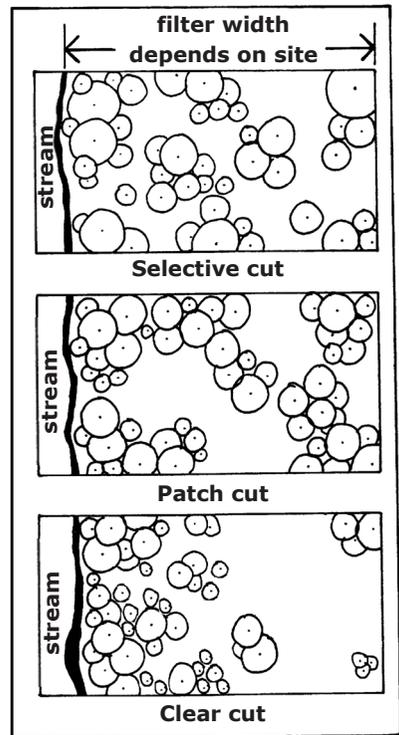
Trees and other vegetation are important components of filter areas. One of the most important BMPs for trails is to keep enough trees and other vegetation within the filter area to provide adequate shade, stabilize the banks, limit impacts to soils, and supply organic material to the water.



Harvest restrictions and required practices may apply in some jurisdictions. Call the Maine Forest Service at (800) 367-0223 in-state or (207) 287-2791 for assistance.

BMPs

- 1 Modify the filter area width as needed to achieve the goals mentioned above.**
- 2 Maintain a diverse species composition.**
- 3 Retain a range of both larger- and smaller-diameter trees.**
- 4 Leave an adequate canopy of trees and shrubs to shade the water surface and provide leaf litter.**
- 5 Limit harvesting that removes most of the forest structure (like clearcuts or overstory removal) in filter areas.** Some small patch openings may be appropriate if they maintain or enhance the forest structure.
- 6 In general, harvest less and less intensively as you get nearer to the waterbody, although harvest intensity will vary with local stand conditions.**
- 7 Use directional felling to drop trees away from waterbodies.** Avoid dropping slash or logs into stream channels and other waterbodies.
- 8 Remove slash that has fallen into waterbodies with a boom, winch, or by hand.** Leave any tops or stems that have fallen into the water naturally.



No matter the type of cut, always retain more trees near waterbodies

MAINTAIN IT

BMPS

- 1 Use brush on main trails and in filter areas to prevent ruts from developing. If ruts develop anyway, stabilize them using more brush and consider relocating to firmer ground, or waiting for drier or frozen conditions.**
- 2 Inspect and maintain water bars periodically to prevent water channels from developing in the trails.**
- 3 Stay alert to weather forecasts of significant rain or substantial thawing.** Consider:
 - limiting equipment use, working in a different area, or doing other work until the site dries up or refreezes;
 - applying brush to soft areas to distribute the equipment's weight before problems develop; and
 - installing additional temporary diversions, especially water bars, to prevent water from running in the trail.



Water bars move water out of the trail onto the forest floor.

CLOSE IT OUT CORRECTLY

Proper closeout ensures that future problems do not develop.

BMPs

- 1 **Identify the long-term monitoring and maintenance needs appropriate to the harvest site and decide who is responsible for them.** Communicate this to the landowner, forester, and logger.



A trail closed-out with water bar and seeding.

BMPs

- 2 Close out unused trails as the job progresses.
- 3 Install diversions such as water bars on trails before leaving a site permanently or suspending operations for more than a few weeks. Diversions should be installed wherever water channels could develop that will carry runoff to waterbodies or their filter areas.
- 4 Smooth rutted trails, if necessary, to keep channels from forming, and to divert runoff directly into filter areas.



HIGHEST PRIORITIES

- Know how to handle and store hazardous materials.
- Avoid leaks and spills.
- Know how to deal with accidents.

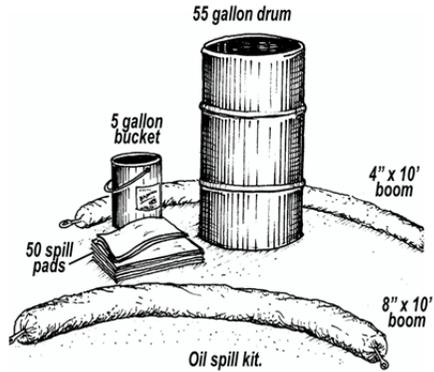
HAZARDOUS MATERIALS

FUELS, OIL AND COOLANTS

Oils, fuels, hydraulic fluids, coolants, etc. are hazardous materials commonly used at log landings. It is important to know how to handle these materials, how to avoid spills while maintaining or repairing equipment, and how to respond to accidents.

BMPs

- 1 **Use appropriate containers for collecting and storing oils, fuels, coolants, or hazardous wastes.** Store these materials in designated areas and remove them from the site when they are no longer needed.
- 2 **Maintain and repair all equipment outside of filter areas.** Inspect hoses, fuel trucks, and tanks for leaks, and make repairs immediately.
- 3 **Have spill kits or other absorbent materials for mopping up spills readily available.** Hay or sawdust may be adequate for very small spills. Waste containment kits are available commercially and should be on hand for larger spills.
- 4 **If a spill occurs, keep it from flowing off the yard and into surface waters.**
- 5 **Know what state agency phone numbers to call in case of an emergency.**
- 6 **Collect trash and dispose of it properly.**



For assistance with spills of hazardous materials, call the Department of Environmental Protection's Division of Response Services office nearest you:

Augusta	(207) 287-7688
Bangor	(207) 941-4570
Presque Isle	(207) 764-0477
Portland	(207) 822-6300

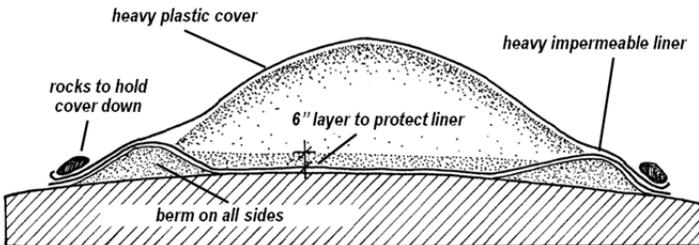
In an emergency, call
 (800) 482-0777 (oils/fuels)
 (800) 452-4664 (other chemicals)

TEMPORARY SAND AND SALT STORAGE

Sand and salt are often necessary to maintain safe winter conditions on truck roads. The following BMPs will help minimize or eliminate the possibility that these materials will discharge from storage areas to waterbodies or into the groundwater.

BMPs

- 1 Locate sand and salt storage areas away from waterbodies, wetlands, ephemeral flow areas, or other wet areas.** At a minimum, storage areas should be outside filter areas.
- 2 Locate storage areas on high flat ground, near the road, and away from water diversions that direct water into road ditches.**
- 3 Enclose the storage area with a berm high enough to contain rain and snow that may collect in the storage area.** Put a heavy impermeable liner, such as heavy plastic, on the ground where the sand and salt will be stored. Run the liner up the sides of the berm. The goal is to minimize the amount of moisture reaching the groundwater.
- 4 Leave at least a 6-inch layer of mixed sand and salt over the liner at all times to avoid puncturing it when digging in the pile.**
- 5 Cover the sand and salt mixture with heavy plastic when it is not being used.**
- 6 When abandoning the site, remove the remaining sand and salt mixture and the liner, and properly dispose of them off-site.**
- 7 Return the site to its original condition.** If necessary, seed or plant with a vegetative cover.



Temporary salt and sand storage pile.

PESTICIDE USE

Pesticides include chemical agents such as herbicides, insecticides, fungicides, rodenticides, or other chemicals used to control plants or animals that are interfering with forest growth. All herbicides and pesticides are regulated by state law through the Board of Pesticide Control (Maine Department of Agriculture, Conservation and Forestry).



Commercial herbicide and pesticide applicators must be licensed and certified by the Board. Landowners or managers who wish to apply herbicides and pesticides themselves on their own land should contact the Board before proceeding.

BMPs

- 1 **Maintain the required buffers between spray operations and waterbodies.**
- 2 **Apply pesticides and herbicides during favorable weather conditions.**
- 3 **Abide by all pesticide label requirements, including use rates, handling, storage, and disposal.**
- 4 **All herbicide and pesticide handling—mixing, loading, equipment cleaning, and storage—should be done away from waterbodies, outside filter areas, and away from road drainage systems.**
- 5 **Remove stored chemicals from the site when they are no longer needed.**
- 6 **Have spill kits or other absorbent materials on hand for mopping up spills.**



Refer to the Maine Board of Pesticides Control for rules and licensing requirements regarding the use of pesticides.

Phone (207) 287-2731

Website www.maine.gov/dacf/php/pesticides

FOR MORE INFORMATION

TECHNICAL ASSISTANCE

Maine Forest Service

Maine Department of Agriculture, Conservation & Forestry
 22 State House Station
 Augusta, ME 04333
 (800) 367-0223 (in-state only), or (207) 287-2791
www.maineforestservice.org

Maine Department of Environmental Protection

17 State House Station
 Augusta, ME 04333
 General number: (800) 452-1942 (in-state only) or (207) 287-7688
 Bureau of Land and Water Quality: (207) 287-2111

Maine Department of Inland Fisheries and Wildlife

41 State House Station
 Augusta, ME 04333
 (207) 287-8000

USDA Natural Resources Conservation Service

967 Illinois Avenue, Suite #3
 Bangor, ME 04401
 (207) 990-9100 x 3

MAINE FOREST SERVICE PUBLICATIONS

Other Maine Forest Service publications can be found at maineforestservice.gov under "Publications" including:

- The Forest Rules of Maine
- Stumpage Price Reports
- The Forest Trees of Maine
- Forest Health and Monitoring Information Sheets
- Forest Policy and Management Information Sheets



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Maine Department of Agriculture, Conservation & Forestry

Maine Forest Service

22 State House Station

1 (800) 367-0223 (in-state)

(207) 287-2791

www.maineforestservice.org



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Best Management Practices for Forestry: Protecting Maine's Water Quality - Third Edition

Maine Forest Service
Forest Policy and Management Division

Maine Department of Agriculture, Conservation & Forestry

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