Right-of-Way Forestry for a 6.7-Mile Section of I-95 in Maine

HAROLD E. YOUNG and DAVID T. EDSON

ABSTRACT

As a prelude to trial harvest operations, a detailed study of forestry potential was conducted on 6.7 mi of the right-of-way (ROW) median strip of I-95 in Maine, between Routes 143 and 69. Color infrared photography was used to classify forest stands into immature and mature composition classes. Three maps were digitized and plotted (1:2400) to show all forest stands and nonforest areas and to estimate the area in acres for each. The first field session was conducted to verify photo interpretation and to assess open areas for tree plantations. A second session was used to measure 24 temporary sample points. Total volume, total weight, and harvestable volume and weight were estimated for all mature stands. It was concluded that only the median strip would be harvested in the trials; harvested stands could be left windfirm without serious erosion problems; planned harvests can reduce individual tree cleanup by the Maine Department of Transportation; maps and inventory of the ROW can be used to plan and record landscape and forestry treatments; a stumpage value in excess of $1,000 per mile was assessed in the 6.7-mi study area.

In May 1983 a detailed study of a 6.7-mi segment of I-95 between Routes 143 and 69 was commissioned by the Maine Department of Transportation (MDOT). The inventory and mapping phases of the study were performed by James W. Sewall Company.

Woody fiber farming (1) was an early suggestion in the study followed by more conventional forestry (2-3). The latter was based on a study of the forest management possibilities of a 23-mi section of I-95 (4).

The primary objective of this study was to develop a procedure for assessing both stocked and nonstocked areas of the median strip and sidestrips of the right-of-way (ROW) for forestry potential. Implicit in this objective was the assumption that safe and economic harvesting could be accomplished without impairing traffic flow; a separate study was envisioned that would explore traffic and contractual problems with logging contractors during a bonafide harvest of stands within this same 6.7-mi segment of I-95.

A secondary objective was to determine, within the nonstocked areas, whether trees could be planted, which would thereby reduce mowing costs. As highway budgets have been reduced in recent years, there has been less mowing, less spraying, and less planting on the ROW. Alternatives such as slower-growing shrubs and grasses must be compared with establishing small plantations that can produce income and offset some ROW maintenance costs.

A third objective was to get foresters and highway engineers involved in a dialogue. Engineers have problems and opportunities presented by the presence of forest land within the ROW. Foresters are familiar with the sequence of forest stand development. A dialogue between the two professions can help to identify forest stands that may present shading problems, windfall hazard, or income-producing opportunity. A method for chronicling natural and manmade change within the ROW was developed through the mapping process.

James W. Sewall Company, 147 Center St., Old Town, Maine 04468.

METHODS

Aerial Photography

On May 19, 1983, a series of 28 color infrared vertical aerial photographs was taken extending over the study area. A Zeiss 6-in focal length camera with a 9-in. film format was used. The nominal scale was 1:6000 (1 in. equals 500 ft).

The roll of film was processed to positive transparency form and cut into individual exposures. Each exposure was mounted and taped in an acetate envelope. Fiducial marks were traced on the acetate envelope to ensure permanent registration.

Photo Interpretation

Photo interpretation of all forest stands was performed using a Bausch & Lomb Zoom 95 stereoscope with light table. All vegetation was segregated into one of the following categories: (a) open areas, (b) immature stands with a predominance of small premerchantable stems, (c) mature stands with a predominance of merchantable stems, (d) swamp (SW), or (e) rocky (RY). The immature and mature stands were further defined as softwood (more than two-thirds softwood), hardwood (more than two-thirds hardwood), or mixedwood (having less than two-thirds softwood or hardwood). Paved areas and adjacent grassy slopes were not described. Open areas in the sidestrips and median were delimited from the grassy slopes at the bottom edge of the fill line.

Blueprints furnished by the Maine DOT were used to mark the ROW boundaries on the transparencies. Mile markers were noted on the transparencies to facilitate mapping.

First Ground Reconnaissance

After preliminary photo interpretation was completed, the entire 6.7-mi segment was walked to verify photo interpretation and to conduct an assessment of all areas that had been designated as open.

Open areas were evaluated for potential plantation sites, and all recommendations were noted by stand number. Only sites with good or moderate drainage were recommended. This evaluation was performed with a check sheet that had boxes for the following items:

Location:
1. Mile number
2. Stand number
3. Acreage

Size class:
1. Mature
2. Immature

Crown closure:
1. 0 to 33 percent
2. 34 to 66 percent (Over)
3. 67 to 100 percent (Understory)

Composition class:
1. Softwood
2. Hardwood
3. Mixedwood

Removals:
1. Biomass chips
2. Firewood
3. Pulpwood
4. Sawlogs/veneer

Operating condition:
1. Wet
2. Steep
3. Rocky
4. Normal

Regeneration:
1. Species
2. Spacing

Necessary changes in photo interpretation were noted directly on the transparencies. These field observations permitted the following decisions to be made: (a) the forest area within the sidestrips of the ROW is so narrow that it was excluded from the mapping and first forestry operations; (b) no treatment was recommended for the immature stands until harvesting trials had been conducted on mature stands in the median.

Mapping

Lines and designation codes were marked on the acetate envelopes covering the transparencies and transferred onto a base map that was built on the Maine State Plane Coordinate System. Starting with U.S. Geological Survey (USGS) topographic quadrangle sheets, control points and planimetric features were identified and digitized using a computer mapping complex that consists of an AED color graphics terminal, a Talos digitizing tablet, a DEC 11/23 computer, and a Houston CP-15 drum plotter. Enough control points and planimetric features were selected to cover the 6.7-mi segment.

After all lines and designations had been transferred onto the base map, the lines were digitized and the designations were encoded on a separate tabular file. The computer mapping complex was used to compute area in acres for each designated area, and a map was produced (1:2400) with the two-letter designation code and the area number. On a separate listing, the area number was sequenced and each area was further described by this two-letter code and area in acres.

Three maps (1:2400) were plotted to cover the entire 6.7-mi segment. Note that these maps contained information only on the median strip.

Forest Inventory

The second visit to the 6.7-mi segment involved a forest inventory of only the mature forest stands. Eight sample points were established in each of the three composition classes (e.g., mixedwood, softwood, and hardwood). These points were established as temporary with a 10-basal area factor wedge prism. All trees selected by this process were recorded if they had a diameter at breast height (dbh) greater than 4.6 in. All trees and woody shrubs within the range of 0.6 to 4.5 in. dbh were measured on a 1/300-acre fixed-radius subplot (radius equals 6.8 ft).

Trees larger than 4.5 in. dbh were measured at dbh using tree calipers and were graded as pulpwood, undersized, boltwood, sawlog, or cull. These products correspond with local market conditions. Defect codes were used to describe missing tops, rot, insect damage, and so forth.

In coincidence with the grading of each tree for product, a subjective rating was applied to indicate the probability of harvest for each tree sampled. Although this rating did not encompass all stands and trees, it did provide a useful estimate of the percentage of trees that could be harvested within each mature composition class.

Following field tally, all data were encoded and processed by computer. For each mature area, an estimate of volume and weight per acre was computed; this per-acre estimate was multiplied by the number of acres within each mature composition class to produce a total estimate of standing volume, possible harvestable volume, and weight for the entire 6.7-mi segment. One of the points selected for the mature mixedwood was so heavily wooded that it was treated as a separate stand.

The computer report details volume per acre for each product and species by diameter class. A weight estimate in fresh tons per acre was computed using the tally of submerchantable (0.6 to 4.5 in.) and merchantable trees. The weight estimate was reported by species and diameter breast height with subtotals for (a) stump and roots, (b) bole, (c) limbs and top, and (d) total.

A statistical report for the volume and weight estimates was produced that lists the mean, the allowable error as a percent for 2:1, 9:1, and 19.1 confidence limits, standard deviation, coefficient of variation, and standard error of the mean as a percent.

RESULTS

Maps

Three paper maps (1:2400) were plotted with the two-letter designation code and area number. Area boundaries were plotted in black. Both north and south lanes of I-95 were plotted in red; a red dash was marked at each mile marker. Water bodies were plotted in blue.

Acreage Reports

A total of 93.0 acres was mapped, exclusive of the paved area and grassy slopes in the median strip. An acreage summary of the median strip is given in Table 1.

TABLE 1 Summary of Median Strip Acreage

Designation	Acres
SW-swamp	4.4
O-open	19.6
RY-rock	1.6
IM-immature mixedwood	15.6
IS-immature softwood	3.4
IH-immature hardwood	3.0
MM-mature mixedwood	15.5
MS-mature softwood	8.4
MH-mature hardwood	21.5
Total	93.0

TABLE 2 Summary of Inventory in All Mature Stands

Diameter Class (dbh)	No. of Trees Per Acre	No. of Trees to be Harvested Per Acre	Percentage Harvested Per Acre
1-4	1,603	0	0
5-9	181	74	41
10-11	22	18	82
12 and up	14	14	100
Subtotal			
5 and up	217	106	49
Total	1,820	106	6

Forest Inventory

A concise summary of the inventory work is given in Table 2. Reference should be made to the statistical table in the separate computer report to interpret the reliability of these numbers.

The species that comprise the three mature composition classes are listed in Table 3 by volume per acre in cords for all products and as a percentage of total volume per acre. A summary of fresh weight per acre for softwood, hardwood, noncommercial species, and all species combined is given in Table 4.

The primary purpose of the harvest would be to remove mature trees that will provide income and reduce the risk for windfall and insect damage within mature stands. All trees in the sample 12 in. dbh and larger were recommended for harvest. In the 5- to 11-in. dbh classes only 45 percent of those tallied in the sample were recommended for harvest.

TABLE 3 Species Volume Per Acre for All Mature Stands

Species	Volume Per Acre (cords)	Percent of Total
Red spruce	0.1	1
White spruce	0.1	1
Balsam fir	2.2	14
Hemlock	2.4	15
White cedar	0.0	0
White pine	0.8	5
Tamarack	0.1	1
All softwood	5.8	37
White birch	1.0	6
Sugar maple	1.4	9
Red maple	3.4	22
American beech	1.0	6
Poplar	1.3	8
Basswood	0.1	1
White ash	0.6	4
Red oak	0.4	3
Black cherry	0.2	1
Gray birch	0.1	1
Other hardwoods	0.4	2
All hardwoods	9.9	63
All species	15.7	100

TABLE 4 Summary of Fresh Biomass

Species Group	Component	Tons Per Acre
Softwood	Stump and roots	8.0
	Bole	22.0
	Limbs and top	10.0
	Total	40.0
Hardwood	Stump and roots	12.0
	Bole	32.9
	Limbs and top	15.0
	Total	59.9
Noncommercial	Stump and roots	0.1
	Bole	0.2
	Limbs and top	0.1
	Total	0.4
All species	Stump and roots	20.0
	Bole	55.0
	Limbs and top	25.0
	Total	100.0

Tree Plantations

In conjunction with the ground reconnaissance, open areas with good or moderate drainage were evaluated for establishment of tree plantations. Of the 25 stands classified as open, only 12 were considered suitable for plantations. These stands are enumerated in Table 5 and the species and spacing recommendations are listed.

TABLE 5 Summary of Stands Recommended for Planting

Stand No.	Acreage	Species to Plant	Spacing, ft	Total No. to Plant
7	0.5	Larch	6x8	454
13	0.9	Larch	6x8	817
15	0.4	Red pine	8x10	218
19	0.2	Larch	8x8	181
21	0.3	Red pine	8x10	163
23	1.7	White pine	6x8	926
49 and 50	3.5	White spruce	6x8	3,176
56 and 57	2.0	White spruce	6x8	1,815
70	0.9	Larch	6x8	817
74	0.6	Larch	5x8	544
Total	11.0			9,111

DISCUSSION OF RESULTS

Risk Assessment/Harvest Planning

The most significant product of an inventory and mapping process is the visitation of forest stands and the recording of observations in tabular and map form. Forest stands can be rated as immature, mature, prone to windfall, defoliated, or any number of other conditions. Highway maintenance crews clean up fallen trees one at a time; risk assessment could alleviate much of this work by targeting for harvest stands that contain trees that have obvious windfall risk. A forester can review the map and inventory information to predict changes in stand structure (diameter, class, height) and species composition over a period of many decades. Such changes will dramatically af-

fect shading problems, light mitigation, fire hazard, and aesthetics.

The map and tabular information also provide a method for chronicling forest treatments or landscape activities.

Timber Marking

Marking of each harvest tree will provide department personnel proper control. If each tree selected for harvest is marked with a paint spot on the stump below the cut level and on the bole, supervisory personnel can monitor harvest operations. Paint spots directed toward the center of the median would shield such markings from passing motorists.

It is anticipated that when forest management is extended to other sections of the Interstate system, timber marking and field records will be the principal basis for estimating the amount to be advertised for future harvesting.

Harvesting

Maine Department of Transportation personnel could be trained to conduct the harvest, and the necessary harvesting equipment could be rented or purchased; however, this is not recommended. Training time, safety requirements, and brokering wood to local markets are complicating factors. A better arrangement would be to announce the estimated amount of wood available and request stumpage bids with skidding and trucking routes from established contractors. This approach is used in Mississippi where logging on the ROW is earning the state Mississippi Department of Transportation about $1,000 per mile of highway. The contractor marks the wood and the department personnel supervises the harvest operation.

The inventory data collected in this study indicate that about 532 cord equivalents of pulpwood, boltwood, and sawlogs plus 500 fresh tons of biomass are available within the 6.7-mi study area. Valuing this wood at $10 per cord for the roundwood products and $16 per ton for the biomass, the total value is approximately $13,320 or $1,988 per mile average.

Safety

Highway safety is a major concern of the Maine DOT and the Maine State Police. It would be well to visit the operations in Mississippi and learn from the Mississippi Department of Transportation's experience. If exit and entry to the median strip is carefully situated and timed, the first harvest trials will help to determine whether additional measures, such as caution lights or police traffic monitors, are required.

Performance bonds can be posted by the local contractor to ensure that safety requirements are enforced.

Aesthetics

Few motorists are unhappy with the appearance of the I-95 median. The landscape architects have successfully seeded and planted where construction left bare soil, fill or burrow pits, and access ramps. Harvesting operations will elicit response from motorists regardless of the quality of the operation. Clearly, harvests should be planned to foster public support without undue economic penalty to the logging contractor. Harvesting is recommended in this paper only in some stands on the median strip with most of the harvesting confined to the center of the median strip. After the harvest, few motorists will detect cutting because of the dense advanced softwood regeneration that faces the roadway. Clearcuts should be avoided where possible, and it is anticipated that openings created by removal of mature trees will seed in rapidly.

SUMMARY AND CONCLUSIONS

As a prelude to trial harvest operations, a detailed study of forestry potential was conducted on 6.7-mi of the ROW median strip of I-95 in Maine, between Routes 143 and 69. Color infrared transparencies (1:6000) were produced on which forest stands and nonforest areas were delineated. Three maps were digitized and plotted (1:2400) to show all forest stands and to estimate the area in acres for each.

Two field sessions were conducted to (a) verify photo interpretation and assess open areas for tree plantations, and (b) to measure a total of 24 temporary sample points for volume and weight estimates within mature forest stands. An estimate of harvestable volume and weight were also made.

Analysis of the maps and inventory information leads to the following conclusions:

1. Trial harvest operations should be limited to the median strip and to mature stands excluding the sidestrips.
2. Harvested stands should be aesthetically appealing and windfirm without serious erosion problems.
3. Safety and legal problems can be avoided through discussions, contracts, and performance bonds.
4. Harvests can be scheduled to reduce the cleanup of individual trees by the Maine Department of Transportation.
5. Inventory and map information can be used by the department to chronicle landscape activity and to plan harvest operations that will alleviate maintenance as forest stand structure changes over a span of decades.
6. Within the 6.7-mi study area, the stumpage value of roundwood and biomass should range between $1,000 and $2,000 per mile.

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