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ENVIRONMENTAL IMPACT STATEMENT

DICKEY-LINCOLN SCHOOL LAKES

MAINE, NEW HAMPSHIRE AND VERMONT, U.S.A. AND QUEBEC, CANADA

Vol. 1

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

VOLUME 1

SEPTEMBER 1978

FINAL
ENVIRONMENTAL STATEMENT

DICKEY-LINCOLN SCHOOL
LAKES PROJECT

AT

DICKEY, MAINE

U.S. ARMY ENGINEER DIVISION,
NEW ENGLAND
WALTHAM, MASSACHUSETTS
SEPTEMBER, 1978

SUMMARY

DICKEY-LINCOLN SCHOOL LAKES
PROJECT AT DICKEY, MAINE

(X) FINAL ENVIRONMENTAL STATEMENT

RESPONSIBLE OFFICE: Colonel John P. Chandler
Division Engineer
U.S. Army Corps of Engineers
New England Division
424 Trapelo Road
Waltham, Massachusetts 02154
Telephone (617) 894-2400

1. NAME OF ACTION: (X) ADMINISTRATIVE ( ) LEGISLATIVE

2. DESCRIPTION OF ACTION: The proposed Dickey-Lincoln School Lakes Project in northern Maine is a multipurpose installation on the St. John River. The combination hydroelectric power and flood control project is located in Aroostook County, Maine, near the Canadian border.

The two proposed earth fill dams located at Dickey are 10,200 feet in length with a maximum height of 335 feet. They would impound 7.7 million acre feet of water at a maximum pool elevation 910 feet mean sea level. A second earth filled dam located 11 miles downstream at Lincoln School would serve as a regulatory dam. It would be 2100 feet in length, 90 feet above the existing streambed.

The initial power installation at Dickey Dam would be 760 megawatts (mw) with the potential for an additional 380 mw of capacity in the future. Lincoln School Dam would have a total installed capacity of 70 mw. Construction time for the dam structures and facilities would be about eight years. Initial filling would begin in year five and would be completed during year eight.

Electrical transmission facilities associated with the proposed action include: a 138 kilovolt (kv) transmission line from the proposed Dickey Dam substation to Fish River substation in Fort Kent, Maine; a steel double circuit single tower 345-kv transmission line from Dickey Dam substation to Moore substation near Littleton, New Hampshire; a 345-kv wood pole transmission line from Moore substation to Granite substation near Barre, Vermont; a 345-kv wood pole transmission line from Granite substation to Essex substation near Essex Junction, Vermont. The total length of the proposed line is 365 miles. Right-of-way widths are 100 feet for the 138 kv lines and 150 feet for the 345 kv lines. The action also includes the construction of three new substations; the expansion of three existing substations; and construction of 12 microwave communication stations.

The total project including transmission facilities has a benefit-cost ratio (BCR) of 2.1 to 1 based on an authorized interest rate of 3-1/4%, at October 1977 price levels. At 6-5/8%, the BCR is 1.2 to 1.

3. a. ENVIRONMENTAL IMPACTS: The proposed project would provide 830 mw of installed capacity and 1.2 billion kilowatt hours (kwh) annually of peaking energy, and 262 million kwh annually of intermediate range energy to the New England system. The downstream impact of flow regulation on Canadian power plants would be to increase their annual energy output by approximately 350 million kwh. This impact would result from flow augmentation during naturally occurring low flow periods.

Storage of spring snowmelt would provide flood protection for downstream communities and agricultural lands.

Labor force required would average 200 during winter and 900 from May through October. Peak labor force of up to 1900 people would occur during constructions years 4 through 7. The labor force required for the 365 miles of transmission facilities would be about 870 man years of effort spread over a 5-1/2 year construction period. Peak labor force during years 4 through 5 would be 300 to 450. Approximately 68 workers would be required for the operational phase of the dams. Sixty of these would be from the local area. About 21 workers would be required for operation and maintenance of the transmission facilities.

Implementation of the project would commit 134,242 acres of land and water within the United States. This does not include lands necessary for fish and wildlife mitigation purposes. In the reservoir area, 88,650 acres of existing terrestrial and aquatic habitat would be converted to a standing water ecosystem.

Seventy-five miles of private logging roads would be inundated and about 200 miles of additional new access roads would be needed off the transmission line right-of-way. The line would cross 37 paved roads. Some 247 acres of active agricultural land would be flooded by the impoundments. Forty-two acres of agriculture land would be impacted during transmission line construction and about two acres of agriculture land would be permanently impacted by transmission structures. The dams would provide varying degrees of protection to some 4500 acres of agricultural land downstream along the St. John River.

Thirty-seven archaeological sites and 6 historical sites are within the area of the project that would be inundated. Within 1/4 mile of the proposed transmission line route, there are 5 potential archaeological sites and 25 historical sites. In addition to these, there are 41 historic resources that are within the viewshed of the transmission line.

b. ADVERSE ENVIRONMENTAL EFFECTS: Inundation would destroy 278 miles of free flowing rivers and streams plus 30 lakes and ponds would be lost. Transmission facilities would cross 352 rivers and streams and 80 wetland areas. Streams involved in the transmission line would be subjected to slight local increases of temperature and short-term increases in sediment load.

In total, 80,455 acres of terrestrial habitat would be lost in the reservoir area and 6030 acres modified by the transmission lines. 36,893 acres of deer wintering yards would be inundated and 138 acres impacted by the transmission lines.

Flooded reservoir areas and rights-of-way clearing would cause 81,946 acres of timberland to be removed from production resulting in a loss of annual net growth of timber of 25,825 to 34,525 cords.

An estimated 166 families and 16 commercial facilities would have to be relocated as a result of the project. Of these, 5 residences and 1 commercial facility are along the proposed transmission route.

The influx of an outside construction force is expected to adversely impact the rural communities near the dam construction site in the St. John Valley by placing burdens on services and facilities. The present social and economic structure of the area would be irreversibly altered. It would be replaced in part by a different set of values and standards. Construction forces for the transmission facility would be distributed at locations along the 365 miles of line and socio-economic impacts would be dissipated and consequently minimized.

4. <u>ALTERNATIVES</u>: The following alternatives to the project or portions of the project were considered:

<u>Power</u>

a. No Federal Action
b. Load Management and Conservation
c. Power Purchases
d. Gas Turbines
e. Hydroelectric
f. Combined Cycle Thermal
g. Conventional Pumped Hydro
h. Batteries (Lead Acid)
i. Underground Compressed Air Storage
j. Underground Pumped Hydro
k. Solar
l. Wind
m. Other Thermal

<u>Flood Control</u>

n. Flood Control Dam
o. Local Flood Protection
p. National Flood Plain Insurance Programs
q. Building Codes
r. Flood Proofing
s. Permanent Evacuation

<u>Recreation</u>

t. Non-structural Recreation
u. Alternate Recreation Plans

<u>Transmission Line Facilities</u>

v. Alternative of not building the transmission lines
w. Alternative of use of existing transmission system
x. Alternative electrical plan of service and corridors

Transmission Line Facilities (Cont'd)

y. Alternative transmission routes

z. Alternative plans involving Canada

5. a. COMMENTS REQUESTED:

Department of Energy
Department of Housing and Urban Development
Department of Commerce
Department of Health, Education and Welfare
Department of Agriculture
Department of State
Department of Transportation
Department of Defense
Environmental Protection Agency
Federal Energy Administration
Advisory Council on Historic Preservation
U.S. Geological Survey
Federal Energy Regulatory Commission
New England River Basins Commission
Federal Regional Council of New England
Interstate Commerce Commission
Inland Water Directorate, Environment Canada

Maine State Clearinghouse - A-95
New Hampshire Coordinator of Federal Funds
Vermont State A-95 Coordinator
Massachusetts A-95 Coordinator, Boston, MA
New England Governors' Conference
New England Regional Commission
Maine State Historic Preservation Commission
New Hampshire Division of Historic Preservation
Vermont Division of Historic Preservation
Northern Maine Regional Planning Commission, ME
Androscoggin Regional Planning Commission, ME
North Kennebec Regional Planning Commission, ME
Penobscot Valley Regional Planning Commission, ME
North Country Council, NH
Central Vermont Planning Commission, VT
Chittenden County Regional Planning Commission, VT
Northeast Vermont Development Association, VT
Maine Association of Conservation Commissions
Massachusetts Division of Water Pollution Control
Office of Legislative Research, CT
New Hampshire Association of Conservation Commissions

Town Manager, Fort Kent, ME
Chamber of Commerce, Fort Kent, ME
Board of Selectmen, St. John Plantation, ME
Board of Selectmen, St. Francis, ME
Selectmen, Allagash, ME
Town Manager, Wallagrass Plantation, ME
Town Manager, New Canada Plantation, ME
Board of Selectmen, Madawaska, ME
Selectmen, Frenchville, ME

Boise Cascade Corporation, ME
Brown Paper Company, NH
Dead River Company, ME
Diamond International Corporation, ME
Dunn Heirs, ME
G. Pierce Webber, ME
Georgia-Pacific Corporation, ME
Great Northern Paper Company, ME
J. M. Huber Corporation, ME
International Paper Company, ME
St. Regis Paper Company, ME
Scott Paper Company, ME
Seven Islands Land Company, ME
James W. Sewall Company, ME
Maine Forest Products Council
Society of American Foresters, ME

Associated General Contractors of Maine
Carpenter's Local 621, ME
Economics Resource Council, ME
Maine Electrical Cooperative Association
Maine AFL-CIO
Maine State Chamber of Commerce
Industrial Development Council of Maine
International Brotherhood of Electrical Workers
Business & Industry Association of New Hampshire
Vermont State Chamber of Commerce

American Association of University Women, ME
American Rivers Conservation Council, Washington, D.C.
Audubon Society of Maine
Audubon Society of New Hampshire
Appalachian Mountain Club, MA
Bates Outing Club, ME
Colby Environmental Council, ME
Connecticut River Watershed Council
Conservation Law Foundation of New England, ME
Conservation Society of Vermont
Friends of the St. John, MA
Institute of Natural and Environmental Resources, Univ. of New Hampshire
Garden Club Federation of Maine
Green Mountain Club, VT
Land Use Foundation of New Hampshire
Land and Water Resources Institute, Univ. of Maine, Orono
League of Women Voters, ME
Midcoast Audubon Society, ME
National Audubon Society, Inc., Washington, D.C.
National Wildlife Federation, Washington, D.C.
Nature Conservancy, MA
Nature Conservancy, NH
Natural Resources Council of Maine
Natural Resources Council of Vermont
New England Forestry Federation, Inc.
New England Natural Resources Center, MA

New Hampshire Wildlife Federation
Penobscot Paddle and Chowder Society, ME
Sierra Club, MA
Society for Protection of New Hampshire Forests
SPACE: Statewide Program to Conserve our Environment, NH
Sportsman's Alliance of Maine
Sunkhaze Chapter of Trout Unlimited, ME
Valley Residents Against Dickey-Lincoln, ME

Bangor Hydroelectric Company, ME
Boston Edison Company, MA
Central Maine Power Company, ME
Eastern Maine Electric Coop.
Eastern Utilities Associates Service Corporation, ME
Fitchburg Gas and Electric Light Company, MA
Green Mountain Power Corporation, VT
Maine Public Service Company, ME
Massachusetts Municipal Wholesale Electric Company, MA
Municipal Electric Association of Vermont
New England Electric Gas and Electric Association, MA
New England Electric Service, MA
New England Power Planning, MA
Newport Electric Corporation, RI
Northeast Public Power Association, MA
Northeast Utilities Service Company, CT
Public Service Company of New Hampshire
United Illuminating Company, CT
Vermont Electric Power Company

b. COMMENTS RECEIVED:

Dams and Reservoirs

Department of the Interior
Department of Housing and Urban Development
Department of Energy
Department of Health, Education and Welfare
Department of Agriculture (U.S. Forestry Service)
Federal Energy Regulatory Commission
U.S. Representative Silvio Conte
U.S. Environmental Protection Agency

State of Maine, Office of the Governor
Northern Maine Regional Planning Commission
Eastern Midcoast Regional Planning Commission
Maine State Bureau of Parks and Recreation

Natural Resources Council of Maine
Friends of the St. John
National Wildlife Federation
Maine Public Interest Research Group
Seven Islands Land Company
Harvard Environmental Law Society
Maine Citizens for Dickey-Lincoln

Appalachian Mountain Club
Charles T. Main, Incorporated
Environmental Defense Fund
Sierra Club of Northern Vermont
Friends of the Earth
Maine Association of Planners
Sportsman's Alliance of Maine
Appalachian Mountain Club of Maine
National Parks and Conservation Association
Isaak Walton League
Valley Residents Against Dickey-Lincoln
Municipal Electric Association of Vermont
American Association of University Women
Garden Club Federation of Maine
Geological Society of Maine
Northern New England District, Council of Carpenters
State Biologists Association
Trout Unlimited
Association of Aroostook Indians, Incorporated
International Brotherhood of Electrical Workers
Maine Archaeological Society
Penobscot Paddle and Chowder Society
United Fly Tyers, Incorporated

Institute of Natural and Environmental Resources, Univ. of New Hampshire
Larry E. Morse
Lowell E. Daigle
Edward P. Cyr
Unity College
Simon's Rock Early College
Stanley R. Flagg
Laura A. Huffstetler
Lee A. Spielmann
Bev Agler
Kenneth and Sarah Kimball
Elizabeth M. Brown
Garrett C. Clough
Mrs. Stanley R. Flagg
Marion Bing
Arthur R. Day
Thomas E. Eastler
Madeline and G. Randolph Erskine
Ron Gunther
Howard W. Hodgdon
Marian Killam
Linda and Edward Klein
James Logan
Kathy Olson
W. Bradford Patterson
John R. Swanson
Eberhard Thiele
Eben B. Thomas
Dean P. Morrison
Auburn E. Brower
Walter and Marjorie Wade

Transmission Facilities

U.S. Nuclear Regulatory Commission
U.S. Department of Health, Education and Welfare
U.S. Senator William D. Hathaway
U.S. Department of Agriculture
U.S. Department of Transportation
U.S. Environmental Protection Agency
U.S. Department of the Interior
U.S. Army Corps of Engineers, New England Division

State of Vermont, Agency of Transportation
State of New Hampshire, Office of the Governor
State of Vermont, Energy Office
State of Vermont, Agency of Development and Community Affairs
State of Vermont, Agency of Environmental Conservation
State of Vermont, Public Service Board
State of Vermont, Pesticide Advisory Council
State of Maine, Department of Inland Fisheries and Wildlife
State of New Hampshire, Office of Comprehensive Planning
State of Vermont, Department of Health
Penobscot Valley Regional Planning Commission
Central Vermont Regional Planning Commission
North Kennebec Regional Planning Commission

Town of Northumberland, NH
Town of Berlin, VT
Town of Jackman, ME
Moose River Selectmen, ME
Moretown, VT
Marshfield, VT

Union River Electric Coop., Incorporated
Eastern Maine Electric Coop., Incorporated
Van Buren Light and Power District
Massachusetts Municipal Wholesale Electric Company
Vermont Electric Coop., Inc.
Peabody Municipal Light Plant
Northeast Public Power Association
Vermont Public Power Supply System, Incorporated

Maine Citizens for Dickey-Lincoln
Valley Residents Against Dickey-Lincoln
Sportsman's Alliance of Maine
National Wildlife Federation
The Association of Aroostook Indians, Incorporated
Maine Audubon Society
Vermont Group of the Sierra Club
Vermont Natural Resources Council
Central Vermont Audubon Society
Vermont Public Interest Research Group, Incorporated
Society for the Protection of New Hampshire Forest
American Association of University Women
Wildlife Management Institute

Garden Club Federation of Maine
Appalachian Mountain Club
Trout Unlimited - Sunkhaze Stream Chapter
Natural Resources Council of Maine
Environmental Defense Fund
New Hampshire Wildlife Federation
Trout Limited, Manchester Chapter

James L. Elsman
Jess Z. Mase
Eberhard Thiele
Land and Water Resources Institute
Harvey A. Smith
Brooks B. Mills
Dean P. Morrison
Auburn E. Brower
Elizabeth H. Doak
Guy L. Krapp
Carlton Schaller, Jr.
Ad Hoc Committee on Research of Environmental Law Corporation
Harry Bissex
Jan Wells
Harlan J. Cantin
Mr. & Mrs. John F. Portelance
Hal Clifford
Irene M. Storks
Elva Reeg
E. Martin Kaufman
Dartmouth College
Mark F. Norton
Carol Coley
Harvard Environmental Law Society

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Design Memorandum No. 3	Hydropower Capacity and Project Economics	- CE, 1977
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Department of Energy

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Appendix A	Transmission System Planning	- DOE, 1978
Appendix B	Alternative Power Transmission Corridors	- DOE, 1978
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Appendix I	Visual-Recreation Resources Impact Study	- DOE, 1978
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Facilities Location Maps		- DOE, 1978
Errata Sheets		- DOE, 1978

PREFACE

Separate draft Environmental Impact Statements were prepared by the Corps of Engineers and the Department of Energy. The Corps of Engineers' draft addressed the impacts of the dams and appurtenant structures while the Department of Energy's draft addressed the transmission facilities. The two draft impact statements have been integrated into this one complete Final Impact Statement on the Dickey-Lincoln School Lakes Project.

The Final Impact Statement is the product of several inputs including the drafts of the Environmental Impact Statement, the comments to both drafts, direction from the Council on Environmental Quality and from public involvement. It is supported by all appendices from both drafts as well as supplementary information provided in Supplements to those Appendices. It comprises three volumes. Volume I is the statement volume; Volume II contains the comment and response portion of Section 9 and Volume III contains the original comment letters.

The Council on Environmental Quality has directed that the Final Impact Statement be more concise than the drafts and contain only that information necessary for decision-making. At present, their proposed guidelines would call for a document not in excess of 300 pages (excluding comment and response).

Accompanying this document for filing with the Environmental Protection Agency are the following:

1. Supplements and Errata Sheets to the Appendices
2. Errata Sheets to the draft EIS's
3. The Federal Water Pollution Control Act Section "404" Evaluation for Dickey-Lincoln School Lakes

Copies of the Final and all support data have been distributed throughout the six New England states and may be seen at the following depositories:

Connecticut

Hartford	State Library
Storrs	University of Connecticut

Maine

Allagash	Town Hall
Ashland	Town Council
Augusta	Natural Resources Council
	State House Law & Legislative Library
Auburn	Androscoggin Regional Planning Commission
Bangor	Public Library
	U.S. Department of Energy
	Penobscot Valley Regional Planning Commission
Biddeford	McArthur Public Library

Maine (Cont'd)

Brunswick	Bowdoin College - Longfellow Library
Caribou	Northern Maine Regional Planning Commission
Castine	Maine Maritime Academy - Nutting Memorial Library
Farmington	University of Maine, Documents Library
Fort Kent	Chamber of Commerce
	University of Maine, Documents Library
Jackman	Town Hall
Lewiston	Bates College, Documents Library
Machias	University of Maine, Documents Library
Madawaska	First Selectman
Orono	University of Maine - Raymond H. Fogler Library
Portland	Public Library
	University of Maine - Center of Research - Advanced Study
	University of Maine - Law Library
	University of Maine - Documents Library
Presque Isle	University of Maine - Documents Library
Springvale	Nasson College - Anderson Learning Center Library
St. Francis	First Selectman
Unity	Unity College - Documents Library
Waterville	Public Library
	Colby College - Miller Library
Winslow	North Kennebec Regional Planning Commission

Massachusetts

Amherst	University of Massachusetts
Boston	Boston Public Library
	Department of Energy
	State Library - Fingold Library
Cambridge	Harvard Graduate School of Design - Gund Hall
	Harvard Widener Library
	Massachusetts Institute of Technology
Chestnut Hill	Boston College, Babst Library
Lowell	University of Lowell - Alumni Memorial Library
Waltham	Brandeis University - Goldfarb Library
	U.S. Army Corps of Engineers - New England Division
Worcester	Worcester Polytechnical Institute - Gordon Library

New Hampshire

Concord	State Library
Durham	University of New Hampshire - Ezekiel W. Dimond Library
Franconia	North Country Council
Groveton	Public Library
Hanover	Dartmouth College - Baker Library
Hudson	Hills Memorial Library
Manchester	City Library

Rhode Island

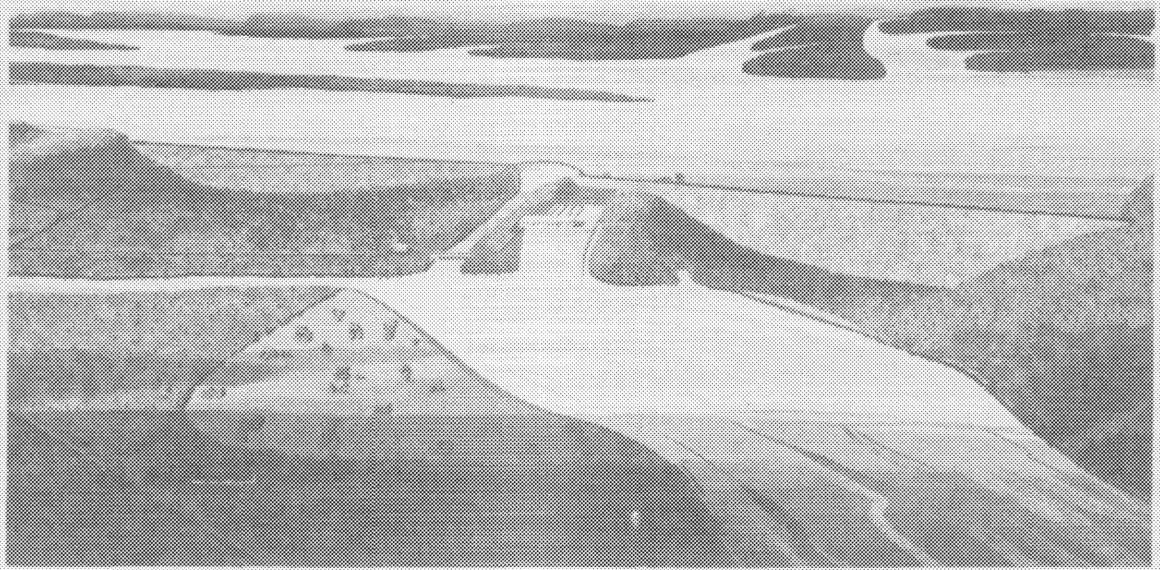
Kingston	University of Rhode Island
Providence	Brown University
	State Library

Vermont

Burlington	University of Vermont - Guy W. Bailey Memorial Library
Essex Junc.	Chittenden County Regional Planning Commission
Montpelier	Central Vermont Regional Planning Commission
	State Library
	The Free Library
St. Johnsbury	Northeast Vermont Development Association
	St. Johnsbury Athenaem
So. Royalton	Vermont Law School Library

Copies of the Final EIS have been sent to all agencies, groups and individuals that have commented on either draft and to those who have specifically requested the EIS. Copies of the Final EIS may be obtained by written request to:

Colonel John P. Chandler
Division Engineer
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154



SECTION 1

PROJECT DESCRIPTION

1.00 PROJECT DESCRIPTION

1.01 Location and Name

Dickey-Lincoln School Lakes is a proposed multi-purpose project located on the upper reaches of the St. John River in Aroostook County, Maine (Fig. 1.0-1). The proposed development consists of two dams with associated reservoirs and hydroelectric generating facilities, five dikes and transmission facilities. Dickey Dam, the larger of the two, would be located immediately above the confluence of the St. John and Allagash Rivers near the village of Dickey in the Town of Allagash and about 28 miles upstream from Fort Kent. The smaller, Lincoln School Dam, would be located 11 miles downstream from the Dickey Dam at the site of the now abandoned Lincoln School in the Town of St. Francis. Project details are summarized in Table 1.0-1.

1.02 Purpose of the Project

The purpose of the proposed project is to utilize the upper St. John River as a source of energy to produce electricity. Power benefits account for approximately 96% of the project benefits.

The project would be operated as a unit within the New England electric system, principally as a peaking power plant. The Dickey development would be able to generate approximately 1.2 billion kilowatt-hours (kwh) of peaking energy annually and Lincoln School would generate approximately 262 million kwh of intermediate range energy annually. In addition to this generation, downstream hydroelectric plants in New Brunswick would realize an estimated increase of 350 million kwh annually due to the project's streamflow regulation. A draft treaty under negotiation in the mid-1960's provided for equal sharing of this increased downstream output between the U. S. and Canada. Pending resumption of future negotiations, it has been assumed that this split would be retained.

The storage of water during the spring snowmelt for later release to generate power during lower flow periods has the inherent effect of providing flood control protection for downstream areas and communities which have experienced severe flooding in recent years.

Federally financed recreation facilities recommended for Dickey Lake would be minimum and would include a scenic overlook, visitor center and a canoe take-out area in the upstream limits of the lake for canoeists entering project waters from the upper St. John. Basic access facilities to project waters would be provided in the vicinity of the Dickey Dam. The present semi-wilderness characteristics of the project's shoreline would be maintained.

The minimum recreation development would be managed by the Corps of Engineers. Full development would require appropriate State involvement in management responsibilities and related costs.

TABLE 1.0-1
SUMMARY OF PERTINENT DATA
DICKEY-LINCOLN SCHOOL LAKES PROJECT

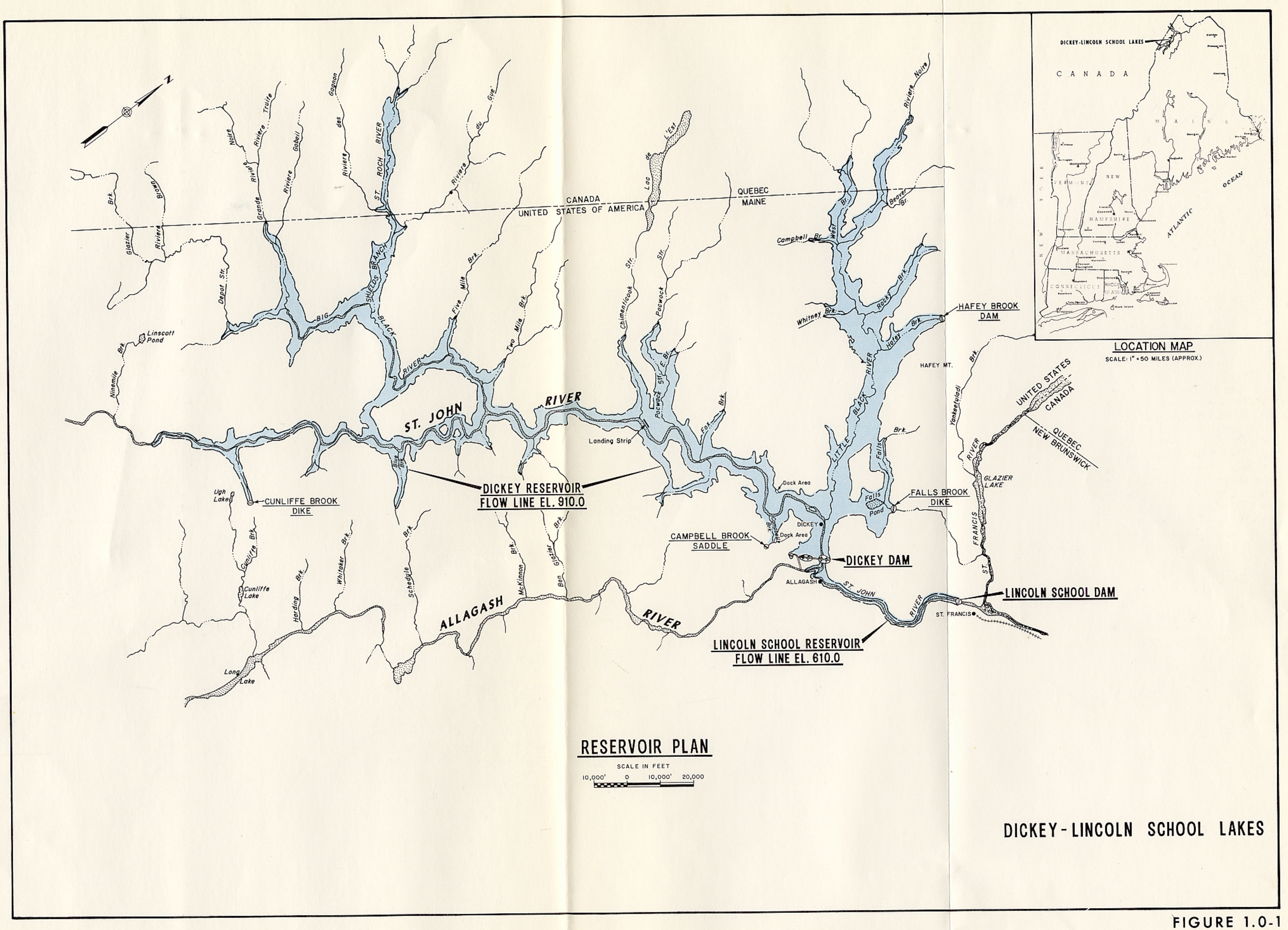
Dickey Dam

Purpose -------------- Multipurpose
Location ------------- St. John River, Aroostook County, Maine
Streamflow Data
Ave. Annual Runoff -- 3,309,300 acre feet
Max. Discharge ------ 87,200 cfs
Min. Discharge ------ 129 cfs
Ave. Discharge ------ 4,569 cfs
Reservoir
Drainage area ------- 2,725 sq. mi.
Max. Operating level- 910 MSL
Min. Operating level- 868 MSL
Inactive Storage ---- 4,800,000 acre feet
Active Storage ------ 2,900,000 acre feet
Total Storage ------- 7,700,000 acre feet
Area ---------------- 86,024 acres
Embankments
North Dam ----------- Earth Fill
Length ------------- 3,860 feet
Top Elevation ------ 925 MSL
South Dam ----------- Earth Fill
Length ------------- 4,380 feet
Top Elevation ------ 925 MSL
Spillway ------------ Uncontrolled
Elevation ---------- 910 MSL
Crest Length ------- 600 feet
Power Plant
Penstocks ---------- 4 27-foot dams
Powerhouse --------- indoor
Power Units -------- 3 Francis-type turbines
- 190,000 KW, 3 phase, 60 cycle generator
1 Francis-type pump/turbine
- 190,000 KW, 3 phase, 60 cycle generator/motor
Nameplate Capacity
Initial ------------ 760 MW
Future ------------- 1,140 MW

Lincoln School Dam

Purpose -------------- Streamflow regulation, power and afterbay for pump-back
Location ------------- St. John River, Aroostook County, Maine
Streamflow Data
Ave. Annual Runoff -- 4,780,300 acre feet
Max. Discharge ------ 110,000± cfs
Min. Discharge ------ 220± cfs
Ave. Discharge ------ 6,600 cfs
Reservoir
Drainage Area ------- 4,086 sq. mi.
Max. Operating level* 620 feet MSL
Min. Operating level* 590 feet MSL
Inactive Storage* --- 27,265 acre feet
Usable Storage* ----- 59,090 acre feet
Total Storage* ------ 86,355 acre feet
Area ---------------- 2,619 acres
Embankment
Type ---------------- Earth Fill
Length -------------- 1,520 feet
Top Elevation ------- 630 feet MSL
Spillway ------------ Gated, 4-60 ft. x 50 ft. tainter
Elevation-top of gates--620 feet MSL
Power Plant
Powerhouse ---------- indoor
Power Units --------- 3 Kaplan-type turbine 3 phase, 60 cycle generators
Nameplate Capacity -- 70 MW

* Until the Dickey Plant is expanded to ultimate capacity, the normal Lincoln School pool range will be 595 to 612 feet MSL (32,450 acre-feet active pondage).



DICKEY-LINCOLN SCHOOL LAKES

FIGURE 1.0-1

Due to extreme fluctuation of the Lincoln School Lake, no recreational use would be proposed for that facility. A canoe take-out point would be provided for canoeists entering the lake from the Allagash River.

1.02.1 Authority

The Dickey-Lincoln School Lakes project was authorized by the 1965 Flood Control Act, Public Law 89-298, dated 27 October, 1965.

Power generated at the proposed project would be marketed under the basic power marketing guidelines set forth in Section 5 of the Flood Control Act of 1944 (16 U.S.C. 1970 ed. sec 825s).

1.02.2 Need

Projections of New England power demands are prepared annually by the New England Power Pool (NEPOOL). The latest projections developed by NEPOOL, dated 1 January 1978, reflect an estimated annual compound growth rate of 4.5%. At this rate, electrical peak loads for New England would increase from the actual 14.9 million kilowatts in 1977/78 (winter peak) to 23.4 million kilowatts in 1987/88, an increase of 57% or 8.5 million kilowatts over the next ten years. The Federal Energy Regulatory Commission (FERC) - the Federal expert in power matters - has indicated that there is less than 1,000 MW of new peaking capacity planned by NEPOOL, representing less than 10% of all new additions through 1988. Based on NEPOOL's latest projected growth rate, FERC studies concluded Dickey-Lincoln School Lakes could serve as a source of peaking power in New England in the late 1980's.

An assessment of New England power demands was also conducted by a Corps consultant as part of the study of power alternatives to the proposed project. The results indicated an average annual growth rate, without demand controls and conservation, of 5.2 percent. As a test of project need, two New England regional power systems were evaluated - one without Dickey-Lincoln School and a second system which included the project. Both systems reflected the latest available information on NEPOOL planned additions.

The systems analysis, details of which are presented in Appendix I (CE, 1977), concluded that a need existed for the type of power that would be provided by the project and that the system with the proposed project was more economical than the without project mix. The project need was further evaluated under various levels of load management and conservation with annual growth rates, reduced to 4.29 percent and 3.49 percent. At these reduced rates, a need remained for peaking type power and the systems including the project proved more economical. These analyses are presented in Appendix I (CE 1977) and the Supplement to Appendix I (CE, 1978).

1.02.3 NEPOOL Relationship

The New England electrical system must provide, with existing and planned power and energy storage facilities, sufficient capacity and the energy to meet the requirements of the six New England states. The New England Power Pool (NEPOOL) which was formally adopted in 1971 to coordinate and plan the power supply industry for the region is comprised of 150 organizations in the six states. The Dickey-Lincoln School Lakes project would be operated as an integral component of the NEPOOL system serving the entire six state region.

1.03 Power Marketing

1.03.1 General

As required by Section 5 of the Flood Control Act of 1944, electric power and energy at a Corps of Engineers project is marketed by the Department of Energy in such a manner as to encourage the most widespread use at the lowest possible rates to consumers consistent with sound business principles. Rate schedules are drawn to allow for the recovery of all costs for producing and transmitting such electric energy including amortization of the capital investment allocated to the power purpose of the project. Approximately $694.0 million of the $705.3 million project construction cost, including transmission facilities, would be recovered through the sale of project power. Preference in the sale of power and energy is given to public bodies and corporations.

1.03.2 Market Area

The six state New England region is the market area for the project. Specific market arrangements would not be initiated until well into the construction phases of the project. Following are the tentative allocations of power as proposed by the Department of Energy, Southeastern Power Administration[1] (Table 1.0-2).

In addition to the capacity and energy generated from streamflows, additional energy would be realized from pumped storage operations. Under the preliminary concept developed by the Department of Energy, a split-the-savings agreement would be negotiated with the supplier of the off-peak pumping energy.

1.03.3 Repayment of Costs

A Department of Energy analysis has determined that revenues from the sale of power produced by the Dickey-Lincoln School Lakes Project would be sufficient to repay all costs allocated to the production and

[1] "Preliminary Financial Feasibility Study for Electric Power - Dickey-Lincoln School Project" - Southeastern Power Administration, August 1977.

TABLE 1.0-2
PROPOSED ANNUAL POWER SALES

Sales in Maine*

100 MW @ 50% Load Factor	=	438 GWH	(Intermediate)
100 MW @ 953 Hrs. Use	=	95 GWH	(Peaking)
200 MW		533 GWH	

Sales in New England Outside of Maine*

700 MW @ 953 Hrs. Use	=	667 GWH	(Peaking)

Total Sales

900 MW	=	1200 GWH

*Preference customer loads in Maine are estimated to be 100 MW in 1986 and preference customer loads outside of Maine are estimated @ 2400 MW.

distribution of the power. This included interest on and the amortization of capital costs for the project, the associated transmission facilities and future operation and maintenance expenses. The repayment period is set at 50 years, and the current interest rate for this analysis is 7% as determined by the Secretary.

1.04 Operation

The operation of the proposed project would be flexible and would be responsive to the system power demands. Under normal operating conditions, the project would generate energy to meet varying demands 12 months a year. The electrical energy producing potential is related to the amount of annual discharge, reservoir storage and hydraulic head available at the dam site. This energy potential can either be realized through low generation for long periods of time, i.e., base load operation, or large generation for short periods of time, i.e. peak load operation. From the standpoint of economic and operational efficiency, hydroelectric plants have their greatest value as peaking plants.

The annual capacity factor for the Dickey Dam is 15.4%. This means the project is capable of being operated at full capacity for 15.4% of the time on an annual basis to meet peak power demands. The project would also have "load following" capability on a daily and seasonal basis with the potential to operate for longer periods of time at reduced capacity. Due to these characteristics, the plant can provide "spinning reserve" capacity for the NEPOOL system, by being readily available to cover electrical loads in the event of forced outages in the system.

The operation should not be viewed as a uniform daily rate. Rather, the flexibility inherent in hydroelectric plants makes it capable of generating for varying periods of time, dependent on the demands placed on the New England system.

The Lincoln School reregulating dam with an annual capacity factor of 42.9% would normally operate 10 hours per day, 7 days a week. When the Dickey facility operates 7 or more hours per day, the Lincoln School facility would be capable of generating 24 hours per day at full capacity.

The proposed operational allocation of the project's annual energy output is shown in Table 1.0-3.

1.05 Description of the Proposed Facilities

The proposed project would consist of two dams with appurtenant hydraulic control and electrical generation facilities, reservoirs, five dikes and transmission lines and facilities.

TABLE 1.0-3
ENERGY OUTPUT - GWH (KWH x 10^6)

Dickey-760 MW
(Initial Development)

Month	Conventional Hydro	Estimated Pumped Storage	Lincoln School 70 MW	Total
January	142	46	30	218
February	115	37	25	177
March	55	18	13	86
April	38	12	22	72
May	39	12	34	85
June	53	17	19	89
July	56	18	16	90
August	70	23	18	111
September	50	16	14	80
October	52	17	15	84
November	73	23	21	117
December	151	50	35	236
ANNUAL	894	289	262	1445

1.05.1 Dickey Dam

Dickey Dam consists of two earthfill embankments termed the North Dam and the South Dam, separated by a rock knoll in which the power facilities, outlet works, and spillway are located (Figs. 1.0-2 and 1.0-3). Two concrete-lined tunnels would be located in the right abutment of the North Dam and would be used for stream diversion during construction and subsequently for flood control regulation and emergency lake evacuation purposes.

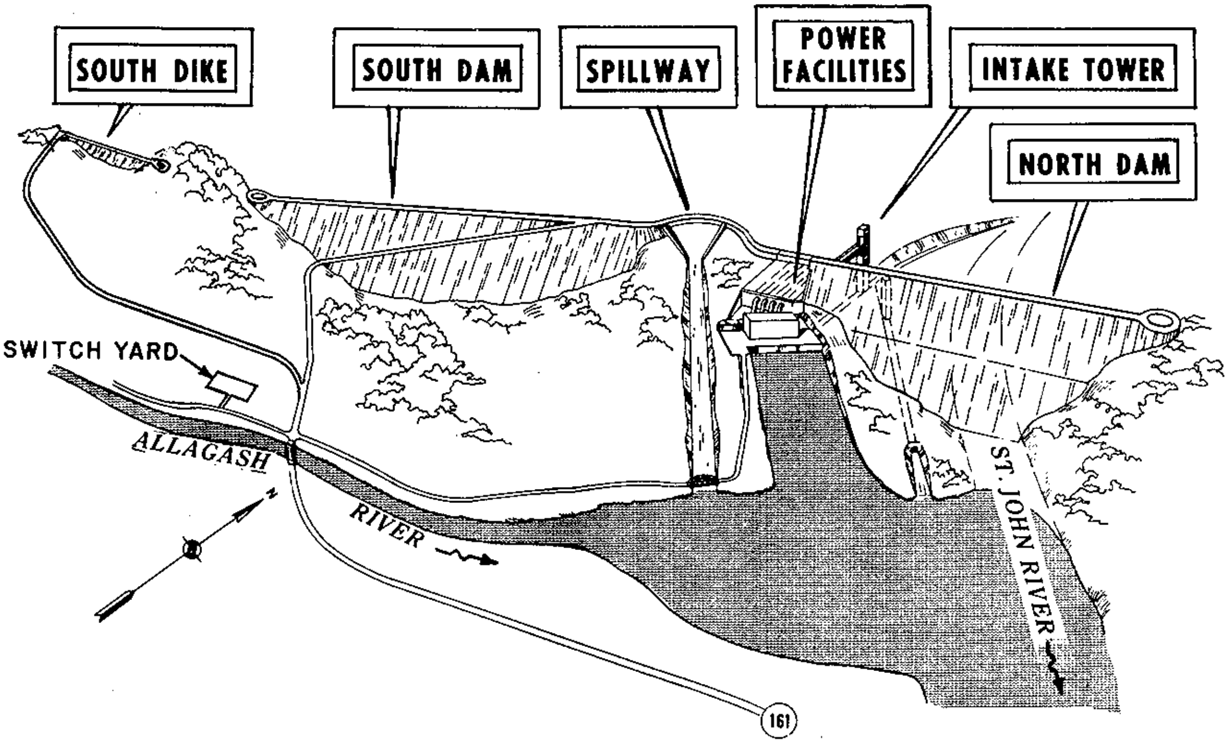
The Dickey Dam would have a total length of 10,200 feet and a maximum height of 335 feet above the streambed. The embankment would be constructed with an impervious earth center core flanked by zones of random earth fill. The upstream faces would have rock slope protection and the downstream faces would be protected with a processed gravel and cobble blanket. Rock slope protection would be placed on that part of the downstream face within the operating levels of Lincoln School Lake. Total volume of fills would approximate 54 million cubic yards.

The spillway located between the North and South Dams would be a chute-type, converging from a 600-foot long curved crest to a 100-foot width in the first 650-foot segment of the 3,200-foot long channel. The converging portion of the spillway would be lined with concrete. The remaining length would be exposed rock cut.

The power facilities would be located in the rock knoll between the North and South Dams. These consist of a penstock headworks structure, penstocks, power plant and tailrace. The initial construction would include four penstocks. The two penstocks for future units would be constructed at the time future expansion is implemented. The headworks structure would include vertical gates to provide capability for selective withdrawal to control water quality.

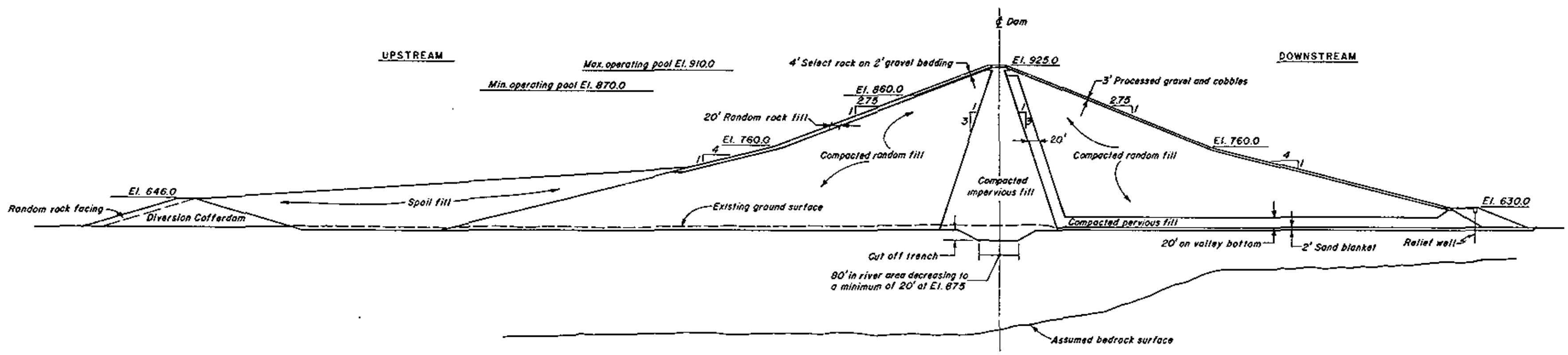
The powerhouse would include six operating bays, four for the initial generating units and two for future units. The four initial generating units would be 190 MW capacity each, for a total initial installed capacity of 760 MW; one would be a reversible unit. Ultimate inclusion of two additional 190 MW reversible units would increase the total installed capacity to 1,140 MW. In addition to the operating bays, the powerhouse structure would also include service and assembly bays and other ancillary control, maintenance and storage areas. The overall structure would be approximately 580 feet long, 150 feet wide and 150 feet high.

Dickey Lake would have a gross storage capacity of 7.7 million acre-feet at a maximum pool elevation of 910 feet msl and would have a total water surface area of 86,000 acres. The shoreline would be 390 miles long of which 41 miles would be on islands. The area of the 21 islands within the reservoir would be approximately 13,400 acres. The Lake would extend 55 river miles up the mainstem of the St. John River.



DICKEY DAM

FIGURE 1.0-2



EMBANKMENT CROSS-SECTION

SCALE IN FEET
100' 0 100' 200'

DICKEY DAM

FIGURE 1.0-3

1.05.2 Dikes

There would be five earthfill dikes in saddle areas along the reservoir perimeter to prevent overflow into adjacent watersheds. They are Campbell Brook, Cunliffe Brook, Falls Brook, Hafey Brook and South Dike (adjacent to the Dickey South Dam - Fig. 1.0-2). The approximate sizes of these dikes are:

Dike	Length (ft)	Height (ft)
Campbell Brook	700	9
Cunliffe Brook	1,050	26
Falls Brook	3,450	141
Hafey Brook	2,150	62
South Dike	1,170	15

1.05.3 Lincoln School Dam

Lincoln School Dam consists of an earthfill embankment across the St. John River, a powerhouse in the right abutment, and a gated spillway structure between the embankment and powerhouse. The overall length of the dam would be 2,100 feet, including powerhouse and spillway structures, and the maximum height would be 90 feet above the streambed (Figs. 1.0-4 and 1.0-5).

The embankment portion of the dam would be constructed with a central impervious earth core flanked by zones of random earth fill. Zones of pervious fill would be incorporated for seepage control. It would be approximately 1520 feet long abutting the left bank of the St. John River. The upstream face would be protected with rock and the downstream face would be protected with a processed gravel and cobble blanket. Adjacent to the earth embankment would be the spillway structure and outlet works.

Lincoln School powerhouse facilities would be constructed in the right abutment adjacent to the spillway structure. The powerhouse would include three operating bays, service and assembly bays, and other ancillary control, maintenance and storage areas. The generating units would consist of two 30 MW units and one 10 MW unit for a total installed capacity of 70 MW.

A public highway would be constructed across the Lincoln School Dam to provide access to the area bounded by the St. John and St. Francis Rivers and the International Boundary.

The Lincoln School Lake would provide for regulation of Dickey Dam discharges and serve as storage for pumpback operations. Initially, it would have a maximum pool elevation of 612 feet msl, a gross storage capacity of 67,149 acre-feet of which 32,450 acre-feet would be usable storage, and a surface area of 2,239 acres. Ultimately with the inclusion of the additional units in the Dickey Dam power facility, the

Lincoln School Lake would have a maximum pool elevation of 620 feet msl, a gross storage capacity of 86,355 acre-feet, and a surface area of 2,619 acres. The Lincoln School facility would be initially constructed to meet the ultimate requirements.

The Lincoln School Lake would inundate approximately 11 miles of the St. John River (from the Lincoln School Dam upstream to the Dickey Dam) and approximately 3.5 miles (4.7 miles for the ultimate development) of the Allagash River. No part of the Allagash River protected by the Wild and Scenic River Act would be inundated. The reservoir would have a 32 mile long shoreline.

1.05.4 Dam Safety

Dam safety is of paramount importance to the Corps of Engineers. It is the singular most important consideration extending from the preliminary investigation stage - when the structure is initially sited - through the ultimate operation and maintenance of the completed facility.

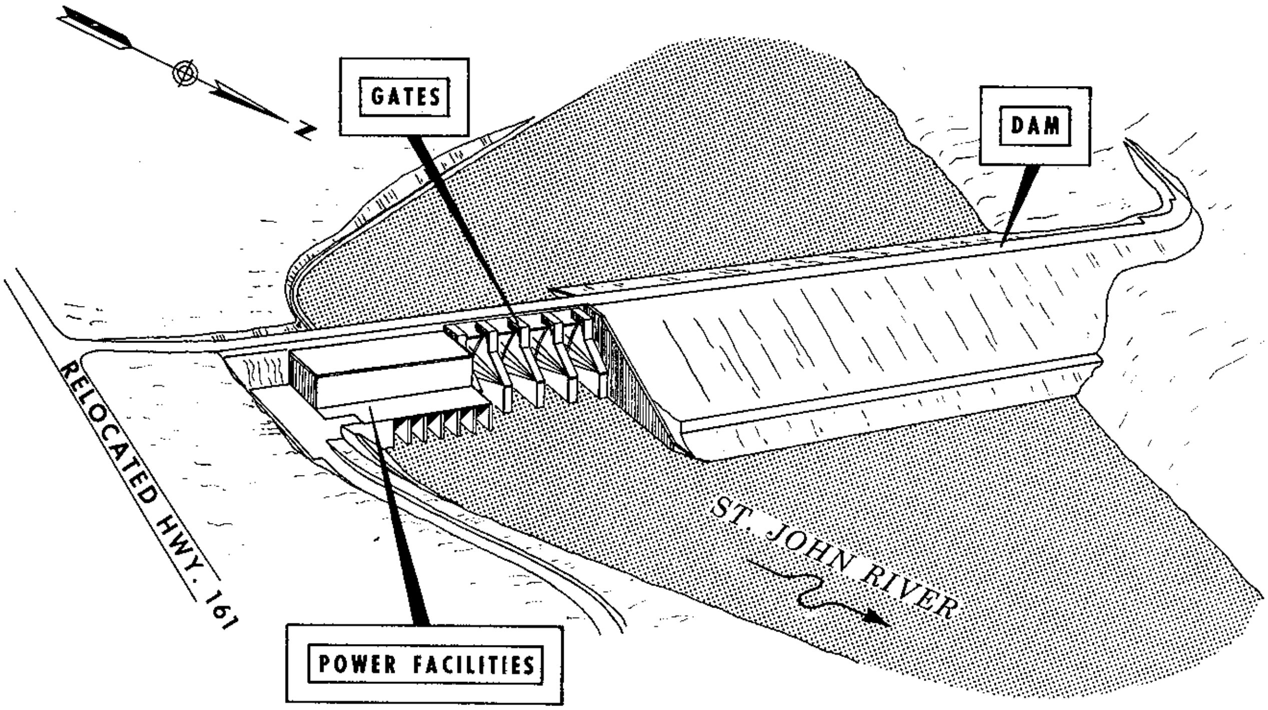
Design of a Corps structure is predicated on the extensive collection of site-specific engineering field data and is guided and reviewed by engineering experts both within and external to the Corps of Engineers. Construction would be conducted within stringent quality control and subject to continued engineering review. The completed structure would be permanently staffed providing continuous inspection capability. All applicable project features would be instrumented and monitored for potential stress. Periodic inspections of the project's structural features would also be conducted by a team of multi-disciplined technical personnel.

Design, construction and maintenance standards are subjected to continuous review and update to reflect the latest scientific and engineering knowledge. Under no condition is dam safety subject to compromise.

As a final element in dam safety, the Corps of Engineers has recently enacted a policy of preparing evacuation plans for areas downstream of all planned and completed Corps dams. Preparation of a dam failure analysis is an integral part of the evacuation plan. A failure analysis would identify the areal boundaries of the downstream area from which relocation would be required and would define the estimated travel time of a flood wave. Both of these are essential data elements in the development of an evacuation plan which would be prepared during future design effort should the project proceed.

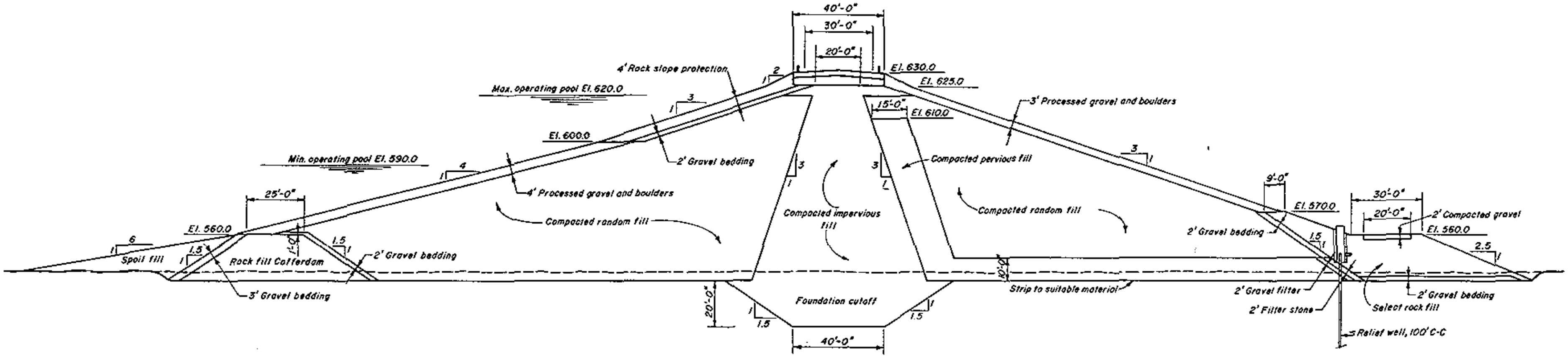
1.05.5 Transmission Facilities

New transmission facilities would be required for the proposed project. The facilities fall into three categories: transmission lines, substation facilities and communication facilities.



LINCOLN SCHOOL DAM

FIGURE 1.0-4



TYPICAL CROSS-SECTION

SCALE IN FEET

20' 0 20' 40

LINCOLN SCHOOL DAM

FIGURE 1.0-5

1.05.5.1 Transmission Lines

1. Two 345-kV (a.c.) circuits from the project site to Moore Substation northwest of Littleton, N.H., over a route through western Maine and northern New Hampshire. The two circuits would be suspended from a single row of double circuit, lattice steel towers (fig. 1.0-6).

2. A 345-kV a.c. wood pole transmission line from Moore Substation to Granite Substation near Barre, Vt. (fig. 1.0-6).

3. A 345-kV a.c. wood pole line from Granite Substation to Essex Substation (a proposed facility near Burlington, Vt.)

4. A 138-kV a.c. wood pole line from Dickey Dam to Lincoln School Dam (fig. 1.0-6).

5. A 138-kV a.c. wood pole line from Lincoln School Dam to Fish River Substation near Fort Kent, Maine.

The route is divided into segments which isolate portions of the proposal between substations or terminal facilities. Five segments occur in the proposed route (fig. 1.0-7). They are: Segment A, Dickey Substation to Fish River Substation via Lincoln School Substation; Segment B, Dickey Substation to Moose River Switching Station; Segment C, Moose River Switching Station to Moore Substation; Segment D, Moore Substation to Granite Substation; and Segment E, Granite Substation to Essex Substation.

Dickey-Lincoln School - Fish River

This segment of the proposed route is 29.4 miles long. Beginning at the proposed Dickey Substation site on the west bank of the Allagash River, the route crosses the river and runs along the southeast side of the St. John River to the site proposed for the Lincoln School Substation. From here, the route runs northeast between the St. John River and the bordering valley walls. The route passes south of St. Francis, Maine, and north of Bossy Mountain. Near the southern end of Stevens Hill southwest of Fort Kent, Maine, the route parallels an existing transmission line across the Fish River to Fish River Substation.

Dickey - Moose River

The proposed route from Dickey Substation to Moose River Switching Station northwest of Moose River, Maine, is 118.6 miles long. It roughly parallels the U.S.-Canada border at distances ranging from 6 to 20 miles.

Moose River - Moore

This portion of the proposed route is 136.8 miles long. It crosses portions of Maine, New Hampshire, and Vermont. The route roughly parallels the U. S. Canada border within Maine. It turns to a more southerly direction in northern New Hampshire and crosses into Vermont en route to Moore Substation on the Connecticut River.

Moore - Granite

The proposed route between Moore and Granite substations is 38.1 miles long. It parallels existing transmission lines.

Granite - Essex

The proposed route from Granite Substation to the Essex Substation is 43.3 miles long. It parallels existing transmission lines for much of its distance and is entirely within Vermont.

The transmission lines would be located upon land for which right-of-way easements would have been acquired from the landowners. Rights-of-way vary in width according to the type and voltage level of the transmission line, and allow for construction, operation, and maintenance of both the line and the necessary access roads. A 150-foot right-of-way width is assumed for the 345-kV transmission line. The 138-kV transmission lines would require a 100-foot right-of-way. However, actual clearing widths could be considerably less. Right-of-way required in each of the three states is summarized in Table 1.0-4.

The owner of the right-of-way property usually retains control and use of the property, subject to the provisions of the easement. Typical easement provisions would prohibit structures, the growing of tall trees, the storage of flammable materials, or other activities on the right-of-way that could be hazardous to people or jeopardize the reliability of the transmission line. Access to the right-of-way and the line is required for construction and maintenance. Access roads are used for brief periods.

Much of the roadway needed for construction can be seeded to grass or other plants after the line is built.

The complete location and design of access roads have not been determined. For the purposes of this statement, it is assumed that:

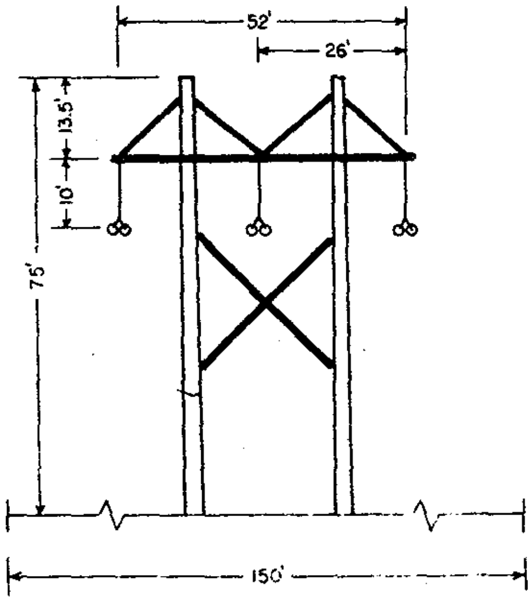
1. Access roads would be graded to provide a travel surface 14 feet wide.

2. Clearing and construction activities for access roads would disturb a total area averaging 20 feet wide.

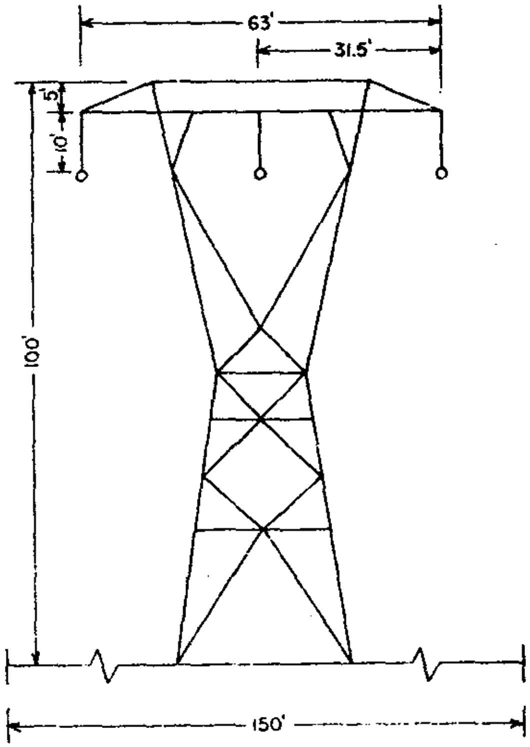
3. The roads would not be surfaced with gravel except where poor soil conditions are encountered. It is estimated that 10 percent of new access road mileage would require gravel surfacing.

4. The amount of new roads required would depend on the extent to which existing roads can be used and the limits imposed by the

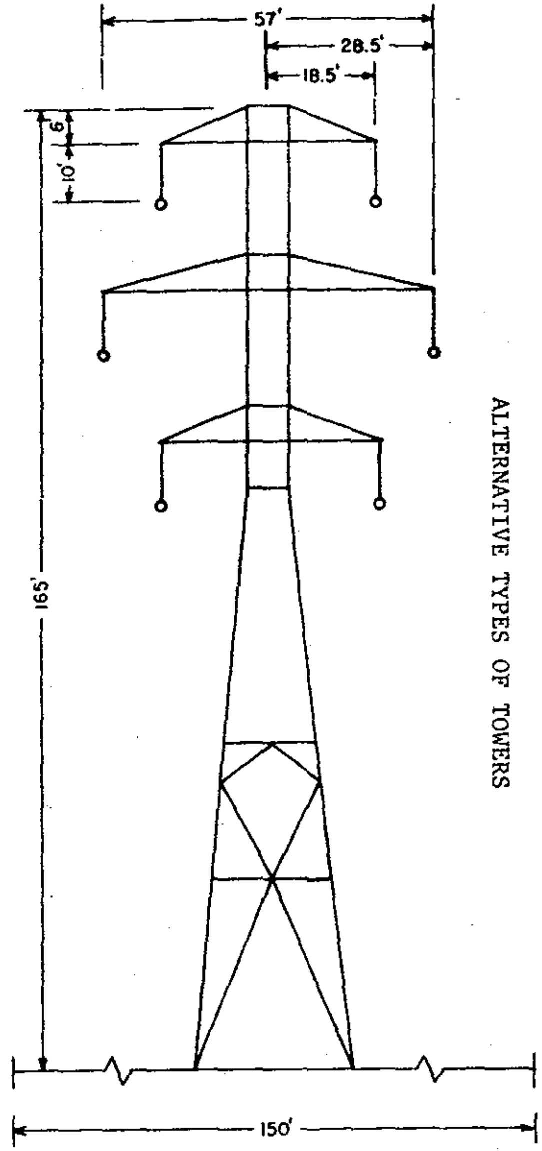
345 KV
TRANSMISSION STRUCTURES



SINGLE CIRCUIT
WOOD POLE

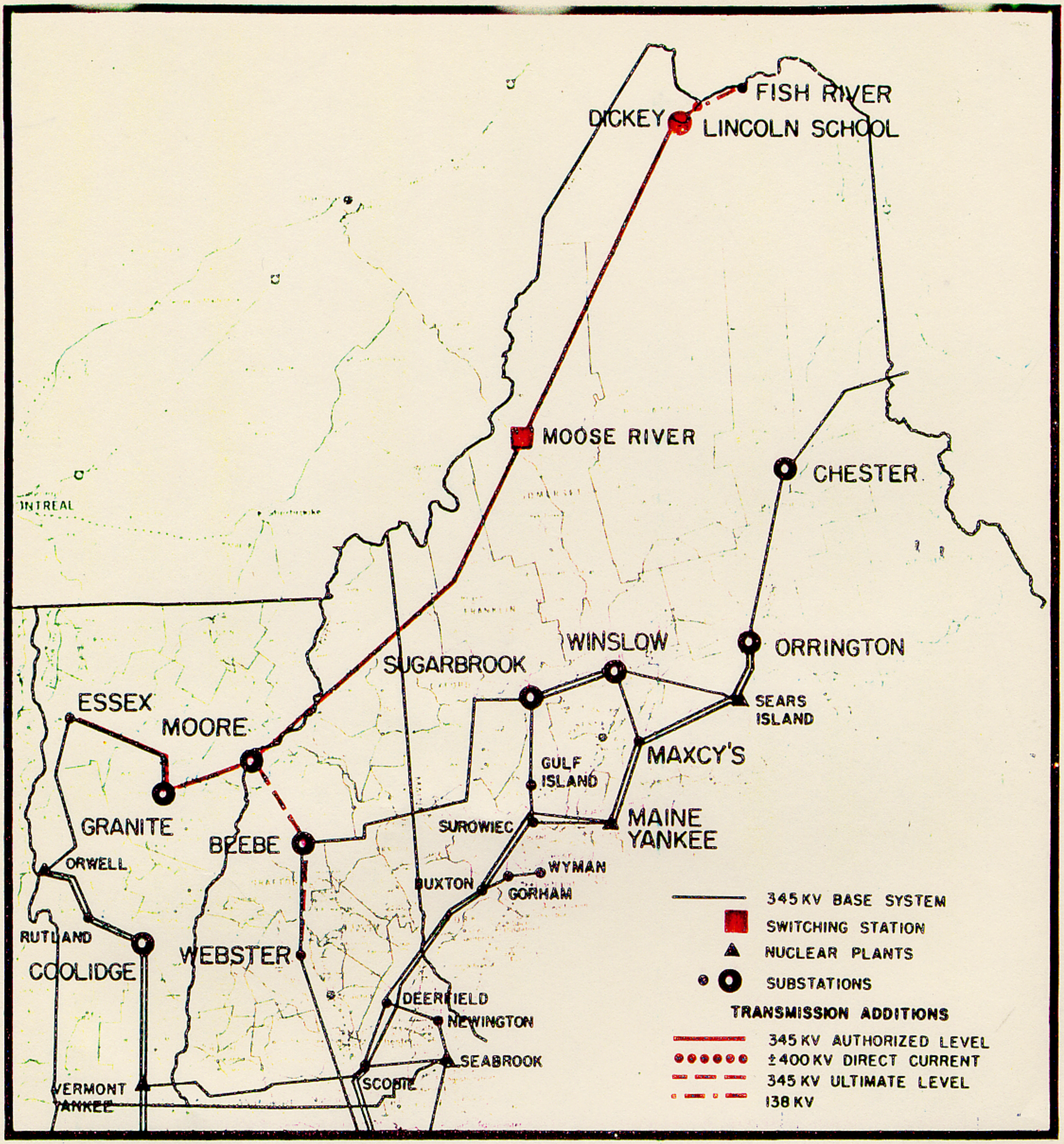


SINGLE CIRCUIT
STEEL TOWER



DOUBLE CIRCUIT
STEEL TOWER

FIGURE 1.0-6
ALTERNATIVE TYPES OF TOWERS



SYSTEM PLAN E

Western AC Plan-Double Circuit

DICKEY-LINCOLN SCHOOL LAKES PROJECT

U.S. Department of Energy March, 1978

FIGURE 1.0-7

TABLE 1.0-4

TRANSMISSION LINE
RIGHT - OF - WAY REQUIREMENTS
PROPOSED ROUTE

TRANSMISSION LINES	MAINE		NEW HAMPSHIRE		VERMONT		TOTALS	
	Miles	Acreage	Miles	Acreage	Miles	Acreage	Miles	Acreage
138kV LINE (100 ft. R.O.W.)	29.4 mi.	356 ac.	0	0	0	0	29.4 mi.	356 ac.
345kV LINES parallel location (100 ft. R.O.W.)	0	0	13.0 mi.	158 ac.	59.0 mi.	715 ac.	72 mi.	873 ac.
non-parallel location (150 ft. R.O.W.)	177.4 mi.	3225 ac.	52.0 mi.	945 ac.	34.7 mi.	631 ac.	264.1 mi.	4801 ac.
TOTALS	206.8 mi.	3581 ac.	65.0 mi.	1103 ac.	93.7 mi.	1346 ac.	365.5 mi.	6030 ac.

terrain, bodies of water, or wetlands. (The availability of existing access is an important consideration in locating the line and other facilities).

Most of the access roads would be on the right-of-way. However, new roads would occasionally have to be constructed outside of the right-of-way to provide access to it; this would necessitate the removal of additional vegetation. Table 1.0-5 presents the estimated access road mileage both on and off rights-of-way for each segment.

TABLE 1.0-5

PROJECTED
ACCESS ROAD MILEAGE

Segment	Location On ROW	Location Off ROW	TOTALS
Dickey-Lincoln School - Fish River	21 mi.* 51 acres**	16 mi. 39 acres	37 mi. 90 acres
Dickey - Moose River	88 mi. 213 acres	62 mi. 150 acres	150 mi. 364 acres
Moose River - Moore	100 mi. 242 acres	87 mi. 211 acres	187 mi. 453 acres
Moore - Granite	4 mi. 10 acres	19 mi. 46 acres	23 mi. 56 acres
Granite - Essex	25 mi. 61 acres	23 mi. 56 acres	48 mi. 116 acres
Totals	238 mi. 577 acres	207 mi. 502 acres	445 mi. 1079 acres

*estimated length
**based on 20' disturbance width X length

Vegetation that could interfere with the operation of the line is removed during construction. Clearing requirements are determined carefully to assure that only those trees that would interfere with the line are removed.

The customary maintenance program for transmission facilities includes routine and emergency maintenance and repair of electrical equipment, tower structures, conductors, radio communication and control facilities, substation equipment, and buildings. The need for line maintenance work is based on inspections which are usually accomplished by helicopter. Aerial inspections may be supplented by an occasional ground patrol of each line.

Many of the roads used in construction are not needed for maintenance or by the landowner. Roads needed for maintenance are protected against erosion and are kept passable by controlling vegetation.

If the project is constructed and the Federal Government builds the transmission facilities, it is estimated that about 21 men would be required to operate and maintain the transmission facilities associated with the Dickey-Lincoln School Lakes project.

Maintaining rights-of-way for the proposed transmission lines would require the removal of hazardous vegetation with herbicides or mechanical cutting. The use of herbicides must comply with Environmental Protection Agency standards and other Federal standards; State laws, regulations and codes; manufacturers' labels; and agreements with landowners.

There are several methods for utilizing herbicides for vegetative control. Among these are aerial application, cutting and stump treatment, basal treatment and the frill, notch or cup method. Aerial application is less selective than ground application as it would affect non-target vegetation. Aerial application may be preferred, however, when selectivity is not important, when terrain is rather inaccessible, when cost considerations are important, and when not hazardous.

1.05.5.2 Substation Facilities

Substation facilities required at the authorized level of development would include:

1. A 345-kV/138-kV substation at Dickey Dam, with braking resistor.

2. A 138-kV substation at Lincoln School Dam.

3. A 345-kV switching station near Moose River, Maine, referred to as Moose River Substation.

4. 345-kV terminal facilities would be added at Moore, Granite, and Essex substations, and 138-kV facilities at Fish River.

The construction of substations, control houses, and maintenance buildings involves the establishment of a permanent entrance road about 20 feet wide with specified cut-and-fill slopes; clearing the site of trees, brush, and other vegetation; grading and surfacing; and placing concrete foundations. Underground conduit runs and an electrical grounding system would be installed. Support structures would be erected. Electrical equipment such as transformers, switchgear, and buses would be installed.

A metal chain link fence would be placed around the equipment. Subdued color schemes that blend with the surroundings would be used for environmentally sensitive areas. Landscaping may be used depending upon the visual characteristics of the adjacent land and the visibility of the facility.

The Fish River Substation is an existing 69-kV facility owned and operated by Maine Public Service Company. It would have to be expanded to accommodate the new lines. The expansion would require about 0.7 acre of land, and the installation of new 138-kV buswork, switchgear, and 138-kV transformation.

The Lincoln School Substation would be a new facility located near the Lincoln School Dam and powerhouse. The site is about 2 miles west of the town of St. Francis on Maine Highway 161. It would be less than one-fourth mile from the relocated highway. An access road, plus about 0.7 acre of land would be required. Lincoln School Substation would be a switching station. It would send power generated at Lincoln School Dam to Fish River Substation or to Dickey Dam at 138-kV.

The Dickey Substation would be a new facility located near the Dickey Dam powerhouse. The site is presently used as a solid waste dump. Access to this site is developed. Dickey Substation would provide transformation between 345 kV and 138 kV. It would have equipment to switch and control Dickey power at both 345 and 138 kV. The equipment would include a braking resistor to help maintain the stability of the system during system fault conditions. The substation would require about 5.2 acres of land.

The proposed site for the Moose River Substation is 4 miles north of Moose River, Maine, and one-fourth mile from U. S. Highway 201. An access road would have to be developed. The station would require about 4.1 acres of land. It would connect the two Dickey-Moore lines with switchgear. This would make it possible to isolate one section of line automatically and thus maintain the stability of the rest of the system.

Moore Substation is an existing facility about one-half mile southwest of Moore Dam on the Connecticut River. About 5.2 acres of land would be required for additional equipment. The existing access would be adequate to serve the new facilities. Transformers would have to be added at the station so that the 345-kV equipment could be connected with the existing 230-kV equipment. Some additional switchgear would also be required.

Granite Substation is an existing facility about 5 miles south of Barre, Vt., and 2 miles east of Williamstown in Orange County. The existing substation would be expanded, requiring the use of about 4.1 acres of additional land. Additional switchgear and 345 to 230-kV transformation would be required.

Essex Substation is a planned facility assumed to be in place and designed when the proposed line is energized. No additional land would be required.

1.05.5.3 Radio Communication and Control Facilities

A communication system would be required to provide power system control capability for the transmission lines associated with the Dickey-Lincoln School Lakes Project. The communication system would in effect be an extension of the existing New England shared microwave system. It would use three types of stations: active, passive, and VHF mobile repeater stations.

The active repeater station would require an access road. It usually is served by central station electric power, backed up by an on-site, self-contained emergency generator. The equipment is located in a one story building with 200 to 300 square feet of floor space. An antenna tower and a fuel storage tank are also usually located on the site.

A passive repeater station resembles a billboard in appearance, except that it is supported by a tower. This type of station can be built and maintained without an access road if helicopters are used. Power is not required. Maintenance after construction is infrequent. Radio signals from an active station striking the passive reflector are directed to the antenna of another active station.

Communication facilities at Dickey Dam Substation would include an 80-foot high antenna tower. Equipment would be housed in the control buildings or a small communications building. A clearing measuring about 50' x 50' would be needed for the microwave facilities.

Active repeater facilities would be constructed at McLean Mountain, Pennington Mountain, Ashland, Oakfield, Bagley, Ferry, Black Cap, Oak Ridge and Parlin. The facility at Hot Brook would be an alternate to the direct path from Oakfield to Bagley.

A microwave station would be required at the Moose River switching station. The microwave facility would include an 80-foot self-supporting tower, electronic equipment housed inside a small control house, and electric station service power.

1.06 Construction Activities

Construction of the project, including all necessary land acquisition, would require approximately eight years. Initial power-on-line would be scheduled six years after initial on-site construction and incrementally increased until total power-on-line would be realized one and one half years later.

Labor force required for the dams and appurtenant facilities would amount to approximately 6,000 man-years of effort and would average 200 during the winter and 900 from May through October. An estimated peak labor force of up to 1900 people would occur during construction years 4 through 7. The labor force required for the 365 miles of transmission facilities would be about 870 man-years of effort spread over a 5½ year construction period occurring over the later years of dam construction. 300-450 people would constitute a peak labor force during years 4 through 5. Construction of substations require six to 12 months. The installation of equipment, final electrical connections, testing and energizing of the equipment would require additional time.

Normal work hours during the construction season would be 10 hours per shift, six days per week with two shifts per day for the dams and appurtenances. During the off-season (November-April) work hours would normally be eight hours per day, five days per week.

1.07 Construction Materials

1.07.1 Earth Borrow

Estimated quantities of earth borrow for construction of the Dickey and Lincoln School Dams and the saddle dikes are presented in Table 1.0-6.

TABLE 1.0-6
Estimated Quantities of Earth Borrow*

	Material Type (cu. yds.)		
Feature	Impervious	Random	Pervious***
Dickey**	8,552,000	43,080,000	742,000
Falls Brook	1,478,000	-	977,000
Hafey Brook	598,000	-	461,000
Cunliffe Brook	47,500	-	17,000
Lincoln School	225,000	-	315,000
TOTALS	10,900,500	43,080,000	2,512,000

* Excludes borrow available from excavation of project features

** Including North and South Dams, South Dike and Campbell Brook Dike.

*** Includes pervious fill, gravel bedding, processed cobbles and gravel and processed sand materials.

Earth borrow for the North and South Dams at Dickey and for the small embankments of the South Dike and the Campbell Brook Dike would be obtained from borrow areas upstream of the Dickey Dams located within or adjacent to the reservoir. The impervious borrow areas would be within two miles of the damsites while those for random and pervious types of materials would be within four miles of the damsites. All of the potential areas have been sampled and tested on a preliminary basis. The results show that satisfactory borrow areas can be developed to furnish the required quantities of earth borrow materials.

Earth borrow for the Lincoln School Dam would be obtained from borrow areas upstream of the damsite and within or adjacent to the reservoir. The impervious borrow area would be within two miles of the site while that for random and pervious types of materials would be within one mile of the site. These areas have been sampled and tested on a preliminary basis. The results show that satisfactory borrow areas can be developed to furnish the required quantities of earth borrow materials for this dam.

Based on the results of preliminary dike foundation explorations, photogeological investigations and ground reconnaissance, it is considered that impervious earth borrow for the Falls Brook Dike would be obtained from a borrow area developed in the reservoir area at a distance of less than 2 miles from the site. Random and pervious types of materials would be obtained from the borrow areas developed for the Dickey Dams at a distance of about 4 miles from the site.

Preliminary foundation explorations, site reconnaissance and photogeological investigation indicate that borrow sources for earth borrow materials can be developed within two miles of the Hafey Brook dike site.

Photogeological data indicates that sources of earth borrow materials can be developed within five miles of the Cunliffe Brook dike site.

1.07.2 Rock Borrow

Rock from required excavations for Dickey and Lincoln School Dams would be fully utilized in the construction of the project structures. The regional Seboomook slate rock formation, although generally fissile and slabby in fragmentation, would produce suitable material for use in cofferdam construction at Lincoln School and for random rock and spoil blanket fills at Dickey. The non-fissile, quartzitic phases of the slate would be selected for use in toe fills for Dickey Dam and as slope protection for Falls Brook Dike. In addition to the material from required excavation, approximately one half million cubic yards of select rock would be required for the upstream faces of project impoundment structures. Slope protection for the more remote Hafey Brook Dike would probably be produced by local quarrying of quartzite which is extensively exposed on Hafey Mountain about 1½ miles southerly of the dike site.

Potential sources of protection stone for the upstream slopes above minimum pools and of concrete aggregate materials for Dickey and Lincoln School Dams had been previously explored in the Deboullie Mountain, a major igneous intrusion in an area southeasterly of Dickey Dam.

The results of recent explorations and laboratory tests indicate that rock borrow and concrete aggregates can be obtained from a potential sandstone quarry to be developed in one of two areas to the southeast of the Dickey site at a haul distance of about 5 miles. Ultimately, test quarrying will be done in the selected area after laboratory tests and additional borings confirm preliminary testing in the areas. The Deboullie Mountain area is no longer considered as a source of rock borrow.

1.07.3 Concrete Materials

The project would require approximately 850,000 cubic yards of concrete for construction of appurtenant structures for the two earth fill dams, powerhouses, walls and relocations.

1.07.3.1 Concrete Aggregates

About 850,000 tons of coarse aggregates and 500,000 tons of fine aggregate would be needed for the concrete. All known commercial and undeveloped sources of natural deposits of sand and gravel within a very wide radius of the sites in the United States contain a high proportion of flat, elongated and/or friable fragments of shale, slate and sandstone. The regional bedrock, Seboomook Slate, is unsuitable for production of aggregates.

The nearest commercial source of quality aggregate is in Presque Isle, Maine, about 80 miles from the Dickey Dam site. Rail facilities are available adjacent to the plant. The rail line terminates at St. Francis, about two miles downstream of the Lincoln School site and 12 miles from the Dickey site.

With respect to possible quarry sources, several major exposures of crystalline type rocks have been located within a 20 mile haul distance. Preliminary investigations of two of these areas as discussed in Section 1.07.2 Rock Borrow indicate that rock of suitable quality for the production of concrete aggregate is available within 5 miles of the dam site.

1.07.3.2 Cementing Materials

The nearest source of portland cement is Thomaston, Maine, about 200 miles distance by rail. The nearest other sources of cement are New York and Pennsylvania. The use of the cement additive pozzolan may result in a more economic mix in the massive-type concrete. A study will be made of the possible economic savings utilizing pozzolan and availability of commercial sources of pozzolan.

1.07.4 Transmission line facilities

It is estimated that a total of 17,000 tons of tower steel, 1700 tons of conductor steel, and 6800 tons of conductor aluminum would be used in the proposed transmission line. Approximately 45,000 cubic yards of sand and gravel materials will be used in the construction of access roads.

1.08 Reservoir Filling and Operating Cycle

1.08.1 Dickey Reservoir

Initial filling of the reservoir would start in June of the fifth construction year. The rate of filling would be dependent upon the available amount of water. Assuming a sequence of hydrologically normal years, it would take at least three spring runoff seasons to obtain an operational pool level and a minimum of four seasons to fill the pool. The sequence of reservoir filling is portrayed in Table 1.0-7.

TABLE 1.0-7

Maximum Reservoir Filling Sequence

End of Construction Year	Pool Elevation (m.s.l.)	Area of Pool (Acres)
5	700*	10,700
6 (Initial Spring Runoff)	802	26,600
7	858	47,800
8	890	69,800 (Project in operation, full pool next spring)

*Fill to invert of upper level tunnel

During a normal year, the pool would be nearly full in June following the spring refill period, and then fall about 1.5 feet by the first of October. Daily pool fluctuations during this period, due to power operation, would be minute; generally less than two to three inches.

The normal pool fluctutation during the summer season (from minimum to maximum) would be about two feet. The maximum summertime drawdown based on 41 years of computerized simulation was 4.5 feet.

The maximum pool elevation would not be re-established every year and would be dependent upon hydrologic conditions. The 41 year simulation indicates that the 910 msl elevation was attained in 22 of the years. An elevation of 907 or higher was attained in 30 of the years, 905 or better in 33 years and 900 or higher in 36 of the years. In four of the years studied, three of which occurred during the drought of the 1960's, the summer pool did not exceed elevation 900. The lowest summertime pool would have occurred in 1957 at approximately 890 feet msl.

The exposed shoreline for the normal summer drawdown of two feet would be about 1,500 acres, equivalent to a 35-foot wide strip around the 350-mile periphery of the lake. Maximum drawdown, normally about 22 feet, would occur each year during the winter months when snow would effectively cover the exposed area totaling some 17,700 acres. The minimum power pool level of 868 feet msl occurred once during the 41-year simulation and was in the month of March just prior to the spring refill season. The difference in the lake area between the full pool level at 910 feet msl and the minimum pool is 32,000 acres.

1.08.2 Lincoln School Reservoir

Initial filling of the Lincoln School Reservoir could be accomplished in a matter of days once the area is prepared and the necessary structures are substantially complete. It is anticipated that Lincoln School Reservoir would be filled when its facilities are ready for placing power on line in the 7th construction year.

During project operation, the Lincoln School reservoir would serve to reregulate releases from the Dickey Dam varying from zero to 40,000 cfs, for the initial development and as high as 60,000 cfs for the ultimate development and also provide afterbay storage for pump-back to Dickey Lake. Generating discharges from Lincoln School would vary from 1,000 to 16,000 cfs. Spillway discharge would occur occasionally during snowmelt runoff from the relatively uncontrolled Allagash watershed. With the initial development at Dickey Dam, Lincoln School Lake would have a 17-foot maximum operating range from elevation 595 to 612 feet msl. Under typical operating conditions, it is expected the pool might fluctuate about 12 feet weekly with six to seven foot fluctuations on a daily basis. Maximum rates of change would be in the order of one foot per hour. The pool would normally be at its weekly minimum on Monday morning prior to peaking releases from Dickey and would generally rise (though fluctuating daily due to releases for Lincoln School generation and evening/early morning pump back to Dickey Lake) to a maximum on Friday evenings. The pool would then be drawn down fairly steadily over the weekend to near minimum on Monday morning. This same sequence would apply for the ultimate development at Dickey, except that the maximum operating range would be 30 feet, from elevation 590 to 620 feet msl and the pool could fluctuate about 22 feet weekly with 8-12 foot fluctuations on a daily basis.

1.08.3 Debris Control

1.08.3.1 Sources

The areas which would be inundated by Dickey Lake are presently heavily forested and contain forest litter. Experience has shown that this debris would float to the surface during reservoir filling, but the timber left standing in the reservoir would remain in place after inundation. Standing timber in deep, cold water does not disintegrate or uproot and float to the surface. Therefore, the amount of debris floating to the surface during reservoir impoundment would depend on the type and degree of reservoir clearing prior to inundation. Present plans call for clearing a band around the reservoir between elevations 913 and 828 feet msl plus the entire area below elevation 913 feet msl for a distance of one mile upstream from Dickey Dam. These limits incorporate about 54,400 acres of land. The rest of the reservoir (about 34,000 acres) would most likely be left in its present state. However, current policy would allow landowners to clear lands below elevation 828 feet msl. Construction schedules allow up to eight years to accomplish this clearing.

There would undoubtedly be a significant amount of floating debris during the initial reservoir filling period. It is anticipated that intensive debris removal and disposal operations would be conducted during the latter stages of impoundment and during the first year or two of the project operation thereby greatly reducing the amount of debris resulting from clearing operations and initial reservoir filling.

1.08.3.2 Methods of Control

The debris expected to surface during the initial reservoir filling period would be removed during the latter stages of initial impoundment and during the first year or two of project operation. Depending on the degree and intensity of this initial debris removal operation, it is possible that the debris would continue to be a problem for three or four years after the project becomes fully operational.

In post project periods, the Corps would maintain a buffer zone of at least 300 feet around the lake. No clear cut commercial harvesting would be allowed in this zone. This would eliminate any significant debris from timbering operations. Downed or diseased trees would be removed periodically as part of project maintenance activities.

Sources of debris would be located during normal reservoir maintenance patrols. Proper steps would then be taken to prevent this debris from entering the lake.

Major areas of debris accumulation in the lake would be located and then be cleared during normal debris removal operations.

In order to prevent debris from entering the power intakes, in addition to trash racks, a log boom would be placed approximately 400 to 600 feet upstream from the forebay area. This log boom would not have an opening for boat passage, and thus also keep boats a safe distance from the structure.

1.08.3.3 Methods of Disposal

Five basic methods to disposal of debris that might be collected from the lake are as follows:

Placing the debris on the ground to decompose.

Burying the debris with or without processing to reduce its volume.

Selling the unprocessed debris.

Processing the debris for sale as mulch, firewood, etc.

Burning the debris using confined or unconfined burning techniques.

1.09 Landscape Development

Landscape development associated with the project would occur in conjunction with dams, dikes, buildings, roads, parking areas, borrow areas, construction roads, and other project facilities. The extent of landscape development would depend largely on the relative merits of each site. Some areas would receive minimal treatment while others would undergo total reforestation.

Vegetation is anticipated to be utilized to perform various functions in the design of the project. Where feasible, it would be used to enframe, accent or blend project structures to their surroundings. Trees and shrubs would be used as focal points to add variety, color and form to the landscape. Project work areas and storage yards, which may be visually unattractive, would be screened where possible through the use of plant materials. Plantings of grasses and other vegetation would be employed for slope stabilization and erosion control. Restoration of borrow areas and areas disturbed by construction activities would be accomplished by reseeding and planting to insure a minimal amount of landscape defacement.

Due to the extreme weather conditions of the project site, only those plant species indigenous to the area would be used. Native vegetation would be utilized in all planting plans to insure that they blend properly with the surrounding environment.

1.10 Benefit Cost Ratio

The justification for authorization of all Corps of Engineers' projects is measured in terms of the benefit-to-cost ratio. The economic analysis used to develop this yardstick for Dickey-Lincoln School Lakes is based on standards prescribed by Senate Document No. 97, 87th Congress, entitled Policies, Standards and Procedures in the Formulation, Evaluation and Review of Plans for Use and Development of Water and Related Land Resources as modified by subsequent executive and legislative actions.

The project cost is evaluated on an annual basis reflecting amortization of the investment and annual operation and maintenance expenses over a 100-year project life. The cost has been increased to provide for the transmission of power by adding the total annual cost of a line between the project and the New England Power Pool (NEPOOL) System Transmission Grid.

The 3¼% interest rate used in the economic analysis has been the subject of considerable discussion. Accordingly, an explanation of the derivation of this rate is appropriate. The interest rate is in accordance with a Water Resources Council (WRC) regulation implemented in December, 1968. This regulation revised the method of computing the interest rate as previously outlined in Senate Document 97. The regulation permitted an exception, however, for those projects already authorized such as Dickey-Lincoln School Lakes which was authorized in 1965. As a result, the interest rate was retained at 3¼%.

The WRC subsequently established new principles and standards for water resource planning effective in October, 1973. A section of these new standards included the provision for increasing the interest rate to 6-7/8%. However, the Water Resources Development Act of 1974, enacted by the Congress on 7 March 1974, included a section which requires that interest rates used for water resource projects be consistent with the implementation of the December, 1968 WRC regulation. Accordingly, the 3¼% interest rate remains applicable to Dickey-Lincoln School Lakes.

The calculation of the benefit to cost ratio includes a limited range of the impacts of the Dickey-Lincoln project. It focuses on quantifiable primary benefits and costs. The impact section of the EIS enumerates secondary and non-quantifiable benefits and costs.

Economics is not an exact science and as such many of the projections made are based on the most likely occurrence and these may or may not be borne out over time. Listed below are the major primary benefits and costs considered in calculating the benefit to cost ratio. Under each heading a reference is given to the detailed back-up figures. In addition, the reader is referred to a comment or selection of comments representative of the diverse public views on the methodology utilized and/or the assumptions made. This material should aid by providing a ready reference to assist in understanding the derivations of project benefits and costs. The references, however, are by no means intended to be totally comprehensive, but rather provide a general sense of the complex issues involved. The reader is referred to Table 1.0-8 which provides a detailed breakdown of the costs and benefits utilized in deriving the benefit to cost ratio.

1. Project Costs:

A detailed computation of project costs is included in paragraph number 78-80 and 90-91 Sections BB Cost Estimates and DD Operation and Maintenance (GDM No. 4A, Vol I), also see Appendix M (GDM No. 4A, Vol II) - Project cost estimates. The GDM values have been escalated to Oct. 1977 price levels used in the EIS and the prevailing water resources interest rate has changed, but the methodology is the same.

Comments on the methodology can be found in Section 9.06.1.2 number 35, 9.06.3.2 numbers 4-6, 9, 13, 20 and 9.06.3.8 number 15, 16, 17, 20, 24.

2. Power Benefits:

Power benefits calculations are discussed in paragraph 96 section FF Benefits with a detailed description of the methodology presented in Appendix E (GDM No. 4A, Vol II).

Comments on the methodology can be found in 9.06.3.2 number 7, 8, 10, 11 and 9.06.3.8 number 14, 18, 23, 24.

3. Redevelopment Benefits:

Redevelopment benefit methodology is detailed in Appendix J (GDM No. 4A, Vol. II).

Comments 9.06.3.1 number 101 and 9.06.3.8 number 22 discuss redevelopment methodology.

4. Flood Damage Prevention:

The methodology for the prevention of flood damges is detailed in Appendix J (GDM No. 4A, Vol II).

Comments 9.06.3.2 number 13 and 9.06.3.3 numbers 8, 9, 10 discuss concerns regarding this methodology.

5. Lost Recreation Opportunities:

Lost recreation opportunities are discussed in Appendix A (GDM No. 4A, Vol II).

Comments 9.06.1.1 number 36, 37, 40 and 9.06.3.8 number 21 discuss concerns regarding this methodology.

At October 1977 price levels, the benefit to cost ratio for the project purposes of power and flood control were estimated to be 2.1 to 1 based on 100 year project life and the authorized 3¼% interest rate. As a point of interest and due to considerable discussion pertaining to the 3¼% interest rate, the benefit to cost ratio was also accomplished at the prevailing rate for new water resource projects of 6-5/8% and estimated to be 1.2 to 1. This is summarized in Table 1.0-8.

The Corps of Engineers also uses a procedure referred to as an "Economic Efficiency Test". Basically, the test provides for a comparison of the costs of providing an equivalent amount of power from the most feasible alternatives, likely to develop in the absence of the Federal project, evaluated on a basis comparable with the determination of the project costs (with respect to interest rate, i.e. 3¼%, taxes and insurance). The Corps' "Economic Efficiency Test" indicates that the annual cost for Dickey-Lincoln School Lakes amounts to $37,019,000 while alternative equivalent costs, with an appropriate adjustment for benefits foregone, amount to $60,747,000. This results in a favorable comparability ratio of 1.6 to 1. At the 6-5/8% interest rate, the comparability ratio is 1.0 to 1.

TABLE 1.0-8a

Summary of Construction Costs

Dams	
Lands & Damages	$ 34,300,000
Relocations	7,440,000
Reservoirs	33,300,000
Dams	249,000,000
Power Plants	175,100,000
Roads & Bridges	2,580,000
Cultural Resources	930,000
Buildings, Grounds & Utilities	1,820,000
Permanent Operating Equipment	930,000
Sub-Total	$505,400,000
Engineering & Design	24,300,000
Supervision & Administration	29,300,000
Total Construction Cost	$559,000,000
Transmission	
Lines	
Steel Towers-Double Circuit	$ 96,200,000
Wood H-Frame - Single Circuit	17,700,000
Substation	30,400,000
Power System Control	2,000,000
Total Construction Cost	$146,300,000
Total Project	$705,300,000

TABLE 1.0-8b

ECONOMIC DATA
(October 1977 Price Levels)

	3 1/4%	6 5/8 %
DAMS		
Total Investment		
Construction Costs of Dams	$559,000,000	$559,000,000
Less Basic Provisions for Future Facilities	- 31,000,000	- 31,000,000
Net Construction Costs	528,000,000	528,000,000
Interest During Construction	55,000,000	112,000,000
Total	$583,000,000	$640,000,000
Capital Recovery Factor (Dams)	.03388	.06635
Annual Costs		
Interest and Amortization	$ 19,750,000	$ 42,470,000
Operation and Maintenance	2,188,000	2,188,000
Pumping Power (438,000,000 kwh x $.010)	4,380,000	4,380,000
Major Replacements	327,000	164,000
Lost Recreational Opportunities	164,000	137,000
Sub-Total Dams	$ 26,809,000	$ 49,339,000
TRANSMISSION LINES		
Total Investment		
Construction Costs of Transmission	$146,300,000	$146,300,000
Interest During Construction	10,410,000	21,770,000
Total	$156,710,000	$168,070,000
Annual Costs		
Interest and Amortization	$ 6,950,000	$ 12,020,000
Operation and Maintenance	3,650,000	3,650,000
Reduction - future Wheeling by Others; Granite-Essex	- 390,000	- 450,000
Sub-Total Transmission	$ 10,210,000	$ 15,220,000
TOTAL PROJECT		
Total Investment Costs		
Construction	$705,300,000	$705,300,000
Less Provisions for Future Facilities	- 31,000,000	- 31,000,000
Interest During Construction	65,410,000	133,770,000
Total	$739,710,000	$808,070,000
Total Annual Costs	$ 37,019,000	$ 64,559,000

TABLE 1.0-8b

(continued)

	3 1/4%	6 5/8%
Annual Costs	$ 37,019,000	$ 64,559,000
Annual Benefits 1) 2)		
Peaking Power (15.4% Capacity Factor)		
874,000 kw x .904 x $30.50	24,098,000	24,098,000
1,182,600,000 kwh x .914 x $.034	36,750,000	36,750,000
Intermediate Power (42.9% Capacity Factor)		
70,000 kw x .980 x $69.25	4,751,000	4,751,000
262,800,000 kwh x .989 x $.027	7,018,000	7,018,000
Downstream		
350,000,000 kwh x $.010	3,500,000	3,500,000
Subtotal Power	$ 76,117,000	$ 76,117,000
Redevelopment	1,360,000	2,662,000
Prevention of Flood Damages 3)	717,000	705,000
TOTAL ANNUAL BENEFITS	$ 78,194,000	$ 79,484,000
TOTAL ANNUAL COSTS	$ 37,019,000	$ 64,559,000
Benefit/Cost Ratio	2.1 to 1 (2.11)	1.2 to 1 (1.23)

1) Cost of pumpback energy is included in project Annual Costs.

2) The .904 and .914 etc. factors noted in power benefit analysis reflect estimated reduction in capacity and energy outputs due to transmission line losses.

3) Excludes benefits realized by the completed Ft. Kent Local Protection Project.

TABLE 1.0-8c
ECONOMIC EFFICIENCY ANALYSIS
Comparably Financed - Federal Funds
(Oct. 1977 Price Levels)

	3-1/4%	6-5/8%
Power Alternatives 1/		
Peaking		
874,000 kw x .904 x $12.00	$ 9,481,000	---
x $16.00	---	$12,642,000
1,182,600,000 kwh x .914 x $.034	36,750,000	36,750,000
Intermediate		
70,000 kw x .980 x $28.00	1,921,000	---
x $37.25	---	2,555,000
262,800,000 kwh x .989 x $.027	7,018,000	7,018,000
Downstream		
350,000,000 kwh x $.010	3,500,000	3,500,000
Sub-Total Power	$58,670,000	$62,465,000
Benefits Foregone:		
Redevelopment 2/	$ 1,360,000	$ 2,662,000
Flood Control 2/	$ 717,000	$ 705,000
TOTAL ALTERNATIVE COSTS	$60,747,000	$65,832,000
Annual Costs -		
Total Project	$37,019,000	$64,559,000
COMPARABILITY RATIO	1.6 to 1 (1.64)	1.0 to 1 (1.02)

Notes: 1/ The .904, .914, etc. factors noted reflect estimated reduction in capacity and energy output due to transmission line losses.

2/ Redevelopment and flood control benefits which are provided incidentally to construction of Dickey-Lincoln School would be foregone by the alternative. Therefore, the values of these benefits are added to the alternative in order to obtain a valid comparison.

1.11 Relationship and Compatibility with Other Corps Projects

Fort Kent, located about 28 miles below the Dickey Dam site, has experienced 10 floods during the past 50 years of record. The most recent floods occurred in April 1973 and May 1974. The May 1974 flood is the "flood or record" and caused damages estimated at that time at $3.0 million. These losses would be prevented by the project. In view of the uncertain status of Dickey-Lincoln School Lakes and the recurring flood problem at Fort Kent, a small local protection project consisting of a dike and pumping station has been constructed in the Town of Fort Kent. The local protection project will protect to a 100-year frequency flood level and the protection is limited principally to the commercial center of Fort Kent. The Dickey-Lincoln School Lakes project would provide full flood protection to the entire Fort Kent area and other downstream areas.

There are no other Corps of Engineers projects in the area of the upper St. John River.

1.12 Fish and Wildlife Programs

The U. S. Fish and Wildlife Service (USF&WS) in its coordination process has made several recommendations. These recommendations are in their Conservation and Development Reports, Mitigation Plan and several planning aid letters. In addition to the aforementioned documents, a Section 7 Consultation report pertaining to the endangered Furbish lousewort contains several recommendations pertaining to that species. These documents are contained in the Supplement to Appendix J, Coordination With Other Agencies and Public Involvement, CE, 1978.

The following recommendations are from the U. S. Fish and Wildlife Service Conservation and Development Report for the Dams and Reservoirs, 4 Jan. 1978.

> "I. We recommend that the Dickey-Lincoln School Project not be constructed. This recommendation is based on our consideration of the large-scale destruction of terrestrial and aquatic resources in the project area. In addition, our recommendation is conditioned by the fact that the project involves elimination of an important part of the last remaining wilderness recreational area in the Northeast, and an area whose unique combination of aesthetic and natural resource values no longer exists anywhere else in the United States. The proposed project also involves impacts to Canadian resources, which are not documented in this report.
>
> II. Before the Corps of Engineers prepares final estimates for the Congress on the costs of constructing the Dickey-Lincoln Project, we recommend a series of measures to develop estimates of those project costs that will be required to lessen the damage to fish and wildlife values as much as possible. These measures include the following:

A. Fisheries

1. The Maine Department of Inland Fisheries and Wildlife be designated and funded as the agency to manage project waters (Dickey and Lincoln School Lakes and tailwaters) at their maximum potential, with the understanding that there would be very little fishery potential for 11-mile section from the Dickey Dam downstream to the Lincoln School Dam, because of water level fluctuations.

2. The U. S. Fish and Wildlife Service, in coordination with Maine Department of Inland Fisheries and Wildlife, develop a conceptual fishery management plan and cost estimates for implementing the plan for project waters during FY 1978. This will require expanding upon the general fishery management concepts presented in this report.

3. The Maine Department of Inland Fisheries and Wildlife has made the decision to manage any project-related fisheries at a maximum level. Confirming studies and cost estimates should be developed for the following aspects of the fisheries management plan:

a. Clear cutting all trees from the total area to be flooded.

b. Authorization and funding for a fishery management team at the level presented in this report.

c. Authorization and funding for the construction of a fish hatchery and rearing station at the level presented in this report. Water intake structures at several levels should be designed into the dam for fish hatching and rearing purposes. An alternative source of spring or subsurface water be included in the hatchery design and site selection.

B. Wildlife

1. The Maine Department of Inland Fisheries and Wildlife be designated and funded as the agency to manage all mitigation lands, including deer wintering yards, at the level envisioned by the H.E.P. team.

2. The Fish and Wildlife Service, in coordination with Maine Department of Inland Fisheries and Wildlife, will identify the types and general locales of lands to be acquired for mitigation and develop a conceptual wildlife management plan including cost estimates for implementing the plan on those lands.* The H.E.P. team members will expand upon the general wildlife management concepts presented in this report.

*Used in the sense of having wildlife management authority. Does not mean purchase as the only option.

3. The Corps of Engineers develop cost estimates for acquiring approximately 161,000** acres of land, which may include some or all of the 30,000 acres of deer wintering areas, to mitigate wildlife habitat losses. The actual acres cannot be determined until all the data are available from the transmission line evaluation, and the deer wintering yard habitat has been located.

4. The Corps of Engineers develop engineering cost estimates for any structures proposed in the conceptual plan to be developed by the Fish and Wildlife Service. An example may be the subimpoundments for waterfowl management, as envisioned by the H.E.P. team.

5. The Corps of Engineers determine whether the mitigated lands will be purchased, leased or a combination of both. The option selected should be reflected in the final cost/benefit ratio.

C. Wildlife and Plants of Special Interest

1. The Corps of Engineers initiate formal consultation procedures should the lousewort (*Pedicularis furbishiae*) be listed as an Endangered Species.

2. The Corps of Engineers initiate formal consultation procedures on any rare or endangered plant or animal species discovered as a result of continuing studies or during construction.

3. The Corps of Engineers initiate studies to determine the status of several animals known to be in the project area, such as, but not limited to, marten, lynx and bobcat.

D. Toxicants

1. The Corps of Engineers determine the source and input/uptake rates of mercury and other contaminants that could adversely impact on the fisheries, particularly if these fishes are to be consumed by people. A decision by a regulatory agency that these fishes will never be approved for human consumption will limit the ability to mitigate fishery losses.

E. Funding

1. The Fish and Wildlife Service be funded for FY 1978 at $41,500 ($30,000 plus 38% overhead) to carry out recommendations A2 and B2 during FY 1978.

**This acreage does not include ± values from the transmission line or deer wintering yard acreages that might be located outside the mitigation lands.

F. Cost/Benefit Ratio

1. The cost/benefit ratio should reflect the level of funding required to carry out all the mitigation recommendations including annual operational costs."

The conclusionary portion of the U. S. Fish and Wildlife Service's Section 7 (Endangered Species Act) consultation report follows:

"Conclusion

Based on my consultation team's review of the above information and other information and data available to the Service, it is my biological opinion that the Dickey-Lincoln School Lakes Project, if constructed as planned, is likely to jeopardize the continued existence of the Furbish lousewort. However, if the Corps develops and implements successfully the following conservation program, in consultation with and with the assistance of the Service, the continued existence of this Endangered species is not likely to be jeopardized as defined in Section 402.02 of the Interagency Cooperation Regulation published in the Federal Register on January 4, 1978. The Conservation program must include, at a minimum, the following:

1. Development of information which will lead to a functional understanding of the habitat needs and propogation techniques of the Furbish lousewort.

2. Acquisition and protection of existing habitats below the project impoundment area currently supporting lousewort populations.

3. Acquisition of habitat identified as capable of supporting new populations of louseworts.

4. Establishment of new, self-sustaining colonies through transplantation, seeding or other appropriate techniques.

5. Obtaining better information on what the effects will be of downstream flows, after construction of the project, on the lousewort and its habitat.

6. Development of a monitoring program which will be capable of detecting any changes in lousewort biological status, such as habitat changes, population increases or decreases, and microclimatic conditions.

If as a result of the conservation program, new information is revealed that was not considered during this consultation, or prior to implementation of recommendations 2, 3, or 4 above, the project is modified or a new species is listed in the project area, Section 7 Consultation must be reinitiated. Further, the Corps should not make any irreversible or irretrievable commitment of resources which would foreclose the consideration of modifications or alternatives to the proposed project during the development and successful implementation of the recommended conservation program."

Planning Aid letters suggest methodologies for mitigating impacts of construction and operation on resident birds of prey (Osprey and Eagles). Basically, they recommend that activities in the vicinity of the nests be curtailed until the birds have fledged their current offspring for the year. They also recommend that potential nest sites be identified and protected.

The Corps of Engineers has prepared an alternate mitigation plan to that recommended by the U. S. Fish and Wildlife Service. At this time, both plans are being reviewed.

Due to the magnitude of lands required for either mitigation plan an authorization report must be prepared to request Congressional authorization for mitigation land acquisition. The required lands range from approximately 90,000 acres to approximately 160,000 acres depending upon which plan is selected. This land taking for mitigation is considered to be a major action and would require an environmental impact statement.

1.13 Current Status

Preconstruction planning for the project was resumed in November, 1974, seven years subsequent to earlier post-authorization planning and is nearing completion. Primary efforts have concentrated on preparation of this Environmental Impact Statement, update of project design to reflect current criteria and an update of the project cost estimate and its economic and financial justification.

SECTION 2

ENVIRONMENTAL SETTING

2.00 ENVIRONMENTAL SETTING

2.01 General

The St. John River Basin is located in Maine and the Canadian provinces of Quebec and New Brunswick. The total drainage area of 21,600 square miles makes this one of the largest for any river on the Atlantic seaboard of North America. There are approximately 7,400 square miles of drainage area within the State of Maine. The basin has common divides with the watersheds of the St. Lawrence River, Penobscot River and the St. Croix River. The St. John River flows northeasterly through Maine from its headwaters in Little St. John Lake and then courses southerly through Canada and ultimately empties into the Bay of Fundy. Its length is approximately 415 miles. One hundred miles of the river form the international boundary.

Principal tributaries to the St. John in Maine are the Allagash River, Fish River and the Aroostook River.

The proposed transmission route courses through northwestern Maine, northern New Hampshire and northern Vermont.

2.02 Topography

2.02.1 St. John River Basin

The upper St. John River basin is a maturely dissected upland region which has been modified by glaciation. The headwaters area is predominantly a region of low relief with wide flat plains, swamps and wetlands, and low broadly domed hills with widely scattered monadnocks. Downstream from Ninemile Bridge along the main river and in the Little Black River drainage areas, the relief is greater and the topography is rougher with steep hills and narrow crested broken ridges rising above generally narrow trough-like valleys. Relief in this area approximates 800-1000 feet with the higher hill tops having approximate elevations of 1400 to 1700 feet.

Two major rivers flow to the north and east to unite immediately downstream of the proposed Dickey dam site. The lakes in the region are located at the headwaters of the major rivers and their tributaries.

2.02.2 Proposed Transmission Route

Dickey-Lincoln School-Fish River

This segment of the transmission line extends from Dickey to Fort Kent along the southeast side of the St. John River Valley. The topographic setting is one of moderate relief with mature stream development. Relief ranges from approximately 550 feet to slightly over 1,500 feet (M.S.L.). Most ridge and hill summits range between 1,300 and 1,400 feet.

Dickey-Moose River

This proposed route segment extends southwest and south-southwest across relatively flat to moderately rolling topography (see section 2.02.1 for geographical description). Elevation ranges from approximately 1,000 to 1,600 feet over the route. Changes in relief are typically gradual and less than 200 to 300 feet.

Moose River-Moore

The route runs from the Jackman-Moose River area southwestward through the hilly to mountainous terrain of northwestern Maine and northern New Hampshire to the Moore substation on the Connecticut River. Due to the rugged terrain, areas of steep to excessive slopes are encountered. The mountainous areas transversed are part of the northern extension of the White Mountains. In general, the summit elevations increase from Moose River area to the Groveton area of New Hampshire. The topography decreases from here to Moore Substation. Summit elevations around Groveton range from 2,000 to 3,600 feet.

Moore-Granite

This segment runs from Moore Substation on the Connecticut River west and southwestward across the hilly to mountainous terrain of east central Vermont. In general, the topography is moderately hilly with numerous isolated peaks with summit elevations between 2,000 and 3,000 feet.

Granite-Essex

This portion of the proposed route topograph ranges from hilly to mountainous along the axis of the Green Mountains. Relief along the route ranges from several hundred feet to nearly 1,000 feet. The higher percentage of steep to excessive slopes are mainly due to the steep valley walls of the entrenched streams through this segment.

2.03 Geology

Limited bedrock mapping has been done in the St. John Valley area. Geologic mapping of the upper St. John and the Allagash River basins is limited to a reconnaissance level of detail except for the detailed investigations in the rock areas at Deboullie Mountain and the Spider Lake quadrangle.

Detailed geological information for the proposed project may be found in Appendix A, Geology and Seismology (CE, 1977) and Appendix F, Geotechnical Impact Study (DOE, 1978).

The continental glaciers profoundly modified the surface geology of the study area. Some of these glaciers are believed to have been thousands of feet thick. The last one retreated some 11,000 to 15,000 years ago. Although the ice sheets did not change the elevations of the hills and mountains very much, they did create marked changes in the physiography, land forms, and surface materials. A brief reference was made to these physiographic changes in the previous section. The New England soils are typically rocky and often infertile. They resulted when the glaciers stripped away the original soil and soil mantle of New England and left behind a veneer of unsorted clay, sand, and rock fragments called till. In other places they exposed bedrock. The third kind of surface deposit occurring in the study area is alluvium which has been deposited along the streams and rivers and on the flood plains.

Eighty to 90 percent of the St. John River study area is covered by till. This till is composed of a heterogeneous mixture of silt, sand, clay, gravel, cobbles, and boulders. There are three kinds of till: basal till, superglacial till, and moraines. All three occur in the study area.

2.03.1 Bedrock Geology

2.03.1.1 St. John River Basin

Reconnaissance mapping was done in the region of the upper St. John and Allagash basins by the U. S. Geological Survey in August and September 1966 (Fig. 2.03-1)[1]. The mapping of these basins indicated that the bedrock is largely of sedimentary origin and consists primarily of beds of slate, sandstone and limestone. Many of the shales grade into poor slate. The major part of the basin is underlain by slate and sandstone.

The isolated igneous masses which occur in the region generally project above the surrounding hills to form monadnocks. There are two significant and unique igneous intrusives within the region. The larger lies approximately 12 miles southeasterly of the project site and is defined by the Gardner and Deboullie Mountain complex. The second intrusive known as the Priestly Lake intrusive is located approximately 40 miles south of the project site. It is two to three square miles in area. This intrusive underlies Priestly Lake and the adjacent area.

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[1] Reconnaissance Geology of the upper St. John and Allagash River Basins, Maine. E. L. Boudette, N. L. Hatch, Jr. and D. S. Harwood, Geological Survey Bulletin 1406.

2.03.1.2 Proposed Transmission Route

Dickey-Lincoln School - Fish River Segment

Bedrock along the proposed route is of the Seboomook formation. This sequence of rocks is predominantly a sequence of gray slate, sandstone, and some graywacke.

Dickey-Lincoln School - Moose River Segment

The bedrock of this region is also of the Seboomook formation and varies somewhat from that of the Dickey-Lincoln School - Fish River segment.

Moose River - Moore Segment

Underlying this segment is metamorphic sedimentary rock. In many areas, volcanic rock is interspersed with slates, shales, phyllites and schists.

Moose - Granite Segment

The underlying bedrock of this segment is much the same as for the Moose River - Moore Segment.

Granite - Essex

The bedrock of this segment is sedimentary rock. It contains intrusives of volcanic origin. The geologic structure of this area is quite varied.

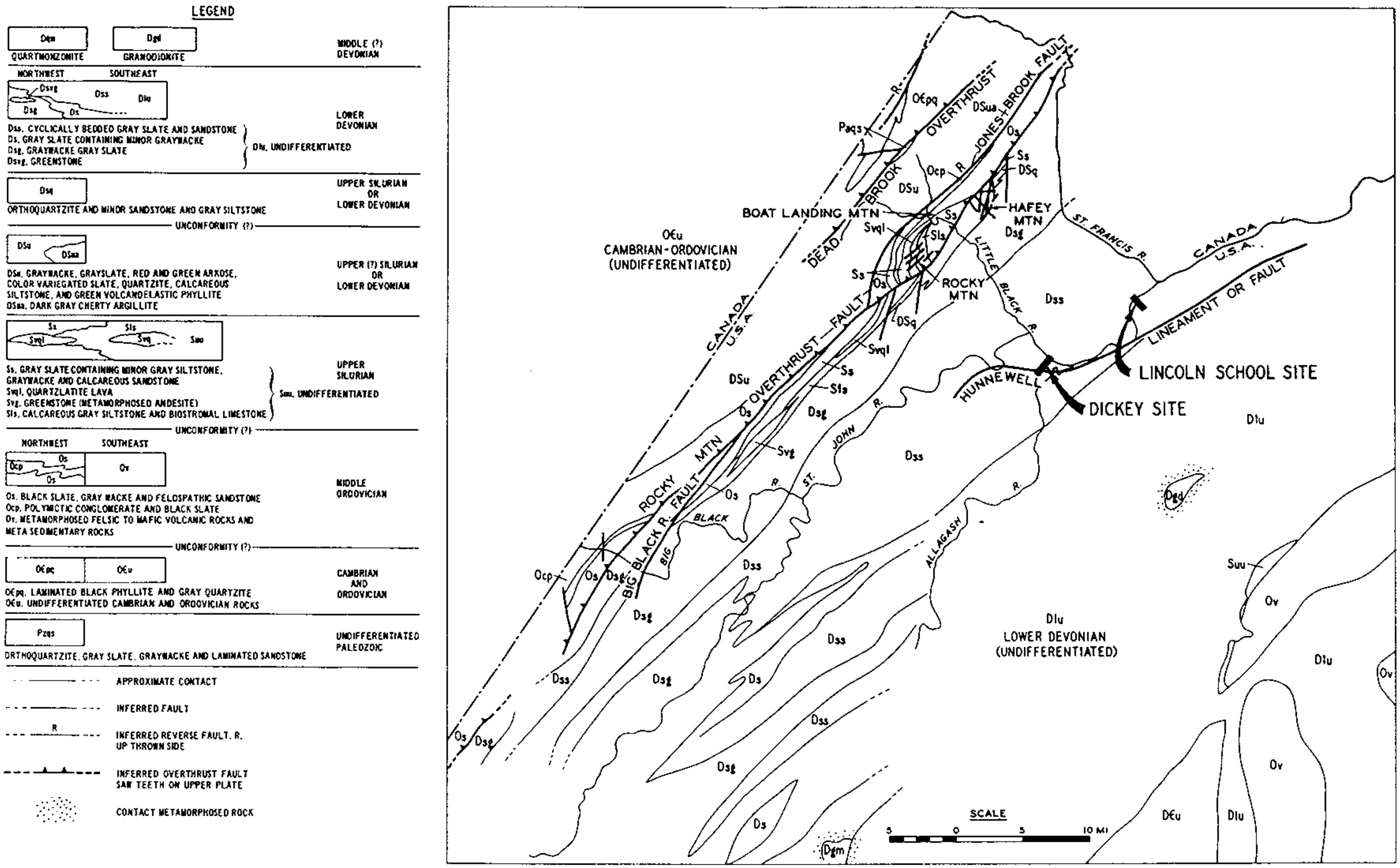
2.03.2 Surficial Geology

2.03.2.1 St. John River Basin

The St. John River, its tributaries and the Allagash River occupy valleys that contain deposits of glaciofluvial sand, gravel and occasionally clay. The granular deposits along the St. John Valley appear to represent a valley train which resulted from the wearing of the last continental glacier. Larger streams have cut through the glaciofluvial deposits so that sand and gravel are exposed on the valley sides as high as 75 to 100 feet above the present river bed. Stream terraces occurring along the St. John River valley are irregularly developed. Slump features and steep dips in these terraces indicate that they may have been deposited in contact with glacier ice.

The valley is now an alluvial flood plain bordered by terraces of fine gravel and sand near the river while high on the valley walls are irregular kame and till terraces. The lower terraces are well stratified and appear to have been deposited in quiet water. The higher terraces were deposited along the ice as it receded from the

FIGURE 2.03-1



General geology of northwestern Maine (after Boudette et al.[2])

valley walls. Recent aerial photo-geology surveys indicate relatively few eskers and kame terraces rising from the valley floors. The valley terraces between the towns of St. Francis and Allagash contain gravel banks which may be 100 feet or more in height.

The mapping of the surficial geology of the proposed project area was done utilizing black and white aerial photography (scale = 1:33,600). Fourteen surficial geological units were defined in the 1100 square mile area studies. During the design and construction phases of the proposed project, additional information which will be developed on the extent and nature of the surficial deposits would be integrated with the existing data.

2.03.2.2 Proposed Transmission Route

Dickey-Lincoln School - Fish River and Dickey-Lincoln School - Moose River

The surficial deposits along this proposed segment are discussed in the preceding section.

Moose River - Moore

The predominant surface material is glacial till with some fine granular and potential aggregate sources located along the stream valleys.

Moore - Granite

Glacial till is the predominant surface material. Along the Connecticut River from Moore substation to Barnet, NH, fine lacustrine/outwash deposits are exposed along the steeper valley walls.

Granite - Essex

Extensive lacustrine/outwash deposits, which are transitional to a marine deltaic sequence, occur throughout this area as a result of numerous lakes formed during the waning glacial period. These deposits are exposed along the valley walls and lower upper surfaces along most major streams. These lake and outwash materials often form the steep slopes along the moderately deep entrenched stream valleys. Those sediments, due to their high silt and fine sand fractions, are highly erodable when the surface soils are disturbed.

2.03.3 Economic Geology

2.03.3.1 St. John River Basin

Mineral resources currently being worked in the proposed project area are limited to sands and gravel. During 1973, the value of sand and gravel from Aroostook County was $848,000.[2] A survey of road materials made in 1934 indicated that most sand and gravels in the Allagash and St. Francis Plantations generally were weak as determined by wear tests.[3] This weakness was attributed to the predominant rock types which are shale and sandstone. Most of the existing pits are operated sporadically as the demands require. There are no major commercial pits within the proposed reservoir areas. A clay producing well located on residential property in the Village of Dickey provides material for the operation of a seasonal pottery shop. The well is presently inactive as the removal of the clay was causing settlement in the property.

The area has had limited mapping, even though a number of mineral occurrences have been theorized. Stream sediment analyses were conducted on 263 samples of fine-grained sediment. The samples were collected from active channels of streams during the geologic reconnaissance conducted by the U.S.G.S. in 1963.[1] Anomalous values of heavy metals and copper were reported as raw data in the report. The report cautions that apparent heavy metal anomalies should be interpreted with full recognition that they may not be related to mineral deposits but represent natural enrichment of metal from unmineralized source rocks.

A magnetometer survey of the area was conducted in 1976 using an airborne instrument with a resolution of one gamma (Appendix A, CE, 1977). The survey did not produce any anomalies of the type usually associated with abnormally high magnetic mineralization. In general, the reservoir showed a featureless magnetic condition. Correspondence with the Government of Quebec and the Bureau of Mines Liaison Office in Maine indicated that there were no known sources of mineral deposits within the proposed project area.

2.03.3.2 Proposed Transmission Route

No important mineral deposits are known to occur along the proposed route, and no developed mining facilities were encountered. Granite and slate mines occur in the general area of the route between Moore and Granite substations. Aggregate sources were identified along all segments of the proposed route. An area of relatively high aggregate potential is located along the Winooski River between Granite and Essex Substations.

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[2] Minerals Yearbook, Vol. II, 1974, Area Reports, Domestic Bureau of Mines, U. S. Department of the Interior.

[3] A Survey of Road Materials and Glacial Geology of Maine. H. W. Leavitt and E. H. Perkins, Maine Technology Experiment Station Bulletin No. 30, 1935.

2.04 Seismology

The historic record which dates from 1638 includes over 100 earthquakes in northern New England and adjacent Canada (Fig. 2.04-1). Several of these are considered to be major events. The "Seismic Risk Map of the United States" places this area of northern Maine into Zones 2 and 3. This relates to zones of moderate to major damage with comparable intensity scales (Modified Mercalli-MM) of VII and VIII (Fig. 2.04-2).

The most important concentration of earthquake activity occurs as a discontinuous trend along the St. Lawrence River. Earthquakes in the St. Lawrence Valley can be related to geological structures in only a general way. The exact locations of the epicenters are not known and the faults that accompanied historic earthquakes cannot be seen at the surface. This may be due to deep alluvium in the valley.

Five major faults have been mapped in the project area. The largest inferred fault in the vicinity of the project structures is the Hunnewell Lineament or fault. The criterion for recognition was the lineament as seen in aerial photographs and topographic expressions.

The most direct way of categorizing the historic seismicity in the region is to define zones to represent areas susceptible to specific levels of earthquake events. Utilizing this approach, three zones are defined as shown in Figure 2.04-3. These zones are not to be confused with those shown on the seismic risk map (Fig. 2.04-2). Zone "C" is the lowest level of historic event with an intensity (MM) of IV or less. Development of a maximum credible intensity at the dam sites was made utilizing the potential length of the fault rupture along the St. Lawrence Valley and the maximum historic event attenuated over the distance to the proposed project structures. The motion at the dam sites after attenuation is predicted to have a peak acceleration of 0.35 g., a peak velocity of 65 cm/sec (25.6 in/sec), and a peak displacement of 22 cm (8.6 in.) with a duration of 18 seconds.

A three component 2Hz seismometer was installed in the Town of Allagash near the proposed dam site. This station is called "Allagash Station" and is part of the Northeast Seismic Network. This network is continually monitored at the Weston Observatory of Boston College, Weston, Massachusetts. A seismic array of six stations surrounding the proposed reservoir has been installed with the first three stations installed in 1976. These stations will also be monitored at the Weston Observatory.

A detailed report on the tectonism, faulting, present activity of any faults, effects of glacial loading and unloading and significance of the seismic history in the region is in Appendix A (CE, 1977).

2.05 Ground Water

The occurrence and quality of ground water is unmeasured in the area of the proposed project. Except for populated areas in the Town of Allagash and downstream, the vast upstream reaches are uninhabited. Because of the sparse settlement of the proposed reservoir site, there are no published reports on the ground water. There are reports on ground water in the adjacent areas to the east and a limited amount of information is available from selected geological reports (Appendix A, CE, 1977).[1,3]

The occurrence of ground water is assumed and considered present based on principles derived from analogous physical settings and material types.

The majority of the reservoir will be underlain by members of the Seboomook Formation.[1] These rock types generally yield water slowly although large amounts of water may be stored in them as a whole. Openings in the rock diminish with depth, reducing the contained quantity of water.

Demand and utilization of ground water in the proposed project area is low due to the sparse population. Most usage is for domestic purposes and is from shallow dug wells or springs. Drilled wells are rare and are not documented in the literature.

Existing ground water conditions along the proposed transmission line are described in Appendix E (DOE, 1978).

2.06 Hydrology

The average annual runoff from the upper 2,725 square mile St. John River Basin is 23 inches. This is approximately 65 percent of the annual precipitation. The average flow at the proposed Dickey Dam site is 4,600 cubic feet per second (cfs), which is equivalent to an average annual runoff volume of about 3.4 million acre-feet. Similarly, at the Lincoln School Dam site (drainage area of 4,086 square miles), the average flow is 6,600 cfs which is equivalent to an average annual runoff volume of 4.8 million acre-feet.[4]

Notwithstanding uniform distribution of the annual precipitation, there is considerable seasonal variation in runoff. This is due to the accumulation and melting of the snowpack during the winter and spring. As a result of this, about two-thirds of the annual runoff occurs during the months of April, May and June.

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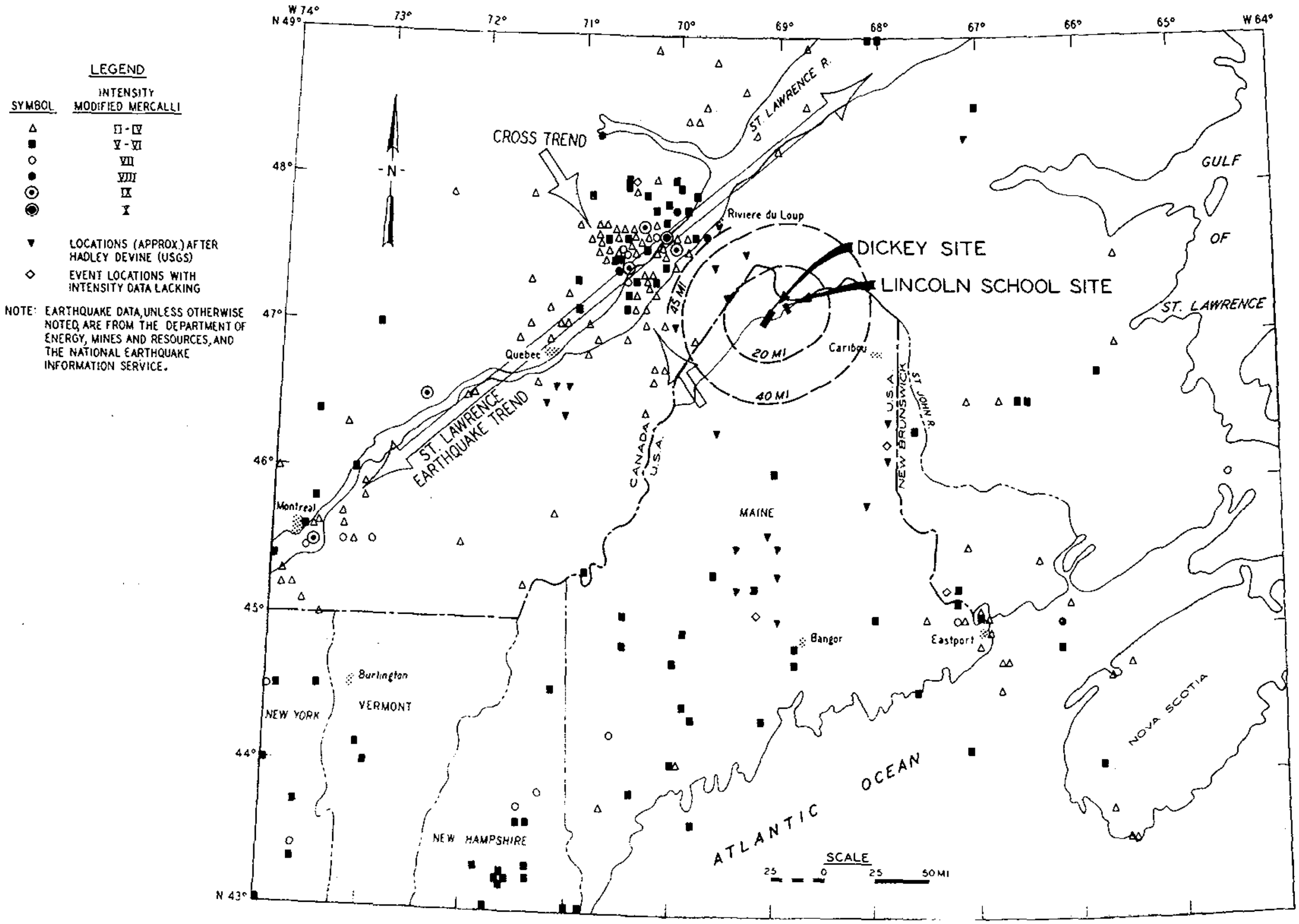
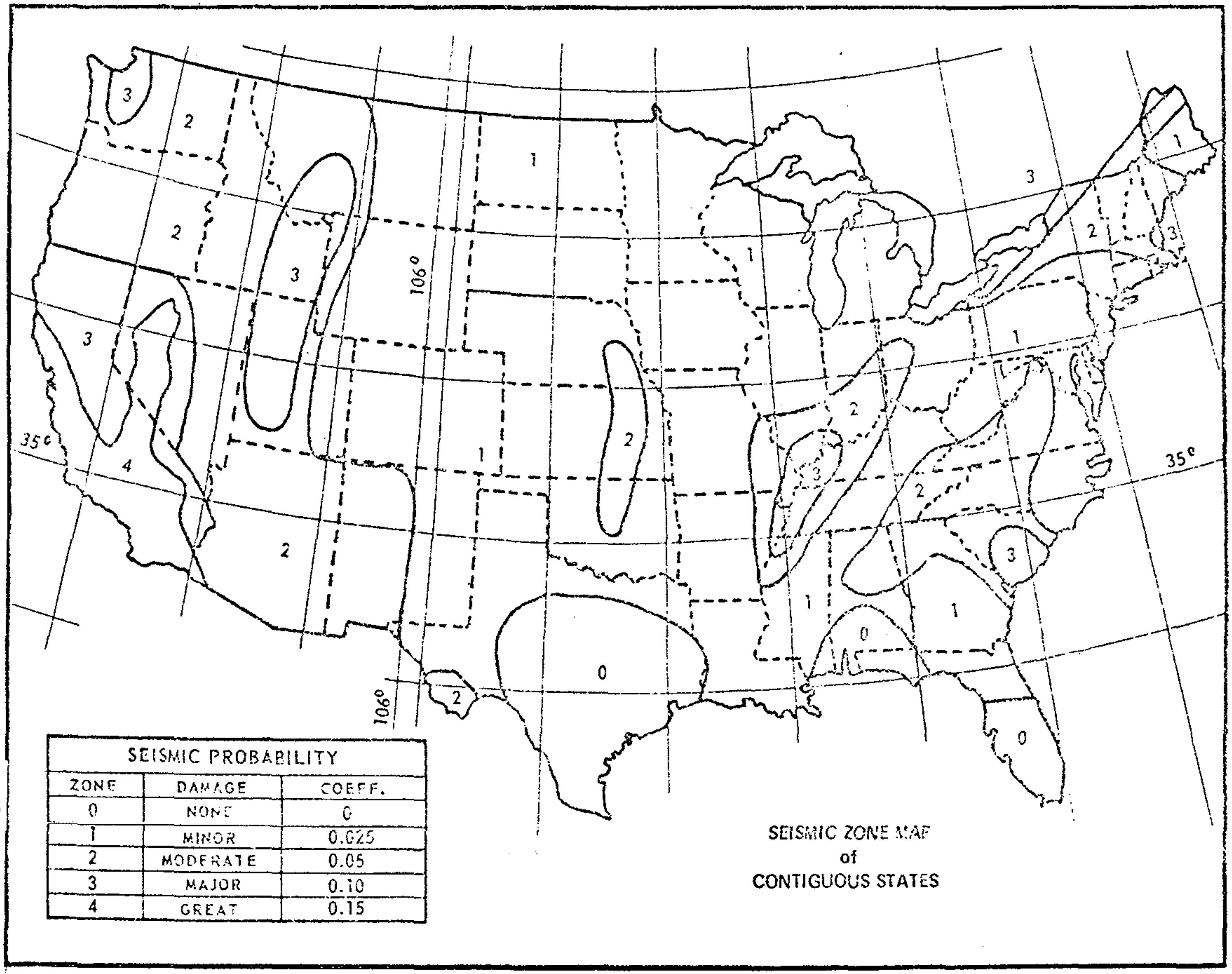
[4]"Water Resources for Maine.", U. S. Department of Interior, Geological Survey (annual publication).

FIGURE 2.04-1



Historic earthquakes in northern New England and adjacent parts of Canada: 1638 to 1975



SEISMIC PROBABILITY		
ZONE	DAMAGE	COEFF.
0	NONE	0
1	MINOR	0.025
2	MODERATE	0.05
3	MAJOR	0.10
4	GREAT	0.15

FIGURE 2.04-2

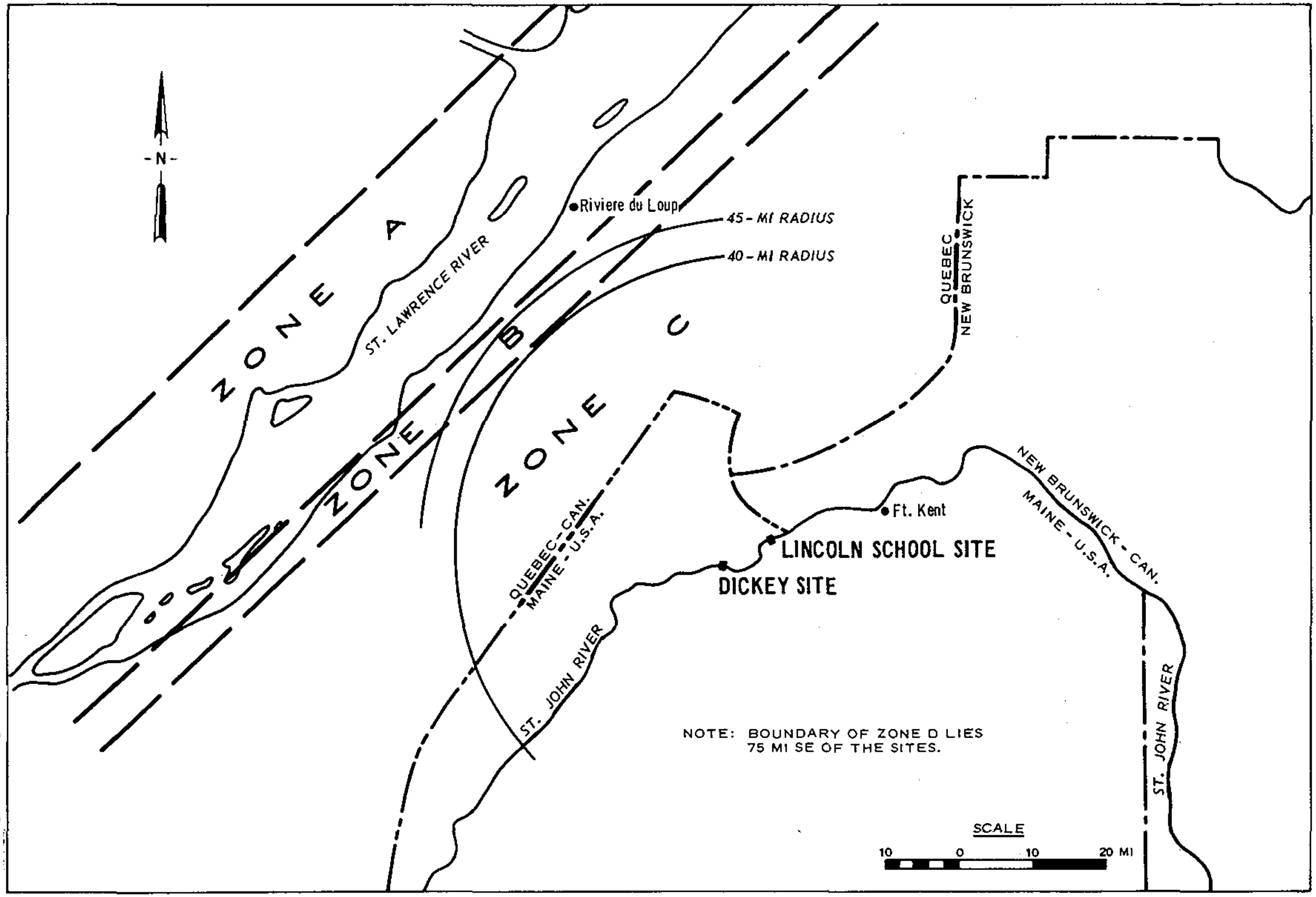


FIGURE 2.04-3

Seismic zones in the general area of the project

2.06.1 Present Flow Regime

Average monthly flows at the proposed Dickey Dam site vary from a low of 960 cfs in February to a high of 17,000 cfs in May. Extremes in flow at the proposed site have varied from 129 cfs to 87,000 cfs. These extremes in flow represent a range in river depth along the St. John of from near zero to about 25 feet, with a corresponding range in average velocities from near zero to approximately 10 feet per second.

2.06.2 Flood History

Historically, large floods have occurred only during periods of spring snowmelt. The greatest floods, both in terms of peak and volume, have resulted from snowmelt alone or in conjunction with rain but rarely from rain alone. A large flood occurred in May 1961 which resulted almost entirely from snowmelt. This occurred when air temperatures climbed to the 70's (^{o}F) for five consecutive days. The four greatest floods at Dickey peaked on 1 May 1974 (87,200 cfs), 10 May 1969 (75,400 cfs), 29 April 1973 (72,000 cfs) and 15 May 1961 (71,700 cfs).

2.07 Water Quality

Water quality sampling in the project area was conducted by the Corps of Engineers with assistance from the U. S. Environmental Protection Agency (EPA), the U. S. Geological Survey (USGS), the U. S. Army at Fort Devens, Massachusetts, the Maine Department of Environmental Protection (DEP), the Maine National Guard and the Province of Quebec, Ministry of Natural Resources.

A thorough description of water quality conditions in the St. John River basin above the project site is provided in Design Memorandum No. 5, Water Quality (CE, 1977).

2.07.1 St. John River Basin

2.07.1.1 Water Temperature

Analysis of the data and field observations indicate that water temperatures vary directly with air temperature and inversely with streamflow and degree of shading. Three curves representing the range in natural water temperature and the variation of mean temperature for the St. John River below the Lincoln School Dam site are shown on Fig. 2.07-1. Temperatures exhibit seasonal variations with highest values generally occurring in mid-July through mid-August. From late autumn through mid-spring, water temperatures are at or near freezing. No unusual variations in water temperature were observed, therefore, ambient water temperature conditions for streams in the watershed are entirely a function of natural phenomena.

2.07.1.2 Dissolved Oxygen (D.O.)

Dissolved oxygen is an essential element for all plant and animal life in the aquatic environment. Substantial concentrations are required for the survival of many organisms, and a lack of DO can produce great changes in the biota.

Mean values for DO concentrations (ranging from 8.1 to 11.9 mg/l) and percent of saturation levels (ranging from 74.0 to 107.6 percent) are high throughout the watershed. These values are within stream water quality standards established by the State of Maine. Moderate, short-term depressions of dissolved oxygen concentrations were observed at several tributary stations. These depressions generally corresponded to the occurrence of a rainfall event a few days prior to sampling, indicating that a temporary increase in the amount of oxygen-demanding substances in the runoff may have occurred.

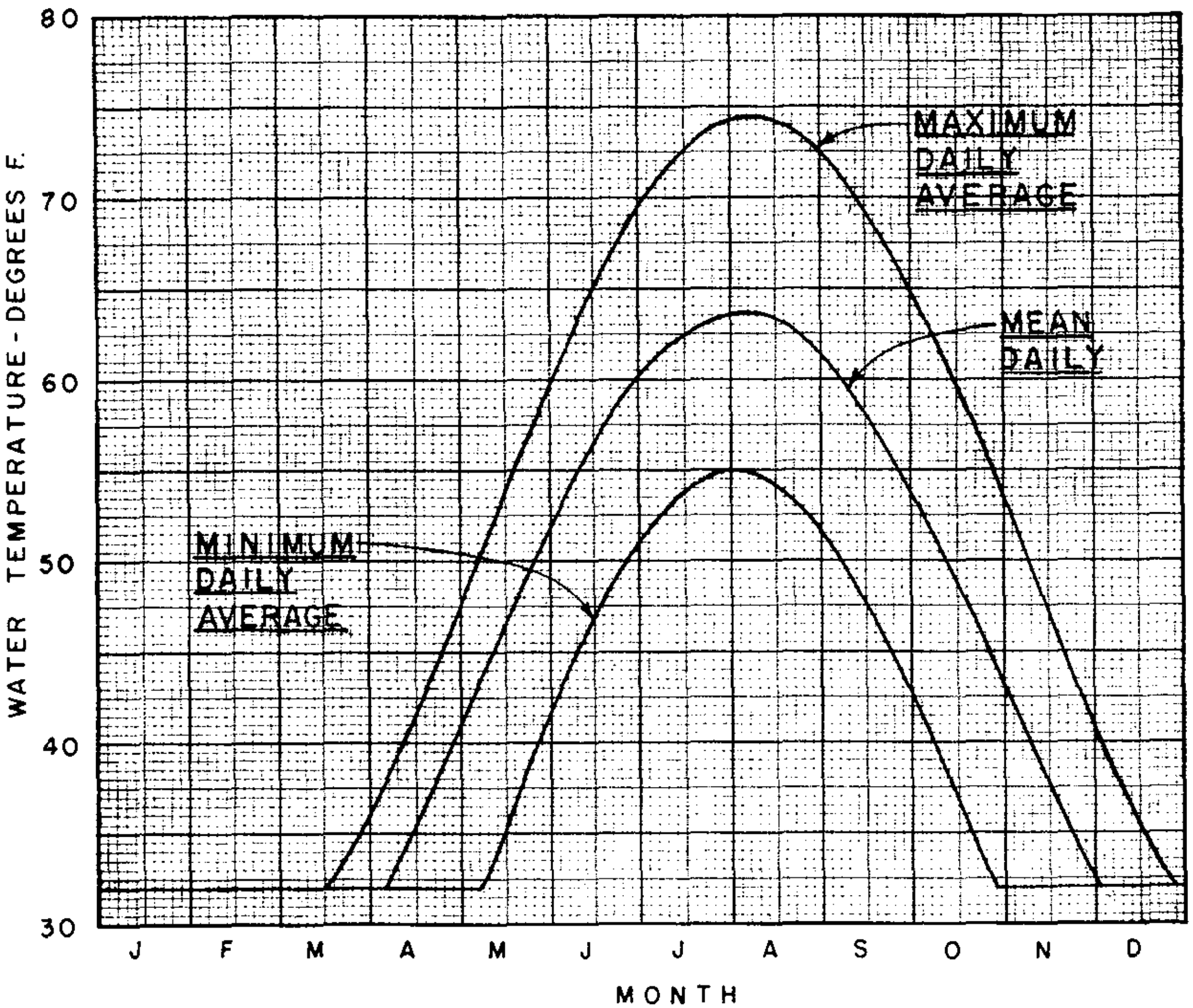
2.07.1.3 Chemical Oxygen Demand (C.O.D.)

COD levels in the watershed vary directly with streamflow and fall within the 5 to 50 mg/l range. The major portion of the chemical demand is believed to be due to organic materials of vegetative origin. This assumption is strengthened by the fact that the highest levels were found on streams draining developed lands in Canada and disturbed forested areas in Maine.

2.07.1.4 Turbidity and Apparent Color

Levels of turbidity in the watershed were found to correlate directly with runoff. Significant increases over the normally low background levels were observed during the flood of August 1976. The flow-weighted average turbidity values for the St. John River at Dickey (7.7 JTU) and the Allagash River (7.8 JTU) are higher than the arithmetic averages for those stations (6.5 and 6.3 JTU, respectively). This indicates that higher turbidity levels occurred with higher flows. Mean turbidity levels throughout the watershed ranged from 0.8 to 15.1 JTU, but only 9 of the 28 sampling stations had mean values above 2.0 JTU. The Big Black River, the Little Black River and the Allagash River have been identified as the tributaries with the most significant levels of turbidity.

Apparent color is a measure of the color of water including the effect of suspended matter. As with turbidity, this parameter varied directly with flowrate throughout the watershed. Increases of 100 percent to 200 percent over background levels occurred during the 1976 summer flood. High levels of apparent color are more widespread throughout the watershed than high levels of turbidity. This indicates that background levels of true (dissolved) color may be high. Mean values of apparent color ranged from 30 to 123 Platinum-Cobalt (Pt-Co) units. Eight of 34 sampling stations had mean values less than 50 and 13 had means greater than 100.



NOTE:
BASED ON 22 YEARS OF SYNTHESIZED WATER TEMPERATURE DATA FOR ST. JOHN RIVER BELOW LINCOLN SCHOOL DAM.

WATER RESOURCES
DEVELOPMENT PROJECT
SAINT JOHN RIVER BASIN, MAINE
DICKEY-LINCOLN SCHOOL LAKES

OBJECTIVE
TEMPERATURE RANGE
ST. JOHN RIVER BELOW
LINCOLN SCHOOL DAM

NEW ENGLAND DIVISION, WALTHAM, MASS

FIGURE 2.07-1

2.07.1.5 Nutrients

Nutrients including nitrogen and phosphorus represent essential matter for the growth of plant and animal life. Ammonia concentrations throughout the watershed are at levels that are characteristic of unpolluted streams (less than 0.2 mg/l). Background levels of nitrite plus nitrate nitrogen and total phosphorus are low. These two parameters were observed to increase in concentration directly with streamflow. The highest nutrient levels are found in the Big Black River and the Little Black River; the probable source for the first is agricultural activity and, for the second, logging activity.

2.07.1.6 Metals

Calcium, copper, iron, lead, manganese, zinc and mercury were monitored in the watershed. All of the metals, except mercury, are commonly found in trace amounts in surface waters as a result of mineral leaching. Calcium is the only one that commonly appears in natural concentrations above 1 mg/l. Natural levels of zinc and copper are usually below 100 mg/l and iron, lead and manganese may be found in concentrations of several hundred micrograms per liter. The presence of mercury in water is usually associated with industrial pollutant discharges, but can occur naturally.

Concentrations of calcium, copper, lead and manganese observed in the watershed are within naturally occurring ranges. Calcium exhibited the highest concentrations with mean station values ranging from 5.5 to 16.3 mg/l. Zinc was found in isolated occurrences in concentrations of several hundred micrograms per liter, and, likewise, iron appeared in concentrations over 1 mg/l. Since there are no known sources of industrial discharge in either Maine or Canada that could contribute to these metal concentrations, and since background levels are low, it is assumed that the high iron and zinc levels are influenced solely by natural events.

Total mercury concentrations observed in the watershed varied from fairly high in 1975 to undetectable in 1977. Data collected in 1975 disclosed high concentrations throughout the watershed, while the 1976 data showed lesser but still quantifiable concentrations. However, analyses performed during 1977 failed to uncover mercury concentrations anywhere in the watershed greater than the detection level of the analytical procedure employed. These results supported the trend of decreasing concentrations that was observed in the data collected during the latter part of the summer of 1976.

The origin of mercury in the Saint John River Basin is unknown. Mercury was present in air samples collected over the project area in September, November and December of 1975 in concentrations ranging from 3.0 to 43.0 nanograms per cubic meter. Atmospheric fallout and washout may have contributed to surface water concentrations. However, the high values monitored suggest that the primary source was of a geologic nature, especially since there are no known industrial discharges in the watershed. Several other factors tend to corroborate this assumption: first, mercury of geologic origin would be in the elemental state which is volatile under normal atmospheric conditions and consequently would be present in the atmosphere; secondly, the widespread occurrence of mercury throughout the watershed suggests a common origin such as watershed geology; thirdly, mercury was found to be present in sediments taken from the St. John River basin and analyzed by the U. S. Geological Survey. An additional source of mercury has been postulated, that being the possible use of mercuric fungicides by the timber industry. This use, however, has not been substantiated.

Selenium was found in samples of trout fish taken from the watershed in September 1976. Water samples were collected in November 1976 and analyzed for the presence of selenium by the EPA. However, detectable levels of the metal were not found. Further sampling and analyses in 1977 did not locate the presence of selenium nor the source for the earlier observation.

2.07.1.7 Total and Fecal Coliform Bacteria

Analyses for total coliform bacteria disclosed their presence in amounts exceeding the State of Maine water quality standards at 11 stations in 1975 but at only two stations, both minor tributaries, in 1976. Fecal coliform data for all stations conformed to the standards in 1975, however two primary stations had mean fecal coliform levels exceeding state standards in 1976.

Two sources of coliform bacteria have been considered. The first is the vegetation and wildlife of the watershed. The second possible source is human contamination from the developed areas of the Canadian portion of the watershed and recreational uses. The effects of this source were particularly evident in the data collected at the sampling stations on the Shields Branch of the Big Black River. The bulk of the bacterial content during the sampling period is assumed to be from the first source.

2.07.1.8 Conductivity, pH, and Alkalinity

Mean conductivity levels measured throughout the watershed ranged from 40 to 100 micromhos per centimeter and lie within the range of natural waters.

Alkalinity and pH levels monitored throughout the watershed were characteristic of natural New England waters.

2.07.1.9 Suspended Sediments

Sediment data collected by the USGS at the St. John River in Dickey, Maine, just upstream from the Dickey Dam site (drainage area = 2,700 square miles), and at the Allagash River at its confluence with the St. John River (drainage area = 1,250$^+$ square miles) indicate annual yields of 36.5 tons/square mile/year and 35.4 tons/square mile/year, respectively. These yields are considerably lower than the representative value of 100/tons/square mile/year for New England streams of over 10 square miles drainage area.

2.07.2 Proposed Transmission Route

All streams which lie within the proposed transmission line route fall within the classification of A or B for all states. The one exception to an A or B rating on State standards is Steven's Branch within the Granite-Essex segment. This stream carries a "C" rating.

2.08 Climatology and Air Quality

2.08.1 Climatology

2.08.1.1 St. John River Basin

The Dickey-Lincoln School project is in the most northern extremity of the continental United States east of the Mississippi. At this latitude (approximately 47°N), the climate can best be characterized as cool. The average growing season between killing frosts is 100 days, extending from the end of May to mid-September.[5]

Further and more comprehensive data on the project area is presented in Section I of Design Memorandum No. 2, "Hydrology and Hydraulic Analyses" dated April 1967 and in Section III of the same Design Memorandum, dated May 1975.

2.08.1.2 Proposed Transmission Route

Mountain elevations above 2,000 feet experience the most severe weather conditions in terms of extreme cold temperatures, heaviest precipitation, heaviest snowfall, greatest frequency of high winds, and greatest exposure. Alpine-tundra vegetation occurs above the treeline on the tops of the higher mountains and is indicative of severe climatic extremes. The treeline generally occurs at 4,800 feet on north slopes and at 5,200 feet on south slopes.

2.08.2 Air Quality

The quality of the air in the project area (both the proposed reservoirs and transmission route) is considered to be of high quality with low atmospheric pollution in the entire northwestern region of Maine, northern New Hampshire and northern Vermont. This area is far

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[5]"Climatological Data, New England," NOAA, Environmental Data Service, National Climatic Center, Ashville, NC.

removed from the industrial complexes of Canada and the United States. The prevailing wind direction is west by north during the colder half of the year and west by south during the warmer half of the year. This keeps the region well out of major pollution drift most of the time. The occasional times that the wind is such that the area is in the driftline of the high pollution, it does not last long enough to create a pollution problem. The region lies directly across the strongest dispersive wind belt to be found anywhere in the United States. This maintains the turbulent and convective conditions that rapidly disperse surface pollutants upwards to be further dispersed by the stronger winds aloft.

2.09 Socio-Economic Profile

Figures 2.09-1 and 2.09-2 indicate the Immediate socio-economic Impact Area (IIA) and municipal Service Impact Areas (SIA) in Northern Aroostook County for the Dickey-Lincoln School Lakes dam construction. In Figure 2.09-3, political units and regional divisions within the transmission impact corridor are illustrated.

2.09.1 Population

2.09.1.1 St. John River Basin

The population in the service impact area (see Appendix C, CE, 1977) in 1973 was 16,239, an increase of 1,490 people from 1970 figures. This increase in population was a reversal from the decreasing trend observed between 1940 and 1970. The reasons for the changing trend include reduced out-migration and the general tendency of some urban residents to relocate to rural areas.

The four communities in the IIA are mainly of two heritages. People residing in Fort Kent, St. John and St. Francis are primarily of French-speaking Canadian and Acadian backgrounds; 78-94% of the families speak French. Those in Allagash are mostly of Scotch-Irish heritage.

In a survey conducted in 1976, 85% of the respondents in the IIA classified their dominant religious preference as Catholic. Beyond the church's spiritual influence, its social force is evidenced by popular membership in church-related groups. In Allagash, the Protestant church is of major importance in community life.

As evidenced in the social survey, nearly ninety percent of the households in the vicinity are family units. Households with children average 3.2 per family, demonstrating a local orientation towards large families.

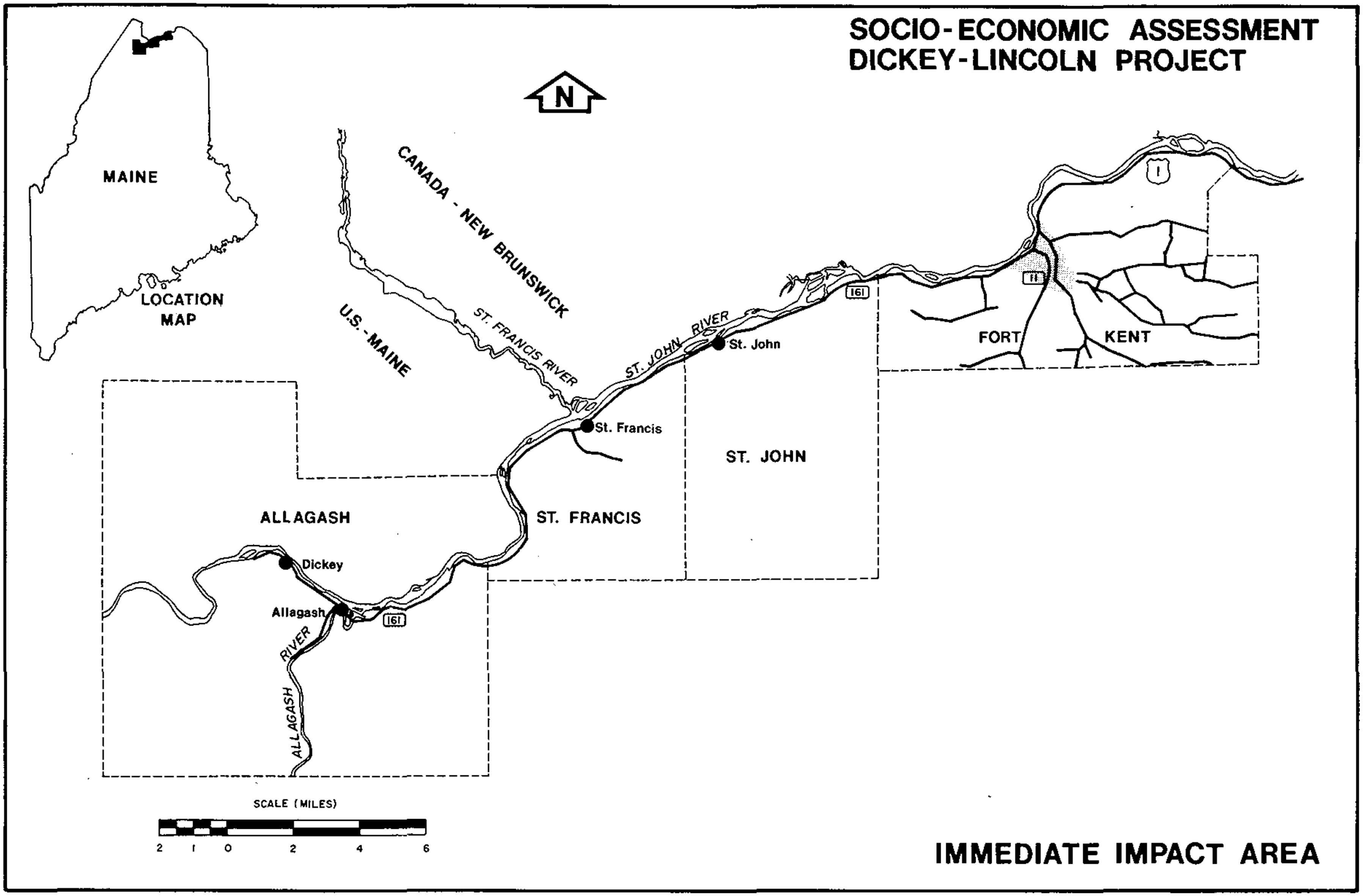
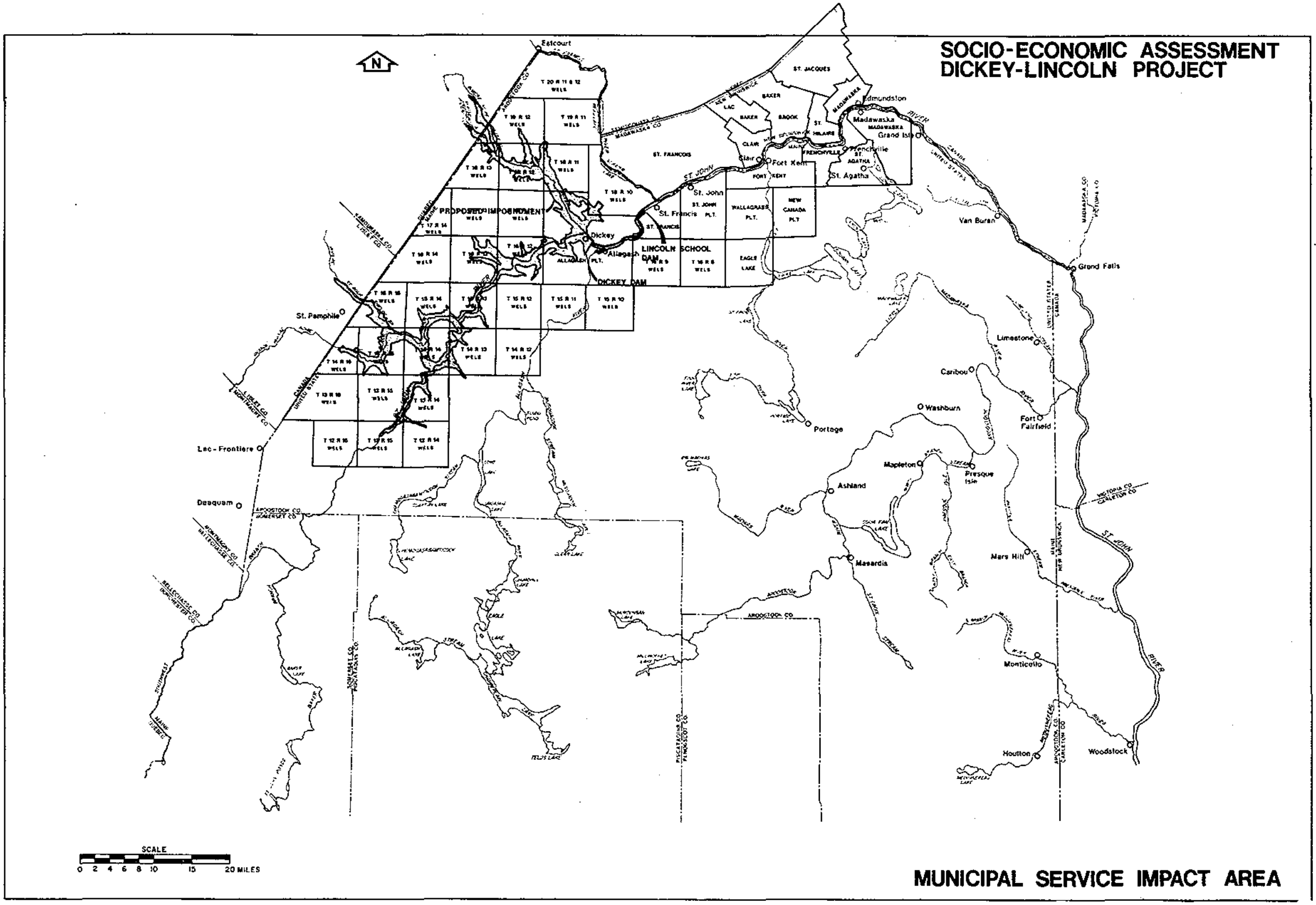

SOCIO-ECONOMIC ASSESSMENT
DICKEY-LINCOLN PROJECT
N
MAINE
LOCATION MAP
CANADA - NEW BRUNSWICK
U.S. - MAINE
ST. FRANCIS RIVER
ST. JOHN RIVER
ALLAGASH RIVER
St. John
St. Francis
Dickey
Allagash
161
1
11
FORT KENT
ST. JOHN
ST. FRANCIS
ALLAGASH
SCALE (MILES)
2 1 0 2 4 6
IMMEDIATE IMPACT AREA

FIGURE 2.09-1

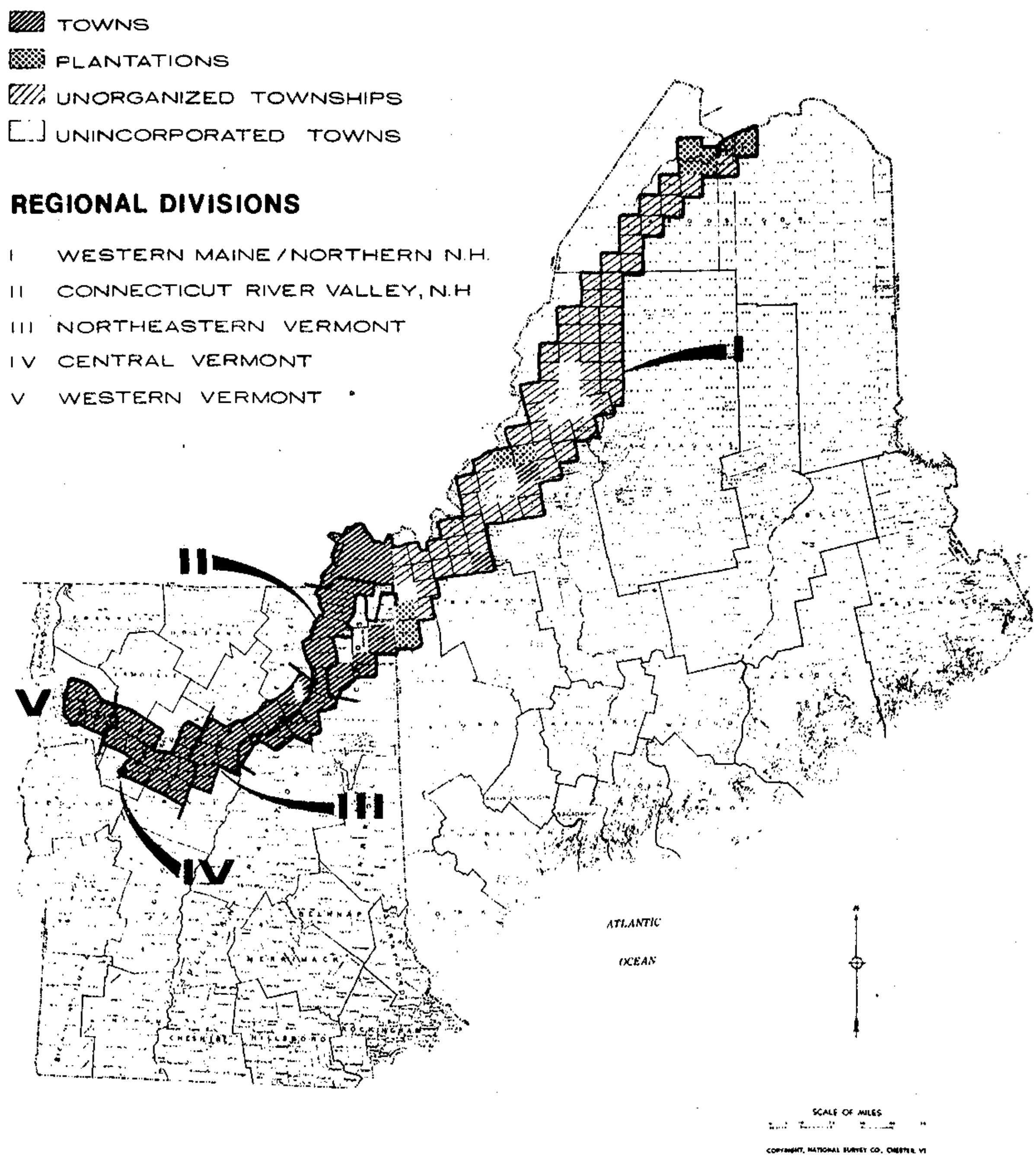


SOCIO-ECONOMIC ASSESSMENT
DICKEY-LINCOLN PROJECT
MUNICIPAL SERVICE IMPACT AREA
N
SCALE
0 2 4 6 8 10 15 20 MILES
Estcourt
Edmundston
Madawaska
Grand Isle
Frenchville
St. Agatha
Fort Kent
St. John
St. Francis
Dickey
Allagash
LINCOLN SCHOOL DAM
DICKEY DAM
PROPOSED IMPOUNDMENT
Van Buren
Grand Falls
St. Pamphile
Limestone
Caribou
Washburn
Portage
Fort Fairfield
Mapleton
Presque Isle
Ashland
Lac-Frontiere
Daaquam
Masardis
Mars Hill
Monticello
Houlton
Woodstock
ST. JOHN RIVER

FIGURE 2.09-2

Figure 2.09-3

POLITICAL STRUCTURE



Most of the interview respondents had a maximum of twelve years of formal education. In keeping with the national trend, a higher proportion of the young adults (age 20-29) have extended their formal schooling into some years of college.

The majority of the men in families were gainfully employed. The principal occupations were farming, woods work, machine operation, and skilled crafts. Twenty-seven percent of the wives in the sample worked for wages; their source of employment being service work, clerical and sales jobs and in the professional-technical categories. This may be a higher proportion than generally found in the area population, as the large family orientation tends to require mothers in the home.

The most popular forms of community activity on a formal level are organized around schools, churches, and veteran status. People are not politically active. On an informal level, the most popular interactions are shared meals or social gatherings, church socials or helping neighbors as with repair work. High school athletics are well attended and a source of entertainment. The only really popular commercial recreational outlets are local "drinking and gathering spots."

2.09.1.2 Proposed Transmission Route

Population densities are very low in most of the study area. Along the transmission corridor, the southernmost areas of New Hampshire are becoming urban due to increased industry. From 1960 to 1970, New Hampshire's population growth rate was 21.5 percent, Vermont's 14.1 percent, and Maine's 2.3 percent. The average growth rate for New Hampshire and Vermont counties in the study area is 11.2 percent and 5.7% respectively. In these states, seasonal population growth is common because of the recreational resources. For a population breakdown of regions and communities along the transmission line corridor, refer to Appendix H (DOE, 1978).

2.09.2 Government

2.09.2.1 St. John River Basin

St. Francis has a selectboard-town meeting form of government. The town meeting is an example of direct democracy and has been practiced in New England for over 300 years. It is a gathering of all qualified voters of a town to act on ordinances and other legislative matters, adopt the municipal budget, elect municipal officials, and debate other matters of concern to the municipality. The importance of the town meeting is that it exclusively holds the legislative powers of that town's government. The primary officials elected at the town meeting are selectmen. In St. Francis, there are three selectmen with the first selectman serving essentially as a town manager. The municipality employs no full-time and 4 part-time staff.

St. John is a plantation; a form of government that is unique to Maine. The plantation form of government resembles town government in organization, powers and procedures. However, the operations tend to be more simplified. A three member board of assessors serves as the executive body of the plantation and generally exercises the powers of selectmen and municipal officers under Maine law.

Like town government, the annual meeting of eligible voters is the municipal governing body. As in towns, the annual meeting is called by warrant of the municipal officers; but unlike towns, the plantation meeting is required to be held in March. The plantation meeting elects officers, raises and appropriates tax monies for governmental activities, and attends to other matters of importance to the plantation. St. John employs no full-time and 1 part-time staff.

Allagash has a town meeting form of government with three selectmen. Shoreland zoning policies are in effect in Allagash. They are working towards the development of zoning ordinances and a comprehensive plan.

Fort Kent has a council-manager town meeting form of government. With this form of government, an elected council appoints the manager who is responsible to that council. The addition of the town meeting is the only difference between this and a regular council-manager form. The municipality employs 47 full-time staff.

2.09.2.2 Proposed Transmission Route

The following communities are those on which some degree of impact may be expected in the socio-economic realm.

Montpelier is the capital of Vermont and an incorporated city. It has a city manager/alderman form of government with 6 aldermen. There is a zoning board and Montpelier is a member of a regional planning commission.

Jackman, Maine is in Sommerset County. With a population of 848 people (in 1970), it has a town manager/town meeting form of government with selectmen. Jackman has a planning board and a partial town plan.

Eustis, Maine is a town of 595 people (as of 1970) in Franklin County. It has a town meeting form of government with three selectmen. There is a planning board and there are some local zoning ordinances in Eustis.

Colebrook, New Hampshire is an incorporated township in Coos County. Its 1970 population was 2094. The town meeting form of government elects 2 selectmen. Colebrook has a conservation commission.

Groveton, New Hampshire is the incorporated township of North Umbria, Coos County. Its population was 2493 in 1970. It has a town meeting/town manager form of government with 3 selectmen. A conservation commission exists in the town and a master plan has been developed.

Clarkeville, New Hampshire is an incorporated township of 166 (in 1970) people in Coos County. It has a town meeting form of government with three selectmen.

Pittsburg, New Hampshire is an incorporated town populated by 726 people in 1970. It is in Coos County and has a town meeting form of government with 3 selectmen.

2.09.3 Municipal Services and Facilities

2.09.3.1 St. John River Basin

Planning

St. Francis and Fort Kent have municipal planning boards, which are individuals appointed or selected by the town officials to advise them on planning problems. They are responsible for preparation of comprehensive plans and subdivision ordinances, and the review of subdivision applications. However, only Fort Kent has a zoning ordinance.

Land use in St. John Plantation and Allagash, according to state law, is under the authority of the Maine Land Use Regulation Commission. However, Allagash became a town in April of 1976. Until it developes a comprehensive plan which is approved by the LURC their land use will be governed by the state.

Water Supply

Of the four communities under study, Fort Kent and St. Francis have public water systems. However, many residents in Fort Kent and St. Francis, as well as all residents in St. John and Allagash, depend on private wells for their water supplies.

Sewerage Disposal

Fort Kent is the only community that has a municipal sewerage system and treatment plant. It has a capacity of 700,000 gpd. Fort Kent's system could accommodate 3,000 additional users; all new residents are required to connect to the system. St. Francis, St. John and Allagash rely on subsurface systems--mostly septic tanks.

Solid Waste

St. Francis and St. John have sanitary landfills. The Board of Assessors of St. John are confident that their landfill can accommodate increased population. However, St. Francis officials indicate that they may need a new site shortly.

Allagash and Fort Kent are currently using open burning dumps which do not meet federal or state requirements. The communities are currently operating under a variance through the state. However, they must, by state law, develop an acceptable solid waste disposal area by 1980.

Transportation

Fort Kent is the only community with a full-time public works department. The Fort Kent public works department is responsible for major street and road maintenance programs. In Allagash, St. John and St. Francis, side roads are maintained by the town governments, but all major street functions are the responsibility of the county and state. Generally, the public works functions are partially filled by the municipalities and partially by the state or county government.

Public Safety

Fort Kent is the only community in the IIA with a full-time police department. The other communities use a variety of combinations including constables, county sheriff, state police and mutual assistance agreements. St. Francis was the only community that felt that their current police protection was not adequate and that increasing the service levels was warranted. Fort Kent, St. Francis, and Allagash have volunteer fire departments and equipment. St. John provides fire service through a contractual arrangement with Fort Kent. However, because it does not have a public water system, it must depend on the Fort Kent tank truck to provide water for fire fighting.

Recreation

Fort Kent provides a full range of recreational activities - both indoor and outdoor; the town also employs a recreation director. St. Francis residents use the facilities in Fort Kent and pay an annual user fee. St. John is developing a large outdoor recreation area; residents also use the services and facilities of Fort Kent presently. Fort Kent is attempting to expand its current recreation program, and St. Francis recently formed a citizen committee to investigate availability of funds for recreation facilities.

Allagash residents use the school gymnasium for adult and children's programs. They do not have any outdoor facilities.

Education

Three of the communities involved in the IIA are members of School Administrative District (SAD) #27. The fourth, Allagash, is a member of SAD #10. A SAD is a district formed by several municipalities to combine educational and funding opportunities, attempting to reach an economy of scale of students using facilities. SAD #27 is adequate for present requirements. SAD #10 requires more classrooms presently.

Social Services

There are six major providers, other than churches, of social services in the four community area. Those six agencies are: The Maine Department of Human Services, Aroostook Mental Health Clinic, the University of Maine Extension Service, Holy Innocents Homemakers, Aroostook County Action Programs, and the U. S. Department of Health, Education and Welfare (HEW). Most of the services are provided through offices in Fort Kent.

Health

Fort Kent is the only community in the SIA that has a hospital. The facility has 70 beds and is a general acute care hospital with medical-surgical, physical therapy, lab, x-ray, emergency room, pediatrics, and obstetrics capabilities. Only 2/3 of the beds are utilized at present.

Fort Kent is the only community with practicing doctors. It also provides ambulance service on a contractual basis to St. John, St. Francis and Allagash.

Housing

A recent housing survey for Fort Kent indicates that there is a two percent vacancy rate within that community. In addition, the survey indicated that 19 percent of the units currently occupied are overcrowded. There have not been similar recent housing surveys performed in St. Francis, St. John or Allagash; however, officials indicate that there is a vacancy rate of approximately one percent in these communities. Housing shortages exist throughout the area. Much of the existing housing is below federal standards.

2.09.4 Economy

2.09.4.1 St. John River Basin

2.09.4.1.1 Labor and Employment

In Aroostook County from 1960 to 1970, the portion of the labor market represented by agriculture, forestry and fisheries declined while manufacturing and professional services increased. Trade remained the largest sector. In terms of occupation the largest increases occurred in the skills involving craftsmen, foremen and machine operators. Seventy-three percent of all basic jobs in the county are affected by the change in seasons.

Nearly 80% of the manufacturing sector is represented by lumber and wood, food and paper. There are a large number of self-employed managers in the lumber and wood industry and there are many experienced foremen. The food industry engages large numbers of skilled foremen and the paper industry employs many skilled craftsmen. The trade group employs many sales workers and agriculture, forestry and fisheries account for the farm workers and many of the unskilled laborers.

The female labor force in Aroostook County increased by 27% between 1960 and 1970, while that of the males decreased by 19%. In 1970, female employment comprised 35% of the county labor force. During the 1970's, the annual unemployment rate remained at close to 10%, going to 16% in some parts of the county in 1975. In March 1977, the county labor force totaled 35,080 of whom 12.6% were unemployed. In spite of unemployment rates, there are unmet manpower needs in the potato and forestry industries during harvest. Many local residents have seasonal informal employment relationships with these industries.

Approximately 7% of all workers in the area are covered by union contract. For many years, Canadians have found employment in the agricultural and manufacturing sector in Aroostook County. This has caused some discontent within local worker groups.

The economy of Aroostook County is similar to that of a developing area where the emphasis of activity is upon extracting resources from the land and subsequent export of these resources. The major sectors that grow or harvest the resources are agriculture and forestry. The processing of some of the resources takes place before export. Also, wholesale-retail trade is an important sector serving the final demands of the population.

2.09.4.1.2 Sales and Tax Base

The communities within the SIA depend heavily upon property tax for operating revenue. Five have no municipal debt; four have expended less than one-fourth of their maximum debt limit; and one, Wallagrass, is under one-half of its maximum. Based on the per capita incomes, it appears that the tax burden is relatively high on residents of the SIA, particularly in St. Francis and Wallagrass.

2.09.4.1.3 Industry

Forestry commands a leading role in the economy of Aroostook County, although it does not employ large numbers of people. Commercial forest land consumes 86% of the county's total land area and the raw product of this sector is used for some industries within the manufacturing sector accounting for a significant portion of manufacturing employment.

The total annual stumpage value of timber harvested from Aroostook County is approximately $8-10 million ($7.4 million in 1975 and $11.2 million in 1974). It is estimated that 1973 employment in the lumber and wood products industry accounted for one-third of all manufacturing jobs in the county and 22% of the total gross manufacturing product. The product value of paper represents approximately 50% of the total manufactured products and employment represents 20% of all manufacturing jobs.

Using a 10-year average (1965-1975) for annual cut and estimated productivity, an estimated 600-900 people are engaged in wood harvesting in Aroostook County. Addition of support and land management personnel will bring the total labor force involved in commercial forestry to nearly 1,000 in a typical year.

Aroostook County has 22.2% of Maine's commercial forest land but 29.2% of its more marketable timber.

Over the past 10 years, the total timber cut in Aroostook County, in general, has been increasing. The county's portion of the total State of Maine timber cut (22%) is approximately the same as its percentage of the forest lands in Maine. Yearly fluctuations are due to market conditions in the pulp and paper and construction industries.

According to initial studies and despite the large volume of wood cut every year, Maine and Aroostook County, in general, do not cut all that they grow. In the proposed project area, approximately 50% of total growth is harvested. This is based on the U. S. Forest Service's growth statistics which are controversial within various segments of the industry. Total growth is not all merchantable because of the class of timber cut and the markets.

A recent indepth study (Supplement to Appendix C, CE, 1978) of the forestry sector of the Aroostook County economy indicates that the spruce budworm is having a significant effect on the growth rate.

Rea and Houseweart indicates a zero net growth rate in the softwood and mixed wood forests of the six county study area which included Aroostook County (Supplement to Appendix C, CE, 1978). Since the study is in its early stages, the results are inconclusive. Growth increments are more significant over a longer time frame. However, the estimate of 0.45 cords/acre of annual mortality, (excepting harvest and logging related) is reliable and when compared to the prior estimate of annual net growth of 0.5 cords per acre, it is readily apparent that the spruce-fir timber supply will be quickly drained.

Potato production is the backbone of agriculture, with the county output accounting for about 95% of Maine potato production. Dependence on potatoes makes the "one-crop agricultural sector" vulnerable to changes in market prices and costs of inputs for growing and harvesting potatoes. Maine's potato production is in a constant state of flux. Since 1960 the yield per acre has varied from 210 to 274 cwts and production from 26.8 million to 38.4 million cwts. Competition from Washington State and Idaho potatoes indirectly affects prices received by Maine farmers. In 1969, tablestock accounted for 47% of Maine's potato crop sales; processing for 32%; and seed for 21%. The sales value ranged from $37 million to $183 million during 1960-1974.

In addition to the major industry sectors of agriculture and forestry in Aroostook County, there are firms in other sectors of the economy (such as contract construction, manufacturing, transportation, etc.) that contribute to satisfaction of local needs and/or production in the major sectors. In all sectors, Aroostook County average wages were below Maine's, which were in turn below National averages as of 1973.

The contract construction sector is the smallest employer of the non-agricultural/forestry work force in Aroostook County with 652 employees in 1973. From 1967-1973, employment remained relatively constant at approximately 4% of the labor force. This proportion is slightly less than that at the state and national levels. There is a low level of unionization of various trades in this sector.

The numbers of people employed by the manufacturing sector in Maine decreased from 1967 to 1973. The value of the products has risen from $1.7 billion in 1964 to $3.7 billion in 1975. Prices of primary forest products rose sharply in 1973-74 and then fell nearly as sharply in 1975.

Four sectors including lumber and wood products, paper and allied products, food and kindred products, and chemicals and allied products account for 90% of the total value of manufactured products in Aroostook County. More people are employed in manufacturing than any other sector. The growth in the total value of manufacturing products has been substantial. However, the area closest to the Dickey-Lincoln School project has obtained a smaller share of this.

The transportation and public utilities sector does not play a significant role in the Maine state economy, employing only 5.3% of the nonagricultural work force in 1973. In that same year, municipal electric and rural cooperative electric systems generated 16.1 million kwh and purchased 168.1 million kwh.

The wholesale and retail trade sectors employ a smaller portion of Maine's labor force than of Aroostook County's. The state falls between the Aroostook County and U. S. statistics on the labor force employed in the finance, insurance and real estate sector. The services sector employed 18.1% of the state's nonagricultural labor force in 1973 although it only employed 14.3% in 1967.

2.09.4.2 Proposed Transmission Route

2.09.4.2.1 Sales and Tax Base

Along the proposed transmission route, in terms of forest, all Maine forest land parcels 500 acres and larger in area are taxed under the "Tree Growth Tax Law," (title 36 MRSA, sec. 572-584A) according to the productivity of the land for growing timber. Parcels between 10 and 500 acres in size may be enrolled under the law at their owner's option. No separate tax is levied on the timber.

New Hampshire has an optional modified assessment law, which provides for the valuation of forest land according to current use, and a mandatory yield tax. Under the yield tax law, bare forest land remains subject to the general property tax at current use assessment, if so designated. Timber is taxed only when harvested, at a rate of 12 percent of stumpage value levied on the harvester.

All Vermont forest land is assessed at fair market value according to its "highest and best use." The state has no special property tax provisions for forest land. Valuation ratios among different towns varied from 10 percent to 100 percent prior to July 1, 1977, by which date all towns were supposed to be assessing at 100 percent of fair market value.

2.09.4.2.2 Industry

The farming trend in the three transmission corridor states is toward larger, mechanized farms that produce more per acre. However, the total land area farmed in the three states has declined. The percentage of land area devoted to farming is greatest in Vermont where some 32 percent of the land is farmed. Agriculture is Maine's second largest industry and the state ranks second in the nation for the production of potatoes. Other important farm products include poultry, eggs, dairy products, apples, and blueberries.

In New Hampshire, agriculture is the third largest industry. The number of farms in the state has dropped precipitously from 15,800 in 1950 to 2,600 in 1976. The acreage farmed declined from nearly 2 million acres in 1950 to 560,000 in 1976. Most of the farms are in the southern part of the state. Farm areas are found along the Connecticut, Merrimack, Saco, and Androscoggin Rivers. The most important farm activities are dairying and cattle raising.

In Vermont, agriculture is the state's most important industry, and dairying is the most important farm activity. Dairying is concentrated along the Connecticut River Valley, in central Vermont, and in the Burlington area. Vermont derives a greater percentage of its farm income from dairying than any other state. Milk production and the number of cows are increasing. Other farm produce includes eggs, chickens, maple syrup and sugar, and berries and fruits. The number of farms, however, has dropped from 6,000 to 3,200 in the past 6 years. The farm areas in Vermont are spread rather evenly over the state.

Maine, New Hampshire, and Vermont are all largely dependent upon the extensive forests which cover 90 percent of Maine, 86 percent of New Hampshire, and 75 percent of Vermont. A combination of favorable climate, physiography, and the decline of agriculture has produced large areas of forest cover.

Most of the total forested land area within the three states is considered to be commercial forest land. This land is defined as producing or capable of producing crops of industrial wood (more than 20 cubic feet per acre per year) and is not withdrawn from timber utilization.

The commercial forest lands are owned mostly by private firms and individuals. Forest industries control about 40 percent of the commercial forest in Maine. This percentage is higher in Maine than any other state. Less than 0.5 percent of the commercial forest land in Maine is publicly owned. This is the lowest in the United States. Commercial forest lands contribute substantial revenues to the economies of the three states in the study area and Canada.

Current growth of forest lands along the three state transmission corridor varies greatly. Maine's commercial forest land was growing at a rate of 42 cubic feet per acre per year in 1970. New Hampshire's forests grew 43.6 cubic feet/acre/year between 1958-1972, and Vermont's forests reached a net annual growth rate of 24 cubic feet/acre in 1972. Data are not available for New Hampshire, but nearly 80 percent of Maine's and 66 percent of Vermont's lands are believed capable of growing over 50 cubic feet/acre/year.

Total employment in logging is difficult to estimate because of the large number of individual entrepreneurs and small groups who participate in this work. Logging is a major source of employment in many of the small towns in western Maine and northern New Hampshire. Four of Maine's primary wood processing plants are located within towns crossed by the proposed transmission route.

The route through northern New Hampshire passes through regions of low population and few processing facilities, but, the small towns in these areas depend heavily on logging for employment. Northern Vermont's forest economy rests more on logging than on primary processing. All of the state's 1972 hardwood pulpwood cut was exported to other states, primarily New Hampshire, as was 80 percent of its softwood pulpwood. Much of Vermont's sawlog output also leaves the state. Timber production grows progressively less important as the route runs west from Essex County, Vermont's most heavily forested county, to suburban Chittenden County.

2.10 Cultural Resources

2.10.1 St. John River Basin

Indian utilization of the St. John Valley is not documented to any extent. Older residents of the area recall stories of Indians travelling through, but no permanent settlements are indicated. It might be hypothesized that Indians utilized the valley during the early fur trade period, but of this there is no known record. Because of the transient nature of Indian occupation, it is difficult to attach any specific tribal name. It is probably adequate, and accurate to refer to them as Abnaki, meaning a group of Algonkian speaking peoples occupying much of the northeast.

The distribution of sites and their physical characteristics allows some tentative reconstruction of how the project area was utilized prehistorically. There is one site which can be considered large by regional standards and this is the Big Black site. The size of this site and the kinds of artifacts it has yielded suggests repetitive occupation over many years. It was the last good camping area between the Big Black Rapids and the Priestly Rapids area. Inhabitants of the Big Black site could ascend the Big Black River to upstream hunting and fishing grounds during their journey downstream.

It seems unlikely that the project area could have supported great numbers of prehistoric people at any one time on a year-round basis. It is also doubtful that the area could have supported many on an intensive seasonal basis. Agriculture was impossible because of the extremely short growing season in northern Maine. Therefore, a hunting and gathering way of life was the rule in the north woods. Moose and caribou were plentiful during early historic times and today, the white-tail deer has replaced the caribou.

A major food resource for much of the northeast prehistoric population was fish. During much of the year, Indians took both indigenous fresh water and anadromous fish. The existence of a natural barrier located on the St. John River downstream from the study area at Grand Falls, N.B., Canada prevents large anadromous fish runs into the project area. This substantially reduced the available fish resource to the prehistoric inhabitants of the project area. There simply was not enough food to sustain large numbers of inhabitants for long periods of time.

One possible use of the St. John River is that of a travel route. The upper St. John would be an important highway through an area of dense, impenetrable forest. Through the St. John system, Indians could move from the St. Lawrence Valley to the populous lower St. John Valley (below Grand Falls) in one direction and to the Penobscot and Kennebec Valleys in the other.

The locations and size of sites in the study area suggest that many of the sites may have been used by travelers rather than permanent residents of base camps for resource exploitation.

It is difficult to fit the few artifacts found to date into a well developed cultural chronology due to the undeveloped nature of archaeology in northern Maine.

The project area appears to have been used most often in the period from 3,000 years ago to the Historic Period (the time of Indian contact with white man). It has been suggested that the Big Black Site could produce evidence for older habitation by man, but diagnostic artifacts have not yet been found. It would not be correct to assume that the study area has been utilized only on a repetitive basis for the past 2,000 years. The effects of erosion on deposits preclude that assumption.

The prehistoric emphasis throughout the project is one of exploitation of the rivers and lakes for fishing and transport. Movement in the closed forest is quite difficult, whereas the interconnecting systems of rivers and lakes provide for ready travel routes.

Seven Islands as a potential National Register site consists of seven individually numbered historic sites located on both banks of the St. John River. The river valley at Seven Islands is unusually broad. This feature allowed for farms to be developed. The combination of suitable agricultural land and access to the region made Seven Islands a natural area to develop. The area is one of considerable significance to the people of the state of Maine where lumbering is very much a part of their historical heritage. Seven Islands represents a community whose sole function was to support the lumbering industry of the upper St. John River Valley. During the 19th Century, it was the major settlement on the main road from Ashland to Canada. As such, it was the hub from which various companies sent out cutting crews. It served as the rendezvous for the spring logging drives.

Logging techniques in the 19th and early 20th Centuries were dependent upon horses and oxen for hauling out the logs. The farms at Seven Islands grew the hay and oats required to feed the animals and the vegetables and beef necessary for the crews. Seven Islands represents both a lumbering community and a farming settlement and in essence it supported a major facet of early northern Maine's economy.

2.10.2 Proposed Transmission Route

At the regional level, the portions of all three states through which the line passes have been subject to natural resource exploitation, rural and occasional urban development and other utilities facilities construction. As regions, they do not contain unusually significant cultural resources of sufficient integrity at this level of analysis to warrant detailed evaluation.

At the district level of analysis, the district in the Town of Peacham, Vermont, is of sufficiently significant content and integrity to warrant planning consideration as an outstanding example of a rural Vermont village with standing functional properties dating from the late eighteenth and early nineteenth centuries. There are other areas containing properties of possible historic significance, but they appear to lack the content, integrity and uniqueness which make the Peacham area noteworthy. Areas in this category include Whitefield, New Hampshire, and Plainfield, Richmond and Williston, Vermont. No locales of sufficient density and character of archaeological sites were discovered to warrant discussion at the scale of district.

Most of the cultural resources considered in this study were evaluated at the site specific level. Field survey samples revealed no previously undiscovered archaeological sites within ¼ mile of the planned facilities. Several sites were discovered in the vicinity of the lines but, in general, known archaeological sites are few in the project area. Design and route constraints were combined to locate facilities in areas of low archaeological site density. Because little is known about the archaeology of this area, any sites discovered would be of significance. There are two areas of outstanding archaeological concern. These are the crossings of the Connecticut River and the crossings of the Bailey-Hazen Military Road which are both in Vermont.

With the exceptions noted above, there were no resources discovered which would be of such significance that mitigation would be impossible at this stage in the planning process.

2.11 Aquatic Ecosystem

2.11.1 Rivers & Streams

2.11.1.1 St. John River Basin

The upper St. John River basin above the proposed dam sites covers 4,086 square miles and contains approximately 3,450 miles of intermittent and continuously flowing streams. There are approximately 1,900 miles of streams above the proposed Dickey Dam and an additional 1,550 stream miles in the watershed between Lincoln School and Dickey. The majority of the mileage between Dickey and Lincoln School is in the Allagash River Watershed.

Most streams tributary to the St. John and Allagash Rivers are characterized as 7 to 33 feet wide, .5 to 3.3 feet deep, of a riffle-pool type configuration and with good stream and fish cover. Summer water temperatures are generally less than 68°F and oxygen levels are greater than 7.0 parts per million (ppm). Most streams contain beaver activity and adult brook trout are present in most streams. The streams in both proposed reservoir areas are characterized in Tables 2.11-1, 2.11-2 and in Appendix E (CE, 1977).

2.11.1.2 Proposed Transmission Route

Dickey-Lincoln School to Fish River Segment

The Dickey-Lincoln School to Fish River Segment is the same as discussed for the St. John River Valley.

Dickey-Lincoln School to Moose River Segment

The Dickey-Lincoln School to Moose River segment includes Ben Glazier Brook, McKinnon Brook, and Whittaker Brook which are reported by the Maine Department of Inland Fisheries and Wildlife to have excellent populations of brook trout. Turner Brook is crossed about 2 miles above its confluence with the Baker Branch of the St. John River. Two branches of Knowles Brook which support excellent brook trout fisheries are crossed. The Baker Branch of the St. John River is crossed about 1 mile below Baker Lake. The river is large and supports a very good trout fishery. Excellent spawning and nursery facilities for salmon and brook trout are present both upstream and downstream from the lake.

Norris Brook and Dole Brook are crossed about 2 miles above their confluences with the North Branch of the Penobscot River. Two branches of the Little Penobscot River are crossed and both are good trout streams.

TABLE 2.11-1 TRIBUTARY STREAM MILEAGE BELOW MAXIMUM POOL HEIGHT.*

SUBDRAINAGE		TOTAL** MILEAGE	# STREAMS SURVEYED	MILEAGE+ SURVEYED	SPAWNING MILEAGE SURVEYED				NURSERY MILEAGE SURVEYED			
					EXC.	GOOD	FAIR	POOR	EXC.	GOOD	FAIR	POOR
Ninemile Bridge to Big Black	#(miles)	22.9	5	3.8	0	3.0	0.8	0	0	1.5	2.3	0
	%			16.6	0	79.0	21.0	0	0	39.5	60.5	0
Big Black	#(miles)	36.2	3	6.2	0	0	4.5	1.7	0	0	6.2	0
	%			17.2	0	0	72.6	27.4	0	0	100.0	0
Big Black to Chimenticook	#(miles)	6.4	0	---	NO	STREAMS	SURVEYED					
Chimenticook & Pocwock	#(miles)	14.8	2	10.1	0	3.0	1.0	6.1	0	5.5	1.6	3.0
	%			68.2	0	29.7	9.9	60.4	0	54.5	15.8	29.7
Pocwock to Little Black	#(miles)	23.4	3	10.9	0.6	1.0	9.3	0	0.6	10.0	0.3	0
	%			46.6	5.5	9.2	85.3	0	5.5	92.2	2.3	0
Little Black	#(miles)	49.4	7	15.6	0	4.9	6.5	4.2	0	11.6	4.0	0
	%			6.0	0	31.3	41.6	27.1	0	74.4	25.6	0
Little Black to Dickey Dam Site	#(miles)	0	0	---	NO	STREAMS	THIS	SECTION				
	%											
Dickey Dam Site to Lincoln School	#(miles)	2.2	3	0.6	0	0	0.6	0	0	0.3	0.3	0
	%			27.3	0	0	100.0	0	0	42.0	58.0	0
TOTAL ABOVE DICKEY DAM	#(miles)	153.1	20	46.6	0.6	11.9	22.1	12.03	0.6	28.6	14.4	3.0
	%			30.4	1.3	25.2	47.3	25.5	1.3	61.5	30.8	6.5
TOTAL BELOW DICKEY DAM	#(miles)	2.2	6	0.6	0	0	0.6	0	0	0	0.3	0
	%			27.3	0	0	100.0	0	0	42.0	58.0	0

SUBDRAINAGE		ADULT HOLDING MILEAGE				BEAVER ACTIVITY			NO. OF STREAMS WITH OBSTRUCTIONS TO TROUT PASSAGE AT LOW WATER				
		EXC.	GOOD	FAIR	POOR	EXT.	LIM.	ABS.	UNOBST.	BEAVER DAM	BOULDER CASCADE	GRAVEL DELTA	UNKNOWN
Ninemile Bridge to Big Black	#(miles)	0	1.5	2.3	0	1.5	0.8	1.5	4				1
	%	0	39.5	60.5	0	39.5	21.0	29.5					
Big Black	#(miles)	0	3.0	3.2	0	0	1.5	4.7	2				2
	%	0	48.4	51.6	0	0	24.2	75.8					
Big Black to Chimenticook	#(miles)	---	NO	STREAMS	SURVEYED								
	%												
Chimenticook & Pocwock	#(miles)	0	4.0	1.6	4.5	1.6	4.5	4.0	2				
	%	0	39.6	15.8	44.6	15.8	44.6	39.6					
Pocwock to Little Black	#(miles)	6.0	4.0	0.6	0.3	5.0	5.0	0.9	2			1	
	%	55.3	36.9	5.5	2.3	46.1	46.1	7.8					
Little Black	#(miles)	1.0	10.3	4.3	0.0	4.5	5.9	5.2	4	2		1	
	%	6.4	65.9	27.7	34.2	28.8	37.7	33.5					
Little Black to Dickey Dam Site	#(miles)	---	NO	STREAMS	THIS	SECTION							
Dickey Dam Site to Lincoln School	#(miles)	0	0	0.6	0	0	0.6	0	1			2	
	%	0	0	100.0	0	0	100.0	0					
TOTAL ABOVE DICKEY DAM	#(miles)	7.0	22.8	12.0	4.8	12.6	17.7	16.3	14	2	0	2	3
	%	14.9	48.3	25.8	10.1	26.7	38.0	34.5					
TOTAL BELOW DICKEY DAM	#(miles)	0	0	0.6	0	0	0.6	0	1	0	0	2	0
		[illegible]	0	100.0	0	0	100.0	0					

*910 ft msl above Dickey Dam site, 612 ft msl below

**Total tributary mileage (surveyed and unsurveyed) from maximum pool height to confluence

+Does not include mileage of Big Black, Little Black or Saint John River mainstem

TABLE 2.11-2 TRIBUTARY STREAM MILEAGE ABOVE MAXIMUM POOL HEIGHT*.

SUBDRAINAGE		# STREAMS SURVEYED	TOTAL** MILEAGE	MILEAGE SURVEYED	SPAWNING MILEAGE EXC.	SPAWNING MILEAGE GOOD	SPAWNING MILEAGE FAIR	SPAWNING MILEAGE POOR	NURSERY MILEAGE EXC.	NURSERY MILEAGE GOOD	NURSERY MILEAGE FAIR	NURSERY MILEAGE POOR	ADULT HOLDING MILEAGE EXC.	ADULT HOLDING MILEAGE GOOD	ADULT HOLDING MILEAGE FAIR	ADULT HOLDING MILEAGE POOR	BEAVER ACTIVITY EXT.	BEAVER ACTIVITY LIMT.	BEAVER ACTIVITY ABS.
Ninemile Bridge to Big Black	#(miles)	5	72.7	10.7	0	0	3.2	7.5	0	7.2	2.0	1.5	0	6.5	2.7	1.5	4.0	6.7	0
	%			14.7	0	0	29.9	70.1	0	67.3	18.7	14.0	0	60.8	25.2	14.0	37.4	62.6	0
Big Black	#(miles)	4	372.4	8.3	0	0	2.0	6.3	0		8.3	0	0	0	8.3	0	0	5.0	3.3
	%			2.2	0	0	24.1	75.9	0	0	100.0	0	0	0	100.0	0	0	60.2	39.8
Big Black to Chimenticook	#(miles)	0	8.0	0	--- NO STREAMS SURVEYED THIS SECTION														
	%			0															
Chimenticook & Pocwock	#(miles)	2	86.4	16.4	0	2.0	11.5	2.9	2.5	11.0	2.9	0	2.5	11.0	2.9	0	7.9	6.0	2.5
	%			19.0	0	12.2	70.1	17.7	15.2	67.1	17.7	0	15.2	67.1	17.7	0	48.2	36.6	15.2
Pocwock to Little Black	#(miles)	3	46.4	14.7	3.9	1.0	7.8	2.0	3.9	10.5	0.3	0	4.5	60	3.9	0.3	3.5	5	6.2
	%			31.7	26.6	6.8	52.9	13.7	26.6	71.7	1.7	0	30.7	41.0	26.6	1.7	23.9	34.1	42
Little Black	#(miles)	6	109.1	18.9	0	0.1	6.0	12.8	0	18.9	0	0	3.0	11.2	4.7	0	2.0	9.1	7.8
	%			17.3	0	0.5	31.8	67.7	0	100.0	0	0	15.9	59.4	24.7	0	10.6	48.2	41.2
Little Black to Dickey Dam Site	#(miles)	0	0		--- NO STREAMS THIS SECTION														
	%																		
Dickey Dam Site to Lincoln School	#(miles)	6	70.2	18.9	8.5	0.7	7.2	2.5	1.5	14.7	2.7	0	1.5	14.2	3.2	0	0	16.5	2.4
	%			26.9	45.1	3.7	37.9	13.3	8.0	78.0	14.0	0	8.0	75.3	16.7	0	0	87.5	12.5
TOTAL ABOVE DICKEY	#(miles)	20	695.0	69.9	3.9	3.1	30.5	31.5	6.4	47.6	13.5	1.5	10.0	34.7	22.5	1.8	17.4	31.8	19.8
	%			9.9	5.7	4.5	44.2	45.6	9.3	69.0	19.5	2.2	14.5	50.4	33.6	2.5	25.3	46.1	28.6
TOTAL BELOW DICKEY	#(miles)	6	70.2	18.9	8.5	0.7	7.2	2.5	1.5	14.7	2.7	0	1.5	14.2	3.2	0	0	16.5	2.4
	%			26.9	45.1	3.7	37.9	13.3	8.0	78.0	14.0	0	8.0	75.3	16.7	0	0	87.5	12.5

*910 ft msl above Dickey Dam Site, 610 ft msl below
**Total Tributary Mileage (Surveyed and Unsurveyed) from headwaters to maximum pool height.

The corridor parallels the south branch of the Penobscot River for about 2 miles and then crosses the river as it enters Canada Falls Lake. The South Branch of the Penobscot River, Hale Brook, Fish Brook, Alder Brook, Upper Churchill Stream, and Heald Stream all support good brook trout fisheries.

Moose River to Moore Segment

Sandy Stream, North Branch Wood Stream, McKenney Brook, Moose River, Kibby Stream, Gold Brook, North Branch Dead River, and Alder Stream are all reported to have good to very good brook trout fisheries.

The Kennebago River would be crossed at a point where it is small and smooth flowing. The Kennebago and two of its tributaries that are crossed provide spawning areas for brook trout from Kennebago Lake. The Cupsuptic River is an excellent brook trout stream. The Magalloway River is crossed about 2 miles upstream from Parmachenee Lake and is an important spawning tributary for brook trout in Parmachenee Lake. The little Magalloway River supports an excellent population of brook trout.

Tributaries to the First and Second Connecticut Lakes would be crossed at seven points. They are stocked with salmon, brook, and lake trout. The Mohawk River has excellent habitat for trout and is stocked with rainbow and brook trout. The proposed route crosses three branches of Simms Stream which is stocked with brook trout. The route parallels Nash Stream for 5.5 miles with the centerline within one-fourth mile of the stream. However, the streamside vegetation is regenerating. Nash Stream is considered a high quality trout stream and is stocked with brook trout. Tributaries to the stream are crossed at six locations.

The Upper Ammonoosuc River is a large stream and an excellent habitat for trout. It is stocked with brook trout. The Connecticut River is a very good habitat for warm-water fisheries.

Moore to Granite Segment

The route follows the southeast bank of the Connecticut River from the Moore Dam to the Stevens River and crosses 10 tributaries. All the tributaries are small. The Connecticut River is crossed 1 mile below its confluence with the Passumpsic River. At this point, the Connecticut supports good populations of smallmouth bass, brown trout, and rainbow trout. The Connecticut River has been proposed as a salmon restoration area but dams, such as Moore, and pollution have prevented salmon from becoming established. Stevens River is crossed one-half mile above its confluence with the Connecticut River and contains small population of brown trout. The Wells River has a very good brook trout fishery. The Waits River is crossed twice and supports a very good brook trout fishery. Jail Branch Brook is crossed and has an excellent brown trout fishery and is stocked with steelhead rainbow trout.

Granite to Essex Segment

The route crosses the Winooski River in two locations and runs parallel to the river for most of its length. It crosses a number of tributaries. It has good rainbow trout, excellent brown trout, and small mouth bass fisheries.

Cold Spring Brook is crossed midway between its source and mouth. Stevens Branch has a very good brook trout fishery which is maintained by stocking. Mad River is crossed one-half mile above its confluence with Winooski River. It is a large stream and has very good rainbow trout and brown trout fisheries. Dog River is a large river which supports very good populations of stocked brook and brown trout. The route crosses the main tributary to Bolster Reservoir as it enters the reservoir. Bolster Reservoir is part of the water supply system for the town.

2.11.2 Lakes and Ponds

2.11.2.1 St. John River Basin

There are numerous lakes and ponds throughout the watershed. The more important ones include the Negro Lakes, Depot Lake, East Lake, Little East Lake and the Falls Ponds. Standing water within this region also includes many small ponds and numerable beaver impoundments.

There are approximately 27 names lakes and ponds within the study area and 10 were surveyed as part of the studies for the impact statement (Appendix E, CE, 1977). In addition, 14 were surveyed by the State of Maine. Data now exists for a total of 18 lakes and ponds. Generally the lakes surveyed can be categorized as three types: 1) trout lakes in which a source of cool, well oxygenated water is present throughout the year (Big and Little Falls Ponds); 2) warm water lakes such as Depot Lake and Little East Lake, which contain primarily non-trout species including yellow perch and suckers because no cool, well oxygenated water is present throughout the year; and 3) winterkill lakes such as Blue Pond and Ed Jones Pond. The Falls Ponds and Blue Pond lie below the proposed maximum pool heights.

In general, the following conclusions may be drawn regarding the existing lakes within the proposed project area: 1) those lakes which have trout also contained other species such as minnows and/or chubs; 2) several lakes in the area suffer from winterkill and contain only minnows or no fish at all; and 3) several lakes were too warm for trout and contained primarily warm water fishes such as yellow perch, suckers and chubs.

Brook trout found in lakes and ponds of the area tend to be larger and longer lived than their stream counterparts. When compared to the rest of northern Maine, these trout are large for Age III and small for Age IV. Their feeding habits remain essentially the same as the stream populations in that they feed on invertebrates. However, their increased size should assist in capturing and utilizing larger forms of food such as other fish and small vertebrates.

2.11.2.2 Proposed Transmission Route

Dickey-Lincoln to Moose River Segment

The route runs along the northwest shore of Baker Lake, a 1,231-acre lake with depths to 30 feet. It is managed for both brook trout and salmon. Large numbers of perch, suckers, chub, fall fish, and horned pout limit the trout populations but have less effect on landlocked salmon.

The route passes within a half mile of the shore of Long Pond. This 845-acre lake provides good habitat for lake trout, white fish and cusk. The tributaries provide adequate spawning and nursery facilities to maintain a good brook trout fishery.

Canada Falls Lake supports a good brook trout fishery. It has excellent spawning areas in tributaries, cool areas near the inlets, and springs for brook trout during warm weather. Whitefish are also present.

Trickey Pond is a small pond which supports a good brook trout fishery. The inlets are intermittent and of little value to the brook trout for spawning.

Adler Pond supports a good population of brook trout which spawn in the gravel along the shoreline and in the outlets. They feed on the large populations of aquatic insects and small minnows.

Moose River to Moore Segment

Daymond Pond is an 11-acre pond one-half mile from the centerline. It is stocked with brook trout. Crocker Pond, adjacent to the centerline, is a 227-acre pond stocked with brook trout. Two small brook trout ponds lie on either side of the corridor. They are the 25-acre Mud Pond and 98-acre Long Pond. Chain-of-Ponds has an area of 700 acres and a maximum depth of 106 feet. Sport fisheries include brook trout, salmon, and lake trout. There are sufficient spawning and nursery areas in the tributaries to maintain the former two species, but the lake trout are stocked. Also present are yellow perch and smelt. The route crosses Chain-of-Ponds at the outlet. Round Mountain Pond is a 75-acre brook trout pond one-half mile from the centerline.

The route follows within one-fourth mile of the western shore of Moore Reservoir and then crosses the Connecticut River just below the hydroelectric dam. In addition to warm-water fisheries, Moore Reservoir contains small populations of trout near cold-water inlets.

Moore to Granite Segment

Coburn Pond is a 5-acre pond adjacent to the centerline at mile 4. The centerline is one-fourth mile from the south shore of 38-acre Lower Symmes Pond. Both ponds support warm-water fisheries.

Information on geographical considerations, chemical and physical characteristics, and wildlife species associated with aquatic resources along the transmission route is presented in section 3 of Appendix E (DOE, 1978).

2.11.3 Aquatic Fauna

In addition to brook trout, 17 other species of fish are known to inhabit the streams and lakes within the proposed Dickey Lake area. Chubs, suckers, minnows, shiners, burbot (cusk), yellow perch, brown bullheads and sculpins were captured or known to be present in the Big Black and Little Black Rivers and the St. John River. Round whitefish were found only in the Little Black River.

Brook trout in the tributaries are average growing and live approximately three years. Brook trout in small cold water streams frequently mature early and have a short life span. Some age 0 trout (less than one year old) were determined to be mature at the end of their first summer. The age distribution of the stream dwelling brook trout is representative of these types of early maturing populations (Age 0 = 52.8%, Age I = 37.0%, Age II = 9.2%, Age III = 0.9%).

These trout populations feed almost exclusively on insects and other invertebrate forms. Their feeding habits varied from subdrainage to subdrainage but with little exception they did not vary from this pattern.

There is a rich and varied aquatic faunal community within the streams, rivers and ponds of the area. This was indicated by a survey of 18 stations within the proposed project site which produced a total of 147 genera of insects. A detailed report of this survey is found in the supplement to Appendix E (CE, 1978).

2.12 Terrestrial Ecosystem

2.12.1 Vegetation

2.12.1.1 St. John River Basin

The St. John River watershed is covered by extensive second-growth forest characterized by a spruce-fir and broad-leaved hardwood association. The area of the proposed impoundments is predominantly a commercial spruce-fir forest interspersed with northern hardwoods and aquatic systems. These combine to form varied and unique habitats for both plants and wildlife.

The total terrestrial environment (all habitats except lakes, ponds and rivers) within the proposed impoundments encompasses 80,455 acres. This is 93% of the impoundment acreage. Forest communities cover 76,173 acres which equals 95% of the terrestrial habitat. Coniferous forest, primarily red spruce and balsam fir, covers 56,976 acres within the impoundments. Mixed forest types comprise 21% of the forest in the reservoir areas. Other softwood species in the project area include northern white cedar, black spruce, tamarack and white pine. Northern hardwood forests composed of sugar maple, yellow birch, beech and white ash constitute only 2% of the proposed inundation area. They are common on surrounding ridges. Other hardwood species include paper birch, trembling aspen, bigtooth aspen and balsam poplar.

Various wetland communities represent 2% of the terrestrial environment. Bogs and seasonally flooded flats along the river are the dominant wetland types. The streamside habitat of the St. John River mainstem is particularly unique and supports a number of rare and unusual plants.

Eleven rare and unusual plants of particular interest are: Furbish lousewort, Josselyn's sedge, northern paintbrush, cut-leaved anemone, field oxytrope, bird's-eye primrose, alpine rush, Blake's milk vetch, Alpine milk vetch, Sweet broom and Lake Huron tansey. All but two of these rare plants (Josselyn's sedge and Blake's milk vetch) were found during field investigations. A full description of survey results is contained in Appendix F (CE, 1977). Additional species which are uncommon to northern Maine and known to exist or potentially exist in the project area are listed in Appendix F (CE, 1977).

Within the spruce-hardwood forests, a variety of common shrubs and herbs occur. In comparison to the mature spruce-fir forests, moss cover tends to be less significant and ferns and herbs more common. Northern hardwoods or maple-beech-birch types occur predominantly on better drained ridgelands or hilltops. Understory vegetation common to the hardwood stands are hobblebush, striped maple, mountain maple, beaked hazelnut, trillium, whorled wood aster, false Solomon's seal, wood sorrel and various ferns.

2.12.1.2 Proposed Transmission Route

Dickey-Lincoln School to Fish River

Most of the route crosses areas presently in forest cover. Areas in which agriculture or other activities have removed the forest cover constitute 12 percent of route acreage.

Mature stands of mixed hardwoods make up the most abundant category of vegetation encountered along the route. Mature softwood-hardwood and hardwood-softwood communities occur together on 43 percent of the route acreage.

The second most abundant cover type along the route is regenerating forest.

Dickey to Moose River

The proposed route from Dickey to Moose River Substation crosses an extensively forested area. The dominant cover category is regenerating forest. It constitutes 32.6 percent of both its areal acreage and its lineal length. The area traversed by the proposed route is largely commercial forestland. Mature stands of spruce-fir and mixed hardwood-softwoods are the second most abundant cover types along the route.

Moose River to Moore

The proposed route from Moose River to Moore Substation also is an area of extensive forest cover. Agriculture and other forms of land development together make up less than 2 percent of the acreage encountered along the route.

Mature hardwood forest is the dominant land cover, occupying 30 percent of the route acreage and 31 percent of its length. The second most prevalent type of vegetation is mature hardwood-softwood communities which occur over 20 percent of the route's acreage and 21 percent of its length.

Moore to Granite

This segment contains more open agricultural areas than any of the previous segments. These areas occupy slightly more than 10 percent of the route's acreage. Hardwood forest are the dominant vegetative category with the segment. Mature hardwood-softwood stands occupy over 45% of the segment. Pine-hemlock stands occur in this segment.

Granite to Essex

Mixed mature forest with softwood predominating is the largest forest cover category intersected by this portion of the route (approximately 33%). The softwoods on this route are predominantly white pine as contrasted with the spruce and fir of more northerly route segments. Pure cedar stands are more prevalent than on other segments.

More open or unforested lands are encountered on this route segment. The combination of farmfields and man made cover types account for 25 percent of the acreage.

2.12.2 Forestry

2.12.2.1 St. John River Basin

The proposed project area is primarily commercial forest. A unique system of forest land management exists within the project area. Since 1840, owners in northern Maine have joined together to form a unified land management system. Much of the forest land is held in undivided and common ownership. Under this system, owners have formed organizations or retained firms to manage large tracts of forest land as one ownership. This land ownership and management system provides an opportunity for integrated and long term forest management.

Throughout the project area, a selective cutting system is used whenever possible. In this sytem, stands are partially cut to remove trees of economic value. Proper harvesting results in a young, vigorous stand ready for another cutting in 20 to 30 years. Volume yield is greater using this system, but road maintenance and operations are costly. Presently, a fairly well developed private road system to move timber exists within the St. John watershed.

The selective cutting system requires increased management involving proper selection of individual trees. Past events such as spruce budworm attacks and fire have caused damage which required salvage clearcutting and subsequent regeneration of even aged stands.

The existing forest resource is a function of site productivity and is strongly influenced by past forest management and natural events. Forest productivity is measured in terms of wood products, mainly pulpwood and sawtimber volumes. A new trend in measuring forest productivity and utilization is currently being developed. This is the biomass concept wherein the entire tree is involved.

In Aroostook County, the average growing stock volume for all species is 17.5 cords/acre. Rough and rotten trees account for an additional 2.1 cords/acre. Softwood forests support greater growing stock, total and per acre volumes, than hardwood forests. Softwood stands average 19.7 cords/acre compared to 12.3 cords/acre for hardwoods. The average growing stock for red spruce and balsam fir, specifically is 18.5 cords/acre. Northern Hardwoods (maple-beech-birch) and aspen-birch stands maintain an average growing stock of 9.6 and 15.4 cords/acre respectively. Pure stands of paper birch support the greatest average growing stock with 30.9 cords/acre.

During 1958 to 1970, annual net growth for spruce fir in Aroostook County averaged .58 cords/acre/year. Northern hardwood and aspen-birch stands sustained an average annual net growth of 0.15 and 0.48 cords/acre/year, respectively. Although net growth of hardwoods was generally less than softwoods, paper birch was an exception with an average net growth of 0.82 cords/acre/year. The major land management company in the project area, Seven Islands Land Company, states that growth rates averaged 0.66 cords/acre/year for spruce fir in the St. John watershed before the current spruce budworm outbreak. The spruce fir bottom lands of the project area are unique and produce 0.75 to 0.80 cords/acre/year compared to the County average of 0.58 cords/acre/year. Considering the nature of the impoundment area and that much of the spruce-fir occurs on primary sites, it could be assumed that 60 percent of the spruce-fir occurs on prime sites and 40 percent on average sites. Using these proportions combined with the 0.75 cords/acre/year growth estimate for prime bottomlands and 0.66 cords/acre/year as a watershed average, the annual net growth for spruce-fir is 40,681 cords. Including the mixed forest, northern hardwood and aspen birch stands the total net growth for the 75,869 acres of forest land within the impoundments is expected to range from 41,645 to 50,351 cords per year. An additional 304 acres exists as non-stocked forest land dominated by shrubs. Eventual conversion of this additional acreage to hardwood or softwood could yield 46 to 201 cords.

Total growing stock for all species within the impoundments, including rough and rotten trees, is 1.40 million cords. In Aroostook County, total growing stock for all species is estimated at 61.9 million cords.

2.12.2.2 Proposed Transmission Route

The proposed route crosses a wide variety of forest sites and timber types. The acreages of forest land along the route are classified in eight timber types: softwood (S), hardwood (H), softwood-hardwood mix (SH), hardwood-softwood mix (HS), cedar swamp (CS), pine-hemlock (PN), poplar-birch (PB), and forest wetlands (W). Forest acreage along the proposed route is presented in table 2.12-1.

TABLE 2.12-1

ACRES OF FOREST LAND BY TIMBER TYPE[1]
ALONG THE PROPOSED ROUTE

	TIMBER TYPES[2]								
	S	H	SH	HS	CS	PN	PB	W	TOTAL[3]
Dickey-Lincoln School-Fish River	113	109	105	117	5		6	1	456
Dickey-Moose River	1,245	420	143	152	54			35	2,049
Moose River-Moore	587	855	368	387		18	10	36	2,261
Moore-Granite	25	90	32	132		24			303
Granite-Essex	47	170	261	150		1			629
TOTALS	2,017	1,647	909	938	59	43	16	72	5,698

[1]Reference: Socioeconomic Impact Study, Appendix H (DOE, 1978)
[2]Timber Type Abreviations are Explained above
[3]Exclusive of Wetlands

Timber-type acreages for the proposed route within Maine's unorganized towns were calculated using the forestland information contained on town tax maps. The Cooperative Extension Service maps of New Hampshire were used to derive timber acreages in that state. The vegetative cover information from the Ecological Resources Impact Study (appendix B) was used to determine timber acreages in Maine's organized towns and within the State of Vermont.

Current growth of forest lands along the corridor varies greatly. Maine's commercial forest land was growing at a rate of 42 cubic feet per acre per year in 1970 (forest industry lands averaged 46 cubic feet) (Ferguson and Kingsley, 1972). New Hampshire's forests grew 43.6 cubic feet/acre/year between 1958-1972 (Bernard and Bowers, 1974), and Vermont's forests reached a net annual growth rate of only 24 cubic feet/acre in 1972 (Kingsley, 1977). Data are not available for New Hampshire, but nearly 80 percent of Maine's and 66 percent of Vermont's lands are believed capable of growing over 50 cubic feet/acre/year.

Failure to achieve potential in all three states reflects overstocking with low-quality, slow-growing hardwood, and loss of intermediate growth through natural mortality in extensively managed softwood stands.

The route through northern New Hampshire passes through regions of low population and few processing facilities, but, as in Maine, the small towns in these areas depend heavily on logging for employment. The proposed route is within an economical pulpwood haul of Brown Company in Berlin, NH, and two pulp and paper mills in western Maine. Sawlog and boltwood markets are likewise within reach.

Northern Vermont's forest economy rests more on logging than on primary processing. All of the state's 1972 hardwood pulpwood cut was exported to other states, primarily New Hampshire, as was 80 percent of its softwood pulpwood (mostly to New York) (Kingsley, 1977). Table 2.14-8 indicates that much of Vermont's sawlog output also leaves the state. Timber production grows progressively less important as the route runs west from Essex County, Vermont's most heavily forested county, to suburban Chittenden.

2.12.3 Wildlife

2.12.3.1 St. John River Basin

The proposed project area serves as suitable habitat for 50 different species of mammals and numerous species of birds, reptiles and amphibians (Appendix F, CE, 1977) provides a comprehensive listing of these species.

The whitetail deer and moose attract the greatest amount of attention of any mammal in the project area. Presently, moose populations throughout the state are showing a dramatic increase, and shifts in population densities are noticeable. The State of Maine is divided into eight wildlife management units. The project area is within the State of Maine's Land Use Regulation Commission's Wildlife Management Unit (WMU) 2 (Fig. 2.12-1). In the 1940's, moose were considered rare in WMU 2. In 1971, this unit had the highest population estimate in the state, at 78 animals per 100 square miles, or 7,228 animals. A 1975 survey indicates a population of 14,607 moose in WMU 2. The increase in moose in this unit is apparently a reflection of the current forestry practices.

Density of deer within WMU 2 are the lowest in the state, ranging from 12 to 48 animals per 10 square miles. This represents a deer population of 10,000 to 42,000 animals. The project area has an estimated population of 2.2 to 8.6 deer per square mile. For a two-mile border around the proposed impoundments a population of between

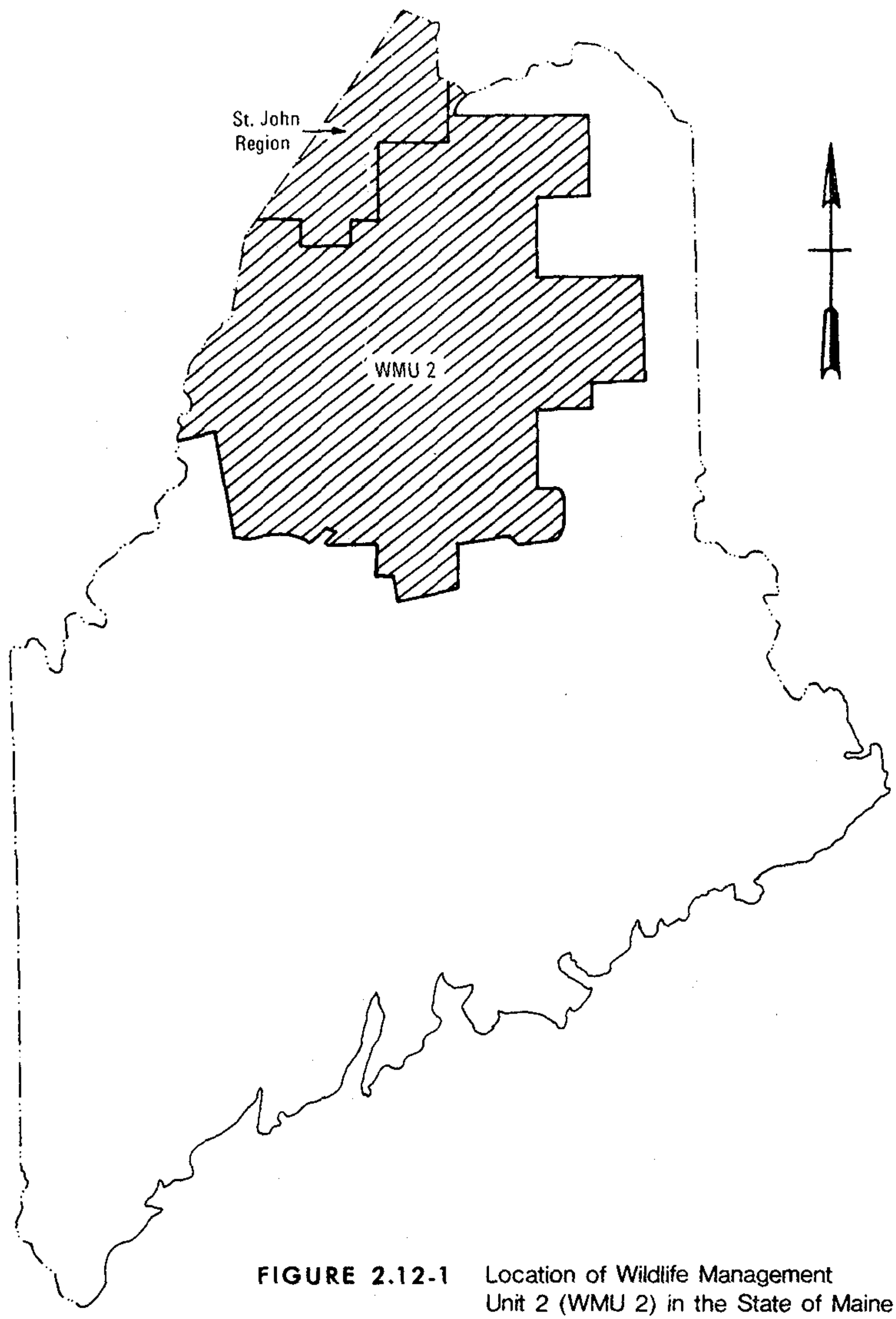


FIGURE 2.12-1 Location of Wildlife Management Unit 2 (WMU 2) in the State of Maine in Relation to the St. John Region

1,341 and 5,242 deer, or a mean of 3,241 deer, can be projected from the density. A study made to determine deer yards on the impoundment area indicated a total of 53 yards encompassing a total of 36,893 acres. This same study records a total of 74,000 ± acres of winter habitat within a survey area of 23 surrounding townships.

The most critical habitat requirement of deer in northern Maine is the winter range. Deer concentrate during winter primarily in dense spruce-fir forests. Their survival and their reproductive potential for the following spring depends upon their condition in the deer yards. Deep, soft snow presents severe conditions for deer, and the duration of winter conditions into the spring also appears to be critical.

In addition to the deer and moose, the reservoir area provides adequate habitat for nine species of bats, seven species of shrews, two species of moles, eighteen species of rodents (including the beaver) and one species of rabbit.

A total of 14 carnivores potentially inhabit the project area. All are furbearers and are currently protected by state laws which allow open trapping seasons. Among the more significant carnivores are the black bear, martin, fisher, otter and three species of cats.

The black bear is the largest carnivore inhabiting the project area. Its shy manner dictates that this species is typically found in remote forested regions where human populations are low or non-existent. In the project area, this means that bear habitat is comprised of the spruce-fir forests of the lowlands, combined with the hardwoods on the ridges in continuous large blocks of land.

The marten and the fisher are characteristic species of the spruce-fir forests of northern Maine. The preferred habitat consists of large dense coniferous forests, especially the spruce-fir type. The marten is very unsuspicious and is readily trapped, and population densities are generally low.

The fisher has been essentially an animal of dense spruce-fir forests at lower elevations, especially near water. Recently, however, this species has been expanding in numbers and is occurring in farmlands which are reverting to forest habitats, especially second-growth hardwoods as well as mature hardwoods.

The otter is the most aquatically adapted carnivore in the project area. It is seldom found far from water, especially streams. The home range of an otter varies between 15 and 100 miles of shoreline.

The three members of the cat family that potentially inhabit the project area are the bobcat, the lynx and the eastern cougar. The cougar potentially inhabits the project area, but no confirmed sightings have been made recently.

The lynx is restricted to northern Maine and is an inhabitant of the dense north woods. It is not common and no density estimates are available for this species.

The bobcat is the most common cat on the project area. This cat apparently prefers dense second-growth spruce-fir forests which are broken by openings (logging, farmland, windthrows) and by swamps.

The project area and the two mile surrounding band support a variety of birdlife. Other than the surveys for bald eagles and osprey, no intensive bird monitoring studies were conducted as part of this study. There are, however, several accounts of research conducted in northern Maine on bird diversity, bird population dynamics in association with forest types, and populations in association with insect outbreaks. Bird families most often associated with spruce-fir forests are wood warblers, chickadees, woodpeckers, nuthatches, thrushes, sparrows and finches. One of the major factors that influences the abundance and distribution of these types of birds in the project area is the intensity of spruce budworm infestations.

Aerial surveys were conducted during April, June and October, 1976 to determine the potential occurrence of eagles, osprey and peregrine falcons and other birds of special concern such as the various hawks. Biologists from the Maine Department of Inland Fisheries and Wildlife and the U. S. Fish & Wildlife Service wildlife agencies participated in the joint reconnaissance. One bald eagle was sighted during the April trip and no active eagle nests were observed. During the June survey, nine osprey, four active osprey nests and two great blue heron rookeries were observed. No nests of bald eagle or peregrine falcon were observed, nor were there any sightings of the peregrine falcon in the project area. The third survey flight was initiated to verify the existence of eagle nests reported within the project area. On October 19, a total of 5.5 hours was spent searching six reported sites. No eagle nests were confirmed.

Although the St. John watershed is within the peregrine falcons flyway, there is no recent evidence of this falcon in the project area. Several peregrines have been released in New England in an effort to re-establish potential breeders. Restocking of the peregrine in the Northeast may increase the possibility of sightings and nesting in Maine.

Little is known of the frogs, toads, salamanders, turtles and snakes of the project area. A list of species present or suspected to be present in the project area is found in Appendix F (CE, 1978). Field surveys were not conducted for these organisms and the literature is very sparse concerning the status of amphibians and reptiles in northern Maine. At present, there is no definitive list of these species or their status in Maine.

2.12.3.2 Proposed Transmission Route

The distribution of the region's wildlife conforms to three forest zones. From northern Maine to a line in New Hampshire delineated approximately by Highway 26, both the vegetative cover and wildlife are predominantly boreal. Here, spruce-fir is the common forest type. Along the Connecticut River Valley and in western Vermont, the vegetation and wildlife have southern affinities. White pine, oak, great-crested flycatchers, and rufous-sided towhees occur frequently. The third zone is transitional.

Dickey-Lincoln School to Fish River

This segment has been adequately described in the preceeding section.

Dickey-Lincoln School to Moose River

Winters along the route from Dickey to Moose River are too severe to support a large deer population. Moose, however, are at their prime, with densities of 0.95-2.33 per sq. mi. (F. Dunn 1976, MDIFW). Bear are abundant. Beaver, waterfowl, and marten are probably more common here than in any other area in Maine, and osprey and otter are relatively common.

This proposed segment of the route passes through wildlife habitat which is considered to be of moderate to high value for wildlife. It is quite remote and offers seclusion for deep forest species.

A total of eight deer wintering areas were identified along this segment. No eagle, osprey, or heron nesting sites were observed along the route. An area near the center of the route, near Big Bog, Little Bog, and Sweeney Bog, is thought to be a bald eagle nesting area, although no nests were found. Also, Trickey Bluffs, adjacent to the route near Canada Falls Lake, seem to offer good potential sites for breeding peregrine falcons, golden eagles, and other raptors.

Two species of very rare insects are known to occur in the general vicinity of the Boundary Bald Mountain area. The northern busy-katydid has been collected near the base of the mountain, and a wingless relict grasshopper, has been collected on the mountain's heath-like slopes.

Moose River to Moore

The mountainous, northern part of this route provides good habitat for bobcat and bear. Here, in Oxford County, coyotes reach their maximum abundance in Maine. This is also an important area for marten and otter. The route crosses at least two popular hunting regions: the area east of Connecticut Lakes, and Nash Brook valley. The area around Nash Brook valley supports a significant number of bear. Deer habitat, however, is not as good as on the more southerly segments.

Although Moose are scarce, they do inhabit some scattered beaver flowages and streamsides marshes. In general, the fauna along this segment is characteristically boreal south to the Umbagog-Connecticut Lakes area where it becomes transitional.

The proposed centerline crosses four deer wintering areas. Three additional deer yards were identified within the one-half mile wide route. No eagle, osprey, or heron nests were identified along the route. The steep slopes abutting Nash Stream valley probably provide good habitat for nesting raptors. The Parmachenee Lake area, located 2 miles south of the route, has one of the few heron rookeries in inland Maine. Bald eagles are thought to nest in the Chain of Ponds area, but no nests or eagles were observed.

Moore to Granite

The high proportion of regenerating forest and agricultural lands along the route makes this area productive for deer. In addition, its hardwood covered ridges provide a good food supply and denning sites for relatively high numbers of bear.

Two deer yards are crossed by the route where it follows an existing transmission line right-of-way. No eagle, osprey, or heron nesting sites were observed along the route. However, raptors are common in the area. Several species were seen in the Connecticut River Valley in June 1977. Six turkey vultures, which are uncommon in the region, were sighted.

About 1.5 miles of the State of Vermont's 1,850-acre Pine Mountain Wildlife Management Area is crossed near Groton, Vt. Due to a shortage of cover for grouse and woodcock, portions of this area have been selectively cut to improve their habitat.

Granite to Essex

This route is in a region that provides a diverse and productive environment for many species of wildlife. There are probably more game species here than in any other segment. Reverting farmland and fields interspersed with forest create prime habitat.

Deer numbers are very high along the segment. Six deer wintering areas are encountered. One of these yards is near the end of the Montpelier-Barre Regional Airport. Due to a lack of other cover, the yard is especially critical.

The western part of the segment is in an important east-west corridor through the Green Mountains. Three deer yards are crossed. The relatively low elevation may be important to wintering deer. No eagle, osprey or heron nesting sites are known to occur along this segment.

2.12.4 Rare and Endangered Species

2.12.4.1 St. John River Basin

The project area offers suitable habitat for a number of uncommon and unique floral and faunal species. There are three species of wildlife and one species of plant which are known to exist or suspected to exist in the project area that are listed as endangered as defined by the Endangered Species Act of 1973. These species are the Bald Eagle, Peregrine Falcon, Eastern Cougar and the Furbish lousewort.

2.12.4.2 Proposed Transmission Route

The proposed transmission route courses thru areas suitable for four endangered species (as listed in the Endangered Species Act of 1973). These listed species are the Bald Eagle, Peregrine Falcon, Indian myotis and the Eastern Cougar. In addition, there are several plant species proposed for inclusion on the list of Endangered Species. In Maine, there are two species of plants nominated for endangered status and five species nominated for threatened status which are known to occur in counties crossed by the proposed transmission route. There is one species of plant in New Hampshire proposed for endangered status and four species proposed for threatened status in NH counties crossed by the proposed route. Vermont has two species proposed for endangered and two for threatened status in counties crossed by the proposed route. There are other proposed listings within these states which may or may not be crossed by the proposed route. Their exact locations have not been ascertained.

Beyond the Federal jurisdiction of Endangered status, the three states crossed by the transmission line maintain lists of protected and unofficially endangered species. These lists are contained within Appendix E (DOE, 1978). In Maine, legislation has been enacted to protect endangered species and lists are pending. New Hampshire has a list of uncommon species but has no legislation protecting State defined endangered species. There is specific legislation for certain species. Vermont has enacted legislation to protect endangered species and has listed several species for protection.

2.12.5 Wetlands

The distribution of wetland types was presented graphically by the vegetative mapping of the Dickey-Lincoln project area (Appendix F, CE, 1977). In addition, a report entitled "Wetland Habitats of the Dickey-Lincoln School Lakes Project, Maine" occurs as a supplement to Appendix F (CE, 1978).

Acreages within the proposed impoundments reflect the dominance of the riverine systems in the upper or middle St. John River Valley (proposed impoundments). River systems represent 6.6% of the land area and 74% of the existing wetland and deep-water habitats within the proposed impoundment areas. Within a 2-mile border of the proposed reservoir, wetland and deep-water habitats cover 0.5% of the land area, with bogs being the dominant type (60%). The evaluation of the existing upland wetland habitat did not include beaver ponds less than 2.5 acres. Considerable beaver activity occurs on most streams within the project area, therefore, beaver ponds are assumed to be important additional wetland habitat in upland areas.

The following are significant wetland areas within the project area:

Little Black Floodplain

The Little Black floodplain from the mouth of Johnson Brook upstream to the mouth of Oxbow Brook contains diverse wetland habitats interspersed with shrub, spruce-fir, and mixed hardwood-softwood types. Along this 5-mile stretch, the river meanders with many old oxbows. Shrub swamps and meadows are dominant wetland types. The broad wetland areas are interspersed with other wetland types including shallow marsh, deep marsh, and seasonally flooded flats. Both the meadow and shrub swamp types occur as broad flood plain basins. Their water regime is influenced by seasonal flooding of the Little Black River and small streams which diffuse through the basins. Deep marshes are present at Carrie Bogan and are more numerous in the first half-mile downstream from Oxbow Brook.

Nine-mile Deadwater of the Big Black River

The most significant wetlands of the Nine-mile Deadwater of the Big Black River occur along five miles of river below the mouth of Shields Branch. This wide slow-moving portion of the Big Black River provides a deep-water habitat larger than the Little Black River. Shallow marshes, shrub swamps, seasonally flooded flats, and bogs occupy a significant portion of the floodplain. Shrub types dominated by alder and dogwood are well interspersed with wetlands. Deep marsh portions are found in the large shallow marsh types.

Shields Branch

Shields Branch meanders for approximately 3 miles upstream from its mouth on the Big Black River. Portions of this meandering floodplain are a half-mile wide with intermixed deep marsh, shrub swamp, and shrub types. Deep marsh habitats are principally old oxbows. The Shields Branch complex could be considered as a continuation of the Nine-mile Deadwater of the Big Black River.

Little Falls and Falls Ponds

Little Falls Pond and Falls Pond, excluding the river systems, are the largest deep-water habitats (70 and 263 acres) within the proposed reservoirs. These well oxygenated trout ponds have maximum depths of 6-7'. The maximum depth indicates that these ponds are approaching deep marsh habitat. Little Falls Pond is surrounded by shrub swamp. Falls Pond exists as the largest open water body with adjacent bog habitat in the project area.

2.13 Recreation

2.13.1 St. John River Basin

The upper St. John River is one of the last lengthy segments of freeflowing, near wilderness rivers remaining in the densely populated northeastern United States. Although the presence of roads and on-going activities prevent this area from being called a true wilderness, it has the potential for remaining an informal, "semi-wilderness."

Difficult access has and should continue to protect the remote character of this area. This combination of factors makes the project area unique as a wilderness type recreational opportunity. The remoteness and relatively undisturbed character coupled with some of the most challenging whitewater river segments in the Northeast makes a canoe trip down the Upper St. John River a memorable experience. Canoe usage visitor day figures for 1975 show that 81% were accounted for by non-residents who must travel considerable distances to reach the area.

Existing recreational use in the project area is typically non-mechanized and extensive in nature. Primary activities include hunting, fishing, camping in a semi-wilderness setting, and canoeing. The many whitewater rapids offer varied challenges to canoeists. Day activities are of lesser significance and include picnicking, hiking, sightseeing, etc.

Table 2.13-1 shows that recreational use in the project area during 1975 totaled 17,867 visitor-days.

TABLE 2.13-1

1975 Recreational use by Activity for the Project Area
(Visitor Days)

	Total	Camping	Fishing	Hunting	Canoeing	Day Activity
Non-Resident	9,442	817	1,592	4,914	1,881	238
Resident	8,425	892	2,821	3,378	447	887
Total	17,867	1,709	4,413	8,292	2,328	1,125

Fishing and canoeing usually begin in May, peak in June, then taper off through the summer. Fishing ends early in August with the closing of the legal trout season. Canoeing usually becomes difficult after late June as the river levels drop.

Camping use of the project area occurs throughout the May-November period in conjunction with other activities or as a separate activity, and dominates recreational uses during July and August. The North Maine Woods Association maintains 74 campsites within the project area, and nearly all of the camping activity in the project area occurred in these campsites.

There are no formal hiking trails within the project area, but abandoned logging roads provide easy access into different areas. Hikers are generally seeking remoteness and are often involved in nature study or photography. Most participants in these day-use activities are local residents who travel over public roads to the northern portion of the project area to engage in their activity.

The recreationist seeking a top quality fishing experience can find ample opportunities on the Upper St. John River. The project area includes 113 miles of major streams (St. John River, Big Black River, and Little Black River), and 950 miles of named and unnamed tributary streams. Several moderately large lakes (Depot and Negro lakes, Big East Lake, and the Falls Ponds), many smaller ponds, and innumerable beaver impoundments occur.

Hunting is the most important recreational activity in the project area. Non-residents accounted for 59% of the hunters. Although it is the most important recreational activity, hunting pressure is light when compared to the rest of the state.

Other recreational resources that are just outside and adjacent to the proposed project area should also be considered in the description of recreational resources of the region. These include the Allagash Wilderness Waterway and the Fish River Chain of Lakes.

2.13.2 Proposed Transmission Line

Dickey-Lincoln School to Fish River

This route segment offers a variety of developed and undeveloped recreational opportunities. The route frequently encounters linear recreational features. Eight maintained and nine unmaintained snowmobile trails are crossed or occur within the one-half mile wide route. These trails are used by several clubs in towns along the route. Routes 161 and 11 are fall foliage routes. Route 11 is also a sightseeing route and designated scenic highway. The Allagash, St. John and Fish Rivers, popular canoeing routes, are crossed or are in close proximity. The Allagash River, designated the Allagash Wilderness Waterway, is crossed near its confluence with the St. John River. A hiking trail along this river would be crossed by the route.

Dickey-Lincoln School to Moose River

This portion of the route is in a remote area, and convenient vehicular access to many areas does not exist. Thus, the type of recreational sites encountered are both undeveloped and of semi-wilderness character.

Moose River to Moore

The diversity of recreational resources contained within this segment is due in part to the fact that the segment spans all of three states -- Maine, New Hampshire and Vermont. It ranges from a remote and undeveloped recreational base to one which is developed and highly accessible.

A number of recreational features were identified in that portion of the route between Moose River and the Connecticut Lakes area. Moose River and Kibby Stream, which are under study by the DOI for potential inclusion in the national wild and scenic river system, are crossed. Route 27, which follows the North Branch of the Dead River, is a designated scenic highway and is crossed by the route. This highway is aligned with the Arnold Trail, a national register historic site, which also is crossed by the route. Several water features used as canoe routes are crossed. A Great Pond, (Twin Island Pond), is adjacent to the route. Hiking trails are encountered in four locations, as are three proposed hiking trails. A parcel of public land is crossed in the area west of the Kibby Mountains. One maintained and 12 unmaintained snowmobile trails were identified along the route.

Developed recreational sites were encountered from the Connecticut Lakes to the Groveton area. The Connecticut Lakes Region is west of the route. This area is noted for its waterbased recreational opportunities. The route viewshed encompasses First Connecticut Lake and lands adjacent to Lake Francis which includes the Lake Francis Wildlife Area. In this same general area, Magalloway Mountain, which is west of the route, provides a vantage point for hiking trails.

The route crosses Highway 26 near Kidderville, N.H. This highway is designated as a fall foliage and sightseeing route. Four maintained snowmobile trails are also encountered. East of the route in the Colebrook area are Coleman State Park, Diamond Ponds and Dixville Notch. A recreational resort complex near Dixville Notch features a championship golf course and a skiing area.

The route south of the Colebrook area is close to Nash Stream and crosses the Upper Ammonoosoc River. These water features are recommended for inclusion in the New Hampshire wild and scenic river system and currently provide a variety of recreational opportunities.

From Groveton to Moore Substation, a portion of the route is close to the Connecticut River, an important canoeing route which is being studied for inclusion in the national wild and scenic river system. Routes 3, 102, and 135 in New Hampshire and Vermont are along this river and provide access to this area. These roads are used as fall foliage, sightseeing, and bicycling routes.

After crossing the Connecticut River, the route is located in a more undeveloped area. Recreational features encountered include hiking trails, a snowmobile trail, several bodies of water, and facilities which accommodate use of these waters. The Connecticut River and Moore Reservoir are the most heavily used waters.

Moore to Granite

This segment of the proposed route follows an existing transmission line. Public recreational lands are crossed. The route crosses the southern end of the Groton State Forest and the northern edge of the Pine Mountain Wildlife Management Area.

The route crosses several linear recreation features. These include the Connecticut River, a major canoe route; Route 135 in New Hampshire, a scenic road, fall foliage and bicycle route; Route 5 in Vermont, a scenic road; the Waits River and several other fishing streams; the Bailey Hazen Military Road, a historic site; and Highway 110, a fall foliage route and proposed scenic road.

The area in which the route crosses the Connecticut River is a proposed recreation and conservation area.

Granite to Essex

The recreational environment along this segment gets its identity from the Winooski River Valley. The Winooski River and its tributaries combine to form a dramatic landscape for recreation. The route generally parallels the Winooski River and the major highway network in its valley. These highways integrate a number of recreational resource areas around Barre, Montpelier, Middlesex, Duxbury, Waterbury, Bolton, Jonesville, and Richmond. Major recreational features within the areas include Mt. Mansfield State Forest, Camels Hump State Park, the Long Trail, and a variety of scenic, sightseeing, and fall foliage routes, bicycle routes, and canoeing and fishing streams.

The proposed transmission route crosses a number of linear recreational features. These include Stevens Brook and the Dog River, fishing streams; Route 14, a scenic road and bicycle route; Route 89, a scenic road; Route 12, a bicycle route; and several snowmobile trails. The areas penetrated by the proposed route include Barre City Forest, Berlin Municipal Forest and a natural area valued for its geological significance.

Two important recreational features in the viewshed of the valley include Mt. Mansfield State Forest and Camels Hump State Park. Camels Hump, elevation 4,083 feet, serves as a natural area. It is the highest point along the proposed route. The Long Trail is crossed in the Town of Bolton near Jonesville. This trail is maintained by the Green Mountain Club and extends 263 miles from the Massachusetts to the Canadian border. Other features along the route include Bolton Falls, a natural area; a small ski area with a memorial ski jump; streams designated as having high recreation potential; several historic sites; bicycle routes, and a proposed recreation and conservation area in Waterbury, south of Mansfield State Forest.

2.14 Aesthetics

2.14.1 St. John River Basin

Northwestern Maine and the headwaters of the St. John River are considered by most to be remote and wild. However remote and wild it is, it cannot be classed as a wilderness due to the presence of roads and logging activities. Thus, it is viewed as a semi-wilderness and as the largest stretch of uninhabited forestland in the northeast. The upper reaches of the river during the summer is wide, shallow and boulder strewn. It flows gently through a landscape of low topographic relief. There are few signs of man's presence on the river above the confluence of the Big Black River and the St. John. This aspect of remoteness and lack of mans' impact elicits a strong positive aesthetic response.

The landscape is relatively untouched and wild when viewed from the river. There is little topographic relief in the upper portions of the river. Further downstream, the relief becomes more pronounced as Dickey and Allagash are approached. In this region steepsided, irregularly shaped hills and ridgelines confine the river to a narrow valley. The predominant vegetation is a mixture of spruce, fir and northern hardwoods. Speckled alder and redosier dogwood line the river and act as a transition from the river to the forest. This transition presents a relatively unmarked panorama of forest and river. The perceptual experience is dampened to some extent where man's activities have scarred the river banks and adjacent hills.

Although there may be differences of opinion concerning the aesthetic quality of specific places within the proposed project area, the area has an overall positive appeal. Its remoteness and natural setting are key factors which bring about this assessment. The scarcity of relatively untouched land in the northeast heightens the aesthetic appeal of the area.

Evidence of former settlements and man can still be seen today at Ninemile Bridge, Seven Islands, Simmons Farm, Castonia Farm, Ouellette Farm and the U. S. Forest Service and U. S. Immigration Camps. These remains serve as a reminder of the activities of the white man who once settled along the river. Remnants of our earliest settlers are still in evidence with the many Indian names in the region such as Pocwoc, Chementicook and Chemquassabamticook. These historical remnants add much to the favorable aesthetic experience.

2.14.2 Proposed Transmission Route

Dickey-Lincoln School to Fish River

The existing aesthetic quality of this segment is one of a moderately pleasing nature. There are some very scenic areas and those which are not, but they are few in number.

Dickey-Lincoln to Moose River

This portion of the route traverses wildlands which are considered aesthetically pleasing. It has a gently rolling topography covered by mature forests, marshes, rivers and beaver ponds.

Moose River to Moore

This segment passes through scenic mountainous terrain containing forests, lakes and rivers. It is considered to be among the more aesthetically pleasing areas and serves as a region of recreational activities.

Moore to Granite

This segment is similar to the preceding, but contains more roads and evidence of human activity. The proposed route follows existing rights-of way in many sections.

Granite to Essex

This segment goes through populated areas with the proposed route following existing right-of way. The Winooski River Valley offers the best visual landscape.

2.15 Noise

2.15.1 St. John River Basin

A detailed report describing the methodology used and the results obtained in the assessment of ambient and predicted noise levels is presented in Appendix H (CE, 1977).

The project area can be described as a very quiet natural area, remote from any major industrial activity. However, it is subject to high traffic noise levels (L_{10} and L_{eq} sound levels were 55 to 65 dBA) along the main road. Noise sensitive areas consist of low density residential areas in the villages and widely spaced residences along the main road. The estimated yearly average day-night equivalent sound level (L_{DN}) for all noise sensitive areas is 60 dB due to the close proximity of traffic to all residences. This L_{DN} decreases to 40 dB at 600 feet from the main road and to 30 dB in the timberland area.

2.15.2 Proposed Transmission Route

The proposed transmission route follows a course which takes it through quiet natural areas. With the exception of the Granite to Essex segment and to some extent the southern and western end of the Moore to Granite segment, there are no major human developments. The level of ambient noise would be higher in the more urban areas of the proposed route than the natural areas.

2.16 Substation Sites

The areas where new substation facilities would be developed have been located. However, exact sites have not been selected and therefore no contacts with property owners have been made. Dickey, Lincoln School, and Moose River substations would be developed for this project and would require sites.

2.16.1 Dickey Substation

The proposed site for Dickey Substation is on the west bank of the Allagash River southwest of the Dickey Dam site. It is west of the Michaud Tote Road, which follows the Allagash River. The site is located on a gentle slope with deep glacial till deposits. The vegetative cover at the site, except for the landfill, is a regenerating forest of mixed hardwoods and softwoods.

Wildlife habitat values for game species and species of special concern are average around the site. The potential for encountering rare plant species is average and the area is presently fairly remote. The site area is designated as a management district by the Maine Land Use Regulation Commission. Visual landscape quality in the area of the site is rated as moderate, and visual site attractiveness is low. No historical sites are known in the area proposed for Dickey Substation, nor in its viewshed.

2.16.2 Lincoln School Substation

The proposed Lincoln School Substation site is near the Lincoln School Dam site. It is south of Route 160 about 2 miles west of St. Francis, Maine. The site is presently used to grow potatoes. About six single family residences are within a distance of one-half mile. The area is unclassified with respect to proposed land uses.

Wildlife habitat values are minimal for most species. The remoteness value for the area is average. Visual landscape quality at the Lincoln School site is very high, as is its site attractiveness. A 1.5-mile stretch of Maine Highway 161 crosses the viewshed. Several residences and two medium density clusters of residences stand along the highway near the site. No known sites of potential historic or archaeological significance occur at or close to the proposed site.

2.16.3 Moose River Substation

The proposed site for Moose River Switching Station is west of U. S. Route 201, 3 miles north of Moose River, Maine. Jackman, Maine is about 4 miles to the south along Highway 201. Topography at the site is gently sloping. Surficial deposits at the site are glacial tills. The depth to bedrock is shallow.

The East Branch of Sandy Stream is 0.1 mile west of the site. Vegetative cover at the site is mixed mature forest with softwoods predominating. Wildlife habitat values in the area of the site are average, as was the probability for encountering rare plants. The site is classified as a management district by the Maine Land Use Regulation Commission.

Visual landscape quality at the site is very high. Site attractiveness is also high. The viewshed contains Highway 201 and a residence on the highway. No known historical or archaeological sites exist in the site area. An intensive survey would be conducted prior to site development.

2.16.4 *Existing and Non-Federal Planned Substations*

Existing substations which are proposed for use are: Fish River Substation, Moore Substation and Granite Substation.

Fish River Substation is on Maine State Highway 161, 1 mile south of Ft. Kent, Maine. The substation, owned by Maine Public Service Company, takes its name from the Fish River, which is one-fourth mile west of the site.

Moore Substation is on the New Hampshire side of the Connecticut River at Moore Dam. This facility would be expanded into an adjacent area to accommodate the proposed facilities.

Granite Substation is located on Baptist Street, about 1.5 miles south of the Barre Granite Quarry. The City of Barre is 5 miles to the north.

Additional facilities would be constructed adjacent to the existing substation. Based upon site characteristics, expansion is proposed within a pasture.

At Essex Substation, the terminal facilities for the Granite-Essex line would be located within a substation presently planned for construction by Vermont Electric Company.

The site of the proposed Essex Substation is on the south bank of the Winooski River, 1 mile southeast of Essex Junction, Vermont. This facility is scheduled for construction by Vermont Electric Company. It is assumed the substation will include adequate space or facilities for this project.

2.17 Microwave Sites

Eleven microwave stations are required for the proposed transmission system. A general description of the location of each microwave site follows.

2.17.1 Pennington Mountain

The site is on Pennington Mountain, about 8 miles south-southeast of Eagle Lake, Maine and east of Highway 11. The elevation of the summit is about 1,540 feet, this is 600 to 700 feet above the surrounding area.

2.17.2 Ashland

This site is located about 2 miles southwest of Ashland on Young Hill in Garfield, Maine. Its elevation is about 790 feet, or about 250 feet above the surrounding area.

2.17.3 Oakfield Hill

This proposed site is about 4 miles south of the town center of Oakfield, Maine. The proposed site is at an elevation of 1,200 feet, which is 600 to 700 feet above the surrounding area.

2.17.4 Hot Brook

This site is adjacent to an existing microwave station approximately 3 miles southwest of Danforth, Maine. It is on the northwest side of Highway 169. The site at an elevation of 850 feet is 350 to 400 feet above the surrounding area.

2.17.5 Bagley Mountain

Bagley Mountain contains an existing microwave station. This site is 5.5 miles northeast of Lincoln, Maine, south of Bagley Mountain Road. The summit of Bagley Mountain is 850 feet high, or some 450 feet higher than the surrounding area.

2.17.6 Ferry

This site, an existing microwave station, is located 5 miles east of Milo, south of Piscataquis River. The site is approximately 450 feet in elevation and 250 feet above the surrounding area.

2.17.7 Black Cap

This site, an existing microwave station, is 3 miles south-southwest of East Eddington. The summit ridge ranges from 950 to 1,022 feet in elevation and is 600 to 700 feet above the surrounding area. The ridge has several other tower structures. The site has access from East Eddington by way of Black Cap Road.

2.17.8 Oak Ridge

This proposed microwave site is on Oak Ridge along the eastern town line of Shirley, Maine. The elevation is approximately 1,660 feet, which is 250 to 400 feet above the surrounding area. It is situated about 3 miles from the nearest paved road and 5 miles from the Town of Greenville. A powerline right-of-way crosses the eastern flank of the mountain.

2.17.9 Parlin

This site is on a 2,600-foot mountain at the boundary intersections of Jackman, Long Pond and Misery Gore. The summit area is located about 1 mile east-northeast of Jackman Field on U. S. Highway 201 and 7 miles southeast of Jackman, Maine. The topography is mountainous. It appears that access would be from U. S. Highway 201 near Jackman Field.

2.17.10 McLean Mountain

This site is located approximately four miles south-southeast of St. Francis at the southern end of the McLean Mountain Ridge Line. The summit is 1824 feet elevation with relief of approximately 800 feet. The entire summit area is heavily wooded.

Access to the summit can either be made from the Back Settlement or the McKinley School area of St. Francis and will be steep.

2.18 Lincoln School Passive Repeater Site

This site is located on the northwest side of the St. John River opposite the Lincoln School area. The summit has an elevation of 1120 feet and is 400 feet above the river. Access to the site is limited by both the St. John and St. Francis rivers. Several private logging roads enter the area from the southwest across the St. John Bridge at Dickey approximately 8 miles upstream of the site.

2.19 Future Environmental Setting Without the Project

2.19.1 St. John River Basin

2.19.1.1 Topography and General Geology

No drastic changes would be expected without the project throughout the estimated life of the proposed project. A continued erosion and stream meandering would continue the present geomorphic cycle. This would cause a gradual modification to an already mature topography.

2.19.1.2 Ground Water

Future demands for ground water would be similar to the demands today due to the sparse nature of settlement, climatic conditions and vast areas which are unsettled. Radical shifts or expansions of human activity are not foreseen. Any new or accelerated activity concerned with land and mineral resource exploitation would bring with them the problems of pollution control and waste disposal. This would affect the ground water in those areas of exploitation.

2.19.1.3 Hydrology

There are no appreciable changes expected in the hydrology of the upper St. John basin in the reasonably near future. Changes in forestry practices could conceivably have minute effects which would be localized and of an unknown duration. Clearcutting would temporarily effect local runoff patterns and reduce the evapotransporation. This would cause earlier snowmelt and runoff but would be temporary and as soon as ground cover re-established itself, the condition would be attenuated.

2.19.1.4 Socio-Economic

Demography

Population dynamics of the Immediate Impact Area and Service Impact Area through 1990 is expected to continue the slight growth trend set in the early 1970's, with the population reaching about 7,200 and 20,500 respectively. The county is expected to have 105,000 people of whom 11,000 will be pre-schoolers, 27,000 school age, 57,000 aged 18-64, and 10,000 senior citizens.

Social and Cultural Characteristics

It is assumed that social and cultural characteristics will remain similar to present characteristics. Smaller families may, however, improve per capita income and unemployment figures. Increasing educational levels and immigration from more urban places will change cultural values slightly.

Infrastructure

It is postulated that as demand for services increase due to enlarged populations, towns will be more able to afford their own personnel. It is further postulated that the cooperative systems may not then be as useful. More solid waste systems will be needed as will medical facilities, but schools should remain adequate.

Housing

With normal growth, the greatest impact will come in the form of increased pressure for housing and its supportive services. Much housing which is substandard will require replacement.

Labor and Employment

It is likely that the total labor requirements for the wood products industry will grow to 5,000 by the year 2000. Skill surpluses, shortages, levels of unionization, and wage bargaining will all undergo change. Increased activity in the pulp and paper industry will enlarge the professional and technical capabilities of Aroostook County labor force since a large percentage of its personnel are highly skilled. If county food processors and farmers adjust to changing consumption patterns, variations in the food and kindred products sector will be minimized. Growth in the trade industries will be in the relatively unskilled occupations, providing balance to the manufacturing sector. Trade is expected to employ 6,500-7,000 people by the year 2000. It is assumed that the services sector will increase modestly the labor skill/unskilled ratios for the county. The agriculture sector is also expected to increase and transportation and public utilities, finance, insurance, and real estate and public administration will show modest gains.

Agriculture

As marginal potato land continues to go out of production, fallow land will continue to have production possibilities. In this manner, the one-crop economy of Aroostook County may be able to become more diverse and therefore more stable. Soil productivity could increase with diversification. Also, linkages between grains and livestock, just beginning in the county, could materialize. As in the past, the pace of change between the present and future conditions will be dependent on the crop budgets influenced by outside market forces as well as internal management efforts in the county.

Farms will be consolidated into fewer units of larger size. Better conservation practices, marketing system changes, and improvements in technology are apt to improve yields and stabilize production.

Forestry

Demand for forest products in Aroostook County is expected to increase rapidly. Based on historical evidence, as more wood is harvested, there will be a gradual shift away from labor intensive forest harvest practices to more mechanized operations. This may not decrease total employment as intensified forest management practices require additional workers.

Figure 2.19-1 shows spruce-fir timber inventory (supply) reaching parity with projected annual cut (demand) near 1990. Due to the complex array of variables the actual parity year is impossible to predict. The graph does however show the overall effect of the budworm on supply conditions. The graph is based on the following assumptions: (1) prior net growth of 0.5 cords/acre; (2) present mortality of 0.45 cords per acre; (3) the spray control program exists similar to todays; and (4) annual cut follows past trends. Annual removals are from the Maine Timber Cut Report, 1971-1977. The 1971 spruce-fir inventory was based on data in The Timber Resources of Maine.

Industry

Little growth is expected in the contract construction sector. Manufacturing will continue to be important primarily as an extension of its existing scope. A potential market of over two billion bd-ft of wood currently exists in New England alone. There is also potential for expansion in the finished and semi-finished wood products industry. Paper consumption is expected to increase therefore the pulp and paper sector should increase its share of Aroostook County's manufacturing product value. Food and kindred products are expected to continue having yearly fluctuations but long term stability. Other sectors are expected to show little change.

2.19.1.5 Cultural Resources

The future of known cultural resources without the project is dependent upon three basic factors: (1) the geomorphic cycle, (2) present and future forest management practices, and (3) the continued public accessibility to known archaeological sites. If the project area continues along its present geomorphic cycle, many known and recorded archaeological sites would be further damaged as a result of continued ice and highwater erosion and natural stream meandering. Should present forest management practices continue or increase, there would be continued degradation of these sites. Lumbering practices without a cultural resource assessment could impact archaeological sites located in sensitive areas such as forested riverine terraces and wooded stream confluences. Continued recreational use of the St. John River for canoeing and/or camping would continue to impact the publically known Big Black archaeological site presently listed on the National Register of Historic Places. Through the course of time, these three phenomena are expected to uncover and thereby disturb hitherto unknown sites.

2.19.1.6 Aquatic Ecosystem

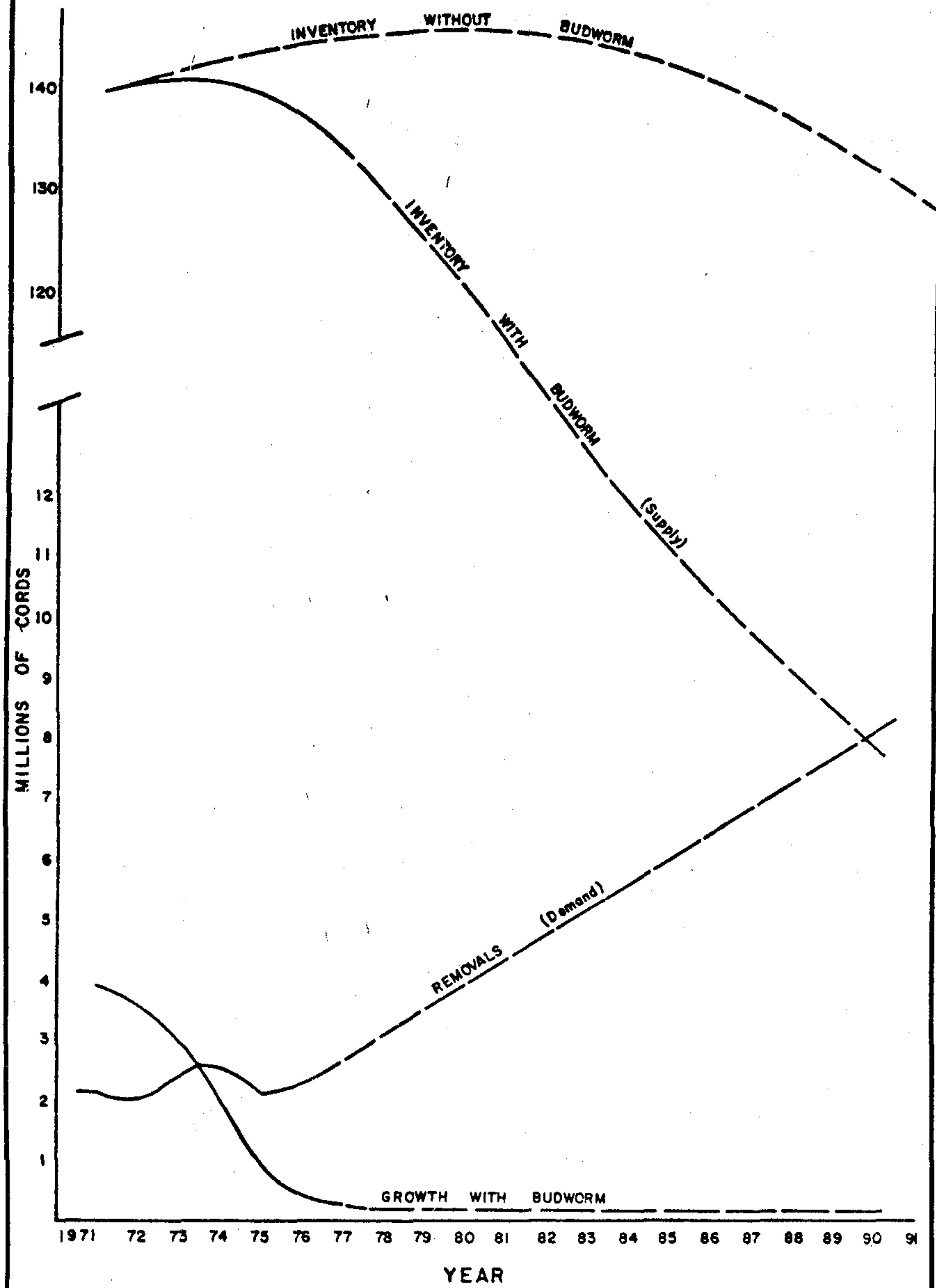
The state of the aquatic ecosystem within the project area through the projected 100 year life of the proposed project is directly dependent upon socio-economic considerations. The assumption that the area will continue to be managed for timber is made for this projection.

Timber management is not expected to remain at its current level. The stream systems are subjected to periodic sedimentation resulting from road building and other harvesting activities. Streams in the watershed would continue to produce short-lived, early maturing populations of brook trout. This is provided that exploitation remains at the same levels. Little East Lake and Rideout Pond and the shallower trout lakes such as Falls Ponds and several of the Negro Lakes are currently marginal as trout water. It is possible that they will mature to the eutrophic level and make them less valuable as trout water. If timber exploitation increases, there would be a corresponding increase in the frequency of disturbances associated with logging operations. As the percentage of the land being harvested for timber at any given time increases, the magnitude of the "indirect" effects such as decreased water holding ability and associated increase in runoff would be expected to take their toll on the quality and quantity of cold water stream habitat available.

There are indications that the techniques employed by the logging operators today will change. That is to say that whole tree harvesting will become the way in the future. This concept of total biomass utilization will result in a reduction of energy input to the aquatic ecosystem. Slash will be utilized and removed and thus this form of organic material will be transported away from the area. Any reduction in energy input to the aquatic ecosystem would result in a reduction of energy output and production. The use of potentially damaging toxicants as pesticides has been largely restricted by law. If for any reason it were deemed necessary to reinstate the use of these toxic substances, the stream community structure and long term production would be altered.

2.19.1.7 Terrestrial Ecosystem

Several factors including future forest management, natural events and institutional considerations may interact to influence the future terrestrial ecosystem of the project area. Portions of the St. John River could be registered as critical areas under "An Act Establishing a State Register of Critical Areas" (State of Maine Legislature, 1974). Critical areas are those officially recognized areas protected through conservation which contain natural features of state significance, including exceptional plant or animal habitat. Along the river-land interface, the calcareous ledges and gravelly banks provide a unique habitat for several rare and unusual plants. The St. John River above the Town of Allagash was considered for inclusion under the "Wild and Scenic Rivers Act" (U. S. House of Representatives, House Bill 270, January 4, 1977).



EFFECT OF SPRUCE BUDWORM ON MAINE SPRUCE-FIR INVENTORY.

FIGURE 2.19-1

Major influences on the structure, composition and diversity of both wildlife and forest communities will depend on future forest management practices. Currently, the potential timber productivity of the project area is not fully utilized. Increased demands for wood products and intensification of the selective cutting system in a 20 year cycle should promote increased productivity as overmature and rough growing stock is removed. Although the major land managing company in the project area foresees continuation of the selective cutting system, future demands could change management goals. The use of whole tree harvesting and chipping is increasing. The use of trees down to 1 inch diameter at breast height by chipping in the forest would result in yields as high as 3 cords/acre/year. Regardless of the forest management practices that may be utilized in the future, the value of the forest resources in the project area will continue to increase.

As the structure and composition of the vegetative community changes, the wildlife populations will respond to those changes in habitat. The intensification of forest management practices is expected to reduce the extent of mature spruce-fir and hardwood forests in the project area. In general, those species which are representative of mature forests (e.g. spruce grouse, red squirrel) will decline in numbers whereas those species typically called edge species (e.g. white-tail deer) will be favored. The protection of deer wintering areas and the enforcement of existing state regulations pertaining to cutting practices within such areas should also enhance the region's deer population. Reduction of mature spruce-fir stands is also expected to reduce spruce budworm populations, which in turn will reduce those species of birds (e.g. warblers) that show a marked correlation with insect populations. Little change is expected in the amphibian and reptile populations which presently exist on the project area.

2.19.1.8 Recreation

The demand for recreational activities of the type presently found in the project area will increase with population growth, increasing amounts of leisure time, and increasing disposable income. Additionally, the number of recreationists desiring "wilderness" or "semi-wilderness" activities will increase significantly. This would accompany a dwindling resource capable of providing such activities.

Because the area is presently privately owned and managed primarily for its forest products, the extensive road network designed for access to the forest resources would undoubtedly be expanded. This in turn should provide greater access for recreationists seeking to utilize the area. At the present time, the North Maine Woods Association is developing a detailed recreational management plan. This plan is being designed to improve campsites and to direct the distribution of recreationists to reduce conflicts with timber harvesting operations. Their plan emphasizes the maintenance of the unique semi-wilderness recreation experience, concurrent with the timber industry. Improved management techniques and a growing awareness of the value of the project area's resources will serve to improve the quality of the primary pursuits of camping, hunting, fishing and canoeing.

The recreational demand projections without the proposed project are found in Table 2.19-1. An explanation of the development of these figures including the methodology and criteria by which the figures were generated is contained in the revised Appendix G (CE, 1978).

2.19.2 Proposed Transmission Route

Those areas crossed by the proposed route have exhibited slow growth. Thus, one could assume existing conditions closely reflect future conditions barring unforeseen changes in the growth patterns of Northern New England.

The discussion on planned land use in section 3 and Appendix I (DOE, 1978) indicates the goals of future land use planing along the proposed route. As these projections are considered to be as valid as any, it is assumed that they reflect the future environment without the project.

TABLE 2.19-1

Recreation Demand Projections

VISITOR DAYS OF RECREATION
WITHOUT
DICKEY-LINCOLN SCHOOL LAKES

	1975	1980	1985	1988	1990	1995	2000	2005	2010	2015	2020	2025	2030
Camping	1,700	2,000	2,300	2,500	2,600	2,900	3,200	3,500	3,900	4,300	4,700	5,200	5,700
Fishing	4,400	5,100	5,900	6,500	6,900	7,900	9,200	10,700	12,400	14,400	16,600	19,300	22,400
Hunting	8,300	8,700	9,200	9,400	9,600	10,100	10,600	11,200	11,800	12,400	13,000	13,700	14,300
Canoeing	2,300	2,900	3,700	4,300	4,600	5,300	6,100	7,100	8,200	9,600	11,100	12,800	14,900
Day Activities	1,100	1,300	1,500	1,600	1,700	1,800	2,000	2,200	2,500	2,700	3,000	3,300	3,700
TOTAL	17,800	20,000	22,600	24,300	25,400	28,000	31,100	34,700	38,800	43,400	48,400	54,300	61,000

NOTE: 1975 is the base year for which the visitor day projections were made, with the 1975 visitor days being the actual recorded visitation by the North Maine Woods Association.

SECTION 3

LAND USE

3.00 RELATIONSHIP OF THE PROPOSED PROJECT TO LAND USE

3.01 Land Use Characteristics

3.01.1 St. John River Basin

Commercial forests cover 86% of Aroostook County. Timber production is the dominant land use in the unorganized townships. Much of the woodland is held in undivided and in-common ownership, a pattern dating back to the 1820's. There are very few small private operators harvesting in the north woods of Maine.

Agriculture is the second largest land use in Aroostook County, consuming 12.8% of total area of the county. The cropland is concentrated in the incorporated townships of the eastern part of the county. From 1959 to 1969, many farms were consolidated. This served to decrease the numbers of farms, but the acreage in production remained approximately the same. Potatoes are the principal crop, followed by peas, buckwheat and sugar beets.

A very small portion of the county's land is devoted to non-timberland industrial uses. Manufacturing, especially the processing of forest and agricultural products, is mostly centered around population centers.

There are eight towns with populations over 2500 and they consume a relatively insignificant portion of land in comparison to the county's 6805 square miles. Residential land use is distributed along highways and secondary roads. Aroostook County had a population density of 13.8 people per square mile in 1970. About 65% of the households in the immediate impact area are located on lots of one acre or less.

A relatively small percentage of Aroostook County is devoted to transportation. U.S. Route 1 is the principal highway artery. Three railroads have a combined trackage of about 400 miles. Analysis indicated that given the existing traffic, one accident occurs approximately every ten years on the five grade crossings.

Loring Air Force Base is the only significant military installation in the county. It occupies 9700 acres, much of which is undeveloped.

Most of the open farm and woodland within Aroostook County is available for outdoor recreation. The North Maine Woods (NMW) is a partnership of landowners, managers, and natural resource agencies which formed to organize and control the uses of their land (see Figure 3.01-1). In 1974, 51,673 people used NMW lands, mostly for hunting and fishing.

Zoning controls are in effect on more than 75% of the land in Aroostook County including the proposed Dickey-Lincoln School project site. Shoreland zoning is in effect throughout the state.

Presently, the Maine Land Use Regulation Commission (LURC) has planning and zoning powers over all of Maine's plantations and unorganized townships. Sixty-nine percent of Aroostook County's land is under LURC's control, including the area of the Dickey-Lincoln site. LURC has adopted rules and regulations designed to enforce its Comprehensive Land Use Plan. These rules and regulations contain a section on land use standards for flood prone area protection. One of the stated purposes is to regulate certain land use activities in flood prone areas to comply with the cooperative agreement between LURC and HUD regarding the regulation of land use so that flood insurance can be made available to persons in flood prone areas. These rules and regulations become effective when an official Land Use Guidance Map is certified by LURC. Until that time, there are interim standards which are presently in effect. Table 3.0-1 provides a synopsis of LURC's major policies, zoning districts, development potential and need for protection.

3.01.2 Proposed Transmission Route

Most of northern and western Maine and extensive parts of northern New Hampshire and Vermont are large, private landholdings. In Maine, the landholdings of International Paper, Scott Paper, Georgia-Pacific, Seven Islands, Diamond International, Saint Regis, and Great Northern Paper companies are within the transmission line route. Several of these timber companies, plus Brown and Wagner Woodlands Company, have holdings in New Hampshire and Vermont.

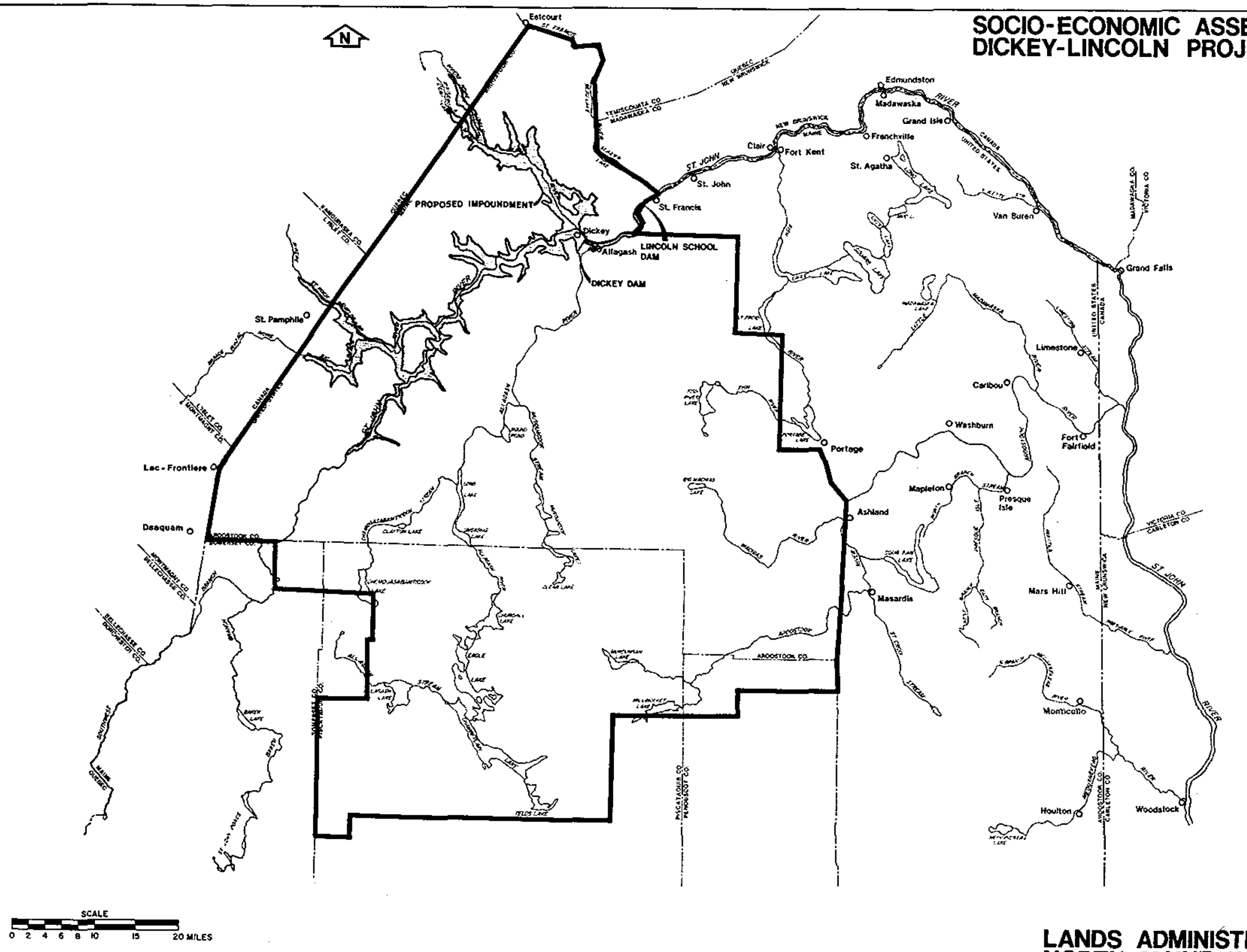
The pattern of parcel densities in the transmission line study area (including the proposed route) reflects low densities in the managed forest of northwestern Maine, northern New Hampshire, and Vermont (1-8 parcels/sq. mi., 0-7 people/sq. mi.). Parcel densities are medium in the south and east where agricultural areas are encountered (8-28 parcels/sq. mi., 7-50 people/sq. mi.). At the southern and the western extremes of the study region, parcel density is high, reflecting such urban areas as Bangor, Waterville, and Lewiston, Maine; Plymouth and Newport, New Hampshire; and Ludlow and Montpelier, Vermont (greater than 28 parcels/sq. mi., and greater than 50 people/sq. mi.).

The White Mountain National Forest in northern New Hampshire and western Maine covers 735,598 acres. It is the largest public landholding in New England and one of the most heavily used forests in the national forest system. It provides a variety of outdoor recreation opportunities as well as timber for wood product industries.

Presently, the only lands legally established as Indian reservation lands governed by tribal councils within the study area are a series of islands within the lower Penobscot River of Maine comprising the Penobscot Indian Reservation. A lawsuit in behalf of several Maine Indian Tribes is pending in Federal courts. The outcome of this suit could increase the extent of Indian lands within Maine.

State-owned lands along the transmission route are extensive but scattered. However, the size of each is generally less than 1000 acres.

SOCIO-ECONOMIC ASSESSMENT DICKEY-LINCOLN PROJECT



LANDS ADMINISTERED BY NORTH MAINE WOODS

FIGURE 3.01-1

TABLE 3.0-1

POLICY AND DISTRICT INTER-RELATIONSHIPS

MAJOR POLICIES	DISTRICTS	DEVELOPMENT POTENTIAL	NEED FOR PROTECTION
	PROTECTION	LEAST	MOST
Protect the Natural Resources	P-WL Wetland P-FP Flood Prone P-SG Soils and Geology P-RR Remote Recreation P-MA Mountain Area P-FW Fish & Wildlife P-WS Watershed P-AR Aquifer Recharge P-CA Conservation Area P-UA Unusual Area P-RS Rivers & Streams S-SL Shoreland	. No new buildings permitted (except in special circumstances) . Other development strictly regulated	. Needs most protection because of hazards of flooding, erosion, sedimentation and potential harm to water quality, wildlife habitat and special recreational resources
	MANAGEMENT		
Maintain the Wild Character of Certain Large Areas	M-NC Natural Character	. Forest and agricultural management related development permitted . All other development limited and strictly regulated	. Needs high degree of protection to ensure conservation of wild character
		MOST	LEAST

POLICY AND DISTRICT INTER-RELATIONSHIPS (Cont.)

MAJOR POLICIES	DISTRICTS	DEVELOPMENT POTENTIAL	NEED FOR PROTECTION
	MANAGEMENT	LEAST	MOST
Support Multiple Land Use Management	M-HP Highly Productive M-Gen General	. Forest and agricultural management related development permitted . Low density residential development permitted on large lots	. Needs intermediate degree of protection to ensure that the resource continue to produce a sustained yield
	DEVELOPMENT		
Encourage New Development Within Reasonable Limits	D-PUD Planned Unit Development D-NR Non-Residential D-Gen General	. Any development permitted within limits of district and resource capability	. Needs least protection because only those sites most suitable for development will be so zoned
		MOST	LEAST

Included within this designation are state parks, state forests, state universities, public lots (Maine), and wildlife management areas.

Institutional/semi-public lands are owned by semi-public or non-profit educational organizations or institutions. They are not extensive and are mostly in southwestern Maine and neighboring parts of New Hampshire and Vermont.

Urban centers of populations are those which have more than 1000 inhabitants and cover an area more than 1 mile square. They occur largely along the southern and eastern edges of the transmission line study region. "Ex-urban development" is a land use classification used to describe areas that are less densely developed than urban centers. Many are linear and occur along transportation corridors. Ex-urban development is found mostly along the southern and eastern edges of the study region.

Town centers are those areas and populated places with the least development which include small towns and villages appearing on USGS quadrangle sheets or official highway maps. Town centers are numerous, except in the northwest portion of the transmission study region.

Open agricultural lands are presently used for agriculture or have potential as croplands. They are distributed through the transmission route in a pattern corresponding to that of ex-urban development lands. They occur along the eastern border of Maine, throughout southern portions of the study region, along the Connecticut River, and throughout all but the northernmost portion of Vermont.

Four interstate highways occur in the transmission study region; I-95 runs north-south through Maine, I-93 runs north-south through New Hampshire along the Merrimack River, I-91 follows the Connecticut River in a north-south direction within Vermont, I-89 runs northwest from Bow, New Hampshire to Burlington, Vermont.

A fairly well-developed system of state highways exists throughout most of the region. However, portions of northwestern Maine are served solely by Maine Highway 201.

There are many local and timber haul roads throughout the region. Most areas are accessible by vehicle.

The northern portion of the New England electric power grid is in the study area. Existing transmission lines tend to be oriented in a north-south direction and most of them are in the southern and western portions of the transmission line study region.

The segment from Dickey to Fish River is in a heavily forested area. Two lumber mills occur along the route between Lincoln School and Fish River. Roughly 90% of the acreage on the route is being used for timber production.

Most residential structures in the segment are along Highway 161 which follows the St. John River, and Highway 11, located along the Fish River near the eastern end of the segment. Agricultural areas, used largely for hay fields of row crops, also occur frequently within the route. In relation to the entire proposed transmission route, 39% of the row crops are on this segment.

Highway 161 is located at the southern edge of the route near St. Francis. The Bangor and Aroostook Railroad is located north of the transmission route between St. Francis and Fort Kent, Maine.

Land use along the segment from Dickey to Moose River is almost all commercial forestry. Most of the land along the route is privately owned, with large blocks of land held by timber and paper companies. Mining quarries located along the route furnish material to surface timber haul roads.

Roads within the area crossed by the route are unpaved and are used for commercial timber operations. The segment contains 112.4 miles of unsurfaced road within its one-half mile width.

The major land use from Moose River-Moore is forestry. Residential areas occur in the Colebrook area where the segment passes through agricultural fields west of Kidderville, New Hampshire, and again along the Connecticut River near Groveton, New Hampshire.

Residential dwellings are evenly distributed from Moore-Granite. Areas traversed are more highly populated than the previous segments. Agricultural areas are secondary in acreage to forest lands.

The Granite-Essex route is relatively close to several town centers. The route passes one-half mile south of Barre, Vermont, within one-fourth mile of the villages of Middlesex, Bolton, Jonesville, and Richmond and one-half mile from the north-south runway of the Barre-Montpelier Regional Airport. Interstate Highway 89 is crossed twice with this route being located near the highway for most of its length.

3.02 Future Land Use Characteristics Without the Project

3.02.1 St. John River Basin

Land use is not expected to change significantly in Aroostook County. Ownership of forest lands should remain basically the same but increased cutting, better use of wood cut, and active reforestation programs will likely occur. Land values should continue to rise. Land in agricultural production is expected to decline; but that which remains will be more diverse in terms of crops and there could be an increase in livestock production.

No major changes are expected in the industrial or residential area. The county should retain its rural character. Public roads are expected to generally remain limited to the eastern corridor although an east-west highway has been considered. Recreation demands are expected to increase as shown in Table 2.19-1.

The land will remain subject to periodic flooding except for the section of Fort Kent where a dike has been constructed. This dike provides limited protection. More formal land use planning will need to be instituted and improved water quality will increase the use of the St. John River Basin.

The management of the lands in the unorganized towns by LURC is expected to continue. The result of this management is expected to develop a balanced usage of the forest and wildlife resource.

3.02.2 Proposed Transmission Route

The probability of accurately projecting future land uses to the same degree of accuracy as existing land uses is impossible. However, some land use goals have been identified by the North Country Council, Inc.[1]

The North Country Council's Regional Land Use Element (May 1978) identifies three general policies which should be considered in regional land use decisions:

1. To recognize those agricultural and forestry enterprises best suited to conditions of the North Country and to cooperate with agriculture and forestry agencies to assure that agriculture and forestry will make their maximum contribution to the total economy.

2. To place special emphasis on the preservation and conservation of prime agricultural land in the North Country.

3. To recognize and maintain the desirable qualities of the unique natural resource heritage of the North Country.

Practically all of the land which the proposed route and its alternatives would cross are described by the North Country Council's Land Use Element as Rural Resource or Conservation Areas. The goals and policies for these two areas, while directed in large part to smaller-scale land use decisions, also serve as a basis for the evaluation of large projects such as the Dickey-Lincoln School transmission lines.

In Rural Resource Areas, the overall goal is the maintenance of residential use of low or scattered density and the planning of new development to maintain the rural integrity of the land. There are three goals which guide the use of Conservation Areas:

[1]Correspondence from North Country Council, Inc., dated 14 July 1978 to the Department of Energy through the State of New Hampshire, Office of Comprehensive Planning.

1. To conserve agricultural, forest, water, historic and cultural resources, and other natural resources for long-term production and utilization.

2. To protect unique or fragile natural features and resources from uncontrolled or incompatible development.

3. To limit development of those areas which because of locational or natural characteristics pose significant hazards or serious environmental problems if subjected to uncontrolled development.

Even with the most current planning tools and documents on hand, many variables may cause the actual land uses to deviate from the proposed plan. Comprehensive plans and future land use planning documents were obtained from all agencies and authorities along the proposed corridor. In several cases, no plan or maps were available, only policy statements. There was no consistency of terms and definitions for the maps and categories nor were any of the plans specific in the same terms as existing land use. This is to say that categories were general, such as zoning districts, and were not site specific.

No timetable for implementation of the plans exist and there is no guarantee that all or any part of the plans will be implemented. Many existing forest lands are zoned for some type of low density residential use. If the transmission line were built today, however, the impact would be on forest land use, not residential. Whether or not the transmission line constitutes a conflict with nonexistent but potential housing is far too complex a question for this study. Certainly, the answer lies in the specifics of the property, type and quality of housing, and the question of how realistic is the probability of development of the future land use.

Those areas crossed by the proposed transmission route have exhibited slow growth. Thus, one could assume existing conditions closely reflect future conditions barring unforeseen changes in the development patterns of northern New England.

3.03 Land Use Characteristics With the Proposed Project

3.03.1 St. John River Basin

Construction of the project would require the relocation of 112 residences in the Town of Allagash and 44 in St. Francis. This relocation would require lands currently being used for other purposes. St. Francis already owns a 100-acre site that is available for relocation of displaced residents should the proposed action be approved for construction. St. Francis town officials have recommended that a portion of this 100-acre site be used by construction workers for residences.

It is reasonable to expect that the surrounding towns would enact various zoning ordinances in response to the added demands on their lands by the construction force and to the added flood protection. Floodplains development could be expected, thereby taking agricultural lands out of production and putting them into commercial and residential use. However, land is plentiful and floodplains could be protected from development if proper zoning were instituted.

Project implementation would take 88,000 acres of forest and wildlife habitat out of existence. Further impacts upon current land use would result from the loss of private logging roads and existing access to harvestable timber. Approximately 38,737 acres of land would be acquired as project lands beyond the requirements of the reservoirs. This land would be controlled and therefore the use placed upon it would differ from its current usage. Additional lands may be required for fish and wildlife mitigation. This land would be managed for that purpose and as such could differ from current or future use.

Project implementation is in direct conflict with private land use patterns for the above stated reasons. A severance fee would be included in the land valuation to compensate for this loss of land and access. It also conflicts with the State of Maine's LURC designation of this area as a wildlife habitat unit. Fish and wildlife mitigation measures would mitigate a portion of this impact. The remainder of the lands would be classified for a different use. The loss of continuity and rather sizable change in environment would have to be re-evaluated and new plans and policies would have to be drawn up by LURC. The zone surrounding the lake that would be in Federal ownership would not be subject to LURC due to Federal sovereignty. However, land use plans for the Federal lands would be coordinated with LURC to conform to its standards wherever possible.

Usage of Rte. 161 between Fort Kent and the project area would experience a temporary growth in traffic of about 200-300%. The rail traffic may not increase substantially, but the probability of accidents at the 5 grade crossings would be expected to go from 1 every 10 years to 1 in every 5 years.

3.03.2 Proposed Transmission Route

When a powerline is built, the right-of-way is committed to use for electric power transmission. The land can no longer be used for commercial forestry, nor can structures be built on it. Land areas limited by their use for electrical facilities could be restored to former uses, or used for some new purpose, should the line be decommissioned and removed. Some land uses, such as agriculture, can co-exist with the facility during its operational life.

The transmission line would directly affect land use. Land occupied by a tower would usually be unavailable for other uses. The proposed line also would place certain limitations on land use underneath the conductors.

If possible, existing roads would be used for construction and maintenance. Where existing roads could not be used, temporary or permanent access roads would be built. In many cases, these roads would be located within the cleared right-of-way, effectively reducing their impact on neighboring land uses. After a line is constructed, temporary access roads would be restored as nearly as possible to their original condition. Permanent roads would be constructed and maintained to prevent soil erosion and deterioration of the roads. Land occupied by permanent access roads would not be used for other purposes. Occasionally, access roads would lend themselves to land use patterns of adjacent property such as providing access to farm fields, timber, or to public land for recreation. Land uses for utilities are compatible with the transmission lines. At some segment locations, vegetation could often block views of the proposed line thus reducing the impact on land uses.

Long-term indirect effects on adjacent land uses may occur through short-term use of the land for powerline rights-of-way. Future transmission lines will likely involve using existing rights-of-way. This could tend to discourage the development of residences, commercial establishments, scenic areas, and public parks which may be incompatible with transmission lines. Thus, the corridor could limit opportunities for short-term use and long-term productivity of adjacent lands.

The transmission lines would preempt use of the land at substation and tower sites and along permanent access roads. Small areas of agricultural land would be taken out of production for tower footings. Timber production and sap extraction would be eliminated along cleared rights-of-way and permanent access roads. Up to five residences may have to be moved from their present locations.

The proposed plan would restrict land use within the right-of-way to types compatible with high voltage transmission lines. Indirect effects on the future development of adjacent lands are possible.

A discussion on land use views impacts is found in Appendix I (Department of Energy, 1978).

3.04 Reconciliation of Land Use Conflicts With the Proposed Project

Reservoir

Conflict	Reconciliation
-LURC's designation of the project area as a wildlife habitat unit	-F&W mitigation measures. -Remainder of area to be classified for a different use. -The loss of continuity and rather sizable change in environment would have to be re-evaluated and new plans and policies would have to be drawn up by LURC.
-Direct conflict with private land-use patterns	-A severance fee would be included in the land valuation to compensate for the loss of land and access.

Reservoir (Cont'd)

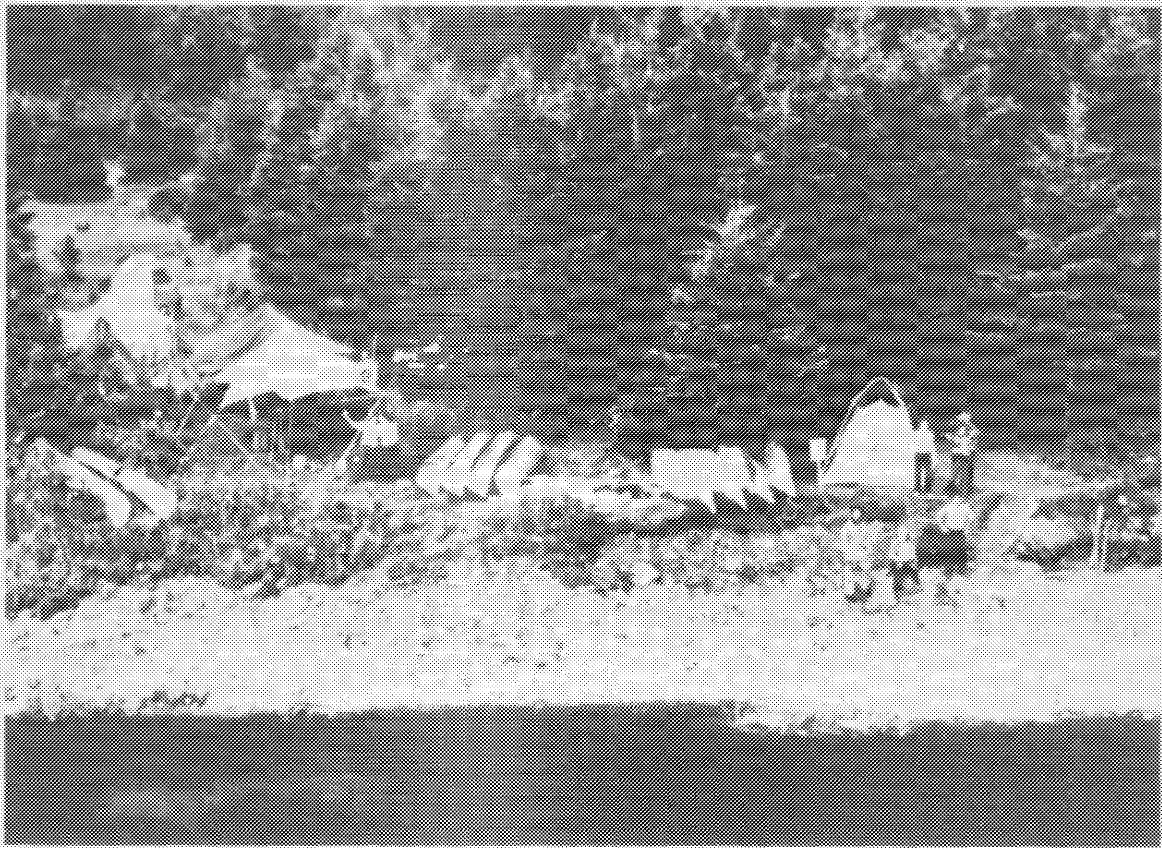
Conflict	Reconciliation
-Relocation of 112 residences in the Town of Allagash and 44 in St. Francis	-Ownership by St. Francis of a 100-acre site for displaced residents.
-Floodplain development	-Enactment of various zoning ordinances. -Corps/community planning to identify acceptable relocation sites.

Transmission Line Route

Conflict	Reconciliation
-Conflicts with croplands and disturbed agricultural lands	-Compacted soils would be loosened, and topsoil stockpiled and replaced in areas of excavation. Ruts and other disturbed surfaces would be filled or smoothed. Fences and gates would be repaired or installed to prevent escape of livestock and to control unauthorized entry or damage to agricultural lands.
-Direct conflicts with private land use, i.e., removal and/or damage of structures, access to residential properties and landowners' rights	-Landowners would be compensated for the rights granted in the right-of-way easement. -Owners would be compensated for homes and other structures which must be removed from the right-of-way. -If any water supply facilities, fences, driveways, and landscaping are damaged, repairs would be made or the owner compensated for the loss. -Construction forces would make provisions to assure that access to residential properties is maintained.
-Logging Activities	-The use of existing roads by contractors would be scheduled so as not to interfere with logging activities.

Transmission Line Route (Cont'd)

Conflict	Reconciliation
-Existence of access roads	-Access roads developed to construct transmission facilities would be left for use by landowners after construction if so requested.
-Land usage within the right-of-way	-The cultivation of Christmas trees, nursery stock, or other low growing species within the cleared right-of-way would be encouraged. Maintenance of the right-of-way would be designed to be compatible with the owner's plans. Care would be taken to minimize the number of towers in cropped areas.
-Conflicts with croplands and other disturbed agricultural lands	-Permanent access roads would not be constructed in croplands-restricted to periods of least impact to standing crops or to soils. Any cropland disturbed would be restored to as near its original condition as possible. Noxious weeds would be controlled around the towers in cooperation with the landowner.



SECTION 4

IMPACTS

4.0 IMPACTS

4.01 Topography

4.01.1 St. John River Basin

The reservoir pools reduce the stream bed area available for erosion during high flow conditions. The amount of sediments that would be released downstream would be trapped within the proposed reservoirs. The pool areas would permanently inundate the steep banks along the present stream courses which periodically slough debris into the streams. Some of the existing terraces and scarp surfaces at reservoir level in the Lincoln School pool may become unstable because of fluctuating levels in pool elevation. These critical slopes would be investigated and measures would be taken to minimize the occurrence of slides during the reservoir operation.

The reservoirs would create a large dendritic pool not unlike those formed during the last glacial recession.

4.01.2 Proposed Transmission Route

Natural erosion in agricultural areas would be increased by transmission line towers and poles that become obstructions to tillage. They tend to force tillage operations into the same pattern year after year. Water collects at the same points and runs off in a more or less permanent pattern, deepening its channels.

The potential for erosion along the proposed route has been evaluated in terms of the erodability of the soil and the degree of the slope. (Information on the measurement of erosion is contained in Appendix F, DOE, 1978). Table 4.01-1 shows the miles of slight, moderate, and high erosion potentials on the route.

TABLE 4.01-1

EROSION POTENTIALS FOR TRANSMISSION ROUTE

	Slight		Moderate		High	
	(Miles)	(%)	(Miles)	(%)	(Miles)	(%)
Dickey/Fish River	19.5	67%	7.2	24%	2.7	9%
Dickey/Midpoint (Moose River)	86.7	72%	31.5	27%	0.4	1%
Midpoint/Moore (Moose River)	70.7	52%	60.8	45%	4.6	3%
Moore/Granite	23.6	63%	14.0	36%	0.5	1%
Granite/Essex	21.4	49%	15.5	36%	6.4	15%

Most line segments have only slight to moderate erosion potential.

Four percent of the route has a high erosion potential.

4.02 Geology

4.02.1 Bedrock Geology

4.02.1.1 St. John River Basin

The project would require approximately one-half million cubic yards of select rock for slope protection. The impact of removal of quantities of rock such as these would produce an excavation of approximately 150 yards square by 50 yards deep. The excavation would be dressed to leave a minimal visual impact.

4.02.1.2 Proposed Transmission Route

Construction of the proposed transmission facilities will have little impact on the geologic structure of the region. Some geologic features, such as unstable areas, landslides, are of considerable importance in planning, constructing, and operating transmission systems. Shallow bedrock, steep slopes, and wet soils require special designs.

4.02.2 Surficial Geology

4.02.2.1 St. John River Basin

Inundation of the valley would cover the existing deposits of sand and gravel. The proposed project would add to the deposition of fine grained materials such as sand, silt and clay. It would change the location of coarse deposits to areas higher up on the valley walls. It would be expected that limited areas of new sand and gravel deposits would be established.

Approximately 57 million cubic yards of earth would be removed from the reservoir areas for the construction of the project structures. Present studies indicate that sufficient material is available from areas which would be inundated. Final design would designate the actual limits for each of the areas of required excavations for construction materials.

4.02.2.2 Proposed Transmission Route

No direct impacts upon areas presently utilized for extraction of minerals or aggregates would occur as a result of the proposed transmission route. Areas in which such deposits exist but as yet are not mined would not be adversely affected. In most circumstances, the facility may remain in place while mining activities occur around it. In other cases, the capital investment required to mine such resources under most circumstances so overwhelms the cost of moving a transmission line, that the value of the underlying resource is not considered to be altered.

4.03 Seismology

4.03.1 St. John River Basin

An increase in seismic activity as a result of reservoir loading and water fluctuation is likely to occur. Reservoirs such as Dickey are not the cause of earthquakes, they are the triggering mechanism for the release of already present earth stresses. Analysis of potential seismic forces from a smaller magnitude fault such as the inferred Hunnewell fault indicate that greater forces would be produced by the major fault in the St. Lawrence Valley attenuated over the distance to the dam. Hence, the maximum credible earthquake for which the dams are designed is greater than any possible earthquakes that may be triggered by the reservoir.

4.03.2 Proposed Transmission Route

Transmission facilities may be subjected to seismic activity. However, the transmission lines, the substations, the right-of-way clearings and the access roads do not influence the frequency or intensity of earthquakes. Earthquakes of low or medium intensity would have little or no effect on the line. Substations would also be designed to withstand earth movements. Projections of earthquake magnitudes and their probable effects are calculated and provisions to withstand such forces are incorporated into substation designs.

4.04 Groundwater

4.04.1 St. John River Basin

The lakes caused by the Dickey and Lincoln School dams would inundate the river valleys to elevation 910 and 620 respectively. Unconsolidated deposits within the reservoir and some rock at the valley walls would be submerged permanently. The higher water surface would provide some recharge to the groundwater through hydraulic connections with permeable zones. The water table would readjust and rise adjacent to the reservoirs. Groundwater would have a limited demand around the reservoir; residents affected by the project are to be relocated. A higher water table around the pool above the Lincoln School would alter drainage in the overburden and affect the use of water at shallow depths such as in dug wells and septic systems.

4.04.2 Proposed Transmission Route

A possible impact on the groundwater could result from excessive applications of herbicides along the right-of-way. Water-soluble, persistent herbicides could be transported through the upper soil horizons to the water table below causing some amount of local contamination. Because of the relatively small size of the right-of-way as compared to the size of major aquifers, this is not expected to cause a significant problem with existing groundwater quality.

4.05 Hydrology

4.05.1 Reservoir Characteristics

The reservoir would utilize the upper 42 feet of storage for flow regulation for at site and downstream power generation. This represents approximately 2.9 million acre-feet of storage. The lake would normally experience about a 22-foot drawdown during the annual operational cycle. Maximum drawdown would be attained during the winter months when the snowpack accumulates and runoff is at a minimum. The reservoir would then refill during the April-May runoff. Pool fluctuations during the summer months would approximate two feet (June through October) and generally less than two to three inches daily.

Lincoln School Reservoir would serve to partially reregulate releases from Dickey Reservoir, which would vary from zero to 40,000 cfs. Lincoln School would also provide afterbay storage for pump back to Dickey Reservoir. Generating discharges from Lincoln School would vary from 1000 cfs to 16,000 cfs. Some spillway discharge would occur occasionally during snowmelt runoff. Such excess discharge would originate mostly from the relatively uncontrolled Allagash River watershed. The maximum operational range provides 58,000 acre-feet of reregulating storage. Typical operating conditions for the inital installation would produce fluctuations of about 12 feet weekly with daily fluctuations expected to be six to seven feet. Maximum rates of change within the reregulating reservoir would be about one foot per hour.

4.05.2 Downstream Flow Regime

Late summer and winter months normally experience low discharges. The demand for electrical generation in New England is nearly the converse of this phenomenon, with the greatest loads occuring in winter and minimal loads in April and May. Consequently during the winter months, releases from Dickey storage would be maximum, and in the springtime, releases would be minimal. The result would be an average augmentation of about 7000 cfs in downstream flows during the normally low flow winter months and an average reduction of approximately 15,000 cfs during the normally high flow spring months. Peak floodflows would be reduced by approximately 50 percent at the downstream damage center of Fort Kent. Downstream flow augmentation would result in about a one foot increase in the annual average river stage during the summer to as much as four feet during the winter months.

Lincoln School would not provide a steady discharge rate. Releases would vary depending upon power demand. Changes in river stage near the Town of Fort Kent would normally not exceed three to four feet on a daily basis or five feet on a weekly basis. Maximum hourly rate of change would approximate 1.5 feet per hour near the mouth of the St. Francis River and about one foot at Fort Kent. These effects would be further attenuated downstream to Grand Falls. At this point, the New Brunswick Electric Power Commission dam would further reregulate discharges in connection with normal power operations.

A more detailed discussion of the expected project operation, pool fluctuations and resulting flow regimes is contained in Design Memorandum No. 3, "Hydropower Capacity and Project Economics", USCE.

4.05.3 Proposed Transmission Route

The nature of the transmission lines is such that natural drainage patterns usually would not be altered. Vegetation cover would be changed within the right-of-way but tower and microwave construction would not affect existing drainage patterns to a significant degree.

Clearing of vegetation along the transmission right-of-way would create a change in surface runoff conditions. Surface runoff for a given rainfall event would be greater along the right-of-way due to the loss of vegetation cover that previously intercepted precipitation and slowed runoff. However, the area occupied by this right-of-way would be small in relation to the remaining watershed area except in the smallest of first order stream watersheds.

Significant streamflow alteration would only occur when there are major changes in land cover in a watershed. This would not be the case as a result of transmission line construction. Access roads, however, can impact runoff and streamflow. Inadequately designed stream crossings, can impede the natural flow characteristics of a stream by creating a retaining structure with under-sized culverts and extensive fill. This is easily mitigated by proper design and installation of drainage facilities.

4.06 Water Quality

The results of extensive physical and mathematical model investigations of the hydrodynamic and thermal stratification characteristics of the tandem lakes are presented in detail in Design Memorandum No. 5, "Water Quality", USCE.

4.06.1 Reservoir Water Quality

4.06.1.1 Dickey Lake

Construction of the project would create two impoundments, Dickey and Lincoln School Lakes. Dickey Lake would have a dendritic shape with three major arms, created by the St. John River, the Little Black River, and the Big Black River. Its maximum depth would be 325 feet near the dam, the mean depth would be 78 feet and the detention time would be 2-3 years. Lincoln School Lake would be elongate impoundment with no major arms, and would have a maximum detention time of several weeks. The lake's ultimate maximum depth would be 80 feet, and its mean depth would be 33 feet.

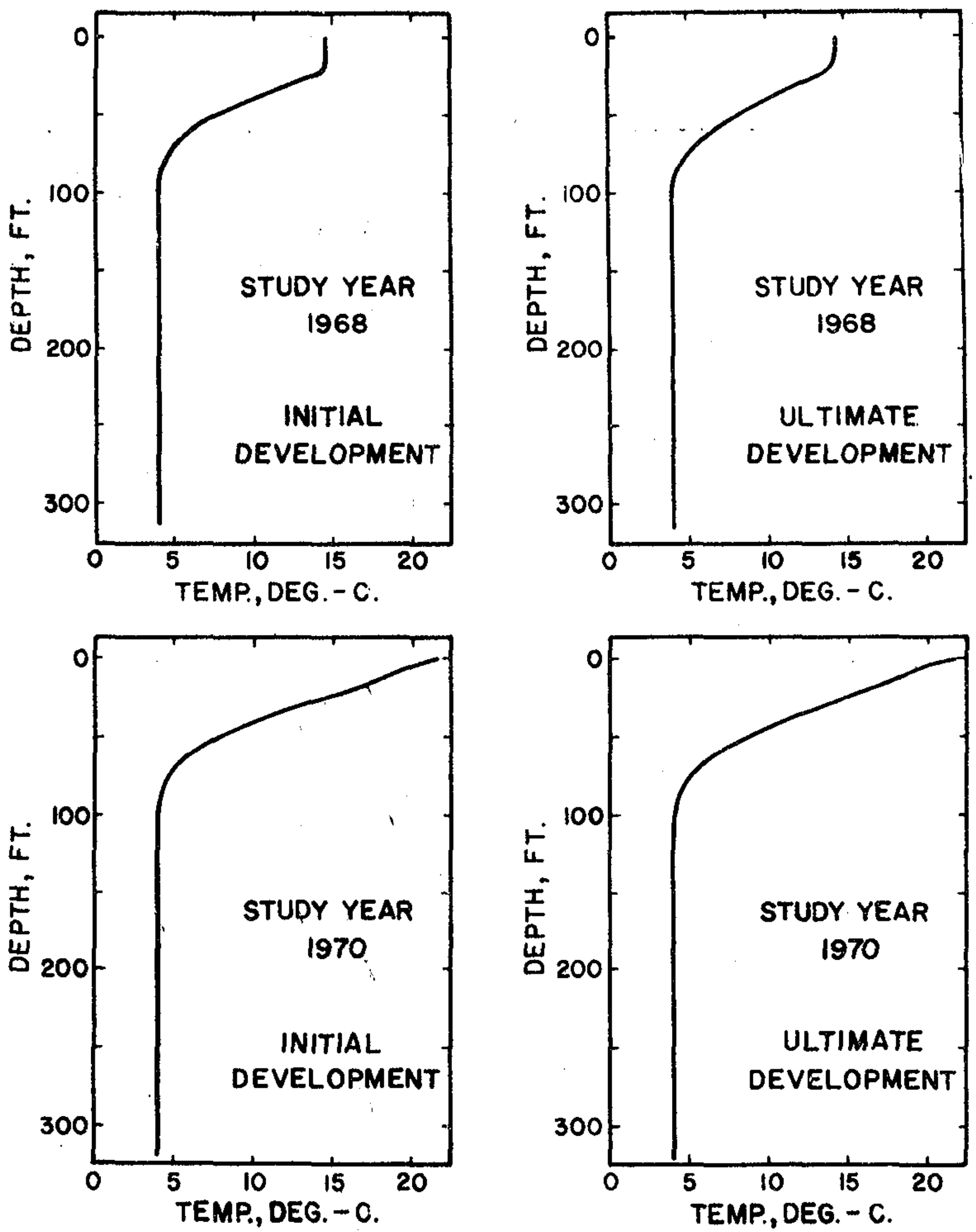
As a consequence of the project, the existing terrestrial environment in the project area would be converted to an acquatic environment through inundation. Differences would occur in Dickey Lake between the quality of water in the coves at tributary inflow points and that of the main body along the St. John River arm. Lincoln School Lake would be totally mixed with homogenous quality conditions.

Dickey Lake would exhibit temperature-induced density stratification as a result of weather conditions. Temperature simulations indicate that the strongest stratification conditions would exist in mid-summer when temperature difference as large as 36 Farenheit degrees (20 C^{o}) would exist between the surface and bottom waters. The temperature of the lower 200 to 250 feet of the lake would remain near 39^{o}F (4^{o}C) throughout the year, while mid-summer surface termperatures would range from 57^{o}F-75^{o}F (14^{o}C-24^{o}C). The location of the thermocline would vary from 5 feet to 45 feet below the surface. Simulated temperature profiles representing the most wide range of conditions on August 15 from six historical years studied in the temperature regime analysis are presented on Figure 4.06.1.

During the filling period of Dickey Lake, biogenic meromixis could develop. Initiation of pumpback operations immediately after filling would destroy any such condition. The lake would experience two turnover periods per year (spring and fall) and the turnover would encompass the entire depth of the lake. Following the fall turnover period, an ice cover would form and would last until the following spring. Thus, the lake would exhibit a reverse stratification pattern. Temperatures would range from 32^{o}F (0^{o}C) at the surface, through a zone of increasing temperature, to as high as 39^{o}F (4^{o}C) in the major portion of the lake's depth. As a consequence of winter stratification, the temperature of outflows from Dickey Lake would be several degrees warmer than natural conditions. This warm water would preclude freezing and would be transferred downstream through Lincoln School Lake, and perhaps, below Lincoln School Lake to the St. John River.

Dissolved oxygen concentrations would be near 100 percent of saturation in the upper portion of the lake and at or about 6 mg/l in the lower portion at the end of the summer stratification period. The turnover periods would be of sufficient duration to satisfy the oxygen demand of the bottom waters and maintain a high dissolved oxygen level through transfer at the air-water interface. Some shallow coves may exhibit dissolved oxygen concentrations approaching 2 mg/l during the summer due to warmer bottom temperatures and associated greater biological activity, and due to the morphometry of the cove bottom.

Dickey Lake would have a 96 to 98 percent sediment trapping efficiency because of its long detention time. Coarse-grained particles (bed load) would be deposited rapidly near each inflow point, while finer material (suspended sediment) would be transported farther out to other portions of the cove and arms of the lake before being deposited. Daily suspended sediment discharge data were collected by the USGS at the streamflow gaging station on the St. John River at Dickey for the period October 1975 through September 1976. This data disclosed a suspended sediment load of 36.5 tons per square mile per year. Using these loading rates and assuming the bed load portion of the total



DICKEY LAKE
TEMPERATURE PROFILES
FOR AUGUST 15

FIGURE 4.06-1

sediment load was equal to the suspended sediment load, it was determined that 0.13 percent (10,000 acre-feet) of the total volume of the lake would be lost due to sediment accumulation in 100 years.

The true color of Dickey Lake would depend on the amount of dissolved solids in the water column. The main determinant, in this case, is dissolved organic matter. When stabilized, the surface waters would vary seasonally at different lake locations from greenish-yellow to greenish-blue. The true color should not interfere with post-stabilization phytoplankton productivity. Color would increase with depth during summer stratification with maxima occurring in the area of the thermocline due to a complex stratification of algae, bacteria and colloidal and dissolved materials.

The ionic composition of Dickey Lake would depend upon the constituent loadings from precipitation and the biogeochemical processes of the watershed and the lake. The anion composition of Dickey Lake would tend toward a concentration order (decreasing) of bicarbonates, sulfates and chlorides. The cation composition would tend toward an order (decreasing) of calcium, sodium, magnesium and potassium.

The most important heavy metal from an environmental health standpoint that would be present in Dickey Lake is mercury. Suspended material has a greater adsorptive capacity than coarser bed load material and would tend to carry the mercury to the deeper portions of the lake before deposition occurs. During circulation periods, mercury in the lake would be distributed throughout the water column and would become available for biological uptake. During stratification periods, much of the mercury would precipitate to the lake bottom, some of which would be buried in the bottom sediments and would be lost to further resuspension. The cold temperatures of the lake bottom would not favor the conversion of mercury compounds to mercuric ions or their subsequent methylation.

Nutrients would be introduced into the lake by tributary inflows, sediments, precipitation and leaching from the inundated soils and vegetation. Predictions of the natural loadings of nitrogen and phosphorus from the watershed and precipitation lead to the conclusion that Dickey Lake would be a phosphorus limited, oligotrophic water body. Leaching from the soils and vegetation would be greatest during the filling stage and for several years after until chemical stability is achieved.

The greatest impacts from reservoir clearing practices would result from the leaching of nutrients from inundated soils and vegetation and the decomposition of organic material. These occurrences would cause short-term enrichment of the lake and an anaerobic condition in the lake bottom. The releases of water from the bottom of the lake through the diversion tunnel during filling would withdraw some of the nutrients and organics from the lake, thereby causing a short-term effect downstream. Water temperature would be the major factor controlling leaching and decomposition rates. As the lake fills and thermal stratification develops, colder water at the bottom of the lake would bring about a reduction in these rates. In six to nine years after filling, the initial mass of organic substances is expected to stabilize and Dickey Lake would reach chemical stability.

Nitrogen supersaturation is expected to occur in Dickey Lake as a result of natural processes. If, with the onset of thermal stratification, the rate of warming of the surface layers of the lake exceeds the rate of nitrogen gas loss, nitrogen in the zone below the influence of thermal circulation and wind mixing would supersaturate as a consequence of the hydrostatic pressure. The major portion of the water withdrawn from the lake would come from the supersaturated zone, therefore the waters entering Lincoln School Lake would also be supersaturated. The effect of the pumpback current upon nitrogen levels in Dickey Lake is not quantifiable, however, it is expected to have a moderating effect in the area of the lake near the dam and thus on the nitrogen levels of discharges into Lincoln School Lake.

Nitrogen supersaturation resulting from the normal operation of the water control facilities at Dickey Lake would not occur. The spillway at Dickey Lake would be of the emergency rather than operating type and would discharge very infrequently (time interval between events is measured in years). There is no evidence that the other water control facilities at Dickey Lake (the turbines and diversion tunnels) would contribute to any nitrogen supersaturation.

Coliform bacteria levels introduced to Dickey Lake at the inflow points are expected to fluctuate as observed during the baseline water quality survey. The lake is expected to display the typical characteristics of other artificial impoundments by effecting a significant reduction in bacterial levels during storage. Open water levels would be lower than those of the coves affected by the littoral influences of the shoreline and tributary streams.

4.06.1.2 Lincoln School Lake

Lincoln School Lake, because of its short detention time and large flow-through volume, would have the flow characteristics of a run-of-the-river impoundment. Results of the physical hydraulic model study of the lake indicate that it would be totally mixed. Conditions in the lake would be further complicated by the fact that water would be withdrawn from it at two locations; discharges would be made through the outlet facilities at Lincoln School Dam and water would be pumped back into Dickey Lake from the upstream end. Discharges from Dickey Lake would have the greatest influence on water quality conditions in Lincoln School Lake because of the large volume of the inflows over short durations. The natural flows of the Allagash River would be the other major source of water to the lake.

Water temperatures in the lake would be uniform with depth (isothermal) and would be influenced by the temperature of inflows from Dickey Lake and the Allagash River and by climatic conditions. Significant warming of the cool outflows from Dickey Lake would occur in Lincoln School Lake. The temperature of outflows from Lincoln School Lake would be the mixed in-lake temperature. Warm winter outflow temperatures from Dickey Lake coupled with the dynamic nature of Lincoln School Lake could result in warmer than natural outflow temperatures and perhaps the prevention of an ice cover on the lake.

Dissolved oxygen concentrations in Lincoln School Lake would be greatly influenced by Dickey Lake outflows. These discharges are expected to have dissolved oxygen concentrations ranging from 60 to near 100 percent of saturation.

The entire Lincoln School Lake area would be cleared of woody vegetation. Filling of the lake would be accomplished over a very short period of time ranging from a few days to a few weeks, depending on the time of year and coincident operations at Dickey Lake. Because of the short filling time and dynamic operation of the lake, water quality changes due to leaching from the inundated soils and decomposing vegetation would be transferred downstream from the lake through the outflows.

Turbulent mixing and the isothermal conditions within Lincoln School Lake should decrease the dissolved nitrogen concentrations. Lincoln School Lake would have an operating spillway that would discharge more frequently than the Dickey Lake spillway. Steps would be taken to mitigate against any nitrogen supersaturation problem through the exercise of appropriate hydraulic design procedures, such as design of a shallow, rather than deep stilling basin.

The major source of sediments to the lake would be the Allagash River since Dickey Lake would greatly reduce the load from the St. John River. The dynamic nature of the lake should not be conducive to sediment accumulation.

4.06.2 Downstream Water Quality

The quality of the waters of the St. John River below the project site would be affected by the construction and operation of the project. Short to intermediate-term effects could be caused by erosion during construction. Some material could be washed into the river despite the employment of mitigation methods. The result would be increased dissolved and suspended sediment with associated increases in the values of specific electrical conductance and turbidity, and an increase in the bed load portion of the total sediment load. These effects would occur during rainfall-runoff events and are expected to be of a magnitude similar to that which occurs presently from the disturbed portions of the watershed.

Short-term nutrient enrichment could occur as a result of reservoir clearing and filling activities. Waters expected to have somewhat higher than normal nutrient levels would be released from Dickey Lake throughout the duration of these activities. Lincoln School Lake would have a short detention time and, consequently, would pass downstream the enriched waters from Dickey plus the nutrients leached from the lake bottom soils and vegetation.

Impact analysis of the project on downstream water temperatures with both initial and ultimate power development showed that the daily average outflow temperatures from Dickey Lake would be much cooler than natural while those from Lincoln School Lake would be consistently near the lower curve of natural conditions. The results of simulations for the two years exhibiting the greatest difference in outflow temperatures are presented in Figures 4.06-2 and 4.06-3.

The temperature regime of the St. John River immediately below the Lincoln School Dam would be much cooler than that experienced in the past with summertime average temperatures 5F°-11F° (3C°-6C°) cooler. Natural summertime water temperatures fall within a 20F° (11C°) band whereas post-project temperatures are expected to fall within a 9F° (5C°) band. Because outflow rates from Lincoln School Lake within each day would range from a base flow condition of 1,000 cfs to a power generation flow of 16,000 cfs, it is possible that fluctuations in temperature may be experienced for an indeterminable distance downstream over the course of a day. These variations would depend on the flow rate and temperature, time of day and ambient conditions.

Winter time outflows from Lincoln School Lake would be warmer than natural river conditions. This could result in the prevention of ice formation on the St. John River below the project. The extent of such a condition would depend on the rate and temperature of the outflow and the climatic conditions.

The sediment load in the river would be reduced because of the high trapping efficiency of Dickey Lake. The major portion of the remaining sediment load would be that portion contributed by the Allagash River which would not settle out in Lincoln School Lake.

Dissolved oxygen levels are expected to range from 60 to 100 percent of saturation, depending on the degree of aeration effected by the Lincoln School Dam outlet works. Nitrogen supersaturation conditions are not expected to result from the operation of the Lincoln School Lake project.

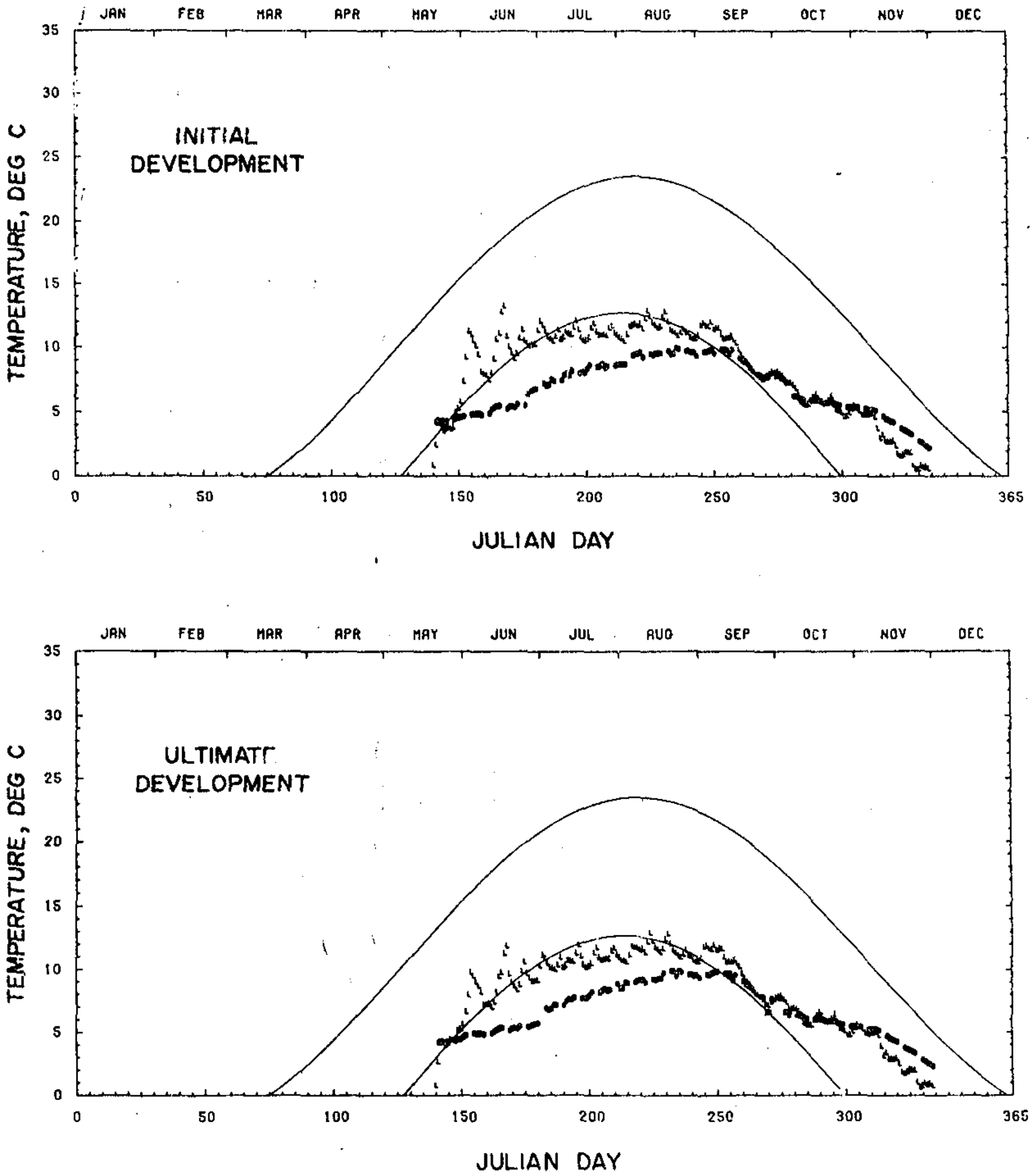
All other physicochemical parameters in the St. John River below the project would correlate with their levels in Lincoln School Lake.

4.06.3 Proposed Transmission Route

Right-of-way clearing, construction of access roads and transmission facilities will result in short-term impacts on aquatic ecosystems. Of particular concern is erosion and the consequent sediment impact to the streams, wetlands, and lakes and temperature changes.

4.06.3.1 Sedimentation

Sedimentation potentials for all water features along the route have been calculated for existing conditions, conditions without mitigation, and conditions with mitigation. Table 4.06-1 shows the three conditions for which sediment yields have been estimated.

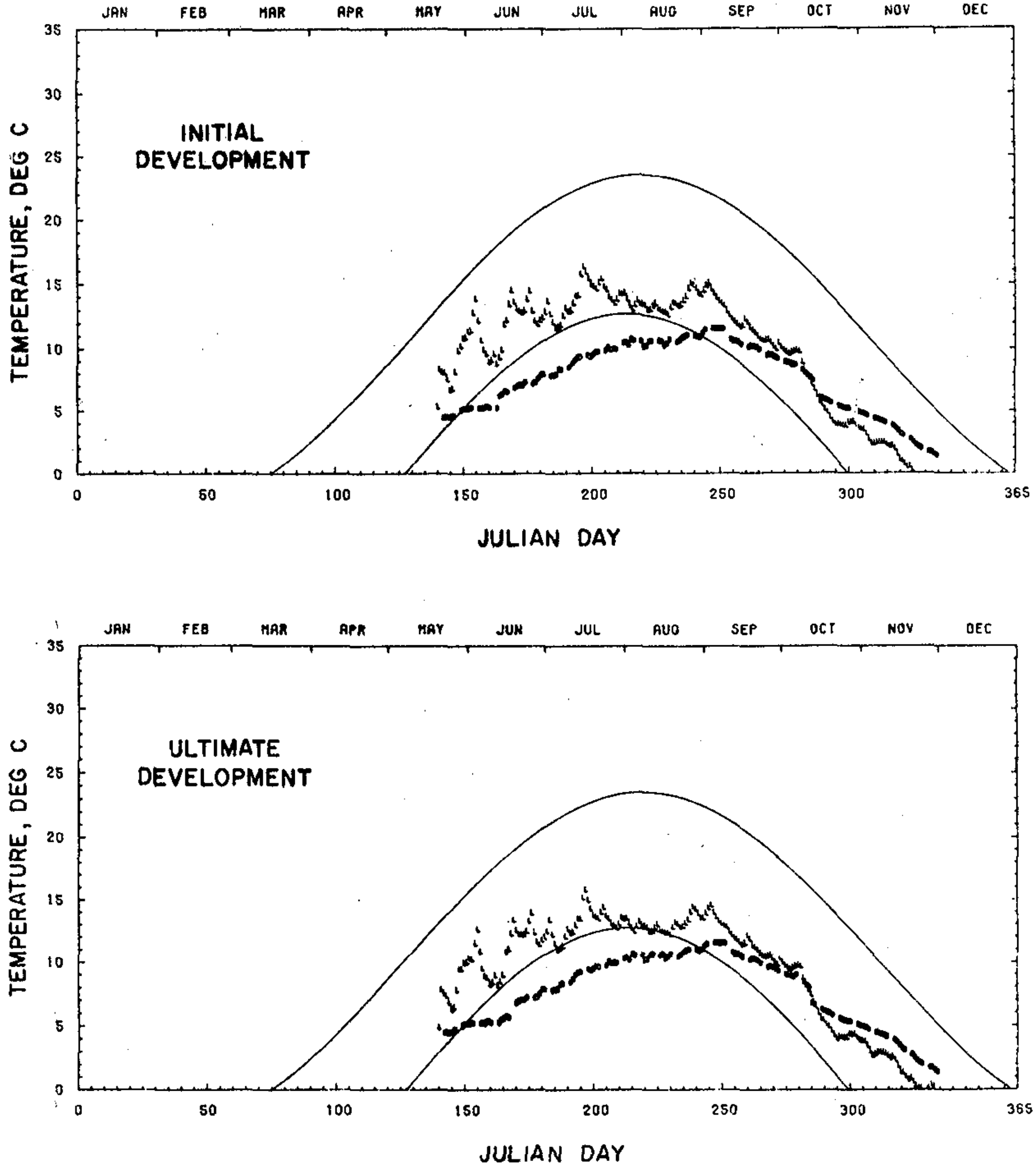


Dickey Lake outflow temperature denoted by "D"

Lincoln School Lake outflow temperature denoted by "L"

DICKEY-LINCOLN SCHOOL LAKES
SIMULATED OUTFLOW TEMPERATURES
AND
OBJECTIVE TEMPERATURE BAND
STUDY YEAR 1956

FIGURE 4.06-2



Dickey Lake outflow temperature denoted by "D"

Lincoln School Lake outflow temperature denoted by "L"

DICKEY-LINCOLN SCHOOL LAKES
SIMULATED OUTFLOW TEMPERATURES
AND
OBJECTIVE TEMPERATURE BAND
STUDY YEAR 1972

FIGURE 4.06-3

TABLE 4.06-1

TONS OF SEDIMENT DEPOSITED INTO WATER SYSTEMS/YEAR[1]
PROPOSED ROUTE

	Existing Conditions	Conditions with no Mitigation	Conditions with Mitigation
Dickey-Lincoln School-Fish River	41 tons	214 tons	63 tons
Dickey-Moose River	13 tons	635 tons	113 tons
Moose River-Moore	205 tons	3938 tons	695 tons
Moore-Granite	90 tons	944 tons	194 tons
Granite-Essex	602 tons	2783 tons	794 tons

[1]Reference: Geotechnical Impact Study, Appendix F (DOE, 1978)

4.06.3.2 Water Temperature

Heating of the water will take place where rights-of-way parallel streams for any distance. Cold-water game fishes are generally displaced by warm-water species in streams whose shorelines have been devegetated because the increase in water temperature causes decreases in dissolved oxygen and increases in metabolism of the fishes.

4.07 Impacts on Climatology and Air Quality

4.07.1 Climatological Impacts

4.07.1.1 St. John River Basin

Based on the comparison of various field data for the five year period, 1970-1974, an analysis of the impacts on the meso-climate by the proposed project suggests the following:

a. The impact would be trivial and insignificant compared with that of Lakes Erie and Ontario of the Great Lakes System, for two reasons. The Maine lakes, even including the proposed Dickey-Lincoln project, can have no measurable trace of an impact on the macro-climate compared to the Great Lakes system. Also the area of the proposed project is some 30-40 times smaller than that of Lake Erie or Ontario and would not furnish air trajectories over water long enough to generate strong atmospheric reactions in the upper atmosphere.

b. Observable impacts would be maximal at the downwind edge of the lake and minimal at the upwind edge. This favors the east side of the proposed lake over the west side for maximum impact. It also favors the southern end of the proposed lake during the colder half and the northern end during the warmer half of the year.

c. The meso-climatic impact of the proposed lake, like that of any other lake, would tend to be at maximum intensity at those times of the year when the lake's surface is warmest or coldest relative to the ambient atmosphere. The time of minimum meso-climatic impact of the Maine lakes occurs in late winter when they are most deeply covered with ice and snow.

d. At these critical times of the year, the following observable degree of impacts on the favored edge of the proposed lake can be expected.

(1) Late Winter (February): During this month of minimum impact, no observable effect whatsoever of the proposed project on the local environment is indicated nor is it to be expected.

(2) Late Spring (May): During this month of maximum relative coldness of lake waters in northern Maine, the only observable impact on the local environment would be an average lowering of the daytime maximum temperatures by 1F° to 3F° in favorable locations. Some suppression directly over the lake of midday cloudiness and light convective showers can be expected. However, these would not be sufficient enough so as to affect monthly precipitation totals measurably.

(3) Late Summer (August): During this late summer month of early autumn, the nocturnal radiational cooling coupled with the continuing warmth of the lake waters would result in an increase in fog, especially in the early morning.

(4) Late Autumn and early Winter (November): The local effect of the proposed project would be to raise nocturnal minimum temperatures on the average of 1F° to 3F° . Daytime temperatures would be elevated to a lesser extent.

4.07.1.2 Proposed Transmission Route

The removal of vegetation from the right-of-way during construction of the transmission lines would cause microclimatic changes in air temperature, solar radiation, and wind velocities. Periodic vegetative management activities would insure that these microclimatic changes would be perpetuated. The changes would be confined mainly to the immediate right-of-way in forested lands and may be adverse or beneficial depending on site conditions. Reflection and back-radiation would also be changed. The width and the orientation of the right-of-way relative to the prevailing winds would change wind patterns.

The net effect would be a change in the site microclimate after clearing the right-of-way and a shift in competitive balance which with time would bring about a shift in vegetative species composition, and possibly a change in cover types.

Two climatic factors, wind and ice, exert forces upon the transmission towers and conductors. Criteria for the design of transmission lines in response to wind and ice loading are set forth in the National

Electric Safety Code (NESC) of the American National Standard. The proposed transmission lines would be located in an area classified by the National Electric Safety Code (NESC) of the American National Standard as having heavy combined loading due to combined ice and wind.

4.07.2 Air Quality Impacts

4.07.2.1 St. John River Basin

The impact of construction and operations of the proposed project on atmospheric pollutants is estimated to be negligible.

Temporary and local degradation of the air quality could be experienced during the construction phase of the proposed project. This activity would produce temporary smog conditions in local sections of the valley, but such conditions would be local and of very short duration. Burning would be carried out under optimum conditions and not for prolonged periods. The burning would be carried out during unsettled windy conditions usually accompanied by light showers or snow flurries. These conditions would facilitate the rapid dispersion of smoke.

4.07.2.2 Proposed Transmission Route

Operation of power transmission systems does not result in the discharge of air pollutants, except very minor and barely detectable amounts of oxidants. Activities during the construction period would result in some adverse air quality impacts that include combustion by-products from burning, dust from disturbed soil, vehicle and equipment exhaust emissions, and fumes and odors from miscellaneous operations. The impacts of these construction activities on ambient air quality are normally localized and short-lived.

In areas where unmerchantable timber and slash are being disposed of by open burning, some increase in the level of air pollutants would probably be experienced. Contractors may use controlled open burning in stacks, pits, or tubs to dispose of slash and unmerchantable timber where and when permitted by local, State, and Federal air pollution regulations.

New substations and maintenance buildings constructed as part of the proposed program would be heated and cooled with electricity. They are not expected to contribute directly to air pollution. Certain substations, communication facilities, and control stations have emergency power capability fueled by propane or diesel.

Odors and drifting particulate matter results from the application of herbicides during right-of-way vegetation management activities. Herbicides sprayed by aerial or ground blower techniques are prone to drift beyond the right-of-way.

The production of ozone and nitrous oxides are associated with the corona (see Section 4.16.2.2). Experience and studies to date indicate that the amounts of the oxidants produced by transmission lines are minimal and have no adverse effects of humans, animals, or plants. The levels of ozone and nitrous created by the proposed transmission facilities would be indistinguishable from ambient levels.

4.08 Socio-Economic Impacts

4.08.1 Construction Phase

4.08.1.1 Population

4.08.1.1.1 St. John River Basin

The construction of the Dickey-Lincoln School Lakes dam project would result in a major increase in population in the Service Impact Area, especially in the Immediate Impact Area. Some pre-project temporary moves have been occurring since 1975, but the major movement would begin when workers come from other parts of the country and possibly Canada to cut trees and construct the project.

The population would increase significantly during the 7½ year construction period. Peak seasonal population is expected in the first half of the sixth year with an estimated 2,700 to 3,200 new residents, representing 19% of the estimated 1973 population of the Service Impact Area. It is further estimated that 350-550 secondary and tertiary jobs would be generated as a result of the project during years 4-7, but would be seasonal, temporary, and occupied by residents and spouses of construction workers. Most of these would occur in the Immediate and Service Impact areas. It is probable that 90% of the workers would leave the area as construction phases down. Regional population is not expected to be affected.

Workers would start coming in large numbers during the second year of impoundment construction, after residents have had some experience with small numbers of immigrants. Most of the early workers would bring their families and intend to stay for the duration. During the second and third year, larger numbers of workers, some seasonal and without their families, would move into the area. Many more jobs both in construction and services would become available to local residents.

In Allagash and St. Francis, 156 households would be relocated within the communities. Their upgraded homes are apt to provide a more comfortable life style but may be more costly to maintain. The families would experience many economic, physical, psychological and social problems due to moving and relocating.

At peak construction, there would be about 1,200-1,400 workers, many men with families, living in a more rural setting than most are used to. This has the potential of creating social and psychological adjustment problems for new and old residents alike. It would create the need for a variety of expanded facilities and services and an increase in local business generally.

4.08.1.1.2 Proposed Transmission Route

During the second year of the project, as the right-of-way is cleared and the transmission line is constructed, line work crews would be recruited along the route. Some would be from specific towns along the right-of-way and would work clearing their own or neighbors' lands. Others would work on several segments while living at home and a number would work on many segments, moving as the line progresses. These workers would temporarily increase the population in areas. Assuming no workers are hired who would be residing at home (the conservative approach), a maximum of 40 workers would move into an area during clearing work, and a maximum of 60 during construction. They would remain in an area from 2 to 6 months. It is possible that two 60-man crews would work out of the Jackman area at one time. A survey of contractors showed that few workers bring families. Those that do bring them only for the summer months where construction is in a desirable area and where rental facilities or trailer sites are available. Minimal impact from line worker dependents upon communities is expected.

According to the survey taken of major construction companies (see Appendix H, DOE, 1978), work crews experience social and psychological impacts when working in remote areas. There is a good deal of remote area between Dickey and Moore substations. Workers from nearby areas in northern New England and Canada might drive home on weekends, lessening their feelings of isolation; however, workers who spend the entire week at the campsite are the likely to be impacted by the isolation. The experiences of contractors working in similar remote areas indicate that the social isolation, lack of recreational outlets, and close group quarters result in a buildup of tension and anxiety. Contractors have indicated that winter work conditions in these areas are severe; consequently, worker turnover becomes a problem during the cold months.

The employment of Canadians to clear the right-of-way and construct transmission facilities could become a social and political issue. Since wages paid workers on this project would be higher than local wages for comparable work, it is likely that some U.S. workers who would normally not be seeking work in this remote region could be looking for employment on the project. This would cause conflict with Canadians as, according to the survey of contractors in this region, it is common to have some 30 percent of woods workers from Canada. When the right-of-way was cleared for the Central Maine Power Company line, (Appendix H, DOE, 1978), a much higher percentage of the clearing crew was Canadian. U.S. workers are likely to resent a high proportion of Canadian labor getting available jobs, which depends on how the situation is handled by labor contractors.

In order to meet National Electric Safety Code standards, Occupational Safety and Health Act Regulations, and to provide ready access to transmission lines for maintenance, residences and other tall structures would not usually be allowed on rights-of-way. Where single family residential structures are now located within the proposed right-of-way the line might be moved slightly to avoid the structure. Up to six families may require relocation from the transmission route.

4.08.1.2 Government

4.08.1.2.1 St. John River Basin

Allagash would experience many structural and governmental problems due to the relocation of 73% of its residents. The large number of people moving into all of the communities in the immediate impact area, temporarily, could influence policies and decisions made in town meetings. If these new residents form interest groups, they could carry decisions due to their numbers, lack of political interest by long term residents, and the town meeting form of government.

4.08.1.3 Municipal Services and Facilities

4.08.1.3.1 St. John River Basin

Planning

Since most communities in the immediate impact and service areas do not have comprehensive plans with zoning ordinances, it is likely that many types of temporary housing would be set up by the impoundment construction workers on any available land in all other communities. Impacts on services and facilities in areas with weak zoning ordinances may be extensive. Expanded capabilities would not be compensated for by the increased tax base due to the temporary nature of the construction and potential types of housing. Community development corporations could be instituted to plan for any impacts in community infrastructure facilities and services.

Water Supply

The Fort Kent water system currently handles 675 accounts and could service 1400 accounts. This would be adequate for the proposed dam related population increase. St. Francis' public water supply system could service 100 additional units. St. John and Allagash as well as many St. Francis residents presently use private wells, as would the increased population. The water supply would be adequate for the temporarily immigrating population.

Sewage Disposal

The Fort Kent sewage disposal system can accommodate 3000 additional users. Ground conditions in other communities are adequate to handle additional septic systems.

Solid Waste

Of the four communities in the immediate impact area which are most likely to receive the greatest development, three have presently inadequate solid waste disposal systems. Though adequate land is available for development of solid waste sites, these would have to be developed to accommodate increased population.

Transportation, Streets and Roads

Route 161 between Fort Kent and the impoundment would experience a temporary growth in traffic of 200-300% due to project-related traffic. The same route between Fort Kent and Caribou would, in some sections, experience a 50% increase in traffic volume. U.S. Route 1 between Fort Kent and Madawaska would nearly double in volume. Other highway segments in the impact area would not significantly be affected by increased traffic volumes.

Rail traffic would not increase substantially during project construction, but the probability of an accident occurring at the five grade crossings would go from one every ten years to one every five.

Heavy equipment can create damage to road surfaces. On secondary paved roads, continued passage of heavy transports during the spring "frost heave" season can result in severe road damage requiring unscheduled expenditure for road repairs. Many roads are posted as being closed to heavy traffic during certain spring months. Expansion of public works would be required in the area of highway maintenance. A major influx of population in either St. John or St. Francis would require additional funds and personnel to expand the present systems and install new facilities.

Traffic problems are likely to result from the competing demands of project traffic and that of other users of the highways and secondary and tote roads.

Approximately five miles of State Highway Route No. 161 between the Lincoln School Dam and the Allagash River would be inundated by the Lincoln School Reservoir. New two-lane bridges would be provided to carry the relocated Route 161 over Negro Brook and the Allagash River. The total length of relocated highway would be eight miles.

There are approximately 13.4 miles of town maintained roads located in the project area. Except for a short portion along the left bank of the Allagash River which would be relocated, these roads would be abandoned or demolished.

Two state-owned bridges over the St. John and the Little Black Rivers in the Dickey Reservoir area would be abandoned or demolished.

Many miles of private logging roads and trails exist in the Dickey Reservoir area. These roads and trails and associated bridges would be abandoned. It is anticipated that substitute road networks would be constructed by the owners. The owners of these private roads would be compensated in accordance with standard Federal real estate practices.

Public Safety

Fire service problems may arise when fire fighters encounter difficulty locating new residences. Police services and the criminal justice system would be strained by increased crime due to increased population in violations such as drug use, alcoholism and burglary.

It is likely that from three to nine additional police officers would be necessary in the immediate impact area during construction. Also from one to nine additional police vehicles would be required. The fire equipment would be adequate to handle increased population, however, additional volunteers would be necessary within volunteer departments.

Recreation

Evening recreation places such as bars, taverns and restaurants are popular in the upper St. John Valley. These activities would be a major site for interaction of local male residents and the construction work force. It is likely that business would increase for these establishments but conflicts between new and old residents may take place because of limited resources. Citizens might set up a dialogue with the University of Maine at Fort Kent to enable utilization of recreational facilities and to develop cultural and community recreational programs.

Hunting and fishing seasons overlap with peak construction activity. Resources are expected to experience an increase of users. The major impact of the dam construction on recreation would be the loss of the use of the impoundment area for the duration of construction. At the completion of the project, the Corps of Engineers would develop minimal recreational facilities on the impoundment.

Education

Most school systems in the area would receive some increase in the number of school children. From 400 to 600 school aged children may be expected to move into the area. This increase could be met with existing facilities in some of the communities. Classrooms and teachers would have to be added in others.

It is estimated that 200 new pupils could be accommodated within SAD #27. If the Allagash school is displaced, a new facility would be built for Allagash students. Since there are presently over 100 employment applications on file, recruitment of additional teachers would not be problematic, though an additional expenditure. Adjustments would have to be made by the new students to the school system.

Adult education programs, if developed with the university, could provide a basis for decreasing new resident alienation.

Social Services

Expansion of social services may be needed to cope with the social problems generated by the interaction between urban construction workers and the rural local residents, as well as the relocation of a number of families. This is viewed as a state or federal problem by officials.

It is likely that construction worker families would develop additional religious institutions and these would supply some of the needed social services.

Health

The increase in numbers of residents would extend the shortage of health services which exists in Fort Kent presently. This shortage would be further intensified by accidents suffered by workers. The IIA is already experiencing a shortage of medical personnel. Those communities rely on the hospital in Fort Kent to meet their needs. An additional ambulance would also be necessary.

Housing

The projected housing demands generated by the impoundment construction workers is shown in Table 4.08-1. Since there are many fewer housing possibilities than construction workers, there are three potential housing solutions: 1) leave construction workers on their own to obtain housing at whatever distance; 2) plan housing such as a labor camp; or 3) concentrate workers in specific areas utilizing available housing as well as building according to temporary construction needs, dispersing sites. This latter option is preferred by the Army Corps of Engineers due to the results of other projects and will be fully explored with local townspeople. This includes the development of temporary single unit housing, mobile home sites and multiple housing units such as dormitories. The first option would likely require all towns to make adjustments, some of which could impede the construction process. The second option would place less impact on facilities or current residents but could not provide a diversified choice of living situations and would generate onsite or nearsite problems such as traffic congestion or waste disposal. This option would also create the most severe impacts on health problems and crime, due to crowding . The third option is seen as minimizing service impacts while maximizing short and long term benefits. Many workers would prefer to bring their own mobile homes.

Because each of these options would cause a good deal of impact upon the services, facilities and life styles of residents, steps would be taken to minimize possible effects. The Corps of Engineers could develop a task force of relevant government and local citizen representatives to construct mitigation and management plans insuring the best interest of local residents and construction worker families (see Supplement to Appendix C, CE, 1978).

TABLE 4.08.1

ESTIMATED HOUSING DEMAND IN SERVICE IMPACT AREA BY YEAR OF CONSTRUCTION PHASE[1]

Year of Project	Year-round Single Family Dwellings	Year-round Apartments	Year-round Own Trailers	Seasonal Housing Provided (Contractor Developer or Commercial)	Seasonal Own Trailers
1	50	10	20	10	2
2	65	10	25	60	20
3	65	10	25	150	50
4	80	10	30	675	225
5	160	20	60	1010	340
6	160	20	60	1010	340
7	65	10	25	975	325
8	25	5	10	10	4

[1]Estimated assuming items (1) to (5) presented in this paragraph.

Rents and market values would increase, perhaps causing dissension in immediate impact areas where housing is usually kept within extended families. Local residents would be likely to experience more competition for housing and have to pay higher prices. All forms of housing would be absorbed and many would be substandard.

Families housed in mobile home parks or worker developments may experience lack of integration and alienation from the communities. This can be alleviated by developing feelings of community through proper planning of temporary housing and facilities as observed in a variety of new town developments. New residents' committees could be set up to establish the necessary social facilities and networks in order to integrate new arrivals quicker into the community. Some of the programs could involve older residents as well to bring the communities together.

The relocation of displaced resident housing in St. Francis and Allagash is presently under study. Several meetings have taken place with town officials of both affected communities to discuss potential relocation sites and develop criteria for site selection. St. Francis has acquired a 100-acre site which is being retained for the relocation of its displaced residents. Interviews were held with each resident homeowner within the project area to determine physical condition of existing dwellings, number of occupants, employment data, relocation preference and replacement requirements.

Provisions for relocating these households are covered under the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646. Basically, no person shall be required to move from his existing dwelling unless there is available a decent, safe, and sanitary replacement dwelling within a reasonable time prior to displacement. Some housing would have to be provided under "Last Resort Housing," Section 206 of the Act, because of a lack of available replacement housing. Last resort housing would expedite relocation of displaced residents who have low value properties and have little or no income. There would be sufficient land remaining in both communities to relocate the displaced homeowners within their own community.

Public Utilities

The existing telephone lines are located on the electric pole lines and therefore disposition of these lines would be the same as electric utility lines.

Approximately six miles of pole line is located along existing Route No. 161. This would be relocated generally along the relocated Route 161. Approximately seven miles of existing pole line located west of the Allagash River would be abandoned.

Investigations to date indicate five cemeteries are located within the project area. In addition to these five cemeteries, there is a possibility that a small Indian cemetery and single graves of "river drivers" also exist in the area. The five cemeteries are:

Allagash Town Cemetery

St. Paul's Catholic Cemetery

Baptist Church Cemetery

Gardner Family Cemetery

Currier Farms Cemetery

The Town, Baptist and Catholic cemeteries would be relocated and clustered into a cemetery complex in the general location of the relocated residences. The concept of clustering these three cemeteries into a cemetery complex has been initially approved by the respective officials of each cemetery.

Unless the Gardner family heirs elect not to have the Gardner family cemetery relocated, this cemetery would also be relocated to the complex mentioned above.

The Seven Islands area addressed in Section 2.10 hereof titled Cultural Resources would include the Currier Farms cemetery site and the Indian graves site. The disposition of these cemetery sites is covered in that section of this statement.

4.08.1.3.2 Proposed Transmission Route

The impact of the transmission facilities on public and municipal services is likely to be slight. As part of the research for the assessment of socioeconomic impacts, contractors who had worked on a similar transmission line in eastern Maine, as well as the officials of municipalities along its route were interviewed. Responses indicated that there was no noticeable increase in demand for services or increased burden of work on town government, town planning boards, fire departments, conservation commissions, highway departments, police departments, public schools, hospitals, solid waste and sewage treatment facilities, water, private services, or private recreational facilities from transmission line work forces.

A slight impact may be experienced in the Jackman area, however, if two crews are located in that proximity simultaneously. Since Jackman, Maine, and Pittsburg, N.H. are relatively isolated, all service needs of workers in those areas would have to be met externally. The Town of Jackman is expected to be effected by increased population. It is not presently required to comply with federal sewage disposal standards due to a low population. This might change as a result of temporary work crews housed in Jackman.

It is unlikely that other existing public or private services or facilities would be more than slightly impacted by line construction workers. In the Fort Kent region, the impacts of the crews working on transmission facilities would be overshadowed by the construction crews working on the impoundment and hydroelectric facilities.

Transportation, Streets and Roads

There is some concern about the effects of construction vehicles on local roads. The economic impact of road damage by heavy construction equipment would be mitigated by limiting the use of roads during early spring when they are easily damaged and by maintaining the roads properly.

Railroads are compatible with transmission lines, with low impacts at railroad crossings. Slight visual impacts would be associated with railroads that carry passengers.

Impacts at airport facilities are severe. Transmission lines and aircraft and associated facilities are usually incompatible. Even with markers on the conductors to show their position, the conductors present a threat to air traffic. Transmission lines must be located at safe distances from heavily used aircraft landing sites in accordance with Federal Aviation Administration standards.

Transmission lines typically cross and parallel roads and do not affect the safety or operation of roads.

Housing

The impacts of housing workers in local communities during the right-of-way clearing, tower construction, and substation construction of the transmission line would be slight. The small size of the work crews and the short duration of their study in any one community would create a demand for temporary housing but little demand for more permanent housing. Interviews with contractors familiar with this type of work indicate that few construction workers would bring their families and rent homes. If local labor were hired, this would further reduce the demand for housing.

The availability of temporary housing, such as motels, tourist homes, or boarding houses, as well as trailer sites, varies throughout the region, although it is generally adequate to meet work crew demand. In New Hampshire, along the Connecticut River, and in Vermont, there are enough hotels, motels, and inns to provide housing for workers. Workers may also use campers in campgrounds or trailer parks which have electric hookups and waste disposal facilities. In Fort Kent, however, where the construction of the hydroelectric dam, the substation and transmission lines would be going on at about the same time, a severe housing shortage may occur unless the transmission schedule for that section is timed to avoid the peak construction periods at the dams.

In the Jackman-Moose River area, work crew size could be 60 workers. There are nine motels in the area, but it is probable that local labor would be hired and no housing shortage would occur. If two such crews work in the same vicinity at one time, a temporary housing shortage could occur during the summer and winter tourist seasons. The recreation users would encounter a shortage of rooms.

Discussions with area contractors suggest that about 25 percent of the workers are likely to bring mobile homes to the more remote areas of western Maine. However, access roads are few, and campground space is scarce.

Contractors have indicated that in remote areas similar to western Maine and northern New Hampshire they have used existing lumber and sporting camps when and where they were available. There are some areas that are so far from camps or towns that the contractors may bring in mobile camps and set them up along the right-of-way.

A significant social impact would occur when residences or other property improvements are displaced by the transmission line. This impact would occur infrequently because route location activities are designed to avoid it. When structures must be removed from a proposed right-of-way, owners would be compensated as set forth in the Uniform Relocation Assistance and Real Property Acquisition Act of 1970 (42 U.S.C.A., sec. 4601), and in accordance with the Uniform Appraisal Standards for Federal Land Acquisition (Interagency Land Acquisition Conference, 1973). Where desirable, homes may be moved away from the right-of-way to an adjacent site.

Health

Emergency medical treatment facilities would be needed when transmission facilities construction was in progress. The remote areas of western Maine and northern New Hampshire would require special emergency transportation via helicopters because of the distances to hospitals and a lack of landing areas for airplanes. Hospitals closest to the remote areas, such as Fort Kent and Jackman in Maine, and at Berlin, N.H. would be involved. The Fort Kent hospital may require additional nursing services to insure a full bed capacity utilization potential.

The construction of high voltage power transmission facilities have negative health impacts which include impacts from the use of heavy equipment during construction and the open burning of slash during right-of-way clearing. During construction, air pollution caused by construction vehicles and burning of cleared vegetation may be a slight impact on the health of nearby residents, especially those suffering from respiratory conditions. During dry seasons, dust can be created by construction vehicles traveling on unpaved access roads. This, also, could have a slight impact on health of nearby residents and would depend on the proximity of residences. It is unlikely that the burning of slash would cause health problems except in special cases where burning occurs close to a residence where a health problem already exists.

4.08.1.4 Economy

4.08.1.4.1 St. John River Basin

4.08.1.4.1.1 Labor and Employment

In accordance with the Davis-Bacon Act, wages for construction workers would be equal to those paid in other Federal projects in the county. The lowest "regular time" wage on the proposed Dickey-Lincoln pay scale is $5.70 per hour for unskilled labor. This is more than double the wage of a farm laborer or unskilled processing plant worker making $2.75 per hour. Due to this large wage differential, there would be a strong incentive for full-time farm laborers and processing plant employees to change jobs for the seven year construction period.

The most experienced (and presently employed) would have the best edge in securing the relatively high paid project jobs. Unemployed workers may be hired to fill the slots of those who are currently employed but seek project jobs. Farmers and businesses may have to pay higher wages to retain employees and cope with increasing prices and the cost of living in the area. Tradesmen may not be available to neighbors. It is likely that members of construction worker's families would take on many of the farm and clerical jobs made available.

In March 1977, unemployment rates for the labor market areas in Aroostook County ranged from 10.5% in Houlton to 16.7% in Fort Kent. This is an increase over the 9.5% averaged between 1970-1976. It is likely that all unskilled workers required for the project would come from Fort Kent and the Aroostook County area since those classified as unskilled and unemployed comprise a larger number of people than jobs available.

4.08.1.4.1.2 Sales and Tax Base

There would be a potential for a municipality to commit itself to expanding its infrastructure for short term "boom period" needs without tax compensation. This would require close examination by the towns. Increased tax base from housing would be slight because most housing would consist of mobile homes and other nonpermanent solutions.

4.08.1.4.1.3 Industry

<u>Agriculture</u>

Construction of the dam would prevent flooding of the St. John River from Allagash to Van Buren. This would impact the production of agricultural lands by reducing loss of topsoil and destruction of river edge farmland.

Forestry

The most significant impact upon the forestry sector during construction could be the effect of placing the timber cut within the impoundment area on the Aroostook timber market. A detailed assessment of the impact the harvesting (clearing) operation would have on the marketability, timber management schedules and labor is found in the supplement to Appendix C, CE, 1978. Results of this assessment indicate that if an eight-year harvesting schedule were to be instituted, the impacts would be considerably reduced from other shorter term schedules. However, during the eight year period, timber management practices and schedules would have to be revised to accommodate the volume of timber harvested from the impoundment area. These changes would entail an opportunity cost.

Other Industrial Sectors

During construction of the project, the trade and service sectors of the Immediate Impact Area and the businesses in Aroostook County would experience a significant economic increase. As much as $60 million in salaries could be spent in these sectors during the construction period. The potential $35 million spent on goods over the seven years represents about 3% of all annual retail sales in Aroostook County and 15% in the Madawaska-Fort Kent area. Up to $25 million could be spent in the services sector and this represents approximately 20% of the county sales. Additional retail facilities and services activity might be needed. This may function as a benefit in that retail or service establishments not currently available would be developed. It may act as an adverse impact in that establishments of low quality might arise.

Relatively sudden increases in demand for goods and services can cause price increases or temporary inflation.

4.08.1.4.2 Proposed Transmission Route

4.08.1.4.2.1 Labor and Employment

Construction falls into two phases. Phase I includes the construction of access roads, surveying, and right-of-way clearing. Phase II includes construction of transmission structures and stringing. All of Phase I work would be completed before Phase II begins. Therefore, the total labor force at any time would depend only on the phase in progress.

Because the majority of the proposed transmission route traverses heavily forested lands, Phase I labor requirements for surveying and clearing the rights-of-way would represent about 50 percent of total direct labor used in the project.

The average size for a phase I clearing crew is estimated at about 40 workers per section. Individual crews may have 2 to 10 workers. The size of any crew on phase II would average about 60 workers per work segment.

A combination of labor requirements and working conditions in isolated woods areas indicates that experience would be an important factor in initial hiring practices. The present timber industry labor force in northern New England includes about 70 to 80 percent local labor and 20 to 30 percent imported labor. Local labor refers to any workers who are residents of the State where construction would take place. The labor pool for the proposed transmission line would, therefore, probably be 70 to 80 percent local and 20 to 30 percent imported for phase I. The largest percentage of imported labor is expected in Maine. It would come from Canada. Less imported labor is expected in Vermont where numerous small landowners who may elect to remove their timber prior to the sale of easement would be more likely to use local labor.

Based on discussions with local contractors, labor unions, and power companies, it is estimated that about 50 percent of phase II labor force would be imported. This estimate reflects the high level of skills required and the mobility of the specialty labor at a national level.

It is estimated that about as many laborers would be required for phase I work as for phase II, but for a shorter period of time. The number of jobs likely to be supplied from the labor force in Maine would be 266 for a maximum of 13 working months per job spread over a 2-year period. The wage scale would be competitive with existing wages, thus it may be expected that some shift in the labor force would occur.

Due to the total length of the transmission line and the time frame for construction, several simultaneous contracts would be let for the construction work. This would create a greater number of short-term employment opportunities.

In the tri-state area, there would be some competition with private industry for workers needed for road construction and right-of-way clearing. Weather conditions may cause layoff periods. The longer the layoff, the more likely workers would be to disperse from the work site.

Because of the construction schedule and the mobility of the crews, secondary employment opportunities are generally expected to be few to none. In most cases due to the short duration of increased demand, an increase in manhours worked by existing employees would suffice.

Income estimates for the transmission line construction are based on an average hourly wage of $10 for class I woodcutters as of 1977. This wage meets the prevailing wage of other local Federal projects, as required by the Davis-Bacon Act. Under the 5½-year schedule for the transmission project, an estimated annual net income in Maine would be $1 million, in New Hampshire $300,000, and in Vermont, $200,000.

The income impact would be more significant in regions I and II (western Maine, northern N.H., and the Connecticut River Valley, N.H.) based on both absolute and relative levels of existing income in western Maine and Coos County, N.H.. It would be moderate for all state levels.

It is estimated that 35% of the net wages of workers would be spent within the total three state construction corridor, depending upon worker proximity.

Because the transmission route is rather isolated in western Maine, secondary income benefits would be concentrated in the Towns of Fort Kent, Jackman, and Eustis. In Fort Kent, where significant income would be associated with the impoundment work, income impacts from the transmission line would account for about one percent of the total direct income.

In New Hampshire, most of the anticipated secondary impact is expected to stay in Coos County. Colebrook and Groveton would receive the most impact.

There may be some mobility to the St. Johnsbury area of Vermont during construction within region II. In Vermont, secondary income benefits will be dispersed throughout the populated centers along the route.

Statewide, secondary income cannot be viewed as significant for any segment of the line. However, for specific Towns such as Jackman, Eustis, and Clarksville, the impact may be significant.

Active mining along the transmission route is limited to the surface extraction of gravel, sand, and quarried rock. The location of a transmission line could limit the potential for expansion of such an operation and thus cause the land use to cease. Lines adjacent to surface mining activities would not affect the mining operation or its efficiency if no expansion were to take place.

4.08.1.4.2.2 Sales and Tax Base

The construction schedule and seasonal nature of the work would not warrant the introduction of new businesses in any area of the transportation route. Communities would become suppliers of goods and services for construction and for workers and should experience a temporary increase in sales volume. In the cases of communities such as Jackman and Eustis, Maine, and Pittsburg and Colebrook, N.H., the short-term impact to local businesses such as machine parts and repair, gasoline and sand and gravel may be substantial.

The primary materials required for the proposed transmission line are not available in Maine, New Hampshire, or Vermont, and in most cases are not available in New England. Respondents in a Central Maine Power (CMP) case study indicated that all primary materials were purchased on a bid basis and all came from outside the New England area (Appendix H, DOE, 1978). The Vermont Agency of Development and Community Affairs indicated that the major suppliers of wooden tower poles to the State were in Canada.

The two principal purchases of gravel for access road construction and gasoline and parts for construction equipment would be local. Most of these purchases would be made in Maine because most of the line is in that state. Materials may be delivered by rail. Jackman is on the only railroad near the line between Fort Kent and Berlin, N.H. Nearly two-thirds of the transmission line, all with steel tower construction, would be constructed in this area.

The value of gravel required for access roads is estimated at about $152,000 in Maine, $50,000 in New Hampshire, and $28,000 in Vermont. This estimate is based on an average price of $5 per cubic yard and 100 cubic yards of gravel per mile of road. This assumes that 10 percent of the access mileage would require gravel. Since the transportation of gravel is considerable portion of its cost, it is reasonable to expect purchases would be made from the sources near the route whenever possible.

In the purchase of easements for the transmission line right-of-way, a method of payment based on the difference between the present appraised value of the property and the appraised future value has been traditionally used. This compensation does not extend to property owners in the viewshed who may experience an aesthetic impact and potential property value decrease. The Department of Energy is expected to follow this same policy.

The question as to whether property values are affected by the presence of a transmission line right-of-way has not yet been resolved satisfactorily. Studies have found little empirical evidence to suggest that property values are adversely affected. Nearly 40 percent of respondents to a residential survey cited a decrease in property values as a major impact of the right-of-way. At the present time, there is not enough evidence to predict that property values would be impacted by a transmission line right-of-way. These impacts may interfere with a planned future use, such as subdivision development or ski trails.

4.08.1.4.2.3 Industry

Agriculture

During construction, a double circuit tower site disturbs an area of about 150 by 200 feet and when completed occupies an area of 50 by 50 feet. Thus, some production may be lost temporarily during construction.

4.08.2 Operational Phase

4.08.2.1 Population

4.08.2.1.1 St. John River Basin

At the end of the construction of the dam, most workers would be expected to leave the area. The operational phase would require approximately 68 workers, 8 of whom are expected to be from outside the area, and 60 from within the area. If a worse case of 30 workers relocating into the area is considered, there would be a population increase of up to 100 persons in the immediate area. Since construction families would be leaving at this time, very little impact from the operational worker families is expected.

The initial impact of the operational phase would be the loss of construction workers. Noise and traffic would decline but so would consumer demands. The project would have become an integral part of the local residents' environment. Some concerns of residents include fear of dam breakthrough and change of recreational usage.

It is expected that the communities to the immediate impact area would experience little permanent change. Due to strength of identity, the region would, in fact, retain all of the preconstruction cultural and structural characteristics as the population normalizes.

4.08.2.1.2 Proposed Transmission Route

The amount of impact on various town residents because of the transmission lines would vary. The reactions obtained from a survey of residents included concern for past growth rates, projected growth, length of settlement in their area, and emphasis on local planning.

If past growth has led to rapid development with few controls, local resentment against change could result in opposition to a transmission line. This would occur in the central Vermont regions IV and V (see Appendix H, DOE, 1978). The existence of the transmission line would be inconsistent with community goals and could be considered a detriment for years to come. Conversely, if a community welcomes development and associates it with a positive image, the line might be seen as an asset.

The transmission facilities could affect the views of residents adjacent to the right-of-way. In the survey of residents of the 345-kV Central Maine Power line (Appendix H, DOE, 1978), one-half of the residents within view of the transmission line and towers considered the line to be a negative impact on area aesthetics. Aesthetic impacts can have secondary social and economic implication as people's actions are dictated by the way they perceive a situation.

Transmission lines sometimes produce audible noise. It may occur in wet weather when there is rain or snow on the conductors. They can also interfere with television and radio reception near the line particularly in wet weather in areas with a low station strength.

There is some concern by local residents for safety and electrical field effects in the line vicinity. The proposed transmission facilities would be designed to meet or exceed requirements of the National Electric Safety Code which establishes safety criteria for electrical facilities. The proposed facilities would be marked for air traffic safety in accordance with Federal Aviation Administration Standards. The public would be informed by means of brochures, news releases, and notices on the hazards of such activities as flying kites, model airplanes, or climbing the towers.

The proposed transmission route would have an impact on the wilderness character of the western Maine region and, on those who use it because of its qualities.

To reduce visual impact, especially in forested areas, right-of-way clearing would be limited to the width necessary to prevent vegetative interference with the line. The clearing would be "feathered" or would have undulating boundaries. In locations where the right-of-way enters timber from a meadow or other open area, clearing edges would be "feathered" into the timber to approximate natural vegetative patterns.

Nonspecular conductor and treated steel towers would be used if necessary in sensitive scenic areas to reduce reflection.

Towers would be located as far as possible from the banks of rivers and edges of primary and secondary roads. An effort would be made to retain all but the tallest trees at high crossings and to screen the towers from the view of motorists with vegetation.

Towers would be located to minimize skyline effects.

Centerline selection would take advantage of topographic features to screen towers from view (behind ridges).

Roads would be designed to "fit" the terrain.

Access roads can be located to accommodate the access needs of recreation areas and parks.

Additional visual studies would be conducted during the design phase to reduce impacts.

4.08.2.2 Government

4.08.2.2.1 St. John River Basin

It is likely that the operational workers and the 10% of the construction workers who remain in the area would become active in community government. This may create changes in community services, facilities and governmental structure since new ideas would be brought into the region.

4.08.2.3 Municipal Services and Facilities

4.08.2.3.1 St. John River Basin

Demand on municipal services would decline as construction leaves the area. Some communities, however, would still have the burden of maintaining project-induced commitments. The lessening of flooding problems should reduce stress on police, public works and medical services.

4.08.2.3.2 Proposed Transmission Route

The impact of the transmission facilities on public and municipal services is likely to be slight. Contractors who had worked on a similar transmission line in eastern Maine, as well as the officials of municipalities along its route were interviewed and their responses indicated that there is no noticeable increase in demand for services or increased burden of work on town government, town planning boards, fire departments, conservation commissions, highway departments, police departments, public schools, hospitals, solid waste and sewage treatment facilities, water, private services, or private recreational facilities.

More of an impact on public and private services would probably be felt on the Fort Kent and Jackman areas. In the Fort Kent region, the impacts of the crews working on transmission facilities will be overshadowed by the construction crews working on the impoundment and hydroelectric facilities. The impacts, then, would add to those impacts, and depend to some degree on the actual timing of the transmission facilities construction.

Since Jackman, Maine, and Pittsburg, N.H., are relatively isolated, all service needs of workers in those areas would need to be met. The possibility of two work crews in the Jackman area would place further demands on services. Workers not commuting home on weekends would remain in the immediate area seeking entertainment. There is a possibility of the work crews having a slight to moderate impact on grocery stores, restaurants, and private recreational establishments. It is also possible that increased police services would be required in the evenings or on weekends when workers staying in the area will be seeking recreation. It is unlikely that other public or private services or facilities would be more than slightly impacted.

Emergency medical treatment facilities would be needed when transmission facilities construction was in progress. The remote areas of western Maine and northern New Hampshire would require special emergency transportation via helicopters because of the distances to hospitals and a lack of landing areas for airplanes. Hospitals closest to the remote area, such as at Fort Kent and Jackman in Maine, and at Berlin, N.H. would be involved.

4.08.2.4 Economy

4.08.2.4.1 St. John River Basin

4.08.2.4.1.1 Labor and Employment

During the operational phase of Dickey-Lincoln, 59 full-time and 9 seasonal employees would be necessary for maintenance. It is expected that the majority of these workers would be from local areas. Those jobs which require high degrees of technical or managerial skill, would most likely be filled by immigrants. It is expected that salaries from the project jobs will be higher than those generally found in the region for equivalent positions.

4.08.2.4.1.2 Tax Base

For some locations such as Allagash there would be a net property valuation loss due to the land consumed by the project. In Allagash, approximately 12,000 acres of forest land would be lost to the project. The value of this land as adjusted by the town's assessment ratio is approximately $105,000. At the current mill rate, the town would lose $40,000 annually. Loss of forest lands in the unorganized townships (approximately 100,000 acres) for taxation purposes amounts to $97,000 per year.[1]

A few energy intensive industries are usually attracted by the availability of low cost power. The intermediate range power from Lincoln School would provide power attractive to industry. However, peaking power is not particularly suited to fulfilling this need. To the extent that baseload power is better utilized through load diversification, peaking power may be helpful in keeping existing industry and encouraging new light industry.

4.08.2.4.1.3 Industry

Agriculture

Due to the large infusion of funds into the economy during construction, one can expect the general price level to increase as would farmer's budgets. This impact may overshadow the slight increase in demand for farm output within the county due to the construction of the dam. Baseline conditions support the contention that the economics of potato production could be very sensitive to the changes in the cost of production; at least for the majority of family farmers.

Forestry

In terms of how wood is utilized today, the acreage taken out of production due to Dickey-Lincoln would not materially

[1]Partial reimbursement for lost taxes would be possible through Public Law 94-565 which provides for payments to local governments by the Secretary of Interior.

impact the forestry sector of Aroostook County. The amount of land taken out of production (2% of total forest land in the county) would not be of sufficient size to have a major adverse impact. However, in the future, responses to increasing demands for wood would be limited by Aroostook's ability to provide raw materials.

The transport of timber would be greatly affected by the reservoir and major modification of this transportation system would be necessitated. This would significantly increase transportation costs. An area between the Little Black, Big Black and St. John Rivers could be cut off from direct access by the proposed impoundment. Access could be constructed by the landowners with negotiated severance compensation provided by the Federal government. Specific impacts would depend upon the road network and marketing patterns prevailing at the time of project implementation.

Other increased timber harvest costs would result from project implementation. Labor costs would increase due to longer times required for logging crews and management personnel to reach the timber harvest areas. Similarly, the costs of transporting machinery and the costs of maintenance would increase.

Other Industrial Sectors

The acreage taken out of production would not materially impact the manufacturing sectors of Aroostook County. Although the cost is large for the project life, annual costs are a small percentage of total manufactured products.

The demand for wood is expected to exceed supply in 15 to 30 years (1990-2005). Opportunity costs due to the foregone wood resulting from Dickey-Lincoln would begin to occur during these years. The implications for Maine and the County labor force are that they would not be able to realize the employment, wages, taxes and income otherwise possible if the wood were available.

4.08.2.4.2 Proposed Transmission Route

4.08.2.4.2.1 Sales and Tax Base

Under current assessment practice in the State of Maine, conversion of forest lands to a cleared right-of-way would actually increase, rather than decrease, the tax yields from those lands. The land, once cleared, no longer qualifies for Tree Growth Tax Law treatment. State assessors regard a right-of-way as a "high and better use" of the land, even if the power line is in tax-exempt public ownership and the landowner is unable to grow timber on it. For lack of empirical evidence as to the actual market value in this use, the rule of thumb currently used is to assess the property as before the change but on double the acreage, thus doubling the tax yield. The effect of the tax shift, then, will appear as a project cost to the extent that the landowner is able to include the capitalized value of expected tax levies in the compensation negotiated for the easement.

The impact of the transmission line on tax revenues from New Hampshire forest lands would probably be limited to yield tax losses. A number of powerline and pipeline rights-of-way through the state's forest lands exist where no distinction has been made between these rights-of-way and adjacent forested lands in assessing bare land value. Accordingly, the total tax loss in New Hampshire would be $322 per year (capitalized loss of $4885). The transmission route would probably have little effect on tax yields from Vermont forest lands. Except perhaps for highly-valued maple trees, market prices for these lands appear to reflect values other than for timber production. There might be some decrease in valuation in towns such as Jericho and Barre, where there is now considerable pressure for development, but remote forest lands in towns such as Guildhall and Lunenberg would probably not change in valuation under the route easement.

4.08.2.4.2.2 Industry

Agriculture

The impacts associated with temporary loss of economic production in the transmission line construction corridor are very site specific and cannot be determined until the final right-of-way is located, individual landowners are identified, and the number and location of access roads are known. Short-term impacts on agricultural land would occur during transmission line construction. Access roads would disturb an area 20 feet wide along the right-of-way.

Long-term impacts on agriculture would also occur at tower sites. Double circuit towers would remove an area measuring 50 by 50 feet from production. Each wood pole structure would remove 10 square feet from production.

The loss of productive croplands would be minimized by limiting the number of towers on croplands; the use of self-standing structures would limit the areas lost to production by guy wires. When a new line parallels an existing right-of-way, new towers would be located opposite existing towers, where possible, to reduce inconvenience to farming.

The disruption to standing crops would be mitigated by scheduling construction during non-growing seasons. Disturbances to livestock would be prevented through temporary fencing on the right-of-way or through the provision of alternate pasture lands.

Forestry

The overall impact would be an increase in the timber transportation costs. Unless the acreage removed from production by the transportation route would actually be needed to avoid a shortage of timber raw material in the future, then its withdrawal has no impact on the timber economy. Such needs are always difficult to forecast, and tend to be regionally specific.

The following estimates of opportunity costs due to the proposed transmission route assume a discount rate of 10 percent, deflated by an estimated average annual rate of inflation of 3 percent. The adjusted rate was used to capitalize the volumes listed in Appendix H, (DOE, 1978) multiplied by the values of shipments per cord. The maximum economic impacts, using conservative growth rates are:

Maine	$4,495,000
New Hampshire	3,083,000
Vermont	2,316,000
Total	$9,894,000

4.09 Cultural Resources

4.09.1 Archaeological Sites

4.09.1.1 St. John River Basin

There are 37 known prehistoric sites within the project area that would be inundated at the maximum pool height of 910 feet msl. All of these sites have been tested and evaluated (Appendix D, CE, 1977). There appears to be nine sites that fit the eligibility criteria for nomination to the National Register of Historic Places.

The mitigation plan for these sites would require four field seasons to complete the fieldwork, analysis and comprehensive ethnographic documentation of the study area. The estimated direct cost of mitigation totals $280,000 and is included in the project cost estimate.

4.09.1.2 Proposed Transmission Route

Dickey-Lincoln School - Fish River Segment

Two potential archaeological sites in St. Francis township are in the viewshed. They are the Xavier-Cyr Mill and an Indian burial ground in Jonesmill.

Dickey-Lincoln School - Moose River Segment

An archaeological site known as the Gorge-on-waterline is listed on the State register and is within view of the line.

Moose River - Moore Segment

Three archaeological sites were identified: Fort Wentworth, 1775, which is listed on the State register; the remains of an 18th century fort north of Guildhall; and cellar holes north of Lunenburg, VT.

Moore-Granite Segment

Three archaeological sites are listed on the State register, two on the route, and one in the viewshed.

Granite-Essex Segment

One archaeological site was listed on the State register. This is the Bolton Falls site, a rock shelter in Washington County.

The transmission route studies were not intended to locate all archaeological resources within the routes. There is a moderate potential for presently unknown sites also occurring in each of the five segments. If project construction is authorized to proceed, further intensive surveys would be accomplished to locate such sites and a comprehensive mitigation plan for impacted sites would be developed.

4.09.2 Historic Sites

4.09.2.1 St. John River Basin

There are six historic period sites in the Seven Islands area which are considered to be significant and fit the eligibility criteria for nomination to the National Register. These six sites are presently being considered as an Historic District instead of individual sites. This historic district would be totally inundated should the proposed project be constructed.

A comprehensive mitigation plan has been developed on the assumption that this region will be nominated to the National Register. It would require an estimated one year of historic research, three years of field work and one year to integrate data and prepare the final report. The total estimated direct cost is $545,300 which is included in the project cost estimates.

4.09.2.2 Proposed Transmission Route

Dickey-Lincoln School - Fish River Segment

One historical site on this segment is within view of the line. It is the Villa d'Aigle house in St. Francis township.

Dickey-Lincoln School - Moose River Segment

One significant historical area on this segment is where the line crosses the abandoned Bald Mountain Railroad in Somerset County.

Moose River - Moore Segment

There are 11 historical sites within the viewshed of this segment. Six are within the viewshed but are outside the route. Four sites are on the State register: The Guildhall, VT Common Area, the

Guildhall Central School, and the Old Crawford home in Guildhall, and the Arnold Trail. The Trail is also on the National Register. Also of significance are an 1820 house near Littleton, N.H. and two 19th century frame houses in the township of Guildhall.

Moore-Granite Segment

There are 16 historical sites on this segment. Seven are within the one-half-mile-wide route. Nine of the sites are identified on the State Register. Significant sites within the route include the crossing of the Bailey Hazen Military Road in Ryegate, VT; the Bouville route in Groton, VT; the Downing Lot Cemetery; the Joseph Calef Place, two 19th century frame houses in Groton, VT; and a 19th century cemetery in Concord, VT.

Granite-Essex Segment

There are 37 historic sites along this segment, five of which are on the one-half-mile-wide route. Twenty-nine of these historical sites are listed on the Vermont State Register. Four sites were determined from other sources. The line would cross two Indian trails, the Winooski River Trail and the First Branch River Trail, both in Washington County, VT.

No standing structures need be impacted directly by the proposed construction. Historically significant standing structures may be impacted by the intrusive effect of facilities construction (indirect impact). The close proximity of the right-of-way to Peacham and its late eighteenth century tavern is an outstanding example of this impact potential on standing structures. Other areas with potentially significant structures lie mostly in Vermont along the Winooski River (Williston and Plainfield, Peacham and Guildhall) and at Whitefield, New Hampshire.

With the exceptions noted above, there were no resources discovered which would be of such significance that mitigation would be impossible at this stage in the planning process.

4.10 Aquatic Ecosystem

4.10.1 General

4.10.1.1 St. John River Basin

The most serious effect of Dickey-Lincoln School Lakes Project implementation on the aquatic ecosystem would be that substantial portions of the St. John and Big and Little Black Rivers' drainages would be changed from flowing water to standing water habitat. This change would involve a shift in the makeup of the entire ecosystem.

4.10.1.2 Proposed Transmission Route

Right-of-way clearing, construction of access roads and transmission facilities would result in short-term impacts on aquatic ecosystems. Of particular concern is erosion and the consequent sediment impact to the streams, wetlands, and lakes.

The major impacts of the transmission line of the aquatic ecosystems are:

1. Sediment runoff from line construction activities;
2. Sediment runoff from access road construction;
3. Herbicide runoff from line maintenance activities; and
4. Increased water temperatures from removal of streamside vegetation.

4.10.2 Rivers and Streams

4.10.2.1 St. John River Basin

The proposed project would inundate 278 miles of streams and rivers in the basin, 66 miles of which are along the main stem of the St. John River. Table 4.10-1 displays the relationship between mileage inundated and total mileage present within the watershed above the proposed Dickey Dam; the mileage of stream and river inundation within the United States and Canada.

TABLE 4.10-1

RELATIONSHIP OF STREAM INUNDATION TO TOTAL LENGTH OF STREAMS IN THE WATERSHED ABOVE DICKEY DAM

	Area (sq. mi.)	Length Inundated U.S.	Length Inundated Can.	Length Inundated Total	Total Length of Streams in Watershed
Project Area (Dickey Dam to Ninemile Bridge)	1,380	246.7	20.4	267.1	961.8
St. John River (Upstream of Ninemile Bridge)	1,345	0	0	0	950
Total	2,725	246.7	20.4	267.1	1,911.8

The total project area can be broken down into subwatersheds for a more detailed analysis of the inundation impact. The subwatersheds are the Little Black River, Pocwock Stream, Cheminticook Stream, Big Black River and the local drainage into the St. John River between the Dickey Dam site and Ninemile Bridge. In terms of percent of stream which would be inundated, they are 43, 24, 14, 8 and 30 percent, respectively. Further analysis is provided in Table 4.10-2.

TABLE 4.10-2

STREAMS INUNDATED BY DICKEY LAKE
(Elevation 910 feet msl)

Stream	Length of Inundated Reach (miles)
Big Black River	26.4
Shields Branch	16.4
Billy Jack Bk.	0.6
Bishop Bk.	0.7
Blue Bk.	3.4
Brown Bk.	4.2
Bruleau Pond (Brook from)	0.9
Campbell Bk.	1.8
Carrie Bogan Bk.	0.8
Carter Bk.	1.4
Charles Pond (Brook from)	0.6
Chimenticook Stm.	4.8
Conners Bk.	1.7
Cunliffe (Bk. at the dike)	3.6
Depot Stm.	2.1
Falls Bk. (Little Falls Pond)	3.1
Falls Bk. (Falls Pond)	0.6
Fishing Bk.	1.7
Fivemile Bk.	2.5
Fox Bk.	3.0
Good Bk.	0.3
Hafey Bk.	2.5
Hafford Bk.	1.1
Halfway Bk.	0.5
Harvey Bk.	0.8
Houlton Bk.	0.2
Johnson Bk.	2.0
Kelly Bk.	1.3
Knowland Bk.	1.7
Little Black River	31.6
Beaver Branch	0.5
Campbell Branch	1.5
West Branch	5.3
Little Hafey Br.	2.5
Little St. Roch R.	0.7
Lizotte Brk.	0.7
Meadow Brk.	1.2
Moores Bk.	0.9
Morrison Bk.	0.9
Ouellette Bk.	1.0
Oxbow Bk.	1.5
Pocwock Stm.	7.6
East Branch	1.4
Poplar Island Bk.	1.3
Priestly Bk.	1.7
Riviere des Gagnon	0.6
Riviere St. Roch-Nord	0.2
Rocky Bk.	5.8
Saint Amants Bk.	0.3
Saint John River	54.9
Seminary Bk.	0.8
Thoroughfare Bk.	0.5
Two mile Bk.	1.7
Walker Bk.	0.8
White Bk. (White Pond)	1.1
White Bk.	0.4
Whitney Bk.	2.2
West Branch	1.3
Un-named Streams	45.5
TOTAL	267.1

4.10.2.2 Proposed Transmission Route

Dickey-Lincoln School to Fish River Segment

The majority of the rivers and streams along this route segment are crossed perpendicularly by the route and would be moderately impacted by sediment and herbicide runoff. This would include both Fish River and the Allagash River.

Petite Brook, a high quality trout stream is paralleled by the route and is within the proposed right-of-way. The stream would be severely impacted by the disturbance or removal of streamside vegetation during construction.

Dickey-Lincoln School to Moose River Segment

The majority of the streams identified in Section 2.11.1.2 would be crossed perpendicularly or obliquely by the route and could be moderately impacted. Impacts by sedimentation and herbicide runoff is of particular concern to: the south branch of West Twin Brook where the route parallels the stream for about one-eighth mile to Blue Pond and a medium size wetland on Little Penobscot Brook. The tributaries and outlets from Baker Lake would be particularly sensitive to sedimentation impacts during the fall spawning season of salmon and brook trout. Alder Brook and Alder Stream would also be impacted by sedimentation and runoff.

Moose River to Moore Segment

Most impacts to the aquatic ecosystem in this segment of the route would be caused by sedimentation and herbicide runoff. Almost all of the streams in this segment were judged to have impacts considered moderate or greater. The Cupsuptic, Magalloway, and Nash Rivers could be impacted by sediment and herbicide runoff as well as removal of streamside and wetland vegetation during the construction activities. The Kennebago River is especially vulnerable to impact during the fall spawning season.

The impact on the aquatic ecosystem would be greatest in the portion of the route between Moose River Substation and Groveton, N.H. A tributary to the Connecticut River between Groveton and Moore Reservoir is parallel for about one-half mile and could be severely impacted by the removal of streamside vegetation during construction. Also of concern between Groveton and Moore Substation is Catbow Brook and Miles Stream both of which could be highly impacted.

Moore to Granite Segment

The majority of the aquatic ecosystem resources in this segment would receive low to moderate impacts. The exception to this is where the right-of-way parallels Manchester Brook, Keenan Brook, Waits River, and a tributary to Waits River all of which could be impacted by the removal of streamside vegetation during construction and by sedimentation and herbicide runoff.

Granite to Essex Segment

The streams in the first part of this route between Granite Substation and a location just north of the Montpelier-Barre Regional Airport would have moderate impacts. A mile of route along the stream bed of the Dog River could be severely impacted by sediment and herbicide runoff.

Where Kelley Brook is paralleled and crossed, this Brook could be highly impacted by sediment and herbicide runoff. The impact on parts of the Winooski River, where the transmission line would be close and parallel, could be highly but locally significant.

4.10.3 Lakes and Ponds

4.10.3.1 St. John River Basin

The proposed Dickey Reservoir would inundate 30 identified ponds and numerous temporary beaver ponds. Twenty-eight of the identified ponds have an area of less than 0.1 square miles. Falls Pond and Little Falls Pond have surface areas of 0.4 and 0.1 square miles, respectively.

4.10.3.2 Proposed Transmission Route

Dickey-Lincoln School to Fish River Segment

The Dickey-Lincoln School to Fish River Segment is essentially the same as discussed for the St. John River Valley.

Dickey-Lincoln School to Moose River Segment

Canada Falls Lake, Trickey Pond, Alder Ponds, Long Pond and associated wetlands could be impacted from sedimentation and runoff.

Moose River to Moore Segment

Those lakes and ponds identified in Section 2.11.2.2 would experience impacts from runoff and sedimentation.

Moore to Granite Segment

The impact to Coburn Lake near the Connecticut River across from Monroe, N.H. could be high.

Information on the impacts associated with those species associated with aquatic resources along the transmission route is presented in Appendix E (DOE, 1978).

4.10.4 Dickey Reservoir

Dickey Lake would represent a deep, cold impoundment with a relatively long shoreline, limited littoral development, and an extensive but well-oxygenated hypolimnion.

Primary productivity within the impoundment would be derived primarily from phytoplankton. Water level fluctuations and resulting erosion and freezing would severely limit rooted plant and bottom growth in the near shore areas. Primary productivity in the impoundment would be comparatively low due to phosphorous limitation.

Zooplankton abundance after the impoundment reaches steady-state conditions should also be comparatively low. Relationships compiled on a world-wide basis indicate that zooplankton production is closely correlated with primary productivity. However, zooplankton are also linked to the detritus cycle. For this reason zooplankton productivity may be, at least initially, enhanced by the organic matter contributed by the flooded forest. Downstream zooplankton losses would probably be comparatively low due to the midwater placement of the Dickey Dam outlet works.

Near shore bottom dwelling organisms' productivity would be affected by winter powerpool drawdown. The combined effects of erosion, freezing and attendant low plant community production would render most of the near shore substrate unsuitable as habitat for near shore animals. These animals are an important component in the diet of brook trout and other fish species and would be restricted to isolated stumps, rocks, and other irregularities in the otherwise sand-gravel-cobble-bedrock periodically exposed areas. A zone of maximum benthic productivity would develop in the area of fine sediment deposition just below the average winter drawdown level.

Deep water bottom conditions should be nearly ideal for the establishment and maintenance of benthic fauna. Comparatively high insect larvae and worm productivity would be expected as a result of the flooded forest, which would provide both food and substrate for these animals.

A period of initial high benthic productivity would occur during, and for the first few years following, filling. In this period, shallow water forms would be comparatively abundant as a result of inundating the surrounding forest. As erosion resulting from several winter's drawdown proceeds, habitat succession and reduced detritus availability would make the shallow water zone progressively less suitable for benthic animals.

Initial fisheries productivity would be largely limited to the near shore and deep water bottom regions of the proposed impoundment; there are presently no open water fishes other than landlocked salmon within the project area, and these landlocked salmon would probably not reproduce successfully. The most abundant species would most likely be longnose suckers, white suckers, burbot, sculpins, round whitefish, lake chubs, fallfish, and brook trout. Yellow perch and brown bullheads should also be common during this period.

Species such as brook trout and yellow perch would be stressed to some degree as the reservoir reaches a steady state. Shallow embayments would favor yellow perch, fallfish and sucker, whereas brook trout and sculpins would be favored by the deeper, cooler waters near shore.

Several combinations of open water forage and game fish could be considered for introduction. The proposed impoundment is best suited for deep water spawning lake trout.

Lake trout can live on a variety of forage species. In addition to threespine sticklebacks, which are already present in the project area, three species are available for consideration (smelt, alewives, dwarfed lake whitefish). Of these, dwarfed lake whitefish probably represent the best choice in terms of lowest potential interference with the brook trout fishery. Should the whitefish lose their dwarf characteristics and grow to normal size after transplantation, fully-grown individuals would be too large for lake trout forage and would compete for food with juvenile lake trout. They would, however, provide an additional sport fishery. An additional potential problem is that whitefish spawn during autumn; their eggs may also be exposed during the winter. Results of Swedish investigations indicate that sufficient eggs would survive to ensure adequate recruitment.

Landlocked alewives are also well suited to the proposed project. This species would have no trouble with water levels, as it spawns in spring. It would not compete as directly with brook trout or young lake trout as would some other pelagic forage species. In addition, deepwater-spawning lake trout and landlocked alewives could be introduced simultaneously from the same source, possibly increasing the likelihood that the alewives would be utilized as forage.

A landlocked salmon fishery in Dickey Lake would require stocking of considerable numbers of yearlings either annually or every other year. Natural reproduction in streams may occur, but it would most likely be insufficient to support a fishery of any magnitude. In addition, landlocked salmon would most likely require smelt for forage. Smelt may also invade the impoundment naturally; they have already spread throughout the lakes of the Allagash system. Should they become established either through introduction or naturally, smelt should be very successful in Dickey Lake.

Clearing strategy involving tree removal to a depth of 828 feet while leaving stumps and brush probably represents a reasonable compromise for maximizing sport fishery production. Removing the trees would allow pelagic species to associate with the substrate and allow fishermen to troll near bottom. Leaving roots and shrubs would stabilize the littoral substrate somewhat, increasing benthic productivity and brook trout growth. Yellow perch would also benefit from this, but water temperatures would still limit their distribution to the warmer, shallower embayments.

Sport fishery productivity in the proposed impoundment should be similar to that reported for other large New England oligotrophic lakes. Annual yield on the order of 0.18 lb/acre/yr result from the lake trout-brook trout management, based on regression estimates. Direct return-to-creel computations reveal a potential annual yield of 0.07 to 0.35 lb/acre/yr for landlocked salmon plantings. Productivity would probably not be additive if both species were introduced.

Mercury contamination could be a problem among the large lake-dwelling sport fishes. Lake trout, by virtue of their greater longevity and more pronounced fish eating habits could be the most seriously affected. Finally, the reservoir could become a trap for persistent pesticides should current forest spraying restrictions be relaxed in the future.

4.10.5 *Lincoln School Reservoir*

The Lincoln School Reservoir would be well oxygenated, and completely mixed as a result of turbulence. Because of Dickey Lake's influence, water temperatures would only reach a maximum of 59-61^{o}F during midsummer.

Phytoplankton would be the dominant Lincoln School primary producers. Short-term water level fluctuations and resulting erosion would render much of the littoral substrate unsuitable for rooted plants and periphyton. Nutrients exported from Dickey Lake's hypolimnion would be available in quantity during the summer. As a result, Lincoln School primary producers would be limited by light availability rather than nutrients. Zooplankton would be abundant in Lincoln School Reservoir as a result of inputs from Dickey Lake.

The Lincoln School fish life would be dominated by those tolerant of cold temperatures and either able to reproduce within the Lincoln School area or import recruits from Dickey Lake of influent streams. Examples would be burbot, sculpins, smelt, longnose suckers, blacknose dace, lake chub, lake trout, and landlocked salmon. Lincoln School Reservoir would support marginal fisheries for cold water forms. Temperature would be below optimum for brook trout and salmon throughout the year, but would be near ideal for lake trout during summer.

Streams and lakes within the Lincoln School Area would be unaffected by the proposed project due to the presence of migration barriers in the lower reaches of most tributary streams. Nitrogen gas supersaturation would not be a problem given the proposed Dickey Dam outlet configuration.

4.10.6 Downstream

The existing biota of the downstream area would be altered and a new equilibrium would be established. This would involve the elimination of species that could not adapt to the new environment and the introduction or proliferation of those forms well suited to the new conditions. Fluctuating discharges such as those expected from the proposed project would reduce the diversity of both the plant and animal communities for some distance downstream. Water conditions in the St. John below Lincoln School would be cold, clear and fluctuating 3 to 4 feet daily. A decrease in plant and animal diversity is expected. This loss in diversity would be most apparent near the project. Diversity in the plants and animals would increase progressively downstream as the daily discharge fluctuations are dampened by input flows from the St. Francis and Fish Rivers.

The cold, variable-discharge habitat of the Downstream Area would be populated primarily by brook trout, blacknose dace, creek chubs, common shiners, longnose suckers, slimy sculpins, and burbot. Landlocked Atlantic salmon, lake chubs, and fallfish could also become established in the upper portions of the reach. In addition to these species, white suckers, brown bullheads, and yellow perch would likely remain in the St. John River below Fort Kent.

4.10.7 Aquatic Insects

Based on the habitat requirements indicated by the distribution of the organisms in the study area and from a review of the literature, it is apparent that 70% of the insect fauna now present at the sampling sites would not be present in Dickey Lake. The change from a running water to a standing water habitat would eliminate organisms dependent on flowing water. All non-insect fauna now present at the sampling sites would be present in Dickey Lake. It is also expected that 9% of the insect fauna and 33% of the non-insect fauna would persist in limited areas of Dickey Lake while 21% of the insects and 67% of the non-insects would be found widely occurring within the project area.

A more varied insect/non-insect fauna would be expected to persist in the Lincoln School Reservoir with a number of rheophilic forms included. Exactly which of the existing species would survive the lowered temperature regime is difficult to predict.

4.11 Terrestrial Ecosystem

4.11.1 Vegetation

4.11.1.1 St. John River Basin

The proposed project would inundate 80,455 acres of terrestrial habitat (excluding waterways, lakes and ponds). Due to the natural distribution of plant communities in the St. John River valley, there would be greater losses of spruce-fir forests. Critical riparian habitats which support several rare and unusual plants would be inundated.

A periodically inundated zone would occur along the Dickey reservoir shores due to hydroelectric operations. Grass and sedge communities with limited shrubs are expected to dominate the seasonally flooded areas. The presence of specific emergents such as bulrushes, cattails and wild millet would depend on the time of year when the area is exposed, amount of subsequent flooding and vegetation already in the vicinity. In general, there would be sparse vegetational development along the perimeters of the two reservoirs. In sheltered areas or those less subject to stress conditions due to periodic flooding and exposure, a more vigorous and diverse vegetational community may become established. Plant development on rocky or steep slopes, such as those near the dam sites, would be restricted or in many cases prevented. The nature of forest soils in the project area may create problems for vegetation establishment on the shoreline terrace. Glacial till soils supporting spruce-fir are shallow with a hardpan layer often within 18 inches of the surface. Erosion of the surface soils due to natural events would create poor sites for plant development. The delta sites at the mouth of tributaries to the reservoir, such as the Big Black River and the Shields Branch, may provide a supply of silt that would encourage emergent wetland types.

Shrubs such as speckled alder, redosier dogwood, and willow are expected to be significant lakeside communities. Stressed trees along the edge of the reservoir may be subject to increased disease, insect attack and windthrow. The lake expanse would also create windthrow problems extending beyond the lake edge. Shallow rooted species such as spruce-fir would be especially susceptible.

4.11.1.2 Proposed Transmission Route

<u>Dickey-Lincoln School to Fish River</u>

The alteration of adjacent plant communities is likely to be greatest near the confluence of the Allagash and St. John rivers, near McLean Brook, and near where the route crosses Wheelock Brook.

<u>Dickey-Moose River</u>

The alteration of the adjacent plant communities would be greatest at certain locations on the first 35 miles of the segment. Most of these locations are in the area between Baker Lake and Dickey Substation.

Several cedar swamps on this segment are cause for concern. They range in size from 5 to 74 acres and are discussed in detail in Appendix E (DOE, 1978).

<u>Moose River-Moore</u>

Alterations of adjacent plant communities may occur along 52 miles of the segment.

<u>Moore-Granite</u>

There are many areas along this segment where alterations of the adjacent plant communities could be substantial. Twenty-one miles of the route have locations where significant alterations might occur.

<u>Granite-Essex</u>

Areas where adjacent plant communities are most likely to be altered occur along 28 miles of the segment.

A discussion of impacts on vegetation relating to microclimate, ozone generation, and snowmobile traffic can be found in Section 3, Appendix E (DOE, 1978).

4.11.2 Forestry

Presently, the most productive forest lands in the watershed occur within the area to be inundated. The loss of 76,173 acres of commercial forest land represents approximately 2 percent of the forest land in Aroostook County. An additional 13,400 acres would exist as islands, thus being less accessible for harvesting. This loss would not be only for the duration of the project, but also for the time required to restore the area to productive forest. Forest lands within the Dickey-Lincoln Impoundments support an estimated 1.4 million cords of growing stock. The average for all species is 18.9 cords per acre. In Aroostook County, the average for all species is 17.5 cords per acre. The predominance of spruce-fir which averages 18.5 cords per acre accounts for the greater growing stock average on the project site than for Aroostook County. The total growing stock for all species in the county was estimated to be 61.9 million cords. The impact on forest resources includes the loss of expected growing stock increasing during the life of the project. Growing stock volumes in Maine have been steadily increasing since 1958. If present forest management were to continue on the proposed project site, stand improvements would improve growth and convert standing volumes of rough or rotten trees to growing stock. Timber harvesting operations could also be seriously impacted by the procurement of additional forestlands for fish and wildlife mitigation. It is expected that cutting operations would be instituted for the maximum benefit of wildlife populations which may not be consistent with economic timber production.

Impact on current operations would also include disruption of approximately 75 miles of private forest access road systems.

Long-term impacts include the loss of land suitable for future intensive forestry. The primary softwood sites at lower elevations are responsive to silvacultural treatments. Depending on the forest economy, it may be feasible to intensify forest management only on the most productive sites. Loss of primary sites also affects the economics of operations in the area. There would be higher operating costs in the hilly terrain. Operations in poor quality hardwood stands that presently have a limited pulpwood market may not be economically feasible.

The harvesting of portions of the inundation area could create timber supply problems. Harvesting would include a greater proportion of spruce-fir. The volume cut annually during construction would have to be carefully regulated to maintain a stable forest economy. Even if carefully planned, concentrated harvesting in the project area would affect cutting cycles in surrounding forests. It is anticipated that operations would be affected for a ten year period. In the future, the loss of this commercial forest land may force intensified management of surrounding forests. Intensive forestry in surrounding lands could maintain the pulpwood economy in the area, but it would take long-term management to replace sawtimber growing stock.

Project implementation would mean the loss of an annual net growth range for all species of 25,825 to 34,525 cords of wood. Annual net growth for spruce-fir on the project site (75% of timberland acreage) is estimated to be 40,681 cords from 56,976 acres. Spruce-fir dominates 67% of the mixed forest on the project site. The total mixed forest (16,538 acres) has an estimated annual net growth of 8,770 cords for all species. Hardwood forests average 900 cords net growth per year within the impoundments.

Hardwood and mixed forest found on the uplands within the study area presently have a lower net growth than primary spruce-fir sites. These upland soils are productive but would require intensive management to produce fast-growing merchantable hardwoods or to maintain softwoods.

In evaluating long-term effects, it must be recognized that forest stands have been increasing in productivity due to management and recovery from past damage. This increasing trend should continue during the life of the project. The impact is greater than the loss of the existing forest as returns have not been realized from recent selective management.

A major impact would be on utilization of surrounding forest lands. There is expected to be a decrease in harvesting during the project construction followed by increasing harvesting to meet timber demands. Utilization of certain tracts would be altered due to limited access.

4.11.3 Wildlife

4.11.3.1 St. John River Basin

The conversion of 80,455 acres of terrestrial habitats into aquatic habitat would have an effect on the resident wildlife as well as upon those animals which utilize onsite habitats for only a portion of the year (e.g. whitetail deer wintering areas).

Resident mammals would perish or be displaced into adjacent habitats with the advent of reservoir filling. If these adjacent habitats are already occupied at the maximum carrying capacity (it is assumed that they will be), the displaced animals would be literally forced to move on. These displaced animals would continue to move until they either find an unoccupied habitat or succumb to any of a number of causes such as exhaustion, predation, exposure, and territorial fighting.

Some species, including the whitetail deer, would occupy habitats for short periods of time at carrying capacities exceeding the maximum sustained annual yield level. This situation reduces the carrying capacity through overbrowsing which is one of the major factors controlling populations. The result would be lower populations on lands surrounding the project area.

The conservative approach is to conclude that all displaced resident mammals would perish. This conclusion may not apply to all species, due to special circumstances which are presently influencing populations on the project area. The moose population is apparently benefiting from the current forest harvesting activities and is increasing in number each year. It thus appears that some of the moose may survive and occupy habitats on areas outside of the reservoir. Other species (fisher) seem to be increasing their population size within the project area. These species may have more members survive than other species whose populations are either stable (black bear) or declining (lynx).

Filling of the reservoirs would influence more animals than those which reside only within the impoundments. The best example of this class of animals is the whitetail deer. Deer use wintering areas which are located within the impoundments, but for the remainder of the year may reside on areas outside of the project area. The distance that a deer will travel to a wintering area has not been definitely established. Research has suggested six miles as the distance deer will travel to a current logging operation in order to browse on the tops of felled trees. Deer may travel such distances or greater to get to a wintering area. Thus, the removal of 36,893 acres of deer wintering areas within the impoundments can be expected to affect deer from a much larger area. It is assumed that one half ot the deer within 23 townships of the St. John region (684,500 acres) would be affected by the impoundment. Average annual deer population (over winter), without the project, is 7,964 deer; with the project, 4,151 deer. An average total of 3,813 deer would be lost due to the project (Appendix F, Supplement, CE, 1978); within the first two to three years.

Depending upon the treatment of the reservoir areas prior to inundation, some mammals would be affected more severely than others. If the forests within the area of inundation are left standing as the area is flooded, the population of the pool area would be affected as stated previously. If the merchantable timber is harvested from the pool area prior to flooding, two situations, with differing impacts, are anticipated. First, if harvesting progresses from the 913 elevation towards the dam, a period of time would pass prior to actual flooding. This period of time may be comprised of five or six years of timber harvesting plus two years of flooding. Provided that this or a similar time frame is realistic, the area at the 913 elevation would have undergone secondary succession for a total of seven to nine years. Animal populations would have responded to the new habitat and, in general, the rodent and other small mammal populations would have increased. Other species would respond to the habitat change with an increased utilization of the clear-cut area. Examples include whitetail deer, moose, and the larger carnivores. Thus, as the reservoir is filled, an increased population of mammals would be forced into adjacent habitats.

The second situation involved harvesting progressing from the dam site towards the 913 elevation with flooding occurring almost immediately after harvesting. In this situation, the maximum time interval between clearcutting and flooding should be about three to four years. Secondary succession would not have advanced to the extent previously mentioned and therefore the mammalian populations would not have responded to the new habitat situation as completely. It is expected that the lowest population would exist on the inundation area at this time and minimum mammalian impact would result. Resident mammals remaining after clear-cutting would be displaced by the rising water level, but the number displaced should be the lowest for any of the alternatives discussed.

Animal movements would be affected by inundation of the reservoirs. Two types of migration would be affected: altitudinal migration and local migration. The most important species affected is the whitetail deer which migrates locally between its summer range and wintering areas. Altitudinal migration probably also occurs with whitetail deer, and perhaps with a few other species or individual animals such as the river otter and black bear.

The creation of new islands within the impoundment may alter the genetic pool of insular forms. Such genetic changes would occur only over long periods of time with genetic isolation and would result either from a limited genetic pool on the island, or severe selective pressure. If genetic change does occur, the creation of a new subspecies would be a probable result. However, this is deemed unlikely for highly mobile species, due to the minimal distance of islands from the mainland, and the presence of ice during winter which would limit the potential for genetic isolation.

Another impact typical of newly created island populations is the eventual loss of a species from the island. This loss generally occurs when the island is not sufficiently large enough to maintain a minimum breeding population This may occur with some of the larger mammals (e.g., lynx, and black bear), which have large home ranges and are isolated on a small island. Since the impoundment would freeze each winter, the possibility for movement onto or away from the islands should reduce this impact. However, the breeding population on the island would still be eliminated and species presence would be intermittent.

During flooding, temporary islands would form within the pool area. It is expected that mammal populations would increase on these islands and that these animals would perish as the water floods the temporary islands.

Permanent islands would experience the same increase in population density as animals are trapped by the rising water and forced to concentrate in a smaller area. Mortality factors would operate on these animals and the population would decline. The potential exists for reduction of the carrying capacity of the island if overbrowsing occurs. This would result in a lower carrying capacity than prior to the filling of the reservoir.

Lake ice would create another impact for animals which attempt to cross the ice. An increased frequency of injuries due to falls on ice is expected due to the approximately seven-fold increase in water surface in the study area. Additionally, predation should increase for those animals which are caught out on the lake ice, especially whitetail deer.

Total standing crop of mammals within the project area would be reduced due to the loss of 80,455 acres of terrestrial habitat. This is approximately 20% of the acreage within two miles of the lake. For species which are more specific in their habitat requirements, the change in standing crop may be either greater or less than 20%, depending upon which habitat the species occupies. Species typical of the northern hardwood type (deer mouse) would be affected much less, as there is very little loss of hardwoods in the impoundments.

Species typical of the spruce-fir forest (red squirrel) would be more severely affected, as a majority of the pool area is comprised of softwood types. Changes in total standing crop cannot be specified as the percent habitat utilization by each species is not known. However, the maximum reduction in standing crop of a species should occur with the whitetail deer, where a 50% reduction in the population of the St. John region is expected. Some mitigation of this impact is possible.

Mean productivity of individual animals outside of the impoundments is not expected to change. A slight reduction in productivity may be observed during inundation of the flood pools for those species which respond to high populations with reduced fertility or productivity. Any reduction in productivity should return to normal within a few years after inundation of the impoundments.

Harvest pressure on the wildlife resource would change from the present pressure due to two factors:

1) decreased game populations within the areas as a whole (although the population per unit area may not be significantly changed). and

2) increased population of humans in the area partially due to personnel required for construction of the dams and personnel required to operate the facilities.

Construction of the proposed project would create temporary impacts on mammalian populations in the immediate vicinity of construction activities. The immediate impact would result from land clearing activities. More mobile species would leave the vicinity of the disturbance.

As the reservoir level reaches the 910 elevation, the displaced mammals would have reached their maximum density adjacent to the reservoir and on the interior islands. Maximum mortality of these mammals would begin at this time and continue for perhaps two years. Grazing mammals would be the first mammals to experience mortality; carnivores would be the last.

A limited number of species may benefit wherever shallow water edges occur. This benefit would ultimately depend on the degree of reservoir fluctuation. Minor water level changes can be expected to reflect the pattern of precipitation, power plant operation and evaporation.

Fluctuating water levels and drawdowns would have an adverse impact in the long term on waterfowl nesting and productivity. Temporary increases in waterfowl use of the impoundments can be expected for a few years after flooding. Species such as dabbling ducks, herons and shorebirds may benefit from an increase in aquatic habitat. Loons, grebes, coots, bitterns, and marsh hawks also breed near or on the surface of lakes or ponds. It is expected that fluctuations in pool level would negate any attraction a new habitat may offer over the long term use for these species.

The existence of the reservoirs may attract eagles and ospreys, but initial clearcutting of portions of the reservoir area and inundation would eliminate the osprey nesting sites within the project area and force breeding pairs to relocate onto adjacent areas. Bald eagle production is low in Maine and the availability of adequate nest sites would be limited onsite by human activity and forest management. Currently there are no nesting eagles in the project area. The osprey would also be affected by these two factors. Other birds of prey, hawks and owls, would essentially lose preferred habitat.

Species in higher trophic levels may be impacted over a longer period of time. It appears that predicted declines of the budworm will in itself reduce avian production within the St. John watershed. Implementation of the project would eliminate the main food supply for nearly all bird life within the impoundment area.

The impact upon migratory summer bird residents would limit production and decrease avian population due to the loss or preferred habitat for territorial birds occupying the 80,455 acres of terrestrial habitats in the project area. Displaced populations onto adjacent habitat would be stressed as a result of increased competition for optimal breeding habitat, increased competition upon a predicted declining insect population, and poor reproductive success.

The impact of the proposed project on the amphibians and reptiles of the study area would be adverse. Production of terrestrial salamanders, snakes and terrestrial turtles would drop to near zero within the 80,455 acres of terrestrial habitats on the project area. Some emigration of these species could be expected from the project area. Some snake species are expected to remove themselves rather easily as inundation occurs; frogs should be able to survive inundation fairly well. Salamanders and toads are not expected to survive initial inundation. A permanent increase in these species populations on land adjacent to the impoundments is not expected due to the combined effects on predation, exposure, and competition. Aquatic species of salamanders, snakes and turtles may respond positively to an increase in aquatic habitat.

Implementation of the dam may isolate population of the wood turtle and prevent them from invading northeastern Quebec at least through northern Maine. Too little is known about Maine populations of herpetofauna to suggest any benefit from the creation of large lakes in Maine.

4.11.3.2 Proposed Transmission Route

The creation of a continuous 150-foot wide strip of predominately regenerating habitat over a three-state area would provide a corridor that would enhance the dispersal of many species. Increased dispersal of some species would allow increased genetic mixing of their populations. Where the line crosses roads, increased road kill, especially birds, is expected. Table 3.08-1 (Draft EIS, DOE, 1978) indicates the status of all terrestrial vertebrates inhabiting the region and the impact of the transmission line upon them.

In areas that now have few clearings, the route would serve to create clearing and more open areas. By creating this corridor, the northward range of several wildlife species adapted to early successional stages would be expanded. The migrants could compete with species now inhabiting the forested areas and perhaps create an adverse impact on these species.

The regeneration habitat created by the right-of-way, the edge associated with it, and the edge associated with access roads would usually benefit wildlife diversity and productivity. This effect would be most noticeable in regions which are mostly forested. Analysis of edge effects is presented on a species basis in Table 3.08-1 (Draft EIS, DOE, 1978).

Serious fragmentation of large blocks of habitat by clearing surrounding land could lead to a long-term loss of species in these blocks. Fragmentation creates "habitat islands", and bird species which breed on these forest islands tend to be plagued with more egg predators, brood parasites, and non-native nest-hole competitors. Most vulnerable are ground-nesting and hole-nesting species, and neo-tropical migrants (e.g., warblers and flycatchers).

There is the slight possibility that the 150-foot right-of-way and access roads might be sufficiently wide to isolate some forest tracts into "islands". The cummulative effect of this impact could be great. It would be most likely to occur in areas having a high percentage of fields, such as in western Vermont.

The transmission facilities may impact wildlife populations through disturbances caused by increased human activity and off-road vehicle traffic. The area may be avoided by some species of wildlife. Game species and fur-bearers may be subjected to increased harvest pressure.

Electrical effects from the proposed lines are not expected to have any impact on wildlife.

Powerline structures could serve as barriers to movement for a few mammals that are very sensitive to disturbance by man. Powerlines may also cause wetland habitat to be avoided by nesting waterfowl. Because powerlines are used by birds of prey for perching, electrocution of these birds sometimes occurs, but the steel tower or H-frame wood pole design proposed for use would greatly reduce this possibility.

Disturbance impact during construction was assumed to be of higher intensity but shorter duration than disturbance impact after construction. Collision hazard was assumed to be greatest among large birds, birds that concentrate along narrow migration routes (e.g., many waterbirds), and breeding birds having nocturnal aerial display. Vegetation control would alter wildlife habitat, but this impact would depend on which control practices are chosen. These include broadcast spraying of herbicides, selective spraying of herbicides to basal or foliar areas of plants, hand or mechanical cutting of vegetation, planting other vegetation, and combinations of practices.

Broadcast spraying causes the most severe impact on wildlife, when compared to other control methods. Broadcast spraying of 2, 4-D and 2, 4, 5-T, when used regularly, results in the reduction of abundance or elimination of many woody plants, some of which are of high value as wildlife food and cover. In contrast, maintenance operations that involve the selective control of vegetation that could interfere with operations can have a positive effect on some kinds of wildlife. Vegetation maintenance by hand or mechanical means would eliminate the risks of toxic herbicides, but would subject wildlife to more disturbances.

Tables 4.11-1 and 4.11-2 indicate the total wildlife distrubance impact for the proposed route. These tables represent a summary of the habitat change for: 1) all wildlife species, and 2) habitat value for species of special concern and game species.

Species of special concern are those that are rare, threatened, endangered, decreasing, or otherwise highly significant and vulnerable according to state or federal agencies, National Audubon Society or the Center for Natural Areas. Species legally harvested (shot or trapped) in one or more of the three states are shown in Table 3-11 of Appendix E (DOE, 1978).

The habitat changes mentioned above are presented on a scale of highly positive (+5) to highly negative (-5). A measure of impact disturbance is included. This is a qualitative assessment of slight, low, moderate, high or severe impacts on the remoteness qualities and needs of many species of wildlife.

Whitetail deer may both gain and lose habitat as a result of the proposed action through the alteration of deer wintering yards and a gain in food resources and non-wintering habitat. About 154 acres of known deer wintering yards are crossed by the proposed rights-of-way. The yards used by deer for wintering vary from year to year. Those shown as adjacent to the route may actually be on the route at the time of construction and vice versa. Deer wintering yards (at least in Maine) are usually situated in low-lying areas, and in proximity to brooks or streams. Those yards, lying along brooks or in low-lying areas which are crossed by the proposed route, may be more likely to be impacted than if they were separated from the route by rises in elevation. About as many deer wintering areas are expected to be harmed by right-of-way clearing as would be benefitted.

TABLE 4.11-1
WILDLIFE HABITAT IMPACT SUMMARY
PROPOSED ROUTE - ALL SEGMENTS

Impact Levels		Species Sp. Concern Miles Impacted	Species Sp. Concern Percent	Game Species Miles Impacted	Game Species Percent	All Species Miles Impacted	All Species Percent
Highly Positive	+5	-	-	-	-	-	-
	+4	15.9 mi.	4.4%	1.0 mi.	0.3%	-	-
	+3	17.7 mi.	4.8%	17.6 mi.	4.8%	0.3 mi.	0.1%
	+2	78.6 mi.	21.5%	125.3 mi.	34.3%	59.1 mi.	16.2%
	+1	181.0 mi.	49.5%	203.1 mi.	55.6%	279.9 mi.	76.6%
	0	2.0 mi.	0.5%	2.0 mi.	0.5%	2.0 mi.	0.5%
	-1	69.3 mi.	19.0%	16.5 mi.	4.5%	24.2 mi.	6.6%
	-2	1.0 mi.	0.3%	-	-	-	-
	-3	-	-	-	-	-	-
	-4	-	-	-	-	-	-
Highly Negative	-5	-	-	-	-	-	-

TABLE 4.11-2
DISTURBANCE PROBABILITY SUMMARY
PROPOSED ROUTE - ALL SEGMENTS

Impact Levels		Miles of Impact	Percent
Very Low	1	7.3 mi.	2.0%
	2	91.5 mi.	25.0%
	3	140.7 mi.	38.5%
	4	91.1 mi.	25.0%
Very High	5	34.9 mi.	9.5%

A second source of impact upon deer populations in wintering yards may be caused by increased human access with off road recreation vehicles. The magnitude of this impact will vary with the condition of the habitat and the severity of the winter. Snowmobile trails are shown in the Appendix I (DOE, 1978) map volume.

Transmission line construction and operations may impact deer habitat other than wintering areas. Short-term impacts from construction would destroy vegetation and slightly alter local drainage patterns. Access roads would cause permanent loss of food and shelter. Long-term impacts of the right-of-way upon non-wintering habitat will be generally beneficial, depending upon the kind of vegetation that develops on the right-of-way. An additional impact involves small areas of wetlands that may be filled to support towers, these "islands" may be preferred by calving deer (Thorsell 1976).

A potential exists for moderate to severe long-term adverse impacts on deer populations of regions surrounding the proposed route. However, with only selective removal of vegetation, moderately beneficial impacts to deer populations may result.

Potential impacts on moose have not been well documented, however, moose habitat may be slightly benefitted by the transmission line, while populations are expected to suffer adverse impacts from removal of vegetation by access roads, possible competition from increased populations of other animals (Whitetail deer and snowshoe hare), and increased illegal harvest resulting from increased access.

Black bear would suffer local, adverse impacts from the loss or disturbance of potential denning sites directly on the proposed route. However, the increased windthrow of timber, especially in rocky areas, would create new denning sites next to the route. The short-term loss of secondary vegetation would temporarily reduce the amount of food on the right-of-way and permanently reduce the food supply where ground is crossed by access roads.

The presence of humans during construction and the potential for increased disturbance and greater accessibility may initially cause bear to avoid certain areas. However, bear are expected to soon become accustomed to human disturbance.

If the right-of-way becomes vegetated with herbicide-tolerant grasses and herbacious vegetation, this vegetation may replace preferred foods. If, however, vegetation providing food for bear is fostered by maintenance techniques (such as blackberry, raspberry and blueberry), bear would be benefitted. Assuming that the right-of-way would support beneficial food plants, a slightly beneficial long-term impact would result.

Impacts upon small mammal populations would vary, depending upon the vegetation management techniques. Under favorable circumstances, a diverse layer of herbacious vegetation of woody shrubs could benefit species adapted to fields and earlier successional stages (e.g., deer mouse, meadow vole) and adverse impact forest species, like the red-backed vole. The development of herbicide tolerant grasses would benefit neither group. Felling of large seedbearing trees during construction could provide small mammals with a temporarily large amount of food and shelter, and cause large but short-term population increases. Impacts would be mostly local. It appears that the right-of-way should not serve as a barrier to the movements of small mammals except in the winter. During the winter, movement may be restricted by snow compaction as a result of snowmobile use, and by conditions of short vegetation and deep snow which would offer no protection from predators.

The impact on various predator species would depend largely upon the impacts of the proposed action on the small mammal populations. If the transmission line construction leads to increases in these prey species, then the red fox, coyote, gray fox, bobcat, canada lynx, long-tailed weasel, and the short-tailed weasel benefit.

Construction activities and other human disturbances could adversely impact species such as the eastern timber wolf, Canada lynx, fisher, and the marten.

Both fisher and marten could be adversely impacted by loss of wooded habitat, though marten may be more susceptable to habitat loss than fisher. Since fisher and marten den in dead trees or logs, the removal of dead trees along the right-of-way could adversely impact fisher populations. Additional denning sites may be created, however, by increased windthrow of trees in rocky soils.

Mink, river otters, and long-tailed weasels would be impacted through the loss, gain, or alteration of wetland habitats. Skunks would be benefitted by the addition of early successional stages of vegetation.

Impacts on the muskrat and the beaver can be expected to be insignificant to mildly beneficial. The raccoon is well adapted to human disturbance and is expected to benefit from the proposed action. While some forms of herbicide management on the right-of-way would produce vegetation not valuable to raccoons, the fostering of shrubby, berry-producing vegetation on the right-of-way would benefit raccoon populations.

Snowshoe hare habitat would in some instances be created and in others destroyed by the proposed action. In the short-term, destruction of regenerating softwood-hardwood habitat would cause locally adverse impacts upon snowshoe hare populations. If the present vegetation along the right-of-way is replaced with herbicide tolerant grass and herbacious vegetation, a locally significant and adverse long-term impact may result. The development of woody and diverse herbacious vegetation would increase snowshoe hare habitat.

Most species of hawks and owls rely heavily on small mammals for food. The creation of an earlier successional stage of vegetation on the right-of-way would increase the food available to them. Nest sites on or next to the right-of-way would be destroyed or disturbed through construction operations, however, a slight increase in the incidence of wind damage to native trees would cause an increase in nesting habitat for snag-nesting species of owls. Disturbances near nest sites would be most critical in April-May for owls and bald eagles, and June-early July for ospreys, golden eagles and most hawks. Raptors nesting in remote areas are perhaps less accustomed to disturbance and, therefore, may suffer slightly more from disturbing activities near their nests.

The impact of the proposed line and access roads on forest dwelling birds may be seen essentially as a tradeoff. Population productivity would be lost due to destruction of nest-trees. The normal inhabitants of this area would be displaced into adjacent forest habitat. Balancing this postulated loss would be a possible tendency of forest edge-nesting individuals to have a larger, or more available food supply and, thus larger broods. Although experimental evidence is presently insufficient to indicate the true impact of the right-of-way on most populations of birds, information is available for a few species.

An abundant supply of berries would grow in many places on the right-of-way, providing food and cover for cedar waxwings, catbirds, mourning warblers, yellowthroats, and other species. If brush is cut by hand during maintenance and left piled on the right-of-way, it would provide nest sites for some wrens and sparrows. A slight increase in the incidence of wind damage to mature trees would cause an increase in feeding and nesting habitat for snag-nesting species, such as woodpeckers and chickadees. By increasing the sunlight reaching the floor of the adjacent forest, the understory would grow thicker and species such as Swainson's thrush and magnolia warbler would prosper. Still other species such as the pine grosbeak and the black-backed three-toed woodpecker seem to benefit from small clearings. The towers could serve as nest sites for birds such as the eastern kingbirds, red-winged blackbirds and the rusty blackbirds.

The chances of a significant dispersal of brown-headed cowbird and starlings occurring as a result of the presence of the powerline are slight as long as the right-of-way is maintained at shrub height or higher.

Ruffed grouse would suffer adverse, short-term impacts due to loss of early-successional habitat during and immediately following construction. Adverse impacts on ruffed grouse include the destruction of mature aspen used for winter food and for courtship and territorial displays by male grouse. New sites would be created if timber felled during construction is left lying in adjacent wooded areas. However, areas underneath the powerline would regenerate to vegetation beneficial to ruffed grouse.

Habitat for woodcock would be lost initially because of construction of the powerline, but increased in the long run. The impacts upon the Virgnia rail, sora rail and the common snipe are related to impact on their habitats which are primarily wetlands.

Waterfowl would be predominantly affected through wetland impacts. Alterations in upland sites would impact feeding or nesting habitat for a few species in a minor way. Instances of waterfowl and other large birds colliding with wires, especially during courtship rituals, have been recorded and could present an additional unmitigatable source of long-term mortality to waterfowl populations.

Due to the small home ranges of reptiles and amphibians, most adverse impacts would be local in extent. For those species (e.g., most salamanders) which require moist, shaded forest, removal of overstory or disturbance of the forest duff layer would cause initial adverse impacts. Removal of bank cover, siltation of temporal pools, and scouring from slight increases in runoff would also have a negative affect, especially in the headwaters of streams. Fallen slash and logs may provide a habitat for many salamanders, if ground temperatures have not been altered above specific species' tolerance limits by removal of the canopy. For these herptiles which prefer warm, exposed brushy and rocky areas (e.g., most snakes), the substitution of regeneration habitat for dense forest would have a positive affect.

The proposed transmission route is expected to cause the following highly significant impacts:

1. A continuous edge habitat would be created over a three-state region that includes some of the more remote forests in the northeastern United States. This edge habitat would benefit most terrestrial vertebrates, but a few would suffer irretrievable loss of habitat.

2. Some sensitive and important wildlife species in remote areas would be significantly stressed as a result of increased access afforded to off-road vehicles and commercial logging operations.

3. Habitats with a significant potential for harboring rare plants would be irretrievably altered by construction activity and long-term changes in micorclimate on and very near the right-of-way.

4. Ecosystems of many streams would be subject to possible significant local and long-term increases in sediment load. Unless mitigative measures are implemented fully, the value of several excellent coldwater fisheries will suffer.

4.11.4 Rare and Endangered Species

4.11.4.1 St. John River Basin

Riparian habitats which support several rare and unusual plants would be inundated. This habitat supports the endangered Furbish lousewort. At this time, it is not known what the impacts would be on the rare flora populations downstream of the Lincoln School dam due to project operation. The July 1976 field surveys for rare plants were conducted following a period of unusually high precipitation. The river stage below the project area was similar to the expected river stage during operation of the proposed Lincoln School dam and many populations of rare plants were found above the high water mark.

Consultation with the U. S. Fish and Wildlife Service on the endangered Furbish lousewort has been carried out. Their threshold examination concluded that the proposed project would jeopardize the continued existence of the species. A determination of critical habitat was not made. The complete report is included in Supplement to Appendix J, CE, 1978.

The Bald Eagle, Peregrine Falcon, and the Eastern Cougar are listed as endangered as defined by the Endangered Species Act of 1973.

The cougar has not been observed or reported on site, but it would appear that the project area contains suitable habitat and remoteness for this species. The U. S. Fish and Wildlife Service has determined that the proposed project would not adversely impact habitat critical to the cougar's survival. The peregrine falcon has not been located within the project area and is considered to be a transient and the U. S. Fish and Wildlife Service has determined that this proposed project would not adversely affect the species. Eagles have been frequently sighted in the project area, but no active eagle nests were observed during the 1976 surveys. The U. S. Fish and Wildlife Service has concluded that the proposed project would not adversely impact the Bald Eagle (Supplement to Appendix J, CE, 1978).

4.11.4.2 Proposed Transmission Route

A recovery plan for the peregrine falcon, an endangered species, calls for its reintroduction into selected regions of the eastern United States. The proposed route would pass through the Connecticut River Valley-White Mountain region, which is preliminarily given fourth priority within designation of 11 regions for restocking efforts.

<u>Dickey-Lincoln School - Fish River</u>

The adverse impact on potential rare plant habitat is slight to moderate in this segment. The most important area for potential rare plant habitat between Dickey and Lincoln School Substation is near where the route crosses McLean Brook. Other important areas on this segment would be near St. Francis, St. John, and along the base of Bossy Mountain.

<u>Dickey - Moose River</u>

The adverse impact on potential rare plant habitat is slight to moderate for most of this segment. However, there is one part of this segment where the adverse impact is probably quite high. It extends from near Canada Falls Lake southwest towards Moose River. That part of the route where it crosses Alder Brook has the highest potential for rare plant habitat. Also of concern is that area on the route just east of Boundry Bald Mountain.

Moose River - Moore

From Moose River Substation to State Route 16 in New Hampshire, the segment would in general have slight to moderate impacts on potential rare plant habitat except for an area of calcareous metasedimentary rock north of Little Big Wood Pond in the Town of Dennistown, Maine. Severe impacts would be expected in an area near Boil Mountain about 6 miles southwest of Maine State Highway 27. This is the area where the route crosses the North and Middle Branch of Alder Stream.

That part of the segment between New Hampshire State Highway 16 and a point a few miles north of Moore Substation could cause a highly adverse impact on potential rare plant habitat. The most critical areas are near Cranberry Bog Notch, Nash Stream, and Groveton, N.H. A 2-acre wetland in the Connecticut River floodplain near the Vermont side of the river and a stand of naturally growing red pine along the western slope of Cape Horn Mountain are also of special concern.

Concern has also been expressed for Catbow Brook swamp, a classic spruce-fir swamp just southeast of Alden Mountain in the Town of Guildhall, Vermont.

High adverse impacts on potential rare plant habitat may occur in the area between Halibut Mountain and Sheraton Mountain and along the route through Catbow swamp as well as just west of Baldwin Hill in the town of Lunenburg, Vermont.

The area of the route near the Moore Substation may receive moderate adverse impacts on rare plant habitat. The Littleton Dam Wildflower Area near Moore Reservoir is also an area of concern.

Moore - Granite

The portion of this segment that parallels the Connecticut River is expected to have moderate adverse impacts on potential rare plant habitat. That part of the segment from Barnet, Vermont, to Granite Substation has high adverse impact. Ledges near Barnet, and an unusual stand of burled hemlocks near Haden Hill on Vermont Highway 302 are of special concern.

Granite - Essex

Special concern has been expressed for pockets of cedar between Granite Substation and an area north of the Montpelier-Barre Regional Airport. Moderate impacts are expected to occur on the portion of route starting just north of Berlin, Vermont, west for about 6 miles parallel to the Winooski River Valley. Severe adverse impacts may occur on potential rare plant habitat near Middlesex, Vermont, in the Winooski Valley. West from Middlesex, Vermont, until the line crosses the Winooski River, adverse impacts on the potential rare plant habitat are judged to be moderate. Part of the segment on the north side of the Winooski River may have a high impact potential on potential plant habitat. Several ledges near the segment could harbor rare plants. The rest of the route--after it crosses the Winooski River near the Vermont Research Forest Agriculture Experiment Station--was judged to have moderate impact.

4.11.5 Wetlands

The four significant wetland areas described in Section 2.12.5 would be inundated by the Dickey Reservoir. Wetlands are less common in the upland areas adjacent to the proposed lakes and therefore wetland complexes comparable to these four significant wetland areas would not exist in the portion of the project area surrounding the proposed reservoirs. Bogs would be the predominate wetland type in this portion of the project area.

The existing beaver activity and the distribution of this activity suggests that beaver ponds could be the common wetland type should the project be implemented.

4.12 Recreation

4.12.3 St. John River Basin

Project implementation would have a significant impact on the existing recreational activities of camping, hunting, fishing and canoeing in the upper St. John River area.

Whitewater canoeing, as it now exists, would virtually be eliminated within the project area, although limited canoe tripping may continue to exist on the St. John River above Nine Mile Bridge. Dickey Lake would be unsuited to canoe tripping and only localized, inshore use of canoes would be safe.

Approximately 42 of the existing 74 primitive campsites in the project area would be eliminated. The remaining 32 sites would be located at comparatively more distant and remote locations from Dickey Dam and not likely to be as well utilized as at present. Camping use tends to peak in the June-August period, but would begin in May and extend through November since it would provide an important means of accommodation for fishermen in the spring and hunters during the fall.

Fishing would become more lake oriented than stream oriented. Stream fishing for native brook trout would still be likely to remain popular even though stream fishing opportunities would be reduced as streams are flooded by the impoundment. Early season fishing is likely to increase slightly, associated with ice-out on the lake. However, fishing would continue on the brooks and streams.

If fishing effort for salmon in Dickey Lake were comparable with that for the nearby Fish River Lakes region, anglers would catch 3,000-15,000 salmon averaging two pounds each from Dickey Lake annually. Angling effort at the Fish River Lakes is now significantly below what the lakes could support.

Hunting would remain similar in character to that presently existing with upland game species preferred. The loss of forestland, including nearly half of the existing deer yards, and the corresponding reductions in wildlife populations would result in the concentration of hunters in a smaller area, competing for less game than is now available. However, hunting supply would continue to exceed demand and therefore no significant changes in utilization of project lands would be expected.

If the project were constructed, an information area and scenic overlook off Route 161 would be constructed to accommodate visitors. Only minimal recreation facilities, consisting of a visitor center and canoe takeout areas on the St. John and Allagash Rivers, would be provided since additional facilities cannot be economically justified at this time based on recently revised use projections. However, various recreational alternatives and site development plans were evaluated, using the methodology of plan formulation, criteria, and site development specifications contained in Revised Appendix G (CE, 1978), along with visitation projections for development of full recreation facilities should they be desired and deemed economically feasible in the future.

Remoteness of the project area, travel time to the site and high quality recreational opportunities which are more accessible elsewhere would influence the recreational utilization of the proposed project. Therefore, projections for use of the project area are influenced by these considerations. The projected recreational visitation is presented in Table 4.12-1. The assumptions, methodologies and criteria used to generate these figures are also discussed in Revised Appendix G (CE, 1978).

Because of the water level fluctuations associated with the Lincoln School reservoir, there would be no feasible recreational use of that impoundment. Consequently, no recreational development has been considered for Lincoln School Lake.

4.12.2 Proposed Transmission Route

The adverse impacts primarily affect visual quality and recreational use. Positive impacts occur where transmission rights-of-way can be used for recreation.

In scenic areas, viewers are impacted by structures that dominate views and affect the scenic values of the recreation sites. Such a distraction or contrast can detract from one's enjoyment of natural aesthetic features. Visual impacts are most noticeable where there is a contrast between the man-made form of the tower or cleared right-of-way and a natural land element such as a lake, waterfall, or mountain.

Because of their linear nature, transmission lines may pass near or cross scenic highways, rivers, lakes, and trails which are heavily used for recreation. Tower size, design, and color influence the degree of visual impact.

TABLE 4.12-1

Recreation Demand Projections

-VISITOR DAYS OF RECREATION
WITH
DICKEY-LINCOLN SCHOOL LAKES
WITH MINIMAL RECREATION FACILITIES

	1975	1980	1985	1988	1990	1995	2000	2005	2010	2015	2020	2025	2030
Camping	1,700	2,100	1,000	600	700	800	1,000	1,300	1,600	2,000	2,500	3,100	3,800
Fishing	4,400	5,100	2,000	2,000	2,700	6,000	7,800	8,900	10,000	10,000	10,000	10,000	10,000
Hunting	8,300	9,100	10,000	10,600	11,000	12,100	13,300	14,600	14,600	14,600	14,600	14,600	14,600
Canoeing	2,300	2,800	-	-	-	-	-	-	-	-	-	-	-
Day Activities	1,100	1,400	1,700	11,700	12,300	12,900	13,500	14,200	14,900	15,700	16,500	17,300	18,200
TOTAL	17,800	20,500	14,700	24,900	26,700	31,800	35,600	39,000	41,100	42,300	43,600	45,000	46,600

NOTE: Impoundment commences in 1985, with project expected to be on line in 1988.

The commitment of land for a transmission right-of-way limit the present and future use of a recreation facility. A transmission line could reduce an area's potential recreation designation or classification. The visual impacts created may be sufficiently adverse to prevent an area's development for a specific recreational purpose. An existing recreational area's potential for expansion also could be reduced by lines adjacent to, or paralleling, its boundaries.

Unauthorized or uncontrolled use of transmission line rights-of-way by recreational vehicles can cause detrimental effects such as erosion, disturbance to wildlife, fire hazards, and annoyances to landowners. Improved access could also accommodate recreational use of previously inaccessible areas.

Preemptive impact or actual interference with land use for recreational sites was also assessed. The preemptive impacts on land use would be experienced within the one-half-mile-wide route at the centerline, or at a tower, substation or microwave facility site. The impact on recreational viewers would be experienced both within the route and the viewshed of the transmission facilities. Through this distinction of impact types, the total site specific impacts of the proposed transmission facilities, both direct and indirect, as well as the constant long-term and short-term effects, has been addressed and is discussed in detail in Appendix I (DOE, 1978). Table 4.12-2 summarizes the impacts on recreation for the entire transmission line corridor.

TABLE 4.12-2

SUMMARY OF RECREATIONAL RESOURCE IMPACTS
ALL SEGMENTS OF
PROPOSED TRANSMISSION ROUTE

	Preemptive Impacts		Recreation Viewer Impacts	
Impact Levels	Number of Occurances	Percent	Miles with Impacts	Percent
None	-	-	122.1 mi.	33.3%
Low	64	28.4%	85.9 mi.	23.5%
Moderate	82	36.4%	76.7 mi.	21.1%
High	66	29.3%	66.1 mi.	18.1%
Severe	13	5.9%	14.7 mi.	4.0%

4.13 Debris

4.13.1 St. John River Basin

Debris is expected to be a significant problem during the filling phase and for the first year or two of operation. This would result in hazardous situations for boating. Within three to four years, this debris would be removed from the reservoir area. Debris entering the reservoir on the spring freshet would remain as a minor problem. As sources of this debris become known, measures would be taken to minimize the impacts. The amount of debris in the lake is expected to decline rapidly within the first five years of operation. It is expected that the only significant effect on recreational boating might be in the spring of each year before steps can be taken to remove the new debris.

Another problem with debris would be deposition at recreation sites. This would be removed during normal spring maintenance operations.

The methods employed for control removal and disposal of debris would comply with Federal and State standards regarding air and water pollution. Thus, they should have minimal adverse effects. Any log booms that might be needed would be located to have minimum effect on boating or would contain openings for boat passage.

4.13.2 Proposed Transmission Route

In vegetated areas, slash and unmerchantable timber are inevitable by-products resulting from right-of-way clearing and construction operations for transmission facilities. The amount of waste products would be reduced by clearing only that vegetation hazardous to the facility and fulfilling the requirement that all merchantable wood products be marketed. Burning would be conducted in accordance with State or local smoke abatement programs and with approved practices of the region. The burning of tires and plastic materials would be prohibited. A non-burning disposal method, such as chipping, would be used if necessary in areas where burning is prohibited.

The contractors would be required to use brush blades on tractors when gathering debris for disposal.

Debris resulting from periodic vegetation management activities would not be placed within the high water mark of any watercourse, pond, lake, or reservoir.

4.14 Power

The latest projections developed by the New England Power Pool (NEPOOL) indicate New England peak power demands will grow at a compound annual rate of 4.5 percent.[1] At this rate, peak loads would increase from the current level of 14.9 million kilowatts (Dec. 1977) to 23.4 million kilowatts in the winter of 1987/88.

[1] New England Load and Capacity Report 1977-1988 dated 1 Jan. 1978.

The portion of the total demand met by peaking type facilities - such as the proposed Dickey Dam installation - approximately 20% of the total load. On this basis, about 4.7 million kilowatts of peaking type capacity would be required in the 1987-88 period. The dependable capacity of the initial Dickey Dam facilities would be 874,000 kilowatts which represents nearly 19 percent of the estimated 1987/88 New England peaking capacity needs.

The proposed project would have a favorable impact on the integrated NEPOOL system. Operating within the NEPOOL system, its output would be utilized in a manner that would optimize the regional system's economy. Its large impoundment would make it a flexible facility capable of meeting intermittent peak demands at sustained maximum output. It would also have "load-following" capability on a daily and seasonal basis which would complement other diverse system generation sources.

The Dickey-Lincoln School project has quick start capability and rapid response to load change making it especially well adapted for serving peak loads and for frequency control and spinning reserve to meet emergency demands should major New England system faults occur. Operating at less than full load, the project would be capable of responding very rapidly to sudden demands for increased power. It would also have the ability to supply starting power to steam-electric plants following a major power failure.

Hydro-electric machinery is relatively simple and operates at low speeds and temperatures resulting in a long life and fewer outages which enhance the reliability of a regional system.

A hydro-electric facility such as Dickey-Lincoln School is normally out of service about two days per year due to forced outages and about one to two weeks for scheduled maintenance. The average outage rates of modern steam-electric units are several times greater.

The pumped storage feature would enable the project to store large blocks of energy produced by relatively low production cost fossil fueled or nuclear plants during off-peak hours. The use of off-peak energy for pumping improves the plant factor of the system's base-load thermal units thereby reducing cycling of these units with a resulting improvement in their efficiency and life expectancy.

Project operation would not consume natural fuel resources and would therefore not be susceptible to the future availability of fuels or escalating costs. Operating within the NEPOOL system, the project could conserve some 2.3 million barrels of oil annually. Dependent upon the alternative fuel source, the project output of 1.4 billion kilowatt hours also equates to an annual consumption of 636,000 tons of coal or 16.6 billion cubic feet of natural gas.

Project operation would be pollution free. There would be no emissions adversely affecting air quality or heat discharges to receiving waters.

4.15 Aesthetics

4.15.1 St. John River Basin

Construction of the proposed project would have several major impacts on the aesthetics of the region. The greatest impact would result from the flooding of nearly 66 miles of the St. John River. The visual quality of this portion of a scenic river valley would be lost forever. This loss in visual quality is a product of the loss of thousands of acres of forest, the loss of a free-flowing river with its many rapids and tributaries.

Pool fluctuations would expose shorelines which would be boulder strewn and appear to be barren of vegetation. This impact would be most apparent at the Lincoln School Reservoir. Floating debris would create some negative visual impact for one or two years after project completion.

The filling of Dickey Reservoir would create numerous scenic coves and islands with forested backdrops. To the recreationist, there would be many pleasant visual experiences offered by the lake, hills and natural surroundings. To the angler, the anticipation of catching a salmon or lake trout in a remote and semi-wild area could be an experience of aesthetic enjoyment. The inner experience of being in a natural and remote area secluded from the hurried life of an urban setting would still be available and one of emotional satisfaction.

The subject of aesthetics is controversial simply because each individual has a different set of values as they pertain to what is aesthetically appealing. This is evident when the physical structure and appurtenant power facilities are considered. There are those who feel that they are a beautiful and magnificent monument to man's ability to create. On the other side, there are those who feel that nothing could be more obtrusive and unnatural to a scenic river valley.

4.15.2 Proposed Transmission Route

The location, construction, and maintenance of the proposed transmission lines, substation, and control facilities would have varying degrees of visual impact. These impacts would depend on each facilities compatibility with its surroundings, the scenic quality of the area, the screening provided by terrain and vegetative cover, the design of the structures, control buildings, access roads, and rights-of-way. They would also depend on the number of viewers at any given point, their distance from the line, their activity at the time of viewing, and their subjective reaction to the scene.

Dickey-Lincoln to Fish River Segment

Viewer impacts are generally moderate. Most of the high impacts occur in the vicinity of Fort Kent Mills and near St. Francis. Some moderate and high viewer impacts would occur at other locations in the St. John River Valley. Impacts on visual landscape quality for this segment are moderate. The only area which may have a high impact is near Fort Kent Mills where the line may cross part of Stevens Hill and some adjacent smaller peaks. About 95 percent of the proposed alinement would result in moderate impacts.

Impacts on site attractiveness in this segment are largely moderate. Severe impacts are identified at the Fish River and Allagash River crossings. High impacts would occur in two state owned public lands for which the timber and grass rights have been retained. For the rest of the segment, impacts reflect the attractiveness of land cover types along the route. The western part of the segment has a greater concentration of mature woodlands which are rated as having moderate impact. The eastern half passes through farmland and abandoned fields, resulting in high impacts.

Dickey-Lincoln to Moose River Segment

The impacts on viewers are extremely low because the line would pass through the unpopulated wildlands in northwestern Maine. High impacts are predicted where recreation and transportation viewers are encountered. Impacts would be moderate for urban land use viewers and where the proposed route crosses Maine Highway 201. Impacts would be severe on recreation viewers in the vicinity of Baker Lake. Impacts are low on the first half of the segment with high impacts occurring where the line crosses ridges or hills on the South Branch of the Penobscot River and near Long Pond. Impacts occur where streams or rivers are crossed;. and where the line would pass near wetlands such as swamps, marshes and beaver dam impoundments.

Moose River to Moore Segment

The impacts in western Maine would fall primarily on recreational viewers. Within New Hampshire, the route would encounter residential and highway viewers as well. Views from historic sites along the Connecticut River are impacted. Severe impacts are forecast for 4 miles of the route along the Connecticut River Valley southwest of Groveton, N.H. High impacts would occur near Kidderville, N.H.; in the Black Hill area northeast of Groveton, N.H.; Mills Pond; and along Moore Reservoir.

Landscape quality impacts occur near Burnt Jacket Mountain, west of Jackman, Maine, on several hilltops; in the Connecticut Lakes Region; near Kidderville, N.H.; southwest of Groveton, N.H.; near Cape Horn; and through the Connecticut River Valley.

Impacts on site attractivenss along most of this segment are moderate. Those areas that would be impacted are: wetlands, mature woodlands, regenerating forests, and agricultural lands.

Moore to Granite Segment

This segment contains sections that would have severe impacts on viewers. The average impacts for the entire segment is high because of the number of persons who live in or visit northeast Vermont. Recreation viewer impacts are severe on more than one-fourth of the segment.

Granite to Essex Segment

Because this segment passes through the most populated area on the proposed route, it would cause the most severe impacts on viewers. Severe impacts would occur on viewers traveling Route I-89. Right-of-way sharing is proposed for much of this segment. Much of the land along this segment is developed and is rated lower in scenic quality. Severe impacts would occur on some ridges, with high and moderate impacts being uniformly distributed.

Moderate impacts dominate where the proposed route passes through mature woodlands or abandoned agricultural fields. The most severe impact occurs near Montpelier-Barre Regional Airport where the line would infringe on a designated "unique geological area".

4.16 Noise

4.16.1 St. John River Basin

4.16.1.1 Construction Noise

Construction sound levels were predicted for earth moving and power house construction activities and are addressed as L_{DN} contours.

The predicted outdoor L_{DN} for construction at the Dickey Dam site to the nearest resident is 53 dB and for Lincoln School, 46 dB.

The guidelines outlined in the U. S. Environmental Protection Agency's (EPA) "Levels Document" were used to assess the impacts resulting from construction. This document identified an outdoor L_{DN} of 55 dB and an indoor L_{DN} of 45 dB as "the maximum levels below which no effects on public health and welfare occur due to interference with speech or other activity".

Sound levels from construction at the Dickey Dam site are not expected to affect the public health and welfare of any existing residents. However, a community reaction of "several threats of legal action" to "widespread complaints" due to construction noise is expected from the nearest neighbors.

Sound levels from construction at the Lincoln School Dam site are not expected to affect the public health and welfare. Community reaction to construction at the nearest residences is expected to be "sporadic complaints".

Mitigation of the impacts of noise on the community could be approached by several measures. Construction equipment used on the project should have the lowest available noise levels. Whenever possible, the noisier construction activities should be limited to daytime hours and new residences should not be located within the 55 dB construction noise contour during construction.

4.16.1.2 Operational Noise

Operational sound levels were predicted for normal operation at the Dickey and Lincoln School Dam sites and are addressed as L_{DN} contours. The L_{DN} from operation of the Dickey Dam at the nearest neighbor is 41 dB and for Lincoln School it is 43 dB.

Sound levels from the operation of Dickey Dam are not expected to affect the public health and welfare of any existing residents nor is there any expected community reaction to operational noise.

Sound levels from the operation of the Lincoln School Dam are not expected to affect the health and welfare of the residents, but there is expected community reaction in the form of "sporadic complaints".

Sound levels from operation of the Dickey and Lincoln School Dams are acceptable at all existing residences according to EPA's "Levels Document". In addition, at the Dickey Dam site, no adverse reaction is expected due to operational noise. Therefore, no noise control measures should be necessary for the Dickey Dam site operations as long as housing is not established within the 55 dB operational noise contour.

The community reaction at the Lincoln School Dam site for operational noise was determined without including attenuation due to topography, vegetation or weather conditions. Thus, the actual sound levels from operation may not cause the predicted adverse reaction. Noise control measures should not be necessary as long as residences are not relocated within the 40 dB operational contour. Should an adverse community reaction occur because of operational noise, standard parallel baffle silencers could be added to the air intakes and exhausts of the ventilation system to eliminate the reaction.

4.16.2 Proposed Transmission Route

4.16.2.1 Construction and Maintenance Noise

Noise levels measured 50 feet from construction equipment range from 72 to 96 dB(A) for earthmoving equipment and from 75 to 88 dB(A) for materials handling compressors. The tracks on earthmoving equipment can contribute significantly to noise at a construction site. Pile drivers and pneumatic hammers create noise levels ranging from 82 dB(A) to 106 dB(A).

The low-frequency subaudible vibrations from blasting are usually as significant as the audible noise. Noise from blasting is significant, not so much because of its loudness, but because its occurrence is intermittent.

In clearing operations, skidders and chain saws used for logging make the most noise. In an average situation, a chain saw can be heard from as far away as 1.5 miles. Noise from maintenance activities may include any of those previously described for construction, as well as helicopter noise. Helicopters may be used to visually inspect the line or to spray the right-of-way to control vegetation. As a result, residences adjacent to the line may experience brief noise impacts when a helicopter passes overhead. The noise is a distinct low frequency sound.

4.16.2.2 Operational Noise

Transmission lines sometimes emit a crackling or hissing sound which is audible. This is caused by corona, which occurs in regions of high electric field strength on conductors and other hardware. Sufficient energy is imparted to charged particles to cause ionization of the air. During foul weather raindrops, snowflakes and condensation increase the sound producing activity. Audible noise levels of 43 dB(A) at the edge of the right-of-way would occur during rain. Electrical interference with TV and radio reception is unlikely.

Substations can create noise which is heard beyond the station boundaries for periods of long duration. This noise may include:

1. A constant low frequency hum from transformers and shunt reactors caused by changing magnetic fields inside the equipment;

2. Reciprocating engine exhaust from occasional operation of emergency engine-generators;

3. Noise impulse from operation automatic power circuit breakers, load interruptors, and disconnect switches. At some installations this impulse noise may occur once or twice a day;

4. Noise from work activities caused by operation of such equipment as trucks, automobiles, etc.

The loudness of noise from all of these sources would vary with equipment rating, type of installation, distance from noise source, and some lesser factors such as weather, terrain, and vegetation.

Transformer and shunt reactor noise outside the substations on the proposed lines would generally be low enough to cause little annoyance.

Power circuit breaker noise is an impulse of short duration and high level. If air blast breakers were used, this noise could approach 100 dB(A) at the substation property line. Many state and local noise regulations in various parts of the nation permit higher noise levels than continuous sounds. As a result, residents living near a substation site may experience some degree of discomfort or annoyance.

4.17 Substation Sites

The anticipated impact on the ecological resources of the proposed new substations at Dickey, Lincoln School and Moose River would be minor since no ecological resources of significant regional or local importance are known to be present at this time.

The Fish River, Moore River, and Granite are existing substations. Essex Substation is to be built by Vermont Electric Company and the proposed transmission will tie into the existing facility.

4.18 Microwave Sites

The most significant impacts from the proposed microwave facilities would result from access road construction, because of rugged locations. These roads, even when well constructed, can raise the silt load in streams until it becomes harmful to fish, especially during construction.

The facilities and access roads would cause long-term destruction of vegetation and the habitat for wildlife and will preclude its future use. Microwave stations would destroy one-fourth acre of habitat for each site. These figures do not include habitat removal from access roads.

The most significant impacts of these facilities are the visual and recreation impact associated with each microwave site. Detailed impacts for each specific site are described in the Draft EIS for the Transmission Line (DOE, 1978).

4.19 Mitigation of Substation and Microwave Installation Impacts

The impacts which result from the construction and operation of substations and microwave facilities are largely mitigated during the design and planning phase for these facilities. The sites would be purchased in fee from the present landowners.

Existing substation or microwave installations would be utilized or expanded where possible. Where new substations are to be developed, the site would be located in an area of least total impact.

The same general construction methods used to reduce the impact of transmission lines would be followed to reduce impacts at substations and microwave installations.

4.20 Lincoln School Passive Repeater Site

The impact to recreational viewers would be high due to the direct visibility of the facility. Motorists on Highway 161, snowmobiles, or users of the Rankin Rapids Park or other sites along the St. John could directly observe the proposed facility.

The predicted level of impact on visual landscape quality for this facility is moderate. The land clearing would be minimal and the greatest impact would result from the presence of the reflector.

4.21 Electrical Impacts of the Proposed Transmission Line Facilities

4.21.1 Electromagnetic Interference

Electromagnetic inteference (EMI) is the disruption of electromagnetic waves or the entire frequency spectrum from 10 Hz to 100 Hz. AM radio, television reception, and wire communications circuits operate in a portion of this frequency range and can be susceptible to EMI from some high voltage lines depending upon signal strength and level of interference. The proposed lines, however, are designed to operate at 345 kV with a conductor configuration which is almost interference free. Television reception would not be affected. Interference with radio reception might be noticed when a weak station is being received on the right-of-way.

Power transmission lines produce voltages to appear on telephone and railroad utilities lines. This electrical effect, under certain conditions, can cause electrical noise on voice and data transmission circuits. Interference is not expected if the power transmission line and the communication lines parallel each other for less than a mile and are separated by more than one-fourth to one-half mile.

4.21.2 Field Impacts

It has been suggested that adverse effects result to living organisms from exposure to electric and magnetic fields surrounding substations and transmission lines.

Field effects from transmission lines stem from electric and magnetic fields at the power frequency of 60 Hz in the proximity of high-voltage conductors carrying electric current. The high voltage creates the electric field. Currents flowing in the conductors are the source of the magnetic field.

4.21.2.1 Electric Fields

The electric fields associated with high-voltage lines can induce voltages and currents in metallic fences, structures, equipment, persons, or other conducting objects. This includes wire communications facilities of utility systems which may be in proximity to the powerline. The magnitude of the induced voltage and induced current due to the electrostatic field depend on the line voltage, the size of the object being charged, and the object's distance from the line conductors. Where the lines are less than 500 kV, conducting objects usually are grounded only after the receipt of complaint and an investigation indicates the need.

Induced current effects fall into two classes: (1) perceptible short-term shocks, and (2) possible effects due to long-term exposure to electric fields. Exposure to electric fields of the magnitude found under transmission lines results in currents flowing in an organism which are below the perception level.

When a person becomes a path to ground for short-circuit current from an insulated object, steady state current shocks may occur. The amount of current that will flow through a person contacting such an object is determined by how well both the object and the person are insulated from ground. Stationary objects such as fences, metal roofs, and antennas are grounded to prevent shocks.

Secondary shocks cause no direct physiological harm, but they may annoy a person and cause his muscles to react involuntarily. Primary shocks can produce direct physiological harm.

An extra high voltage line imparts little energy to an insulated person standing on the ground under the line. The amount of energy stored on the person is so low that under the worst possible conditions he would receive only a minor secondary shock.

The experience of the electric utilities indicates that long-term exposure is not a hazard. A survey of several electric utilities throughout the United States found no reports of long-term effects (Hawaiian Electric Co., 1973).[1]

4.21.2.2 Magnetic Fields

The maximum magnetic field intensity under the proposed 345-kV lines for the Dickey-Lincoln School Project would be about 0.3 gauss or half that of the earth's magnetic field.

Two types of possible effects can be identified with the magnetic fields: (1) shocks due to contact with objects where a magnetically induced voltage is present, and (2) long-term biological effects due to magnetically induced voltages and currents. The magnitude of induced current due to the magnetic field depends on the load current in the conductors, the orientation and length of the objects, and its distance from the conductors.

Magnetically induced voltages appear at the open ends of partly grounded loops on conductors--such as fences, irrigation pipes, and distribution lines--parallel to high-voltage circuits. Normally, one end of the conductor is grounded, and the earth serves as the remainder of the loop. A person who completed the loop will be subject to either a steady state or spark discharge shock. Mitigative measures are very effective because objects that are long enough to create a hazard usually are permanent.

[1]Hawaiian Electric Co., Inc. 1973. Ecological Influence of Electric Fields: Memo dated May 18, 1973.

No harmful biological effects are expected from exposure to magnetic fields under transmission lines. This is because the magnetic field levels at which effects occur are generally much higher than levels under powerlines.

4.21.2.3 Electrical Hazards

Certain transmission line failure, such as an energized conductor falling to the ground, while uncommon, are unavoidable. When a line drops to earth or is faulted for any other reason, it is automatically switched off in less than one-half of a second. Fire may result from these accidents.

For a short interval during such failures, current may flow through the earth. Because of the earth's resistance, a voltage appears in the vicinity of the nearest tower. This voltage may present a local hazard.

All transmission lines pose a hazard if long objects, such as lengths of pipe, construction booms, or other conducting materials are brought close to or into contact with the line. Since any transmission line can pose a hazard, people must observe basic safety precautions when near a line. Great care should be exercised when handling lengths of metallic pipes near any overhead conductors.

In designing an electric transmission system, one concern is the possibility that a spark discharge could ignite a flammable mixture such as gasoline vapor. Such an incident might occur under a transmission line where a vehicle was being refueled. The conditions necessary for such an incident could not be achieved under the proposed 345-kV lines.

Transmission lines pose a potential obstruction to low-flying aircrafts. In general, the transmission lines would be be below the minimum flight altitudes allowed by the Federal Aviation Administration (FAA), except for special operations such as crop dusting. FAA standards would be followed in marking lines and structures. These include precautions for large river crossings, such as the painting of towers with airway market colors, and the placing of airway beacon lights on towers and colored spherical markers on the conductors.

SECTION 5

ADVERSE IMPACTS

5.00 ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

5.01 General

Adverse impacts which would arise from project implementation fall into two general categories. These categories are those impacts which arise from inundation and those which arise from the construction and operation of the proposed facilities. Some of the adverse effects can be mitigated to some extent but mitigation in itself does not eliminate the effect.

5.02 Adverse Effects Caused By Inundation

Inundation caused by project implementation would cause the total destruction of 88,000+ acres of terrestrial habitat and its associated aquatic ecosystem. Involved in the loss of this habitat is all current use of this area by all forms of life now indigenous to it. This includes man.

Although the known gravel and sand deposits are of low quality, they are still used in a sporadic manner. Inundation would cover the known sites and render them unusable. The reservoir system would act as a trap for the transportation of these materials downstream thus slowing the replenishment of any deposits located further downstream.

Impoundment would raise the local groundwater levels. This is expected to create localized ponding by altering drainage patterns and creation of new springs. The use of water at shallow depths downstream of Dickey Reservoir, such as dug wells and septic systems, is expected to be adversely impacted.

Climatically, the creation of a reservoir of this magnitude would be expected to create local fogging conditions during the late summer. This condition would be for early morning hours and is not expected to be any different than other sizable lakes in northern Maine.

A major adverse impact that would arise from project implementation involves the relocation of 156 households and 12 commercial facilities for the reservoir systems. These families would be required to move at Government expense into facilities which are anticipated to be much different than those to which they are accustomed. These homes may be more expensive to maintain and may create economic hardships. The reality of the loss of their old homes, land and habits is expected to create a sense of real loss for their old homes. The proposed transmission line could cause the relocation of up to six households depending upon the exact alignment of the route.

The impacts of inundation on the timber management and industry are of prime concern to the region. Project implementation would disrupt current management plans. Disruption would come in several forms such as the loss of approximately 75 miles of existing access roads now in use for hauling cut timber, the shifting of emphasis in harvesting and a replanning process to account for the lost timber. Opportunity costs due to timber lost include lost wages, taxes and other income. The lost jobs in the timber industry are estimated as being comparable to a small to medium size sawmill. There is anticipated a general increase in the cost of transportation of timber should the project be implemented. The timber management companies consider the project area as being prime land for timber production. This consideration is borne out by the data. Loss of this prime land would impact future intensive management schemes. The costs to manage the remaining land would be higher due to more difficult terrain and poor accessibility. The loss of this prime land would create a more costly program of management in order to obtain the same productivity. At present, the loss of annual net growth would be between 25,825 and 34,525 cords.

Taxes accrued to the townships and state on lands which would be acquired would be partially lost. Partial reimbursement as outlined in Section 4.08.2.4.1.2 would mitigate some of the loss.

White water canoeing would be eliminated and replaced by flatwater boating. The project would inundate the prime stretch of river for canoeing. The freeflowing upper St. John River would be eliminated as a unique and irreplaceable recreation resource. Both above and below the project area, the numbers and magnitude of the rapids are small. Approximately 2300 user days of canoeing were recorded for 1975. This usage would be lost.

Inundation would cause the loss of some 267 miles of freeflowing streams and river within the Dickey impoundment. These waterways provide habitat for a native brook trout fishery. In addition to the loss of flowing waters, the project would flood 30 ponds and lakes and numerable beaver ponds. All of these waterways provide a source of habitat which would be adversely impacted.

Wildlife populations residing within the reservoir area would be adversely affected in varying degrees. Those forms which are relatively non-mobile would be lost in their entirety. These include burrowing forms as well as tree dwellers. Approximately 80,455 acres of terrestrial habitat would be lost and an additional 6030 acres would be modified by the transmission line. Inundation would destroy 36,893 acres of deer wintering habitat with the resulting loss of approximately 50% of the deer herd and those species dependent upon it for survival. Other species in the area would be affected to varying degrees. Fauna ending up on islands would stress the habitat and as a result decline in number due to a lowering of the carrying capacity.

Cultural resources would be adversely affected and salvage of the known sites would be required to mitigate a total loss of this resource.

Rare and unique plants would lose their habitat. The majority of these forms are found along the interface of the land and water. One species of plant life which would be adversely affected would be the Furbish lousewort. This plant is currently known only from the St. John River Basin. Inundation would destroy the majority of the known populations. More important is the loss of the unique zone along this river where the majority of these plants reside. There is documentation in the popular literature that claims this ecotone to be unsurpassed for its variety and uniqueness.

5.03 Adverse Effects Caused By Construction and Operation

Impacts of sedimentation and nutrient loading attributable to the dams and reservoirs on downstream waters are expected during the construction phase. These impacts would be controlled to lessen their severity. Sediments would reduce the productivity and cause the loss of bottom dwellers not tolerant to inputs of sediments. Nutrient enrichment in small amounts can have positive effects, but usually the impacts are negative. An unavoidable short-term increase in runoff and erosion would result from vegetation removal and surface compaction during construction of transmission line facilities. Soil would be permanently displaced. Subsoil disturbance would occur at tower locations and where footing excavations and access road cuts and fills are required. This would result in the disruption of soil profiles. The rate of erosion would decrease as revegetation progresses. Adverse impacts on hydrological resources include increased surface runoff and erosion, increased turbidity and sedimentation, the possible introduction of small amounts of herbicides, and possible channel alteration by vehicular traffic. Slight increases in water temperature could have secondary impacts on other ecological resources where vegetation has been removed from stream and pond banks. Most of the impacts would occur during construction and would disappear shortly after the construction is completed.

Operational releases would alter the hydrologic regimes of the downstream reaches. This change would increase the amount of shoreline inundated and adversely affect the existing shoreline vegetation. This impact would be realized for a distance downstream to Fort Kent, Maine.

Although no historic properties would experience direct impacts from the construction or operation of the transmission line and despite the intensive survey which would be made, the increased accessibility to some areas would increase pothunting and vandalism. Disturbance or destruction of undiscovered archaeological sites is possible due to construction activities, and such impacts are not totally avoidable.

Debris would be a continual problem although to a lesser extent after the first few years. The adverse effects would be in the form of navigation hazards to boating and to the aesthetic appeal of the reservoir. Disposal of the debris would create local and short term adverse impacts, but if the disposal is done correctly, these impacts would be negligible.

During construction some unavoidable adverse impacts on air quality would be caused by dust from disturbed soils, combustion by-products from the burning of unmerchantable wood products, vehicle and equipment exhaust emissions and fumes and odors from various operations. These impacts are expected to be localized and short-lived. Small amounts of ozone would be introduced into the atmosphere during line operation.

During construction, wildlife populations would be subjected to severe stress from many different points. Clearing operations and man's presence would drive the existing populations out to other habitat. This would cause an overcrowding condition in that habitat. The results of this overcrowding would be overbrowsing to the detriment of the habitat, mortality of the populations due to starvation, increased predation and interspecies competition for the available habitat.

Existing vegetation would be disturbed or removed along the entire transmission line route. The primary impacts that would result from this loss of vegetation include the alteration of growth patterns and forms, disruption of successionary stages, changes in community composition both within and outside the rights-of-way, and possible disturbance of rare or sensitive plants. Secondary impacts from snowmobile and other recreational vehicle use of rights-of-way and access roads are largely unavoidable. The amount of habitat would be reduced for some forest species, directly reducing their numbers and, in turn, their overall productivity. Increased disturbance of certain species during construction would result in significant stress and the possible temporary abandonment of preferred habitat. Disturbance would continue after construction, owing to human activity along new access roads.

Impacts on aquatic wildlife from changes in stream temperature primarily due to transmission line development and maintenance would be long term and potentially quite adverse. The effect of herbicides introduced into the food chain will depend on the type used and the methods ed to control vegetation. Aquatic wildlife could experience intense, though short-term and localized, impacts from increased turbidity, sedimentation and disturbance of streambeds.

Lake ice during the winter on the reservoirs would present another stress on those organisms moving about during the winter. Animals venturing out onto the ice would be subjected to falling, stranding, predation and drowning.

Adverse microclimatic changes may occur along the rights-of-way where forest vegetation has been altered. Removal of this vegetation would cause minor, long-term microclimatic changes in air temperature, solar radiation and wind velocities. Some windthrow around the edges of the reservoirs is expected and unavoidable.

The agricultural and forest industries would be adversely impacted by demand for skilled workers. The resulting job gaps would be filled by less skilled unemployed.

A major adverse impact on current timber landowners would be large capital gains which would be taxed. There is no shelter available for these large windfalls of unwanted monies nor are there lands available for reinvestment. Landowners owning small parcels of land would be similarly affected but they would be assisted in purchasing new lands under the Uniform Relocation and Assistance and Real Property Acquisition Policy Act.

Loss of economic production on cultivated lands would occur at tower sites along the transmission line. The long-term, unavoidable loss of economic production on forest lands within the rights-of-way would be more severe.

Flooded reservoir areas and rights-of-way clearing would cause 81,946 acres of timber land to be removed from production resulting in a net loss of annual growth of timber of 25,825 to 34,525 cords. Opportunity costs due to foregone timber lost would be significantly below the previously reported $216 to $322 million range over the 100-year economic life of the project. The required downward revision of the potential opportunity cost is based on an analysis of the impact of the spruce budworm on the proposed project area timber stands.

Adverse impacts on human communities during construction are associated with an influx of construction workers to the area. There are several adverse impacts related to construction which include: construction noise, minimal housing available, value systems clash, overburden of municipal services, recreational facilities, and highway use.

Social problems of alcoholism, crime, and drug abuse are expected to increase slightly during the construction phase. This increase is a function of population density and is expected to subside with the end of construction.

The proposed plan would restrict land use within the right-of-way to types compatible with high voltage transmission lines. Land use at substation and tower sites would also preempt current and future proposed land use.

Local noise levels would increase during construction. Though unavoidable, these impacts are expected to be intermittent and of short duration. Line and substation operation would result in minor, long-term increases in local noise levels. Overall, such noise levels are considered annoyances with no adverse health effects.

The aesthetic appeal of the river would be adversely impacted. Construction scars and a change in the overall appearance of the valley would be an adverse effect to those that currently recreate and reside in the valley. Construction scars would be minimal after project completion but nevertheless they would have an adverse impact on the aesthetics. Summer drawdown of the power pool would expose 1500 acres of shoreline. Drawdown would also adversely impact the plants and animals of the nearshore regions of the reservoir. This impact and the winter ice scour precludes the successful development of shoreline vegetation.

The transmission lines would be built through areas looked upon as having "wilderness character." Many recreational activities in these areas along the proposed route focus on natural visual amenities. Thus, views of the lines would conflict with these activities and detract from the recreation experience. The line would be visible from several scenic highways, a small portion of the Allagash Wilderness Waterway, and from several other rivers which are candidates for inclusion in the National Wild and Scenic River System. Towers, lines and rights-of-way, together with the visual consequences of certain necessary construction practices, would result in unavoidable visual impacts. Varying degrees of impact are expected on the quality of the visual landscape, the visual attractiveness of individual sites, and on recreation, residential, and transportation-related viewers. The introduction of visual elements out of character with historic properties could possibly alter their settings.

SECTION 6

ALTERNATIVES

6.00 ALTERNATIVES TO THE PROPOSED PROJECT

6.01 Power

6.01.1 General

The project represents a source of electrical generating capacity which would be integrated into the coordinated New England Power Pool (NEPOOL) system. No singular component of the NEPOOL system can be effectively analyzed in isolation because a combination of various power sources (existing and proposed), market factors and system operational requirements define which particular array of NEPOOL generating facilities is used at any given time to meet system demands. Therefore, the analysis of power alternatives for the project was conducted within the context of the total New England system.

The system's study of power alternatives is detailed in Appendix I (CE, 1977) and Supplement to Appendix I (CE, 1978), and consisted of the following activities:

1. A list of alternatives to be considered in the analysis was defined. This assessment included consideration of the non-conventional and less well-developed sources of energy, i.e. solar, wind, methanol, etc.

2. Load projections for the New England power system were developed for years 1985, 1990, and 2000 utilizing the NEPOOL forecast as a basis for analysis.

3. The least-cost combination of alternatives which would meet the forecasts for years 1985, 1990, and 2000 both with and without the Dickey-Lincoln School Lakes project was determined.

4. The sensitivity of the load forecast to various demand reduction measures (load management and anticipated conservation) was analyzed and the forecast was modified to account for possible changes in demand. The viability of the Dickey-Lincoln School Lakes project and the stability of the least-cost mix of alternatives were assessed in terms of the modified forecast.

5. To evaluate the non-structural alternative to the project additional conservation measures beyond those anticipated in 4. above, that would reduce the peak demands on the system by an amount equivalent to the project's output were identified. The cost of implementing these additional conservation measures was developed. The modified load forecast developed in 4. above was further dampened to reflect the reduction in demand due to these additional conservation measures. The least cost system mixes both with and without the Dickey-Lincoln School Lakes project were then assessed in terms of this reduced forecast.

6.01.2 Generation Sources

Twenty-four potential forms of energy generation and storage were reviewed and evaluated to determine those suitable for consideration as additions to the New England system (Table 6.01-1). Of these, fourteen were rejected due to limited scale of application, unproven resources and economic feasibility and undemonstrated commercial feasibility for implementation within the 1985-1990 timeframe. Ten methods of energy generation and storage were identified as being potentially viable additions to the NEPOOL system to meet projected demands and were incorporated into the systems analysis (Table 6.01-2).

The non-structural measures to reduce demands, i.e. load management, anticipated conservation, and additional conservation equivalent to the project's output are incorporated into the systems analysis by use of modified load shapes and load forecasts which reflect the related load reductions and changes. The latter (additional conservation equivalent) is also identified as a non-structural alternative to the project and analyzed accordingly.

6.01.3 Load Forecast

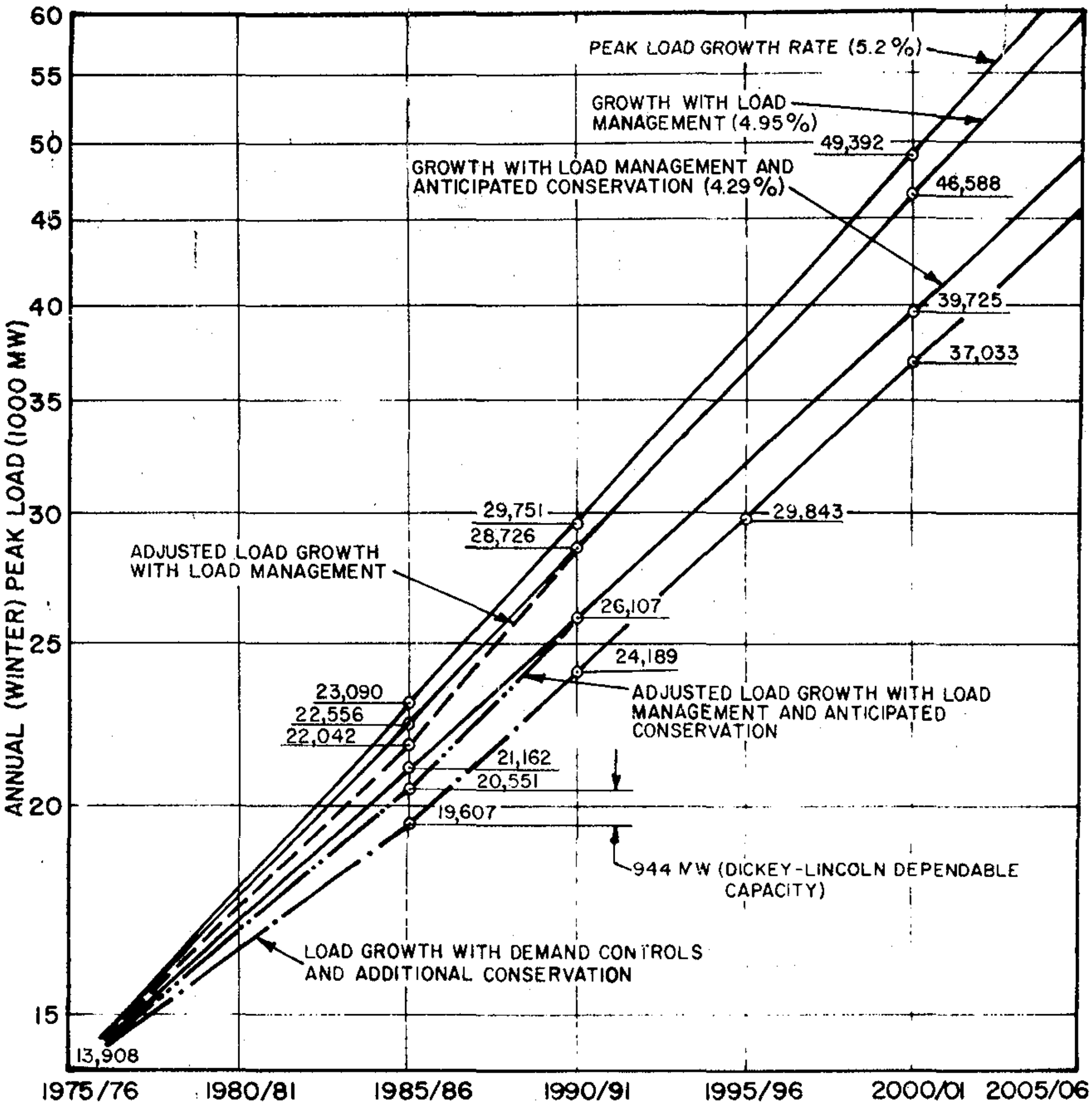
Figure 6.01-1 graphically shows the various load forecasts and growth rates developed for analysis of the system generation mixes. Details on procedures used to create the various load forecasts are presented in Appendix I (CE, 1977) and its Supplement (CE, 1978). The forecasts encompass peak load growth rates ranging from a low of 3.49% to a high of 5.2%. In comparison, it is noted that NEPOOL peak load growth rate projections presented in their annual Load and Capacity Reports have been adjusted from 5.5% in 1976 to 4.5% in 1978.

Peak loads for New England were projected to grow at an average annual rate of 5.2% through the year 2000 (Table 6.01-3). This does not reflect various demand control measures that may or may not be implemented.

6.01.4 Systems Analysis - Without Demand Controls

Utilizing computer simulation techniques, optimum system expansion plans were developed to meet the projected New England demand. Two system generation expansion plans were identified as being the least costly combination of alternatives without the project that would meet the projected New England demand. They consist of an expansion plan based on pumped-hydro/thermal additions to the system and an all-thermal expansion plan. The computer analysis indicates the pumped-hydro/thermal expansion is the more economical of the two.

However, the construction cost data for the pumped storage projects must be considered very subjective. Cost estimates for pumped storage facilities are dependent upon the specific site conditions. Accordingly in the absence of engineering studies for the specific sites considered, general assumptions were necessary for development of the



NEW ENGLAND PEAK LOAD FORECASTS AND GROWTH RATES

FIGURE 6.01-1

Table 6.01-1 INITIAL COMPILATION OF ALTERNATIVES

State of Development	Direct Generation Alternatives Type	Operating Mode*	Energy Storage (Peaking) Alternatives
In General Use	Conventional Thermal Steam Cycle	B/M	Conventional Pumped Hydro
	Diesel Power	P	
	Gas Turbines	P	
	Hydroelectric	B/M/P	
	Nuclear Steam Cycle (LWR,HWR)	B	
	(Power Purchase	B/M/P)	
Developed But in Limited Use	Combined Cycle Thermal	M	Batteries (lead acid)
	Geothermal	B	
	Nuclear Steam Cycle (LMFBR, GCFR, LWBR)	B	
	Tidal Hydroelectric	M	
Experimental	Alternative Fuels	B/M/P	Batteries (Advanced)
	Fuel Cells	P	Flywheels
	Magneto-Hydrodynamic/ Steam Cycle	M	Super Conducting Magnetic Storage
	Nuclear Steam Cycle (HTGR, Fusion)	B	Thermal Storage (Steam or Chemical)
	Solar (Photovoltaic or Thermal	M/P	Underground Compressed Air Storage
	Wind	M/P	Underground Pumped Hydro

*Abbreviations:
B: Base-load plant
M: Mid-range plant
P: Peaking plant
LWR: Light water reactor
HWR: Heavy water reactor
LMFBR: Liquid metal fast breeder reactor
GCFR: Gas cooled fast reactor
LWBR: Light water breeder reactor
HTGR: High temperature gas cooled reactor

Table 6.01-2 ALTERNATIVES SELECTED FOR EVALUATION

Type of Facility	Mode of Operation	Remarks
DIRECT GENERATION ALTERNATES		
Conventional Thermal Steam Cycle	B/M	Oil fired version only to be evaluated
Gas Turbines	P	--
Hydroelectric	B/M/P	Accepted subject to cost comparison with Dickey-Lincoln*
Nuclear Steam Cycle	B	LWR versions only to be evaluated
Power Purchase	B/M/P	Assumed conventional thermal steam cycle
Combined Cycle Thermal	M	--
ENERGY STORAGE ALTERNATES		
Conventional Pumped Hydro	P	Accepted subject to cost comparison with Dickey-Lincoln*
Batteries (lead acid)	P	Accepted subject to cost comparison with conventional energy storage systems*
Underground Compressed Air	P	Accepted subject to cost comparison with conventional energy storage systems*
Underground Pumped Hydro	P	Accepted subject to cost comparison with conventional energy storage systems*

*See Chapter 5, Appendix I (CE, 1977)

Abbreviations: B - Base-load plant
M - Mid-range plant
P - Peaking plant

Table 6.01-3 RECOMMENDED NEW ENGLAND PEAK LOAD AND ENERGY FORECAST 1975-2000* WITHOUT DEMAND CONTROL MEASURES

Year	Winter Peak Load (MW)	Year	Annual Energy (GWh)	Load Factor** Percent
1975/76	13,908	1976	77,096	60.10
1980/81	17,920	1980	95,508	60.78
1985/86	23,090	1985	124,826	61.83
1990/91	29,751	1990	163,142	62.71
1995/96	38,334	1995	213,220	63.61
2000/01	49,392	2000	278,671	64.52
Average Annual Growth Rate:	5.2%		5.5%	

*Exclusive of potential demand control measures

**Based on December peak load in that year cost estimates. Engineering experience suggests that these general estimates are probably optimistically low. Also, a recent evaluation by the Federal Energy Regulatory Commission of several of the pumped storage projects considered in the study resulted in higher costs than those included in the analysis.

The pumped storage projects are also totally dependent upon an external source for pumping energy. There is considerable question as to the availability of economic off-peak energy within the timeframes prescribed by the optimum system mix. The significant delays being experienced by utilities in placing nuclear power plants on-line support this real concern.

In view of these two factors, the all-thermal expansion plan is considered the more realistic and thus the most appropriate reference case for further analysis and discussion herein. Comparative values for the pumped-hydro/thermal expansion are also presented in the tables, however, for informational purposes.

Tables 6.01-4 and 6.01-4a summarize the results of the study noting the system generation mixes and total system costs for expansion without and with Dickey-Lincoln School.

The results show that in the New England system, the existing fossil capacity would remain the most economical mid-range generating alternative, as long as it is available. Thus, the increasing demand must be met with new base, mid-range, and peaking capacity. In all cases the fossil mix remained about 20 to 22 percent of total capability. Nuclear capability -- the most attractive base load alternative -- was between 51-54 percent for all cases.

The addition of Dickey-Lincoln School would result in overall economy because investment in more costly oil-fired gas turbine peaking capacity would be deferred. Table 6.01-4 shows that the cumulative annual costs for the period 1986 through 2000 are lower with Dickey-Lincoln School than for the reference case without the project by $165 million for the initial development and $353 million for the ultimate installation. On an average annual basis, this equates to an annual savings of $11.0 and $23.5 million respectively. As noted in the table, the cost data is based on October 1975 prices and the Federal repayment interest rate was used to determine costs for Dickey-Lincoln School Lakes.

6.01.5 Systems Analysis - With Demand Controls

Projected demands were measured in terms of their sensitivity to demand reduction measures reflecting both peak load management and anticipated conservation measures. The results of these measures on future demands as analyzed in Appendix I (CE, 1977) are summarized in Table 6.01-5.

TABLE 6.01-4
SYSTEM CAPACITY ADDITIONS AND ANNUAL COSTS WITHOUT DEMAND CONTROLS
All Thermal Expansion

Case	Year	Accumulated Capacity Additions (MW) Nuclear	Fossil	Gas Turbine	*Combined Cycle*	*Hydro* & P.S	Total	Accumulated Total Annual Cost ($ million) from 1985(1)	Savings ($ million) Cumulative/Ave. Annual
NEPOOL Jan. 1976 Forecast	1980	4,291	12,644	1,732	205	3,073	21,945	-	
Study Forecast (all cases)	1985	8,891	12,644	3,292	475	3,073	28,375	-	
Without Dickey-Lincoln School	1986	8,891	12,644	4,792	475	3,073	29,875	1,591	
	1990	13,491	12,644	7,492	475	3,073	37,175	9,959	
	1995	22,691	12,644	8,992	1,675	3,073	49,075	25,875	
	2000	31,891	13,444	12,292	1,675	3,073	62,375	49,426	
	% mix(2)	51.1	21.6	19.7	2.7	4.9	100.0	-	
With Dickey-Lincoln School	1986	8,891	12,644	3,532	475	4,017	29,559	1,578	
	1990	13,491	12,644	6,232	575	4,017	36,959	9,898	
(Initial Development)	1995	22,691	12,644	7,732	1,775	4,017	48,859	25,761	
	2000	31,891	13,444	11,032	1,775	4,017	62,159	49,261	165/11.0
	% mix(2)	51.3	21.6	17.7	2.9	6.5	100.0	-	
With Dickey-Lincoln School	1986	8,891	12,644	3,292	475	4,454	29,756	1,576	
	1990	13,491	12,644	5,692	575	4,454	36,856	9,847	
(Ultimate Development)	1995	22,691	12,644	7,192	1,775	4,454	48,756	25,650	
	2000	31,891	13,444	10,492	1,775	4,454	62,056	49,073	353/23.5
	% mix(2)	51.4	21.6	16.9	2.9	7.2	100.0	-	

NOTES: (1) *Annual costs (October 1975 dollars) accumulated for new additions from end of* 1985 only; interest rates for capital investments 6 5/8% for Dickey-Lincoln School, 10% for all others

(2) In 2000

Table 6.01-4

TABLE 6.01-4a
SYSTEM CAPACITY ADDITIONS AND ANNUAL COSTS WITHOUT DEMAND CONTROLS
Pumped Hydro Expansion

Case	Year	Accumulated Capacity Additions (MW) Nuclear	Fossil	Gas Turbine	Combined Cycle	Hydro & P.S	Total	Accumulated Total Annual Cost ($ million) from 1985(1)	Savings ($ million) Cumulative/Ave. Annual
NEPOOL Jan. 1976 Forecast	1980	4,291	12,644	1,732	205	3,073	21,945	-	
Study Forecast (all cases)	1985	8,891	12,644	3,292	475	3,073	28,375	-	
Without Dickey-Lincoln School	1986	8,891	12,644	3,292	475	4,973	30,275	1,607	
	1990	13,491	12,644	4,132	575	5,773	36,615	9,888	
	1995	21,541	12,644	4,132	975	7,673	46,965	25,781	
	2000	33,041	12,644	6,052	1,575	7,673	60,985	49,237	
	% mix(2)	54.2	20.7	9.9	2.6	12.6	100.0	-	
With Dickey-Lincoln School	1986	8,891	12,644	3,532	475	4,017	29,559	1,577	
	1990	13,491	12,644	4,132	475	5,917	36,659	9,859	
(Initial Development)	1995	21,541	12,644	4,612	475	7,617	46,889	25,691	
	2000	33,041	12,644	5,572	1,075	8,617	60,949	49,112	125/8.3
	% mix(2)	54.2	20.8	9.1	1.8	14.1	100.0	-	

NOTES: (1) Annual costs (October 1975 dollars) accumulated for new additions from end of 1985 only; interest rates for capital investments 6 5/8% for Dickey-Lincoln School, 10% for all others

(2) In 2000

Table 6.01-4a

TABLE 6.01-5
PEAK LOAD AND ENERGY DEMAND ADJUSTMENTS WITH DEMAND CONTROLS
(LOAD MANAGEMENT AND ANTICIPATED CONSERVATION)

Year		Winter Peak Load (MW)	Previous Summer Peak Load (MW)	Year	Annual Energy (GWh)	Load Factor (%)
1980/81		16,904	15,707	1980	92,639	62.56
1985/86		20,551	19,083	1985	116,554	64.74
1990/91		26,107	23,644	1990	146,644	64.12
1995/96		32,204	28,929	1995	184,506	65.40
2000/01		39,725	35,397	2000	232,128	66.71
Avg. Annual Growth (%)	1975-2000	4.29	4.12	-	4.7	-
	1975-1985	3.98	3.97	-	4.7	-

System expansions to meet the modified demands were simulated both without and with Dickey-Lincoln School Lakes to reflect the impact of the potential demand reduction measures.

The effect of the modified load forecast inclusive of demand control measures on overall system costs for the optimum system expansion mixes are shown on Tables 6.01-6 and 6.01-6a. The cumulative annual system costs for the period 1986 through 2000 are less for the modified load forecast by a total of $2.8 and $2.6 billion for without and with Dickey-Lincoln School cases respectively.

As in the case without demand controls, the cumulative cost is lower for the system that includes Dickey-Lincoln School. The initial development reflects an estimated $34 million savings over the period of 1986-2000 or $2.3 million annually. The ultimate development would increase the estimated savings to a $160 million total and $10.7 million annual value.

6.01.6 Systems Analysis - With "Additional Conservation"

Projected demands were further reduced to reflect "additional conservation" measures. Additional conservation measures represent the non-structural alternative to the project and are those conservation actions, beyond load management and anticipated conservation previously discussed, necessary to reduce the peak demand in 1986 by an additional 944 MW, equal to the dependable capacity of the Dickey-Lincoln School Lakes project. The forecast with "additional conservation" is, therefore, based on the reduced load growth which would decrease the modified demand by the equivalent of the project output in 1986. The results are summarized in Table 6.01-7.

Systems expansions to meet these reduced demands, reflecting additional conservation measures, were simulated both without and with the project.

The impact of the reduced load forecast inclusive of additional conservation measures on overall system costs for the optimum system expansion mix is shown on Table 6.01-8. The cumulative annual system costs are less than the without and with demand control cases as can be seen by comparison with Tables 6.01-4, 6.01-4a, 6.01-6 and 6.01-6a.

As in previous cases, the cumulative cost is lower for the system including Dickey-Lincoln School. The initial development reflects an estimated savings of $216 million over the period of 1986-2000 or $14.4 million annually when a without and with project comparison is made for the "additional conservation" case.

6.01.7 Environmental Factors.

A quantitative analysis of the more important environmental parameters has been made for the generating capacity additions developed

TABLE 6.01-6
SYSTEM CAPACITY ADDITIONS AND ANNUAL COSTS WITH DEMAND CONTROLS
All Thermal Expansion

Case	Year	Nuclear	Fossil	Gas Turbine	Combined Cycle	Hydro & P/S	Total	Accumulated Total Annual Cost ($ million) from 1985(1)	Savings ($ million) Cumulative/Ave. Annual
		Accumulated Capacity Additions (MW)							
NEPOOL Jan. 1976 Forecast	1980	4,291	12,644	1,732	205	3,073	21,945	-	
Study Forecast (all cases)	1985	4,291	12,644	3,952	475	3,073	24,435	-	
Without Dickey-Lincoln School	1986	5,441	12,644	4,732	475	3,073	26,365	1,836	
	1990	10,041	12,644	5,752	775	3,073	32,285	10,842	
	1995	15,791	12,644	7,492	975	3,073	39,975	26,033	
	2000	22,691	12,644	8,932	2,175	3,073	49,515	46,636	
	% mix(2)	45.8	25.6	18.0	4.4	6.2	100.0	-	
With Dickey-Lincoln School	1986	4,291	12,644	4,192	575	4,017	25,719	1,808	
(Initial Development)	1990	8,891	12,644	5,032	1,275	4,017	31,859	10,774	
	1995	15,791	12,644	5,872	1,475	4,017	39,799	26,014	
	2000	23,841	12,644	7,192	1,675	4,017	49,369	46,602	34/2.3
	% mix(2)	48.3	25.6	14.6	3.4	8.1	100.0	-	
With Dickey-Lincoln School	1986	4,291	12,644	3,952	475	4,454	25,816	1,805	
(Ultimate Development)	1990	8,891	12,644	4,852	975	4,454	31,816	10,737	
	1995	15,791	12,644	5,692	1,275	4,454	39,856	25,927	
	2000	23,841	12,644	7,012	1,475	4,454	49,426	46,476	160/10.7
	% mix(2)	48.2	25.6	14.2	3.0	9.0	100.0	-	

NOTES: (1) Annual costs (October 1975 dollars) accumulated for new additions from en[illegible] 1[illegible] only; interest rates for capital investments 6 5/8% for Dickey-Lincoln, 10% for [illegible] others

(2) In 2000

Table 6.01-6

TABLE 6.01-6a
SYSTEM CAPACITY ADDITIONS AND ANNUAL COSTS WITH DEMAND CONTROLS
Pumped Hydro Expansion

Case	Year	Accumulated Capacity Additions (MW) Nuclear	Fossil	Gas Turbine	Combined Cycle	Hydro & P/S	Total	Accumulated Total Annual Cost ($ million) from 1985(1)	Savings ($ million) Cumulative/Ave. Annual
NEPOOL Jan. 1976 Forecast	1980	4,291	12,644	1,732	205	3,073	21,945	-	
Study Forecast (all cases)	1985	4,291	12,644	3,952	475	3,073	24,435	-	
Without Dickey-Lincoln School	1986	5,441	12,644	3,952	475	3,873	26,385	1,837	
	1990	10,041	12,644	4,912	675	3,873	32,245	10,832	
	1995	15,791	12,644	6,292	1,175	3,873	39,775	26,002	
	2000	23,841	12,644	7,552	1,375	3,873	49,285	46,606	
	% mix(2)	48.4	25.7	15.3	2.8	7.8	100.0	-	
With Dickey-Lincoln School	1986	4,291	12,644	4,192	575	4,017	25,719	1,808	
(Initial Development)	1990	8,891	12,644	5,032	1,375	4,017	31,959	10,776	
	1995	14,691	12,644	5,752	2,475	4,017	39,579	25,970	
	2000	22,691	12,644	6,832	2,875	4,017	49,059	46,592	14/0.9
	% mix(2)	46.2	25.8	13.9	5.9	8.2	100.0	-	

NOTES: (1) Annual costs (October 1975 dollars) accumulated for new additions from end of 1985 only; interest rates for capital investments 6 5/8% for Dickey-Lincoln, 10% for all others

(2) In 2000

Table 6.01-6a

TABLE 6.01-7
PEAK LOAD AND ENERGY DEMAND ADJUSTMENTS
WITH DEMAND CONTROLS AND ADDITIONAL CONSERVATION

Year		Winter Peak Load (MW)	Previous Summer Peak Load (MW)	Year	Annual Energy (GWh)	Load Factor (%)
1980/81		16,517	15,470	1980	90,826	62.77
1985/86		19,607	18,454	1985	111,464	64.90
1990/91		24,189	22,582	1990	140,239	66.18
1995/96		29,843	27,633	1995	176,442	67.49
2000/01		37,033	33,814	2000	221,991	68.43
Ave.% Annual Growth	1975-1985	3.49	3.59	-	4.18	-
	1985-2000	4.29	4.12	-	4.70	-

TABLE 6.01-8
SYSTEM CAPACITY ADDITIONS AND ANNUAL COSTS WITH DEMAND CONTROLS
AND ADDITIONAL CONSERVATION

Case	Year	Nuclear	Fossil	Gas Turbine	Combined Cycle	Hydro & P/S	Total	Total Annual Cost (1) ($ million)	Savings ($ million) Cumulative/Ave. Annual
NEPOOL Jan. 1976 Forecast	1980	4,291	12,644	1,732	205	3,073	21,945	-	
Study Forecast (all cases)	1985	4,291	12,644	2,212	475	3,073	22,695	-	
Without Dickey-Lincoln School	1986	4,291	12,644	4,012	475	3,073	24,495	1,689	
All Thermal Expansion	1990	8,891	12,644	5,212	575	3,073	30,395	10,133	
	1995	14,641	12,644	6,712	875	3,073	37,945	24,497	
	2000	21,541	12,644	7,912	1,775	3,073	46,945	44,003	
	% mix(2)	45.9	26.9	16.9	3.8	6.5	100.0	-	
Without Dickey-Lincoln School	1986	4,291	12,644	2,572	475	3,873	23,855	1,680	
Pumped Hydro Expansion	1990	8,891	12,644	4,252	475	3,873	30,135	10,093	
	1995	14,641	12,644	5,872	475	3,873	37,505	24,428	
	2000	21,541	12,644	7,312	875	3,873	46,245	43,868	
	% mix(2)	46.6	27.3	15.8	1.9	8.4	100.0	-	
With Dickey-Lincoln School	1986	4,291	12,644	2,572	475	4,017	23,999	1,673	
Pumped Hydro Expansion	1990	8,891	12,644	3,652	775	4,017	29,979	10,052	
(Initial Development)	1995	14,641	12,644	5,452	775	4,017	37,529	24,352	(All Thermal) 216/14.4
	2000	21,541	12,644	6,712	1,575	4,017	46,489	43,787	
	% mix(2)	46.3	27.2	14.4	3.4	8.7	100.0	-	(Pumped Hydro) 81/5.4

NOTES: (1) Annual costs (October 1975 dollars) accumulated for new additions from end of 1985 only; interest rates for capital investments 6 5/8% for Dickey-Lincoln, 10% for all others

(2) In 2000

Table 6.01-8

for the with and without Dickey-Lincoln School cases, for load forecasts with and without demand control measures and for additional conservation measures. These parameters include:

- Nuclear fuel consumption (U 308)
- #2 oil fuel consumption
- #6 oil fuel consumption
- Total heat rejection
- Gaseous emissions (SO_2, NO_x, CO)
- Particulate emissions
- Water consumption

A summary of the results is shown in Table 6.01-9 and 10.

The overall environmental system changes because of Dickey-Lincoln School are relatively minor. For the forecast without demand controls, the project represents an oil savings of up to 35 million barrels over 15 years; this represents about 2 percent of the total expected consumption in New England. The reductions in environmental emissions are more modest, with a slight increase in particulate emissions. This is due to major reductions caused by the gas turbines that are replaced by Dickey-Lincoln School, and are offset by increases for the base load thermal units required to make up energy deficiency.

The environmental changes arising as a result of Dickey-Lincoln School with a reduced load forecast are more complex. With reduced load from load management and anticipated conservation, the project causes a deferral of nuclear expansion. Thus, the net result is a decrease in nuclear fuel consumption, a decrease in #2 oil consumption, but an increase in #6 oil consumption.

The changes in environmental emissions because of Dickey-Lincoln School are both modest and varying. For every case, there are conflicting results. For example, reduced nuclear fuel consumption is associated with increased oil consumption and reduced heat rejection is combined with increased particulate emissions.

In summary, the overall environmental impact of Dickey-Lincoln School on New England generation expansion is considered to be marginally beneficial in the period 1986 through 2000.

It should be noted that the above analysis does not address the impacts of Dickey-Lincoln on the present terrestrial ecosystem or the semi-wilderness recreational resources of the upper Saint John Watershed. These impacts are fully discussed in Sections 4 and 5 of the associated Appendices.

TABLE 6.01-9: ENVIRONMENTAL PARAMETERS (Thermal Expansion)
IMPACT OF DICKEY-LINCOLN IN NEW ENGLAND 1986-2000

Load Forecast	Without Controls			With Controls (Load Management & Anticipated Conservation)			With Additional Conservation	
Parameters(1)	Without Dickey Lincoln	With Dickey Lincoln	Change (%)(2)	Without Dickey Lincoln	With Dickey Lincoln	Mean Change (%)(2)	Without Dickey Lincoln	With Dickey Lincoln
Fuel Consumption								
U 308 (10^6 lb.)	16.0	16.0	0	11.5	11.3	-2		10.4
#2 oil (10^6 bbl.)	154.9	111.6	-28	122.7	105.1	-14		81.8
#6 oil (10^6 bbl.)	1,349.7	1,357.2	+0.6	1,589.4	1,605.3	+1		1,610.0
Heat Rejection								
Atmos. (10^{12} BTU)	1,775.1	1,583.1	-11	1,847.9	1,768.7	-4		1,702.2
Water (10^{12} BTU)	17,566.7	17,571.3	+0.1	14,533.8	14,463.8	-0.5	NOT COMPUTED	13,748.9
Emissions								
SO_2 (10^3 ton)	5,393.2	5,352.5	-0.8	6,255.8	6,289.0	+0.5		6,269.4
NO_x (10^3 ton)	3,265.6	3,179.1	-3	3,708.4	3,701.5	-0.2		3,639.4
CO (10^3 ton)	101.2	100.4	-0.8	117.8	118.0	+0.2		117.2
Part. (10^3 ton)	14,880.9	14,975.9	+0.6	17,635.1	17,790.7	+0.9		17,843.9
Water Consumption								
(10^9 gal.)	2,222.1	2,223.2	+0.1	1,588.6	1,530.1	-3.7		1,446.5

NOTES: (1) Estimated values of major environmental parameters for all units in the New England System, totaled for the period 1986 through 2000.

(2) Change in value of parameter as a percentage of the value for all-thermal reference case, without Dickey-Lincoln, i.e. indicative of the impact of Dickey-Lincoln.

Table 6.01-9

TABLE 6.01-10: ENVIRONMENTAL PARAMETERS (Pumped Hydro Expansion)
IMPACT OF DICKEY-LINCOLN IN NEW ENGLAND 1986-2000

Load Forecasts	Without Controls			With Controls			With Additional Conservation		
Parameters(1)	Without Dickey-Lincoln	With Dickey-Lincoln	Change (%)(2)	Without Dickey-Lincoln	With Dickey-Lincoln	Change (%)(2)	Without Dickey-Lincoln	With Dickey-Lincoln	Change (%)(2)
Fuel Consumption									
U_3O_8 (10^6 lb.)	16.13	15.85	-2	11.71	11.30	-4	10.50	10.44	-0.6
#2 oil (10^6 bbl.)	51.73	60.58	+17	86.63	105.13	+21	79.99	81.80	+2
#6 oil (10^6 bbl.)	1,436.42	1,283.22	-11	1,578.21	1,605.34	+2	1,635.98	1,609.95	-2
Heat Rejection									
Atmos. (10^{12} Btu)	1,442.7	1,503.4	4	1,703.3	1,768.7	+4	1,753.4	1,702.2	-3
Water (10^{12} Btu)	17,864.2	17,661.4	-1	14,674.6	14,463.8	-1	13,848.0	13,748.9	-0.7
Emissions									
SO_2 (10^3 ton)	5,559.7	5,621.2	1	6,155.7	6,289.0	+2	6,370.0	6,269.4	-2
NO_x (10^3 ton)	3,188.5	3,224.5	1	3,589.0	3,701.5	+3	3,675.0	3,639.4	-1
CO (10^3 ton)	103.7	104.5	1	115.3	118.0	+2	118.8	117.2	-1
Part. (10^3 ton)	15,930.2	16,034.3	0.6	17,534.2	17,790.7	+1	18,141.8	17,843.9	-2
Water Consumption									
(10^9 gal.)	2,234.9	2,200.8	-2	1,622.0	1,530.1	-6	1,454.4	1,446.5	-0.5

NOTE: (1) Estimated values of major environmental parameters for all units in the New England system, totaled for the period 1986-2000.

(2) Change in value of parameter as a percentage of the value for pumped hydro reference case, without Dickey-Lincoln, i.e. indicative of the impact of Dickey-Lincoln.

6.01.8 No-Action Alternative (Federal)

It would be unrealistic and unresponsible to suggest that no electrical generation capacity would be added to the New England system by the electric utility industry either with or without the proposed project. To not meet load demands and not provide system reliability would be unacceptable to the consumer public. It is for this reason that a "no Federal action" alternative is discussed as being the proper scenario to consider.

The Federal Energy Regulatory Commission (FERC), the Federal agency responsible for licensing and regulatory enforcement of the electrical industry has advised that in the absence of the proposed project, the most likely generation facilities to evolve through implementation by the industry would be gas turbines to meet the peaking demand and combined cycle plants to meet the intermediate demand loads. The power alternatives studies and development of optimum generation mixes for the system contained in Appendix I (CE, 1977) generally support this guidance. Therefore, at current price levels, these are considered to be the types of generating facilities that the industry would implement to meet electric power demands of the kind and magnitude that would be served by the project. It should be realized, however, that the economics of the electric utility industry is continually fluctuating due to fuel shortages and increasing fuel costs.

The system that would evolve in the absence of Dickey-Lincoln School Lakes would be more costly than that with the project. This cost would be borne by the consumers and could be expected to steadily increase in the future due to increases in fuel costs. This alternative would increase the dependence on oil products.

The socio-economic impacts of industry response to a No Action choice in the form of gas turbines and combined cycle plants would be expected to be minimal due to the compact unit size and decentralized facilities envisioned. Environmental impacts of gas turbines and combined cycle plants are generally minimal for such plants. Site disruption would be slight due to anticipated small unit sizes and decentralization. Noise can be effectively controlled to low levels and gaseous emission, primarily nitrogen and sulfur oxides are generally low. The facilities can also be located close to load centers minimizing transmission impacts.

6.01.9 Non-Structural Alternatives

6.01.9.1 Load Management and Conservation

The primary responsibility of an electric utility system is to provide sufficient generating capability, which is economical, reliable and flexible to meet the demands within its service area at all times. This obligation is fulfilled by a combination of generation and storage facilities and purchases from other systems. The demands imposed on an electrical system vary continuously with time and fluctuate markedly on a daily, monthly, seasonal or annual basis as illustrated by Figure 6.01-2. Providing adequate generating capability for the relatively short periods of peak demand has a significant impact on the overall power supply costs. This, coupled with the inflation of fuel costs and capital costs of generating equipment, has led to increased interest in means of controlling or reducing the demands to lower the system costs.

Demand control or reduction measures fall into two general categories - "Load Management" and "Conservation."

Load Management - This is action implemented for the "shifting" and corresponding reduction of peak demands and the alteration of daily load shapes by means of direct or indirect measures, with no significant change in total energy usage. Direct control measures are those in which the utility controls the end-use devices (e.g., water heaters, space heaters, air conditioners, etc.) by supervisory control. A example is radio controlled switches on customer's water heaters permitting switch-off during high demand periods and switch-on during low demand periods. Indirect control measures are those in which price incentives are used to motivate usage shifting by the customer (e.g., peak load pricing, night storage heaters, etc.).

The objective of Load Management is to "flatten" out the load curve (less variation in energy use requirements) by reducing the peak demand (Figure 6.01-3).

Conservation - This is action generally taken to eliminate waste and to improve efficiency of electrical energy usage. Examples are: changed personal habits (turning off lights, TV, etc. when not needed), use of alternative energy sources such as solar or wind and general cost consciousness. Energy conservation, unlike load management, does not change the distribution of energy usage during a period but reduces the total energy demands and has a dampening effect on energy growth rate.

As described in Section 6.01, the alternatives study assessed the potential impact on forecast demands of Load Management and Anticipated Conservation measures which may realistically be implemented in New England through the year 2000. This assumed that major or drastic changes in electrical usage patterns and consumer life styles would not take place. Using the year 1990/91 for comparison, Table 6.01-11 shows the estimated impacts of demand controls. The impact of management and anticipated conservation on a daily load shape is illustrated by Figure 6.01-4.

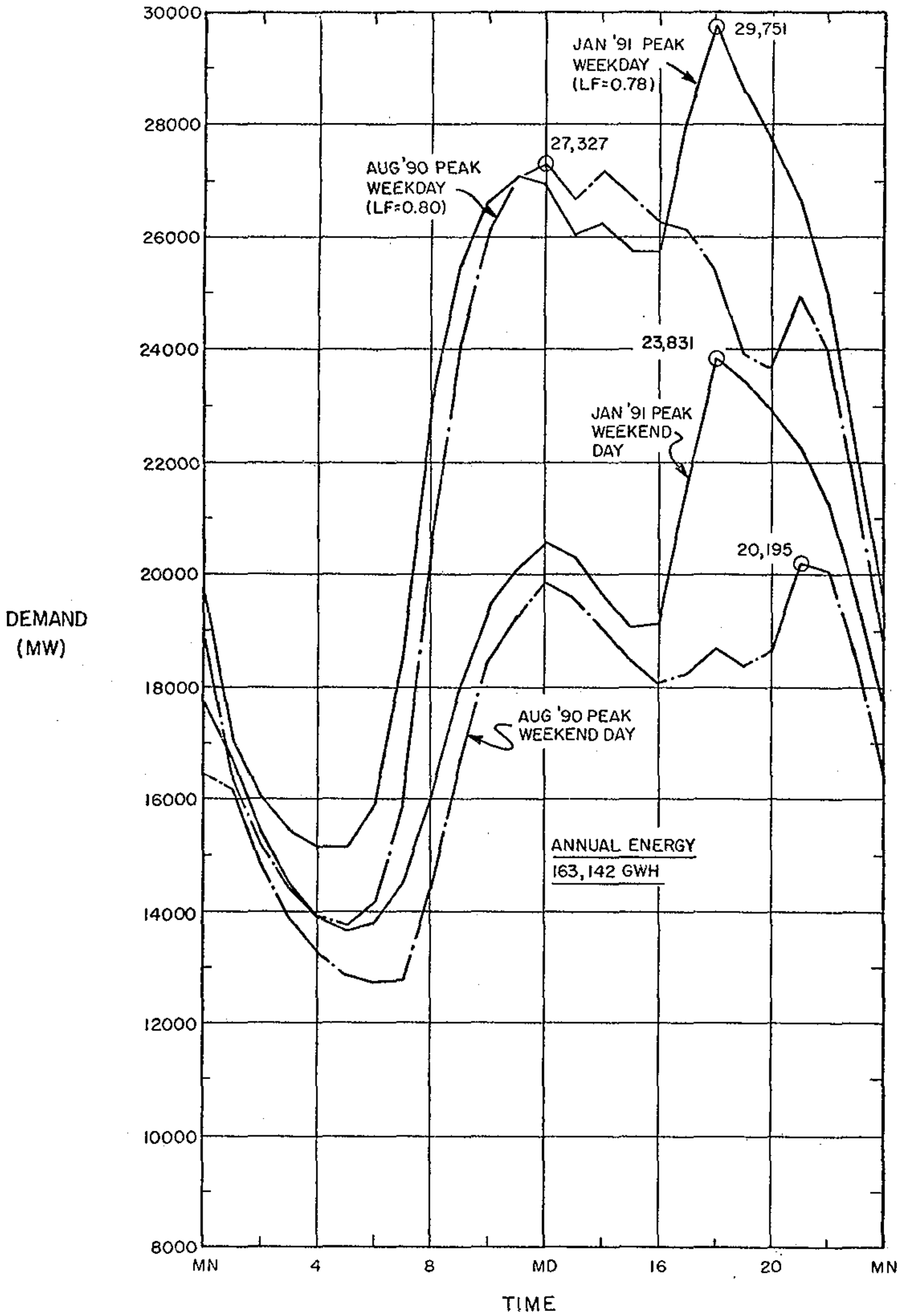
TABLE 6.01-11
COMPARISON OF DEMAND CONTROLS

	Winter Peak		Summer Peak		Annual Energy	
	MW	Avg. Ann. Growth %	MW	Avg Ann. Growth %	GWH	Avg. Ann. Growth %
Forecast 1990/91 w/o demand controls	29,751	5.2	27,327	5.2	163,142	5.5
Forecast 1990/91 w/Load Management only	28,726	4.95	26,039	4.83	163,142	5.5
Forecast 1990/91 w/Load Management & Anticipated Conservation	26,107	4.29	23,644	4.12	146,644	4.7

The generating capability requirements imposed on the system can be reduced significantly as illustrated by the above table if load management and conservation measures are implemented. However, this reduction in capacity requirements will not eliminate the need for additions to the system based on future demand requirements but will defer the magnitude of required additions by dampening the growth rate. As discussed in Section 6.01, an optimum system expansion was deveoped to meet this reduced load forecast both with and without the Dickey-Lincoln School Lakes project. The generation mix with the project was found to be the most economical. Therefore, rather than being viewed as an alternative to the project, implementation of load management and anticipated conservation measures are considered as desirable supplementing measures taken to conserve energy and resources in keeping with national goals, which can be realistically anticipated.

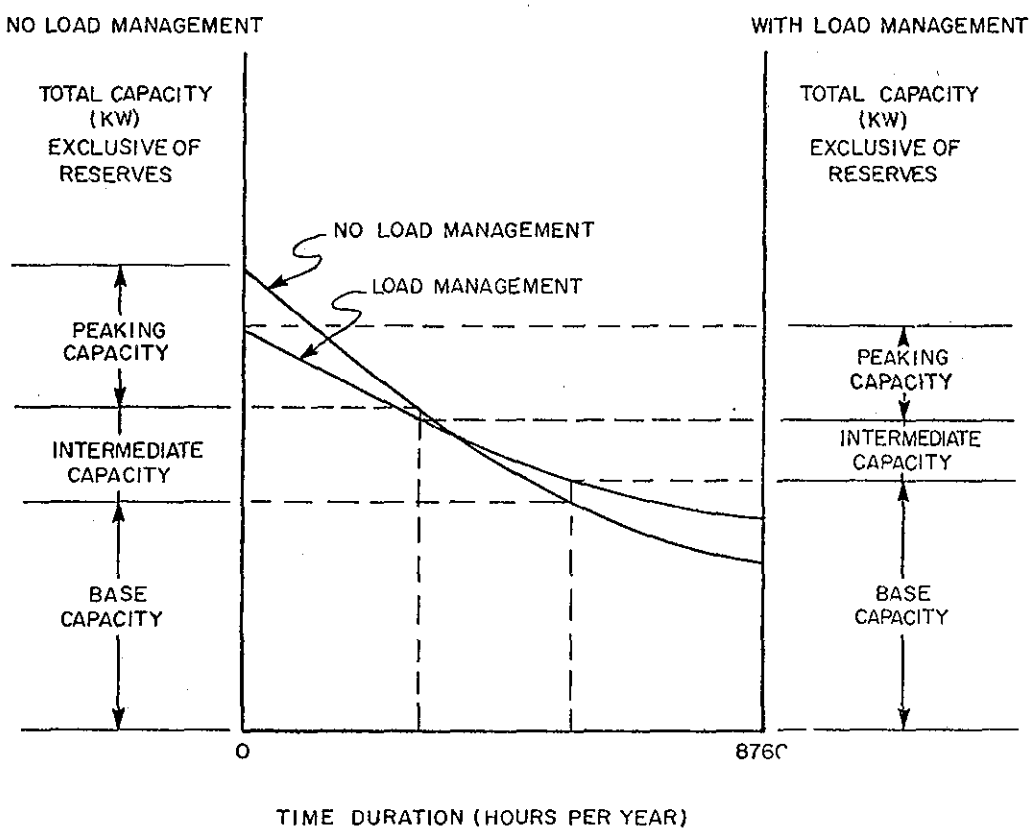
To evaluate conservation as a specific alternative to the project, additional conservation measures were identified which would be required to reduce the peak load demand in 1985 by an added 944 MW beyond those envisioned in the above discussion (load management and anticipated conservation). The 944 MW is the dependable capacity of Dickey-Lincoln and the reduction of the peak load demand by an equivalent amount due to additional conservation measures constitutes a non-structural alternative to the project. Details of the analysis are presented in the Supplement to Appendix I (CE, 1978).

The required additional reductions in demand which would be necessary could theoretically be accomplished but would entail changes in consumer habits and would undoubtedly require further govenment-financed inducements and/or statutory controls. For example, existing electrically-heated homes would require structural modification to allow the installation of increased insulation. Kitchens and bathrooms in



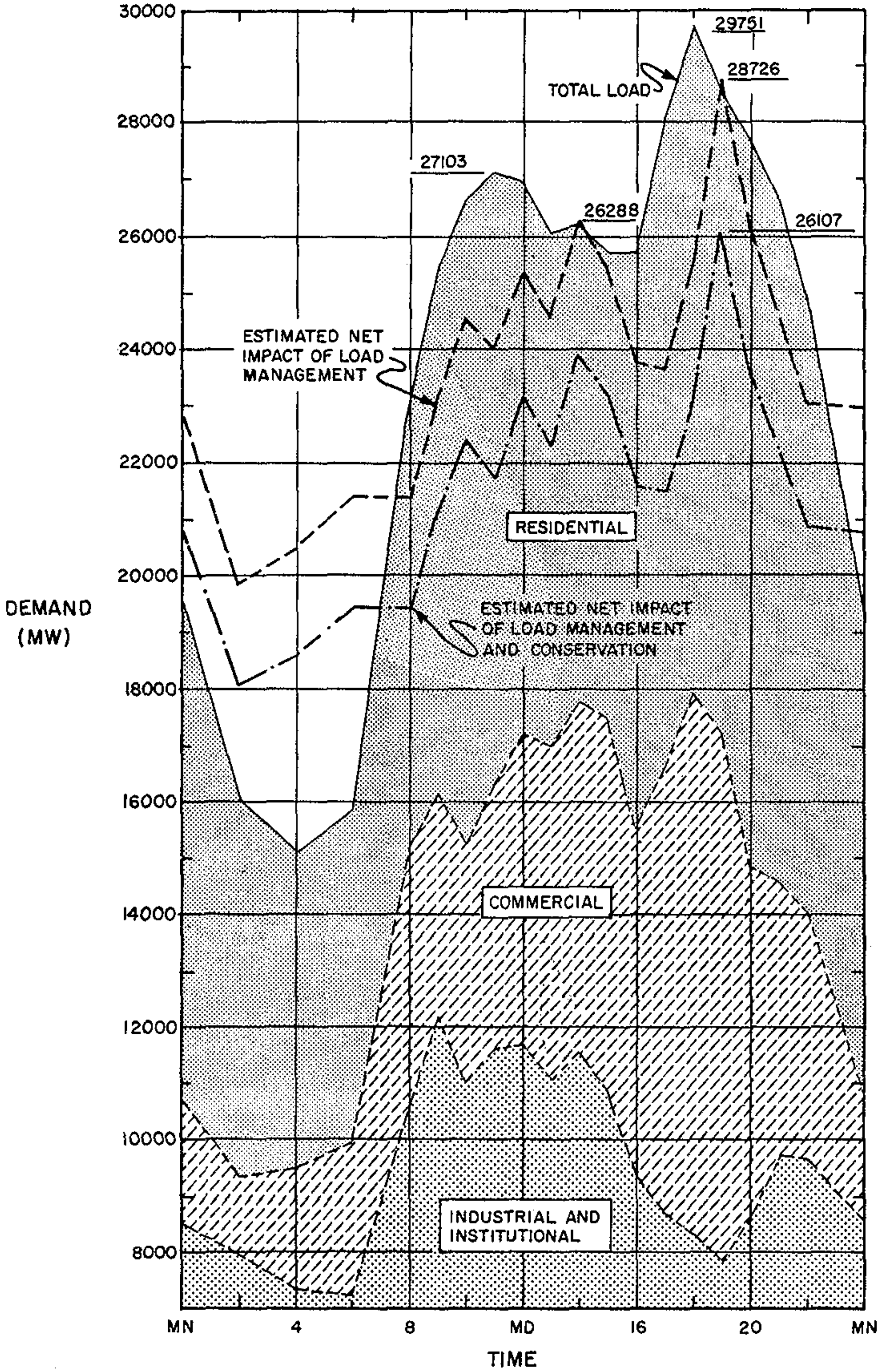
NEW ENGLAND FORECAST PEAK DEMAND LOAD CURVES (1990/91)

FIGURE 6.01-2



ANNUAL LOAD DURATION CURVES

FIGURE 6.01-3



NEW ENGLAND SYNTHESIZED LOAD SHAPES
WORST WINTER DAY, 1990/91

FIGURE 6.01-4

existing homes would have to be compulsorily converted to fluorescent lighting. Water heaters, refrigerators and freezers would have to be "traded-in" for more efficient replacements, manufactured according to Government specifications. For measures such as these to be effectively implemented, a great degree of standardization of appliances would probably be necessary. While the additional demand reductions may be theoretically achievable, the direct cost estimated at $3.3 billion or $3,300 per KW of demand reduction in 1977 dollars, would be prohibitive. The added costs of legislation and administering such a program would also be extremely high. The Dickey-Lincoln School project on the other hand, at under $1000/KW, would be considerably more economical.

The importance, desirability and even necessity of encouraging and implementing conservation measures to cope with overall energy shortages is fully recognized. However, conservation alone will not eliminate electrical energy demand growth nor the need for added peaking capacity in the system. Conservation measures equivalent to the project output cannot, therefore, be regarded as a valid alternative to the Dickey-Lincoln project.

6.01.9.2 Power Purchases

The feasibility of power purchases was evaluated in Appendix I (CE, 1977) and its Supplement (CE, 1978). In 1975 Firm Purchases of power by NEPOOL from outside the New England Area[1] amounted to:

	Summer	Winter (Dec.)
Firm Purchases (MW)	217	226
Total Capability (MW)	18,901	20,212
Ratio $\frac{\text{Purchases}}{\text{Capability}}$ (%)	1.14	1.12

There is undoubtedly some added flexibility in retaining such a relatively small portion of the capability reserve margin in the form of power purchase arrangements. The availability of such power sources outside the New England area must of course be firm. With the current uncertainties in the power supply industry, the future availability of large blocks of power for purchases from utilities outside the area must be considered somewhat speculative. It is likely that neighboring utilities will have relatively small amounts of power available for export.

Table 6.01-12 indicates the projected Firm Purchases outside the New England area to the winter of 1986/87. A total of up to 400 MW of this purchased power is oil or coal-fired base load capacity which is scheduled to be reduced to approximately 200 MW by the end of 1986. More recent NEPOOL Load and Capacity Reports of January 1977 and January 1978 indicate general adherence to these projections.

[1]New England Load and Capability Report, 1975-1986, January 1, 1976. NEPOOL.

Power purchases are feasible for supplementing system capacity to meet projected load demands on a short-term basis or to compensate for slippage in planned capacity implementation. If large blocks of firm peaking power were available for purchase on a long-term basis, it could have the ability to meet most of the project objectives. They could not, however provide the flexibility of response to system demands that the project provides due to the restrictive nature on contractual arrangements. Purchased power of the type and magnitude provided by the project would most likely be more costly and result in higher consumer costs. Except for the higher possible consumer costs, this alternative would have no identifiable socio-economic or environmental impacts on the New England Region.

Future availability of large blocks of firm peaking power for long-term contract purchase is considered very remote and therefore is not a feasible alternative for the proposed project.

The NEPOOL has advised that in their long-range planning, power purchases from sources outside New England including Canada, other than their present purchases, are not considered. Their experience has found planning based on power purchases to be impractical because long-term year-round contracts could not be arranged, particularly with foreign sources. Also due to the New England experience with oil contracts during the oil embargo, it is doubtful that the power companies in New England would expose their customers to the type of power cutoff that could occur from large scale purchases from outside sources. They further confirm that it is not reasonable to expect that external sources would provide long term contracts for large amounts of peaking power.

TABLE 6.01-12 PROJECTED NEPOOL FIRM POWER PURCHASES (MW)

	Summer			Winter		
Year	Firm Purchases	Total Capability	Ratio (%)	Firm Purchases	Total Capability	Ratio (%)
1976/77	426	21133	2.02	594	22158	2.68
1977/78	594	21509	2.76	594	22212	2.67
1978/79	594	21501	2.76	596	22799	2.61
1979/80	596	22103	2.70	599	22802	2.63
1980/81	599	22106	2.71	601	22804	2.64
1981/82	601	23258	2.58	602	24225	2.49
1982/83	602	24639	2.44	603	26676	2.26
1983/84	603	27054	2.23	605	27828	2.17
1984/85	605	27056	2.24	606	28979	2.09
1985/86	606	28207	2.15	405	28778	1.41
1986/87	405	28006	1.45	205	30878	0.66

Source: New England Load and Capability Report, 1975-1986, NEPOOL.

6.01.10 Structural Alternatives

Alternatives addressed in this portion consist of direct generation and energy storage facilities. The alternatives are limited to those that are technically and operationally capable of providing peaking power. Of the energy sources identified on Table 6.01-2, the large conventional thermal and nuclear steam plants are base load facilities designed for continuous operation as opposed to the intermittent operation of peaking plants. These two forms of generating capacity, i.e. baseload vs. peaking, complement each other in an integrated power system and are not alternatives to each other.

The impacts of solar and wind power were reflected in the context of energy conservation as discussed in Section 6.01.2.1. Although no central large scale energy generation is likely within the forseeable future from solar and wind sources, a discussion of the energy potential for these developments has been included.

The alternatives fall into three state of development categories: "In General Use", "Developed but in Limited Use" and "Experimental".

State of Development	Direct Generation	Energy Storage
In General Use	Gas Turbines Hydroelectric	Conventional Pumped Hydro
Developed but in Limited Use	Combined Cycle	Batteries (Lead Acid)
Experimental	Solar Wind	Underground Compressed Air Storage Underground Pumped Hydro

6.01.10.1 Gas Turbines

These special versions of the jet engine have been progressively modified for industrial and power generation purposes. The industrial gas turbine comprises a jet engine driving a generator which may have a capacity in the range of 5 to 100 MW.

This type of generation has been increasingly used since the 1950's for standby and cycling operation. It has low capital costs and short lead times. Because of high fuel costs, however, such units are normally used only for peaking duty and operate 5% or less of the time. Obviously, they are susceptible to oil shortages.

Gas turbines are normally installed close to the load center to minimize transmission costs.

Simple or non-regenerative open cycle turbines are less efficient than steam plants due to lost exhaust heat. The efficiency of a gas turbine may be increased by recovering the heat from exhaust gases and transferring it to the incoming air stream. This system addition increases the initial installation costs. Generation efficiencies of gas turbines range from 30 to 35 percent.

There is a total of 1,488 MW of simple cycle gas turbine generator capability in New England at the present time. Generally, these stations are individually less than 50 MW in capacity.[2] A new MMWEC[3] plant of 170 MW capacity has been approved for commercial operation by 1983.

Gas turbines are considered a feasible addition to the New England system for meeting projected peak load demands. Their short lead time for construction, relatively low first costs and siting flexibility makes gas turbines a viable consideration in planning a system's capacity needs to meet increasing peak demand. The relatively low efficiency and dependence on high cost fuel causes the unit operating costs to be high and could adversely affect its economic feasibility in the future if fuels become scarce and increase in cost. The dependence on oil products would be contrary to national energy goals.

Gas turbines would not, however, meet the intermediate power generation objective of the project. The relocation of low cost excess off-peak power in the system to high value peaking needs, inherent in the pumped-storage features of the project could not be duplicated by gas turbine units.

Because turbines are compact, can be retrofitted to existing facilities and would generally be decentralized, their construction and use would create few aesthetic, environmental, or land use disruptions. Except for higher consumer energy costs, few, if any, socio-economic impacts either beneficial or adverse would be experienced. The generation of noise and gaseous emissions and safety aspects of gas turbines are controllable to acceptable levels.

6.01.10.2 Hydroelectric

In a hydroelectric installation, a flow of water turns a turbine directly coupled to an electric generator.

The requirements of a hydroelectric power plant are:

- a dam across a water course;
- a reservoir to impound the water;
- a waterway to convey the water to the power plant;
- a power plant to house the turbine and generator.

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[2]Directory of Electric Utilities, Electrical World, 1975/76

[3]Massachusetts Municpal Wholesale Electric Company

Such plants are dependent upon the availability of an adequate supply of water and upon terrain suitable for impoundment of the reservoir and development of the required head. Such sites are relatively scarce and development of them usually costly. Operating costs of a hydroelectric plant are low in comparison with equivalent thermal plants. When the available continuous flow of water is low, such as is the case in New England, hydro plants are usually operated in the mid-range or peaking modes.

There is currently 1,287 MW of dependable hydroelectric power capacity developed in New England in a total of 244 plants. In Maine, one 2-MW plant is scheduled for retirement in 1978, and a new 12-MW plant is under study to be on line in 1980. Identified undeveloped sites and existing plant expansions are estimated to amount to an undeveloped capacity of over 2,500 MW, excluding the Dickey-Lincoln School Lakes Project.[4]

This capacity is an aggregation of a large number of relatively small developments. Approximately 1,000 MW of capacity is available in four of these developments with individual capacities of 90 MW or more. The capacity and average annual available energy from each of these sites is as follows:

- Pierce Pond, Kennebec River, ME: 220 MW; 459 GWH
- Pontook, Androscoggin River, NH: 300 MW; 115 GWH
- Williamsville, West River, VT: 145 MW; 84 GWH
- Cold Stream, Kennebec River, ME: (2 Developments Studied)
  New England Federal Regional Council - 120 MW; 260 GWH
  Central Maine Power Company - 250 MW; 295 GWH

Hydroelectric alternatives such as mentioned above are considered technically feasible for additions to the New England system to meet load demands. Under current cost conditions, they are not economically competitive with lower investment cost fossil fueled plants. The high generation efficiency (85%) and the independence from costly fossil fuels of hydroelectric facilities could be expected to cause the economic feasibility to improve in the future if current trends in fuel costs continue. Indication of improvement is evidenced by Central Maine Power Company's recent announcement of their plans to study the Cold Stream development.

No other known hydroelectric site in New England would have the ability to meet the project objectives. However, the total combined capacity of those mentioned would be comparable to the potentials of the proposed project. The costs to the system and related consumer energy costs would be higher for this alternative system expansion.

The economic, social, and environmental impact of hydroelectric development is generally quite considerable. There is no air or

[4]"Hydroelectric Power Resources of the U.S., Developed and Undeveloped", Federal Power Commission, January 1972.

thermal pollution, but a reservoir inevitably causes disruption of the natural ecology of the water course and surrounding area in terms of water, land and social resources. Additionally, hydroelectric sites are often far removed from the load centers, necessitating long transmission corridors for a delivery of power to the system. On the credit side, hydro power utilizes a renewable resource, and reservoirs may have beneficial impacts of flood control and recreation.

Another often mentioned use of hydroelectric potential is development of the many small undeveloped sites for power and upgrading of existing small hydroelectric facilities in the New England area. Federally-funded programs are being implemented for studies of small hydropower potential to develop specific site data and for construction of small demonstration projects to determine feasibility of the concept. These programs are not expected to produce definitive findings for some time, however, physical characteristics as well as competing purposes would most likely preclude developing many of the existing dams for power. Also, most of the sites offer no seasonal regulation of flows and many offer no daily regulation of flows. Due to this lack of flow regulation or storage, these small facilities could not always generate power when needed and would have little or no dependable capacity. As such, they would not preclude construction of firm or planned plant capacity. Their role instead would be as fuel replacement, allowing fossil plants to reduce generation when hydro power is available. Therefore, it is determined that development of small hydroelectric facilities is not an alternative to the project as large dependable hydro capacity, but is considered worthy of investigation as a potential power source to serve as fuel saving facilities.

6.01.10.3 Combined Cycle Thermal

In recent years, hybrid gas turbine/thermal generating or combined cycle units have received increasing attention, especially for mid-range operation. In these plants, gas turbine exhaust possessing a high heat content is used to develop steam for a conventional thermal cycle.

The combined cycle system is a combination of two proven technologies, gas turbines and steam generators, and as such is readily available. It is a fairly recent development in the power industry, and only a few units have been installed. NEPOOL in December 1977 had 201 MW of combined cycle capacity with 340 MW added capacity planned in 1981.

To increase the power output of the steam turbine, additional fuel may be burned in the exhaust. Addition of the thermal power cycle to the gas turbine substantially improves the overall cycle efficiency (35-42%) with the result that these units compare favorably with conventional thermal plants (38-42%).

The environmental constraints associated with the siting of a combined cycle plant in New England would be similar to those for fossil fuel installations. Noise can be effectively controlled, and the particulates and solid wastes produced are minimal with the primary emissions being oxides of sulfur and nitrogen. Plant sizes range from 30 MW to 500 MW, with multiple unit installations possible for even greater capacity.

Lead time for a large (greater than 100 MW) combined cycle unit is approximately five years from inception to commercial operation. However, construction of combined cycle units may be staged so that the combustion turbine portion of the plant is available for peaking service while the steam portion of the plant is being completed.

The combined cycle alternative would have the ability to meet some of the project's objectives in providing intermediate load capacity and perhaps some of the peaking load capacity. It could not, however, meet most of the peaking power generation objective of the project or reallocate low cost excess off-peak system energy to high value peaking energy. The peaking load capacity portion would probably be met with gas turbine additions to the system in conjunction with the combined cycle.

Combined cycle generation capacity is a feasible addition to the New England system for meeting projected load demands. There are several advantages to this alternative. These are: short lead time for construction, relatively low first cost, favorable efficiency and resulting operating costs, and load-following characteristics.

Implementation of the combined cycle alternative would result in higher system costs and related consumer energy costs. Its total dependence on fuel oil could adversely affect its economic feasibility in the future should petroleum fuels become scarce with associated cost increases.

Other than higher energy costs, the socio-economic impacts would be expected to be minimal. The environmental impacts would also be expected to be minimal being generally similar to those associated with gas turbines with a modest condenser cooling water requirement.

6.01.10.4 Conventional Pumped Hydro

Pumped hydro is widely used in electric utility systems. During the past decade, this concept has advanced from relative obscurity in North America to its present significant role in the production of peak and mid-range power.

The operating principles and basic requirements are essentially the same as for a conventional hydro plant. However, the plant operates on a cycling basis and is capable of both generating and pumping. The water stored in the upper reservoir is released to generate power during peak demand. A lower reservoir is required for retention of the water discharged during the generating cycle, for subsequent return to the upper reservoir by pumping.

Because of pumping and generating inefficiencies, there is a net loss in energy production from a pumped storage plant. A pumped storage plant normally generates only 65 to 75 percent of the energy used for pumping. The economy results from the conversion of low-cost off-peak energy to high value peak energy.

Two major pumped storage projects are currently operational in New England. These are Northfield Mountain (100 MW) and Bear Swamp (600 MW) in Massachusetts. The Rocky River pumped storage project in Connecticut was the first project of this type in North America. The proposed project is the only known project planned for construction in the northeast which integrates conventional and pumped storage hydropower.

Conventional pumped hydroelectric facilities are a technically and economically feasible consideration for addition to the New England system to meet projected load demands. Under current cost conditions, they are not economically competitive with gas turbine and combined cycle generation expansion.

This alternative would have the ability to meet the proposed project objectives, however, it would be totally dependent on the availability of low-cost, off-peak energy in the system. The Federal Energy Regulatory Commission (FERC) has advised that low-cost, off-peak energy in the form of nuclear power of the amount necessary to economically sustain pumped storage development will not be available in the New England system until after the 1990 timeframe. At that time, sufficient baseload energy may be available if scheduled implementation of baseload facilities (nuclear and fossil-fuel steam) is realized. Delays in implementing these facilities, especially nuclear plants, is not uncommon. This FERC guidance was a key factor in the proposed two-stage development of the Dickey-Lincoln School Lakes project with only minimum pumped storage capability in the initial phase and the ultimate to be added at a future time when necessary low-cost, off-peak energy becomes available in the system.

The social, economic, and environmental impacts of a pumped hydro plant are characteristically similar to those of a conventional hydro plant, but not necessarily on a similar scale. It is often not necessary to create a large reservoir on an existing water course, particularly if the head is high. Replenishment water need only be limited to relatively small amounts of seepage and evaporation losses. However, pool fluctuations are normally more severe, and there is the potential problem of temperature elevation and the concentration of other potentially dangerous commodities. These would eventually be released to the downstream ecosystem.

6.01.10.5 Batteries[5] (Lead Acid)

Batteries may be considered to be a form of fuel cell. It comprises an anode, a cathode and an electrolyte. These components together convert chemical energy into electric energy. The reactants are held inside the cell and are periodically recharged to keep the chemical process functioning. The lead-acid battery has been in small scale use for many years and is predicted to be commercially available in plants as large as 800 MW with up to 10 hours of storage by about 1990.[6]

For power production, a special inverter is required as part of the installation. This is needed to convert the direct current output of the battery into alternating current at the frequency and voltage levels required. It also serves for the reverse cycle during recharging.

To maintain conversion losses at low levels, high direct current voltages, usually in excess of 1000 volts, are required. In the generating mode, batteries operate efficiently at low power levels and under partial load. However, turnaround efficiency for the recharge/generation cycle is only about 50 percent, so that overall operating costs would be relatively high compared to other forms of storage.

Battery storage plants to be used in conjunction with excess base generation may be sited nearly anywhere sufficient land is available. There appears to be no reason such a plant could not be located in an urban area. Although land area requirements are relatively high, the greatest potential would appear to be in small to medium sized urban areas. Assuming mass production, capital costs, including land requirements, are eventually expected to be competitive with conventional energy storage systems.

Batteries would have the same application in the system as pumped hydroelectric facilities. Decentralized installations near load centers would be the most probable configuration of battery storage facilities because there are no stringent siting requirements. Implementation within the system under current conditions would result in a more costly system operation than other alternatives considered.

This alternative would have the ability to meet the proposed project objectives, however, it would be dependent on the availability of low-cost, off-peak energy in the system. Low-cost, off-peak energy of the amount required is not expected to be available in the system before the 1990 year timeframe.

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[5] "Batteries for Energy Storage: Potential Applications and Alternative Technologies", J.R. Birk, Engineering Foundation Conference on Energy Storage: User Needs and Technology Applications, EPRI, February 1976.

[6] "Peaking Power Batteries for Electric Utilities", Berkowitz and Brown Proceedings of the American Power Conference, Volume 37, 1975.

Other than higher energy costs, the socio-economic impacts would be expected to be minimal. There are potential environmental problems with battery plants. These are associated with the ultimate disposal of spent electrolyte and the danger of accidental spillage. Emission of air pollutants is negligible. Thermal pollution of waterways is not a problem because excess heat is usually vented to the atmosphere. Noise levels are also low.

6.01.10.6 Underground Compressed Air Storage[7]

Underground compressed air storage has been proposed for some time as a peaking system, but has not been put into practice until this past year. The principle of the concept is the storage of air compressed by conventional equipment using low-cost energy during off-peak periods. This air is then released during peak periods to augment the combustible fuel mixture of a conventional gas turbine plant resulting in higher operation efficiencies.

The world's first plant is currently under construction in Germany. This plant uses existing compressor, gas turbine, and steam turbine components, but has a small storage capacity of only 580 MWh. Systems investigated in the U.S. to date have generally been directed towards a storage of 2000 to 3000 MWh or larger.

There are three potential storage methods for compressed air: mined hard rock cavities, solution mined salt cavities, and aquifers. The technology required for the equipment and mining of cavities for each of the first two systems is well-developed and presently available. The aquifer or "bubble" concept is still under investigation. Each of these methods is the subject of a combined ERDA/EPRI study program commenced in 1976, the culmination of which is planned to be the construction of a pilot plant in 1980.

The economics of compressed air storage has still to be proven. The capital costs in favorable circumstances would appear to be competive with conventional energy storage plants.[8] However, the current concept requires the use of fossil fuels and thus their cost vagaries. The efficiency of storage is approximately 55% (45-65%). The air storage system may operate in either of two basic ways: constant pressure or constant volume. The constant pressure method of operation involves the use of a column of water to provide a constant pressure within the system for operational phases. This type consequently requires a surface water storage reservoir. This system is presently applicable only to hard rock caverns.

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[7]"An Assessment of the Technical & Economic Feasibility of Compressed Air Energy Storage", J.B. Bush, et al. EPRI/ERDA Storage Workshop, December 1975.

[8]"A Thermodynamic and Economic Analysis of Compressed Air Energy Storage for Electric Utilities", E.D. Newman, M. Sc. Thesis, Queens University, Ontario, Canada, November 1975.

The constant pressure air storage cycle has a high potential in New England from a siting standpoint as there is an abundance of hard rock formation in this region. These plants may be located close to the load center, and wherever a least impact site may be available for the surface reservoir.

The constant volume or dry cycle type uses no water and operates at continually decreasing pressure during generation. It is less efficient than the constant pressure cycle at the present level of machinery technology but is suitable for both rock and salt type mines. This type is thus only considered a viable alternative where the cavern can be created or is available at relatively low cost. A solution-mined cavern is one possible storage type, but there are no sizeable salt formations in New England. There may, however, be a few mines available with suitable characteristics.

In view of the unproven economics of compressed air storage, its dependence on petroleum based fuels and state of development, this alternative is not considered to be a feasible addition to the New England system. It would have the ability to meet the peaking power objective of the project, however, it would not satisfy the intermediate power generation objective of the project.

Except for higher consumer energy costs, few,if any,socio-economic impacts would be experienced. Environmental impacts requiring consideration include rock disposal, gas turbine emissions, and, if cooling towers are used, drift deposition. Surface reservoirs required for the constant pressure type of plant also require consideration. However, the flexibility offered for siting an underground air storage scheme allows the selection of least impact sites for surface structures.

6.01.10.7 Underground Pumped Hydro

Underground pumped hydro utilizes essentially the same basic principles as conventional pumped hydro. The main exception is that the potential head is developed between an upper reservoir at ground surface and a lower reservoir located in a cavern excavated in rock at depth. The underground pumped hydro concept utilizes essentially proven components from conventional pumped hydro and mining technology assembled to provide a unique approach to bulk energy storage. The primary components are:

- The upper reservoir and other surface-located facilities;
- The shafts and tunnel forming the various accesses and water passages to the underground components;
- The power facilities, including the pump turbines and associated facilities and equipment;
- The lower reservoir cavern.

The head that can be developed is dependent less upon topography than upon limitations imposed by available pump-turbine equipment. The objective is to minimize the required volume and hence the cost of cavern excavation for a given energy storage. To this end, most concepts that have been developed place emphasis on maximizing the head developed. Total heads in the range from 3000 feet to 4500 feet have been proposed. However, the current limit of application of single-stage reversible pump turbine design is at a head of about 1800 feet. Progression beyond this head would require considerable research and development work on machinery, or adoption of a "multi-step" design incorporating one or more intermediate power plants.

Greater depths of power plants also lead to problems of cost and scheduling of the associated underground excavations. The results of studies to date suggest that, using current techniques for shaft sinking and development, there is no significant economic advantage to be gained in the adoption of heads must in excess of 3,000 feet.[9]

A 1,000-MW underground pumped hydro facility with 10,000 MWh of storage at a depth of 2,300 feet is currently planned by General Public Utilities in New Jersey.[10] Studies for plants ranging from 500 MW to 2,500 MW, generally with 10 hours of storage, have also been undertaken by a number of other utilities in the U.S.

A significant amount of research is currently being conducted on the underground pumped hydro concept and it is evident that construction of a pilot plant will probably be undertaken by 1980.

Underground pumped hydroelectric would have the same application in the system as conventional pumped hydroelectric facilities and would have the same storage efficiency of 70 percent. Siting could be closer to load centers requiring less transmission because it is less dependent on natural site conditions. Implementation within the system under current conditions and status of development would result in a more costly system operation than other alternatives such as conventional surface located pumped storage. It appears to be significantly less costly than other forms of energy storages such as batteries, fly wheels and superconduction magnetic storage.

Underground pumped hydroelectric facilities would have the ability to meet the proposed project objectives, however, it would be totally dependent on the availability of low cost, off-peak energy in the system. Low cost energy of the type and magnitude required is not expected to be available in the system before the 1990 year timeframe.

Except for higher energy costs, the socio-economic impacts would be similar to conventional pumped storage hydroelectric facilities. The environmental impact would be expected to be less disruptive because the

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[9]"Underground Pumped Storage Research Priorities", Technical Planning Study No. TPS75-618, EPRI, April 1976 (prepared by Acres American Incorporated).

[10]The Mount Hope Project has subsequently been deferred.

surface reservoir and power transmission lines are the only surface manifestations of underground pumped hydro plants. Disposal of excavated material is an important factor, but the environmental impact of such installations is far less significant than that of a conventional pumped hydro plant. There is an abundance of appropriate rock formations in the New England area. There is thus considerable flexibility for optimum location of an underground pumped hydro plant close to the load center and with a surface reservoir which would cause minimal impact.

6.01.10.8 Solar

Practical application of solar energy is still limited but growing steadily. At the present time, only the space industry has harnessed this energy to any significant extent for direct generation of electricity. Future potential applications of direct use of the sun's energy are:

- Heating and cooling buildings;
- Direct generation of electricity.

Solar generation is particularly adaptable to heat energy storage concepts. Heating and cooling of buildings may be achieved by means of solar collectors which may be integral with the roof structure. Solar collectors contain a black metal surface covered by one or more panes of glass which reduce heat loss. Heat may be held by water or air in the collector, and circulated directly through the building.

A direct generation of electricity from solar energy may be achieved by one of two methods. In the first case, solar radiation is used as the heat source in a thermal steam plant. Reflectors are used to concentrate solar rays to heat water to steam for driving a steam turbine. Land area requirements and investment costs are high, and this method of generation is essentially limited to applications in the southwestern United States.

The second alternative is to use photovoltaic cells which are made of special materials to generate positive and negative charges by absorbing photons. Since each cell develops only half a volt, a large number of cells is required. Capital costs are currently high, efficiency is low (only about 10 percent), and operating life is short.

Solar energy for direct generation of electricity is not a feasible alternative to the project. The high costs, undependable nature and lack of demonstrated feasibility for implementation within the 1990 timeframe are causes for not considering this as an addition to the New England electric supply system.

The greater potential exists for dispersed solar heating and cooling systems for building space. On this basis, solar energy is considered a viable contribution towards energy conservation.

6.01.10.9 Wind

Generation of electricity from wind is relatively simple. The force of the wind turns a windmill, or aero generator, which is connected directly to a generator. The traditional windmill rotates about a horizontal axis. In the past few years, a wind turbine has been developed which rotates about a vertical axis. It uses flexible blades, weighs as little as one-tenth of a conventional windmill, and can rotate at up to six times the speed of the passing wind.

The energy available from winds can be converted to electricity with an overall efficiency of 60 to 80 percent. However, wind energy cannot be concentrated in the same manner as water or solar energy, and the amount of power which can be produced at any given moment is unpredictable. As such, the wind is not a firm source of power, and wind generation must be considered in conjunction with an energy storage system.

The New England area has had a history of wind-power usage. The 1250-KW Grandpa's Knob generator, built in 1941, operated intermittently for four years.[11] As recently as 1950, there were 50,000 small windmill-powered generators in the midwestern United States alone. For the most part, wind generators are confined to residences in remote areas.[12]

Vigorous research programs sponsored by ERDA, NASA, and other agencies are currently under way. Plans are presently being formulated for a utility demonstration wind generator in Massachusetts, but the ERDA schedule for wind power shows no commercial use of wind power until 1985. The first plant is expected to be in the Mid-west where wind power potential is greater.

The 100-KW NASA Plum Brook Station at Sandusky, Ohio, is currently in operation to assess the feasibility of wind power.[13] In this plant, a 125-foot diameter propeller powers the generator atop a 100-foot tower. Current plans for the next wind generator specify a 1.5-MW capacity with a 200-foot propeller. The eventual capacity of wind power generators might reach as high as 20 MW. Proposals have also been made for installation of groups of wind generators on towers floating in the ocean.

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[11] "Energy and the Future", A.L. Hammond et al, 1973. Published by the American Association for the Advancement of Science, Washington, DC.

[12] National Geographic, Volume 149, No. 6, October 1975.

[13] "Preliminary Results of the Large Experimental Wind Turbine Phase of the National Wind Energy Program", R.L. Thomas & J.E. Sholes, NASA Technical Memorandum X-71796.

Capital costs of wind generators are high. Maintenance and operating requirements and costs are as yet undefined.

Wind energy would be an erratic source of electric power because of its intermittent and unpredictable nature. Any method of utilization would require a costly energy storage system or widespread geographic dispersion with inter-connection to achieve dependable capacities.

Wind energy is not considered a feasible alternative to the project. Its high cost, undependable nature, and lack of demonstrated feasibility for implementation within the 1990 timeframe are causes for not considering this as an addition to the New England electric utility system. The potential does exist, however, for considering dispersed windmills as a viable contribution toward energy conservat .

6.01.11 Transmission Facilities for Alternatives

All of the alternatives would require transmission facilitie: to deliver their output to market centers. Gas turbine and battery facilities would require minimal facilities because they can be sited adjacent to load centers. Hydropower facilities needs would vary dependent upon location, size and operational characteristics of the specific site. Small hydro would need relatively small transmission whereas the large pumped storage project would demand extra high voltage lines similar to Dickey-Lincoln School, but not of the equivalent linear extent. Combined cycle plants can be located reasonably close to load centers and nominal high voltage transmission would be required. None of the alternatives would need transmission to the extent of the Dickey-Lincoln School and impacts would be less - the specific degree of which would depend upon the location, nature and size of facility.

6.02 Transmission Line Alternatives

6.02.1 Non-Structural

6.02.1.1 No Action

There is no technologically feasible method of transmitting this power produced by the proposed project other than by transmission lines. A no action action would preclude the distribution of the power should the proposed project be constructed.

6.02.1.2 Use of Existing Transmission Systems

There are no existing powerlines in the vicinity of the Dickey-Lincoln School Lakes Project large enough to transmit the power the project would generate.

6.02.2 Structural

Plan of service and corridor alternatives were established and analyzed in phases I, and II of the transmission study. Details of these analyses are presented in Appendices A, B and C (DOE, 1978). The Dickey-Lincoln School Lakes Project presently is proposed for development at what is termed the "authorized" level. However, if additional pumped storage facilities were installed at Dickey Dam, the project would generate power at its "ultimate level." Studies during phase I and II considered project development at both of these levels.

During phases I and II, the DOI/DOE studies focused on identifying the most suitable plan of service at both development levels. Five plans of service were identified through the Phase I System Planning Study. The Phase II study focused on studying alternative transmission corridors for each plan of service.

Study area boundaries for Phase II of the study were drawn to include all areas that could be considered as locations for any of the system plans under study. The area includes the northern parts of Maine and New Hampshire and Vermont. It encompasses about 32,000 square miles.

The methodology developed and used in the environmental study can possibly best be understood by referring to Figure 6.02-1. Seventy-three data elements are listed across the top of this matrix. These items are the kinds of resources that exist in the study area for which data was collected and mapped and which would be impacted by the construction, maintenance, and operation of transmission facilities. Seventy-three separate data map overlays were made, one for each data element. (See Appendix B - Map Volume, DOE, 1978).

A list of the six major concerns that would affect the location acceptability of transmission circuits was developed. They are designated as A-level, "major concerns" in Figure 6.02.1. The A-level, major concerns were then separated into subsets - C-level concerns called "Location Factors". Twenty-eight location factors are listed on Figure 6.02-1. The matrix shows the relationship between the location factors (C-1 through C-28), and the 73 data elements.

A location factor on impact number was then assigned to each of the 28 location factors (see Table 6.02-1). This number indicates the relative impact the transmission facilities could have on the environment. The degree of impact is either severe, moderate, or slight.

Corridors (an area one to ten miles in width) of least impact were located for each plan of service. In addition, corridors for each plan were ranked to identify the best location for the facilities. The ranking of the corridors was accomplished using two methods. A numerical system was developed. A qualitative method was also developed to double check the results of the numerical system.

The numerical system for ranking corridors was developed by first developing an "Impact-Index" number for each of the major A-level concerns. The impact-index number was determined by calculating the

TABLE 6.02-1

LOCATION FACTOR IMPACT NUMBERS

LOCATION FACTORS:	IMPACT NUMBER:
1. SOCIAL	
Land Ownership	two (2)
Human Populations	three (3)
REcreation Land Use	two (2)
2. ECONOMIC	
Recreation Land Value	one (1)
Open/Agricultural Land	one (1)
Existng Forest Industry	three (3)
3. NATURAL SYSTEMS	
Vegetative Cover	three (3)
Surface Water Systems	two (2)
Groundwater Systems	one (1)
Deer Habitat	three (3)
Waterfowl Areas	two (2)
Fish Habitat	three (3)
Significant Wildlife Areas	three (3)
Soils: Increased Erosion	two (2)
4. ESTHETIC/CULTURAL	
Historic Resources	three (3)
Archaeological Resources	two (2)
Unique Resources	three (3)
Existing Visual Quality	three (3)
Visual Quality Due to Visibility/Absorption Parameters	three (3)
Visual Quality Due to Exposure to Land Uses	three (3)
5. LEGAL	
6. SITE DEVELOPMENT COSTS	
Value of Developed Lands	three (3)
Value of Recreation Lands	two (2)
Value of Forest Industry Lands	one (1)
Cost Due to Decreased Accessibility	two (2)
Cost Due to Unstable Soils	three (3)
Cost Due to Steep Slopes	one (1)
Cost Due to Severe Microclimatic Conditions	one (1)
Cost Due to Presence of Unique Rare and/or Endangered Plant Species	two (2)

DEGREES OF IMPACT POSSIBLE

1 = slight
2 = moderate
3 = severe

average of the "Location Factor Impact Numbers" for each of the A-level concerns. For example, in Table 6.02-1, the location factor impact numbers for the three location factors under A-1 Social are 2, 3, and 2. The average of this (the A-Level, impact-index) is 2.3. The resultant A-level, impact-index numbers for the six major concerns are tabulated in Table 6.02-2. A formula was then used to calculate the total impact score. Inputs to this calculation were: the impact index, miles of transmission line, and a factor that represented the level of shading on the overlays for the A-Level concerns map.

TABLE 6.02-2

"A" LEVEL CONCERNS

Social	2.3
Economic	1.7
Natural Systems	2.4
Esthetic/Cultural	2.8
Legal	*
Site Development Costs	1.9

*Items identified as legal concerns tend to be site specific and not particularly difficult to avoid through corridor location. Airports, historic sites, and areas known to be inhabited by endangered or threatened wildlife or plant species are examples of what are termed legal concerns.

The qualitative evaluation was made by overlaying the corridor map over selected data maps and recording the number and/or proximity of resources.

Some corridors present opportunities for sharing existing transmission line rights-of-way. The impact of paralleling an existing right-of-way is often considerably less than a new one. When a shared right-of-way was used, the impact score was reduced by 33 percent to reflect a lower environmental impact. This reflects the reduction in corridor width from 150 feet to 100 feet.

A similar procedure was used to calculate the impact score when the new right-of-way would have two single circuit 345-kV lines adjacent to one another. A factor of 1.66 was applied to the impact score to reflect the additional environmental impact caused by the additional 100 feet of required right-of-way.

These evaluation procedures were used to rank corridors as to environmental impacts (Table 6.02-3). Best corridors for each system plan were then compared and used to select the system plan which would have the least environmental impact. Rankings were made at both the authorized and ultimate level of generation, as well as for plans calling for wood pole or steel towers (Table 6.02-4).

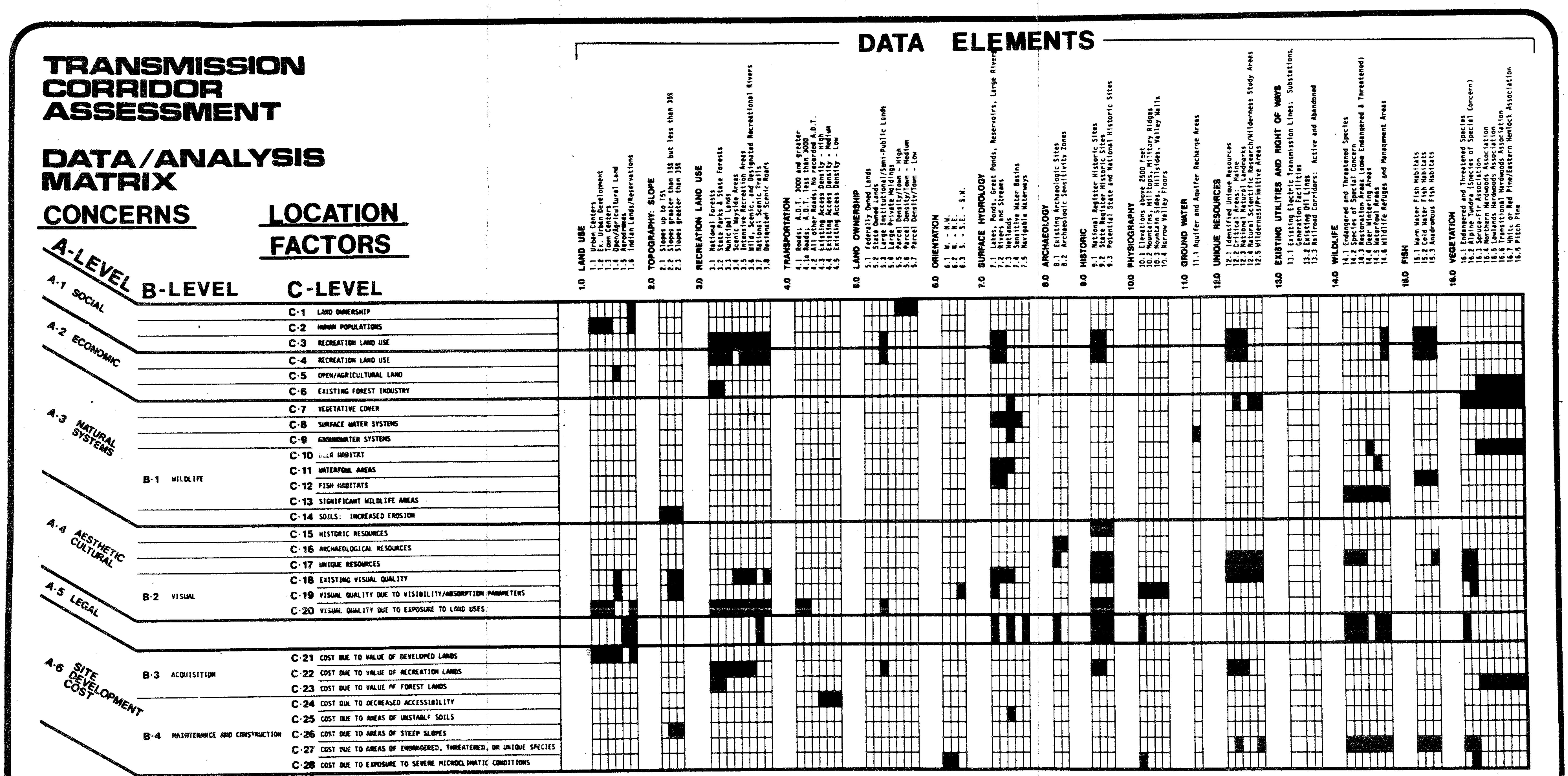

TRANSMISSION CORRIDOR ASSESSMENT
DATA/ANALYSIS MATRIX
CONCERNS
LOCATION FACTORS
A-LEVEL
B-LEVEL
C-LEVEL
A-1 SOCIAL
A-2 ECONOMIC
A-3 NATURAL SYSTEMS
A-4 AESTHETIC CULTURAL
A-5 LEGAL
A-6 SITE DEVELOPMENT COST
B-1 WILDLIFE
B-2 VISUAL
B-3 ACQUISITION
B-4 MAINTENANCE AND CONSTRUCTION
C-1 LAND OWNERSHIP
C-2 HUMAN POPULATIONS
C-3 RECREATION LAND USE
C-4 RECREATION LAND USE
C-5 OPEN/AGRICULTURAL LAND
C-6 EXISTING FOREST INDUSTRY
C-7 VEGETATIVE COVER
C-8 SURFACE WATER SYSTEMS
C-9 GROUNDWATER SYSTEMS
C-10 DEER HABITAT
C-11 WATERFOWL AREAS
C-12 FISH HABITATS
C-13 SIGNIFICANT WILDLIFE AREAS
C-14 SOILS: INCREASED EROSION
C-15 HISTORIC RESOURCES
C-16 ARCHAEOLOGICAL RESOURCES
C-17 UNIQUE RESOURCES
C-18 EXISTING VISUAL QUALITY
C-19 VISUAL QUALITY DUE TO VISIBILITY/ABSORPTION PARAMETERS
C-20 VISUAL QUALITY DUE TO EXPOSURE TO LAND USES
C-21 COST DUE TO VALUE OF DEVELOPED LANDS
C-22 COST DUE TO VALUE OF RECREATION LANDS
C-23 COST DUE TO VALUE OF FOREST LANDS
C-24 COST DUE TO DECREASED ACCESSIBILITY
C-25 COST DUE TO AREAS OF UNSTABLE SOILS
C-26 COST DUE TO AREAS OF STEEP SLOPES
C-27 COST DUE TO AREAS OF ENDANGERED, THREATENED, OR UNIQUE SPECIES
C-28 COST DUE TO EXPOSURE TO SEVERE MICROCLIMATIC CONDITIONS
DATA ELEMENTS
1.0 LAND USE
1.1 Urban Centers
1.2 Ex. Urban Development
1.3 Town Centers
1.4 Open/Agricultural Land
1.5 Aerodromes
1.6 Indian Lands/Reservations
2.0 TOPOGRAPHY: SLOPE
2.1 Slopes up to 15%
2.2 Slopes greater than 15% but less than 35%
2.3 Slopes greater than 35%
3.0 RECREATION LAND USE
3.1 National Forests
3.2 State Parks & State Forests
3.3 Municipal Lands
3.4 Scenic Wayside Areas
3.5 Intensive Recreation Areas
3.6 Wild, Scenic, and Designated Recreational Rivers
3.7 National Scenic Trails
3.8 Designated Scenic Roads
4.0 TRANSPORTATION
4.1 Roads: A.D.T. 3000 and greater
4.1a Roads: A.D.T. less than 3000
4.2 All other Roads; No recorded A.D.T.
4.3 Existing Access Density - High
4.4 Existing Access Density - Medium
4.5 Existing Access Density - Low
5.0 LAND OWNERSHIP
5.1 Federally Owned Lands
5.2 State Owned Lands
5.3 Large Institutional/Semi-Public Lands
5.4 Large Private Holdings
5.5 Parcel Density/Town - High
5.6 Parcel Density/Town - Medium
5.7 Parcel Density/Town - Low
6.0 ORIENTATION
6.1 W. - N.W.
6.2 N. - N.E.
6.3 S. - S.E. - S.W.
7.0 SURFACE HYDROLOGY
7.1 Lakes, Ponds, Great Ponds, Reservoirs, Large Rivers
7.2 Rivers and Streams
7.3 Wetlands
7.4 Sensitive Water Basins
7.5 Navigable Waterways
8.0 ARCHAEOLOGY
8.1 Existing Archaeologic Sites
8.2 Archaeologic Sensitivity Zones
9.0 HISTORIC
9.1 National Register Historic Sites
9.2 State Register Historic Sites
9.3 Potential State and National Historic Sites
10.0 PHYSIOGRAPHY
10.1 Elevations above 2500 feet
10.2 Mountains, Hilltops, Military Ridges
10.3 Mountain Sides, Hillsides, Valley Walls
10.4 Narrow Valley Floors
11.0 GROUND WATER
11.1 Aquifer and Aquifer Recharge Areas
12.0 UNIQUE RESOURCES
12.1 Identified Unique Resources
12.2 Critical Areas: Maine
12.3 National Natural Landmarks
12.4 Natural Scientific Research/Wilderness Study Areas
12.5 Wilderness/Primitive Areas
13.0 EXISTING UTILITIES AND RIGHT OF WAYS
13.1 Existing Electric Transmission Lines; Substations, Generation Facilities
13.2 Existing Oil Lines
13.3 Railroad Corridors: Active and Abandoned
14.0 WILDLIFE
14.1 Endangered and Threatened Species
14.2 Species of Special Concern
14.3 Restoration Areas (some Endangered & Threatened)
14.4 Deer Wintering Areas
14.5 Waterfowl Areas
14.6 Wildlife Refuges and Management Areas
15.0 FISH
15.1 Warm Water Fish Habitats
15.2 Cold Water Fish Habitats
15.3 Anadromous Fish Habitats
16.0 VEGETATION
16.1 Endangered and Threatened Species
16.2 Alpine Tundra (Species of Special Concern)
16.3 Spruce-Fir Association
16.4 Northern Hardwoods Association
16.5 Lowlands Hardwoods Association
16.6 Transitional Hardwoods Association
16.7 White or Red Pine/Eastern Hemlock Association
16.8 Pitch Pine

FIGURE 6.02-1

CORRIDOR RANKINGS

SEGMENTS	Corridor Designations	Links Evaluated	Total Corridor Length (Miles)	Total Corridor Impact Score	Corridor Rank by Impact Score	Average Impact Score by Mile	Corridor Rank by Impact per Mile	Number of Streams and Rivers Crossed	Projected Accessibility: Low	Projected Accessibility: Moderate	Projected Accessibility: High	Number of Wild and Scenic Rivers Crossed	Number of Anadromous Fisheries Crossed	Number of Road Crossings	Number of Scenic Road Crossings	Number of Scenic Trails Crossed	Proximity to Town Centers	Proximity to National and State Parks and Forests (Miles)	Proximity to Scenic Wayside Areas	Proximity to Intensive Recreation Areas	Proximity to Archaeological Sites	Proximity to National Register Historic Sites	Proximity to State Register Historic Sites	Proximity to Potential State Historic Sites	Proximity to Unique Resources	Proximity to Critical Areas: Maine	Proximity to National Natural Landmarks	Proximity to National Research/Wilderness Areas	Proximity to Wilderness Study Areas	Proximity to Threatened/Endangered Wildlife Species	Proximity to Wildlife Species of Special Concern	Proximity to Wildlife Restoration Areas	Proximity to Threatened/Endangered Vegetation Species	FINAL RANKING
DICKEY to CHESTER (PLANS A&B)	A	2,3,5,7,8	130.5	2,078	1	15.9	1	33	32	51	48		6	41			7		2	6					2					2	1	16	3	1
	B	1,7,8	126.0	2,112	2	[illegible]	[illegible]	[illegible]	47	38	42		7	33			3		1	7					5		1				1	2	3	2
	C	2,3,6,8	130.5	2,126	3	16.3	2	50	33	40	58	2	4	43			14		2	2					3		3			2	1	16	3	3
DICKEY to COMERFORD (PLANS C, D&E)	D	14,15,16,22, 27,30,32,36, 37,38,39	250.5	4,349	1	17.4	1	117	82	74	97	1		92	6		5		2	9			1	1	7		1				2	5		1
	E	14,15,20,21, 17,23,28,35, 42,37,38,39	254.5	4,445	2	17.5	2	115	60	87	111	2		88	8		10	1	8	11			2	2	12		3			1	3	6		2
	F	14,15,16,18, 23,26,27,29, 31,34,38,39	257.5	4,588	3	17.8	3	142	58	86	116	1		93	5		8	1	4	9	1		3	1	14		5			2	2	7	1	3
COMERFORD to GRANITE (PLANS A, B, C, D&E)	G	P 28	30.0	401	1	13.4	1	13			30			22	1		5		5	2	6	2			1		1	2				3	1	1
	H	52	31.0	622	2	20.1	2	9		6	25			21	2		5	6	1	6	6		3		1		1				1	2	3	2
	I	53	31.5	641	3	20.3	3	14			32			28	1		5		4	3	2	2	1		1			1			1	3	2	3
SUGARBROOK to COMERFORD (PLANS A&B)	J	P11,P12,44 86,P24,P21 P20,50,51	95.5	2,020	1	21.2	2	73	11	28	58		5	44	6	1	12	10	11	1		2	4	3	2		1	1			2	4	2	1
	K	47,35,P23 P22,P21,P20, 50,51	108.0	2,100	2	19.4	1	72	20	21	69	1	4	50	8	1	14	3	9	3		3	4	5	5		1	3			1	8	1	2
	L	47,35,42,37, 38,39	99.0	2,171	3	21.9	3	63	20	21	60	1		26	7	1	15	3	7	6		2	2	3	4		1				1	6	1	3
COMERFORD to BEEBE (PLANS C, D&E)	M	51,P18,P17, P16	44.0	802	1	18.2	1	24	4	9	31			24	3	1	4	18	4	2			1	3	3		1					6	1	1
	N	P27,P26,58	41.0	883	2	21.5	2	25	2	12	27			22	2	1	5	15	2	1			1	4			3					7		2
	O	59,62	37.5	890	3	23.7	3	20		6	32			18	1	1	7	15	3					2			1					3		3
BEEBE to COOLIDGE (PLAN A)	P	P15	80.0	1,096	1	13.7	1	52			80			55	2		14			7		3	19	7	4					1	1	3	2	1
	Q	63,64	61.0	1,171	2	19.2	2	20	4	3	55			40	1		9	1	1	6		7	10	4	3		4	1		1	1	7		2
SUGARBROOK to BEEBE (PLAN A)	R	P13,P14,67, 65	109.0	1,612	1	14.8	1	58	4	5	100			71	1		12	3	9	1	1	4	3	6	9		6	1		1	3	9	7	1
	S	P13,66,65	110.0	1,649	2	15.0	2	61	4	11	95			74			14	3	4	3	1	2	2	4	8		2				1	5	2	2
	T	68,P14,67, 65	92.0	1,721	3	18.7	3	66	4	5	83			66	1		17	3	8	1	1	2	3	4	9		7	1		1	3	7	6	3
CHESTER to SUGARBROOK (PLANS A&B)	U	83,82,72,86, 69	98.0	1,359	1	13.9	1	37	1	11	87		5	89	1	1	14	15	3	1		3	2	2	2		1				3	5	4	1
	V	83,82,73,88, 85,69	97.0	1,494	2	15.4	3	50	1	21	76		6	73			9		2	1		4		3	1						3	3	3	2
	W	P4,75,P6,69	100.0	1,501	3	15.0	2	51			100		4	91			20		3	3		8		5	4					1	2	1	1	3
ORRINGTON to WINSLOW (PLANS A&B)	X	P4,75	50.0	783	1	15.7	2	23			50		4	50			11			2		4		3	4					1			1	1
	Y	78,76,75	46.0	846	2	18.4	3	21			46		2	48			15			1		2		3	3					1				2
	Z	78,76,P5	59.0	859	3	14.6	1	39			59		4	61			17			1		1		4	3					1	1			3
CHESTER to ORRINGTON (PLANS A&B)	a	P2,P3	46.0	697	1	15.2	2	21	2	4	40		6	23			15		1	1		2		3			2	1					2	1
	b	84,P3	50.0	725	2	14.5	1	25	1	15	35		10	24			8			1		2		2			1	1					4	2
	c	83,81,80,P3	54.0	834	3	15.4	3	21	12	6	36		12	29			11					3		3	1		2	1					4	3
DICKEY to LINCOLN (ALL PLANS)	d	9,10	11.5	230	1	20.0	1	5		8	4			6			1																	1
LINCOLN to FORT KENT (ALL PLANS)	e	12	16.5	356	1	21.6	1	5	8	4	5			15	1		4					1	1										2	1

RANKING BY NUMERIC METHOD — QUALITATIVE CONSIDERATIONS

TABLE 6.02-3

SYSTEM PLAN RANKINGS

RANKING BY NUMERIC METHOD

Level	System Plans	Type of Construction (by Corridor)	Corridors Evaluated	Total Plan Length (Miles)	Total Plan Impact Score	Plan Rank by Impact Score	Average Impact Score by Mile	Plan Rank by Impact per Mile
AUTHORIZED LEVEL	A-B**	STEEL TOWER	A*,G,J,U, X,a	450.0	7,338	2	16.3	1
AUTHORIZED LEVEL	A-B**	WOOD POLE	A,G,J,U, X,a	450.0	8,724	4	19.4	3
AUTHORIZED LEVEL	D	WOOD POLE	D,G	280.5	7,651	3	27.3	4
AUTHORIZED LEVEL	E	STEEL TOWER	D*,G	280.5	4,750	1	17.0	2
ULTIMATE LEVEL	A	STEEL TOWER	A*,G,J,P, R,U,X,a	639.0	10,952	4	17.13	2
ULTIMATE LEVEL	A	WOOD POLE	A,G,J,P, R,U,X,a	639.0	12,338	6	19.3	3
ULTIMATE LEVEL	B	STEEL TOWER	A*,G,J,U, X,a ***	450.0	9,836	3	21.8	4
ULTIMATE LEVEL	B	WOOD POLE	A,G,J,U, X,a ***	450.0	11,222	5	24.9	5
ULTIMATE LEVEL	D	WOOD POLE	D,G,M	324.5	8,453	2	26.0	6
ULTIMATE LEVEL	E	STEEL TOWER	D*,G,M	324.5	5,552	1	17.11	1

QUALITATIVE CONSIDERATIONS

Level	System Plans	Type of Construction	Acres of Right-of-Way	Number of Streams and Rivers Crossed	Projected Accessibility: Low	Projected Accessibility: Moderate	Projected Accessibility: High	Number of Wild and Scenic Rivers Crossed	Number of Anadromous Fisheries Crossed	Number of Road Crossings	Number of Scenic Road Crossings	Number of Scenic Trails Crossed	Proximit to Town Centers
AUTHORIZED LEVEL	A-B	STEEL TOWER	7,500	200	46	94	313		26	269	2	2	64
AUTHORIZED LEVEL	A-B	WOOD POLE	11,570	200	46	94	313		26	269	2	2	64
AUTHORIZED LEVEL	D	WOOD POLE	7,970	130	82	74	127	1		114	7		10
AUTHORIZED LEVEL	E	STEEL TOWER	4,920	130	82	74	127	1		114	7		10
ULTIMATE LEVEL	A	STEEL TOWER	9,800	310	50	99	493		26	395	5	2	90
ULTIMATE LEVEL	A	WOOD POLE	14,260	310	50	99	493		26	395	5	2	90
ULTIMATE LEVEL	B	STEEL TOWER	7,500	200	46	94	313		26	269	2	2	64
ULTIMATE LEVEL	B	WOOD POLE	11,560	200	46	94	313		26	269	2	2	64
ULTIMATE LEVEL	D	WOOD POLE	8,590	154	86	83	158	1		138	10	1	14
ULTIMATE LEVEL	E	STEEL TOWER	5,290	154	86	83	158	1		138	10	1	14

Level	System Plans	Type of Construction	Proximity to National and State Parks and Forests (Miles)	Proximity to Scenic Wayside Areas	Proximity to Intensive Recreation Areas	Proximity to Archaeological Sites	Proximity to National Register Historic Sites	Proximity to State Register Historic Sites	Proximity to Potential State Historic Sites	Proximity to Unique Resources	Proximity to Critical Areas Noise	Proximity to National Natural Landmarks	Proximity to National Research/Wilderness Areas	Proximity to Wilderness Study Areas	Proximity to Threatened/Endangered Wildlife Species	Proximity to Wildlife Species of Special Concern	Proximity to Wildlife Restoration Areas	Proximity to Threatened/Endangered Vegetation Species	FINAL RANKING
AUTHORIZED LEVEL	A-B	STEEL TOWER	25	22	13	6	13	6	11	11		5	4		3	6	28	13	2
AUTHORIZED LEVEL	A-B	WOOD POLE	25	22	13	6	13	6	11	11		5	4		3	6	28	13	4
AUTHORIZED LEVEL	D	WOOD POLE		7	11	6	2	1	1	8		2	2			2	8	1	3
AUTHORIZED LEVEL	E	STEEL TOWER		7	11	6	2	1	1	8		2	2			2	8	1	1
ULTIMATE LEVEL	A	STEEL TOWER	28	31	21	7	20	28	24	24		11	5		5	10	40	22	4
ULTIMATE LEVEL	A	WOOD POLE	28	31	21	7	20	28	24	24		11	5		5	10	40	22	6
ULTIMATE LEVEL	B	STEEL TOWER	25	22	13	6	13	6	11	11		5	4		3	6	28	13	3
ULTIMATE LEVEL	B	WOOD POLE	25	22	13	6	13	6	11	11		5	4		3	6	28	13	5
ULTIMATE LEVEL	D	WOOD POLE	18	11	13	6	2	2	4	11		3	2			2	14	2	2
ULTIMATE LEVEL	E	STEEL TOWER	18	11	13	6	2	2	4	11		3	2			2	14	2	1

LEGEND:

NUMERIC METHOD: High impact scores indicate greater environmental impact.
QUANTITATIVE CONSIDERATIONS: "Number of" - a measure of the number of times the corridor crosses a resource.
PROJECTED ACCESSIBILITY: A measure indicating miles of corridor crossing areas of low, medium or high accessibility.
PROXIMITY TO: A measure indicating the number of times these resources are located within 1 1/2 miles of the "evaluation line" in the corridor.

* Indicates corridors in which steel tower or wood pole construction is an option.
** Authorized System Plans A and B are treated in the same manner for purposes of this assessment.
*** Requires (2) parallel wood pole circuits.

TABLE 6.02-4

Plan E was determined to have the least environmental impact at both the authorized and ultimate level. It is the plan of service described as the proposed action.

After completion of the Alternative Power Transmission Corridors study, additional lines were identified as being required due to the delay or possible elimination of planned generation in southeastern Maine and western Vermont.

At the authorized level these additional lines would include: a) A 43-mile, 345-kV line between Granite Substation and a new substation to be constructed near Essex Junction, Vermont for all plans; b) A 48-mile, 345-kV line from Winslow to Maxcy's to Maine Yankee for Plans A and B. At the ultimate level the additional lines would be: a) A 30-mile, 345-kV line from Beebe to Webster for Plan A; b) A 139-mile, 345-kV line from Sugarbrook to Webster for Plan B.

Table 6.02-5 indicates the miles of impact along the best corridors for each plan of service. These mileages reflect measurements from analysis maps; A1, A2, A3, A4, and A6 (Appendix B, Vol. 1, DOE, 1978). Qualitative values of miles of none, low, moderate, and high impact were calculated for each plan of service. Further comparisons of alternative plans are shown in Table 6.02-4.

For Plans C, D, and E, at the ultimate level, an additional 345-kV line is required between Beebe and Webster Substations. The distance is about 45 miles in length.

The additional lines which were identified after completion of the corridor study are not shown on these tables. Due to the greater length of additions for Plans A and B, these plans would undoubtedly become still less desirable than the proposed plan.

The mileages discussed in the following, include those additional lines that were included after the Alternate Power Transmission Corridor Study.

6.02.2.1 Plan A

Authorized Level

Plan A, at the authorized level, would require about 548 miles of 345-kV transmission lines. It also requires about 30 miles of 138-kV transmission line (Figure 6.02-2).

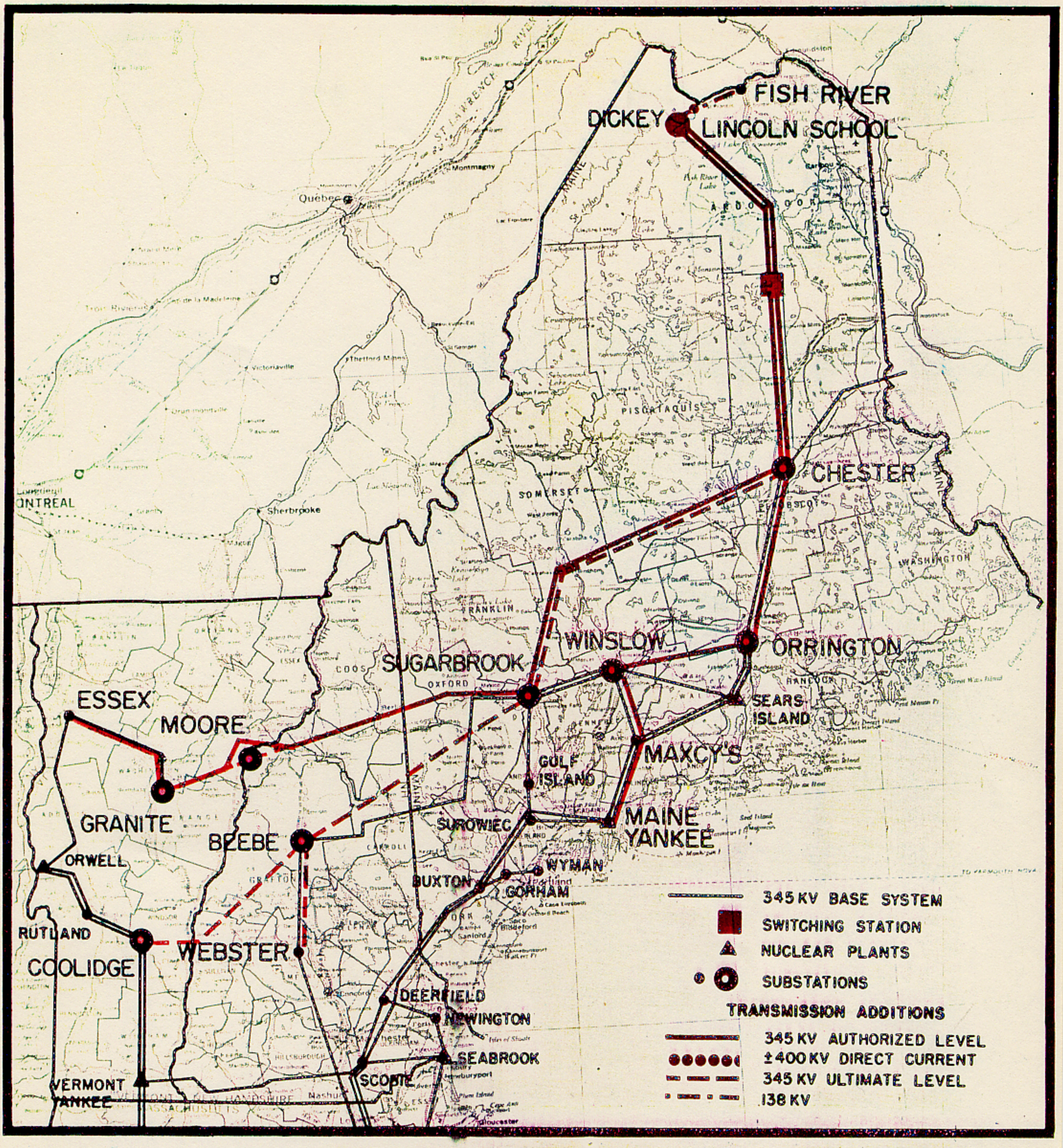
New substations would be required at Dickey and Lincoln School and a switching station would be needed between Dickey and Chester Substations. Substation expansion would be required at Fish River, Chester, Orrington, Winslow, Sugarbrook, Granite, Maxcy's and Maine Yankee Substation.

Plan A, at the authorized level, requires about 213 more miles of 345-kV transmission than the proposed action (Plan E).

TABLE 6.02-5

MILEAGE IMPACT COMPARISON OF ALTERNATIVE PLANS

IMPACT CONCERNS	IMPACT CATEGORIES	AUTHORIZED LEVEL					ULTIMATE LEVEL				
		Plan A	Plan B	Plan C	Plan D	Plan E	Plan A	Plan B	Plan C	Plan D	Plan E
Social	None	0	0	0	0	0	40	0	0	0	0
	Low	341	341	250	250	250	151	161	19	19	19
	Moderate	96	96	29	29	29	83	55	25	25	25
	High	13	13	1	1	1	12	7	0	0	0
Economic	None	0	0	0	0	0	13	0	0	0	0
	Low	106	106	38	38	38	75	66	6	6	6
	Moderate	342	342	242	242	242	196	157	17	17	17
	High	2	2	0	0	0	2	0	21	21	21
Natural Systems	None	0	0	0	0	0	5	0	0	0	0
	Low	79	79	29	29	29	37	48	3	3	3
	Moderate	319	319	221	221	221	227	157	35	35	35
	High	52	52	30	30	30	17	18	6	6	6
Cultural Visual	None	191	191	125	125	125	60	76	1	1	1
	Low	16	16	4	4	4	66	2	1	1	1
	Moderate	156	156	94	94	94	110	89	16	16	16
	High	87	87	57	57	57	50	56	26	26	26
Site Devel. Costs	None	0	0	0	0	0	0	0	0	0	0
	Low	349	349	188	188	188	247	186	20	20	20
	Moderate	78	78	89	89	89	34	31	16	16	16
	High	23	23	3	3	3	5	6	8	8	8



SYSTEM PLAN A

Eastern AC Plan

DICKEY-LINCOLN SCHOOL LAKES PROJECT

U.S. Department of Energy — March, 1978

FIGURE 6.02-2

Ultimate Level

At the ultimate level, Plan A requires an additional 317 miles of 345-kV transmission lines. These lines are required between Chester and Sugarbrook; Sugarbrook and Beebe; Beebe and Coolidge; and Beebe and Webster Substations.

At the ultimate level, Plan A requires a total of 865 miles of 345-kV transmission as contrasted with 409 miles for the proposed plan (Plan E).

Environmental Impacts - Plan A (Authorized Level)

The Alternative Power Transmission Corridors Study (Appendix B, DOE, 1978) found Plan A to have greater impact than the proposal. This was true in terms of both a quantitative and qualitative comparison of impacts (Table 6.02-4). Plan A was shown to have more environmental impact at both levels of development (Table 6.02-5).

PLAN A (Authorized) - Social Impacts

This plan would have greater impact on people-oriented activities than the proposed plan and is located within some of the more populated areas of Maine, New Hampshire, and Vermont. Population centers along the route include Dover-Foxcroft, Milo, Bangor, Waterville, Madison, and Skowhegan, Maine; Gorham, and Littleton, New Hampshire; as well as settled areas near Barre and Waterbury, Vermont. Plan A facilities would be in close proximity to 64 town centers and would cross 269 roads.

PLAN A (Authorized) - Economic Impacts

Plan A facilities would cause moderate or high impacts along more than 340 miles of its corridors. Impacts to the regional economy would fall primarily on the forest products industry, agriculture, and recreation. The greatest economic impacts would occur to commercially managed forests between the project site and Bangor, Maine. Agriculture would be impacted at locations along the route from Bangor to Vermont. The line would pass within 1.5 miles of 13 intensively used recreation areas. The White Mountain National Forest, which is valued for its recreational resources, is along corridors for this plan.

Plan A would have the least impact of any of the plans on commercially managed forests. This plan generally avoids impacts on the wildland aspects of the north Maine woods, the mountainous areas of western Maine and New Hampshire, and on some of the more remote recreation lands within the study area.

PLAN A (Authorized) - Impacts to Natural Systems

This plan would have considerably greater impact on natural systems than would the proposed plan. It would have 371 miles of moderate or high impact. It crosses a number of streams that are used by anadromous fisheries, occurring primarily in Aroostook County on the segment of line between the project and Chester Substation. The plan in total would cross about 200 streams compared with about 130 for the proposed plan.

The plan would impact deer wintering yards, especially between Dickey and Chester Substations. The number of identified deer wintering areas are fewer for this plan than the proposed plan.

The facilities would be built within 1.5 miles of 28 wildlife restoration areas and 4 natural research wilderness areas. Plan A would also be located in close proximity to 11 areas that have been identified as having unique resources.

Most of the high impacts on natural systems would occur between the project and the Dover-Foxcroft areas and in select areas of New Hampshire and Vermont. Greatest adverse impacts on wildlife, waterfowl and fishing areas occur on that portion of the plan from Dickey to Orrington Substation near Bangor. The line would pass through the Aroostook River drainage basin which is classified as a high quality watershed.

Plan A avoids the remote areas of western Maine and northeast New Hampshire where the natural systems are relatively untouched by man. Although Plan A impacts many of the area's natural resources, it is located in areas where development and prior disturbance is also considerable.

Plan A would often be located in a landscape setting which has previously been altered by development and agricultural activities. Thus, this plan would avoid impacting mountainous areas of western Maine and northeast New Hampshire, which are presently unaltered except for logging activities.

Plan A impacts more highly scenic land than the proposed plan but fewer scenic rivers.

PLAN A (Authorized) - Site Development Cost

This plan is considerably longer than the proposed plan. Thus, site development costs in general are greater. Because developed lands are frequently encountered, land values could be considerably higher than the proposed plan. More individual landowners would be impacted. Assessibility is greater and construction of the facilities would require fewer new roads than the proposed plan. Steep slopes and areas of high erodibility are less frequently encountered.

PLAN A (Authorized) - Cultural/Visual Impacts

At the authorized level, 156 miles of the route would have moderate impact and about 87 miles high impact.

Plan A would cross two designated scenic roads and two scenic trails, including the Appalachian trail in western Maine. The line would be in proximity to 22 scenic wayside areas. At the authorized level, it would pass near 13 National Register Historic Sites. Although the archaeological data at the regional scale is quite limited, it was determined that this plan would be close to six archaeological sites and a rather large number of existing or potential sites of state significance.

The facility would be close to Baxter State Park and might be visible from Mount Katahdin. In the vicinity of Baxter State Park, the line would be located near the East Branch of the Penobscot River. Other highly scenic areas impacted would be a portion of the White Mountain National Forest along the Androscoggin Valley and the Connecticut River Valley near Barnet, Vermont.

Environmental Impacts - Plan A (Ultimate Level)

An additional 317 miles of 345-kV transmission line would be required at the ultimate level under Plan A requiring an additional 6,300 acres of right-of-way. Table 6.02-5 projects impact levels within the corridors defined to accommodate these lines. At the ultimate level, Plan A requires more transmission lines than any of the alternatives. Its impacts correspondingly are higher than the proposal and other alternate plans.

6.02.2.2 Plan B

Environmental Impacts - Plan B (Authorized Level)

At the authorized level of project development, Plans A and B are identical.

Additional Environmental Impacts - Plan B (Ultimate Level)

At this level, additional 345-kV lines are required from Chester to Sugarbrook Substation, from Sugarbrook to Moore Substation, and from Beebe to Webster Substations (Figure 6.02.3).

At the ultimate level, Plan B differs from both Plan A and the proposal. Plan B requires fewer additional miles of transmission line than Plan A (237 vs. 317). However, in comparison with the proposed Plan E, it still requires more additional transmission mileage (237 vs. 74).

In terms of its environmental suitability, Plan B at the ultimate level ranks higher than Plan A, but is less desirable than the proposal.

The additional transmission lines which would be needed for Plan B - Ultimate could all be constructed parallel to what will then be existing facilities. Most of the additional lines would parallel those developed at the authorized level (Figure 6.02-3). Approximately 2,900 acres of additional right-of-way would be required.

Table 6.02-5 projects the additional impacts which would result from the added facilities. The additional impacts associated with this plan could be reduced considerably if the lines from Chester to Sugarbrook and west to Moore Substation were initially built as a double circuit line, and additional conductors added later to carry the additional generation. From an economic standpoint, however, this would not be desirable unless the ultimate level was a certainty and scheduled to occur fairly soon after the initial development. Therefore, the impact assessments reflect the construction of wood pole lines adjacent to those which would be then existing.

6.02.2.3 Plan C

Authorized Level

Plan C would be a direct current transmission line from Dickey to Moore Substation through the western portion of the study region (Figure 6.02-4). 345-kV a.c. lines are required from Moore to Granite and from Granite to Essex Substations. Plan C is similar to the proposed plan, except that d.c. transmission is used and a midpoint substation at Jackman or Moose River would not be needed. Impacts are not discussed for Plans C at the authorized level due to their similarities to the proposed plan.

Ultimate Level

Plan C - Ultimate would require an additional 74-mile 345-kV a.c. line from Moore to Webster Substation, needing about 900 additional acres. Plan C and the proposed Plan E are identical in terms of the additional facilities at the ultimate level.

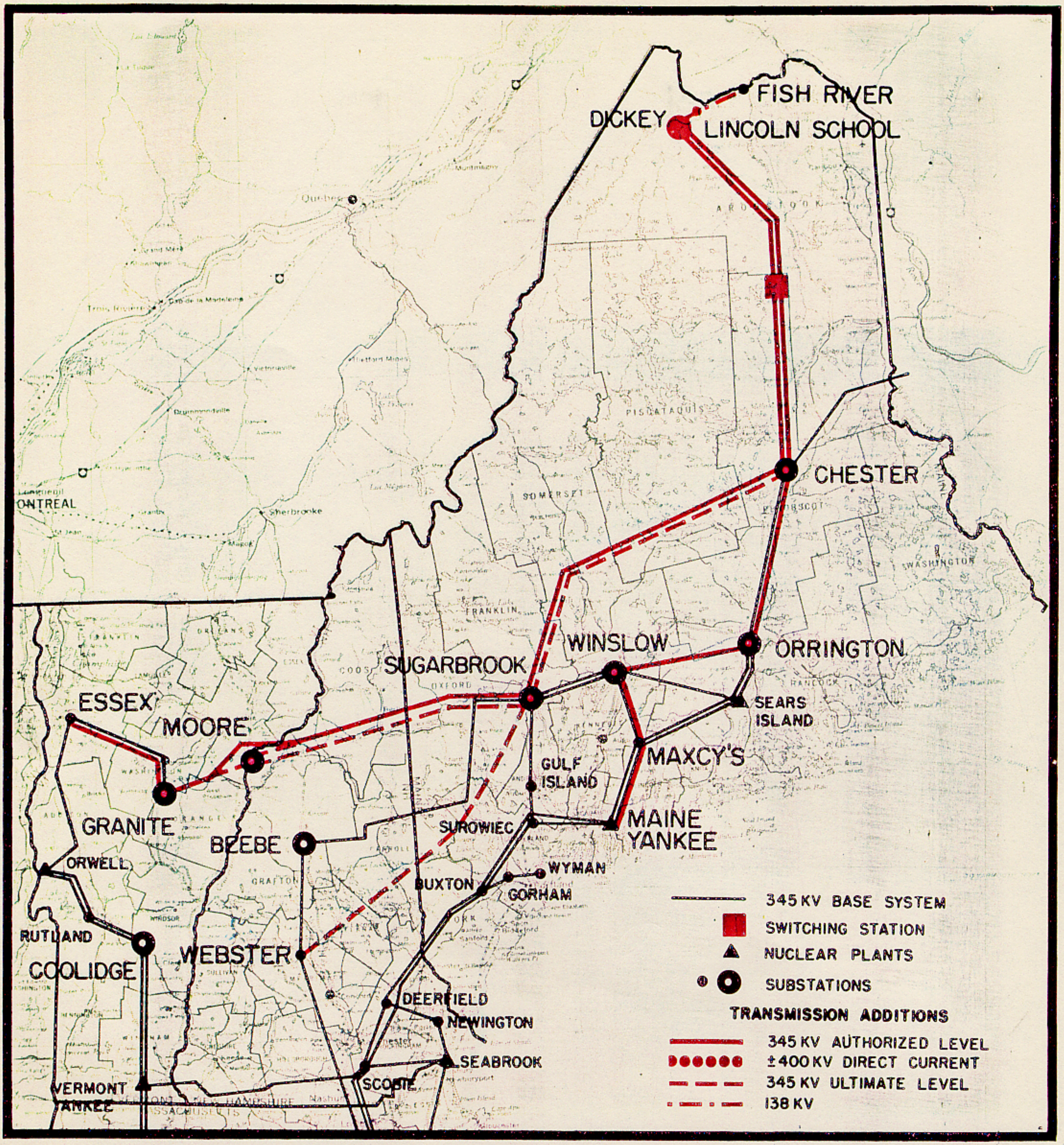
6.02.2.4 Plan D

Authorized Level

Plan D would require two 345-kV a.c. circuits from Dickey to Moore Substation via Moose River Switching Station. The only difference between this plan and the proposal is that in Plan D, the two 345-kV a.c. circuits from Dickey to Moore would be constructed on single circuit wood pool structures rather than the double circuit steel structures. The remainder of the plan is identical in that a 345-kV circuit is needed from Moore to Granite and from Granite to Essex.

Ultimate Level

At the ultimate level, Plan C & D and the proposal are identical. An additional 345-kV circuit is required from Moore to Webster Substation. This circuit is approximately 74 miles in length, and thus constitutes a fraction of the additional transmission needed under Plan A and B - Ultimate.



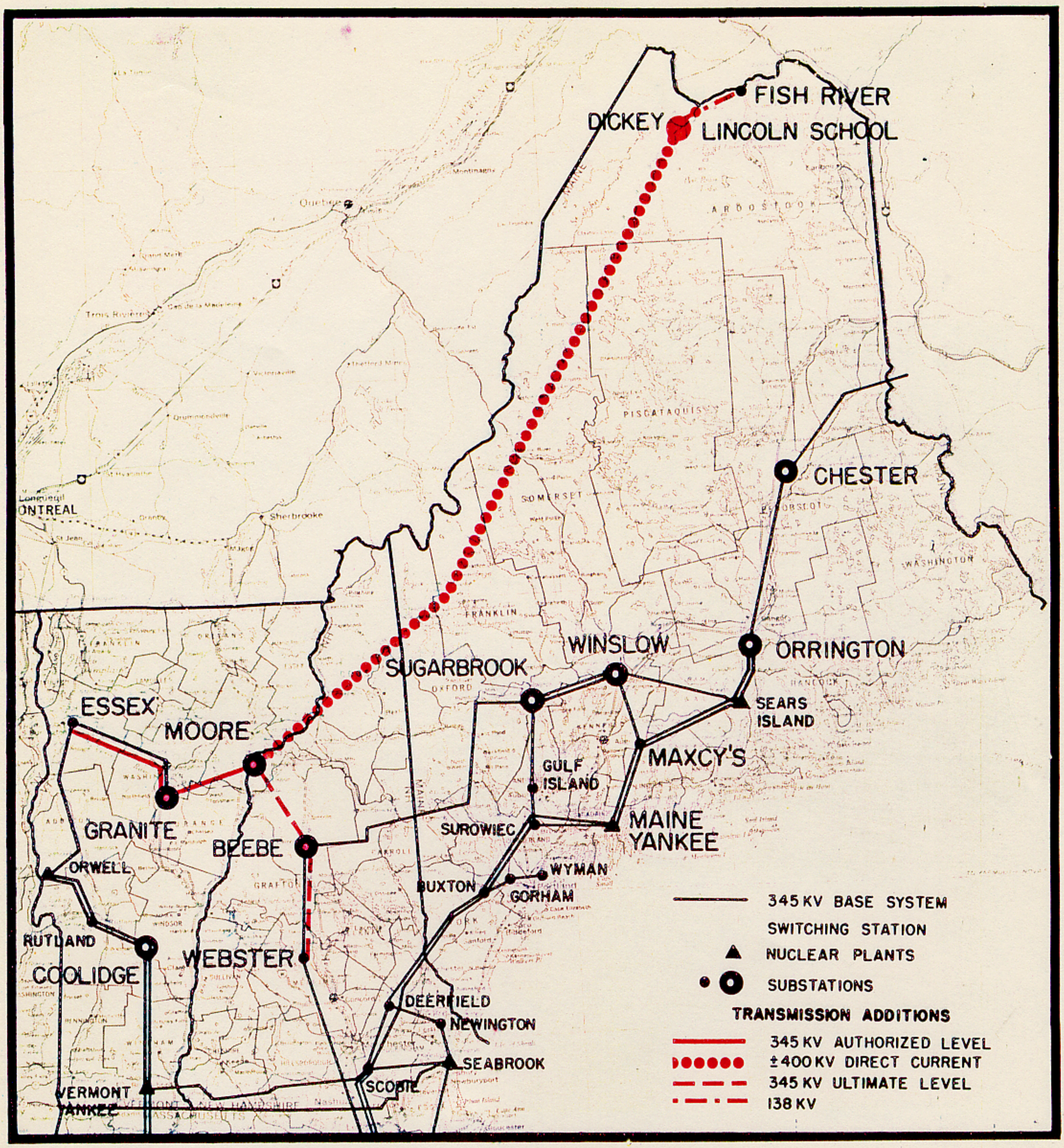
SYSTEM PLAN B

Eastern AC Plan

DICKEY-LINCOLN SCHOOL LAKES PROJECT

U.S. Department of Energy March, 1978

FIGURE 6.02-3



SYSTEM PLAN C

Western DC Plan-Direct Current

DICKEY-LINCOLN SCHOOL LAKES PROJECT

U.S. Department of Energy **March, 1978**

FIGURE 6.02-4

6.02.2.5 Plans Involving Canada

During the planning phases of the Dickey-Lincoln School Lakes Project, several electrical alternatives involving the location of facilities in Canadian provinces were considered. One alternate involves the Province of Quebec, the other New Brunswick.

<u>Quebec Route</u>

Consideration was given to locating a route from the Dickey-Lincoln School Lakes Project site to Moore Substation via a corridor through the Canadian Province of Quebec. This alternative route would probably enter Quebec, near Daaquam, and cross the primarily agricultural lands of eastern Quebec. The line would probably be located west of Lac Megantic and east of Megantic Mountain. It would enter the United States near Norton, Vermont and continue through Vermont to Moore Substation in New Hampshire.

A preliminary review of this alternative revealed that it would encounter more extensively developed lands than the routes through Western Maine. Detailed analysis of a Canadian route would require an agreement between the U. S. and Canada. The time frame for the investigations was not sufficient to allow for such an agreement.

<u>New Brunswick Route</u>

Preliminary discussions were held with the New Brunswick Electric Power Commission on the possibility of developing a tie with a 345-kV transmission system existing and being planned in the Canadian Province of New Brunswick.

This plan was a variation of Plan A in which power from the Dickey-Lincoln School Lakes Project would be transmitted from the project to New England load centers via two 345-kV lines routed through Chester, Maine (eastern route). One of these lines would instead be routed to Grand Falls, New Brunswick. There it would interconnect with a planned 345-kV line to be constructed from Keswick, New Brunswick by the Commission. Another 345-kV line would then be constructed from Keswick to Chester, paralleling an existing 345-kV tie between the New Brunswick and New England systems. The plan seemed promising in that it would take advantage of existing and planned system additions as well as the benefits of combining opposing power schedules (Dickey power south and New Brunswick power north between Keswick and Grand Falls).

A preliminary analysis indicated that the line through New Brunswick would not load as well as one route through Maine because of its greater length. Its cost would be of the same order as Plan A. A treaty would be required before construction of the line could begin. Consideration of these factors and the time required to negotiate and approve a treaty made it inadvisable to include this plan of service in current environmental impact studies.

6.02.3 Proposed Transmission Line Route Alternatives

Alternative transmission line routes (one-half mile width) for Plan E were identified in the Transmission Reconnaissance Study (Appendix D, DOE, 1978). These routes were analyzed by a multidisciplinary environmental team.

Route Designation System

Alternative routes discussed within the following pages are numerous, therefore a route designation structure was devised. The foundation of the route designation system is the link, which is a term used to depict a section of transmission line route which is different in location from any other route section. Each link has a number designation. The complex of links together (72) form what is termed the alternative route network. The route network Resources, Visual and Recreational Resources, Land Use and Historic/Archeological is illustrated on Figure 6.02-5, which is enclosed at the back of this statement. Reference to this map is essential to the following discussions.

A transmission line route is formed by combining a series of links. To aid the comparison of environmental impacts, routes were established between the substations and referred to as route segments. Five segments were defined:

Segment A - Dickey Substation to Lincoln School Substation to Fish River Substation

Segment B_1 - Dickey Substation to Jackman Substation

Segment B_2 - Dickey Substation to Moose River Substation

Segment C_1 - Jackman Substation to Moore Substation

Segment C_2 - Moose River Substation to Moore Substation

Segment D - Moore Substation to Granite Substation

Segment E - Granite Substation to Essex Substation

Routes are first designated by Segment (A through E) and secondly by route number (A-1). The links which are used to form routes are indicated in tables (matrices) which relate route numbers to the links which are used.

A final aspect of the route designation system is the identification of what are termed Localized Routing Alternatives (LRA). These alternatives serve as alternatives within a rather localized area. Environmental comparisons were made of these alternatives and the most acceptable solution was used in the formation of segment routes. For example, in Segment B Links 6 and 7 form what is termed LRA-I. Link 7 was preferred and this link is included in routes which involve this LRA. There are eight LRA's in the route network.

6.02.3.1 Alternative Routes, Dickey-Lincoln School-Fish River - Segment A

6.02.3.1.1 General Description

There is one alternative to the proposed route from Dickey Substation to Fish River Substation. It consists of substituting link 2 for link 1. Link 2 is 17.7 miles long and proceeds southeast from the eastern end of link 1B generally following Petite Brook to Bran Lake. The link continues northeast and parallels the St. John River Valley about 4 miles south of the river. The route crosses largely forested areas and passes close to Hunnewell and Wheelock Lakes.

Table 6.02-6 shows which links comprise the alternative route for Segment A.

TABLE 6.02-6

ALTERNATIVE ROUTES - SEGMENT A

	ROUTES	
LINKS	A-1*	A-2
1	X	
1A	X	X
1B	X	X
1C	X	X
2		X
3	X	X

*Proposed Route

Table 6.02-7 shows the environmental ranking assigned to both the proposed and alternative routes for this segment.

TABLE 6.02-7

ALTERNATIVE ROUTE IMPACT RANKINGS - SEGMENT A

Impact Topics	ROUTES A1*	A2
Geotechnical	2	1
Ecological	1	2
Land Use	1	2
Forestry	1.5	1.5
Recreation	1	2
Socio-economic	1	2
Historic/Archeologic	1.5	1.5
Visual	2	1
Site Engineering	1	2

*Proposed route
(Lower Values = Lower Impacts)

6.02.3.1.2 Significant Impacts of the Alternative

Geotechnical

Alternative route A-2 was ranked as having less impact due to soils with less erosion potential.

Ecological

Ecological studies ranked the proposed route as having the least impact. The alternative route could result in high sedimentation impacts on Petite Brook, Wheelock Brook, and Paradise Brook. The alternate would also impact more deer wintering yards.

Land Use

The preferred route would have fewer impacts on land use than route A-2. This is primarily because it contains a greater percentage of agricultural land which would be only marginally effected. The alternative route is mostly forested, which would cease within the right-of-way due to restrictions on vegetation height.

Recreation

The preferred route would have the fewest recreation impacts. Route A-2 would impact a great pond, a public land parcel, and would be located near an area designated as an elevation of significance.

Socioeconomic

This study ranked the alternative route as having greater impact. This was due to a greater loss of timber resources.

Visual

The preferred route was ranked as having more visual impact that the alternative. Both alternatives were the same in impact on landscape quality and site attractiveness. There is a significant difference, however, in impact on viewers. The alternative would have much less viewer impact.

Site Engineering

The preferred route would have less impact. The alternative route would be more expensive to build, the right-of-way would have to be totally cleared because the route is largely within forest lands.

6.02.3.2 Dickey to Moose River/Jackman (Segment B)

6.02.3.2.1 General Description

There are three alternative routes between Dickey Substation and a substation located at either Jackman or Moose River. Routes terminating at Jackman are designated B-1. Routes terminating at Moose River, B-2.

Table 6.02-8 shows which links form the alternate routes for Segment B.

TABLE. 6.02-8

ALTERNATIVE ROUTES - SEGMENT B

LINKS	ROUTES			
	B1-1	B1-2	B2-1*	B2-2
4	X	X	X	X
5	X		X	
Best LRA I	X		X	
8	X		X	
9		X		X
9A		X		
10	X			
10A				X
11 (1st 7.2 mi)			X	X
11A			X	
12 (1st 1.0 mi)	X	X		

*Proposed Route

The major difference between the alternative routes within segment B is whether the line follows a westerly route about ten miles east and parallel to the U. S. - Canada border or whether it would be located in a more easterly location. The eastern route extends nearly due south from an area west of Clayton Lake to a point north of Moosehead Lake where it turns southwest of Jackman (Figure 6.02-5). These routes join, which allows them to be routed to either the Jackman or the Moose River substation sites.

There is one localized routing alternative (LRA) associated with this segment.

Table 6.02-9 shows the relative ranking that was assigned to each LRA alternative.

TABLE 6.02-9

LOCALIZED ROUTING ALTERNATIVE RANKINGS - SEGMENT B

	LRA	
Impact Topics	I-1	I-2*
Geotechnical	2	1
Ecological	2	1
Land Use	1	2
Forestry	1.5	1.5
Recreation	2	1
Socioeconomic	2	1
Historic/Archaeologic	1.5	1.5
Visual	2	1
Site Engineering	2	1

*selected LRA
(Lower Values = Lower Impact)

Table 6.02-10 presents the impact rankings of the proposed and alternative routes.

TABLE 6.02-10

ALTERNATIVE ROUTE IMPACT RANKINGS - SEGMENT B

Impact Topics	Alternative Routes			
	B1-1	B1-2	B2-1*	B2-2
Geotechnical	1.5	2.5	1.5	2.5
Ecological	1	3	2	4
Land Use	2	4	1	3
Forestry	2.5	2.5	2.5	2.5
Recreation	4	3	2	1
Socioeconomic	3	4	1	2
Historic/Archaeologic	2.5	2.5	2.5	2.5
Visual	1	3	2	4
Site Engineering	2	3	1	4

*Proposed route
(Lower Values = Lower Impact)

6.02.3.2.2 Significant Impact of the Alternative

Geotechnical

The proposed route and route B1-1 were ranked as having the least impact. Alternative routes B2-2 and B1-2 would have the greater impacts, although not significantly. They would encounter steep slopes and potential sedimentation problems near Caucomojomoc Mountain.

Ecological

The proposed route (B2-1) and B1-1 were ranked second and first, respectively, in terms of least impact. Alternative route B2-2 was judged to have the greatest impact on ecological resources. Both routes B1-2 and B2-2 would cross large amounts of deer wintering yards and pass very close to Wadleigh Pond, a habitat for the rare ar' unique Blue Back Trout. They would also cross bogs and shady rock cliffs that are a potential habitat for rare plants. These two routes also cross the west branch of the Penobscot River near Seboomook Lake.

Land Use

The proposed route would cause least land use change. Alternative routes B2-2 and B1-2 would have the greatest potential impact. Route B2-2 would impact a seasonal camp near Luther Pond.

Recreation

All routes are considered to have fairly low impacts. The proposed route would have a significant impact near Baker Lake as would route B1-1. A second area of concern occurs where routes B1-2 and B2-2 cross the west branch of the Penobscot River near Moosehead Lake. Route B1-2 would impact public lands northeast of Long Pond near Jackman.

Socioeconomic

Route B2-2 which also terminates at Moose River switching station was rated as low in impact. Route B1-2 was ranked as having the greatest impact because of a residential structure close to the line near Tomhegan Stream and because the route is located in an area with very little access. Routes B1-1 and B1-2 would terminate at a switching station located in the town of Jackman. Both the town of Jackman and the North Kennebec Regional Planning Commission have voiced concerns about the towers and the proposed switching station site.

Historic/Archaeologic

Both the proposed route and alternatives are considered to have low potentials for impact on the cultural resources. It had been noted, however, that the passage between Seboomook and Moosehead Lakes is a likely area in which to find archaeological artifacts. A slight preference was indicated for route B2-1, the proposed route.

Visual

Routes B1-2 and B2-2 would have significant impacts on viewers. Also of concern is the potential impact on visual quality near the narrow section of land that separates Seboomook and Moosehead Lakes.

Site Engineering

The route with greatest impact would be B2-2 because of its additional length and because the route winds through a series of small lakes and ponds near Boundary Bald Mountain.

6.02.3.3 Jackman/Moose River to Moore (Segment C)

6.02.3.3.1 General Description

Route alternatives within Segment C are numerous. Several LRA's are involved and in several instances portions of one route are combined with portions of a second to form an alternative. Reference to Figure 6.02-5 is recommended while reviewing the following discussions. The LRA shown to have least overall impact was used in the formation of segment routes. Table 6.02-10 shows the links which were compared in each of six LRA's (II-VII). Table 6.02-11 shows the relative impact rankings.

The use of either the Jackman of Moose River switching station as the route origin is indicated by the designations C1 or C2, respectively. The Transmission Reconnaissance Study (Appendix D, DOE, 1978), provides detailed geographical descriptions of each link.

Table 6.02-12 indicates the links utilized in forming the alternative routes in Segment C and Table 6.02-13 shows the impact rankings assigned to the alternative routes.

6.02.3.3.2 Significant Impacts of the Alternatives

Geotechnical

The proposed route was ranked seventh in terms of least geotechnical impact. Routes C1-1 and C2-3 were the least impact routes followed by routes C1-2 and C2-2. Route C2-3 was judged to have the highest impact potential because of several areas with steep slopes and potential sedimentation problems. Of particular concern are areas near Moose Mountain, Boyle Mountain and potential sedimentation of the Kennebago River. The Stratford Mountain and Cape Horn Mountain areas near Groveton also pose potential slope and sedimentation problems.

Ecological

Routes C1-1, C1-3, C2-2, and C2-4 were considered to have the greatest impact. A factor in this ranking was the Second

TABLE 6.02-11

LOCALIZED ROUTING ALTERNATIVE RANKINGS - SEGMENT C

Impact Topics	LRA II		LRA III			LRA IV		LRA V		LRA VI			LRA VII	
	2-1*	2-2	3-1	3-2	3-3*	4-1	4-2*	5-1*	5-2	6-1	6-2*	6-3	7-1*	7-2
Geotechnical	1	2	2	3	1	2	1	2	1	1	3	2	1	2
Ecological	1	2	1	3	2	1	2	1	2	3	1	2	1	2
Land Use	1.5	1.5	2	2	2	1	2	1.5	1.5	2	2	2	2	1
Forestry	1.5	1.5	2	2	2	1.5	1.5	1.5	1.5	2	2	2	1.5	1.5
Recreation	1	2	2	3	1	2	1	1	2	3	1	2	1	2
Socioeconomic	1.5	1.5	3	2	1	1.5	1.5	1.5	1.5	2.5	2.5	1	1.5	1.5
Historic/ Archeologic	1.5	1.5	2	2	2	1.5	1.5	1.5	1.5	2	2	2	1	2
Visual	1.5	1.5	2	3	1	2	1	1.5	1.5	1	2	3	1	2
Site Engineering	1	2	2	3	1	1	2	1	2	3	1	2	2	1

*Selected LRA
(Lower Rank = Lower Impact)

TABLE 6.02-12

ALTERNATIVE ROUTES - SEGMENT C

LINKS	ROUTES							
	C1-1	C1-2	C1-3	C1-4	C2-1*	C2-2	C2-3	C2-4
11(last 37.5 mi)					X	X	X	X
12(last 36.8 mi)	X	X	X	X				
12A		X		X				
13						X		X
13A		X		X				
14		X		X	X		X	
14A					X		X	
Best LRA II		X		X	X		X	
Best LRA III		X		X	X		X	
17		X		X	X		X	
20		X		X	X		X	
Best LRA IV	X		X		X	X		X
25	X		X			X		X
Best LRA V	X		X			X		X
28	X		X			X		X
Best LRA VI		X		X		X	X	
31	X		X			X		X
32	X		X			X		X
33	X		X			X		X
34	X	X	X	X	X	X	X	X
35	X	X			X	X		
Best LRA VII	X	X			X			
38			X	X			X	X
39			X	X			X	X
40	X	X	X	X	X	X	X	X

*Preferred Route

College Grant, a forested area owned by Dartmouth College and managed by Seven Islands Land Company. The Grant encompasses one of the best natural areas in northern New Hampshire. It has an important deer wintering yard, and has high potential for rare plant occurrence. Routes C1-1, C1-2, C1-3, and C1-4 encounter several rare plant localities around Baker Pond, a bog, and three limestone areas. These four routes also are expected to have higher impacts on deer wintering yards, especially in Maine. Considerably fewer deer wintering yards are encountered along the proposed route vs. the alternatives

TABLE 6.02-13

ALTERNATIVE ROUTE IMPACT RANKINGS - SEGMENT C

Impact Topics	Alternative Routes C1-1	C1-2	C1-3	C1-4	C2-1*	C2-2	C2-3	C2-4
Geotechnical	1	3.5	2	6	7	3.5	8	5
Ecological	7	3	8	4	1	5	2	6
Land Use	1	3	3	6.5	6.5	3	8	5
Forestry	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Recreation	7	3	8	4	1	6	2	5
Socioeconomic	3	5	7	8	1	2	6	4
Historic/ Archeologic	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Visual	7	8	4	6	2	5	1	3
Site Engineering	4	2	8	6	1	3	5	7

*Proposed route
(Lower Rank = Lower Impact)

Land Use

Land use impacts are infrequent within this segment. The proposed route was ranked as sixth of eight relative to its impact. The least impact route for land use was route C1-1 as it would have no significant impacts on developed land use. Three routes C1-2, C1-3, and C2-2 tied for second least impacts as they would have slight impact on land use. Routes C1-4, C2-1, and C2-3 all were ranked as having the greatest impact. The few land use impacts which occur in this segment reflect residences along the routes.

Recreation

The proposed route was ranked as having the least impact on recreational resources. The goal was to select an alternative that avoided the eastern most links, where impacts were substantially higher. High impacts were associated with such developed recreation areas as Weaks State Park, the White Mountains, several public land parcels, and rivers that may be designated wild and scenic. The eastern links are also near the Kennebago Lake area.

Socioeconomic

Route C1-4 would have the greatest impact because it utilizes the Jackman substation site near Jackman and would impact the people living in the vicinity. Also, this route would impact residences near Kidderville, Whitefield, and Groveton, New Hampshire.

Another problem common to routes C1-3, C1-4, C2-3, and C2-4 is their proximity to the Connecticut River along the Moore Reservoir. This area was identified as being of high sensitivity for cultural resources and has a high potential for impact. Differences between the routes are nearly equal, thus no route preference was indicated.

Visual

The proposed route was ranked second best. The difference between the least impact route which is C2-3, and the proposed route is not great. One area of significant difference relates to the use of Jackman Substation site. The alternates which use this site (C1-1, C1-2, C1-3, and C1-4) would have severe impacts on visual landscape quality from that point where the route crosses U.S. Highway 201 south of Jackman to the Spencer Lake area. Also, routes C1-2 and C1-4 would also impact viewers on Prospect Mountain south of Lancaster, New Hampshire and again near the Town of Whitefield, New Hampshire. The least impact route visually is C2-3. This route parallels an existing transmission line from the Groveton area past Whitefield, New Hampshire. Although this route is longer, the existing views are not judged to be as scenic as those along the other routes.

Site Engineering

The preferred route was ranked as having the least impact. The routes with the greatest impact are C1-4, C2-4, and C1-3. Routes C1-3 and C2-4 cross the north end of Kennebago Lake which would result in several impacts. Route C1-3 would result in paralleling a much smaller line than the proposed line. This would result in several engineering location problems. Generally, there is considerable turning with a smaller line which would make it quite difficult to parallel with a 345-kV steel tower line.

6.02.3.4 Moore to Granite - Segment D

6.02.3.4.1 General Description

Two alternatives that would connect Moore Substation with Granite Substation were studied. Table 6.02-14 shows the links that are joined to make up the alternative routes for this segment.

TABLE 6.02-14

ALTERNATIVE ROUTES - SEGMENT D

LINKS	ROUTES D-1*	ROUTES D-2
41	X	X
42	X	X
43		X
44	X	
45	X	X

*Proposed route

The alternative to the proposed route is a new right-of-way that would be located about 10 miles north of the proposed route. This route would leave the proposed route near Barnet, Vermont, on the Connecticut River and go between Peacham and East Peacham, Vermont. The route crosses a corner of the Groton State Forest and then turns south to Granite Substation. Appendix D (DOE, 1978) contains a detailed description of the route. There are no localized routing alternatives in this segment.

Table 6.02-15 presents the impact ranking summaries for both the proposed and alternative route.

TABLE 6.02-15

ALTERNATIVE ROUTE IMPACT RANKINGS - SEGMENT D

Impact Topics	ALTERNATIVE ROUTES D-1*	ALTERNATIVE ROUTES D-2
Geotechnical	1	2
Ecological	1	2
Land Use	1	2
Forestry	1.5	1.5
Recreation	1	2
Socioeconomic	1	2
Historic/Archeologic	1	2
Visual	1	2
Site Engineering	1	2

*Proposed route
(Lower Rank = Lower Impact)

6.02.3.4.2 Significant Impacts of Alternatives

Geotechnical

Geotechnical impacts are generally high for both the alternative and the proposed route. Sedimentation potential is the most significant concern. One area of high sedimentation potential along route D-2 is where it crosses Stevens Stream. The proposed route is considered to have the least impact.

Ecological

The alternate route (D-2) would pass through an almost virgin forest on link 43. The alternate encounters more lakes and wetlands than the proposed route and is also more remote. Route D-2 also contains 10 acres of cedar swamp, two deer yards, Peacham Bog which is a recognized botanical area, and a state game refuge in the Groton State Forest.

Land Use

The alternative route would have significantly greater impact on single family residences. The alternate route would also pass through a sugar maple stand which would have high impact.

Recreation

There are 10 recreation areas along the alternative route that would receive high or severe impacts. They include Groton State Forest, a municipal forest, a state park, and scenic roads. The proposed route is ranked as having less impact.

Socioeconomic

The impacts on residences and communities along this route are significant. Three residences would potentially require relocation. Peacham, Plainfield, and Marshfield, Vermont, all have registered opposition to the alternative. The above considerations resulted in a preference for the proposed route as the least social impact alternative.

Historic/Archeologic

The Town of Peacham, Vermont is of utmost concern. It is an historic community and could be of national significance. The concern involves potential impacts to standing historical structures.

Visual

Sixteen areas along this alternative were judged to have high visual impacts. Most of these impacts are views from towns along the alternative route. The proposed route is preferred as it follows an existing line.

Site Engineering

Although terrain poses difficulties, the alternative route could be a difficult line to design and build because of existing land use along its location. Easements could be difficult to acquire and several small communities occur along the route.

6.02.3.5 Granite-Essex - SEGMENT E

6.02.3.5.1 General Description

There is one LRA in this segment. Table 6.02-16 shows the environmental rankings assigned to each LRA.

TABLE 6.02-16

IMPACT RANKINGS
LOCALIZED ROUTING ALTERNATIVE VIII

Impact Topics	LRA 8-1*	LRA 8-2
Geotechnical	1	2
Ecological	1	2
Land Use	1	2
Forestry	1.5	1.5
Recreation	1	2
Socioeconomic	1	2
Historic/Archeologic	1	2
Visual	1	2
Site Engineering	1	2

*Preferred LRA

Eight alternatives have been identified and studied between Granite Substation and a new substation to be built near Essex Junction, Vermont. Table 6.02-17 shows the links that are joined to make up the alternative routes.

The two substation sites are separated by the Green Mountains, a north-south range broken only by the Winooski River Valley. All alternative routes pass through the valley which contains two highway, a railroad, and two transmission lines. Most alternatives would parallel existing facilities.

Table 6.02-18 shows the impact ranking summaries for both the proposed and alternative routes for this segment.

TABLE 6.02-17
ALTERNATIVE ROUTES - SEGMENT E

LINKS	ALTERNATIVE ROUTES E-1A	E-1B	E-2A	E-2B*	E-3A	E-3B	E-4A	E-4B
45A	X	X	X	X	X	X	X	X
Best LRA VIII	X	X	X	X	X	X	X	X
46	X	X	X	X	X	X	X	X
47	X	X			X	X	X	X
47A	X	X					X	X
48	X	X						
49	X	X	X	X	X	X	X	X
50			X	X				
51					X	X		
52			X	X	X	X		
53							X	X
54			X	X	X	X	X	X
55	X		X		X		X	
56		X		X		X		X

*Proposed Route

TABLE 6.02-18

ALTERNATIVE ROUTE IMPACT RANKINGS - SEGMENT E

IMPACT TOPICS	E1A	E1B	E2A	E2B*	E3A	E3B	E4A	E4B
Geotechnical	7	8	3	4	1	2	5	6
Ecological	1	5	3	7	4	8	2	6
Land Use	3	3	6	3	6	6	6	3
Forestry	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Recreation	7	7	3	1	4	4	5	5
Socioeconomic	7	7	4	2	2	4	5	5
Historic/ Archeologic	5	5	1	2	6.5	6.5	5	5
Visual	7	8	3	6	1	4	2	5
Site Engineering	6	5	2	1	4	3	8	7

*Proposed Route
(Lower Values = Lower Impact)

6.02.3.5.2 Significant Impacts of Alternative Routes

Geotechnical

Alternative routes have sedimentation potential, severe slopes, and soil stability problems.

Ecological

Deer wintering yards on alternative Routes E1A, E1B, E3A, E4A, and E4B are important. Sedimentation was slightly higher for the proposed route than for the alternative routes.

Land Use

Significant impacts would occur to some residences and commercial developments along the alternatives. The proposed route was ranked as having the least impact. The alternative routes would create greater impacts on land use. Routes E4A and E4B had the greatest impacts because of their effect on residences. Routes E1A and E1B would have impacts near the Town of Waterbury in the Winooski Valley.

Recreation

The proposed route would have the least impact. Alternative routes E1A and E1B were ranked as having the greatest impact. Of major concern was the fact that the alternatives cross a municipal forest. Impacts are high on recreation viewers where the line crosses the Winooski River.

Socioeconomics

The proposed route was ranked as the least socioeconomic impact route. The alternative routes would have similar impacts, however, they contain more residential structures which might require relocation. Impacts upon residences are much more severe in this segment than others and are the more significant socioeconomic impacts.

Historic/Archeologic

The proposed route has the second least impact on historic and archeologic resources. The use of link 55, which is further from the Winooski River, is preferred over link 56. All routes contain sites that have been identified by the State historical survey in Chittenden County, Vermont.

Visual

The proposed route was ranked sixth in terms of visual impact. The differences between rankings are attributed to landscape quality and impacts on viewers.

Site Engineering

The proposed route was ranked as having the least impact. All of the alternatives would be quite difficult to construct. They have steep slopes, erosion potential, and would be visible from the valley. It would be difficult to parallel the existing 115-kV line for the length of the segment.

6.02.4 Alternative Types of Towers

Two alternative transmission tower designs could be used instead of the proposed double circuit steel structures from Dickey Substation to Moore Substation.

6.02.4.1 Woodpoles

Two parallel rows of woodpole structures would be needed between Dickey and Moore substations to carry the two circuits. Woodpole towers for 345-kV lines stand about 75 feet tall. Their height depends largely on the structural limitations of woodpoles. About 10 woodpole structures would be required for each circuit mile of transmission line. If two woodpole circuits were located parallel to one another, on one right-of-way, the combined right-of-way would be about 250 feet wide. Figure 6.02-6 shows a diagram of a typical woodpole tower.

6.02.4.2 Single Circuit Steel

The second alternative type of tower is a single circuit steel tower. These towers average about 100 feet in height for 345-kV lines. Their added strength and height enables them to support longer conductor spans. About five towers are needed per mile. The right-of-way required for each circuit is about 150 feet wide. When two steel circuits are located parallel to one another, the combined right-of-way is about 250 feet wide. Figure 6.02-6 portrays a diagram of a typical single circuit steel tower.

6.03 Flood Control Alternatives

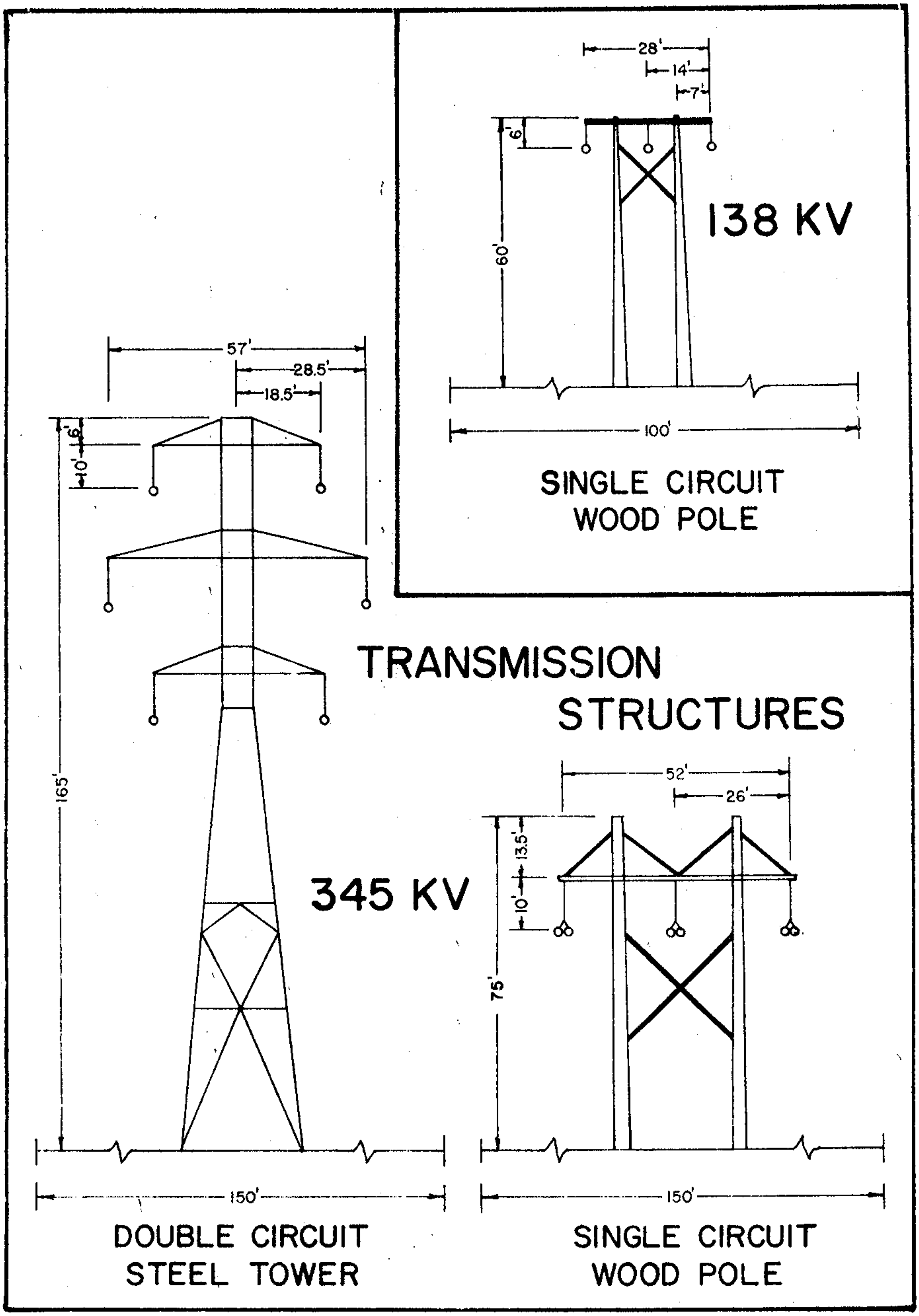
Several alternative measures have been studied and evaluated to determine their effectiveness in preventing the recurring flood losses along the St. John River. These measures have been separated into the two major categories of structural and non-structural.

6.03.1 Non-Structural

With the exception of flood proofing and relocation, non-structural measures are regulatory in nature rather than corrective. As such, they do not prevent or reduce flooding. Instead, they regulate or discourage the use and development of the flood plains, thereby limiting future flood damage and possible loss of life. The non-structurally oriented measures which might be applicable along the St. John River are described in the following paragraphs.

6.03.1.1 National Flood Insurance Program

This program was established under the Housing and Urban Development Act of 1968 and expanded in the Flood Disaster Protection Act of 1973. It was specifically designed to provide flood insurance, at a reasonable rate, to property owners by means of a Federal subsidy.



TRANSMISSION STRUCTURES
28'
14'
7'
6'
60'
138 KV
100'
SINGLE CIRCUIT WOOD POLE
57'
28.5'
18.5'
6'
10'
165'
345 KV
150'
DOUBLE CIRCUIT STEEL TOWER
52'
26'
13.5'
10'
75'
150'
SINGLE CIRCUIT WOOD POLE

FIGURE 6.02-6

In return for this subsidy, the Act requires that State and local governments adopt and enforce land use and control measures that will restrict future development in flood-prone areas in order to avoid or reduce future flood damages. These measures include flood plain zoning, careful siting and drainage preparations, special construction practices and building materials, special treatment of sewage disposal systems, and elevation of the first flood above the level of the 100-year flood. Flood insurance is available through local insurance agents only after a community applies and is declared eligible by the Flood Insurance Administration, U. S. Department of Housing and Urban Development (HUD). The Towns of Fort Kent, Madawaska, Van Buren, Frenchville and Grand Isle have applied for and been declared eligible for the Federally subsidized insurance.

In conjunction with this program, the Corps of Engineers is presently conducting a flood insurance study for the Town of Fort Kent. This study will be used to establish flood insurance rates for coverage above the minimum level currently being provided.

Although the flood insurance program does not reduce actual flooding, it does provide economic protection against physical losses to the property owner by transferring the costs to the Federal Government. Flood insurance does not, however, cover losses to agricultural lands.

6.03.1.2 Flood Plain Regulations

These regulations generally consist of ordinances enacted by State, county or local governmental agencies which are used as legal tools to restrict development within the flood plain. These regulations may be more or less restrictive than the land use control measures required for participation in the National Flood Insurance Program. These regulations would prevent increased damages in the future. The Corps of Engineers is presently conducting a flood plain study for Grand Isle which will delineate the flood hazard areas in that town.

Presently, the Maine Land Use Regulation Commission (LURC) has planning and zoning powers over all of Maine's plantations and unorganized townships. LURC has adopted rules and regulations designed to enforce its Comprehensive Land Use Plan. These rules and regulations contain a section of land use standards for flood prone area protection. One of the stated purposes is to regulate certain land use activities in flood prone areas to comply with the cooperative agreement between LURC and HUD regarding the regulation of land use so that flood insurance can be made available to persons in flood prone areas. These rules and regulations become effective when an official Land Use Guidance Map is certified by LURC. Until that time, there are interim standards which are presently in effect.

6.03.1.3 Building Codes

The primary purpose of building codes is to set up minimum standards for controlling the design, construction and quality of materials used in buildings and structures. Local governmental agencies could adopt such building restriction codes that would assist in reducing future flood damages to any structures or equipment that the regulations mentioned above do not prohibit from the flood plain. Typical regulations that could be adopted are:

-Adequate anchorage to prevent buildings from floating off their foundations;
-Minimum basement and first floor elevations consistent with potential flood hazards;
-Building reinforcement to withstand water pressure or high velocity flows.

6.03.1.4 Flood Proofing

This measure, as opposed to the regulatory measures considered previously, is a corrective step in that it can make existing structures and their contents less vulnerable to flood damages. Various techniques that might be employed include the following:

a. Permanent measures built into a structure such as:

-Waterproofing basement or foundation walls;
-Installation of subsurface drain and pumping systems;
-Use of water resistant interior materials;
-Raise the structure above the flood level;
-Brick-in windows and relocate entrances;

b. Contingency measures that require action to be taken such as installing removable bulkheads for windows, doors and vents;

c. Emergency measures carried out during flood conditions such as sandbagging, pumping or removal of contents to higher elevations.

The application of these techniques within the flood plain of the St. John River could effectively reduce some of the recurring flood damages. Probably the greatest potential use of flood proofing measures is in the area of highway and railroad bed washouts. During flood conditions, the fast moving water causes significant scouring of the embankment slopes and shoulders. Flood proofing in the form of rip-rap protection could significantly reduce this type of damage which constitutes about 40 percent of all urban flooding damages.

Another possible application for flood proofing techniques is in the industrial loss category which constitutes about 19 percent of the urban damages. A significant portion of this damage is not structural in nature but rather is due to the poor quality of the turbid flood waters. Industries that depend on good quality of water to produce a quality product are greatly affected by this condition. Therefore, there is a possibility that the installation of some new water filtering technique could be applied to eliminate this type of loss.

Residential areas at Van Buren and Fort Kent (outside of the local flood protection project) have suffered recurring losses amounting to about 23 percent of the urban damages and public facilities in the flood area have incurred another 10 percent. A few of these structures might be effectively protected from flood losses by applicable flood proofing measures but the majority of the buildings are quite old, have poor substructures and are made of wood frame construction. This would make flood proofing measures very difficult and/or prohibitively expensive to employ.

The losses associated with overland flooding of croplands and streambank erosion along the St. John River in general are not conducive to flood proofing measures.

6.03.1.5 Permanent Evacuation of the Flood Plain

This corrective action generally involves the acquisition of lands, the removal of flood prone structures and the relocation of the population from the flood plain. If this could be implemented, it would virtually eliminate all flood damages to structures and personal property. The agricultural and streambank erosion losses would not be reduced. The vacated lands could be returned to a natural habitat or they could be used for agriculture, public parks, primitive recreation facilities or any other purposes consistent with flood management objectives. This would appear to have an environmentally positive impact, but it must be weighed against the impact on the areas that would receive the relocated facilities. Also, the removal of people from an established location is generally disruptive but this adverse social and economic impact would most likely be short-lived.

The implementation of a relocation alternative for the Town of Fort Kent was investigated by the Corps of Engineers during the studies which ultimately led to the local protection project which was constructed in that town. It was concluded that participation in such a relocation project could not be justified because the costs of building relocation or demolition and reconstruction would outweigh any attributable benefits. As an alternative to the Corps dike proposal, the Northern Maine Regional Planning Commission presented a relocation plan at a public hearing in Fort Kent on 25 July 1975. As a result of that meeting, the Governor of Maine decided that it was in the best interest of Fort Kent to approve the construction of the dikes rather than the relocation alternative.

There is a possibility that a few structures in the flood prone areas along the St. John could be economically relocated and others could be flood-proofed, but as a general solution to the flood problems, these measures would have a relatively insignificant effect.

6.03.2 Structural

Since the flood-prone areas along the St. John River have no major built-up areas, there is a lack of economic justification for structural flood protection measures. However, several structural alternatives have been investigated during the course of various studies involving the St. John River Basin.

6.03.2.1 Flood Control Dam and Reservoir

Possible dam sites have been investigated to determine their effectiveness in eliminating downstream flood damages. In order to be effective as a flood control measure, a dam would have to be located at a site that would control enough runoff to prevent the river from reaching flood stages. The more drainage area that can be controlled, the more effective a site is. The same criteria is true for hydro-power dam sites. Therefore, the best sites for flood control would be these sites previously investigated as hydropower sites.

Rankin Rapids site was initially recommended in connection with the Investigation of the International Passamaquoddy Tidal Power Project in 1959. Indications were that this site would be the most economical development for storage and power on the upper St. John River. The drainage area controlled by this site would have been 4,060 square miles which is about 1.5 times that of the proposed Dickey Dam. Growing demand for the preservation of the Allagash River as a wilderness area led to the abandonment of the Rankin Rapids site. Subsequently, the State of Maine Legislature passed an act creating the Allagash Wilderness Waterway. This legislation preserves the Allagash River from its headwaters down to its confluence with West Twin Brook. The waterway is also included in the National Wild and Scenic Rivers system.

With sites below the mouth of the Allagash River eliminated, investigations were turned to possible dam locations further upstream on the St. John River.

The Big Rapids site was considered during studies for the International Passamaquoddy Tidal Project but the site is above the mouth of the Little Black River and its drainage area is 89 percent of the Dickey site. Since the Dickey site offered the maximum opportunity to develop the full power potential of the St. John River, it was adopted over the Big Rapids site.

As a possible flood control dam, Big Rapids would require about 1,030,000 acre-feet of storage capacity. This would necessitate a dam structure over 220 feet high with a spillway crest elevation at approximately 820 feet msl and containing about 8,000,000 cubic yards (c.y.) of fill material. During times of full control pool, at elevation 820, the reservoir would inundate 16,000 acres of forestland. The cost of such a development has been estimated to be over $49,000,000. Since these costs would greatly exceed the benefits, construction of a single purpose flood control dam at this site would not be economically justified.

The proposed hydropower site at Dickey could also be a location for a single purpose flood control project since it controls a drainage area of 2,725 square miles. A dam structure over 170 feet high with a spillway crest elevation at 746 feet msl and containing over 10,000,000 c.y. of fill material would be needed to contain the required 1,160,000 acre-feet of flood control storage. At elevation 746 msl, the reservoir would inundate 17,000 acres of forestland. The estimated cost of this development is over $57,000,000. Since this greatly exceeds the flood control benefits, construction would not be economically justifiable.

The alternative of siting several small dams on the tributaries and feeder streams in lieu of one large dam on the St. John River was also investigated. Possible locations were initially screened to determine their effectiveness for controlling runoff without regard for foundation conditions, construction costs or environmental impacts.

Flood damage studies have shown that flood damages along the St. John River begin reaching significant proportions when river flows at the U.S.G.S. gage at Fort Kent exceed 100,000 cubic feet per second (cfs). To prevent significant damages from occurring, a flood control dam or series of dams would have to control enough drainage area to prevent flows of over 100,000 cfs. A discharge frequency analysis was made for the St. John River. Results of that analysis show that the 100-year discharge at the Fort Kent gage is 175,000 cfs. In order to reduce this to 100,000 cfs, approximately 43 percent (75,000/175,000) of the discharge would have to be eliminated. Thus, a dam or series of dams would have to control about 43 percent of the drainage area to reduce the 100-year event below flood levels. This equates to about 2,440 square miles of the total 5,690 square miles of drainage area above the Fort Kent gage. Protection for a flood in excess of the 100-year event would require greater drainage area control.

The following is a list of major tributaries to the St. John River and the approximate drainage area in the watershed of each.

Watershed	Drainage Area (sq. mi.)
Little Black River	270
Pocwock Stream	70
Chimenticook Stream	100
Big Black River	620
St. John River	480
(Upstream of Northwest Branch includes Southwest Branch and Baker Branch)	
TOTAL	1,540

Therefore, even though all five of these watersheds could be dammed for flood control purposes, significant damages would still occur. This is not considered to be an effective flood control measure.

6.03.2.2 Local Flood Protection

This type of structural alternative generally involves the construction of levees or floodwalls to protect localized flood-prone areas from flood flows. Unlike impoundments, local protection projects have no control over drainage areas and operationally do not reduce basin-wide flood stages. An example of a local protection project is the Fort Kent project. That project consists of 3,245 linear feet of earth dike, a pumping station, a pressure conduit and a raised roadway designed to protect the commercial center of Fort Kent up to the 100-year frequency flood.

Local protection projects are generally less expensive than dam and reservoir projects, but the benefits are also localized. Experience has shown that they are practical only in developed or urbanized areas. The only flood-prone area along the St. John River that could be considered urbanized is the Lower Village of Fort Kent. This is the residential area on the east side of the Fish River. The detailed studies performed during the development of the Fort Kent Local Flood Protection Project by the Corps of Engineers concluded that protection of the Lower Village would not be economically justified. A recent re-evaluation of this area, completed in May 1978, confirmed the results of the previous studies.

The dike system constructed at Fort Kent has been designed to protect against the 100-year frequency flood. This degree of protection was based on a maximization of benefits. Although the probability of a higher stage flood occurring is very slight (less than 1 percent), the results of such an event could be severe. In order to give a more complete degree of protection equivalent to that provided by Dickey-Lincoln School Lakes, the dike would have to be raised an additional 3 feet. Unless there are some major changes in the hydrology of the St. John River or major economic development behind the new dike, increasing the height of that dike would not be economically justified.

6.04 Recreation

6.04.1 Non-Structural

6.04.1.1 No Action

The No Action or no recreation facility development alternative would provide for no facilities to accommodate the visiting public. Camping would be limited to those campsites remaining after inundation.

Hunting and fishing would not be significantly affected by the no action alternative. However, sightseeing would be considerably reduced. Boating and canoeing would be severely impacted due to a lack of suitable access points.

6.04.1.2 Non-Project Developments

The Maine Department of Conservation has acquired partial ownership of 7,500 - 8,800 acres of land on Squa Pan Lake. This is approximately 15 miles west of Presque Isle, Maine. Although no definite plans have been made for the development of this resource, consideration is being given to developing it as a major day-use facility, with the possibility of having minimal camping facilities. Any development of this site could substantially affect the potential visitation to the proposed project.

The State of Maine has recognized the need for a state park facility for Aroostook County, and is considering various concepts for the location and intensity of any such development. If such a facility is proposed at a location other than at Dickey-Lincoln, it would reduce the use at this project. Any expansion plans anticipated for existing State parks located to the south would impact the user day demand on the proposed project.

The North Maine Woods Association is preparing plans for the recreational use of the entire North Maine Woods Area. These plans and others, such as the Land Use Regulation Commission's adopted plan for the unorganized areas of Maine, are being conducted exclusive of the proposed project.

6.04.2 Structural

6.04.2.1 Recommended Plan

The recommended recreational development plan for the proposed project is discussed in detail in the revised Appendix G (CE, 1978). This plan calls for providing minimum facilities necessary for the health, safety and convenience of the visiting public. These facilities would consist of a visitor center, scenic overlook and two canoe take-out areas, all provided at 100% Federal cost. Any further developments of recreation facilities would have to be cost-shared with a non-Federal public in-interest. With the minimum facility development, no provision would be made for day use recreation or overnight camping. Overnight camping would be restricted to those existing sites which are not inundated.

6.04.2.2 Alternate Plan

An alternate to the minimum development of recreational opportunities includes public use facilities to accommodate camping, boating, fishing, picnicking, swimming, hiking and sightseeing. Specific facility development would consist of an intensive use area located near Dickey Dam. It would include a visitor center, scenic overlook, picnic area, boat launching area, swimming beach, destination campground and connecting trails. A group camping area would be provided apart from the destination campground and have both road and boat access. Primitive campsites would be provided in areas remote from the intensive use area and would be accessible by boat or trail. Canoe take-out facilities would be provided on both the St. John and Allagash Rivers upstream of the proposed project.

SECTION 7

RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

7.00 THE RELATIONSHIP BETWEEN LOCAL SHORT TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG TERM PRODUCTIVITY

7.01 General

The proposed action was authorized in 1965 as a multi-purpose project which included power generation and flood control as purposes. Should the proposed project be implemented, it would result in significant alterations to the existing natural environment of the upper St. John River Valley. These alterations would reduce the long term productivity of the St. John River Valley in varying degrees for the entire length of the river.

For this discussion, "short-term" will refer to the life of the project, or approximately 100 years. It is reasonable to assume that some of the impacts related to the project would last beyond this period.

7.02 Short Term Uses of the Environment

The production of hydroelectric power constitutes the major purpose and benefit derived from this proposed project. Although this power production is expected to continue beyond the 100 year life of the project, it falls well within the category of a short term use of the environment. This is especially true when it is compared with natural evolution of geologic systems and biota. The 1.4 billion kilowatt-hours of annual energy will be produced to help supply man's needs for power. This energy would be produced by a non-pollutant renewable resource. This is in contrast with other sources of energy production now in use. This production would amount to approximately 19% of New England's peaking power needs by the mid-1980's. Implementation of the project would augment downstream flows thereby providing for increased electric energy at three Canadian hydropower facilities.

Flood control as a project purpose both adds to and detracts from the long term productivity of the downstream regions. It adds in that there is a reduction of destructive erosion in the natural environs and destructive waste in the man-made environs. It detracts from the overall productivity in that it reduces the natural flood plain enrichment at some point downstream. Flood protection is expected to increase flood plain development. This development would reduce long term productivity by the natural ecosystem.

Recreation and utilization of the natural productivity of the project area would change as a result of project implementation. In terms of long term productivity, fish and wildlife enhancement and mitigation measures which would be instituted for recreational purposes would be expected to recoup some of the lost productivity. Mitigation measures cannot be expected to attain 100% replacement of lost species. To the contrary, they are aimed at single species or at best habitat types. Enhancement measures, if they are adopted, could assist in regaining some more of the lost productivity and thereby regain some lost recreation potential. The unique and irreplaceable nature of the upper St. John River as a recreation resource would, however, be lost should the proposed impoundment be created. Loss of whitewater canoeing cannot be mitigated since it must consist of increased access and preservation of this use elsewhere, or it amounts to a new loss.

The implementation of the proposed project would create another body of standing water in a region which has numerous lakes and ponds. Changes in the natural environment of the area would include an elevation of heavy metals such as mercury within the food chain. This is especially true for the top carnivores within the system. The river and stream associated levels of mercury are in general lower than the levels found in the surrounding lakes and ponds. The impact of this biological concentration phenomenon is to be considered as minimal. The development of another standing body of water would create another flat water recreation source. This would be in place of the existing whitewater canoeing.

Powerline corridors represent a short term use of the environment. Existing rights of way would probably continue to provide one of the best routes for new transmission facilities.

7.03 Impact Upon Long Term Productivity

Significant loss of productivity to the St. John Valley occurs in the region of the dams and reservoirs. This would be the result of the inundation of 80,455 acres of terrestrial habitat and its associated flora and fauna. The inundation would remove from production all forms of life associated within the proposed pool area. This translates to a reduced utilization of the Spruce-Fir and hardwood forests, a reduction in the populations of game and non-game species of wildlife within the reservoir area, a loss of approximately 278 miles of trout stream habitat and the contribution that it makes to the overall energy budget within the St. John Valley.

The effect on long-term water productivity and water quality due to transmission lines should be minimal. Most impacts on water resources would abate soon after construction of the line is completed.

The riparian community, both within the proposed project area and downstream, will be altered. This alteration will change the species composition now in existence to a less stable condition. The net result of this change would be a general reduction in the productivity for an indeterminant length of time until natural succession established a new and stable community. Also associated with a change in the hydrology of the reservoir area and downstream reaches will be a reduction in the diversity of the flora and fauna. This reduction leads to a less stable ecosystem which will be continuously evolving back to some level of climax stability. Included in the riparian habitat are various plants which are unique to Maine. These include the Furbish lousewort which is on the Rare and Endangered Species List.

Ecological interrelationships on or adjacent to construction sites would be irreversibly altered by construction activities. These changes would last until the effects of vegetation removal and soil disturbances stabilize and a new ecosystem begins to function.

The loss of forest productivity in the valley is documented in Section IV of this report. That loss would be permanent and in terms of forest management it would be significant. There would be a disruption of present access, present plans for harvesting the resource and an impact upon the future forest management practices. Associated with the loss of the forest would be the loss of large amounts of habitat critical to the survival of the whitetail deer. This loss would approximate 50% of the total wintering habitat within a 23 township area surrounding the project area.

The loss of this habitat would directly reduce the available stock which in turn would reduce the productivity of that species. The reduction in the size of the deer herd can, in some measure, be mitigated. A comprehensive plan for the mitigation of lost deer would be instituted. Loss of habitat for any species will of necessity place pressures on that species which will tend to reduce their numbers.

Although many adverse impacts on wildlife would abate after construction of the transmission lines, several changes in wildlife productivity would persist beyond the life of the line. Ecological relationships between predators and prey and those between competing species can be thrown out of balance. Disrupting such a fragile balance can set into motion a synergistic cycle of effects, making the return to original conditions a time-consuming and perhaps impossible process. Continued human access disturbs most wildlife.

Some effects of vegetation removal and disturbance could persist longer than the projected life of the transmission line. Certain weedy species are inevitably introduced. This can lead to long term, perhaps permanent alterations in the community composition. Even if the facilities are eventually removed, a return to former conditions would take decades.

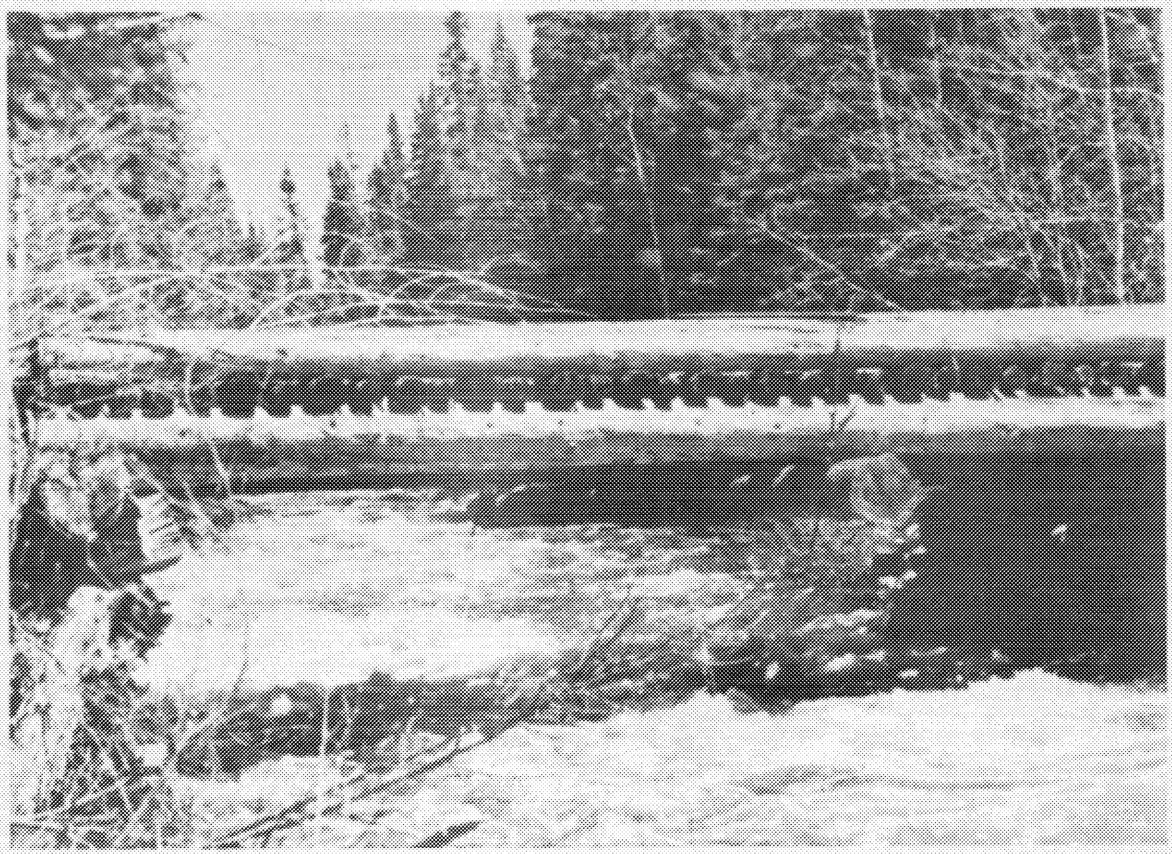
Soils disturbed and eroded by the short-term use of the powerline would result in minor long-term losses in productivity, but most of the impacts would diminish shortly after the project is completed.

The loss of approximately 278 miles of trout stream habitat would reduce by approximately 8% the total stream mileage available above the proposed project dam. The majority of the flora and fauna of this habitat type would be lost to the area and replaced by other forms. The availability of streams for the production of brook trout would be reduced.

Effects of short-term air quality impacts would result in no appreciable reduction in long-term air quality. Microclimatic changes along cleared rights-of-way would gradually diminish in the unlikely event that the facilities should be decommissioned and removed.

In general, there would be a reduction in the long-term productivity of the proposed project area and its associated transmission facilities. This would be in part the result of the conversion of a terrestrial ecosystem to an aquatic ecosystem and in part to the change in habitat structure for the area along the transmission lines and the flood plain.

This is contrasted to the short-term uses of electrical power production, flood control, redevelopment and recreation.



SECTION 8

IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

8.00 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irreversible commitments of resources are resource commitments that, once initiated, would continue after the life of the project. Irretrievable resources are those that are expended or permanently lost through the proposed action.

The implementation of the proposed project would result in the irreversible and irretrievable loss of all those resources identified within the impoundment area and some of those found along the proposed transmission route. Included would be the loss of approximately 75 miles of private logging roads, 81,946 acres of timberland, 80,455 acres of terrestrial habitat inundated and an additional 6030 acres modified. These acreages include 36,893 acres of deer wintering habitat. Approximately 278 miles of free flowing streams and rivers would be committed to destruction. Thirty lakes and ponds would be lost along with the unique recreation resources of the upper St. John River.

The conversion of terrestrial habitat to aquatic habitat would be an irreversible commitment of terrestrial resources. This conversion would commit to loss 42 of 74 existing campsites, 50% of the deer herd and the annual net growth of 25,825 to 34,525 cords of wood. Also committed would be the private forestry management plans and their investments into those plans.

The erosion or displacement of topsoil at the various construction sites is considered an irreversible resource loss.

Visual resources would be irreversibly altered by the proposed action. Construction of the facilities would physically alter the landscape. These alterations would remain for an indefinite period of time should the structures be removed at a later date.

Undiscovered archaeological resources could be accidentally disturbed during construction of the dams and transmission facilities, and perhaps suffer irreversible damage due to the disruption of stratigraphy. Similarly, access into previously inaccessible areas could lead to pothunting and vandalism of both known and undiscovered sites. This type of activity would render them useless as a resource.

Habitats with significant potential for harboring rare or sensitive plants could be irretrievably altered by construction activities and subsequent microclimatic changes.

The present social and economic structure of the area would be irreversibly altered. It would be replaced in part by a different set of values and standards.

Materials required for the construction of the proposed project would constitute an irreversible commitment of those resources identified in Section 1.00 of this impact statement. Materials used in the construction of the transmission towers and lines could be irretrievably committed to transmission use. However, such equipment is either reclaimed for use on other transmission facilities or recycled. In addition to these resources, manpower (approximately 13 million man-hours) and fuel (1.2 million barrels) would be irretrievably committed to the project. Of the 705.3 million dollars required to construct the proposed project, 11.5 million dollars would be irretrievably committed.

SECTION 9

COORDINATION

9.00 COORDINATION

9.01 General

Coordination between the New England Division of the Corps of Engineers and concerned Federal, State and local agencies has been continuous and extensive since environmental studies commenced in 1975. In addition to coordination with public agencies, coordination has been carried on with various private organizations and individuals.

A compilation of the coordination documents is contained in Appendix J (CE, 1977) and the supplement to Appendix J (CE, 1978). These appendices include U.S. Fish and Wildlife Coordination Act documents, Rare and Endangered Species Act, Section 7 Coordination documents, Cultural Resource Coordination correspondence, Corps of Engineers sponsored public workshop reports and summary of Corps action taken in response to those workshops.

The Department of Energy also conducted public informational meetings in various cities and towns in northern New England which would be included in the transmission corridor study region.

Contacts by the various environmental contractors are shown in the technical reports published as appendices (DOE, 1978).

9.02 Federal Agencies

Close coordination has been maintained with the U.S. Fish and Wildlife Service since 1975. Scopes of services for aquatic and terrestrial ecosystems were reviewed and commented upon by them and adjusted when necessary to reflect those comments. A combined U.S. Fish and Wildlife Service, State of Maine and Corps of Engineers Raptor Survey was conducted. Further surveys performed on an inter-agency basis have been funded by the Corps. Coordination and consultation pertaining to rare and endangered species has been conducted with the U.S. Fish and Wildlife Service. Other Federal agencies involved in the organization of this report are the Department of Health, Education and Welfare (Public Health Service), Department of the Interior (Office of the Secretary, Northeast Region, National Park Service, Southeastern Power Administration, Bonneville Power Administration), Federal Power Commission, Bureau of Outdoor Recreation, Department of Agriculture (Forest Service, Soil Conservation Service), U.S. Attorney's Office (Bangor, ME), U.S. Geological Survey (Concord, NH), U.S.D.A. Forest Experiment Station, University of Maine, and the U.S.D.A. (White Mountain National Forest), New Hampshire.

9.03 State Agencies

Coordination has been carried out through the Office of State Planning, which was designated by the Governor as the State liaison for the proposed Dickey-Lincoln Hydro-electric project. Close coordination has been carried out with the Department of Inland Fisheries and Wildlife and they have provided valuable advice, assistance and data. State agencies which have had a role in the coordination and preparation of the Environmental Impact Statement are the Department of Agriculture, Department of Conservation (Bureau of Parks and Recreation and the Bureau of Geology), Department of Transportation and the State Historic Preservation Commission, in addition to various forestry, fisheries and conservation agencies in the states of Maine, New Hampshire, and Vermont.

9.04 Organized Groups, Professional Associations, Universities, Local Communities and Individual Private Citizens

Since preconstruction planning was resumed in the Fall of 1974, intensive efforts have been extended to bring private-sector interests actively into the planning process. These efforts have resulted in a broadened base of public understanding of complex technical issues and a greater insight into the attitudes of the public on the part of government personnel and elected officials.

9.04.1 Public Information

Twenty-five news releases were prepared and disseminated to local, regional and national media describing the scope and status of planning activities. Three editions of a project "news letter" have been published and circulated to a mailing list of 2,000, principally in the State of Maine. The staff has conducted 53 briefings. Written comments have been received, reviewed and acknowledged from 252 individuals. To date, in excess of 350 routine information requests have been processed.

To stimulate public discussion and improve understanding of the project, a comprehensive Fact Sheet has been issued and revised periodically. A public information brochure was also published for use in connection with public meetings.

9.04.2 Citizens' Committee

In February 1976, Governor Longley appointed a citizens' impact committee comprised of ten Maine residents to serve as an independent fact-finding body and to provide a linkage between the State and Federal governments and the public at large. The Committee's advisory report was submitted to the Governor in December 1977 indicating six members opposed to implementation of the project and four in favor. Summary reports of regular meetings and open comment sessions sponsored by the committee are contained in Appendix J.

9.04.3 Workshops

Three hundred organizations were contacted in the course of organizing a series of workshops for an indepth discussion and review of study reports prior to publication of the draft. In accordance with the preferences expressed by these organizations, 14 workshops were scheduled. The workshops attracted 135 participants - 76 individuals - representing 45 Maine-based organizations. Discussion leaders and reporters were trained and assigned by the University of Maine, Orono. Summary reports were prepared and are contained in Appendix J.

9.04.4 Public Meetings

Following publication of the DEIS, six public meetings were conducted at four New England locations. The purpose of the meetings was to disseminate information and receive comments. The public meetings were conducted during the official review period prescribed by the National Environmental Policy Act of 1969 so that citizens who so desired had the option of presenting their formal comments in an open session. Transcripts of the public meetings have been prepared and made available for public inspection at various locations and at the Library of Congress.

9.04.5 Transmission

The U.S. Department of Energy (DOE), formerly the U.S. Department of the Interior, maintained close consultation, coordination and public involvement with public and private agencies on a day-to-day basis throughout the development of a scope of work for conducting various studies of transmission facilities.

Three sets of public information meetings were conducted to solicit public views and comments about various routes and corridors under consideration. The most recent round of eight public meetings provided a forum for comment by individuals living and working in proximity to the preferred corridor and by public officials in states through which transmission lines would pass.

To broaden the base of discussion, Corps of Engineers personnel were present at DOE's public meetings and the latter's representatives were present at the Corps' public involvement functions. The Corps also extended the period for formal comment on the project DEIS to coincide with official review of the transmission DEIS so that the impacts could be considered on an overall basis.

9.04.6 Marketing

In preparing a preliminary economic feasibility study to determine the allocation and distribution of power produced by the project, representatives of the government marketing agency, the Southeastern Power Administration, acting for the U.S. Department of Energy, worked closely with the region's utility systems. SEPA representatives briefed Governor Longley's citizens' committee and attended each of the Corps' public meetings.

9.05 Canada

Informal meetings between various Canadian scientists and Corps personnel were held to keep them informed about our studies. Study reports and the Draft EIS were furnished to applicable Canadian agencies. Formal negotiations through the State Department are not expected to resume until after circulation of the Final EIS and a decision to proceed with project implementation is reasonably firm.

9.06 Comments on the Project

Through December of 1976, out of a total of 203 comments on the project itself, 159 were against, 44 were for the project. (This tally does not include those comments on the draft EIS). Volume II contains the comments and responses for the draft environmental impact statements submitted for review by the Corps of Engineers and the Department of Energy. Volume III contains reproductions of those comments on the drafts.

INFORMATION SUPPLEMENT

On 22 September 1978 the New England Division forwarded a proposed Final Environmental Impact Statement (FEIS) for the Dickey-Lincoln School Lakes Project to the Office of the Chief of Engineers (OCE). In the review by OCE of the proposed FEIS it was concluded that the lack of a recommended fish and wildlife mitigation plan in the proposed FEIS was a major deficiency in light of the President's water policy message of 6 June 1978, and subsequent directives from the President, dated 12 July 1978. Therefore, as directed by OCE, the proposed FEIS is being issued as a revised draft EIS for public review and comment.

Concurrently, the New England Division, in coordination with the U.S. Fish and Wildlife Service will commence active development of a fish and wildlife mitigation report which will be fully described and evaluated in the Final EIS. Mitigation planning will be the priority item in FY 1979.

Funds for mitigation planning were previously requested by the Division Engineer in the FY 1979 budget request and have been approved. The final recommended mitigation plan will consider, but not be limited to the two mitigation proposals which are contained in the supplements to Appendices F and J of this revised draft EIS. As indicated on page 1 - 35 of this document, the essence of the remaining work is to assess and evaluate mitigation strategies, and recommend one to Congress for authorization and implementation.

Development of a fish and wildlife mitigation plan which will be recommended for implementation involves the following basic steps:

1. Review, update and analyze the preliminary U.S. Fish and Wildlife mitigation recommendation (4 Jan. 1978, 15 June 1978, and 26 July 1978), the mitigation proposal prepared for the Corps contained in the revised draft EIS and a search and review of any other mitigation proposals which are relevant and instructive.

2. Formulation of a comprehensive mitigation plan which covers fisheries, wildlife and endangered species mitigation. This step would involve:

(a) determination of the location and availability of appropriate land cover types necessary to meet the land requirements of the proposed mitigation plan;

(b) determination of the location and level of fisheries mitigation that should be planned;

(c) development of the U.S. Fish and Wildlife Services, June 1978, Biological Opinion on the endangered Furbish Lousewort into a workable recovery and mitigation plan.

3. Assessment of the full range of impacts created by implementing the recommended mitigation plan. This would involve both in-house and contractual studies and would result in a companion report ultimately to be integrated into the environmental impact statement.

Throughout the entire process there will be a concerted effort to keep the public and all parties affected informed through a positive public involvement program. This program will include workshops and public meetings limited initially to mitigation planning and impact assessment and evaluation of the mitigation plan. A decision on the need for additional public meetings to review the totality of impacts including mitigation will be made at a later date and will be based on the severity of the additional impacts associated with the recommended mitigation plan.

Reviewers are advised that the proposed FEIS and its appendices have not been physically changed by OCE but are simply reclassified as the REVISED DRAFT EIS. Consequently, any responses to comments in Volume 2 regarding mitigation of adverse impacts to fish and wildlife should be disregarded. It is also noted that the REVISED DRAFT EIS does not contain the Final Federal Water Pollution Control Act Section "404" Evaluation.

The Final EIS to be developed will consider all comments to the REVISED DRAFT EIS and will include a recommended plan for fish and wildlife mitigation and incorporate the analysis of associated impacts. The Final "404" evaluation will accompany the Final EIS.