STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

and
STATE OF MAINE
LAND USE PLANNING COMMISSION

IN THE MATTER OF

CENTRAL MAINE POWER COMPANY
Application for Site Location of Development Act permit
and Natural Resources Protection Act permit
for the New England Clean Energy Connect ("NECEC")

L-27625-26- A-N
L-27625-TB-B-N
L-27625-2C-C-N
L-27625-VP-D-N
L-27625-IW-E-N

SITE LAW CERTIFICATION SLC-9

REBUTTAL TESTIMONY OF GROUP 1 WITNESS JANET MCMAHON
March 22, 2019

I present this testimony in rebuttal to pre-filed testimony presented by CMP witnesses Mark Goodwin, Gerry Mirabile, and Lauren Johnston (by adoption of Goodwin testimony). For my rebuttal testimony I hereby adopt the rebuttal testimony of Dr. David Publicover, dated March 18, 2019, which focuses on the issue of habitat fragmentation, and add the following points.

The testimony of Goodwin, Mirabile and Johnston, like CMP's application in general, fails to acknowledge or address significant regional ecological values that would be negatively impacted by Segment 1. These include:

1) The impact of the transmission corridor on the critical regional ecological linkage that connects the forests of New Hampshire, Maine, New Brunswick and the Gaspé. The yellow arrows in the attached exhibit (Group 1 Rebuttal Exhibit 1) shows the major movement corridors as well as landscapes with the highest resilience (darker green) as determined by The Nature Conservancy.

2) The transmission corridor will reduce landscape resilience and permeability which are intrinsically tied to the number of barriers and degree of fragmentation within a landscape. [redacted]

[redacted] The corridor crosses what is currently part of the most resilient region remaining in the eastern United States (Group 1 Rebuttal Exhibit 1).

3) The transmission corridor will divide many large forest habitat blocks into smaller blocks, which will compromise habitat for forest specialist species and those that require forest interior habitat. From a regional perspective, intact forest habitat blocks are what set this region apart from southern Maine. Large connected blocks are what makes a landscape resilient, connected, and habitable by forest specialist species. The witnesses do not address or quantify permanent fragmentation of large forest habitat blocks.

4) Negative edge effects are not discussed at all and there are many, such as incursion of invasives, changes in microclimate and species composition in adjacent forest, impacts on stream catchment areas and more. The use of the term "soft edge" is misleading when, in fact, the 106 miles of edge along Segment 1 is considered permanent high contrast edge. The witnesses focus on the values of early successional scrub-shrub habitat, when early successional habitat is abundant in the region. The witnesses do not distinguish between the *number* of species the corridor might support and the *kinds* of plants and animals that may be displaced when forest habitat is permanently converted to scrub-shrub and meadow habitat (such as many mosses and spring ephemeral wildflowers, ovenbirds, wood thrushes and a host of other species).

Date: March 22, 2019

By: Janet McMahon
Janet McMahon

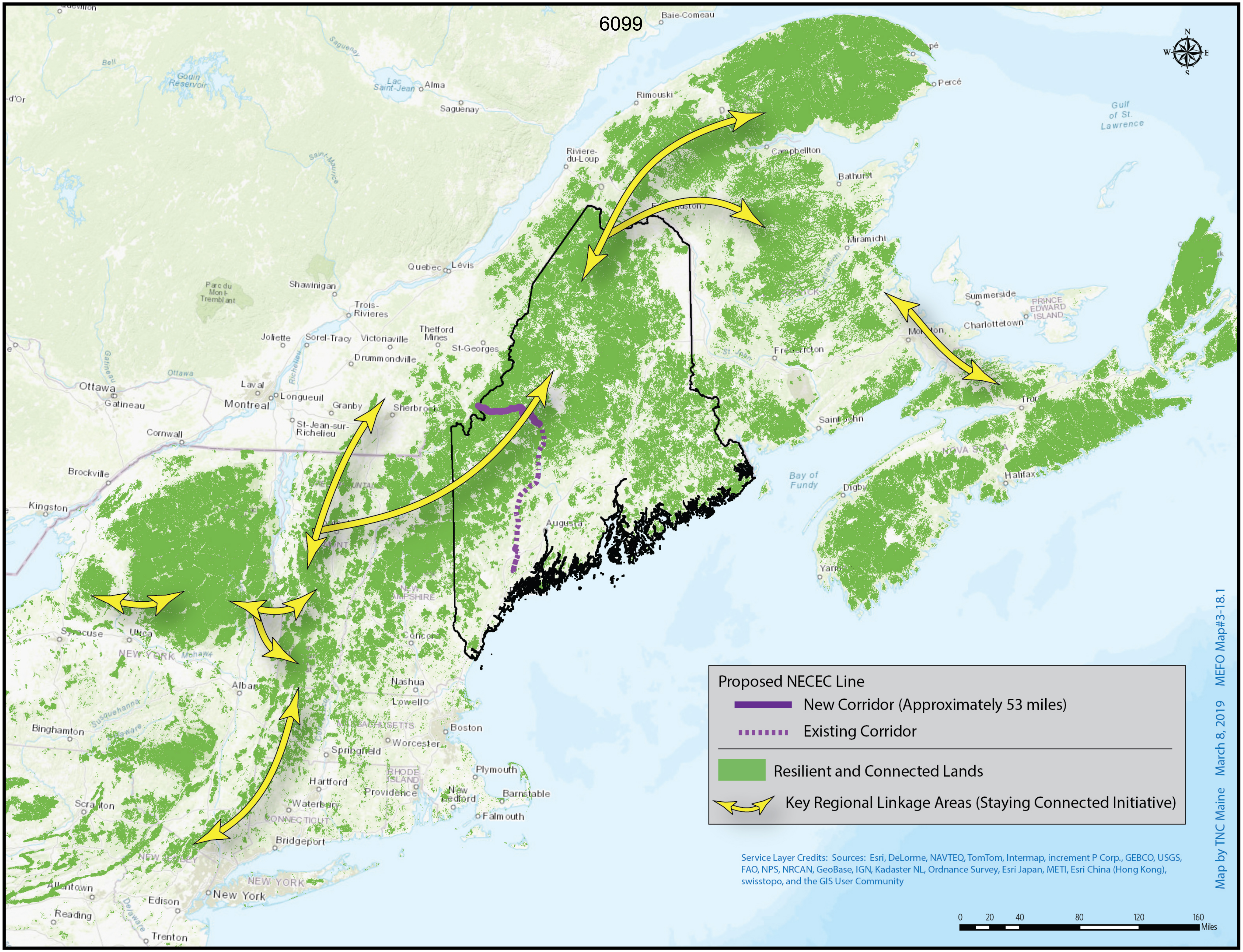
Date: March 22, 2019

The above-named Janet McMahon did personally appear before me and made oath as to the truth of the foregoing rebuttal testimony.

Colleen G Jones
Notary Public

My Commission Expires Dec 16, 2019

COLLEEN G. JONES
Notary Public • State Of Maine
My Commission Expires Dec. 16, 2019



Proposed NECEC Line
New Corridor (Approximately 53 miles)
Existing Corridor
Resilient and Connected Lands
Key Regional Linkage Areas (Staying Connected Initiative)
Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community
Map by TNC Maine March 8, 2019 MEFO Map#3-18.1
0 20 40 80 120 160 Miles
Baie-Comeau
Rimouski
Percé
Gulf of St. Lawrence
Alma
Saguenay
Lac Saint-Jean
Gouin Reservoir
Riviere-du-Loup
Campbellton
Bathurst
Miramichi
Summerside
Charlottetown
PRINCE EDWARD ISLAND
Quebec
Lévis
Shawinigan
Trois-Rivieres
Joliette
Sorel-Tracy
Victoriaville
Thetford Mines
St-Georges
Drummondville
Ottawa
Gatineau
Laval
Montreal
Longueuil
Granby
St-Jean-sur-Richelieu
Cornwall
Brockville
Kingston
Fredericton
Saint John
Halifax
Digby
Bay of Fundy
Augusta
Syracuse
Utica
NEW YORK
Albany
Concord
Nashua
Lowell
Boston
Worcester
Springfield
Binghamton
Hartford
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New Bedford
Barnstable
Falmouth
Waterbury
Bridgeport
Scranton
Allentown
Edison
New York
Reading
Trenton

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THE STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

APPLICATION FOR SITE LOCATION OF DEVELOPMENT ACT PERMIT
AND NATURAL RESOURCES PROTECTION ACT PERMIT
FOR THE NEW ENGLAND CLEAN ENERGY CONNECT
FROM QUÉBEC-MAINE BORDER TO LEWISTON
AND RELATED NETWORK UPGRADES

PRE-FILED DIRECT TESTIMONY OF

ROGER MERCHANT

ON BEHALF OF INTERVENOR GROUPS 2 AND 10

FEBRUARY 28, 2019

Please state your name and business address.

Roger Merchant. 1018 Pushaw Road, Glenburn, Maine.

What is the name of your organization?

Roger Merchant, Place-Based Photography

What is your current position?

Photographer and Forestry Naturalist

What are your qualifications?

I am a Licensed Professional Forester ME #727. From 1965-1972 I managed forestry operations on a 100,000-acre working forest. I hold lifelong experience interpreting aerial photographs and am also a photographer and forest resource documentarian. I had a thirty-two-year career with the UMaine Cooperative Extension, now retired, with program specializations in: 1) forestry and woodlot management, 2) environmental and outdoor education, 3) small business and community development, 4) community-based natural resource and cultural heritage tourism.

What is the purpose of your testimony?

The purpose of my testimony is to present a clear picture of current forest conditions along the proposed power line between Coburn Mountain and the Quebec border, including the existence of pre-existing forest fragmentation, then highlighting evidence on selected, interpreted aerial photographs demonstrating how NECEC will increase fragmentation and edge effects deeper in the woods adjacent to the line.

Please state the introduction to your testimony.

This written testimony illustrates the impact the NECEC corridor will have on forested lands in the headwaters of the Upper Moose River between the Quebec border and Coburn Mtn. to the east. For the reader-viewer, interpreted aerial photographs of sections of this landscape provide visible evidence of: 1) the power line track, 2) the deeper edge effect of the corridor, 3) extent of headwater streams, 4) the mix of continuous forest cover and fragmented forest cover, and 5) the extent of permanent logging roads that will intersect the proposed corridor, contributing to increased fragmentation and habitat degradation.

My field knowledge as a forester from the Maine Woods began in 1965. Over half a century I've witnessed many changes in forestry and logging practice. For example, with the cessation of river drives in 1976, extensive networks of gravel roads now provide access and transportation. These permanent road and yard alterations mark the beginning of forest fragmentation, township by township. The NECEC corridor is simply the latest iteration of landscape fragmentation by infrastructure that will impact habitat conditions on and adjacent to the power line.

Please provide an overview of basic aspects of forest fragmentation.

Managed forests continually produce trees for forest products. Forest cover creates and sustains wildlife habitat while providing recreational opportunities, now and in the future.

Concerns about fragmentation are warranted. A de-forested power line corridor opens up the landscape, permanently. They require large scale, long-term use of herbicides, can lead to disruption of wildlife habitat and behavior, and compromise water quality for key cold-water species like Eastern brook trout. Fragmented landscapes can facilitate additional fragmentation from commercial development and expanded subdivision.

According to Michael Snyder, Forester and Commissioner of Vermont Department of Forests, Parks and Recreation, "forest fragmentation is the breaking of large, contiguous, forested areas into smaller pieces of forest; typically, these pieces are separated by roads, agriculture, utility corridors, subdivisions, or other human development."[1] (see Northern Woodlands, 2014)

Can you describe Maine's forest cover change?

Forest Cover Change 1942-2016: There was a time when continuous forest cover was the norm for conditions in the Maine Woods. Aerial photographs taken in 1942, compared to the same exact aerial view in 2016, reveal very different patterns in the forest over 74 years of forest change (The 1942-2016 Forest Project)[2]. What's abundant in the 1942 views is the presence of largely unbroken, continuous forest cover. And indeed, over the longer span of time-change, trees and forests continue to prevail. However, when contrasting the same aerial views, 1942 - 2016, very distinct patterns of open blocks, patches and strips characterize today's view of the forest. The extent of continuous forest cover in 2016 has been reduced by a larger, more extensive patchwork pattern from newer forest practices. This pattern reveals evidence of significant alteration and fragmentation of forest cover. Change is the one constant in life and this mirrors just as true for any forest. Further examples of 74 years of forest change can be found at The 1942-2016 Forest: (https://www.facebook.com/The-1942-2016-Forest). Accelerated Forest Cover Change 1989-1997: Fast forward from 1942 to the 1989 Maine Forest Practices Act (MFPA). Changes in forests, forestry practice and logging technology prompted concerns about the impact of clear cutting on forests and habitat. Questions emerged about the mandates of the 1989 MFPA and whether or not they were contributing to forest and habitat degradation. Research suggests these concerns were

[1] Hagan, John M. and Boone, Randall B. 1997. *Harvest Rate, Harvest Configuration and Forest Fragmentation,* Manomet Center for Conservation Sciences Rpt.#MCDCF-97001

[2] Merchant, Roger, ME LPF-727. 2016. *The 1942-2016 Forest Project,* A social media page developed to illustrate forest changes from 1942 to and 2016 within the entire Piscataquis Watershed. (https://www.facebook.com/The-1942-2016-Forest)

not superfluous. In 1997, the Manomet Center for Conservation Sciences conducted research on these effects from the allowances and restrictions dictated by the 1989 MFPA. They found that, *"a many-small-clearcut strategy, allowed more harvesting than a fewer-large-clearcut strategy, and that the many-small-clearcut strategy led to greater fragmentation*[3]*"*.

Can you describe the continuous forest cover and fragmented forest cover as it relates to NECEC in 2019?

Field observations from Coburn Mtn. to the Quebec border reveal a mix of largely coniferous, and a smaller portion of deciduous forests, each composed of regenerating, younger, and middle-aged stands. Older growth forests are rare. Robust regeneration involves both coniferous and deciduous species. NECEC's characterization of this landscape as simply "cutover land" diminishes the value of what actually grows there forest-wise; a robust, ever-changing, multiple-use, transitionally fragmented working forest, as well as associated fisheries and wildlife habitats, streams, lakes and wetlands.

When you look closely at the photographs attached with this testimony, you will see the patterns of small blocks, patches and strips that provide visible evidence of the extent of forest fragmentation concerns. The red dash-dot lines on each photograph, distinguishes areas of continuous forest cover, cut and uncut, from the visible patchwork areas of more fragmented forest cover.

Forest fragmentation from forest practices has a transitional life. For example, when a clear cut is made, that patch and its' edges are open and obvious. Over time, natural or artificial regeneration fills in the harvested space and edges, so the initial fragmentation

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[3] Hagan, John M. and Boone, Randall B. 1997. *Harvest Rate, Harvest Configuration and Forest Fragmentation,* Manomet Center for Conservation Sciences Rpt.#MCDCF-97001

and edge effects are somewhat mitigated, softened.

On the longer-term effects of this transitional fragmentation from newer forest practices, I think the jury is still out. In forest time, we haven't lived long enough in this new age to account for the long-term impacts.

Nevertheless, with respect to the distinction between continuous forest cover and more fragmented forest cover, the NECEC corridor will carve through equal portions of both types of forest cover. Fragmented forests occupy 40% of the landscape on and around the power line from Quebec to Coburn.

An argument made by proponents of NECEC is that this project will create no greater environmental impact than logging. They insist the power line will pass through "cut over" industrial forestland that has been actively logged for years, and so, what's the difference?

I argue there is a huge difference when you consider the area in question includes a significant portion (40%) of forest landscape and habitat that has been transitionally fragmented by block, patch and strip cuts. Factor in the extensive network of permanent gravel roads and yards, the second fragmentation; then factor in the third NECEC fragmentation, a permanent 150-foot-wide corridor with some 300 feet of effects deeper in the woods either side of the corridor, then you are looking at a landscape that is being subjected to three fragmentations.

Can you describe potential negative impacts of NECEC with regard to forest fragmentation?

The extent and negative impacts of forest fragmentation are well addressed in Maine Mountain Collaborative, Occasional Paper #2. "Research in Maine, the Northeast and around the word demonstrates unequivocally that fragmentation – whether permanent or temporary – degrades native terrestrial and aquatic ecosystems, and reduces biodiversity and regional connectivity over time and in a number of ways[4].

The NECEC corridor will expand deforestation and fragmentation from Quebec to Coburn Mtn. and south to Moxie. The 300-foot right of way holds great potential for future power line expansion to meet the growing needs of Massachusetts customers, the primary beneficiaries of this distributed power. In return, Maine is expected to shoulder and absorb all the costs - the impacts - of environmental degradation and destruction that will occur as a result of this project.

The NECEC proposal will permanently eliminate forest cover and habitat protections in the cleared corridor, and will significantly impact ecological and habitat conditions deeper within forests adjacent to both sides of the deforested power line corridor.

Fragmentation upon fragmentation seems an unwise course for sustaining forest diversity and habitat continuity.

With two fragmentation strikes already in place, the third NECEC pitch will be a huge contributor to forest and habitat fragmentation. I believe it is deserving of that third classic call, “three strikes - NECEC is out”.

Can you provide representative examples that illustrate NECEC’s environmental impacts?

I would like to present Aerial Photography Documentation. Three sections of the NECEC Project were selected to illustrate and highlight existing forest and environmental conditions on the ground, between Coburn Mtn. and the Quebec border to the west, as well as to reveal environmental impacts including NECEC.

The photos were extracted from Goggle Earth and edited to enhance and make clear the variety of forest conditions, including permanent gravel roads and streams. The three

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[4] McMahon, Janet M.S. 2018. *The Environmental Consequences of Forest Fragmentation in the Western Maine Mountains,* Maine Mountain Collaborative, Occasional Paper #2.

sections selected are approximately 6 miles x 3 miles on each photo. The map scale is in the lower right corner. Interpreted examples for you to investigate further are:

Spencer Road - Coburn Mountain

Rock Pond - The Notch -Tumbledown

Lowelltown - Beattie

A close examination of the aerial photographs will show you field details relevant to this testimony. The photos were converted to black and white to highlight forest conditions. Dark areas are coniferous forest; light areas are deciduous forest. When you look closely at the photographs you will note areas that show patterns of blocks, patches, and strips. This is pre-existing fragmented forest cover. Other areas of forest don't have this patch-work pattern. Those are areas of continuous forest cover. The red dash-dot lines on each photo delineate fragmented forest cover, from continuous forest cover.

Additional details were interpreted from the photos and USGS maps, and highlighted in color to illustrate additional features relevant to the impacts of NECEC. The cold-water streams network is shown in blue, but do not include all the first order streams crucial to brook trout habitat. The network of permanent, gravel roads is shown in brown on each photo.

Last and not least, with the most significant environmental footprint, is the proposed power line, the light-yellow swath across each photo. The approximate 750-foot width on the photos, accounts for the 150-foot wide cleared corridor, plus, an additional 600 feet of environmental impact deeper within the forests adjacent to either side of the power line (300 on each side).

Each photograph is presented with two views: 1) a small image and interpretive notes on the front side, 2) a larger view of the same image on the back side to help you better see the field details addressed on the front.

As was said by a tree sage, a forest picture is worth a thousand words. So, follow the stream and roads and the yellow swath in each photo to discover where they all intersect, and particularly the environmental fragmentation that will occur between the Quebec Border and Coburn Mtn.-Route 201 as a result of NECEC.

Seeing is believing...

First, I present Exhibit 1 - CMP-HQ-NECEC Project - Forest Fragmentation: Spencer Road Pond-Coburn Mtn-Rte 201[5]. Here, you can see continuous forest cover is evident across the heights of Coburn Mt. just above the southern border in the center (S) of this aerial photograph. Dark, unbroken coniferous forests dominate the heights of Coburn, which runs SW – NE to Route 201 at Parlin Pond.

The balance of the landscape in this photo is fragmented forest; blocks, patches, strips. The red dash-dot lines delineate fragmented from continuous forest cover types. With the exception of wetlands and partial cuts next to Spencer Road, which runs E-W from Parlin Pond, the bulk of the remaining landscape is fragmented forest cover. From an eagle's eye view, continuous forest cover occupies 40% of this area, fragmented forests 60%.

Blue indicates the network of streams; brown shows the network of permanent gravel roads. The light-yellow swath (750') across this photo is the track of the proposed power line. This width accounts for the 150-foot cleared corridor, plus 300 feet either side of the corridor to account for ecological impacts deeper within the forests adjacent to both side of the corridor... The larger photo on the next page shows the fragmentation, upon pre-existing fragmentation that will result from NECEC[6].

Next, I direct you to MP/HQ/NECEC Proposal - Forest Fragmentation: North of

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[5] Merchant Aerial Photography Documentation Exhibit 1

[6] Merchant Aerial Photography Documentation Exhibit 2

Tumbledown-The Notch-Rock Pond[7]. This view of NECEC impact reveals the extent of visible, pre-existing forest fragmentation north and west of Tumbledown Mtn. Highly visible blocks, patches and strips characterize fragmented forests in this rugged area. Continuous forest cover of conifers occupies the north slopes of Tumbledown Mtn., extending across the bottom of the photo to Rock Pond.

Continuous forest cover extends from No.6 Mtn. in the NE corner, SW to the Spencer Road west of The Notch *(green circle).* Forest conditions west of the Notch show the extent of forest fragmentation as well as where the power line swath will further fragment the fragmented.

Additionally, the proximity of the power line to the blue-ribbon trout waters of Rock Pond and tributaries is evident in the SE corner of this aerial photograph.

A crow's eye view of this landscape estimates that continuous forest cover, uncut and partially cut, occupies about 60% of this rugged, scenic landscape. Heavily fragmented forests and habitat occupy about 40%. Beyond the edges of the corridor, this permanent fragmentation will impact forest and habitat conditions 300 feet deeper into the woods either side of the cleared zone[8].

Now look at CMP/HQ/NECEC Proposal - Forest Fragmentation – Lowelltown/Beattie Pond[9]. This image shows forest patterns where NECEC, *yellow swath,* will cross the Quebec-Maine border west of Lowelltown on the CMQ RR, a mile north of Beattie Pond. The dark areas are coniferous forests; lighter are deciduous forests. Blue shows the network of headwater streams, but not all of the first-order streams crucial for Eastern brook trout.

Red dot-dash lines delineate two primary types of forest conditions: 1) uncut and

[7] Merchant Aerial Photography Documentation Exhibit 3
[8] Merchant Aerial Photography Documentation Exhibit 4
[9] Merchant Aerial Photography Documentation Exhibit 5

partially cut areas that retain continuous forest cover, 2) fragmented forests - visible blocks, patches, strips of harvested forestland. Permanent logging roads are shown in brown.

The small summit, left of center, covered in dark conifers shows continuous forest cover on top and all around the summit, southwest of the power line. The forests in the NE and SW corners, and along the south border are areas of continuous forest cover.

Note where NECEC intersects streams and roads, as well as where it will cause further fragmentation of forest habitat disruption in a landscape that is highly fragmented.

A crows-eye cruise of this landscape estimates that fragmented forests occupy 45% of the area; continuous forest cover occupies 55%. The fragmenting corridor will impact forest and habitat conditions, 300 feet deeper into the woods either side of the cleared zone[10].

Can you provide representative examples from this region to illustrate forest fragmentation and continuous forests?

Yes. I would also like to submit a series of supplemental photographs from the Quebec Border to Coburn Mountain-Route 201. These photos cover the entire landscape between the Quebec and Coburn Mtn. They show only the yellow-black power line track, providing an open-view of the percent forest fragmentation versus continuous.

<u>Quebec border - Beattie Pond</u>: Extensive fragmentation from strips, blocks, patches occupies 45% of this landscape; the other 55% is in continuous forest cover, coniferous and deciduous[11].

<u>Wing Pond - S. Branch Moose River – West of Tumbledown</u>: Fragmented block and strip cuts account for 45% of forest cover, the other 55% is in partial and uncut

[10] Merchant Aerial Photography Documentation Exhibit 6
[11] Merchant supplemental photo 1

continuous forest cover[12].

Tumbledown Mtn. to Rock Pond: Strips, patches, light and heavily cut blocks account for approximately 40% of this landscape, 60% is continuous cover, high elevation conifers[13].

Rock Pond – Whipple Pond: A mix of blocks, patches, and continuous forest cover, conifers (dark green) plus some deciduous (light gray). Fragmented forests occupy 35% of this landscape, continuous forest cover, 65%[14].

Moore Pond: The intensity of fragmented blocks is less in this section of forested landscape, 70% continuous forest cover, mostly conifers. Extensive permanent road and yard patterns, plus blocks and patches occupy 30%. Extensive wetland and stream at the top (N)[15].

Coburn Mtn North: Block cuts are older and not as obvious, however extensive large angular patches east of Gracie Pond suggest large, older patch cuts. Factor in extensive roads and yards, this area is 60% fragmented, 40% continuous forest cover including extensive conifers on Coburn Mtn. to the south (S)[16].

Coburn Mtn South: SE of Coburn Mtn, upper left corner, extensive block cutting in this view shows extensive fragmentation 75%; continuous forest cover 25%[17].

What is your conclusion about impacts of this project?

The NECEC Project will significantly add to the base of forest fragmentation that already exists in the working forests between Coburn and Quebec, and it will further degrade habitat, fisheries and wildlife, in and around the power line corridor. I can speak to general impacts from my knowledge and literature review, but I am not a wildlife or

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[12] Merchant supplemental photo 2
[13] Merchant supplemental photo 3
[14] Merchant supplemental photo 4
[15] Merchant supplemental photo 5
[16] Merchant supplemental photo 6
[17] Merchant supplemental photo 7

fisheries biologist and cannot speak in great detail to those aspects.

From my interactions with others concerning NECEC, I sense and hear concerns about how NECEC will impact forests and habitats.

It is my view that NECEC is intent upon minimizing their impact overall and everywhere, and, minimizing and dismissing any concerns about the environment in the public arena. They are on mitigation buy-out-frenzy to assure their will prevails, regardless. Economic benefit to NECEC- CMP-HQ-AVENGRID is the sole driving force in this project, and their intent to mitigate all environmental costs, their tool of choice you could say.

Does this conclude your testimony?

Yes.

COMMENTS ON NON-HEARING TOPICS

Protect the Scenic and Environmental Values Of the Upper Moose River Basin and Kennebec River

I walked into the Maine Woods as a forester and photographer in 1965 and spent the next fifty years exploring, appreciating and learning from these woods. Maine natural resources contribute to our rural quality of life, our tourism and forest economies. CMP's proposal to construct a new 53-mile corridor through the woods of the Upper Moose River Basin will degrade these treasured natural assets. And NECEC expects us to absorb and carry the costs of the visual and environmental impacts that will result from the CMP-HQ project, and all in the name of delivering power to Massachusetts?

I recall a conversation with colleague Peter Lammert, prior to his retirement from the Maine Forest Service. I asked him what he thought would be the biggest threat to the future of the Maine Woods. His response, "more and more powerlines." They carve up the woods, fragment and degrade forest cover and wildlife habitat, and they erode, if not destroy, the value of magnificent, scenic viewsheds.

During a 32-year career with UMaine Cooperative Extension, I participated in county and regional nature-based tourism initiatives. Maine's forested landscape, full of beautiful streams and lakes, rivers and mountains, are natural golden eggs that draw people to our remote regions and rural communities. Tourists are not coming here to experience power line views and other industrial scale intrusions.

CMP's line will chop up a vast and beautiful forest landscape, eroding and degrading remote scenic viewsheds like Attean View, Coburn and Sally Mountains, Greenlaw Cliffs, The

Notch, No. 5 and Tumbledown, all in the Upper Moose River Basin. There will be similar impacts at the Kennebec Gorge and Lake Moxie, adjacent to Bald Mountain and the Appalachian Trail. My photographs of this unique, scenic region speak to the permanent fragmentation this proposal will have on the forest environment and natural beauty found here. All of this loss will be in the service of CMP feeding Massachusetts hunger for more Hydro Quebec (HQ) generated power.

[redacted]

[redacted] We already have enough power lines and wind farms intruding into this beautiful landscape. With the CMP line paving the way, what's next? Yet another expanded power line in the accommodating 300-foot right of way? A re-located East-West Highway? A pipeline? The industrial scale incubation possibilities are endless once the first cut is made. The impacts from these possibilities will destroy the value of the natural golden eggs that nourish our rural quality of life, valued irreplaceable assets that feed our rural forestry, tourism, small business base.

To do nothing to protect these natural assets and our legacy of community-based forestry, tourism and environmental protection is to let CMP-HQ "pave over paradise and put up the power line parking lot" in one of the last unique, remote scenic viewsheds in Maine, the Upper Moose River Basin.

I offer this protective possibility; that the communities, counties, tribal nations, and people associated with the Moosehead Region and the Upper Moose River Basin get together to talk about landscape protection for these woods. Seek agreements and draft documents that officially declare and circumscribe Moosehead and the Upper Moose River Basin as a "Power Transmission-Wind Farm-E.W. Highway Free Zone in Maine."

[redacted]

We need to protect the values provided by our environment that support our rural communities, values that feed small businesses, forestry and tourism, and the unbroken scenic beauty that feeds our hearts and souls on a quiet night, by the edge of a lake, on a starlit night.

NOTE: When folks in Massachusetts look at rural Maine, they think there's nothing there. Looking at a NASA nighttime photo of New England, they see the familiar brightness of Boston and Portland. Further north, beyond Route 2 and the "Airline", they see that big black hole on the nighttime map of Maine, leading them to think there's nothing there, so what's the big deal anyway about running a power line through these dark empty woods?

I created this collection of photographs from the Upper Moose River Basin to illustrate the fact that this unique forested environment is Not Empty! It's full and rich in brook trout, wild flowing streams and rivers, wandering souls, magnificent wildlife and scenery to be seen from 'viewshed peaks' like Coburn, Sally, No.5, Tumbledown. Our rural communities as well as visitors, treasure these beautiful natural assets.

This rich natural legacy is in need of our care, attention, management and protection.

Enjoy the following scenic views that include power line tracks.....

Looking west from the base of Tumbledown Mtn. the power line will carve through the gap north of Peaked Mountain on the left. Further west the line drops down and crosses the South Branch Moose River. Trending across the south flank of Moose Mountain in the far distance, the line will turn northwest to the Quebec border near Lowelltown.

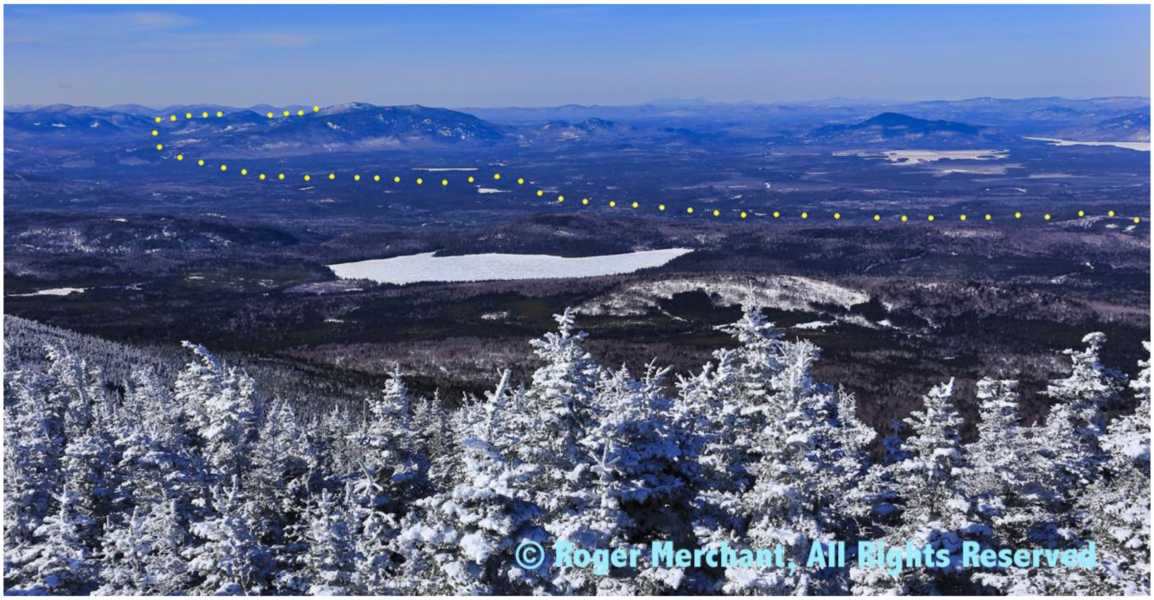
Headwaters throughout the Upper Moose River Basin contain cold-water habitat like this that is crucial for the survival of wild Eastern brook trout. Well shaded from direct sunlight, this brook protects cool waters that support the excellent blue ribbon trout fishing found thought the Upper Moose River Basin.

Concerns about NECEC opening up the forested landscape and warming headwaters, is well illustrated in this photo of a first-order-stream in the Upper Moose River Basin. Forest cover is absent, exposing the water to excessive heat, which in turn feeds and heats downstream cold water habitat. Applications of herbicides will be required to maintain a tree and brush-free power line. How will this impact water quality for brook trout, wildlife and humans? Many first order steams like this are found along the proposed power line pathway through the Upper Moose River Basin.

In between No.5 and Tumbledown Mtn. arises the dramatic remote viewpoint provided by Greenlaw Cliffs, which forms The Notch, just west of Rock Pond. The power line will skirt the north side of Rock Pond, then come straight up through The Notch destroying the rugged beauty found in this unique wild and scenic location.

Coburn Mtn. rises in the eastern end of the Upper Moose River Basin, just west of Rt. 201. In the 1960’s, Enchanted Mountain Ski Area, over on the east slope was a wild, downhill ski for the brave and intrepid. Coburn provides for an amazing viewshed, 360 degrees around, when you stand on the summit lookout platform any season of the year.

The viewshed west of Coburn Mtn. looks up the Moose River Basin. Grace Pond and Camps are on the left. Beyond those waters in the distance rises No.5 Mtn. Just to the left of the magnificent view provided by No.5, you see where the NECEC line will come through The Notch. Attean and Sally Mountains rise above Attean and Wood Ponds in the center background. To the far right is lofty Boundary Bald Mtn. The yellow track of the power line carves across this extensive wild, working forest landscape and will be visible from both Sally and Attean Mtns.



Grace Pond with No.5 behind and Attean on the right, the power line track and impact will be even more noticeable in winter. Higher elevation viewpoints such as Coburn, Sally, No.5, Tumbledown, Peaked, Moose, Van Dyke, provide a more complete picture of the power lines visual impact. CMP photo-simulations tend to focus on lower elevation lakeside views that minimize the visual impact. These photos speak directly to the viewshed impacts that the NECEC project will have from multiple viewpoints within the Upper Moose River Basin.

The Coburn East viewshed looks down to Johnson Mountain, wrapped on the west and then the south by NECEC. The power line then extends further south, reaching across the Kennebec Gorge to Moxie Pond, and The Mosquito in the far, far distance. The power line to the left (north) will cross the northeast shoulder of Coburn Mtn, about a half-mile beyond the two unique, high elevation water bodies, Mountain Ponds.

The Attean viewshed looking south from Sally Mtn. begs the classic questions for each and all of us... What is beauty, only in the eye of one beholder? Or is it within the many eyes and hearts that have walked out into the woods, and up a mountaintop to see and touch, to feel and experience what the joy of beauty is about in this spectacular place?

Beauty is boundless; it is not beholding to any boundary lines, public or private, town or county, yours or mine. Here it is limitless to the horizon, and beyond. A power line carved across a real and scenic landscape like this is in fact, the ultimate and deadly antitheses of Beauty.

Indeed, carving up and fragmenting this incredible scenic landscape while compromising wildlife and wild brook trout habitat and further fragmenting the forest environment is the desired, coveted NECEC-CMP-HQ plan going forward with lavish rewards for all... What a loss of treasured natural values and diminishment of human experience that define the incredible outdoors and sense of place for people near and far, who wander the Upper Moose River Basin.

Will the CMP power line through the Upper Moose River Basin come to pass to feed energy hungry Massachusetts's consumers?

Will we protect and govern what is unique about our particular, shared sense of place, or will we simply be left out, deselected and sold to industrial development by the higher bidders in the global market?

SIGNATURE

Roger Merchant
1018 Pushaw Road
Glenburn, Maine
04401

Heidi Sanders
Notary Public, State of Maine
My Commission Expires October 17, 2023

2/22/19

Roger Merchant
1018 Pushaw Road
Glenburn, Maine 04401
207-343-0969 (c)
rogmerch@gmail.com

A. Vision: My enduring purpose is to contribute to change through initiatives that provide balanced attention to the social, economic and environmental aspects of sustainable development. These practices guide my work:

1. Community-based assessment of issues, opportunities and solutions
2. Facilitating open inquiry through an interactive process
3. Disseminating fact-finding relevant to local issues and decision making
4. Strengthening leadership through the development process

B. Professional Credentials:
2012-Present: Place-Based Photographer, Rural Community Development Resource
Since retiring I devote time and energy to photography, community development and service to the environment.

1980-2012: Associate Extension Professor, Natural Resources and Community Development, University of Maine Cooperative Extension.
My Extension portfolio includes woodland stewardship, environmental and outdoor education, 4H adventure programs, rural development and tourism. Signature programs include: Taking Care of Your Forest, Penobscot Riverkeepers, Life Jackets, Piscataquis County Economic Development Council and Tourism Task Force.

The last decade of my extension career focused on natural resource and cultural heritage tourism in the Maine Highlands. I taught Community-based Tourism Planning at UMaine - College of Forest Resources.

1976-79: Central Kentucky Re-ED, Lexington, Kentucky.
In a community social worker role I coordinated services for children with learning and behavioral challenges. I facilitated parenting and human relations trainings, and provided backcountry leadership for outdoor programs.

1974-76: Comprehensive Care Center, Winchester, Kentucky
As youth services social worker, I provided counseling for children and adolescents, conducted human relations workshops and supervised graduate social work students.

1965-72: Forester: Dead River Company, Bangor, Maine
I administered all aspects of forestry on a 100,000 acre working forest: timber inventory, mapping, road layout, and implementation of forest practices. Ongoing harvest supervision provided quality assurance for sustainable forestry. I conducted field projects in forest nutrients, timber marketing, natural areas protection, and served as forestry liaison to a tribal project involving the Passamaquoddy's, Dead River Timberlands, and UMaine Cooperative Extension.

C. Educational Credentials:

- 1974 - Masters of Social Work, West Virginia University
- 1965 - Bachelors of Science in Forestry, University of Maine
- 1963 - AAS Forestry, Paul Smith's College, New York

D. Other Credentials:

- *2010-2012 Instructor:* PRT470-Community Tourism Planning included field-based community service learning as an integral part of the requirements for this advanced undergraduate course.
- *2002 Sabbatical:* Community Approaches to Rural Tourism Development in Forested Regions East of the Mississippi.
- *1994 International Exchange:* Quebec Labrador Foundation - Landscape Stewardship Exchange in the Southern Czech Republic
- *1988 Sabbatical:* Adventure Education Strategies for Positive Youth Development via Outward Bound and Experiential Education Programs.

C. Public Service:

- Co-Founder - Piscataquis Tourism Task Force
- Co-Founder - Piscataquis County Economic Development Council
- Founder and Former Board President: Life Jackets and Penobscot Riverkeepers 2000
- Board Membership: Hirundo Wildlife Refuge, Maine Highlands Corporation, Penquis Child Abuse Prevention Council, Maine Appalachian Trail Club
- Volunteer Trail Maintainer since 1980, Maine Appalachian Trail Club
- Maine Forest Service - Fire Lookout Volunteer, Burnt Mtn., Baxter State Park

D. Professional Affiliations and Awards:

- Maine Licensed Professional Forester #727
- NAI Interpretive Guide 2009-2019
- Registered Maine Guide 1993-2002
- Facilitator Project Learning Tree

- 2007 King Cummings Regional Leadership Award
- 2005 Pete Myrick-Piscataquis County Community Service Award

E. Other Talents:

- I authored collections of short stories in *Trust* and *The Maine Forest* for Literacy Volunteers of America in 1982. At my grandchildren's prompting, I am currently working on a collection of stories from my life. As a musician for 45 years, I occasionally gig at open-mic with the story-songs of our times.

- I'm an accomplished photographer of forestry, nature, rural life, railroads and the Maine Woods. I am currently developing a new website, My Encyclopedia of Place-based Photography

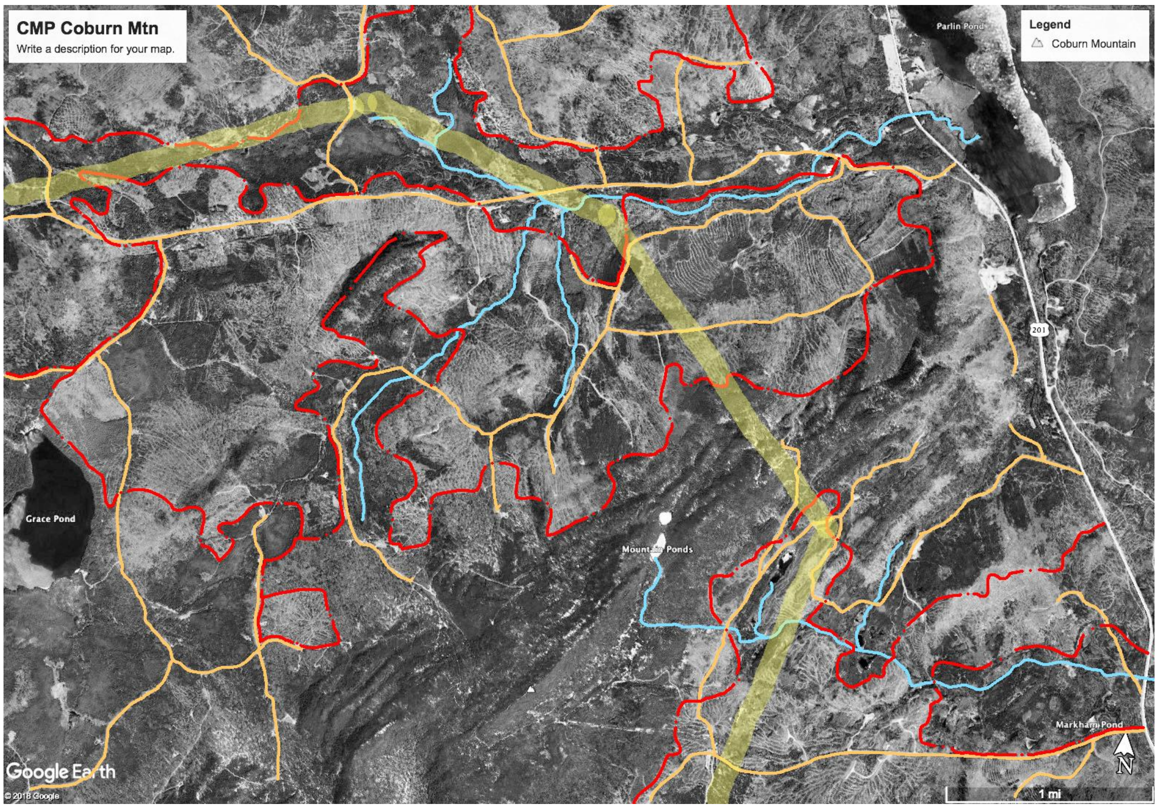
- I enjoy the outdoors, backpacking, lake and river canoeing. I'm a seasoned wilderness canoe paddler. Notable on my water travels are the Allagash, Dead River and Penobscot in Maine, the Spanish and Mississagi Rivers in Ontario.

CMP-HQ-NECEC Project

Forest Fragmentation: Spencer Road Pond-Coburn Mtn-Rte 201

Merchant Aerial Photography Documentation Exhibit 1

NW NE



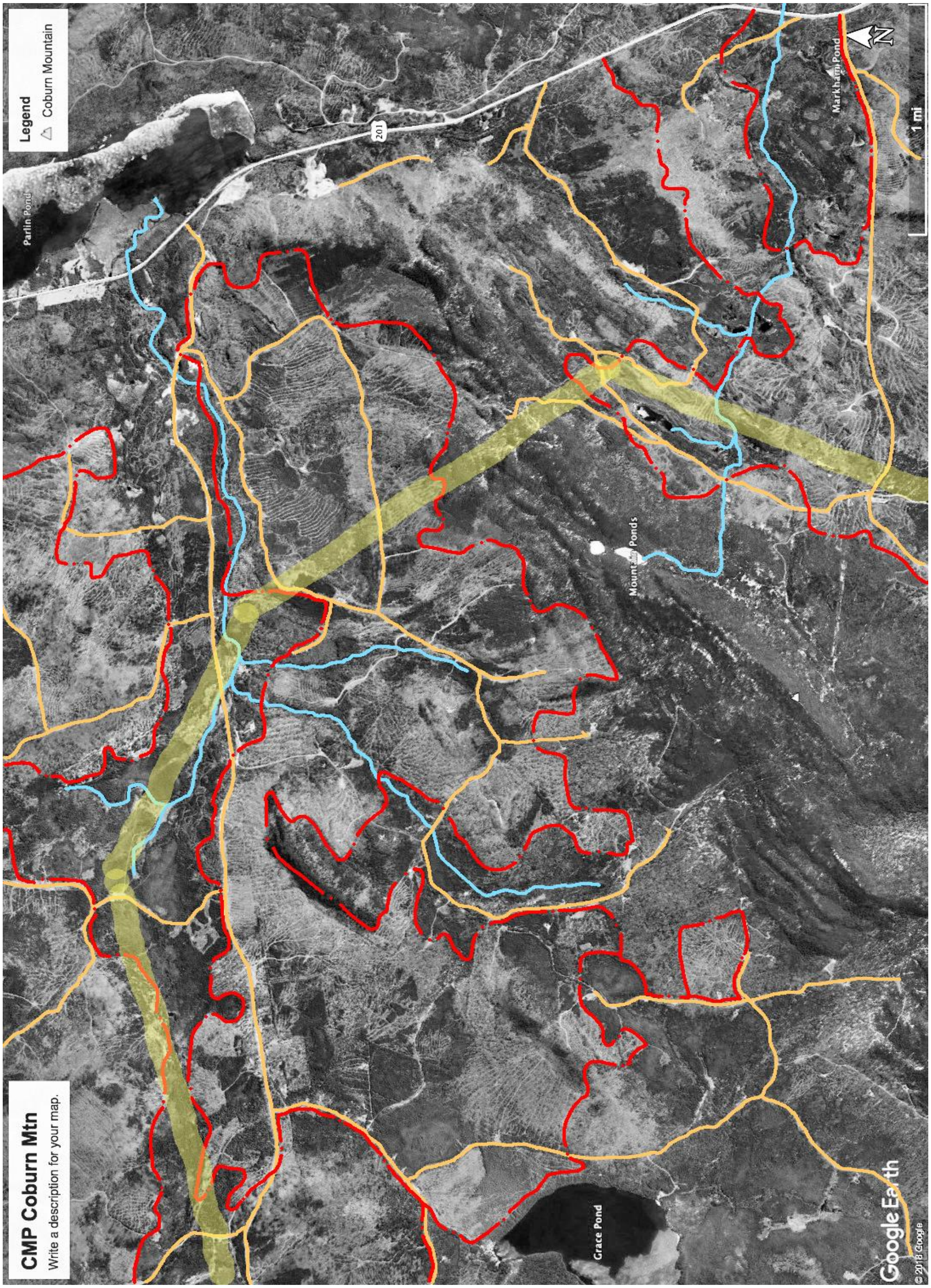
SW S SE

Continuous forest cover is evident across the heights of Coburn Mt. just above the southern border in the center (S) of this aerial photograph. Dark, unbroken coniferous forests dominate the heights of Coburn, which runs SW – NE to Route 201 at Parlin Pond.

The balance of the landscape in this photo is fragmented forest; blocks, patches, strips. The red dash-dot lines delineate fragmented from continuous forest cover types. With the exception of wetlands and partial cuts next to Spencer Road, which runs E-W from Parlin Pond, the bulk of the remaining landscape is fragmented forest cover. From an eagles eye view, continuous forest cover occupies 40% of this area, fragmented forests 60%.

Blue indicates the network of streams; brown shows the network of permanent gravel roads. The light yellow swath (750') across this photo is the track of the proposed power line. This width accounts for the 150 foot cleared corridor, plus 300 feet either side of the corridor to account for ecological impacts deeper within the forests adjacent to both side of the corridor... The larger photo on the next page shows the fragmentation, upon pre-existing fragmentation that will result from NECEC.

Merchant Aerial Photography Documentation Exhibit 2

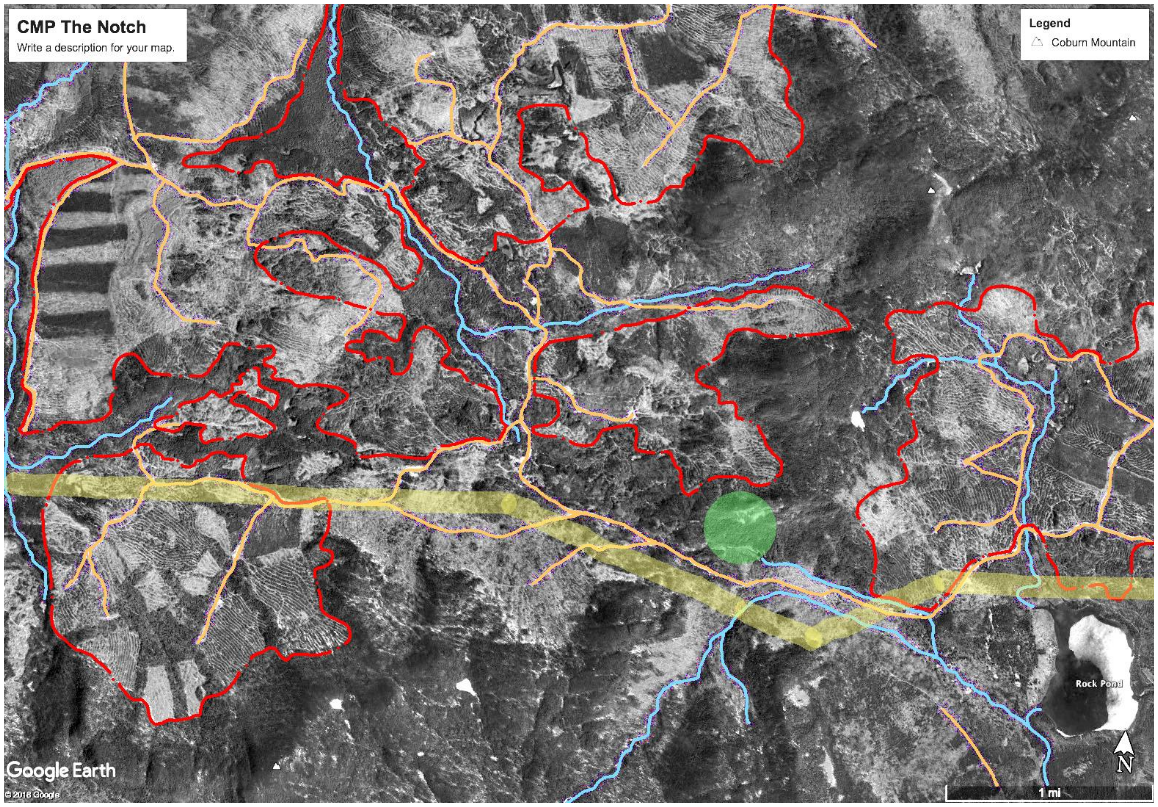


MP/HQ/NECEC Proposal

Forest Fragmentation: North of Tumbledown-The Notch-Rock Pond

Merchant Aerial Photography Documentation Exhibit 3

NW NE



SW SE

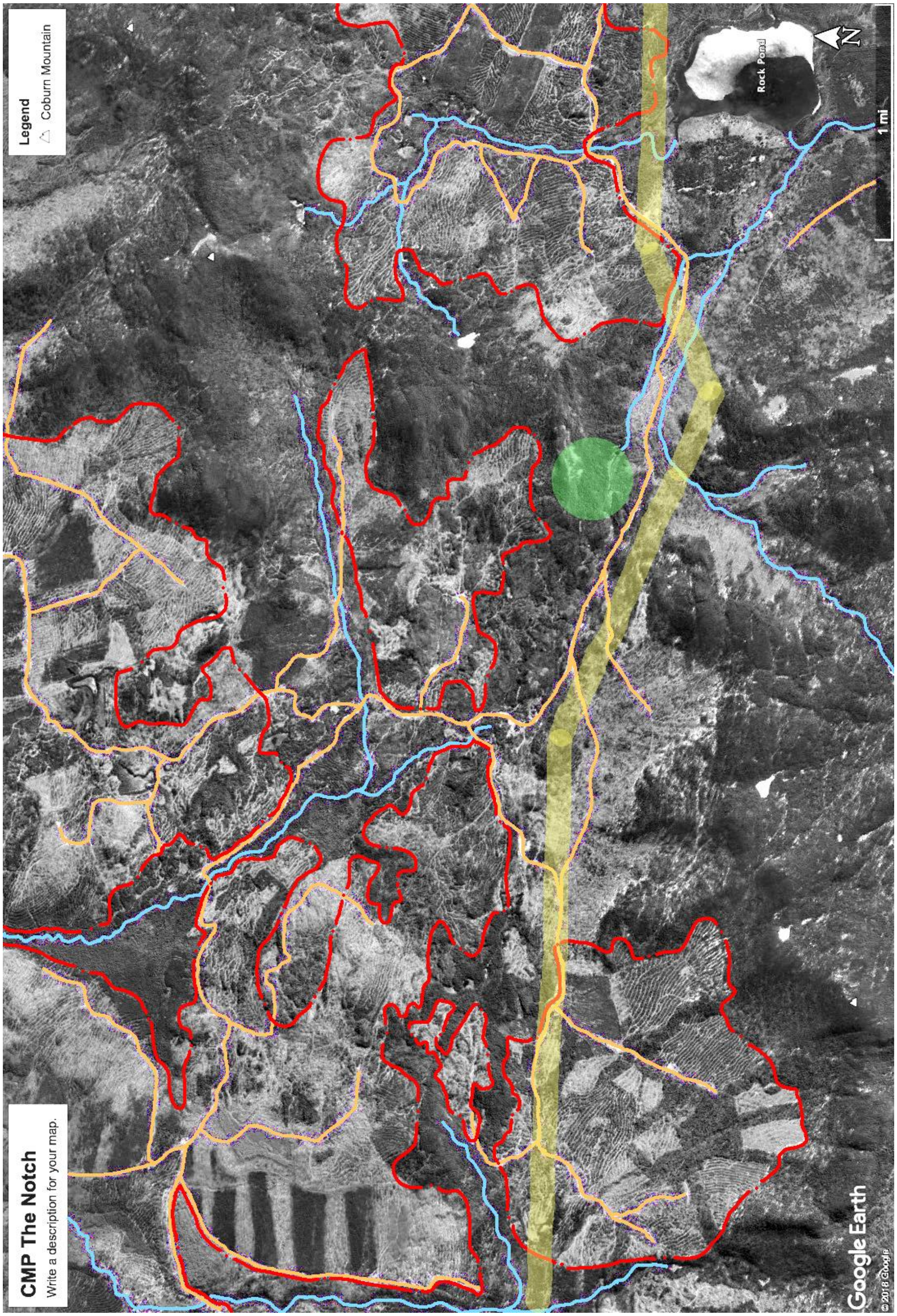
This view of NECEC impact reveals the extent of visible, pre-existing forest fragmentation north and west of Tumbledown Mtn. Highly visible blocks, patches and strips characterize fragmented forests in this rugged area. Continuous forest cover of conifers occupies the north slopes of Tumbledown Mtn., extending across the bottom of the photo to Rock Pond.

Continuous forest cover extends from No.6 Mtn. in the NE corner, SW to the Spencer Road west of The Notch *(green circle)*. Forest conditions west of the Notch show the extent of forest fragmentation as well as where the power line swath will further fragment the fragmented.

Additionally, the proximity of the power line to the blue ribbon trout waters of Rock Pond and tributaries is evident in the SE corner of this aerial photograph.

A crow's eye view of this landscape estimates that continuous forest cover, uncut and partially cut, occupies about 60% of this rugged, scenic landscape. Heavily fragmented forests and habitat occupy about 40%. Beyond the edges of the corridor, this permanent fragmentation will impact forest and habitat conditions 300 feet deeper into the woods either side of the cleared zone.

Merchant Aerial Photography Documentation Exhibit 4

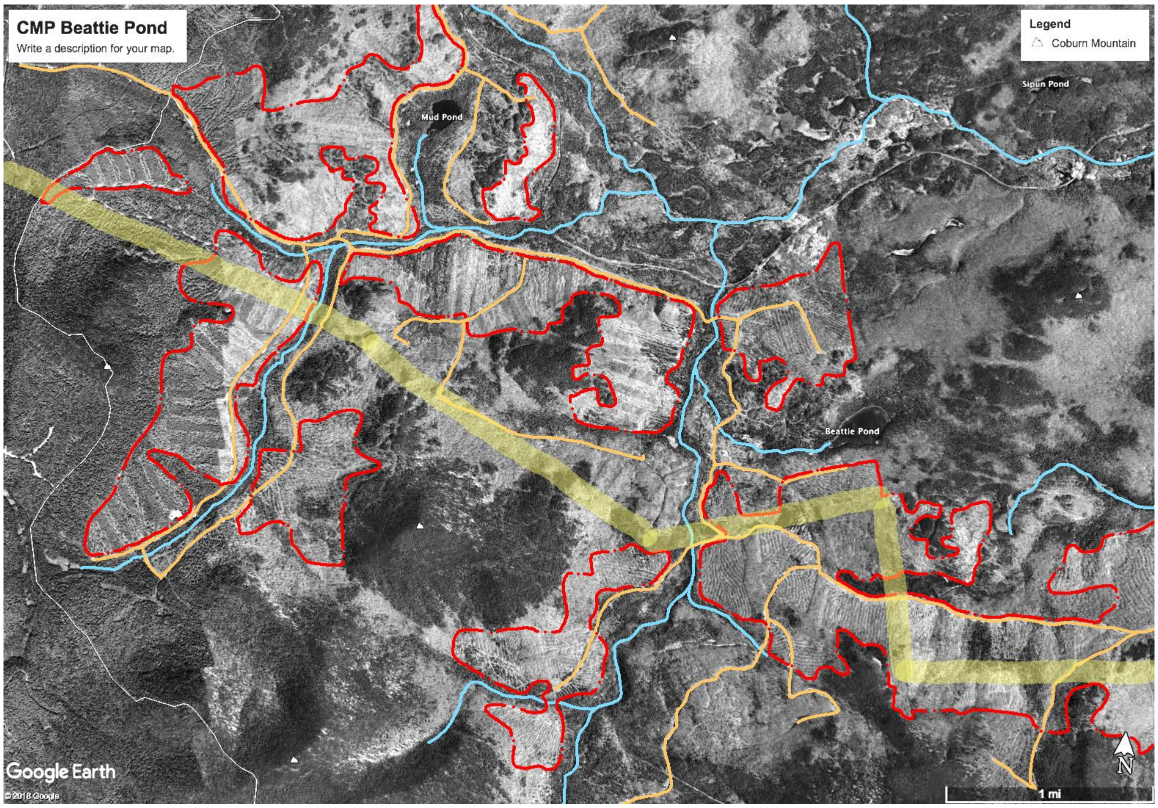


CMP/HQ/NECEC Proposal

Forest Fragmentation – Lowelltown/Beattie Pond

Merchant Aerial Photography Documentation Exhibit 5

NW NE



SW SE

This image shows forest patterns where NECEC, *yellow swath,* will cross the Quebec-Maine border west of Lowelltown on the CMQ RR, a mile north of Beattie Pond. The dark areas are coniferous forests; lighter are deciduous forests. Blue shows the network of headwater streams, but not all of the first-order streams crucial for Eastern brook trout.

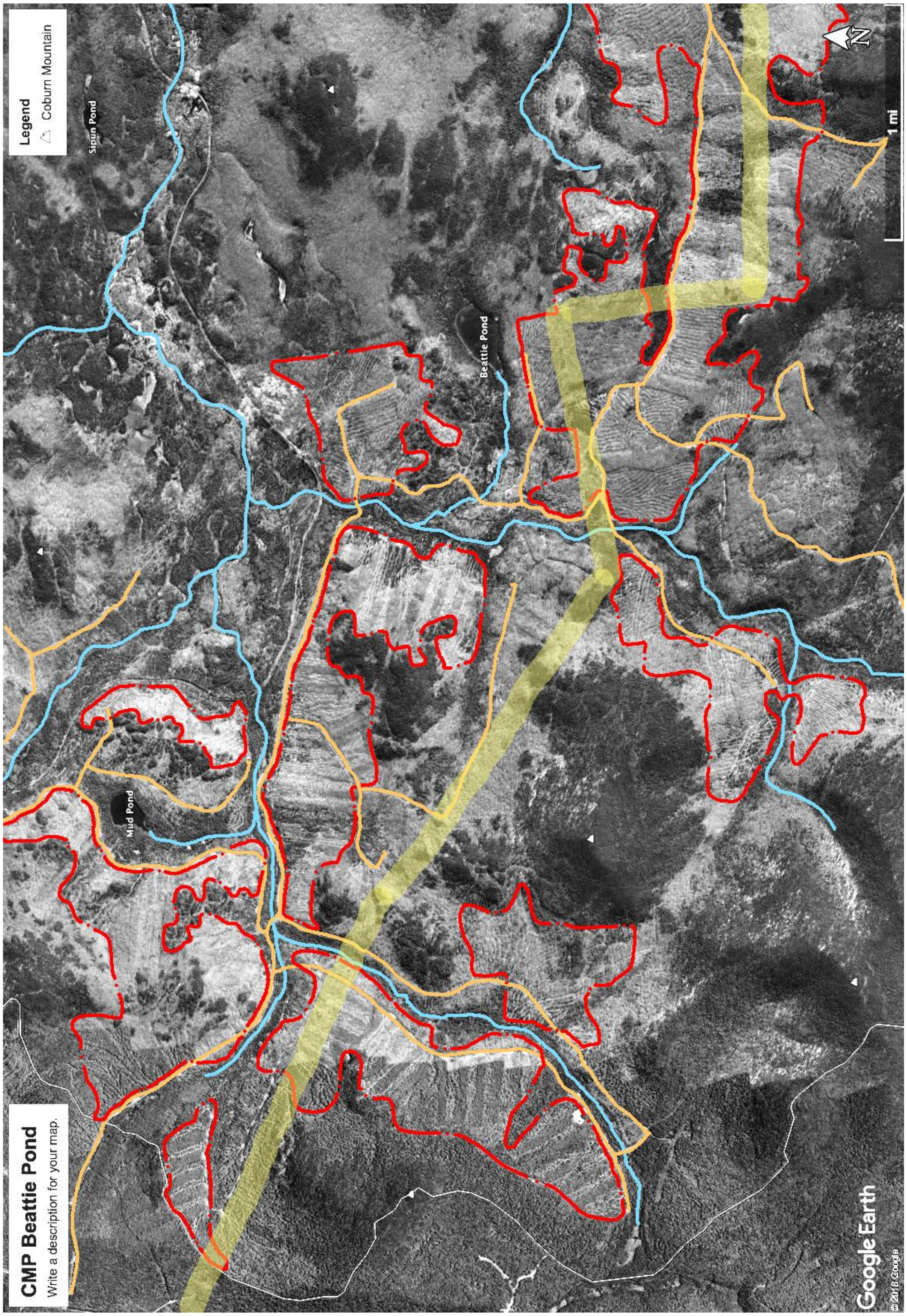
Red dot-dash lines delineate two primary types of forest conditions: 1) uncut and partially cut areas that retain continuous forest cover, 2) fragmented forests - visible blocks, patches, strips of harvested forestland. Permanent logging roads are show in brown

The small summit, left of center, covered in dark conifers shows continuous forest cover on top and all around the summit, southwest of the power line. The forests in the NE and SW corners, and along the south border are areas of continuous forest cover.

Note where NECEC intersects streams and roads, as well as where it will cause further fragmentation of forest habitat disruption in a landscape that is highly fragmented.

A crows-eye cruise of this landscape estimates that fragmented forests occupy 45% of the area; continuous forest cover occupies 55%. The fragmenting corridor will impact forest and habitat conditions, 300 feet deeper into the woods either side of the cleared zone.

Merchant Aerial Photography Documentation Exhibit 6



Supplemental Photographs: Quebec Border to Coburn Mountain-Route 201... These photos cover the entire landscape between the Quebec and Coburn Mtn. They show only the yellow-black power line track, providing an open-view of the % forest fragmentation vs. continuous.

<u>Quebec border - Beattie Pond</u>: Extensive fragmentation from strips, blocks, patches occupies 45% of this landscape; the other 55% is in continuous forest cover, coniferous and deciduous.

SUPPLEMENTAL PHOTO 1

<u>Wing Pond - S.Branch Moose River – West of Tumbledown</u>: Fragmented block and strip cuts account for 45% of forest cover, the other 55% is in partial and uncut continuous forest cover.

SUPPLEMENTAL PHOTO 2

<u>Tumbledown Mtn. to Rock Pond:</u> Strips, patches, light and heavily cut blocks account for approximately 40% of this landscape, 60% is continuous cover, high elevation conifers.

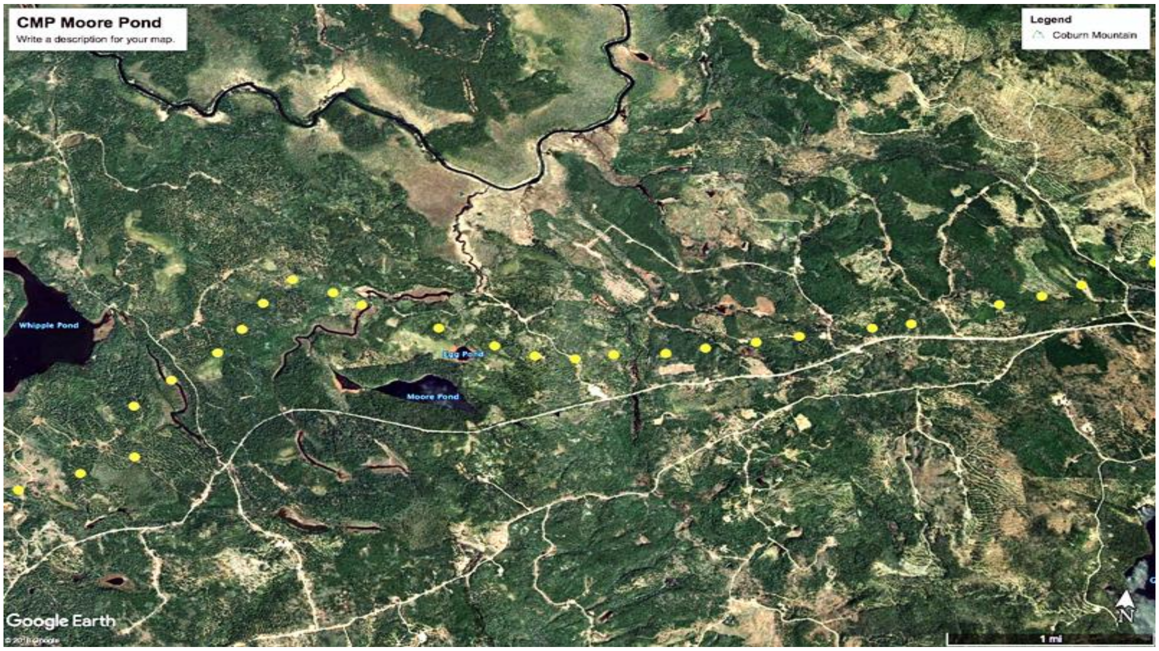
SUPPLEMENTAL PHOTO 3

Rock Pond – Whipple Pond: A mix of blocks, patches, and continuous forest cover, conifers (dark green) plus some deciduous (light gray). Fragmented forests occupy 35% of this landscape, continuous forest cover, 65%.

SUPPLEMENTAL PHOTO 4

Moore Pond: The intensity of fragmented blocks is less in this section of forested landscape, 70% continuous forest cover, mostly conifers. Extensive permanent road and yard patterns, plus blocks and patches occupy 30%. Extensive wetland and stream at the top (N).

SUPPLEMENTAL PHOTO 5

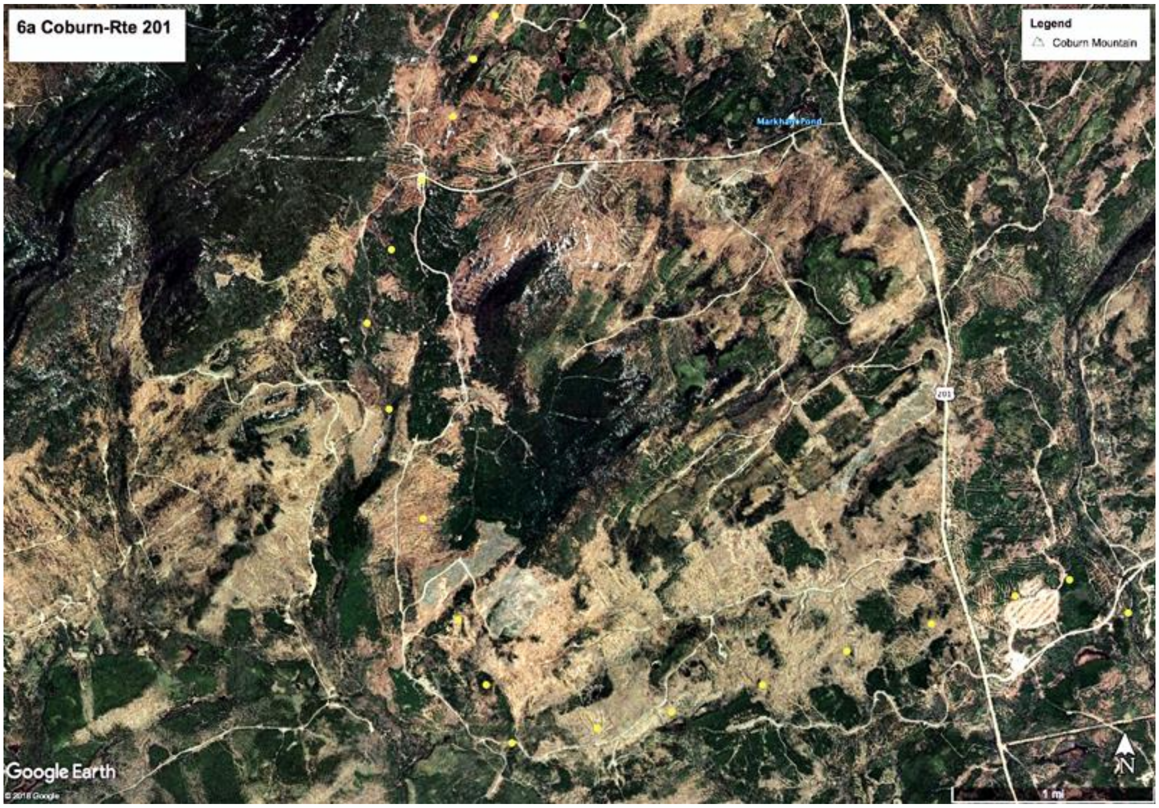


Coburn Mtn North: Block cuts are older and not as obvious, however extensive large angular patches east of Gracie Pond suggest large, older patch cuts. Factor in extensive roads and yards, this area is 60% fragmented, 40% continuous forest cover including extensive conifers on Coburn Mtn. to the south (S).

SUPPLEMENTAL PHOTO 6

Coburn Mtn South: SE of Coburn Mtn, upper left corner, extensive block cutting in this view shows extensive fragmentation 75%; continuous forest cover 25%.

SUPPLEMENTAL PHOTO 7



THE STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

APPLICATION FOR SITE LOCATION OF DEVELOPMENT ACT PERMIT
AND NATURAL RESOURCES PROTECTION ACT PERMIT
FOR THE NEW ENGLAND CLEAN ENERGY CONNECT
FROM QUÉBEC-MAINE BORDER TO LEWISTON
AND RELATED NETWORK UPGRADES

PRE-FILED DIRECT TESTIMONY OF

GARNETT ROBINSON

ON BEHALF OF INTERVENOR GROUPS 2 AND 10

FEBRUARY 28, 2019

Q. Please state your name and address.

My name is Garnett Robinson, and my mailing address is PO Box 82, Dixmont, Maine 04932. I own property located at 331 Moosehead Trail, Dixmont, ME 04932.

Q. What are your general qualifications?

I am a Certified Maine Assessor and Licensed Appraiser and have performed over 20 municipal equalizations/revaluations in Maine (two more in progress). I am the current Assessor or Assessors' Agent for 14 communities (and will be adding two more this spring). I have a Bachelor’s Degree in Land Use Planning. I have taught numerous appraisal and assessing courses including being a long time instructor for Maine Revenue Services Property Tax school. I have performed numerous complicated appraisals of industrial, commercial and residential properties including large and small hydro-electric dams, sawmills, processing plants, railroads, hospitals, etc. I have testified before numerous appellate Boards and Courts regarding valuation issues including the Maine State Board of Property Review. I also am on the Dixmont Planning Board, have served as past president of the Central Maine Assessor's Organization (CMAAO) and have a background in forestry and mapping, having worked as a Forest Ranger and photogrammetrist with my company still performing many municipal tax mapping projects. Please see my resume attached as Exhibit 1.

Q: What is the purpose of your testimony?

The purpose of my testimony is to assess the proposed transmission line project with respect to value considerations (economic impacts and benefits) of scenic character, existing uses, and alternatives along with compensation and mitigation of impacts.

Q. What have you reviewed to prepare this testimony?

I reviewed the following:

1. NECEC Site Location of Development Application, NECEC Natural Resources Protection Act Application and all NECEC associated available documents, maps, photos located on the Maine Department of Environmental Protection Website.

2. Applicable statutes and regulations: 38 M.R.S. § 480-D(1), 38 M.R.S. § 480-D(3), DEP Rules Chapters 315 and 375 § 14; 38 M.R.S. §§480-D(1)&(3), 38 M.R.S. § 484(3), DEP Rules Chapters 310, 315 and 335; 38 M.R.S. § 480-D, 38 M.R.S. § 484(3), DEP Rules Chapters 310 and 375 § 15.

3. Detailed Portions of the NECEC Site Location of Development Application dated October 2, 2017, including:

    a. Section 1.0; Development Description

    b. Section 3.0; Financial Capacity

    c. Section 6.0; Visual Quality And Scenic Character

4. General Questions for CMP dated December 11, 2017

5. Supreme Judicial Court of Maine ruling: *Francis Small Heritage Trust, Inc. v. Town of Limington et al.*, 2014 ME 102, 98 A.3d 1012, 2014 Me. LEXIS 110, 2014 WL 3867782 (Me. Supreme Ct. May 15, 2014).

6. Various online websites and programs such as Google Earth, Newspaper Articles and Selectman e-mails.

7. Williams, Juliet & Thompson, Don (2018, June 9). *Report: Downed power lines sparked deadly California fires*. Retrieved from https://phys.org/news/2018-06-downed-power-lines-deadly-california.html

[redacted]

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Q. Did you review the VIA CMP filed in the context of your assessment of the Scenic/Aesthetic Uses and the Alternatives Analysis?

Yes. Often overlooked in a project of this type are the regional and statewide value of views. It is obvious CMP attempted to identify view sheds affected in Section 6.0 of the Application but it failed to assess the context of regional views left untouched by man-made structures. Driving North from Bingham all the way to the overlook in Jackman, there are only two major road systems that run West through Eustis and towards Canada: the Lower Enchanted Road and the

Upper Enchanted or Spencer Road. If you drive the Lower Enchanted Road the 15 miles or so to Grand Falls, you will find multiple locations where the windmills of the Kibby Project are visible, especially at night with rows of blinking red lights. Similarly, the Attean Overlook has views of Canadian windmills across its whole Northern exposure. Upper Enchanted Road is the only large road system running West toward the Canadian Border between Bingham and Jackman with unimpacted scenic vistas. The same is true for the Kennebec River. The gorge running from Harris Dam to the Gauging Station in the West Forks is the only long section of river not crossed or having roads run parallel with powerlines, houses, etc. all the way to the Atlantic Ocean. Clearly there are many more views impacted by the chosen route than the alternative route which would have turned South from Beattie onto the Gold Brook Road which is only about 3 miles to the start of the Kibby Wind Project. It is clear from site visit photos that water crossings/views were the major impacts reviewed as there do not appear to be any photos of prominent scenic vistas seen often as you travel in on the Spencer Road. It is also clear that there are no visitor surveys or economic impact studies conducted for loss of jobs and associated income for tourist industry jobs heavily dependent on these views. Section 6.1.7 Working population, the applicant clearly has huge errors here as it states the working population includes people who are employed throughout Northern Maine in commercial timber harvesting then goes on to describe central and Southern Maine. The primary employer(s) in the area of the 53.5 mile new section of line in segment 1 is the tourism industry with hundreds of jobs guiding through rafting, hunting, fishing, "recreation biking, hunting, snowmobiling, 4 wheeling, antler hunting, canoeing, moose tours, etc.", and at sporting camps, time shares, photographers, snowmobile/4 wheeler rentals, restaurant employees, small stores, campgrounds, etc. which are all largely dependent on tourists visiting with views being a significant part of the reason. [redacted]

[redacted]

Q. Has CMP demonstrated through their Application that they have adequately considered alternatives?

No they have not. Section 2.3.2 of the Application, Transmission Alternatives, does not list burying the line in the 53.5 mile new section as an alternative. CMP rejected this alternative with a statement in their materials that burying cable costs between 4 to 10 times more than above ground costs but was not supported by any documentation or analysis. Only two small areas involving the Kennebec River and Appalachian Trail crossings were considered for burial in the materials I reviewed. Burying the line would mitigate most effects from view or from hazards such as forest fires. Competing proposals to the NECEC in both New Hampshire and Vermont featured the majority of new lines buried as part of their proposals and permitting and should have been a consideration here. As clearly required by DEP 310.5 (A) a project will not be permitted if there are practicable alternatives that would meet the project purpose and have less environmental impact. Without an in-depth analysis of costs to bury the cable and only a simple statement that it costs four to ten times more, how can the Department and Commission consider the reasonableness of not including this alternative, that apparently is being more commonly considered in large projects of this nature? Without a cost analysis and an analysis of projected revenue over the life of the project how can the Department and Commission consider even the four to ten times the cost to be unreasonable? Anticipated revenue over long term may justify this type of expenditure and more but because of missing documentation the Department and Commission cannot even make those determinations. Further, within the Compensation and Mitigation analysis, businesses affected by the proposed project appear to consist only of the effects on the Kennebec River crossing but largely avoids analysis of many other businesses that will be affected by this project. Analysis is needed and should have been performed to identify numbers of visitors to the region by season, activities they participated in, factors that drew them to the area such as snowmobiling, hunting, fall leaf peeping, etc. the amount of money spent and their perception of proposed impacted views and their likelihood to visit the area after such a project is completed. Likewise an analysis of regional jobs by type and economic impact of any anticipated loss of revenues both long term and during construction should have been performed. [redacted] Finally, to remind the Department and Commission, Maine's Supreme Court's decision, Francis Small Heritage Trust, Inc. v. Town of Limington, et al. (*See* Exhibit 10) which gave Land Trusts tax exemptions for charitable and benevolent organizations found that there is a public benefit and need to protect scenic views, rare mountain habitats, rivers, etc., and referenced the legislature and statutes that are relevant in reviewing the NECEC project:

There can be little doubt that the Legislature has enunciated a strong public policy in favor of the protection and conservation of the natural resources and scenic beauty of Maine. For example, *38 M.R.S. § 480-A* (2013) states: The Legislature find and declares that the State's rivers and streams, great ponds, fragile mountain areas, freshwater wetlands, significant wildlife habitat, coastal wetlands and coastal sand dunes systems are resources of state significance. These resources have great scenic beauty and unique characteristics, unsurpassed recreational, cultural, historical and environmental value of present and future benefit to the citizens of the State and that uses are causing the rapid degradation and, in some cases, the destruction of these critical [***19] resources, producing significant adverse economic and environmental impacts and threatening the health, safety and general welfare of the citizens of the State. The Legislature further finds and declares that the cumulative effect of frequent minor alterations and occasional major alterations of these resources poses a substantial threat to the environment and economy of the State and its quality of life. S*ee also 5 M.R.S. § 6200* (2013) (finding that "the continued availability of public access to [outdoor] recreation opportunities and the protection of the scenic and natural environment are essential for preserving the State's high quality of life" and that the "public interest in the future quality and availability for all Maine people of lands for recreation and conservation is best served by significant additions of lands to the public domain"); *30A M.R.S. § 4312(3)(F)* (2013) (identifying the protection of "critical natural resources, including without limitation, wetlands, wildlife and fisheries habitat, sand dunes, shorelands, scenic vistas and unique natural areas" as a state goal). In creating the Land for Maine's Future program, the Legislature declared that the future social and economic well-being of the citizens of this State depends upon maintaining the quality and availability of natural areas for recreation, hunting and fishing, conservation, wildlife habitat, vital ecologic functions and scenic beauty and that *the State, as the public's trustee, has a responsibility and a duty to pursue an aggressive and coordinated policy to assure that this Maine heritage is passed on to future generations.*

Q. **Does this conclude your testimony?**

Yes, it does.

Criteria Beyond the Scope of the Hearing

[redacted]

Q Does this conclude your testimony?

A Yes.

[redacted]

Date:

Respectfully submitted,

By: ______________________
Print Name: Garnett S. Robinson

STATE OF MAINE
COUNTY OF PENOBSCOT

Personally appeared before me on the above- named Garnett S. Robinson, who being duly sworn, did testify that the foregoing testimony was true and correct to the best of his/her knowledge and belief.

Before me,

____
Notary Public/ ~~Attorney at Law~~
My Commission expires__________

SHIRLENE D. LINDSEY
NOTARY PUBLIC
STATE OF MAINE
MY COMMISSION EXPIRES JANUARY 7, 2025

[redacted]

Garnett S. Robinson
Phone: (207) 234-2822 Fax: (207) 234-2822

P.O. Box 82
Dixmont, Maine 04932

SKILLS

-Land Use Planning and Permitting Specialist B.S. Major: Land Use Planning
-Certified Maine Assessor (CMA)
-Certified Code Enforcement Officer-Inactive
-Knowledge of NEPA, ISO 14001 and environmental permitting procedures
-Working Knowledge of PCs, including Windows, Excel, GIS, Trio, and various C.A.M.A.software
-Appraiser Registration # AP2609
-Instructor-Maine Property Tax School (2005 to Present)

EXPERIENCE

August 2003 — Present
Maine Assessment and Appraisal Services - Dixmont, Maine
President
Property Assessing, Mapping, Appraisal and Revaluation services.

June 2003 to June 2008
R & G Appraisal Services - Orneville, Maine
Fee Appraiser doing residential and commercial' properties.

January 2006 to January 2008
Central Maine Association of Assessing Officers (CMAAO)
President (2Terms)
Organization set up to offer training and materials to newly elected selectmen/assessors.

December 2000 December 2004
Hamlin Associates - Parkman, Maine
Vice President-Assessors' Agent
Property Assessing, Mapping Upgrades and Revaluation Services.

June 1999- June 2000
James W. Sewall Co. - Old Town, Maine
Photogrammetrist- Digitally compiled detaiied Planimetric and Topographicai maps from aerial photography

May 1990 - May 1999
Maine Forest Service - Jackman, Maine
Patrolled to enforce conservation laws, including DEP, LURC, FPA, and fire control. Supervised and trained fire crews. Coordinated payroll reports, ensuring accuracy and timely completion. Assisted with updating maps for the Delorme Atlas Company. Maintained permit sites and oversaw equipment maintenance. Assisted other government agencies.

EDUCATION

May 2001, Suma Cum Laude Honors Graduate University of Maine- Orono, Maine
B.S. Major: Land Use Planning; Member of Phi Kappa Phi Honor Society & Presidential Scholar
August 2001, Certificate: Certified Maine Assessor, Property Tax Division, State of Maine
Certificate: Certified Code Enforcement Officer, State Planning Office- Shoreland- #0725
September 1993, Certificates: Forest Ranger- Maine Forest Service Ranger Academy
September 1990, Certificate: Conservation Officer, Law Enforcement Academy at Waterville 1989-1990 Forest Management Courses (Dean's List), University of Maine - Orono, Maine 1989, Associates Degree, Liberal Studies (Dean's List), University of Maine - Orono, Maine 2001 -Present, USPAP, IAAO, and many advanced appraisal courses.

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Project Overview Map

Configuration Cross Section

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ME - TD

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Central Maine Power Company

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ME - Underground

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Exhibit 5

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Exhibit 7

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Detroit

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ME - Substation DETROIT

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Exhibit 9

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Exhibit 10

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STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

and

STATE OF MAINE
LAND USE PLANNING COMMISSION

IN THE MATTER OF:	)	
	)	
CENTRAL MAINE POWER COMPANY	)	
25 Municipalities, 13 Townships/Plantations,	)	
7 Counties	)	
	)	APPLICATION FOR SITE LOCATION OF
L-27625-26-A-N	)	DEVELOPMENT ACT PERMIT AND
L-27625-TB-B-N	)	NATURAL RESOURCES PROTECTION
L-27625-2C-C-N	)	ACT PERMIT FOR THE NEW ENGLAND
L-27625-VP-D-N	)	CLEAN ENERGY CONNECT
L-27625-IW-E-N	)	
	)	
CENTRAL MAINE POWER COMPANY	)	
NEW ENGLAND CLEAN ENERGY CONNECT	)	
SITE LAW CERTIFICATION SLC-9	)	

REBUTTAL TESTIMONY OF ROGER MERCHANT, ME LPF#727
OF PRE-FILE TESTIMONY OF GERRY MIRABILE (APPLICANT)

A. (Pg.5&6, b., i) Scenic Character and Buffering Visual Impacts

CMP offers some options for minimizing visual impacts, including their willingness to run the power line under the Kennebec, a Class A river according to the state's 1982 Maine Rivers study.

<u>I would argue</u> that going under the Kennebec may reduce visual impacts, but it will not be impact-free with the presence of riverside cooling stations for the buried line. I'd also argue that any disruption, on - adjacent to - above or below, on any Class A river should be avoided and disallowed.

CMP provides attention to some, but not all of the scenic attributes and viewsheds in Segment 1 in the Upper Moose River Basin. Here is what is missing in the CMP view:

<u>I would argue</u> that CMP photo-simulations, mostly taken at lower elevations on moderately flat terrain, tend to minimize the visual impacts of the corridor **and** power line. Higher elevation observation points reveal a dramatically different picture of significant viewshed impacts as documented in my testimony (Merchant, Intervener Group 2).

<u>I would argue</u> that absent from the CMP scenic assessment are four high value viewshed points: 1.) Tumbledown Mountain that provides 360 degree views from the abandoned fire lookout, 2.) Greenlaw Cliffs on the west flank of Number 6 Mountain, 3.) the viewshed west of Coburn Mountain, 4.) last but not least, the highest value viewshed looking south from Sally Mountain... Likewise on GM-Page 6 where the "tapering" of corridor vegetation to reduce visual impact" is addressed, again, these four high value locations are notably absent.

(Field-based photographs of these four missing viewsheds are attached in Exhibit A.)

Field Note: In Segment 1, the section of proposed power line running east from the south flank of Moose Mtn. before it crosses the S. Branch Moose River, then easterly along the north slopes of Peaked and Tumbledown Mtn. through The Notch-Greenlaw Cliffs, and on just east of Rock Pond is a primitive, high value, wild and scenic section. Corridor clearing and power line towering will eliminate and obliterate this remarkable, high value section.

Alternative: Putting the power line underground along this section would protect in perpetuity, the wild and scenic value of this section. From a primitive outdoor and photographic perspective, it stands on equal ground and at par with the scenic value of the Kennebec Crossing. (RM)

This alternative would honor and bolster CMP's Conclusion **(Pg. 8, Par.3, iii)...** "CMP has made adequate provision for fitting the project harmoniously into the existing natural environment… the development will not adversely affect scenic character in the municipality or in neighboring municipalities… the activity will not unreasonably interfere with existing scenic and aesthetic uses.

B. (Pg. 6, par. 5) Proposing riparian stream buffers to minimize visual impacts

CMP states "Proposing riparian stream buffers adjacent to all perennial streams, adjacent to all cold-water fishery streams… [that] within these buffers stringent vegetation clearing and management restrictions, as well as herbicide application restrictions, apply."

I would argue that for a "headwaters" project of this extent and magnitude with intimate connections to cold-water streams in the landscape, and given growing public concerns about water quality for fisheries as well as humans downstream, it is imperative that CMP provide DEP and the public with data about the "proposed" herbicides of choice in CMP's vegetation management plans, including research data on the short and long-term impacts these toxic chemicals will have on fisheries and people downstream.

Additionally, I am not a fisheries biologist but I am a fly fisherman. I remain concerned about the impact this warm, open corridor will have on water temperature sensitive Eastern Brook Trout in this headwaters fragmentation project.

C. (Pg.11, iii) ... Habitat Fragmentation (Relevant to DEP Review)

CMP speaks to siting the NECEC Project "to minimize habitat fragmentation." From my field-work and aerial photographic documentation over the summer of 2018 on Segment 1, between Quebec and Coburn, I foresee a much larger and more significant "multiple fragmentation pattern" emerging across this landscape as a result of NECEC. The key distinction here is that NECEC will introduce a third, cumulative layer of corridor fragmentation, into an already fragmented landscape.

I would argue that NECEC will add yet another layer of fragmentation upon the pre-existing patterns of temporary and permanent fragmentation, already embedded in the landscape. Aerial photographs documenting the power line path across the landscape (Merchant, Intervenor 2) reveal the forests and streams, and the extensive network of permanent gravel roads that will intersect with NECEC.

Janet McMahon's paper encapsulates this problem which seems minimally addressed in CMP's proposal. *"Fragmentation typically begins when people build roads into a natural landscape, then "perforate" the landscape further with associated development. This* *typically leads to additional roads, energy infrastructure and land conversion, and, over time results in "patches" of habitat that are smaller and further apart (McMahon, Pg.6)* McMahon's paper accurately describes what is already happening, and which will evolve into "multiple fragmentations" as a result of NECEC, all along Segment 1. Based upon my interpretation of aerial photography and review of literature, consider these three components of "multiple fragmentations" to be intimately connected to NECEC.

1. <u>Forest fragmentation</u> from harvests already occupies 40% of the landscape. This form of fragmentation is "transitional" and of less concern. Yet, the jury is still out on the longer-term impacts that forest fragmentation will have on species and habitat connectivity at the landscape and regional scale in a warming climate.
2. <u>Permanent gravel roads</u> to access timber are extensive all across Segment 1 and travel in all directions of the compass. Many of these open road corridors and yards are permanent features in the landscape. Forests do not grow back on most of these ROW's, so this second layer of more critical, permanent fragmentation should be of more concern in the NECEC Proposal.

   Additionally, consider the amount of construction materials and equipment needed to haul into the farther reaches of Segment 1. Some pre-existing logging roads will be expanded in width, straightness and drainage, especially on the lesser-developed permanent roads west of The Notch and all the way to Quebec. Indeed, this will contribute to the overall permanent fragmentation effects.
3. <u>NECEC is the third and largest layer of permanent fragmentation</u>, 150 feet wide x 54 miles across the landscape. It's documented that the edge effect impacts from the open corridor will extend some 330 to 1000 feet deeper into the adjacent

woods, (Hunter, Pg.6, Par.1). This third and largest footprint in the "multiple fragmentation" series will significantly expand the base and basis of habitat impacts. The cumulative impact of all three footprints will be substantially larger than what CMP presents from their "minimized habitat fragmentation" position.

I argue that NECEC will create and contribute to significant "multiple fragmentations" across habitats and landscape, forever. Pre-existing, improved gravel logging roads are already contributing forest fragmentation effects. It is worth noting that the NECEC power line, the permanent network of gravel roads adjacent to the corridor, including those roads moving away from it, all will feed into cumulative impacts from "multiple fragmentations" of the landscape and habitats on Segment 1.

Malcolm Hunter's TNC testimony likewise concurs on the cumulative and long-term impacts of fragmentation, and the short-sightedness of the regulatory system.

- *"The regulatory framework often falls short in acknowledging cumulative impacts...most impact assessments neglect the long-term effects of transmission lines on biodiversity. (Pg.7,Par.2)... It is my contention that based on the evidence presented, CMP has not made adequate provisions for the protection of wildlife and fisheries."(Pg.8,Par.2&3)... "It is widely recognized that fragmentation is one of the leading causes of biodiversity decline across the globe (Pg.3,Par.1)...*

I argue this needs further investigation before permitting.

[redacted]

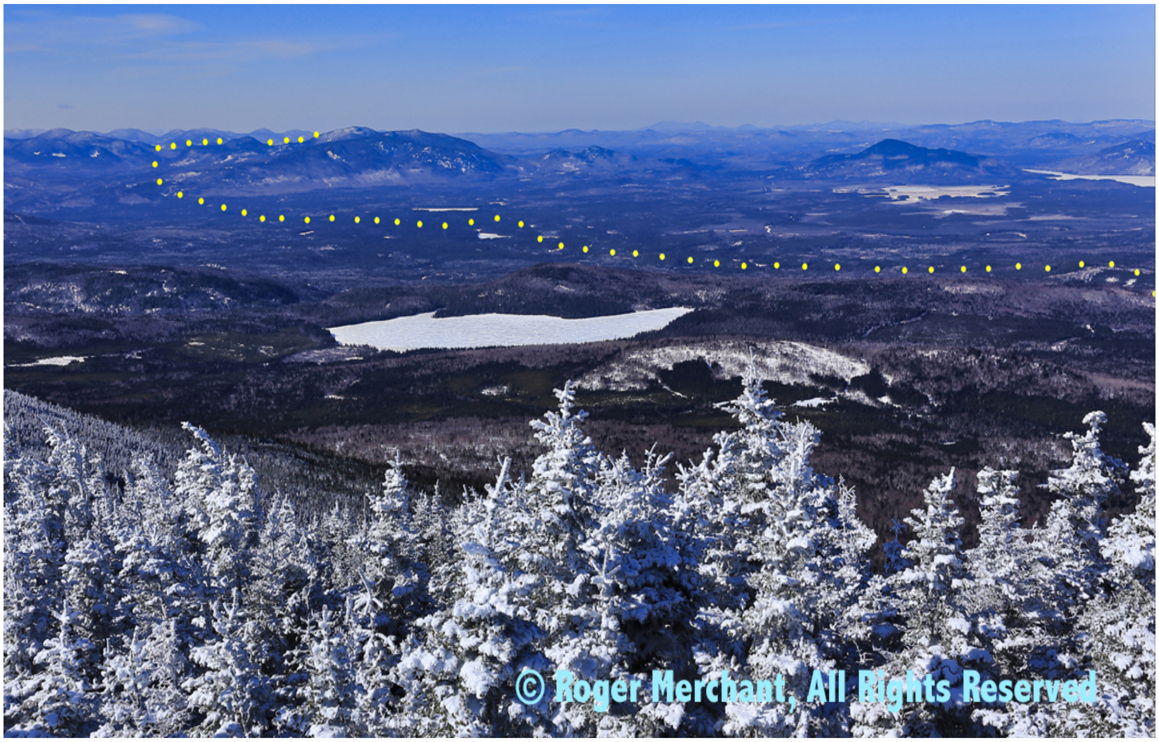
[redacted]

Exhibit A: Scenic Viewsheds Not Addressed by CMP

1.) Tumbledown Mountain West with power line and corridor track in yellow...

2.) Greenlaw Cliffs from The Notch...

3.) Coburn Mountain West with power line and corridor track in yellow...



4.) Sally Mountain South viewshed with power line and corridor in yellow...

STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

and

STATE OF MAINE
LAND USE PLANNING COMMISSION

IN THE MATTER OF: CENTRAL MAINE POWER COMPANY 25 Municipalities, 13 Townships/Plantations, 7 Counties L-27625-26-A-N L-27625-TB-B-N L-27625-2C-C-N L-27625-VP-D-N L-27625-IW-E-N CENTRAL MAINE POWER COMPANY NEW ENGLAND CLEAN ENERGY CONNECT SITE LAW CERTIFICATION SLC-9	APPLICATION FOR SITE LOCATION OF DEVELOPMENT ACT PERMIT AND NATURAL RESOURCES PROTECTION ACT PERMIT FOR THE NEW ENGLAND CLEAN ENERGY CONNECT

Date: 3/14/2019

Respectfully submitted,

By: [signature]
Print Name: Roger Merchant

STATE OF Maine
COUNTY OF Penobscot

Personally appeared before me the above- named Roger Merchant, who being duly sworn, did testify that the testimony submitted in the above captioned proceeding was true and correct to the best of his knowledge and belief.

Before me,
[signature]
Notary Public/ Attorney at Law
My Commission expires 8/16/25

Mishael Romanelli
Notary Public, State of Maine
My Commission Expires August 16, 2025

STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

and

STATE OF MAINE
LAND USE PLANNING COMMISSION

IN THE MATTER OF

CENTRAL MAINE POWER COMPANY)
NEW ENGLAND CLEAN ENERGY CONNECT)
#L-27625-26-A-N/#L-27625-TG-B-N/)
#L-27625-2C-C-N/#L-27625-VP-D-N/)
#L-27625-IW-E-N)

CENTRAL MAINE POWER COMPANY)
NEW ENGLAND CLEAN ENERGY CONNECT)
SITE LAW CERTIFICATION SLC-9)
Beattie Twp, Lowelltown Twp, Skinner Twp,)
Appleton Twp, T5 R7 BKP WKR,)
Hobbstown Twp, Bradstreet Twp,)
Parlin Pond Twp, West Forks Plt, Moxie Gore,)
The Forks Plt, Bald Mountain Twp, Concord Twp)

Pre-Filed Sur-Rebuttal Testimony of Gil A. Paquette on behalf of Group 3

April 19, 2019

A. Introduction and Qualifications

My name is Gil A. Paquette. I am a Managing Director and head of the Energy and Environmental Practice at Vanasse Hangen Brustlin, Inc. located at 500 Southborough Drive, South Portland, Maine. I received a BS degree from the University of Maine in Wildlife Management and an MS degree from the University of Western Ontario in Zoology. I have 23 years of experience working on a variety of energy projects including natural gas pipelines, electric transmission lines (both overhead and underground), hydro-electric relicensing, wind power, and solar power. My CV is attached hereto as “Exhibit Group 3 Sur-rebuttal 1.” A list of Representative project experience is attached hereto as “Exhibit Group 3 Sur-rebuttal 2.”

The primary focus of my consulting is in the areas of stakeholder management, siting, permitting, and construction management of large energy infrastructure, most notably electric transmission lines. I have advised clients on strategic siting issues related to avoiding, minimizing, and mitigating impacts to natural resources. My advice with respect to siting and designing a transmission line is based on a holistic approach, considering input from a variety of stakeholders to balance both societal and natural resource concerns.

I use my skillset and substantial experience to manage and coordinate multi-disciplinary teams on projects that require integration of stakeholder outreach, design, permitting, cost-estimating, materials procurement, and construction. I have worked on many projects from inception to completion. From my 23 years of experience, I have developed an intricate understanding of all aspects of electrical energy infrastructure projects, both large and small, including, as relevant to this Project:

- Project siting;
- Stakeholder management;
- Preparation of RFPs for materials and contractors;
- Cost estimating;
- Preparation of feasibility studies;
- Technology research;
- Preparation of recommendation documents for materials and contractor selection;
- Permitting;
- Construction management;
- Managing alternating current (“AC”) mitigation studies/design/construction;
- Managing electrical, structural, and civil design and studies;
- Preparation of vegetation management plans;
- Preparation of erosion and sedimentation control plans; and
- Managing large teams for natural and cultural resource studies and engineering.

More specifically, I have worked extensively on the development of two high voltage direct current (“HVDC”) electric transmission projects. The first project was the Northeast Energy Link, a proposed 230-mile underground HVDC cable from Orrington, Maine to Tewksbury, Massachusetts. Initially, I was retained by Bangor Hydro (then Emera Maine) to conduct a routing feasibility study of several routes, including terrestrial and submarine. Later, I was asked by Emera Maine to act as overall Project Manager. In that role, I worked with cable manufacturers and contractors to develop a detailed cost estimate to construct the project. For a variety of reasons, the project did not advance beyond the development stage, but my experience with assessing various routes, managing the project, and dealing with cable manufacturers and contractors on cost issues has given me expert knowledge on the use of HVDC technologies in Maine.

The second project was the Atlantic Link proposed by Emera Inc. Atlantic Link was a proposed 375-mile HDVC submarine cable from Coleson Cove, New Brunswick to Plymouth, Massachusetts. I was retained by Emera Inc. as the permitting lead for U.S. facilities and to support siting, the stakeholder team, and surveys. Atlantic Link submitted a response to the Massachusetts Section 83D RFP but was not selected. Despite the project's status on hold, my experience as permitting lead deepened my knowledge of HVDC technologies, and especially cost implications related to logistics.

B. Purpose and Overview of Testimony

I am testifying on behalf of Intervenor Group 3 to rebut certain testimony of the Applicant related to undergrounding the New England Clean Energy Connect Project ("NECEC" or "Project") and to clarify for the Department of Environmental Protection and the Land Use Planning Commission additional technical information highly relevant to the practicability, suitability, and environmental impacts of undergrounding the Project that was overlooked or underestimated in the rebuttal testimony of Mr. Bardwell.

Having prepared site-specific routing analysis and cost-estimates for similar projects, I have learned that many logistical aspects of underground transmission line installation are often oversimplified and overlooked by design engineers. It is only through thorough research and an understanding of the site-specific implications of installing HVDC cable underground along the entire route that the logistical complications and the environmental impacts can be fully understood. However, it is also true that certain complications can arise initially, generally, or with respect to natural resources in specific locations, that would preclude undergrounding as a viable alternative to an overhead line.

In this case, CMP was correct in not initially considering an underground alternative for Segment 1 from a legal perspective, i.e., doing a full-blown regulatory alternatives analysis, because based on initial engineering considerations it could reasonably be determined that undergrounding would not work for myriad reasons associated with practicability, including cost, transportation logistics, and construction challenges, many of which would increase negative environmental impacts compared to an overhead line. One of the most important criteria in determining the ability to install an HVDC cable underground is location. Segment 1's relative remoteness, topography, geology, hydrology, and long stretches of ROW between access points make it inherently unsuitable for burying an HVDC cable. Engineering and other power line construction professionals are or should be aware of these factors, especially as they present in Segment 1, and would not want to invest scarce time, money, and resources in analyzing a fruitless option.

In response to Project opponents' testimony, however, CMP specifically identified many reasons related to the impracticability of undergrounding in its sur-rebuttal testimonies by Mr. Dickinson, Mr. Tribbet, and Mr. Bardwell. These witnesses provided detailed analysis beyond what was initially necessary to make a practicability determination, though overlooking and understating many logistical challenges and the associated environmental impacts of undergrounding. For example, CMP overlooked or understated challenges with mobilization of cable, thermal sand, and equipment along a remote ROW, as well as some of the difficulties associated with splicing relatively short lengths of cable along a remote ROW, protecting those splices with concrete, and ensuring reliable and efficient operation of an underground cable going forward. While I agree with the general conclusions of CMP's rebuttal testimony, at least directionally as they relate to cost and environmental impacts, the testimony failed to consider the full cost and environmental implications associated with many logistical aspects to undergrounding a transmission line that, in my experience, have been determinative of whether undergrounding is practicable, less environmentally damaging, suitable to the proposed use, and reasonably available to the Applicant.

Based on my experience, although an underground transmission line compared to overhead may intuitively seem appealing from the perspective of minimizing environmental impacts, there are in fact far greater environmental impacts from undergrounding, especially to streams, rivers, wetlands and other protected and sensitive natural resources. Undergrounding may appear simple but is often extremely complex and challenging. The following testimony describes the differences in access, logistics, constructability and associated environmental impacts between an underground cable and an overhead conductor, with consideration of the remote setting of Segment 1, where an underground alternative has been suggested by Project opponents.

C. Background and Assumptions

For simplicity, it is important to note initially that the "lines" involved in an underground electric transmission line are called cables, whereas the "lines" in an overhead electric transmission line are called conductors. Reference to "cable" in my testimony shall be in the context of constructing an electric transmission line underground. Reference to "conductor" shall be in the context of constructing an electric transmission line aboveground.

My testimony assumes a polymeric insulated ("PE") HVDC cable design as opposed to a mass-impregnated non-draining ("MIND") HVDC cable to address the undergrounding alternative. It is important to note that because PE cable technology was developed in the late 1990's, to my knowledge, long-term data on the life of the cable and cable splices is not available. I have also assumed that the lifespan of the Project is at least 40 years, which if true for other PE projects means that no PE project has yet to operate for the entirety of its useful life at the proposed voltage of the NECEC.

MIND HVDC cables have been used for long-distance, submarine transmission systems for more than 50 years. The electrical insulation system in MIND cables typically consists of (i) a semi-conducting carbon paper layer around the surface of the cable, (ii) a main insulation layer consisting of vacuum-dried paper impregnated with high-viscosity, insulating oil, and (iii) an outer conductive layer consisting of carbon- and metal-laminated paper. A hermetically-sealed lead sheath with a polyethylene jacket protects the insulation from moisture or water penetration, layers of galvanized steel tape and steel wire provide the required mechanical strength, and an outer layer of bitumen-bonded polypropylene yarn provides corrosion protection to the cable armoring.

Even though MIND cables have been extensively used in long-distance, submarine transmission systems in North America, Europe, New Zealand, Australia, the Philippines, and the Far East, there are few examples of MIND cable installations over any significant distance underground. One of the principal reasons is that MIND cables are challenging and costly to splice and, therefore, are difficult to install unless the cable can be transported from the factory to the installation site in long, continuous lengths on either a turntable or very large steel drums. Transportation of turntables or very large steel drums to an inland site by railroad or public roadways, on the other hand, is generally impractical, if not impossible, due to transport width, height, and weight restrictions.

In some of the few locations where MIND cable circuits were installed underground over significant distance, field splices were avoided by bringing the cable on-shore in long continuous lengths from an off-shore installation vessel. Such off-shore vessels are obviously unavailable for long-distance terrestrial projects. For example, a relatively short 3.3-mile-long underground section on the Swedish side of the 450 kV, 600 MW, Baltic cable system between Sweden and northern Germany was laid in one continuous length in an open cut trench from the shore landing site to the HVDC converter station. (On the German side, the cable was installed in the Trave River up to the location of the HVDC converter station near the City of Lübeck.)

Including to overcome the challenges and limitations of MIND cables in connection with long-distance underground transmission, cable manufactures developed and introduced the PE HVDC cable design in the late 1990's. The insulation system in PE cable consists of a semi-conducting poly-ethylene conductor screen, a main insulation layer, and a semi-conducting poly-ethylene insulation screen. The insulation system is manufactured in a true triple-extrusion process in a continuous vulcanization line. PE cables can be laid in an open cut trench (direct burial) or pulled through conduits in horizontal directional drillings ("HDD") or duct-bank systems. Tape joints are used for splices. The joints are similar to pre-molded cable joints used for ±320 kV AC cross-linked PE cable circuits.

With the development of this new PE technology, terrestrial undergrounding of HVDC cable is now more cost-effective and eliminates the environmental issues associated with oil-filled cables. Additionally, paper-oil insulated cables have a rather complex and expensive manufacturing process. PE cables can offer significant advantages when compared to MIND cables, including: a higher conductor temperature for the same power rating; utilization of lighter moisture barriers, thus reducing weight; a simpler splicing process; utilization of longer lengths of cable; and generally reduced maintenance requirements. Although there tends to be agreement in the field regarding these benefits, it is my understanding that no PE project has operated for the entirety of its useful life at the proposed voltage of the NECEC.

D. Drawbacks to Installing an HVDC Underground Cable in Segment 1

The technology exists to underground an HVDC cable. However, the specific issue in this case, as addressed below and as not sufficiently addressed in the Applicant's rebuttal testimony, is whether installing an underground cable in a remote part of Western Maine with undulating topography is a less environmentally damaging practicable alternative to overhead conductor or is suitable to the proposed use and reasonably available to the Applicant.

Despite the fact that Segment 1 is traversed by hundreds of miles of logging roads, mobilization of materials and equipment, as well as construction specifically used for burying an HVDC cable, would be extremely difficult, if not impossible, in some locations. I was not surprised to learn that CMP did not initially evaluate an underground option for Segment 1 given the much greater costs, the numerous challenges associated with burying an HVDC line in the proposed corridor, and the significant environmental impacts associated with construction and maintenance of an HVDC line. To many in the transmission field, not burying the NECEC would be an obvious conclusion given the Project setting. Through my work and research on other HVDC projects I have compiled a list of often-overlooked issues with respect to undergrounding that illustrates why undergrounding Segment 1 was not initially considered, and that reinforces that such option is not practicable, suitable, or reasonably available to the Applicant.

1. Costs

It is widely known in the industry that the costs of cable far exceed the costs of conductor. However, the intent of this testimony is not to reiterate this cost premium, but to describe the difficulty, overlooked or underestimated by Mr. Bardwell, in obtaining and installing a cable in general and in the context of Segment 1.

PE cable itself is specialized. There are limited PE cable production facilities in the world, as the demand for such cable in long lengths is relatively low when compared to conductor. Thus, PE cable acquisition lead times are long, and scheduling can be a serious constraint. As HVDC cables were originally designed for specific undersea projects, they have typically been fabricated in one continuous length (up to 70 miles), which is made feasible by the fact that the cable is transported by a specialized cable-laying vessel carrying the cable on a large turntable and directly installed on the ocean floor. This process minimizes the number of cable splices that must be made but is unavailable for the remote terrestrial route of Segment 1. As such, the process for undergrounding the NECEC would be far more onerous with significantly higher costs. Even disregarding the cost differential between cable and conductor, installing an HVDC cable in Western Maine is not practicable, suitable, or less environmentally damaging than an overhead conductor.

2. Cable Transportation

On page 4 of his rebuttal testimony, Mr. Bardwell states: "The cables are limited to approximately 2,500-foot shipping lengths …" I believe that Mr. Bardwell is oversimplifying. Based on my experience, 2,500 feet is the maximum shipping length. As cable is very expensive, and to reduce waste, reels would need to be loaded with specified cable lengths to match exact splice locations. Therefore, simply ordering standard 2,500-foot length reels is not a practicable option. Shorter lengths, which would no doubt be required, would have a compounding effect on logistics and environmental impacts for cable transportation, mobilization to the trench, splicing, splice protection, and access to the Segment 1 ROW for each of the foregoing. Mr. Bardwell does not discuss such logistical challenges and their associated environmental implications; in my experience, such challenges can be determinative of whether a line can be buried. He also does not discuss the logistical differences and consequent environmental impacts between an underground line and an overhead line, which are important to consider when determining whether undergrounding might be an alternative less damaging to the environment.

Conductor used in both AC and DC applications is generally transported on large reels, with each reel containing approximately 10,000 feet of conductor, depending on its size. The conductor typically has an inner core of stranded steel for strength and an outer layer of stranded aluminum to conduct the electricity. On a recent overhead project, four reels constituted a typical load using a tractor trailer, with a total payload of approximately 40,000 feet of conductor. Based on these numbers, for Segment 1, an overhead project with 4 conductors (excluding fiberoptic) would require roughly 112 reels and 28 tractor trailer loads for conductor transportation.

Due to weight restrictions, HVDC cable, such as the one that would need to be used on the NECEC, can only be transported in approximately 2,000-foot to 2,500-foot lengths, depending on cable design. It is possible to transport up to four reels of cable on a tractor trailer, but such load would weigh between 55 and 75 tons and would therefore be difficult to transport on rough, uneven, or muddy logging roads and impossible on some logging road bridges. Based on specific project experience, my understanding is that only one reel can be transported per load due to weight restrictions on some highway bridges that act as binding constraints, despite the fact of other bridges being able to accommodate three reels. Conservatively assuming 2,000-foot lengths of cable rolled onto three reels per tractor trailer, transportation of HVDC cable to and on logging roads to the Project site would require over 6 times the amount of tractor trailers compared to using conductor. Based on these numbers, for Segment 1, undergrounding with five cables (including one spare cable and excluding fiberoptic) would require roughly 700 reels and 234 tractor trailer loads. Such increased heavy-duty traffic would cause greater damage to logging roads and could necessitate significant road and access improvements, thus increasing the threat to protected natural resources adjacent to the roads, including wetlands and waterbodies.

3. Trenching

To most cost-effectively install an HVDC cable, the direct burial method would be used, which would require an excavated trench approximately six feet deep along the entire Segment 1 right-of-way ("ROW"). Mr. Bardwell, on page 4 of his rebuttal testimony, states: "A typical trench would be approximately five feet wide at the bottom with sloping sides for a minimum surface width of 12 feet, increasing when trench depth increases." While this is generally true, Mr. Bardwell does not fully explain Occupational Safety and Health Administration ("OSHA") requirements and other variables affecting sloping. Per OSHA, the trench would need to be sloped on each side of the trench to protect workers. Sloping requirements depend on soil type, with greater sloping required for less stable soils and soils generally classified into three types based on their stability (A, B, and C). Assuming a five-foot width at the base of the trench to accommodate five cables, the width of the trench opening would range from an approximate minimum of 14 feet (with the most stable soil type, A) to an approximate maximum of 23 feet (with the least stable soil type, C). In my experience, the least stable soil type, C, occurs with some frequency in Maine. Soils that are less stable than C would require shoring the trench. With an overhead line, it is practicable to sample soils at the proposed location of tower structures and then make minor adjustments to avoid unstable soils. With an underground line, however, it is impracticable to sample soils for the entire length of the trench. Thus, unstable soils are generally unavoidable and can cause many unexpected delays when encountered.

Though sloping could be avoided in stable bedrock, it would be required through wetlands. An overhead transmission line would nearly always span wetland resources and thus avoid direct impacts. Even if a pole had to be placed in a wetland, the disturbance would be limited to a relatively minimal "point" as opposed to a linear disturbance. Undergrounding would also require trenching through streams, brooks, and even small rivers and other sensitive natural resource areas without use of HDD. Overhead structures, however, are never placed in streams, brooks and small rivers. Therefore, there would be far greater construction-related natural resource impacts from an underground project versus an overhead project.

Further, Mr. Bardwell states on page 4 of his rebuttal testimony that: "The cables are placed in a single row in a sand bedding layer approximately one foot deep in the bottom of the trench. Above the sand bedding layer a protective concrete slab would be poured and the trench above the slab would be backfilled with native soil." In my experience, a concrete slab is reasonable but not necessary, as underground warning tape could be used to detect where the buried cable exists under the surface. Additionally, Mr. Bardwell simply references "sand" and "native soil" backfill. I believe he overlooks the need for thermal sand as backfill (as I explain in section 8 below) and the logistical challenges presented by hauling thermal sand to backfill a linear trench that would span up to 53 miles.

4. Ledge

Mr. Bardwell does not sufficiently address the logistical challenges posed by ledge in his rebuttal testimony or compare the environmental impacts associated with ledge between an overhead and underground line. He states on page 14: "The most common risk for below grade construction is encountering bedrock shallower than expected. In areas with shallow bedrock, trenching would require blasting, hoe ram, or similar excavation methods." I agree that to install cable in ledge, the ledge would likely need to be blasted or hoe-rammed. Areas of blasting could extend for long distances, especially due to unforeseen bedrock conditions. However, there are other concerns that must be considered. For example, shot rock would need to be removed from the trench and either be exported off-site by heavy-duty dump truck or windrowed, as thermal sand is also required as trench backfill in bedrock.

Blasting may need to occur to allow for overhead transmission line structure placement, but these are in single-point locations, not along any great lengths, and can generally avoid sensitive areas like streams through structure placement and spanning. Blasting for direct burial of cable at stream and brook crossings would be generally unavoidable without the use of HDD. Such blasting would negatively impact the waterbodies themselves, as well as nearby flora and fauna. Therefore, ledge would cause greater construction-related impacts for an underground project than an overhead project.

5. Cable Mobilization for Installation

In his rebuttal testimony, Mr. Bardwell largely overlooks logistical complications associated with mobilizing cable for burial, especially compared to mobilizing conductor for installation. The logistical complications with undergrounding relate to cable being heavier and fabricated into shorter transportable lengths than conductor and result in additional costs and environmental impacts.

Both overhead AC and DC conductors are typically pulled from one location to another location around three miles away, depending on the type of conductor. As the reels typically contain 10,000 feet of wire, splices are used to create a continuous 3-mile (15,840-foot) length of conductor. The pulling and splicing process involves creating a location for the spools of conductor to be stored and eventually placed on a tensioner. At a second location, a puller would pull the conductor through blocks that are installed on the transmission line structures. The puller/tensioner sites are typically located where there is easy access to facilitate transporting the reels. In the Project setting, logging roads would likely be used to transport conductor to the puller/tensioner sites, which would be located immediately off logging roads in the project ROW. In my experience, sensitive natural resources are generally avoidable when establishing the puller/tensioner sites.

Just like an overhead conductor, an underground line must be spliced together from various reels of cable. But unlike conductor, cable cannot be pulled in a trench or on rollers, as the relatively weak splices would fail due to the weight of the cable. As such, cable reels would need to be mobilized to the location where the cable would be installed, in this case along the entire trenched ROW. Because of the weight of the reels, a significant number of mats would need to be placed along nearly the entire length of the ROW to allow for the transportation of the reels to the installation points. It is reasonable to assume that more environmental damage would be caused during this process when compared to conductor transportation, for which the conductor must only be transported to the puller/tension sites via an existing logging road.

In addition to mats, bridges would need to be installed at nearly every stream, brook, or small river crossing, and the bridges would need to be more robust than the typical temporary construction bridges that are installed at select locations for an overhead transmission line. With nearly every stream or brook requiring a bridge, undergrounding would create far greater impact to aquatic resources when compared to construction of an overhead transmission line.

While wetlands would be protected by mats for an underground line, two or three layers of mats may be needed to transport the cable reels due to the typical subsidence that occurs in wetlands when mats experience heavy loads and frequent traffic. Because of the excessive number of mats that would be required for an underground project, ground cover would likely become more denuded than for overhead construction and the restoration of both uplands and wetlands would be more challenging. It is therefore reasonable to assume that there would be more impacts to wetlands with an underground project compared to an overhead project.

6. Vaults

The weakest link of a cable is a splice. Because splices pose a reliability concern to the electric grid, each one must be protected by concrete vaults, which would also facilitate access to a splice that has failed. Mr. Bardwell, on page 4 of his rebuttal testimony, states: “Temporary structures would be erected over the jointing locations. Once the cables have been jointed, precast concrete enclosures approximately 12 feet long and 4 feet wide would be placed over each joint for additional protection and the jointing pit would be backfilled with sand and native soil.” I believe Mr. Bardwell understates the size of the vaults that would be needed and overlooks the logistical challenges associated with transporting pre-cast concrete vaults.

The dimensions of vaults can vary depending on the project. Based on my experience, for the NECEC, the vaults would likely be around 26’ x 8’ x 8’. This size would require extensive excavating, significantly greater than that needed to install a pole. The excavation for the vaults would occur at approximately every 2,250 feet on average. If bedrock is present it will need to be blasted or hoe-rammed. Avoiding excavation for vaults in wetlands would likely be impossible.

I assume that the concrete vaults would need to be pre-cast, as it would be extremely challenging for concrete-mixing transport vehicles to access the Project ROW at each splice location. Similar to the reels, pre-cast concrete vaults would also need to be transported the length of the Project ROW for installation, necessitating the use of more or heavier-duty temporary facilities (e.g., mats) and possibly the construction and/or reinforcement of some permanent facilities (e.g., bridges). Restoration would be challenging as the topsoil and subsoil would need to be removed to accommodate the vault. Installing on slopes would also be challenging because it would be difficult to stabilize the excavated area on steep slopes.

Thus, the large vaults needed to protect cable splices would cause increased permanent and temporary environmental impacts relative to conductor, and many of those environmental impacts are unavoidable due to the linear nature of trenching.

7. Splices

Regarding splicing, Mr. Bardwell on page 4 of his rebuttal testimony estimates that an underground cable would need to be spliced approximately every 2,200 feet and would involve "weather- and humidity-controlled enclosures." While I generally agree with Mr. Bardwell, I believe that he overlooks the logistical complications associated with splicing in Western Maine. Further, Mr. Bardwell does not provide a comparison of the splicing requirements of an overhead line.

In addition to the need to travel the length of the ROW to transport cable and pre-cast concrete vaults, trailers would need to be transported to each splicing location along the Segment 1 ROW. The trailers are specifically designed for cable splicing, are temperature-controlled, and have a filter system for eliminating dust and other contaminants that could impact the splice. They can be thought of as mobile, sterile labs. There would be approximately 110 to 140 splice locations for Segment 1 assuming five cables (two per pole and one spare (excluding fiberoptic cables)) are installed along 53 miles of ROW and all cables can be spliced using one trailer location. For an overhead line, splices are installed in an open-air environment using a compression sleeve. Comparatively, there would be approximately 27 to 30 splice locations for an overhead line, which would also equate to 27 to 30 puller/tensioner sites. Thus, given the number of splicing locations (110-140), access requirements for those locations (e.g., roads, mats, bridges, etc.) and space and resource requirements needed for splicing trailers, the environmental impacts associated with an underground line are likely to be far greater than those of an overhead line.

8. Thermal Sand

As I previously stated, Mr. Bardwell does not discuss the need for thermal sand in his rebuttal testimony, and thus does not consider the logistical, environmental, and cost implications associated with thermal sand. In my experience, the need for, logistics concerning, and cost of thermal sand is the single most overlooked aspect of undergrounding an HVDC transmission line.

On a recent underground HVDC project I worked on, a major concern was the importation of thermal sand. For cables to operate efficiently and avoid hot spots that could lead to cable failure, the heat they necessarily create must be dissipated using thermal sand that surrounds the cables. Given the geology of Western Maine, with which I am familiar, it is likely that a majority of Segment 1 would require the use of thermal sand as backfill material. During the design phase, thermal resistivity measurements would need to be taken to determine if the native soil has the properties to allow for effective and adequate heat dissipation. Wetlands are particularly challenging because deep organic material does not dissipate heat well. Therefore, thermal sand would be required in all wetland trenches, impacting wetlands much more significantly than an overhead transmission line that would span the same wetlands.

Similar to transportation issues associated with reels, pre-cast concrete vaults, and splicing trailers, installing thermal sand would require extremely heavy dump trucks to travel nearly the entire length of ROW. While use of temporary mats and bridges are generally sufficient for typical overhead construction, in my experience, similar temporary facilities would not likely withstand the extensive, heavy-duty nature of vehicular traffic associated with properly constructing an underground HVDC line in Segment 1 using thermal sand where necessary. Thus, either much more extensive temporary or perhaps permanent facilities would be needed, which facilities would cause more environment impacts.

By way of example, for relatively lighter-duty construction and maintenance of overhead transmission lines, frozen ground and water can at times eliminate or reduce the need for mats and bridges. However, dump trucks containing thermal sand would still require the use of heavy-duty mats and bridges, even in winter. In addition to the issues described above, the thermal sand would displace the native material in the trench. Excess spoils would need to be spread on-site or hauled off-site, creating even more disturbance to natural resources and increasing the likelihood of erosion and sedimentation.

9. Replacing a Section of Damaged Cable

In his rebuttal testimony, Mr. Bardwell does not address the full scope of the logistical challenges and consequent environmental impacts with respect to addressing an operational failure associated with a splice or otherwise.

If damage occurs to a cable either at a splice or in another location, repairs or replacements would need to be conducted quickly to maintain electric reliability. A short length of new cable would need to be transported to the damaged cable location. Equipment would be required for excavating the damaged cable and a splicing trailer would be required as well. If the damaged cable is in a remote location, mats and bridges would need to be installed. There is a strong likelihood that the extent of mats and bridges would be much more extensive when compared to making repairs to an overhead line given the specialty equipment required to complete the repair, thus creating greater environmental damage and a longer window for restoration of power. To facilitate access for repairs, CMP may need to construct permanent access roads and bridges at select locations along the ROW, causing permanent damage to adjacent protected natural resources.

E. Conclusion

Undergrounding the NECEC within the 53 miles of Segment 1 is not practicable, suitable, or an alternative that is reasonably available to the Applicant. Further, undergrounding is not less environmentally damaging than an overhead transmission line. Thus, undergrounding is not an alternative to the NECEC that should have been or should be considered.

My conclusion is based on the physical characteristics of underground cable and my years of experience with the techniques required to transport, mobilize, install, splice, protect, repair, and replace it, as well as to ensure that it operates efficiently and reliably. In sum:

- Underground cable is specialized, heavier, and created in shorter lengths than overhead conductor for terrestrial application (≈ 2,000-2,500 feet underground versus 10,000 feet overhead)
- For Segment 1, more reels (≈ 700 underground versus 112 overhead) and trailer trucks (≈ 234 underground versus 28 overhead) would be required to transport underground cables than overhead conductor.
- Unlike overhead conductor, which can be pulled and tensioned from sites three miles apart, underground cable must be transported to the installation site (trench) spanning the entire ROW.
- With more reels and trucks for underground cable that must access the entire ROW, more mats and bridges, and perhaps some permanent improvements, would be needed than for an overhead line. More and better access roads would likely be needed due to heavier and more frequent traffic.

- Trenching six feet deep, five feet wide at the base, and between 14 feet and 23 feet wide at the opening would occur for 53 miles without interruption or the ability to avoid certain sensitive and protected resources. Testing of all soils along the ROW would not be practicable, so encountering unexpected instances or areas of unstable soils and ledge would add delay, costs, and additional logistical concerns.
- When trenching, ledge would need to be blasted or hoe-rammed wherever encountered.
- Thermal sand would likely be required along the majority of the Segment 1 ROW to backfill the cable trench, requiring excavation and removal of native soil, importation by dump truck of thermal sand, and thus heavy-duty temporary facilities (bridges and mats) or permanent facilities (bridges). Unlike with overhead conductor, sensitive (e.g., wetlands) and challenging (e.g. ledge) areas could not be avoided through structure placement and spanning.
- Splicing, requiring the use of specialized trailers, would occur along the entire ROW at about 140 locations, adding logistical concerns and environmental impacts relative to overhead conductor.
- At each splice, a permanent concrete vault (≈ 26'x 8'x 8') would need to be constructed for protection and access, often requiring a permanent access road.
- Repair or replacement of damaged cable or cable splices would cause extensive disruptions (e.g., heavy equipment, mats and bridges, excavating, splicing trailer, etc.) and protracted outages, unlike with overhead conductor.

For the reasons described above, installing an underground HVDC cable in Western Maine is not practicable, suitable, reasonably available to the Applicant, or less damaging to the environment.

Dated at Scarborough, Maine this 19th day of April, 2019.

By: ______________________

Gil A. Paquette

The aforenamed Gil A. Paquette did personally appear before me and made oath as to the truth of the foregoing pre-filed testimony.

Before me: ______________________

Robert B. Borowski
Attorney at Law
Bar Number: 4905

Gil Paquette, CWS, PWS

Director, Energy/Environmental Services

Education

MS, Zoology, University of Western Ontario, 1995

BS, Wildlife Management, University of Maine at Orono, 1992

Registrations/Certifications

Certified Wildlife Biologist, 2000

Professional Wetland Scientist, 2000

Gil is Director of Energy/Environmental Services and Managing Director of VHB's South Portland, ME, office. He has extensive experience providing strategic technical advisory services for large energy projects along the East Coast. He joined VHB after having been a Principal at another firm where he served as the Bangor Hydro Project Manager to develop a large multi-billion-dollar underground DC transmission line project and two large multi-million-dollar overhead AC transmission line projects.

23 years of professional experience

Emera Maine, Atlantic Link, Massachusetts to Canada
Gil served as the Permitting, Siting Lead and a member of the Stakeholder Team for the U.S. portion of the Atlantic Link Project. This proposed high-voltage direct current transmission line will deliver 1,000 megawatts of clean energy to Massachusetts from land-based wind farms and hydro facilities in Atlantic Canada through a secure, submarine transmission cable. Gil worked very closely with BOEM to permit the project. The project also required a Presidential Permit, a U.S. Army Corps of Engineers permit, and state permits.

Emera Maine/National Grid, Northeast Energy Link, Maine to Massachusetts
Gil served as Project Manager for Emera Maine leading the technical and siting team to develop a 230-mile underground HVDC transmission line from Orrington, Maine, to the Boston, Massachusetts, service area. Gil managed and conducted a routing feasibility study considering a number of routing options including overhead, submarine, and underground, prepared cost estimates for route alternative, and detailed estimates for the preferred route. Gil also led a technical study to evaluate post-operational stability and reliability of the electrical system under steady state operations.

Madison Solar Project, Madison, ME

Gil served as the Project Manager for permitting, siting, storm water management, and erosion and sedimentation control for a 5 MW solar farm in Madison, ME. At the time of completion this project was Maine's largest solar farm. All permits were secured by VHB and the project was completed on time and with no environmental issues.

Emera Maine, Eastern Maine Medical Center, Waterworks Substation, Bangor, ME
Gil served as Project Manager for siting and permitting a new substation designed to support the expanding electrical load of the Eastern Maine Medical Center. A key element of the successful siting of this important project was for VHB to create a number of visual simulations and vegetative screening to support the stakeholder process as the substation was sited in a local park. The visual simulations were key in developing consensus from various stakeholders to gain consensus on the location of the proposed facility. The project was successfully permitted and constructed.

Emera Maine, Northern Maine Reliability Solution, Maine
Gil served as Project Manager for the environmental project siting and permitting team responsible for obtaining necessary federal, state, and local permits for a new 5-mile transmission line. He also managed the permitting process with the Department of Energy, for a Presidential Permit for Emera Maine. Gil managed a diverse assemblage of subconsultants and tasks including siting, visual analysis, archeological surveys, rare/threatened/endangered (RTE) species surveys, wetland surveys, and permitting. All permit applications were prepared, but the project was denied by the Maine Public Utilities Commission based on certain reliability criteria.

Emera Maine, MDI Transmission Upgrade, Bar Harbor, ME
Gil served as Project Manager for siting and permitting a new substation in Bar Harbor, Maine, and permitting associated transmission line upgrades in the region. All environmental permits were secured by VHB and the project was constructed.

Emera Maine, Orrington Series Capacitor, Orrington, ME
Gil served as Project Manager for the environmental project siting and permitting team responsible for obtaining necessary federal, state, and local permits for a new Series Capacitor in Orrington, Maine. All necessary environmental permits were secured in 2015 and the Project is currently under construction.

Emera Maine, Line 85 and 87, Maine
Gil served as Project Manager for the environmental project siting and permitting team responsible for obtaining necessary federal, state, and local permits for the rebuild of a 2-mile transmission line. He managed a diverse team and tasks including siting, visual analysis, archeological surveys, rare/threatened/endangered (RTE) species surveys, wetland surveys, and permitting. VHB also provided environmental monitoring services during construction. All permit applications were received and the Project was successfully completed in 2014 with zero environmental issues.

Bangor Hydro Electric Lines 51 & 93 Re-Rate Project
Gil served as Line Construction Manager for Bangor Hydro Electric leading the design, procurement process, permitting, and construction of the rebuild of a 25-mile 115 kV transmission line. Project consists of an in-kind replacement of H-frame structures coupled with an upgrade in conductor and adding fiber communications. Gil managed all aspects of the project including design, materials procurement, the contractor selection process including the RFP process, and construction.

Bangor Hydro Electric Line 64 Rebuild, Veazie to Chester, ME
Gil was Project Manager for Bangor Hydro Electric leading the design, procurement process, permitting, and construction of the rebuild of a 44-mile 115 kV transmission line. Project consisted of a total in-kind replacement of 344 H-frame structures coupled with an upgrade from single to twin-bundled conductor per phase. Gil managed all aspects of the project including design, materials procurement, the contractor selection process including the RFP process, and construction. The project was energized in December of 2011 and completed on schedule and under budget.

Bangor Hydro Electric, 115 kV Hancock County Reliability Project, ME
Gil was Project Manager for integrated engineering/ environmental project siting and permitting team responsible for obtaining necessary federal, state, and local permits for a 14-mile 115 kV transmission line. He managed a diverse assemblage of subconsultants

and tasks including, preliminary engineering design and siting, visual analysis, aerial photography and orthorectification of photos, archeological surveys, RTE surveys, wetland surveys, civil surveys, and permitting. The construction of the line was completed on schedule in 2008.

Bangor Hydro Electric, Northeast Reliability Interconnect, ME
Gil served as Project Manager for integrated engineering/ environmental project siting and permitting team responsible for obtaining necessary federal, state, and local permits for a new 86-mile transmission line. He established the stakeholder process to meet with various state and federal agencies, environmental groups, and large landowners to identify issues for siting the project. He also managed the permitting process with the Department of Energy, including the NEPA process, the preparation of an EIS, and the acquisition of a Presidential Permit for BHE. Gil managed a diverse assemblage of subconsultants and tasks including, preliminary engineering design and siting, visual analysis, aerial photography and orthorectification of photos, archeological surveys, RTE surveys, wetland surveys, AC mitigation investigations, civil surveys, and permitting. Gil managed the construction of the transmission line for BHE. The transmission line was successfully completed ahead of schedule in 2007. In 2009 managed and wrote the application to amend the Presidential Permit to increase export loads.

Bangor Hydro Electric, Keene Road 345 kV Substation, Chester, ME
Gil served as Project Manager for BHE leading the siting and environmental permitting of a new 345 KV substation in Chester, ME. Gil is currently overseeing environmental compliance for construction of the project.

Maritimes and Northeast Pipeline, Inc., Maritimes & Northeast Pipeline State and Federal Permitting; Wetlands, Wildlife, and Botanical Resource Assessment
Gil served as field technician, field lead, and Project Manager for the DTA consulting team responsible for overseeing and conducting environmental baseline studies and impact assessment for several phases of the Maritimes and Northeast Pipeline. This work included coordinating DTA staff and teaming with other consulting firms to conduct extensive wetland delineation, rare plant and wildlife surveys, impact analysis, and report preparation for state and federal permitting of the project. This position also required working closely with state biologists to address a variety of permitting issues.

Gil A. Paquette

Representative Project Experience

Emera Maine, Atlantic Link, Massachusetts to Canada (2016-2018)

Gil was the Permitting and Siting Lead and a key member of the stakeholder team for the U.S. portion of the Atlantic Link Project. This proposed high-voltage direct current transmission line would have utilized a 1,000 megawatts subsea cable from land-based wind farms and hydro facilities in Atlantic Canada to Massachusetts. Gil worked very closely with BOEM, the DOE and Massachusetts permitting agencies through the Project development stage. Gil also coordinated cultural and natural resource surveys, geotechnical surveys, property and contour surveys for the converter station. The project would have required a Presidential Permit, a U.S. Army Corps of Engineers permit, and state permits.

Madison Solar Farm, Madison, ME (2015-2016)

Gil served as Project Manager for a multidisciplinary VHB team to provide permitting, survey, and civil design of a 5 MW solar farm in Madison. The project is currently Maine's largest solar facility and became operational in 2016.

Emera Maine, Eastern Maine Medical Center, Waterworks Substation, Bangor, ME (2016)

Gil serves as Project Manager for siting and permitting a new substation designed to support the expanding electrical load of the Eastern Maine Medical Center. A key element of the successful siting of this important project was for VHB to create a number of visual simulations and vegetative screening to support the stakeholder process as the substation was sited in a local park. The visual simulations were key in developing consensus from various stakeholders to gain consensus on the location of the proposed facility. The Project was successfully permitted and construed.

Emera Maine, Northern Maine Reliability Solution, Maine (2014-2015)

Gil served as Project Manager for the environmental project siting and permitting team responsible for obtaining necessary federal, state, and local permits for a new 5-mile transmission line. He also managed the permitting process with the Department of Energy, for a Presidential Permit for Emera Maine. Gil managed a diverse assemblage of subconsultants and tasks including siting, visual analysis, archeological surveys, rare/threatened/endangered (RTE) species surveys, wetland surveys, and permitting. All permit applications were prepared, but the project was denied by the Maine Public Utilities Commission based on certain reliability criteria.

Emera Maine, Orrington Series Capacitor, Orrington, ME (2015)

Gil served as Project Manager for the environmental project siting and permitting team responsible for obtaining necessary federal, state, and local permits for a new Series Capacitor in Orrington, Maine. All necessary environmental permits were secured in 2015 and the Project was constructed.

Bangor Hydro Electric Lines 51 & 93 Re-Rate Project (2012-2014)

Gil served as Line Construction Manager for Bangor Hydro Electric leading the design, procurement process, permitting, and construction of the rebuild of a 25-mile 115 kV transmission line. Project consists of an in-kind replacement of H-frame structures coupled with an upgrade in conductor and adding fiber communications. Gil manages all aspects of the project including design, materials procurement, the contractor selection process including the RFP process, and construction. The Project was successfully constructed.

Emera Maine/National Grid, Northeast Energy Link, Maine to Massachusetts (2007-2014)
Gil served as Project Manager for Emera Maine leading the technical and siting team to develop a 230-mile underground HVDC transmission line from Orrington, Maine, to the Boston, Massachusetts, service area. Gil managed and conducted a routing feasibility study considering a number of routing options including overhead, submarine, and underground, prepared cost estimates for route alternative, and detailed estimates for the preferred route. Gil also led a technical study to evaluate post-operational stability and reliability of the electrical system under steady state operations.

Emera Maine, Downeast Reliability Project, Ellsworth to Harrington, ME (2008-2013)
Gil has served as Permitting Manager and Construction Manager for Bangor Hydro Electric's new 43-mile, 115 kV transmission line from Ellsworth to Harrington. He managed wetland surveys, vernal pool surveys, RTE surveys, visual analysis, archeological surveys, and geotech and soil surveys as well as the preparation of all permit applications. Gil also managed construction of the project. The Project was successfully constructed.

Bangor Hydro Electric Line 64 Rebuild, Veazie to Chester, ME (2008-2012)
Gil was Project Manager for Bangor Hydro Electric leading the design, procurement process, permitting, and construction of the rebuild of a 44-mile 115 kV transmission line. Project consisted of a total in-kind replacement of 344 H-frame structures coupled with an upgrade from single to twin-bundled conductor per phase. Gil managed all aspects of the project including design, materials procurement, the contractor selection process including the RFP process, and construction. The project was energized in December of 2011 and completed on schedule and under budget.

Bangor Hydro Electric, 115 kV Hancock County Reliability Project – ME (2006 – 2008)
Mr. Paquette served as Project Manager for integrated engineering/ environmental project siting and permitting team responsible for obtaining necessary federal, state, and local permits for a 14-mile 115 kV transmission line. He managed a diverse assemblage of subconsultants and tasks including, preliminary engineering design and siting, visual analysis, aerial photography and orthorectification of photos, archeological surveys, RTE surveys, wetland surveys, civil surveys, and permitting. The construction of the line was completed on schedule in 2008.

Bangor Hydro Electric, Keene Road 345 kV Substation, Chester, ME (2007-2010)
Gil served as Project Manager for Bangor Hydro leading the siting and environmental permitting of a new 345 KV substation in Chester, ME.

Bangor Hydro Electric, Northeast Reliability Interconnect, ME (2004-2007)
Gil served as Project Manager for integrated engineering/ environmental project siting and permitting team responsible for obtaining necessary federal, state, and local permits for a new 86-mile transmission line. He established the stakeholder process to meet with various state and federal agencies, environmental groups, and large landowners to identify issues for siting the project. He also managed the permitting process with the Department of Energy, including the NEPA process, the preparation of an EIS, and the acquisition of a Presidential Permit for BHE. Gil managed a diverse assemblage of subconsultants and tasks including, preliminary engineering design and siting, visual analysis, aerial photography and orthorectification of photos, archeological surveys, RTE surveys, wetland surveys, AC mitigation investigations, civil surveys, and permitting. Gil managed the construction of the transmission line for BHE. The transmission line was successfully completed ahead of schedule in 2007. In 2009 managed and wrote the application to amend the Presidential Permit to increase export loads.

Central Maine Power, 69 kV Southern York County Reinforcement Project – ME (2002 – 2004)
Mr. Paquette served as Project Manager for integrated engineering/ environmental project siting and permitting team responsible for obtaining necessary federal, state, and local permits and siting and designing the line. He managed integrated engineering/permitting team including siting, developing preliminary and final design, permitting, field surveys, preparing the RFQ for construction, and environmental inspection and compliance

management during construction of a 12-mile, 69 kV transmission in Kittery, York, and Elliot Maine. Project was constructed in 2004 and is energized.

Great Lakes Hydro America, LLC and Bangor Hydro-Electric Company, 115kV Chester-Millinocket Tie Line Project – ME (2002 – 2003)

Mr. Paquette served as Project Manager for environmental project siting and permitting team responsible for obtaining necessary federal, state, and local permits. He managed environmental field studies, data collection and analysis, and assessed facility layout for proposed 25-mile, 115 kV transmission line between Millinocket and Chester, Maine. This position also required working closely with state biologists to address a variety of permitting issues. Project was permitted in record time and constructed and energized in 2003.

Patriot Project, Tennessee, Virginia, North Carolina, East Tennessee Natural Gas (2000 – 2002)

Mr. Paquette served as Project Manager for the environmental consulting team responsible for conducting environmental field investigations, preparing environmental study reports, and preparing federal and state permit applications for the proposed project. Field studies included conducting wetland delineations, conducting wildlife surveys and wildlife habitat evaluations, and searching for RTE plants and wildlife along the pipeline corridor and associated facilities. Also, solely responsible for preparing state and federal permit applications including Section 10/404 (U.S. Army Corps of Engineers) and Tennessee, Virginia, and North Carolina state permit applications. This position also required working closely with state and federal biologists to address a variety of permitting issues. The Project was successfully constructed.

Maritimes and Northeast Pipeline, Inc., Maritimes & Northeast Pipeline State and Federal Permitting; Wetlands, Wildlife, and Botanical Resource Assessment (1996-1999)

Gil served as field technician, field lead, and Project Manager responsible for overseeing and conducting environmental baseline studies and impact assessment for several phases of the Maritimes and Northeast Pipeline. This work included coordinating staff and teaming with other consulting firms to conduct extensive wetland delineation, rare plant and wildlife surveys, impact analysis, and report preparation for state and federal permitting of the project. This position also required working closely with state biologists to address a variety of permitting issues. The Project was successfully constructed.

STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

IN THE MATTER OF

CENTRAL MAINE POWER COMPANY	)
NEW ENGLAND CLEAN ENERGY CONNECT	)
#L-27625-26-A-N/#L-27625-TG-B-N/	)
#L-27625-2C-C-N/#L-27625-VP-D-N/	)
#L-27625-IW-E-N	)

Intervenor Group 3 Response to the Department of Environmental Protection's Tenth Procedural Order: Supplemental Testimony by Gil A. Paquette

May 1, 2019

My name is Gil A. Paquette. Please refer to my sur-rebuttal testimony filed on April 19, 2019 in this proceeding ("Paquette Sur-rebuttal") for a description of my relevant qualifications and work experience. Below I address certain questions posed in Appendix A of the Department of Environmental Protection's Tenth Procedural Order, at times referring to Paquette Sur-rebuttal sections for a more fulsome discussion of the relevant topic.

Answers to Questions in Appendix A

<u>Construction Questions</u>:

2. Description of construction process, staging, and impacts for 100-foot or taller poles.

Answer:

A general understanding of what overhead transmission structures are used, where, and why is a helpful lens through which to answer this question. Generally, there are three types of high-voltage transmission structures: (1) tangent; (2) angle; and (3) termination or dead-end. Tangent structures are used for straight-line segments and are typically monopoles, H-frames, or lattices, each with different attributes that suit them for particular types of locations. Monopoles are single poles that require less ROW width than, for example, H-frames. For voltages as high as the NECEC, monopoles are typically made of steel, making them relatively expensive but strong. Depending on height, monopoles can be directly imbedded into the substrate with or without guying[1] for stability. Monopoles are considered less visually impactful compared to H-frames and most termination structures. H-frames are comprised of two vertical poles with a crossarm connecting their mid-points and are typically made of relatively inexpensive wood. H-frames provide additional stability with their wide base but require relatively more ROW and to some are considered more visually impactful. Lattices are typically extremely strong steel structures similar in form to the Eiffel Tower. Lattices are often the tallest tangent structures used to span the greatest distances, commonly in the flat agricultural areas of the Midwest or for long river crossings. Though lattice structures themselves are more expensive, their use can reduce the total number of structures because they are typically used for longer spans. However, lattices are by far the most industrial, visually striking of the tangent structures.

Angle structures are used when a transmission line changes direction by as little as one or two degrees. These structures must be fortified to distribute the load of the conductor going from one direction to another. In the case of the NECEC, angle structures could take a few forms. There could be two monopoles, each with a concrete foundation. There could also be two monopoles, each with guy wires that anchor the poles to the ground so that the monopoles are not pulled downward by the load of conductor. A single monopole with a concrete foundation is another option.

Finally, termination or dead-end structures are used to create a "break-away" point that limits cascading damage. For example, after 5 continuous miles of spliced conductor, a conductor would typically be terminated on a dead-end structure so that if a tangent structure preceding the termination structure failed, the failure would could not cascade beyond the break-away point and overall damage to the transmission line could be contained. To protect the overall transmission line from cascading, dead-end structures are more robust than a tangent or angle structure, as they need to withstand a cascading event and not collapse under the weight of the conductor that is

[1] Guying in this context refers to the use of a tensioned wire designed to add stability to a free-standing structure (i.e., a structure that is not attached to a foundation). Guy wires are attached to the pole and the other end is anchored to the ground a certain distance away, at roughly a 45-degree angle.

being pulled down by the portion of the line that is cascading. Dead-end structures for an overhead transmission line are either guyed or have concrete foundations.

As currently proposed, the NECEC would involve the use of monopoles for its tangent structures, with an average height of about 94 feet (though some poles would be slightly taller). Each pole would be directly imbedded into the substrate. Burial depth is a function of pole height and, to some extent, the backfill used for the excavation. For steel poles, a common rule of thumb for burial depth is 10 percent of the pole height plus 4 feet of the length of the pole. For example, a 94-foot steel pole would be buried 13.4 feet deep. No concrete foundations or other forms of support like guy wires would be necessary, unless there were extenuating circumstances.

Assuming similar monopole tangent structures, there is no material difference in the construction process, staging, and environmental impacts for poles that are less than 100 feet tall and poles that are up to about 120 feet tall. However, I assume the purpose of asking about "100-foot or taller poles" would be to allow for full vegetation height below the transmission line for the preservation of travel corridors. Pine marten, for example, would require about 30-foot-tall vegetation. To achieve full vegetation height (30 feet) and maintain the proper conductor clearance zone of approximately 26 feet below the lowest sag point of the conductor, significantly taller structures would be needed. The exact height of the monopoles is difficult to estimate, as it is a site-specific, project-specific engineering determination based on a variety of factors, including topography, span length, conductor sag, point where the conductor is attached to the insulator relative to the top of the pole, etc. I would roughly estimate that monopoles between 130 and 150 feet tall would be required to provide full-height vegetation sufficient for pine marten. As CMP proposes to use monopole steel tangent structures, I assume that the taller poles would also be monopole steel. Wood poles made from whole tree trunks are rare over 120 feet, however, laminated wood structures may be available.

Assuming monopoles 140 feet tall (the simple average of 130 and 150 feet), concrete foundations would be required, as opposed to directly embedding the structures into the ground, and therefore the construction process would be quite different. The biggest difference is the need for adequate access to allow concrete mixer trucks to access the structure locations. Concrete foundations for this application are too large for pre-casting followed by site-specific transport. Therefore, to accomplish foundation construction along Segment 1, temporary roads within the ROW of sufficient durability to withstand extremely heavy concrete mixing trucks would need to be cleared, leveled, and stabilized, likely necessitating the use of extensive matting and perhaps the construction of new or re-enforcement of existing bridges. Ideally, existing roads (most likely logging roads) crossed by the ROW, spaced at approximately 1-mile intervals, would be available for use along Segment 1 to provide access to the ROW, as this will tend to minimize environmental impacts. In addition to temporary road impacts, there would be additional environmental impacts at each pole location because a significant amount of excavation would be required to accommodate the concrete foundations, which can be as large as 10 feet in diameter and 45 feet deep (compared to a splice vault which is 28'x 8'x 8'). To the extent excavation is required near wetlands and other waterbodies, unstable soil, or bedrock, the impacts would be even greater. Please refer to Paquette Sur-rebuttal Sections D.3 and D.4 for a discussion of the logistical and environmental impacts associated with excavating near wetlands and in trench.

3. A more detailed description of undergrounding techniques including direct burial, duct bank installation, or trenchless installation. This should also include typical dimensions, materials and cross-section diagrams.

Answer:

I believe that contractors experienced with trenchless transmission installations would be the most appropriate people to address trenchless techniques and their impacts. Further, in my experience, duct banks have been used only in multi-purpose ROWs in an urban or suburban setting, i.e., a road under which various types of utility infrastructure such as electric lines, natural gas mains, water mains, and fiber optic cable are buried. In this context, duct banks provide an added layer of protection to ensure that one utility does not unintentionally damage the infrastructure of another utility while attempting to service its respective facilities. I would not expect to see duct bank installation in many areas of Western Maine, such as Segment 1, if at all. For these reasons, I will only address the direct burial technique.

If direct-burial were used for Segment 1, HVDC cables would need to be buried in a trench of varying depths but approximately 6 feet on average. The slope and width of excavation may vary due to geotechnical conditions and the terrain along the route. As explained in Paquette Sur-Rebuttal in Section D.3., a typical trench would be approximately five feet wide at the bottom with sloping sides and a minimum surface width of 14 feet, increasing when trench depth increases. This is generally true, but Occupational Safety and Health Administration ("OSHA") requirements and other variables will affect sloping and thus the corresponding width of the trench. Per OSHA, the trench would need to be sloped on each side of the trench to protect workers. Sloping requirements depend on soil type, with greater sloping required for less stable soils. Soils are generally classified into three types based on their stability (A, B, and C). Assuming a five-foot width at the base of the trench to accommodate five cables, the width of the trench opening would range from an approximate minimum of 14 feet (with the most stable soil type, A) to an approximate maximum of 23 feet (with the least stable soil type, C). In my experience, the least stable soil type, C, occurs with some frequency in Maine. Soils that are less stable than C would require shoring[2] the trench. Along Segment 1, unstable soils would generally be unavoidable and would cause many unexpected delays when encountered. Though sloping could be avoided in stable bedrock, it would be required through wetlands.

Once the cables are laid into the trench, the cable would be surrounded by a layer of imported thermal sand backfill, as described in Paquette Sur-rebuttal Section D.8. Above the sand backfill High Density Polyethylene (HDPE) "stokboard," warning tape, or both would need to be installed. This would act as a warning for someone digging in proximity to the cable, including third parties. In lieu of stokboard, concrete slabs could be placed above the thermal backfill as an extra level of protection. Depending on the type of native material excavated from the trench, some native material could be re-applied on top of the concrete slab, stokboard, or warning tape and then compacted. The remainder of the excavated material would either need to be spread in uplands or removed from the Project area and disposed of at an appropriate facility.

As the weight of the cable limits the amount that can be installed on reels (average length of 2,250 feet), separate lengths of cable would need to be spliced together and subsequently placed in a pre-cast concrete vault. Vaults would be approximately 26' x 8' x 8'. The trench excavation for the

[2] Trench shoring is the process of bracing the walls of a trench to prevent collapse and cave-ins. Several methods can be used, for example, steel plates pressed outward against the trench wall via hydraulic pressure and steel I-beams driven into the ground with steel plates slid in among the I-beams.

splice vaults will be approximately 14 feet wide at grade (though the width of excavation may be greater due to geotechnical conditions and the terrain along the route). Shoring would be used in areas with highly unstable soil conditions.

After the splice pit is excavated, pre-cast concrete vaults would be installed in the splice pit. The cables would be pulled through the vault and spliced using a temporary splice trailer situated over the vault. The splices would then assembled and placed into the vault, with thermal sand backfilled over them in the vault.

5. Whether fewer longer sections (versus more shorter sections) of the line could be undergrounded that would minimize both the number of transition stations as well as the environmental impact of the project.

Answer:

To answer this question, it is important to remind the reader of cable length restrictions due to the weight of cable. On average, the length of cable on the reels will be about 2,250 feet. As such, any "longer sections" would be limited by the length of the cable on the reel. Every termination of the cable would require splicing and thus a concrete splice vault for protection and access. It is possible to have longer sections of underground, but splice vault locations would need to be excavated and installed at every splice, approximately every 2,000 to 2,250 feet.

A useful term to understand is "porpoising"—used to describe going from an underground project to an overhead project. The electrical characteristics of HVDC allow a line to be "porpoised," whereas it is very difficult to porpoise an HVAC line. While porpoising may help to minimize or avoid certain visual and environmental impacts in certain areas, it causes different and potentially more severe visual and environmental impacts in other areas and complicates overall construction and logistics due to the need to engineer and construct large, permanent transition stations.

If there are longer underground sections, it stands to reason that there will be fewer transition stations needed to transition to an underground cable from an overhead conductor or vice versa. Fewer transition stations would equate to less overall site-specific temporary and permanent environmental impacts associated with transition stations. However, any amount of porpoising would likely create more environmental impacts compared to a purely overhead line throughout Segment 1 based on the need to erect permanent transitions stations and the greater impacts associated with undergrounding generally. Please refer to Paquette Sur-rebuttal Section D for a discussion of the greater logistical and environmental impacts associated with an underground project versus an overhead project. In general, overhead projects minimize or avoid environmental impacts to wetlands and streams and other protected natural resources. Therefore, transitioning to underground from overhead for any discrete sections of Segment 1 would not be the least environmentally damaging practicable alternative without extenuating circumstances, such as those that exist with respect to the visual and recreational impacts associated with the Kennebec Gorge.

6. Explanation of why a permanent road would need to be constructed to each splice location (undergrounding), but not for overhead poles. Explanation of why matting along the ROW (which could be used for overhead poles) could not be used for splice boxes.

Answer:

The biggest difference between overhead and underground construction is the type of equipment that would be required for installing an underground cable. For overhead construction, tracked excavators, tracked cranes, and heavy-duty pickup and bucket trucks must access the ROW. Although this equipment needs to travel within the ROW, the equipment used is specifically designed for traveling a cleared ROW without the need for building a temporary or permanent gravel road for construction. For a project like NECEC, it would be desirable to have access to the ROW from an existing road crossing of the ROW, such as a logging road, about every mile. This would allow for less travel within the ROW, as equipment would only need to travel in either direction for up to half of a mile. A temporary travel lane would be identified within the ROW, with matting used to cross wetlands and temporary bridges used to span waterbodies. Once construction is completed, mats and bridges would be removed, and the ROW would be seeded and mulched. In most situations, after one growing season, the temporary travel lane and work pads at the structures would be stable and vegetated.

Overhead construction can move relatively quickly compared to underground construction because excavation is only required at pole locations and, as planned, the NECEC would not require the use of pole foundations for very tall poles. Overhead construction also provides leeway to avoid many, if not all, sensitive areas (e.g., streams and wetlands) through thoughtful spacing of poles and spanning of the conductor. For example, if there is a waterbody that is too wide for the installation of a temporary bridge, access to pole locations can be made on other side of waterbody, thus avoiding a crossing. This is also true for wetlands, such as peat bogs, where the poles are placed outside the bog, allowing the bog to be spanned. Access could be gained on either side of the bog, thus avoiding a wetland crossing.

For underground construction, the greatest difference in the type of equipment used is based on a variety of factors, including the need: (1) for thermal sand as backfill; (2) to transport reels of cable to the ROW (as opposed to pulling conductor from one location to another); (3) to transport splice trailers to every splice along Segment 1; and (4) to transport splice vaults to every splice location along Segment 1. I describe the logistical and environmental impacts associated with these factors and other similar factors throughout Section D of the Paquette Sur-rebuttal. If excavated material cannot be backfilled into the trench or spread in uplands along the ROW, then the increase in activity associated with material removal alone would warrant the need for additional mats because with excessive traffic, mats tend to "rock" or sink deeper into the substrate. Uplands would also need to be graded smooth and/or matted because wheeled dump trucks cannot traverse rough upland terrain and the soil may be too soft to withstand heavy-duty equipment especially during spring and fall.

With the NECEC being a major transmission line, access for repairs is an important consideration regardless of whether overhead or underground. For an overhead line, the repair process is simpler, beginning with identification of a fault or other problem. Equipment in a substation can provide a rough idea of where a fault has occurred. Once the general area is identified, a focused effort would be conducted to identify the specific issue. With the NECEC, a helicopter would likely be used for visual identification. For relatively simple emergency repairs (such as a downed tree on a line or a failed insulator), emergency response can be fast, with the outage restored within a few hours or a day. During an emergency repair, there are a number of options to access the ROW depending on the emergency and where it is located that could range from a small crew using ATVs to the use of a tracked bucket truck or excavator on a mat road.

For underground cables emergency repairs are much more complicated. Repairs are necessitated by either a cable failure (e.g., a hot spot in the cable) or a fault, where the cable or splice is damaged thus creating a pathway for electricity to surge into the ground. Equipment in a substation or converter station can detect a fault and in microseconds breakers would be opened to stop the flow of electricity. For an underground cable failure or fault, the exact location of the problem would needed to be pinpointed using an excavator, however. Similar to an overhead line, the general location of the failure or fault can be determined by equipment in the substation or converter station. However, there is no way to visually inspect the cable (using a helicopter or otherwise) without excavating. Excavating the general area of the fault must be done carefully so as to not damage the portions of the cable that are still functional. The nature of the required excavation could be considerable, taking even more time.

You can think of a cable failure or fault as a small piece of "bad wire." It cannot generally be fixed, but must be cut out, which requires splicing the two new good ends of cable together or splicing in an entirely new segment of cable. When a cable failure or fault is pinpointed, a splice trailer would need to be transported to the location. If the problem is not at an existing splice site, then a new vault would need to be transported to the new splice location and installed after further excavation. Thermal sand imported with dump trucks would need to be placed in the vault once the splice has been completed. Any impediment to quick access, such as the need to lay mats or build bridges would increase the response time and thus outage time. Therefore, to decrease the risk associated with extended outages, permanent gravel access roads should be built at a minimum to each splice vault.

Environmental Questions:

13. Whether taller poles and travel corridors could provide enough of a link between the habitat on both sides of the corridor for species like the pine marten.

Answer:

Because of the need to access the ROW for maintenance and emergencies, and to ensure that vegetation does not encroach into the conductor clearance zone, in my opinion it is not advisable to attempt to create travel corridors for pine marten under a transmission line. When managing for pine marten, the forest canopy height should be at least 30 ft. Unless a rigorous vegetation maintenance program is implemented that would be similar to managing a city park, it would be impossible to achieve the desired cover and structure of pine marten habitat under a transmission line. Implementing such a maintenance program itself would increase environmental impacts associated with permanent and temporary access requirements.

It has been shown that pine martens avoid clear-cuts. This is understandable given the amount of time pine martens spend in the tree canopy. However, this does not necessarily imply that pine martens would not cross a vegetated transmission line ROW with herbaceous vegetation and shrubs. Consider the following analogy to squirrels.

One can scientifically observe squirrel movements using radio telemetry, the data from which provide “snapshots” in time of the location of specimens. More snapshots of specimens in locations with habitat type A, say tree canopies, implies that squirrels as a species prefer tree canopies. Fewer snapshots of specimens in locations with habitat type B, say roads, implies that squirrels as a species avoid roads. Let’s assume a statistically significant record of squirrel movements every five minutes. How many snapshots do you think would be recorded of squirrels on roads? Probabilistically, there would be very few snapshots of squirrels on roads because squirrels spend relatively little time on or crossing roads compared to being in trees or foraging under tree canopies. But it does not follow that squirrels avoid roads. We know from our everyday experience that squirrels often cross roads. If the amount of time a squirrel is observed crossing the road is proportional to the width of the road, taking into consideration the overall available squirrel habitat, then it cannot be said that squirrels avoid crossing roads, though they do prefer other habitat types.

Similarly, we cannot say that pine martens will avoid crossing transmission lines based on radio telemetry data[3] or daily observation. Pine martens certainly prefer forested habitat, but may be

[3] Continuous monitoring is now possible through satellite tracking, though I am unaware if this has or can be used to monitor pine marten.

willing, like squirrels, to frequently, though very quickly, cross a vegetated transmission corridor to get to forest habitat on the other side. Given the lack of evidence to support that pine marten will not cross vegetated ROWs, and that pine marten are legally permitted to be trapped and are not a protected species in Maine, in my opinion, there will not be a significant adverse impact to pine marten caused by the Project.

14. In TNC's nine areas of concern, whether travel corridors must be located within a certain distance of the structures (poles), and what the minimum width would be of the travel corridors in order for species like the pine marten to use them.

Answer:

In my opinion, there is no need to maintain travel corridors under an overhead transmission line. As discussed above, telemetry data in general does not necessarily support that pine martens, or other species, will totally avoid and thus not cross a transmission line ROW; the data simply mean that pine martens do not spend a lot of time in open habitat. The terms 'prefer' and 'avoid' are artificial terms used to describe the pattern exhibited by the locations of pine marten data. These terms are useful in describing pine marten movement but, again, do not necessarily describe habitat use accurately. Additionally, a ROW is a relatively narrow strip whereas a clear-cut is typically a block of land that has been cleared. It is a stretch to draw a comparison between ROW and clear-cuts.

15. In TNC's nine areas of concern, whether tapering would adequately reduce the forest fragmentation of any clearing.

Answer:

In my opinion, it is not preferable to maintain tapering under an overhead transmission line because tapering would compromise the reliability of the line and likely increase overall environmental impacts. Reliability is compromised when vegetation grows into the conductor clearance zone and creates an opportunity for electricity to arc to the vegetation and create a fault. Vegetation does not have to touch a line for a fault to occur. For the voltage of the NECEC, electricity can create an arc up to 12 to 15 feet in length. The Northeast Blackout of 2003 was caused by such an event.

Further, to create a living, forested habitat using tapering would require significant annual maintenance. If trees were simply topped to provide tapering, most of the tree crowns would be lost and the trees would die. You would be left with tapered, dead trees until younger trees grew taller. Once the younger trees grow taller, annual maintenance would require the use of bucket trucks for trimming those trees that could not be climbed by an arborist. For bucket trucks to access the ROW, a permanent road would need to be constructed or mats and bridges would need to be placed in the ROW during each access event. For standard ROW maintenance, the ROW is accessed every 5 years on average, and on foot. There is typically no need for heavy equipment to travel down the ROW.

17. Whether tapering within the 100-foot buffers around streams would provide adequate large woody vegetation for streams in segment 1 which are typically less than 10 feet wide.

In my opinion, it is not preferable to maintain continuous forested vegetation under a transmission line. The best option in this scenario, in my opinion, would be to create a narrow vegetation buffer (25 feet on either side of a stream) that allows taller vegetation to grow up to a threshold. Hand cutting would be used in the buffer and no herbicides would be allowed. Shrubs such as tall alders would be maintained as well as trees species such as balsam fir up to 10 to 12 feet. For streams less than 10 feet this type of buffer would provide adequate cover, as the streams are narrow enough to be screened by remaining vegetation.

Dated at Scarborough, Maine this 1st day of May, 2019.

By: ______________________
Gil A. Paquette

The aforenamed Gil A. Paquette did personally appear before me and made oath as to the truth of the foregoing pre-filed testimony.

Before me: ______________________
Robert B. Borowski
Attorney at Law
Bar Number: 4905

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State of Maine, Department of Environmental Protection and Land Use Regulatory Commission

CENTRAL MAINE POWER COMPANY NEW ENGLAND CLEAN ENERGY CONNECT Application for Site Location of Development Act permit, and Natural Resources Protection Act permit for the New England Clean Energy Connect ("NECEC") Project in 25 municipalities, 13 Townships or Plantations and 7 Counties from Beattie Township to Lewiston and Wiscasset to Windsor. L-27625-26-A-N L-27625-TB-B-N L-27625-2C-C-N L-27625-VP-D-N L-27625-IW-E-N

Pre-filed Testimony of Jeff Reardon
Maine Brook Trout Project Director
Trout Unlimited
Manchester, ME
Witness for Trout Unlimited

Qualifications and Purpose of Testimony

1. State your name, address and current occupation:

Jeff Reardon, 267 Scribner Hill Road, Manchester, ME 04351. For the past 20 years I have worked for Trout Unlimited in Maine. My current title is Maine Brook Trout Project Director.

2. What is your relevant professional experience?

I have been working for Trout Unlimited in a variety of positions since 1999. I worked as New England Conservation Manager from 1999-2006. From 2006 to 2011 was the Design and Permitting Coordinator for the Penobscot River Restoration Project. Since 2011, I have worked full time on brook trout conservation at Maine Brook Trout Project Director. I have broad experience working on coldwater fish conservation. I have represented Trout Unlimited in more than a dozen hydroelectric dam relicensings before the Federal Energy Regulatory Commission; coordinated four dam removals and construction of a "nature-like" fish bypass; overseen TU's efforts to identify and fix impassable culverts; coordinated citizen-science projects related to water temperature monitoring and identifying undocumented brook trout populations in remote ponds and coastal streams; testified on legislation and regulatory rule-making in the Maine and New Hampshire legislatures and the US House of Representatives; and worked to identify and complete land conservation projects intended to protect brook trout habitat in Maine's rivers, streams, and ponds. Before working for Trout Unlimited, I worked for the Sheepscot Valley Conservation Association, a land trust in mid-Coast Maine, as the Watershed Projects Director for 3 years. In that role, I identified parcels and coordinated conservation of lands through conservation purchase or conservation easement to protect Atlantic salmon habitat; worked with landowners to improve riparian buffers to protect coldwater aquatic habitat; and surveyed the entire length of the Sheepscot River to monitor the condition of riparian buffers.

3. What is your education?

I graduated from Williams College with a degree in biology in 1989. My senior honors thesis was related to impacts of disturbance on northern forests.

4. Have you previously testified before the Maine Department of Environmental Protection (DEP) or the Maine Land Use Planning Commission (LUPC?)

I have testified at many DEP and LUPC (or LURC) hearings, but this is the first time I have done so as an expert witness.

5. Do you have specific expertise that relates directly to your testimony in this case?

I have worked on a number of projects directly related to the issues I am testifying on here, chronologically:

1. In 1997-99, working for the Sheepscot River Conservation Association and as lead for the Sheepscot River Watershed Council, I helped implement and test a "Methodology for Determining Optimal Riparian Buffer Width" that had been developed by Kleinschmidt Associates for the Maine Atlantic Salmon Commission. My role was to work with two landowners to implement the method on conservation lands adjacent to Atlantic salmon habitat in the Sheepscot River. More information on this project is available here: http://kleinschmidtgroup.com/index.php/projects/eco-fisheries/atlantic-salmon-riparian-buffer-zone-determination
2. In 1999, for the Sheepscot Valley Conservation Association, I worked closely with the Maritimes and Northeast Pipeline to coordinate construction of a pipeline corridor through the Sheepscot watershed with no damage to aquatic habitat at stream crossings.
3. From 1999 to 2002 I represented Trout Unlimited during the relicensing of the Indian Pond Dam on the Kennebec River, and, with other parties, negotiated a settlement agreement that required extensive studies of the brook trout population in the Upper Kennebec watershed. These studies informed decisions by the Indian Pond Fisheries Habitat Committee, which used the information to plan habitat restoration and protection projects funded by the Indian Pond licensee. Those studies documented, for the first time, extensive migrations of brook trout between the Kennebec and Dead River mainstems and multiple small tributaries, particularly Cold Stream and Tomhegan Stream. I continue to serve as a member of the Indian Pond Fisheries Habitat Committee.

4. On behalf of Trout Unlimited, in 2003-2006, I hired Kleinschmidt Associates to refine their Atlantic salmon riparian buffer methodology for protection of brook trout habitat, particularly in higher elevation streams in western Maine. We developed a recommended buffer that was broadly applicable for brook trout habitat in Maine. The recommendations were then vetted with fisheries biologists from the Maine Department of Fisheries and Wildlife, and, in cooperation with the Forest Society of Maine, with large forest landowners. Trout Unlimited and partners have used those recommendations as the basis for planning conservation projects, including conservation easement terms, ever since.
5. In 2010-2016, I worked closely with partners at the Maine Department of Inland Fisheries and Wildlife (MDIFW), Maine Bureau of Parks and Lands (MBPL), Trust for Public Land and landowner Plum Creek on the Cold Stream Forest Project, in which MBPL acquired the 8,200-acre parcel primarily to protect brook trout habitat in Cold Stream and its tributaries. Since acquisition was completed in 2016, I have been working with BPL staff to develop the management plan for the property by serving on the Advisory Committee for that planning process.

6. Are you familiar with the application for the New England Clean Energy Connect (NECEC)?

I have reviewed the Site Law application and the Natural Resources Protection Act application. I have spent extensive time reviewing the route and proposed stream crossings, both on the map—primarily using the KMZ layer provided by Maine DEP—and on paper. I have reviewed much of the agency consultation regarding stream crossings, fisheries, riparian buffers, and proposed mitigation. I have reviewed the Compensation Plan, dated January 30, 2019, in detail. I have compared the information and data presented in these documents to other available data on fisheries and aquatic habitat, primarily available in on-line GIS format from the Maine Department of Inland Fisheries and Wildlife[1], from the Eastern Brook Trout Joint Venture[2], from the National Fish Habitat Partnership[3], and from Trout Unlimited's Conservation Portfolio Analysis of native brook trout habitat[4].

7. Are you familiar with area through which the NECEC will pass?

I have worked extensively in two regions that will be impacted by the NECEC. I worked full time on the Sheepscot River from 1996 to 1999, while working as the Watershed Program Director. I have worked extensively in the Upper Kennebec Watershed for my entire 20-year career with TU, with multiple projects in the Dead, Kennebec, and Sandy River drainages. I am most familiar with the Cold Stream watershed, where I worked nearly full time from 2010-2016. I have also fished, hiked and paddled throughout the Upper Kennebec region. I have fished many of the streams that will be crossed by the NECEC and the ponds where the route will pass nearby.

8. What is the purpose of your testimony?

My testimony addresses the impacts of the project as proposed on brook trout and Atlantic salmon fisheries habitat; the failure of the Applicant to adequately assess these impacts; the

[1] Maine Stream Habitat Viewer: https://www.maine.gov/dmr/mcp/environment/streamviewer/
[2] EBTJV data are viewable in an online GIS at http://ecosheds.org:8080/geoserver/www/Web_Map_Viewer.html
[3] http://assessment.fishhabitat.org/
[4] http://trout.maps.arcgis.com/apps/webappviewer/index.html?id=1bbd262b634647b3beb78a6685a607d5

inadequacy of proposed buffers to protect brook trout habitat; the failure of the applicant to adequately assess and pursue potential alternatives to the project that would be less damaging to natural resources, including brook trout habitat—particularly alternative methods or sites for stream crossings; the degree of impact and the quality of resources impacted by the proposed NECEC project; the quality and quantity of brook trout habitat on parcels and funds proposed as compensation for impacts of the proposed project; and the failure of the applicant to adequately mitigate the impacts of the NECEC project on brook trout habitat.

9. Summarize your testimony.

The region through which the proposed NECEC project will be completed is the heart of the largest reservoir of intact aquatic habitat in the Northeast. This habitat supports populations of native brook trout that have been identified as the "last true stronghold for brook trout in the United States."[5] The proposed new corridor would substantially fragment this habitat, with multiple stream crossings that impact brook trout habitat, and the creation of a new corridor that could be a vector for increased human use and introduction of invasive species. The Applicant's assessment of these resources and impacts is inadequate, does not contain a specific analysis of impacts to brook trout habitat, and assumes the impacts of the new permanent corridor will be identical to the impacts of past and present forest management. The Application fails to consider reasonable alternatives to reduce impacts on brook trout habitat—including alternatives that were employed to reduce impacts on other resources. There are practicable alternatives to the project that would be less damaging to brook trout habitat. The Application's proposed mitigation is

[5] Eastern Brook Trout Joint Venture (2006): Eastern Brook Trout: Status and Threats. https://easternbrooktrout.org/reports/eastern-brook-trout-status-and-threats%20%282006%29/view

inadequate to compensate for impacts on brook trout habitat.

With respect to the DEP Site Law and Natural Resources Protection Act Application, the provisions for buffer strips are inadequate to protect brook trout habitat, including brook trout migration. The application does not meet the Chapter 375 standard that "Proposed alterations and activities will not adversely affect wildlife and fisheries lifecycles," particularly with respect to brook trout. The proposed mitigation to address these adverse effects on brook trout is not adequate. The DEP should therefore deny the permit.

With respect to the LUPC's certification that a utility corridor should be allowed within the PRR Zone around Beattie Pond, the Applicant has not demonstrated that there is "no alternative site that is both suitable for the use and reasonably available to the applicant", or that existing uses can be reasonably buffered from the impacts of the NECEC corridor. In particular, we are concerned that the NECEC corridor will become a pathway for motorized vehicles, including ATV's, and this increased motorized use around Beattie Pond will substantially increase the risk that invasive fish species become established in Beattie Pond, a designated State Heritage Fish Water for brook trout.

Brook Trout Habitat Values of Maine's Western Mountains and Impacts of NECEC on Selected Brook Trout Resources

10. Please describe the aquatic habitat and brook trout resource in Maine's Western Mountains Region.

Other witnesses will speak to the broader ecological values of the uninterrupted forest in western Maine, and they will primarily focus on terrestrial resources. I will address the aquatic resources. These are among the most intact watersheds remaining in the continental United States. Western Maine contains the vast majority of un-degraded aquatic habitat in the northeastern states. Just 17% of the land area in the region is considered to have "very low" levels of aquatic habitat degradation, and most of this is in western and northern Maine. The entire Maine/Quebec border falls into this category[6]. (See Exhibit 1.)

This intact habitat supports the nation's most significant stronghold of native brook trout populations. More than half of all subwatersheds designated as supporting "intact" populations of brook trout are in Maine, and the Western Mountains Region is the heart of this stronghold. Maine is the only state with any significant remaining lake and pond populations of brook trout, with more than 97% of those remaining[7]. (See Exhibit 2.) With the notable exception of the mainstem Dead River and the Kennebec River downstream of the Williams Dam, both of which are stocked annually with hatchery trout, virtually every stream and river in the region supports wild brook trout, and assessments of these populations for the Eastern Brook Trout Joint Venture classify almost all of them as "intact" at the subwatershed scale.

This is a resource of national significance. It is without doubt the most important and extensive reservoir of native trout biodiversity east of the Mississippi and may be the most intact native trout resource in the continental United States.

11. Does the Application accurately describe this resource?

No. The description of the brook trout resource in the Site Law Application is limited to a

[6]National Fish Habitat Partnership, 2015. Through a Fish's Eye, the Status of Fish Habitat's in the United States, 2015.

[7] Eastern Brook Trout Joint Venture (2006): Eastern Brook Trout: Status and Threats. https://easternbrooktrout.org/reports/eastern-brook-trout-status-and-threats%20%282006%29/view

single paragraph. Although this paragraph[8] notes that "Brook trout are essentially pervasive in the Project Area and may be found in some portion of many of the waterbodies," it does not distinguish between the essentially intact populations in the region crossed by the "Greenfield" route from Beattie Township to Moxie Gore, and the far less extensive and more fragmented resources found in areas at lower elevations, within the mainstem Kennebec and Dead River and farther south. It also does not provide the important context that intact populations of brook trout at the landscape scale essentially exist only in western and northern Maine, and nowhere else within the species' US range. Other than counting stream crossings—without providing information on the fisheries values of the streams in question—the Alternatives Analysis in the NRPA Application does not discuss fisheries impacts.[9] In the discussion of "Site Specific Design to Minimize Environmental Impacts", measures to avoid or protect fisheries are not discussed, although the Applicant notes that "CMP has been in consultation with MNAP and MDIFW regarding potential rare, threatened, and endangered plant communities and animal occurrences."[10] Consultation with MDIFW staff about brook trout presence at crossings appears to have been left until very late in the process, with handwritten comments on the NECEC Water Body Crossing Table (Exhibit 7-7) provided on by MDIFW February 2, 2019.[11]

Similarly, the Revised Compensation Plan, dated January 30, 2019, contains little information regarding brook trout. Table 1-1: "Summary of Compensation as Required by NRPA and USACE" does not mention impacts to fisheries habitat. In Table 1-2: "Summary of

[8] Site Law Application, Chapter 7, page 40.
[9] NRPA Application, Pages 2-2 to 2-23.
[10] NRPA Application, Pages 2-22 to 2-23.
[11] See emails from Bob Stratton (MDIFW) to Jim Beyer (MDEP), late January/early February 2019, retrieved at: https://www.maine.gov/dep/ftp/projects/necec/review-comments/2019-02-01%20MDIFW%20Comments/

Compensation Resulting from Consultation with Resource Agencies," the only indirect reference to fisheries habitat is the inclusion of "12.02 linear miles of stream" in preservation parcels to compensate for 11.02 linear miles of forested conversion in riparian buffers. There is no assessment of the fisheries resources or habitat values of the streams on the preservation parcels compared to the impacted streams.[12] In the section regarding "Indirect Impacts to Coldwater Fisheries", there is discussion of the need to provide mitigation for the impacts of inadequate buffers, a notation that "CMP also intends to replace improperly installed or non-functioning culverts to improve habitat connectivity", and another reference to the 12.02 miles of streams to be protected on the Grand Falls, Basin, and Lower Enchanted Tracts under a deed restriction or conservation easement.[13] CMP also proposes to make two monetary contributions: $180,000 to the Maine Endangered and Nongame Wildlife Fund "to protect coldwater fishery habitat" and a contribution of "$200,000 of funding, sufficient to replace approximately 20-35 culverts."[14] But there is no actual assessment of the impacts to coldwater fisheries habitat, of the appropriate scale of mitigation, nor of the coldwater fisheries values to be protected, restored, or enhanced by the Compensation Plan.

Finally, there is no discussion whatsoever of impacts to Atlantic salmon habitat, or mitigation for these impacts.

12. Are there particular locations where impacts to brook trout habitat are significant?

Yes. I have not completed an exhaustive analysis of all of the stream crossings, but in the

[12] Compensation Plan, Revised January 30, 2019, pages 5 and 6.
[13] Compensation Plan, Revised January 30, 2019, pages 20-22.
[14] Compensation Plan, Revised January 30, 2019, page 35.

"Greenfield" route from Beattie Township to Moxie Gore, I have identified several locations where high value brook trout streams—some of the "best of the best" of the state's headwater brook trout waters—are impacted by multiple stream crossings that impact a single, relatively small stream. For example:

1. In Skinner TWP, the route includes 18 separate crossings (3 on permanent streams, 12 on intermittent streams, and 3 on ephemeral streams) that impact the West Branch and South Branch of the Moose River near their confluence just east of Moose Mountain. The combination of multiple crossings, each of which will be maintained without a closed canopy cover, in a relatively small area risks cumulative impacts on the headwaters of one of Maine's most remote wilderness trout rivers. (Exhibit 3A)
2. On Piel Brook near the four corners of Bradstreet, Parlin Pond, Upper Enchanted and Johnson Mountain TWPs, a total of 10 crossings (3 on permanent streams, 5 on intermittent streams, and 2 on ephemeral streams) impact the headwaters. (Exhibit 3B)
3. The Cold Stream crossing in Johnson Mountain TWP is an especially important site for brook trout. (See additional discussion about the special value of Cold Stream for brook trout below.) It's also a particularly impactful crossing. In this case, the issue is not so much the number of crossings in close proximity to each other within a single watershed, but the fact that in addition to a crossing of Cold Stream, the NECEC ROW parallels two small perennial tributaries that have their confluence essentially at the NECEC crossing of Cold Stream. This results in an extended reach—about 1400 feet of stream—that closely parallels the cleared ROW. These

impacts are increased because the NECEC ROW abuts an existing cleared ROW at the Capital Road. The ROW also has direct impacts on BPL's Cold Stream Forest Unit, which abuts the ROW to both the north and south. Lack of shade and warming are likely exacerbated by this long parallel impact of road and utility ROW. (Exhibit 3C)

4. The Tomhegan Stream crossing in West Forks Plantation is another example where there are multiple crossings of permanent streams, all of which are either tributaries to or braided channels of Tomhegan Stream, in a very short section. In this case, there are 9 crossings—8 of permanent streams and 1 of an intermittent stream—within about 1200 feet. Like Cold Stream, Tomhegan Stream and its importance to brook trout conservation is discussed in more detail below. (Exhibit 3D)

Failure to Consider Alternatives That Could Have Avoided or Minimized Brook Trout Habitat Impacts

13. Did the Applicant consider alternatives that would avoid or minimize impacts to brook trout and Atlantic salmon habitat?

No. As discussed above, in the Alternatives Analysis, there is no assessment—other than the total number of stream crossings—of the relative fisheries habitat impacts of the alternative routes considered. Nor are any routes co-located along existing disturbed areas—for example, buried along a road corridor. More importantly, with respect to fisheries, minor modifications to the route or to the size and location of structures could have been considered or implemented to avoid or reduce the impacts of lost riparian buffers on brook trout and salmon habitat but were not. These include taller poles to put the wires high enough that full forest canopy closure could be maintained; changing locations of poles—for example, higher on slopes, to achieve the same effect; and minor route changes to avoid stream crossings altogether or to cross at locations where impacts would be smaller.

Significantly, these measures have been used at some stream crossings to reduce impacts on wildlife resources and on recreational users. Similar measures could have been used to reduce impacts on important brook trout streams. Some examples of these measures include:

1. Gold Brook is a highly significant brook trout water that is in a watershed with Rock Pond and Iron Pond, both State Heritage Fish Waters for brook trout, and is a tributary to Baker Stream, which flows into Baker Pond, another State Heritage Water. Gold Brook is important spawning and rearing habitat for these three ponds and is also a fine trout stream on its own. Significant impacts to Gold Brook are caused by a combination of multiple stream crossings, a long section of the ROW that parallels Gold Brook, and additional crossings in the watershed on the inlet to Rock Pond. In this case, however, these impacts were reduced by raising the structure heights at most of these crossings to allow mature trees to be maintained along most of this section of the ROW. These changes were made to address concerns about Roaring Brook Mayfly and Northern Spring Salamander habitat in Gold Brook.[15] (Exhibit 4A) A better solution at this site might have been to reroute the ROW slightly to the north or south. As currently laid out, the

[15] Philip DeMaynadieres, ME DIFW, personal communication.

ROW crosses a curve in Gold Brook twice in a short reach, then closely parallels the shore of Rock Pond, with multiple other crossings nearby. All of these impacts could have been avoided if the ROW had been located a half mile to the north or south to avoid Gold Brook and Rock Pond altogether. (Exhibit 4A)

2. Similar measures were taken, also to prevent impacts to Roaring Brook Mayfly and Northern Spring Salamander, at the crossing on Mountain Brook in Johnson Mountain Township[16]. Again, taller structures allowed for the ROW to be constructed while leaving an intact forested canopy for a buffer on the stream. (Exhibit 4B)
3. Originally, similar plans were made to use tall structures placed high on the walls of the Kennebec Gorge to allow an over-water crossing of the Kennebec River from West Forks TWP to Moxie Gore while maintaining an undisturbed forested buffer on both banks. Impacts at this site have been further reduced by locating the lines underneath the river bed. (Exhibit 4C)

These or similar measures should have been evaluated as alternatives that could avoid or minimize impacts of the NECEC at stream crossings where the Applicant is not proposing to maintain a forested canopy in the buffer area. If these alternatives were reasonable to protect particularly sensitive insect and salamander populations, they could also have been used to protect particularly sensitive brook trout.

14. Are there places where using these techniques to maintain forested riparian buffers

[16] Philip deMaynadier, ME DIFW, personal communication.

would significantly reduce the impacts of the project?

Yes. The crossings at the South Branch/West Branch Moose River, at Cold Stream, and at Tomhegan Stream all are of significantly high impact on brook trout resources of very high value. Further analysis would likely reveal some others. The additional cost of installing taller structures at these sites would be marginal given the total cost of the project.

15. Are there places where impacts to brook trout and salmon habitat especially concern you?

Several areas are of special concern to me.

1. Cold Stream, including Tomhegan Stream and other tributaries. Cold Stream represents one of the most intact and highest value watersheds for native brook trout in Maine. The Cold Stream property contains a combination of pristine native brook trout ponds and intact streams. Cold Stream from its source to its mouth at the Kennebec River is a brook trout factory and there is not a single known occurrence of non-native fish in the watershed. Both the stream and the ponds have been destination fisheries for anglers for more than 100 years. Extensive fisheries studies were conducted before, during, and after the Indian Pond Dam FERC relicensing, including habitat surveys of the Kennebec River and many tributaries, electrofishing, water temperature profiles, and radio-telemetry of adult brook trout. These resources documented the importance of Cold Stream to supporting the Kennebec and Dead River fisheries for wild brook trout. Key findings include: (1) More than 98% of Kennebec River brook trout are wild. (2) No brook trout spawning or juveniles were observed in the Kennebec mainstem. (3) All tributaries to Kennebec Gorge except

Cold Stream have impassable blockages very close to Kennebec River. (4) Cold Stream was the only location where radio-tagged brook trout were observed spawning, with tagged fish during spawning period recorded as much as five miles up Cold Stream. (5) Tagged brook trout also moved into Cold Stream during summer warm periods for thermal refuge. (6) Tagged brook trout seeking thermal refuge not only entered Cold Stream, but also swam upstream and into Tomhegan Stream. (7) The Cold Stream fish community is markedly different from Kennebec mainstem based on angling, snorkel, and electrofishing surveys, and contains no non-native fish species. The Kennebec supports slimy sculpin, blacknose dace, smallmouth bass, fallfish; limited numbers of adult brook trout and landlocked salmon. Cold Stream is dominated by brook trout, mostly juveniles, with limited numbers of slimy sculpin and blacknose dace. [17]

Because of these findings, Cold Stream was prioritized for habitat protection, and TU worked with the ME DIFW, ME BPL, Trust for Public Lands and many other partners to help the state acquire 8,200 acres that protects all the headwater ponds in the Cold Stream watershed and protects the stream corridor from its source to its mouth EXCEPT FOR a narrow corridor along the Capital Road. In the ultimately successful application for funding for the Cold Stream Forest Project from the Land for Maine's Future Fund, the project partners identified the brook trout habitat in on the property as a "Single Exceptional Value" for the property.

The NECEC ROW crosses Cold Stream through this corridor. In addition to this

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[17] E/PRO Engineering & Environmental Consulting, LLC. November 2000. Assessment of Salmonid Fishes in the Upper Kennebec/Lower Dead River Watershed, Maine. Report for The Indian Pond Project Relicensing, FERC # 2142.

crossing—discussed in detail above—there are more than 20 additional NECEC ROW crossings of perennial and intermittent streams in the Cold Stream watershed. The cumulative effects of these crossings, in particular the impacts depicted in Exhibits 3C and 3D at the Cold Stream and Tomhegan Stream ROW crossings, threaten to degrade the public's investment in protecting this valuable habitat.

2. Lakes and Ponds Designated as State Heritage Fish Waters. The NECEC ROW passes very close to several designated State Heritage Fish Waters. These are waters are designated by the ME DIFW based on their native brook trout populations that have been self-sustaining for at least 25 years with no history of stocking. The following designated State Heritage Fish Waters are within less than one mile of the NECEC ROW.

a. Beattie Pond, Beattie TWP. 1200 feet from the ROW.
b. Rock Pond, T5R6 BKP WKR. 900 feet from the ROW. (The ROW also crosses the inlet to Rock Pond.)
c. Iron Pond, T5R6 BKP WKR. 2500 feet from the ROW.
d. Mountain Pond #1, Johnson Mountain TWP. 3700 feet from the ROW.
e. Little Wilson Hill Pond, Johnson Mountain TWP. 1300 feet from the ROW. (The ROW also crosses the inlet to the pond.)
f. Big Wilson Hill Pond, West Forks PLT. 4300 feet from the ROW.
g. Baker Pond, Caratunk. 2300 feet from the ROW

The primary concern for these waters is increased ease of access, if the NECEC ROW is used formally or informally as a motorized road or trail. The primary threat to lake and pond brook trout populations is introduction of non-native fish species that compete with or prey on brook trout.[18]

3. West Branch Sheepscot River. The concern here is the cumulative impact of an additional crossing of the West Branch Sheepscot, an important river for endangered Atlantic salmon. The West Branch Sheepscot is already heavily impacted by powerline and pipeline crossings that have removed most of the riparian vegetation from almost a half mile of the river. The new crossing will have significant impact because it crosses the West Branch at a shallow angle and parallels the river. As a result, the ROW clearing limits stretch for more than 1300 feet along stream. The Google Earth View (Exhibit 5) clearly shows that what little riparian vegetation remains on this impacted river reach is within the ROW clearing limits and will be removed. This is another area where alternatives, including an alternate route or using taller structures so that mature trees could be allowed to remain standing, would have substantially reduced the impact on Atlantic salmon habitat in the Sheepscot.

The Proposed Riparian Buffers Will Not Protect Aquatic Habitat, Including Brook Trout Habitat.

16. What is an adequate buffer to protect brook trout and other aquatic habitat? What are the most important functions of this buffer?

There are a variety of recommendations for buffers to protect brook trout and other aquatic habitat. The Maine Natural Areas Program's Beginning with Habitat reviewed buffer practices

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[18] Eastern Brook Trout Joint Venture (2006): Eastern Brook Trout: Status and Threats. https://easternbrooktrout.org/reports/eastern-brook-trout-status-and-threats%20%282006%29/view

and standards from a range of landowners, managers, foresters, and regulators in northern New England. Their report (attached as Exhibit 6) emphasizes the importance of closed canopy in the riparian zone for some wildlife species and of organic and woody debris inputs to streams that result from allowing standing wood to die and be recruited. The report recommends retention of "relatively continuous forest canopy closure (>70%) in riparian management zones" and consideration of "a limited no-cut zone (25-100 ft is often recommended) immediately adjacent to the stream or wetland shoreline, particularly in areas containing steep slopes and shallow or poorly drained soils."[19]

To protect brook trout habitat, ME DIFW recommends:

> *limiting the harvest of trees and alteration of other vegetation within 100 feet of streams and their associated fringe and floodplain wetlands to maintain an intact and stable mature stand of trees, characterized by heavy crown closure (at least 60 –70%) and resistance to wind-throw. In some situations wider buffers should be considered where severe site conditions (e.g., steep slope, vulnerable soils, poor drainage, etc.) increase risk to soil and stand stability. Any harvest within the riparian management zone should be selective with a goal of maintaining relatively uniform crown closure.* [20]

In a 2005 report for Trout Unlimited, after an extensive literature review and consultation with fisheries biologists, foresters, and land managers, Kleinschmidt Associates recommended a multiple zone buffer with a fixed width no-cut buffer of at least 75 feet, followed by an

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[19] deMaynadier, P., T. Hodgman, and B. Vickery. 2007. Forest Management Recommendations for Maine's Riparian Ecosystems. Technical report submitted to the Maine Department of Inland Fisheries and Wildlife, Bangor, ME.
[20] ME DIFW, undated. Forest Management Recommendations for Brook Trout. https://www.maine.gov/ifw/docs/brook_trout_factsheet_forestry.pdf

additional 75 feet with no soil disturbance and relatively high stocking levels of standing timber. The primary functions of the no-cut buffer—which is difficult to provide with even relatively light levels of cutting, are shading and temperature regulation, large woody debris inputs (dead trees that provide instream habitat when they are recruited into the stream), protection of water quality and bank stabilization.[21] The report is attached. (Exhibit 7)

17. Are the "100-foot riparian buffers" proposed for the stream crossings on the NECEC project adequate to protect brook trout?

They are not. CMP has committed to 100-foot buffers adjacent to all streams identified as "coldwater fisheries", an all perennial streams within segment 1—the "greenfield" portion of new transmission line from Beattie TWP to Moxie Gore. All other streams will have a 75-foot buffer applied. There are several concerns.

1. It is not clear that CMP and ME DIFW have reached agreement on which streams are "coldwater fisheries". The current "record" is a set of hand-marked and highlighted tables provided by Bob Stratton of ME DIFW in early February. There is no evidence that CMP concurs that this is the correct list.
2. The designations of streams as "brook trout" or not appear to be somewhat arbitrary. Based on my experience, anywhere along the NECEC "Greenfield" route in the Moose, Dead, Cold Stream or other Kennebec River tributaries watersheds should be considered as brook trout habitat.

[21] Trout Unlimited. 2005. Riparian Buffer and Watershed Management Recommendations for Brook Trout Habitat Conservation. Focus: Mountainous Brook Trout Watersheds of Maine and Northern New Hampshire. Report Prepared for Trout Unlimited, Augusta, Maine, by Kleinschmidt Associates, Pittsfield, Maine.

3. The biggest concern, however, is not with the width of the buffer, but with how the buffer will be maintained. Nowhere within the clearing limits of the ROW will there be the mature trees and full canopy closure that are required to provide the most important buffer functions for brook trout habitat: shading, recruitment of organic matter and large woody debris, and bank stabilization. In the center 30 feet of the cleared ROW, vegetation will be no more than 10 feet tall. Outside that zone, all "capable" vegetation will be removed. The "100-foot riparian buffer" will therefore be a scrub/shrub habitat at best and will not fulfill the most important buffer functions that are envisioned by the recommendations in ME DIFW and MNAP for closed canopy forest.

18. Do the proposed compensation parcels contain valuable brook trout habitat that would compensate for impacts from inadequate riparian buffers on impacted streams.

As described in the revised Compensation Plan dated January 30, 2019, they provide very little.

1. The Little Jimmie Pond-Harwood Tract has no value for wild brook trout. All streams on the parcel are warmwater habitat.
2. The Flagstaff Lake parcel has very limited value for wild brook trout. Flagstaff Lake is primarily warm water habitat with some stocked salmonids.
3. The Pooler Ponds Tract has some limited value for brook trout habitat, all of it in the mainstem Kennebec River. The Pooler Ponds tract protects only one shore of the Kennebec River, so habitat in the 0.8 miles of Kennebec River that abuts the parcel is not fully protected. This is habitat that provides seasonal angling opportunities, but studies on the Kennebec River have shown that all brook trout spawning and rearing occur in tributaries. This parcel is more valuable for recreation and water access than for fisheries habitat.

4. The Grand Falls Tract, like the Pooler Ponds Tract, primarily provides river access and angling opportunity. It contains only 0.7 miles of streams, the mainstem of the Dead River. Like the Kennebec, the Dead River serves primarily as seasonal habitat for adult trout. The river is stocked with both landlocked salmon and brook trout. There is a wild component to the fishery, but it is supported from habitat in tributaries, not in the mainstem of the Dead River.
5. The Lower Enchanted Tract provides 3.6 miles of river frontage, but most of that is along the northern shore of the Dead River, where the fishery is supported in part by stocking. Like the Pooler Ponds Tract, by protecting only one shoreline the habitat conservation benefits of the parcel are limited. There is approximately 1 mile of Enchanted Stream protected on the parcel. Enchanted Stream is an important tributary for spawning and rearing of wild brook trout. However, without protection of the watershed above this habitat, it is not protected future land use impacts upstream.
6. The Basin Tract has 4.8 miles of stream, almost all of it on the mainstem Dead River where the fishery is largely supported by stocking. Like the other protected sections of the Dead and Kennebec Rivers, this is habitat primarily for adult brook trout and landlocked salmon, with any production of wild brook trout relying on tributary habitat which is not protected, and the conservation land encompasses only one shore of the river.

In summary, most of the river and stream habitat protected on these compensation parcels is unlike the streams that are impacted by the NECEC's inadequate buffers. The impacted streams are mostly cold, high elevation, headwater streams that are highly productive of wild brook trout. The streams "protected" on the compensation parcels are mostly large mainstem rivers that warm significantly in the summer, are protected on only one shoreline, have a recreational fishery at least partially supported by stocking, and have limited or no potential to produce wild brook trout. The one exception is the short reach of Enchanted Stream, but even this is quite unlike most impacted waters.

I would add that even if the parcels contained large amount of valuable and vulnerable coldwater habitat—and they don't—the extent to which the coldwater habitat values, or any other important resources values on the property, will be protected will depend entirely on the terms of the deed restriction, conservation easement, or other durable instrument negotiated for protection. We would recommend specific terms to protect all riparian vegetation from any cutting except that needed to fisheries or wildlife habitat improvement, or to control invasive species if necessary. Any cutting in the riparian zone should require consultation with ME DIFW. Finally, the quality of the easement holder is critical. The easement should be held by either the state of Maine, or by a land trust accredited by the Land Trust Alliance.

A better strategy for coldwater habitat conservation would have been to protect headwater streams like those that are impacted. This would have provided far more brook trout habitat value, particularly if the compensation parcels include long stream reaches where both shorelines and important tributaries are protected. A project of the scale of the Cold Stream Forest Project—which protected 15 miles of stream habitat in the Cold Stream watershed, would be more appropriate.

19. Have you reviewed the proposed NECEC Culvert Replacement Program? Do you think it will result in meaningful benefits to instream habitat for brook trout and salmon?

I have reviewed CMP's proposal. With respect to the fund for off-corridor culvert replacements, I believe CMP's estimate that the $200,000 fund will be sufficient to replace approximately 20-35 culverts is wildly optimistic. My own experience with several culvert projects suggests that cost estimates of $50,000 to $100,000 per culvert are conservative. Costs may be somewhat lower if the culverts to be replaced are on logging roads and need not meet DOT standards. However, some of the most important culverts we identified in surveys of the Kennebec and Dead River watersheds were on tributaries to the Kennebec River that crossed Route 201. A single Route 201 culvert would almost certainly cost more than the entire fund. It is impossible to say how much habitat benefit might accrue from the $200,000 fund, because it depends on the numbers of sites and their habitat impact. My best professional assessment is that with $200,000, it's likely that access to less than 10 miles of additional habitat would be restored.

It is much harder to estimate the potential value of the Culvert Replacement on CMP Controlled Lands. This would be a very meaningful commitment if CMP were to replace or upgrade all of its culverts on all CMP-owned lands in Somerset and Franklin Counties. However, CMP's commitment is qualified. They will replace or remove all culverts on "CMP controlled lands associated with the NECEC." This appears to be a much more limited commitment, particularly given the very small number of streams—and therefore few culverts—on the mitigation parcels. Based on my review of the stream networks on the mitigation parcels, I believe there are likely fewer than 10 culverts on the mitigation parcels.

20. How much coldwater habitat restoration could be completed with the $180,000 contribution to the Maine Endangered and Nongame Wildlife Fund "to protect coldwater fishery habitat"?

First, it's not clear to me that funds from that source would be used for fisheries restoration. I've worked on restoration projects for coldwater fish in Maine for almost 25 years, and I cannot recall a project that used the Maine Endangered and Nongame Wildlife Fund. However, if the funds were allocated to a specific purpose, $180,000 is likely enough funding to accomplish one or two meaningful fish passage (culvert) or instream restoration (rock structures, barrier removal, or large wood additions) on streams that are accessible by equipment.

List of Exhibits

1. Reardon Exhibit 1: Map of Aquatic Habitat Degradation Compared to NECEC Route
2. Reardon Exhibit 2: Brook Trout Population Assessments and NECEC Route
3. Reardon Exhibit 3: Examples of Brook Trout Streams with High Impact—Multiple Crossings in Proximity.
    a. Exhibit 3A—West Branch/South Branch Moose River
    b. Exhibit 3B—Piel Brook
    c. Exhibit 3C—Cold Stream
    d. Exhibit 3D—Tomhegan Stream
4. Reardon Exhibit 4: Stream Crossing Alternatives That Maintain 100% Canopy Cover
    a. Exhibit 4A: Gold Brook
    b. Exhibit 4B: Mountain Brook
    c. Exhibit 4C: Kennebec River Drill
5. Reardon Exhibit 5: West Branch Sheepscot River Crossing
6. Reardon Exhibit 6: Maine Natural Areas Program: Forest Management Recommendations for Maine's Riparian Ecosystems
7. Reardon Exhibit 7: Riparian Buffer and Watershed Management Recommendations for Brook Trout Habitat Conservation. Focus: Mountainous Brook Trout Watersheds of Maine and Northern New Hampshire.

Notarization

I, Jeffrey Reardon, being first duly sworn, affirm that the above testimony is true and accurate to the best of my knowledge.

[signature] 7/27/2019
Name Date

Maine Brook Trust Project Director
Title

Personally appeared the above-named Jeffrey Reardon and made affirmation that the above testimony is true and accurate to the best of his knowledge.

Date: 7/27/2019 Notary: Debora Southiere

DEBORA SOUTHIERE
NOTARY PUBLIC
KENNEBEC COUNTY
MAINE
MY COMMISSION EXPIRES APRIL 2, 2022

Jeff Reardon Testimony Exhibits

Group 4
Exhibit 1-JR

Reardon Exhibit 1: Map of Aquatic Habitat Degradation Compared to NECEC Route

- This map is copied from the National Fish Habitat Partnership's report Through a Fish's Eye, the Status of Fish Habitat's in the United States, 2015.

- It can be accessed in full at http://assessment.fishhabitat.org/

- The map on the following page is from the second page of the "Northeastern States Region" section of the report: http://assessment.fishhabitat.org/#578a9a00e4b0c1aacab896c1/578a9a9fe4b0c1aacab8985c

- NECEC Route is mapped with the most recent KMZ file from Maine DEP: https://www.maine.gov/dep/gis/datamaps/

NECEC "Greenfield" Route Passes Through the Least Degraded Aquatic Habitat in Northern New England.

Northeastern States Region: Habitat Degradation

Select an Assessment:

Streams | Estuaries

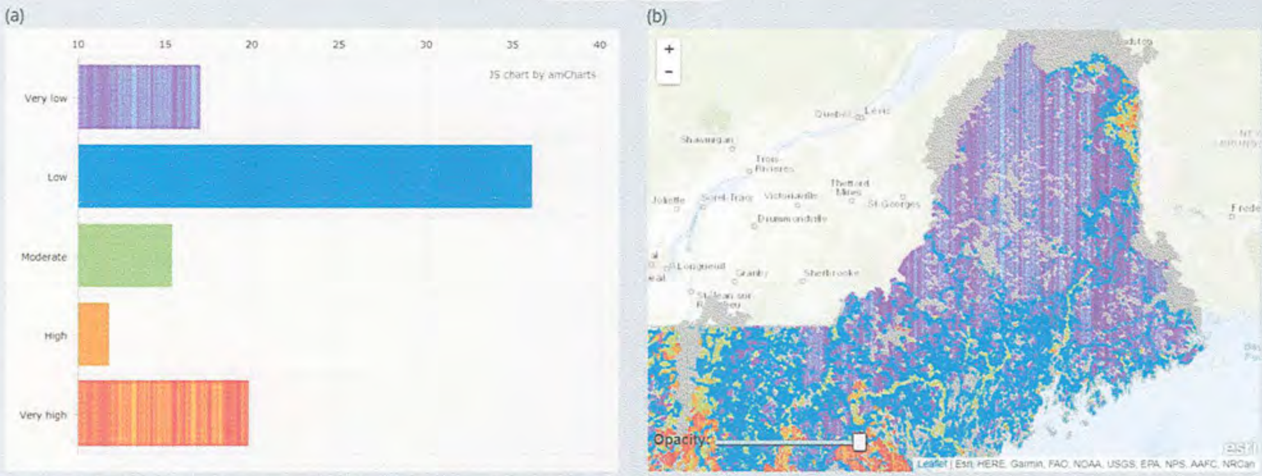
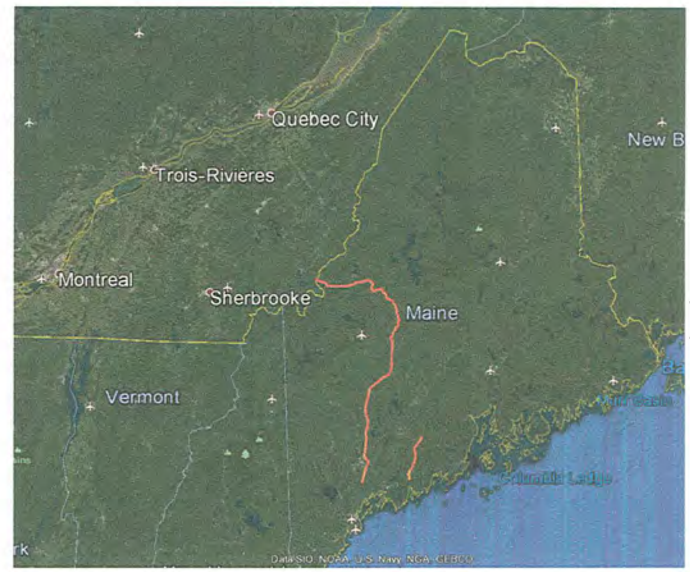


Figure1: This interactive figure summarizes the risk of fish habitat degradation for both perennial and intermittent waters as defined by the National Hydrography Dataset Plus Version 1. Future assessment enhancements will include a map of scores for only perennial streams in the U.S. The currently selected tab shows data from the inland assessment of streams for the contiguous United States. (a) Relative condition of fish habitat in streams. Stream summaries represent percentage of total stream length in each condition class. (b) Map showing risk of fish habitat degradation. The default view shows all stream condition classes. User may change map display by selecting a bar in (a), resulting in a display of the selected condition class in (b). Please see How to Read this Report for important information about strengths and limitations of these findings. Click here to download scores from the inland assessment of streams for the United States.



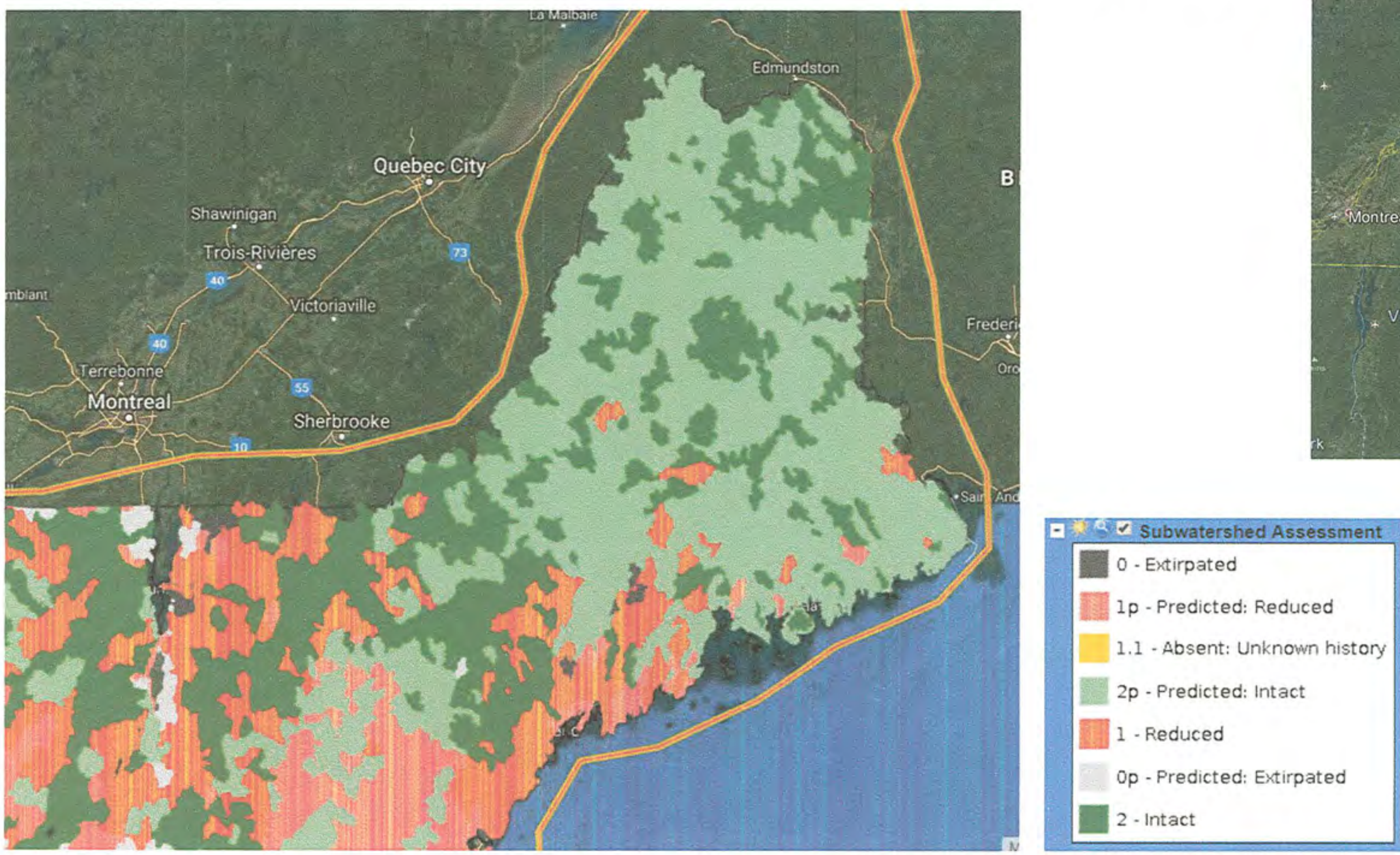
NECEC Route for Comparison

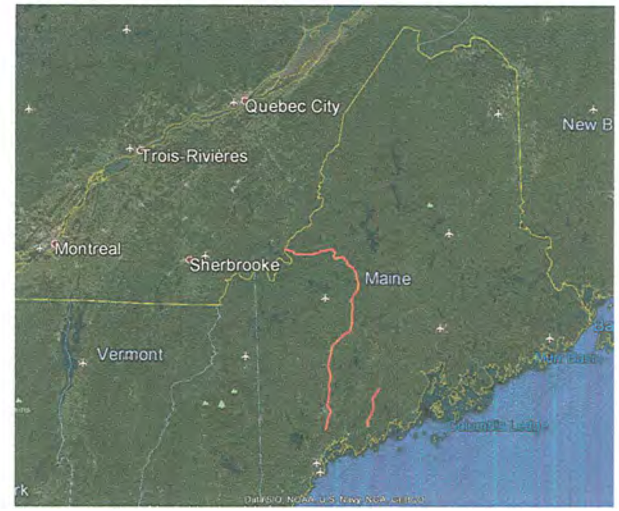
Group 4
Exhibit 2-JR

Reardon Exhibit 2: Brook Trout Population Assessments and NECEC Route

- The map is screenshot of a web-based viewer of Eastern Brook Trout Joint Venture data, described as an "Interactive GIS map featuring data layers (brook trout status and habitat patches) and tools (riparian prioritization, drainage area calculator) developed and endorsed by the EBTJV."
- It can be accessed at: http://ecosheds.org:8080/geoserver/www/Web_Map_Viewer.html
- The map on the following page is a screenshot of Subwatershed Assessments of Brook Population Status data (Ranging from "extirpated" to "intact" in green.
- NECEC Route is mapped with the most recent KMZ file from Maine DEP: https://www.maine.gov/dep/gis/datamaps/

Entire NECEC "Greenfield" Route Passes Through Subwatersheds Assessed as "Intact" Brook Trout Populations.





NECEC Route for Comparison

Reardon Exhibit 3: Examples of Brook Trout Streams With High Impact—Multiple Crossings in Proximity

- The maps are screen shots of the the NECEC Route is mapped with the most recent KMZ file from Maine DEP, showing stream crossings, overlaid on USGS topo data:
  - NECEC Route KMZ File (Jan, 2019) from Maine DEP at https://www.maine.gov/dep/gis/datamaps/
  - USGS Topo Data Downloaded from Earthpoint http://www.earthpoint.us/TopoMap.aspx
  - Aerial Photos/Satellite from Google Earth.
  - Stream Crossing Tables Compiled from NECEC KMZ Files.
- These are selected sites with high impact laid out from west to east.
  - Not a comprehensive survey.

Group 4
Exhibit 3-JR

Exhibit 3A—W. Branch/S. Branch Moose River.

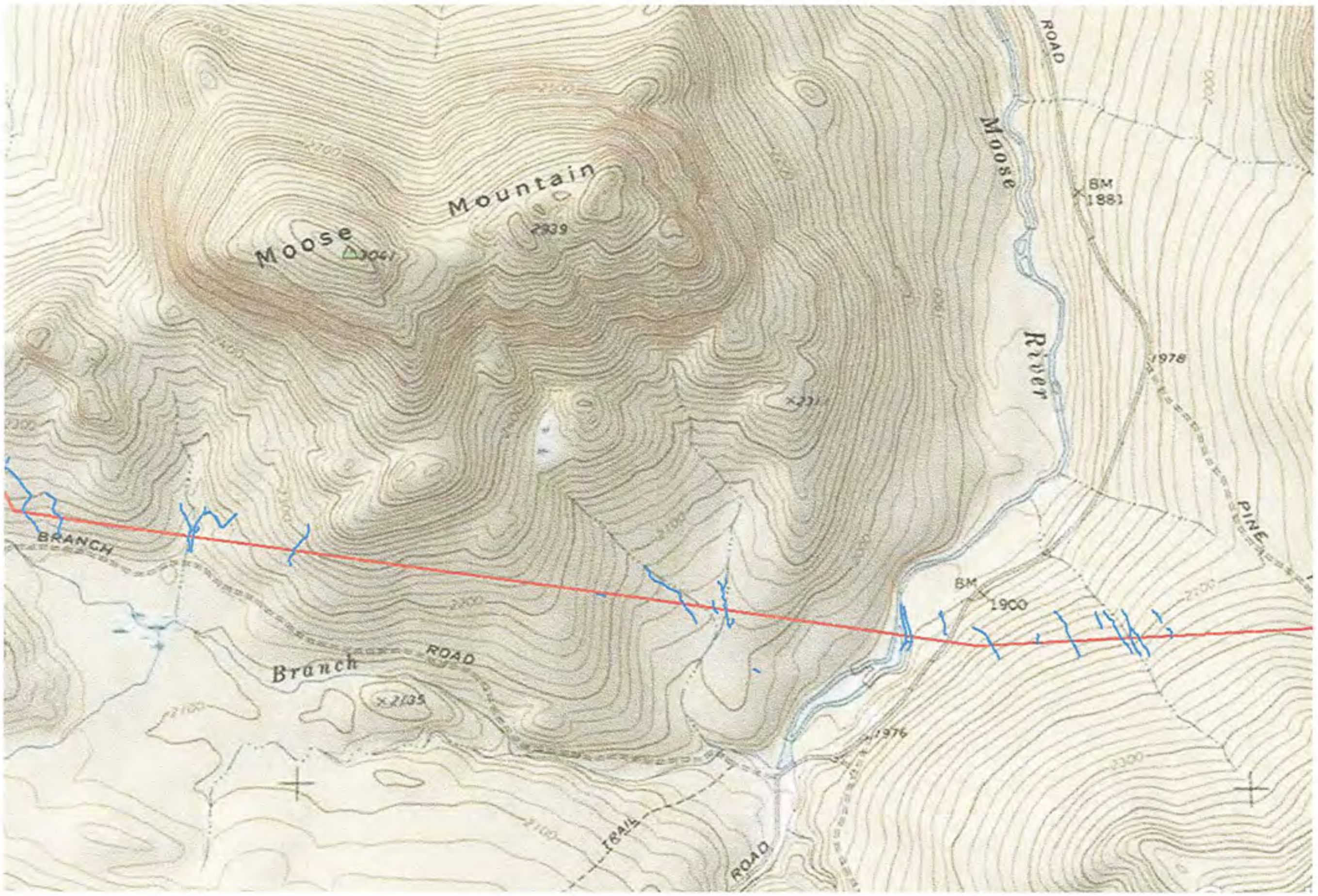


Exhibit 3A—West Branch/South Branch Moose River.

South Branch Moose River	PSTR	ISTR	ESTR	STI-STR
	08-04	07-08	07-05	25
	09-11	07-07	09-01	08-01
	09-06	07-03		28
		07-01		
		08-01		
		09-10		
		09-09		
		09-04		
		09-05		
		09-06		

ROW Length: 2.5 miles

- Stream Crossings
  - Permanent: 3
  - Intermittent
    - ISTR: 10
    - STI-STR: 2
  - Ephemeral: 3

    - **Total: 18**

Exhibit 3B-Piel Brook

Notes:

- The ROW crosses Piel Brook twice in 0.9 miles of stream.
- Parallels this length of stream that distance, never more than 800 feet away.

Exhibit 3B—Piel Brook

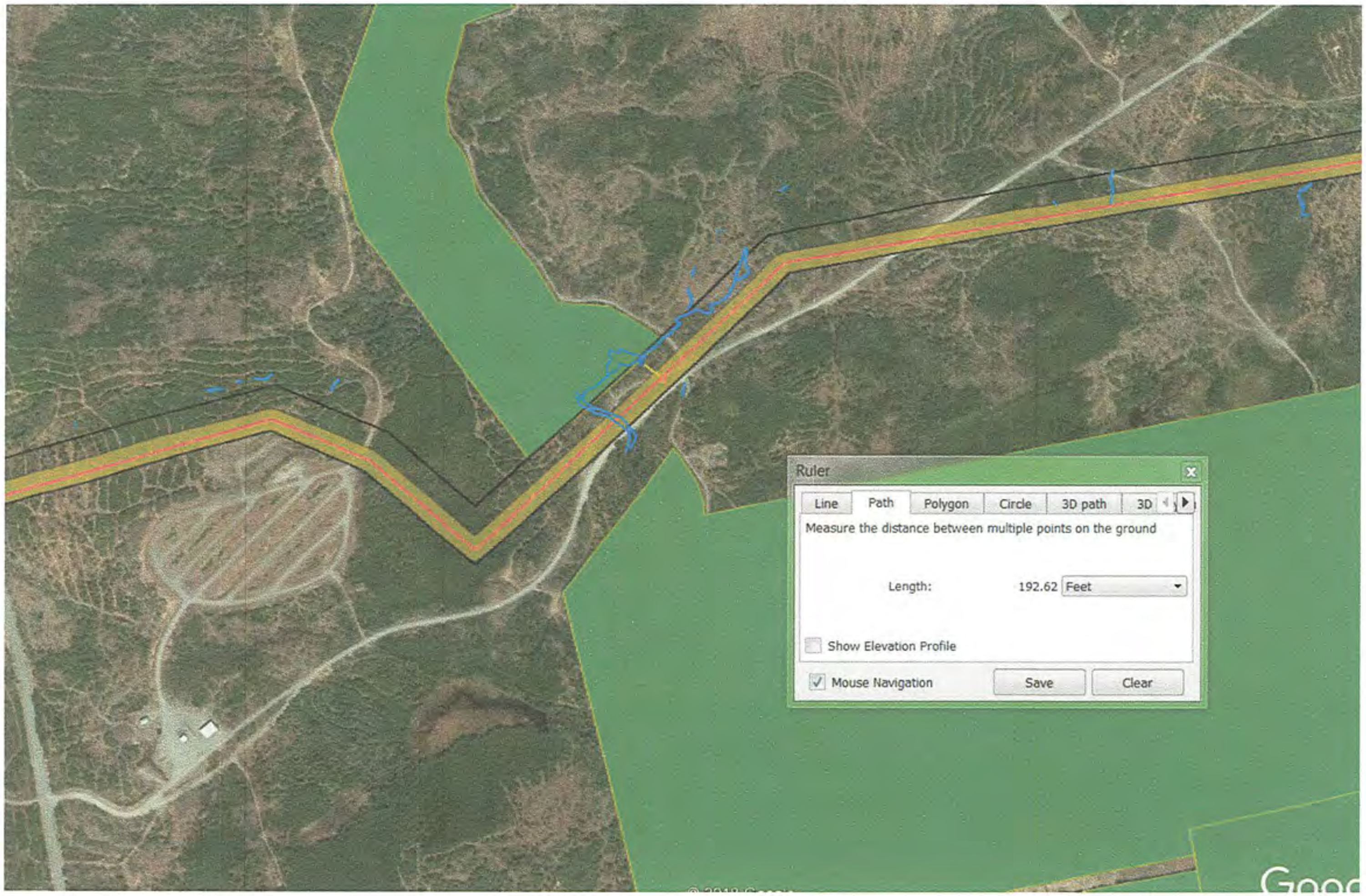
Piel Brook	PSTR	ISTR	ESTR	STI-STR
	30-01	30-02	31-07	
	Sr-31-01	31-02	31-03	
	31-06	31-01		
		32-01		
		32-02		

ROW Length: 2.4 miles

- Stream Crossings
  - Permanent: 3
  - Intermittent
    - ISTR: 5
    - STI-STR: 0
  - Ephemeral: 2

    - **Total: 10**

Exhibit 3C—Cold Stream



Notes:

- Crossing of Cold Stream and 1400 foot long parallel to small tributary.
- ROW within <250 feet of stream for entire length.
- Impacts additive to exiting impact of Capital Road.

Exhibit 3C—Cold Stream

Cold Stream, Capital Road	PSTR	ISTR	ESTR	STI-STR
	40-06			
	40-07			
	40-08			

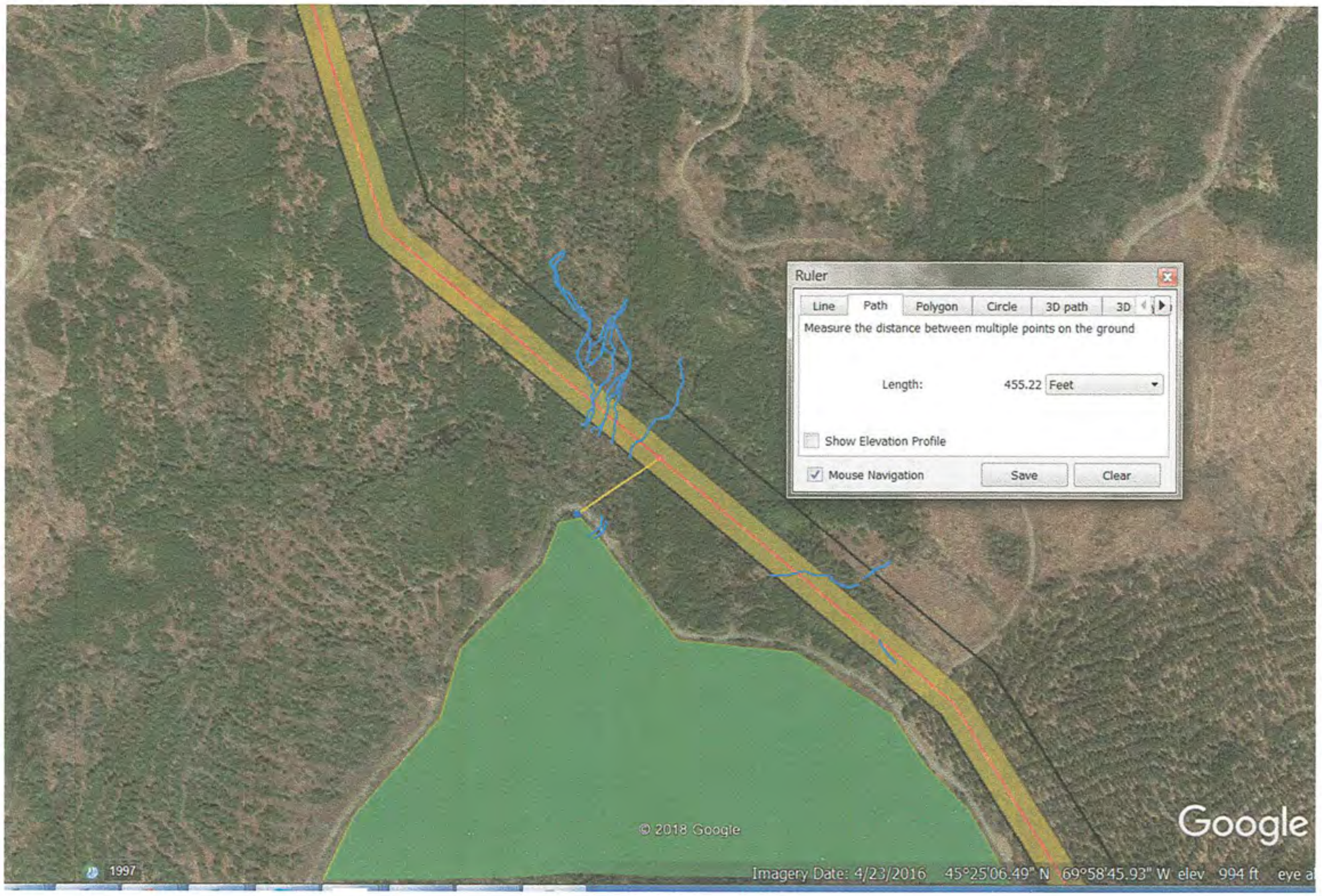
ROW Length: 1500 Feet

- Stream Crossings
  - Permanent: 1
    - Cold Stream
- Stream Parallel
  - 1400 foot parallel to small perennial tributary.

Cold Stream is a very high value resource for brook trout.

- Entire length of Cold Stream from Source to Mount protected for the primary purpose of protecting intact brook trout habitat.
  - Except ~700 foot strip along the Capital Road.
  - $7.5 million in Federal Forest Legacy and Land for Maine's Future Funding to purchase 8,200 acres for state.
  - "Wild Native Brook Trout Habitat" was identified as a "single exceptional value" to justify the LMF Funding.

Exhibit 3D—Tomhegan Stream



Notes:

- Crossing location has multiple permanent stream crossings.
- Less than 500 feet from Cold Stream Forest BPL Unit.

Exhibit 3D—Tomhegan Stream

Tomhegan Stream	PSTR	ISTR	ESTR	STI-STR
	45-03	45-02		
	44-07			
	44-06			
	44-04			
	44-08			
	44-01			
	44-09			
	44-02			

ROW Length: 1200 Feet

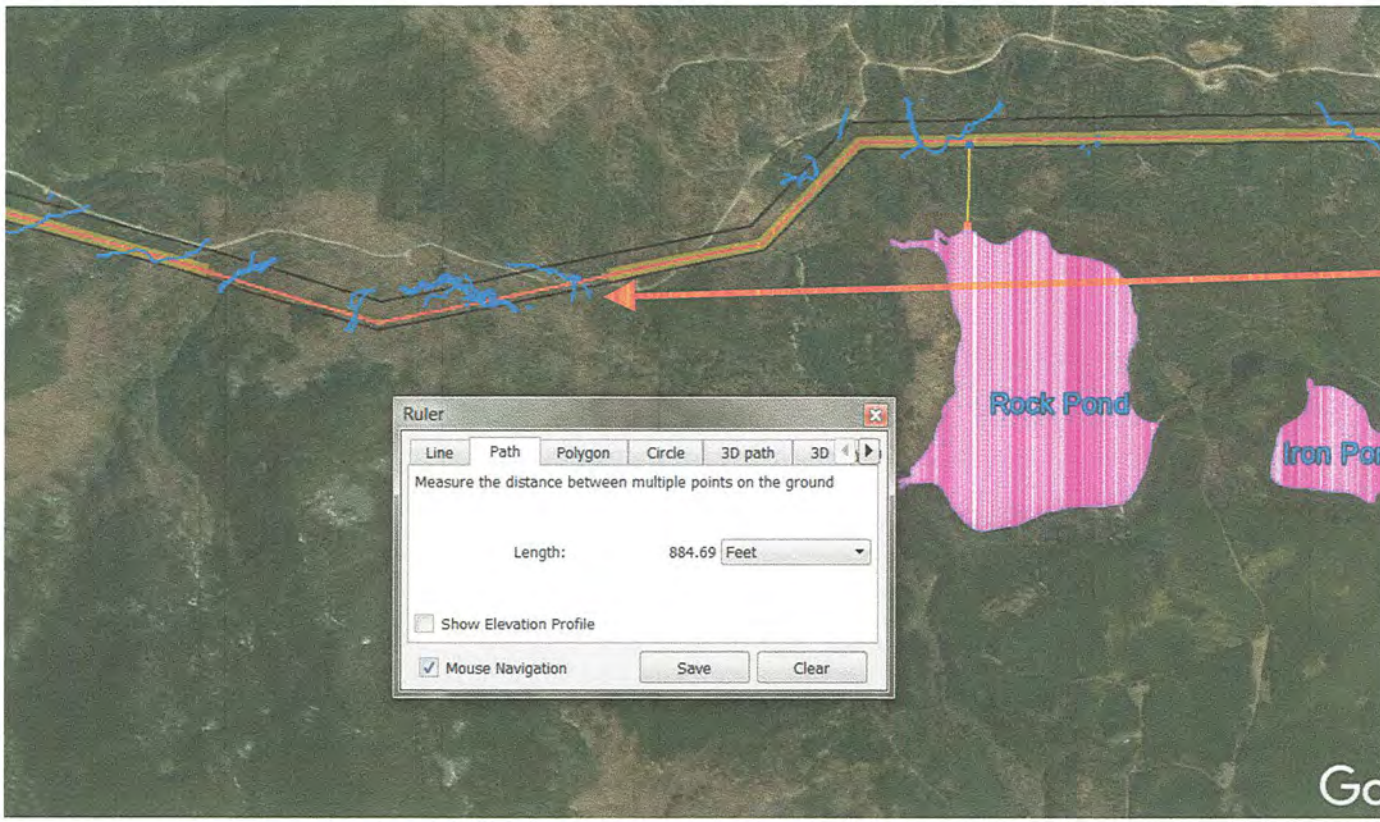
- Stream Crossings
  - Permanent: 8
    - Tomhegan Stream
  - Intermittent: 1
  - **Total: 9**

Group 4
Exhibit 4-JR

Reardon Exhibit 4: Stream Crossing Alternatives That Maintain 100% Canopy Cover

- The maps are screen shots of the NECEC Route as mapped with the most recent KMZ file from Maine DEP, showing stream crossings, overlaid on USGS topo data:
  - NECEC Route KMZ File (Jan, 2019) from Maine DEP at https://www.maine.gov/dep/gis/datamaps/
  - Aerial Photos/Satellite from Google Earth.
- At two sites, structure heights were raised to eliminate the need for clearing over stream segments supporting Roaring Brook Mayfly and/or Northern Spring Salamander.
- At a third site, the NECEC line will be drilled under the Kennebec River to avoid visual impacts.

Exhibit 4A— Gold Brook



Note:

- No cleared ROW.
- Structure heights or placement changed to allow full forested buffer

Exhibit 4A—Gold Brook

Gold Brook/Baker Stream	PSTR	ISTR	ESTR	STI-STR
	16-14	*16-16*	*16-08*	
	16-01	*16-05*	*15-11*	
	16-101	*16-04*		
	16-10	*16-03*		
	16-07	*16-01*		
	15-06	*15-10*		
	15-04			

ROW Length: 2.06 miles

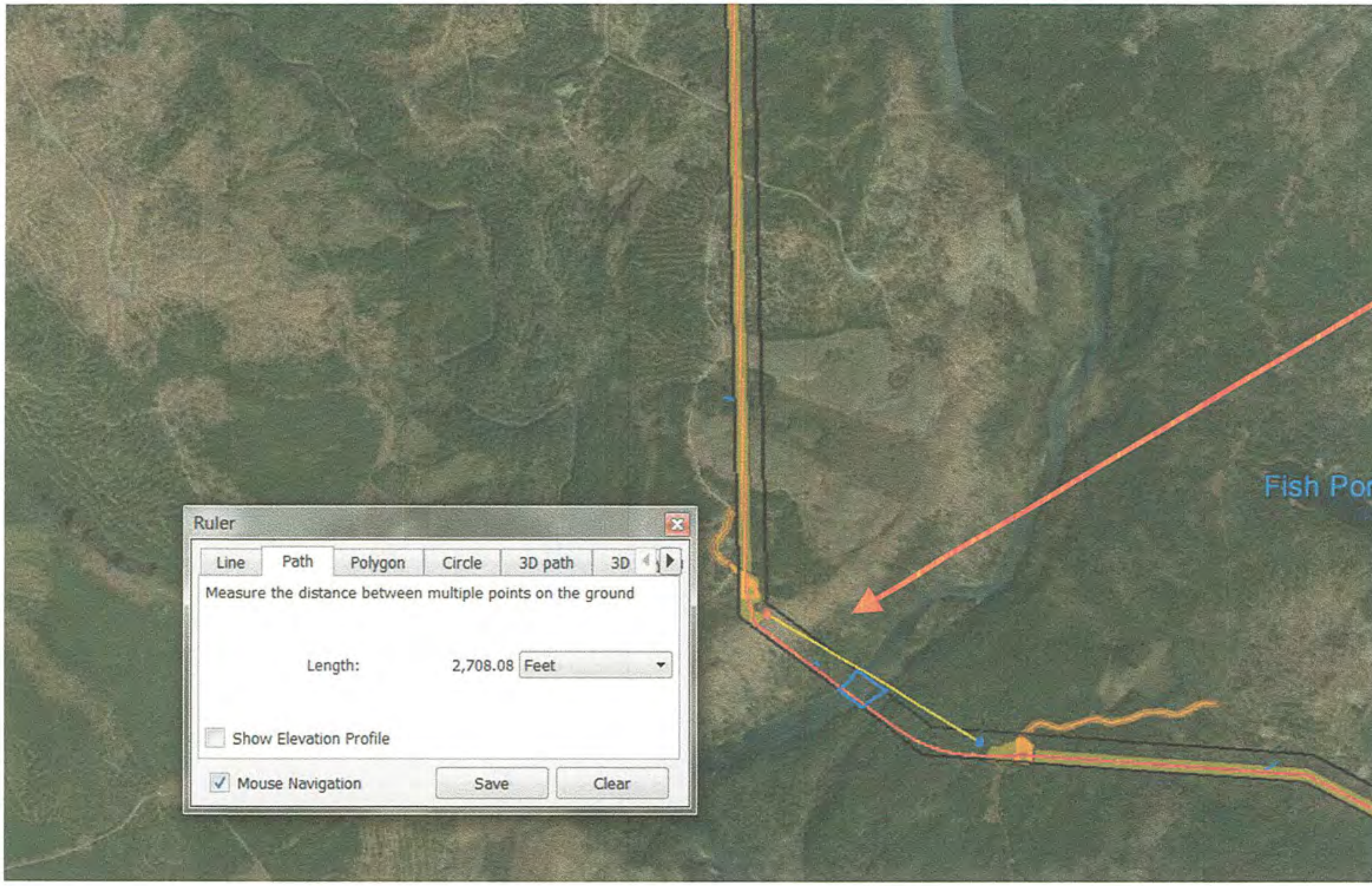
- Stream Crossings
  - Permanent: 7
  - Intermittent
    - ISTR: 6
    - STI-STR: 0
  - Ephemeral: 2
    - **Total: 15**

Notes:

- The ROW crosses Gold Brook mainstem twice in ~0.5 miles of stream.
- Parallels stream between crossings-always within 400 feet.
- Raised pole height through 5 structures and 4300 feet of ROW eliminates most impacts.
  - Eliminated impacts highlighted.

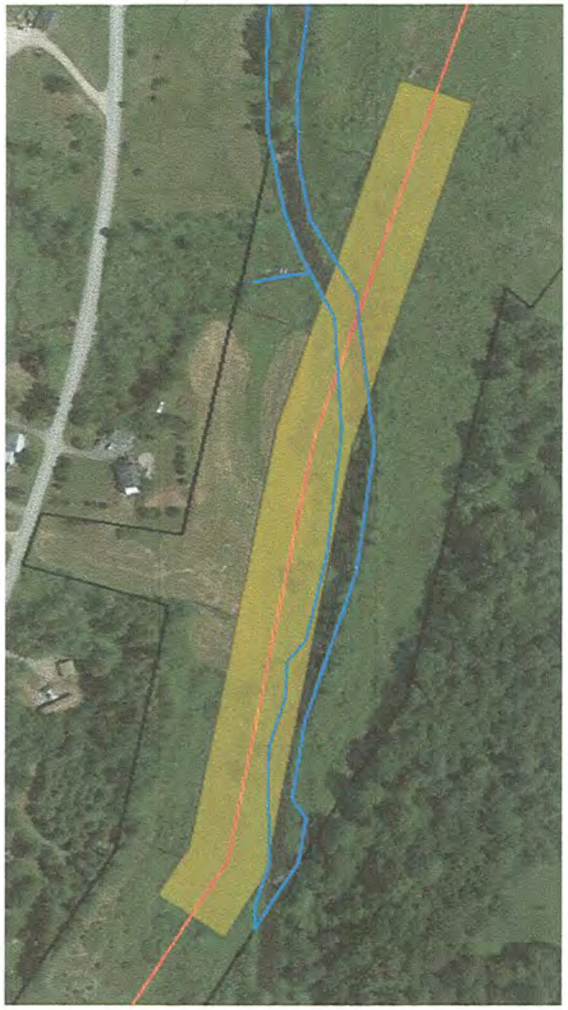
Exhibit 4B: Mountain Brook

Exhibit 4C: Kennebec River Drill



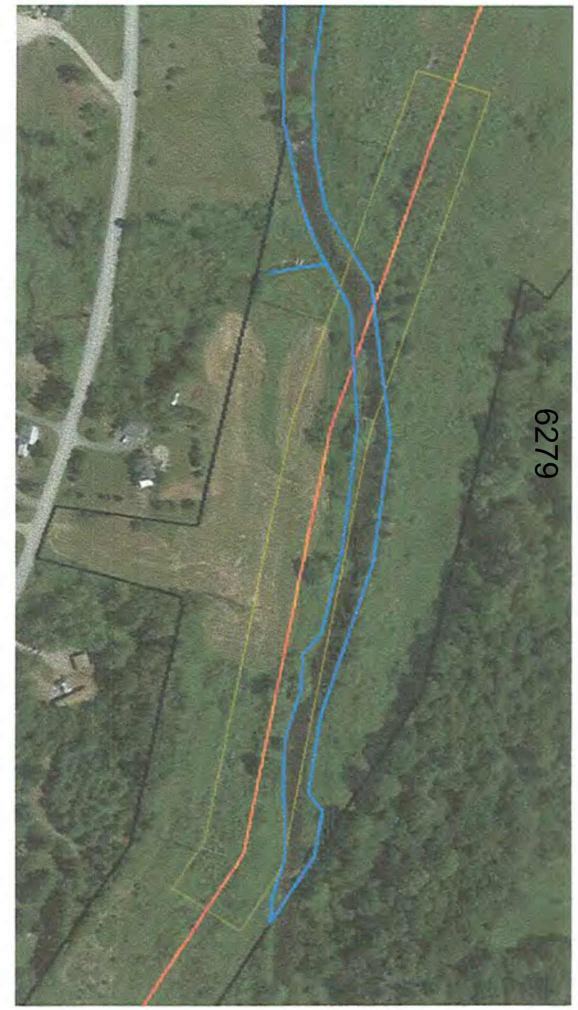
Direction Drill maintains 1000'+ buffers on both banks of Kennebec River.

Exhibit 5: West Branch Sheepscot River



Left view shows limits of new clearing

Right view shows only the outline of new clearing limits, to show existing trees that will be removed.



Group 4 Exhibit 5-JR

Group 4
Exhibit 6-JR

Reardon Exhibit 6:

Maine Natural Areas Program:
Forest Management Recommendations for Maine's Riparian Ecosystems

deMaynadier, P., T. Hodgman, and B. Vickery. 2007. Forest Management Recommendations for Maine's Riparian Ecosystems. Technical report submitted to the Maine Department of Inland Fisheries and Wildlife, Bangor, ME.

Riparian Ecosystems

Definition

Riparian ecosystems comprise an ecological tension zone between aquatic and terrestrial systems. Specific definitions as to the physical extent of riparian ecosystems vary greatly depending on the breadth of functional values included, from water quality to wildlife habitat.

Minimally, most definitions include a) the shoreline of lentic and lotic waterways (streams, rivers, ponds, and wetlands), b) the upland area influenced by these aquatic systems, and c) the area of adjacent uplands influencing the aquatic system. Definitions addressing wildlife habitat functions are further reaching and generally include a variable component of upland forest.

Background and Biodiversity Value

Riparian areas are among the most critical parts of any forest ecosystem because of the diverse ecological values they provide (Hunter 1990). Both structurally complex and ecologically dynamic, many scientists have argued that riparian areas are also among the most sensitive systems to environmental change. Some of the specific biodiversity values provided by a well-managed, ecologically functioning riparian zone include (Elliott 1999):

- Prevention of wetland and water-quality degradation;
- Buffering of aquatic and wetland plants and animals from disturbance;
- Provision of important plant and animal habitat; and
- Contributions of detritus, nutrients, insects, and structural complexity to aquatic systems

Wildlife Values

Although they make up a relatively small proportion of the forest landscape, riparian ecosystems often host some of the greatest species richness. For example, riparian zones, and their associated wetland systems, are utilized by over 90% of the northeastern region's vertebrate species and provide the preferred habitat for over 40% of these species (DeGraaf et al. 1992).

Like the ecotone itself, the suite of species benefiting from forested riparian ecosystems varies along a continuum from aquatic species, to riparian specialists, to upland forest species. Obligate aquatic species such as fish, wading birds, and aquatic invertebrates benefit from the water quality, nutrient input, habitat structure (e.g. woody debris dams), and disturbance-buffer values provided by forested riparian zones. Riparian specialists such as shoreland-nesting ducks (e.g. goldeneyes, mergansers, wood ducks), floodplain wildflowers, wood turtles, dragonflies, and mink frequent the aquatic-riparian gradient while fulfilling life-history requirements. Finally, a variety of largely upland species, from woodpeckers to white-tailed deer, reach peak densities during certain seasons in forested riparian ecosystems because of optimal foraging opportunities (e.g. high insect densities, soft and hard mast abundance) or preferences for riparian nesting or travel corridors.

In landscapes where intensive forest management is practiced forested riparian ecosystems often serve as de-facto refuges for late successional-associated species that prefer specific structural characteristics of mature forests. Among others, these characteristics include high crown height and closure (e.g. deer wintering areas), abundant standing and downed dead wood (e.g. cavity-nesters, shrews, and salamanders), diverse tree species and diameter classes (e.g. bark and foliage gleaning passerines, and lichens), and well-developed pit and mound topography and wind-throw (e.g. herbs, small mammals, northern waterthrush, winter wren and other root mass nesters).

Water Quality and Organic Inputs

Riparian vegetation provides numerous water quality, food-chain, and structural values with the major ones including (Castelle and Johnson 2000):

- Streambank stabilization – determined in part by the density and depth of herbaceous and woody streambank roots;
- Sediment reduction – both by canopy reduction of raindrop impacts and the slowing of surface sheet flow;
- Chemical and nutrient removal – including metals, excess nutrients, and other chemicals by filtering water via plant uptake;
- Shade production – water temperature increases when streamside vegetation, particularly overhead canopy, is reduced which in turn affects fish and aquatic insect species composition and growth.
- Organic inputs and debris structure – particularly important in lower order stream systems where the foodchain is fueled primarily by detrital inputs and where debris dams provide valuable microhabitat structure.

Management Considerations

Riparian ecosystems are among the most ecologically important and sensitive ecosystems in forested landscapes. Following the management guidelines provided below (modified from Elliott 1999) will help conserve the biodiversity values associated with these critical ecosystems:

✓ Establish fixed (by stream order or wetland type) or variable (based on slope, floodplain size, and other local features) riparian management zones along stream, rivers, ponds, and wetlands that exceed the minimum standards required by LURC and DEP statutes. Riparian management zones have been recently developed by several prominent ecological forestry-based initiatives in Maine and elsewhere, and are summarized in Table 1.

✓ Employ forest management systems, such as single-tree or small-group selection cuts, that retain relatively continuous forest canopy cover (>70%) in riparian management zones.

✓ Consider a limited no-cut zone (25-100 ft is often recommended) immediately adjacent to the stream or wetland shoreline, particularly in areas containing steep slopes and shallow or poorly drained soils.

✓ Avoid forest management actions that lead to semi-permanent or permanent conversion of the natural vegetation within riparian management zones including placement of log landings, logging roads, and plantations.

✓ Use streams as stand boundaries to reduce the need for stream crossings. When stream crossings are unavoidable conform to Maine Forest Service's BMP's for erosion control.

deMaynadier, P., T. Hodgman, and B. Vickery. 2007. Forest Management Recommendations for Maine's Riparian Ecosystems. Technical report submitted to the Maine Department of Inland Fisheries and Wildlife, Bangor, ME.

- ✓ Bridges and culverts should be large enough to pass peak flows (from 100-year storm events) without damage to the structure and should not constrict the stream channel. Culverts, preferably with flat bottoms, should be installed at the level of the original streambed to provide fish, amphibian, and invertebrate passage at all flows.

- ✓ Retain snags, trees with cavities or extensive rot, downed logs, and large super-canopy trees to the greatest extent possible in the riparian management zone.

- ✓ Avoid using fertilizers, pesticides, and chemicals within riparian management zones and, if applied aerially, institute wide spray buffers (>1/4 mile) to prevent drift.

- ✓ Apply special precautions to riparian management zones in aquatic systems hosting rare, threatened, or endangered species and natural communities. Consult with MDIFW and MNAP biologists for standards -- e.g. riparian management zone width, extent, and canopy closure -- when operating in the vicinity of these elements.

Table 1. Recommended width of riparian management zones as presented by various ecological forestry-based initiatives.

Aquatic System	TNC (2000) St. John River Watershed[1]	Champion International[2]	Maine Council on SFM (1996)	NH Forest Sustainability Standards (1997)	Maine Forester's Guide (1988)[3]	MDIFW's ET Forester's Guide (1999)
1st & 2nd-order streams	50-250 ft. (50ft. no-cut)	100 ft.	75 ft.[4]	100 ft.		75-100 ft. (25 ft. no-cut)
3rd-order streams	100-500 ft. (100ft. no-cut)	330 ft.	250 ft.	300 ft. (25 ft. no-cut)	100-330 ft.	250-330 ft. (25 ft. no-cut)
4th-order streams	1000 ft. (no-cut)	660 ft.	250 ft.	600 ft. (25 ft. no-cut)	100-330 ft.	250-600 ft. (25 ft. no-cut)
Ponds < 10 acres	125 ft. (no-cut)			100 ft.		75-100 ft. (25 ft. no-cut)
Ponds > 10 acres	250 ft. (no-cut)			300 ft. (25 ft. no-cut)	100-330 ft.	250-300 ft. (75 ft. no-cut)
Permanent Wetlands	50-125 ft. (no-cut)			100-300 ft. (0-25 ft. no-cut)		75-330 ft. (25 ft. no-cut)
High Value Vernal Pools	50-125 ft. (no-cut)			200 ft. (50 ft. low-cut)		400ft (100 ft. low-cut)

[1] No-cut zones are expanded up to 250 ft. in areas where wind-throw hazards, saturated soils, or steep slopes make soil compaction or scarification possible. Additional riparian protection is provided by inclusion of "expansion areas" (300-600-acre blocks designed to support forest interior birds and several pine marten ranges) spaced at ~1-2 mile intervals along stream corridors.

[2] Guidelines were developed by Champion International Corp. whose lands are now managed by International Paper and others.

[3] 100 ft. is recommended for watercourses draining <50 mi^2 and 330 ft. is recommended for watercourses draining >50 mi^2.

[4] Recommend no clearcutting within 250 ft.

deMaynadier, P., T. Hodgman, and B. Vickery. 2007. Forest Management Recommendations for Maine's Riparian Ecosystems. Technical report submitted to the Maine Department of Inland Fisheries and Wildlife, Bangor, ME.

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Group 4
Exhibit 7-JR

Reardon Exhibit 7:

Riparian Buffer and Watershed Management Recommendations for Brook Trout Habitat Conservation. Focus: Mountainous Brook Trout Watersheds of Maine and Northern New Hampshire.

TROUT UNLIMITED

Augusta, Maine

RIPARIAN BUFFER AND WATERSHED MANAGEMENT RECOMMENDATIONS FOR BROOK TROUT HABITAT CONSERVATION

FOCUS:
MOUNTAINOUS BROOK TROUT WATERSHEDS OF WESTERN MAINE AND NORTHERN NEW HAMPSHIRE

MARCH 2005

Prepared by:

Kleinschmidt
Energy & Water Resource Consultants

TROUT UNLIMITED
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ACKNOWLEDGEMENTS

Project Lead:

Jeff Reardon, Trout Unlimited

Consultant:

Kleinschmidt Associates

Funding Provided by: Gale Foundation

This document should be cited as:

I. INTRODUCTION AND OBJECTIVES

This report describes recommended riparian buffer and watershed management standards protective of instream brook trout (*Salvelinus fontinalis)* habitat. The riparian management standards are designed to be applicable to all coldwater (trout and salmon) habitat in northern New England. However, the immediate focus of the recommendations is on river systems in the mountainous terrain of western Maine and northern New Hampshire with high quality brook trout habitat, and in areas where commercial forestry is the dominant land use. The primary emphasis of the recommendations is on riverine (streams and rivers) systems; however the majority of the concepts and recommendations in this report apply equally well to ponds and lakes.

To provide for analysis of actual, rather than hypothetical landscapes, this report includes analysis of buffer requirements for 3 important river systems in Western Maine—the Magalloway, Little Magalloway, and Kennebago Rivers.

Although the three rivers themselves are, in places, flanked by riparian zones characterized by deep, glacial-outwash-derived soils and flat to gently sloping topography, the majority of the contributing watersheds of these river systems are characterized by rugged topography and thin (shallow-to-bedrock) soils that are sensitive to erosion. The small, headwater streams that feed these rivers originate in and flow through this same rugged topography and thin soils. These characteristics, which are typical of streams in western Maine and northeastern New Hampshire, tend to increase the importance of sufficient riparian buffers and Best Management Practices (BMPs) for forestry (and other land uses), to prevent erosion and sedimentation, and other impacts to instream habitat.

Brook trout require clean, cool (commonly groundwater-fed), well-oxygenated streams and rivers to maintain vigorous, naturally-reproducing populations. Brook trout make frequent use of shallow headwater streams for spawning, and also find temporary refuge in spring-fed sections during the late summer. They are sensitive to sedimentation, stream warming, and the quantity and quality of macro invertebrate populations. Brook trout are therefore sensitive to watershed and riparian buffer changes, and serve as an "indicator" of water quality and ecosystem health. Macro invertebrates, for example, use large woody debris and leaf litter for habitat structure and as food. Timber harvesting or any other land use that affects these organic matter inputs will automatically affect brook trout habitat quality. Although the objective of this report is to protect brook trout habitat, the management strategies and recommendations also benefit non-target species in the larger riparian forest and in-stream community, including macro-invertebrates, cavity-nesting birds (*e.g.,* wood duck, barred owl), and riparian forest specialists or species with a preference for riparian habitat (*e.g.,* mink, river otter, red-shouldered hawk, and beaver). With appropriate adjustments to take into account local conditions and objectives, this report is intended to be useful for salmonid habitat conservation throughout northern New England, New York, and Canada.

The subject watersheds are sparsely populated and contain high quality to exceptional brook trout habitat. Nevertheless, these watersheds have been affected by historic timber removal operations. Large scale forest removal may have affected the depth, width and sinuosity of streams, as a result of altered hydrology and sediment load, as well as changes in shoreline vegetation. This is especially true when large cuts occurred over short periods of time so that a large percentage of the watershed was cut or in young growth at a single time. Log drives on the larger streams required that in-stream and shoreline obstacles such as large woody debris, boulders, and rocky riffles be removed by axe, pick, and dynamite to facilitate driving logs downstream during high flows. This undoubtedly had a significant effect on the morphology of certain streams, and resulted in the loss of in-stream and stream bank habitat complexity. Logging today likely continues to impact habitat quality by contributing sediment to these streams, affecting the timing and magnitude of woody debris inputs, and even by impeding fish passage in those cases where haul road and skidder trail stream crossings are not installed properly. Large areas of northern Maine are rapidly changing hands, and the future management and stewardship of wild brook trout waters is uncertain, elevating the importance of developing protective standards (Trout Unlimited, 2004). Increasingly in Maine, liquidation harvesting practices (where large blocks of woodlands are harvested to the limits of the law, often with little regard for subsequent harvests or sustainable forestry principals, and subdivided into numerous lots) threaten brook trout habitat quality. Similarly, large private timber companies are increasingly planning to develop shoreline areas, historically managed as industrial forests, into camp and home lots. One large industrial landowner in Maine, Plum Creek, has recently unveiled development plans that would radically change the pattern of land use in the Moosehead Lake region, which is ecologically and economically similar to the region analyzed here.

The riparian buffer zone and watershed management prescriptions in this report are recommendations, not regulations. This report is intended to be a guidance-level resource for government agencies and NGOs that are: developing land management plans or river corridor management plans, negotiating or developing conservation easement terms, developing permit conditions, or developing management guidelines for working forests. It is hoped that the recommendations will also be useful to private landowners, including the forest industry and small woodlot owners, who wish to manage their lands in a way that protects the ecological integrity of the riparian, wetland, riverine (streams and rivers), lacustrine (ponds and lakes), and upland resources on their property and downstream.

II. METHODS AND APPROACH

A literature search was carried out to identify up-to-date scientific information on riparian buffer characteristics and forested watershed management prescriptions that optimize important brook trout habitat elements (see Section 3.3).

Appropriate buffer widths and management prescriptions were determined by a review of scientific literature that describes the relationship between buffer and watershed characteristics and buffer and watershed function. The following specific steps were taken during method development, largely by researching the existing science-base as reported in the literature:

1. Determine riparian and watershed buffer functions important for salmonid habitat protection.
2. Identify dominant and regionally unique characteristics of target protection areas (*e.g.*, soil characteristics, disturbance regimes, vegetative structure, topography).

3. Determine buffer attributes (such as buffer width) and management approaches (such as specific BMPs) that promote buffer effectiveness and habitat optimization for the functions identified in step 1.

The science-base for the recommendations in this report was developed primarily for forested regions of the northern United States and Canada. To the extent possible, data specific to northern New England and adjacent Canada was utilized. However area-specific data was insufficient to be solely relied upon. The scientific literature provided ranges of buffer widths required for effective buffer function (both for specific functions, such as sediment filtering, and for a suite of related functions). The literature also provided the most recent scientific information with respect to forestry BMPs to protect soils, streams, rivers, ponds, and wetlands.

A watershed approach was used to develop the recommendations. It is essential that analysis of proper buffer management include both the immediate shoreline and adjacent upland areas. If the analysis were limited to the immediate riparian buffer zone, important habitat protection issues would be missed. For example, headwater areas, including small intermittent streams and wetlands, may play a particularly important role in downstream water quality. In fact, habitat quality in a particular stream reach may be affected more by what happens adjacent to an intermittent stream or headwater wetland two miles upstream than by what happens 100 ft away in its immediate riparian zone. Similarly, harvest management at the watershed scale can influence instream processes such as bank erosion and stream geomorphology by changing the annual hydrograph. For example, annual harvests that exceed a certain percentage of the contributing watershed tend to increase peak discharge and result in an increase in bankfull flow and channel width (see Section 4.3). Lastly, cumulative effects at the watershed scale are an important consideration. For example, a stream crossing that eliminates the forested riparian buffer zone on both sides of the stream may be acceptable as long as BMPs are followed, and as long as the vast majority of the forested riparian buffers in the watershed are left intact (*i.e.,* isolated cases of riparian forest buffer removal or thinning will not have a significant impact as long as the vast majority of the buffer remains intact). However, multiple such crossings in close proximity to each other, even if each of them complies with BMPs, may have substantial impacts.

III. SETTING AND BACKGROUND

- Environmental Setting

The Magalloway, Little Magalloway, and Kennebago River subwatersheds are located in extreme northern Oxford and Franklin Counties in the mountains of western Maine and include a small portion of northeastern Coos County in New Hampshire (Figure 3.1-1). Population density is very sparse with 0-1 people/square mile over the majority of the area, and 1-10 people/square mile over remaining areas (Publicover and Weihrauch, 2003). The mountainous topography and infertile soils have limited the development of agriculture in the area, and left timber harvesting as the primary land use. The area was heavily logged beginning in about the 1850s, and the bed and banks of many streams were impacted from log drives, altered hydrology (higher peak flows from heavily cut areas), and erosion and sedimentation (Publicover and Weihrauch, 2003). Instream structure (large woody debris and boulders) was removed from some stream sections to

Insert Figure 3 (separate file)

facilitate log drives. To this day, it is likely that the quantity of large woody debris in and adjacent to the streams in the area is less than it would be if the only disturbance regimes in the watershed were natural (wind, fire, and disease events separated by hundreds of years on average). Some large woody debris takes decades to decompose. The young forests that follow harvests in stream riparian zones do not supply the same degree of large woody debris inputs for many decades following the harvest. Further, large-scale timber removal or other watershed-scale land use changes, and removal of large woody debris and other structure from the channel, can have long-lasting effects on stream geomorphology (Verry and Dolloff, 2000; Sweeney et al, 2004). Effects from historic logging on the streams in the subject watersheds, as well as other parts of the northeast, likely included geomorphic responses that may have negatively affected brook trout habitat. Such responses include but are not limited to stream narrowing and/or widening, alterations to sinuosity, and simplification of in-stream and shoreline structure important for habitat.

The Magalloway and Little Magalloway Rivers are free-flowing systems without dams from Aziscohos Lake to their headwaters. The Kennebago River is undammed and unregulated above Kennebago Lake. A dam at Kennebago Lake raised the level of Kennebago Lake, and is currently used to produce hydropower, but has little overall impact on annual run-off patterns due to limited storage volume. Each of these drainages is located in the headwaters of the Upper Androscoggin watershed. The northern boundary of the Magalloway subwatershed (inclusive of the Little Magalloway) coincides with the border between the United States (Maine and New Hampshire) and Quebec, Canada, as this international boundary was established along watershed divides. The northern boundary of the Kennebago subwatershed coincides with the border between Maine and Quebec for part of its length, and is within the State of Maine in remaining sections. The mountains that make-up this region are known as the Boundary Mountains in Maine. They are part of the Connecticut Lakes subsection of the White Mountain Ecoregion, as defined by US Forest Service and the Nature Conservancy classification systems (Publicover and Weihrauch, 2003).

The subwatersheds draining to these river systems are characterized by extensive areas of rugged topography including large areas of thin (shallow-to-bedrock) soils that are sensitive to erosion (U.S.D.A. Soil Conservation Service, 1995). The small, headwater streams that feed these rivers originate in and flow through this same rugged topography and thin soils. By contrast, the valleys containing the larger streams, which occupy the lowest elevations in the subwatersheds, typically include areas of deep, coarse-textured soils (U.S.D.A. Soil Conservation Service, 1995). The majority of the land in these subwatersheds is characterized by slopes that are >10%, and slopes of >25% are common (Publicover and Weihrauch, 2003). Slopes of <10% tend to occur in the valley bottoms, adjacent to the larger streams. Bedrock is somewhat variable but is dominated by acidic metasedimentary and metavolcanic rocks formed from the Cambrian to the Devonian Periods.

The majority of the lands in the subject subwatersheds contain soils derived from glacial till (Ferwerda, et al., 1997). Till-derived soils tend to occur in the middle and upper portions of the landscape in moderately to steeply sloping areas (*i.e.,* slopes >10%). Till-derived soils include areas that are very shallow-to-bedrock (*i.e.,* bedrock located 20 inches or less below the soil surface), as well as some areas of moderate soil depth (bedrock at 20-40 inches), and areas of deeper soils (depth to bedrock of >40 inches). Till-derived areas include both basal tills and loose or ablation tills, with the former being more common in the subject subwatersheds

(Ferwerda, et al., 1997). Basal tills have a compact glacial till layer (typically at about 2 ft beneath the surface) that formed beneath the ice. This compact layer tends to be very slowly permeable and results in perched runoff, so that basal till soils are similar to shallow-to-bedrock soils from a runoff perspective. Loose or ablation tills, by contrast, are much more permeable and less dense.

The lower portions of the landscape (*i.e.,* valley bottoms) contain areas of deep soils derived from ice-contact glaciofluvial deposits (material moved by glaciers and subsequently moved and sorted by glacial meltwaters). These soils are typically relatively coarse textured (sandy or gravelly) and include glacial features such as kames (stratified glacial drift, sometimes against the base of a hill) and eskers (winding ridge of gravelly or sandy drift deposited by a stream flowing in a tunnel beneath a glacier). The valleys containing the larger streams also include deep soils derived from recent alluvium (sediments deposited by streams on floodplains).

The landscape is forested except for areas of open water, non-forested wetlands (*e.g.,* marshes, bogs, and shrub swamps), and some minor areas of exposed bedrock. At any given time, some percentage of the area is recently cut forest in early succession. Forest age classes range from recent cuts to mature forest. Forest types include northern hardwood, spruce-fir, and mixed hardwood-softwood, fairly evenly interspersed through the subject subwatersheds (Publicover and Weihrauch, 2003). Dominant species are red spruce, balsam fir, sugar maple, red maple, white birch, white pine and yellow birch. Typical site potential tree heights for the region range from around 35-50 ft (or less near tree line) in spruce-fir forests on exposed mountain slopes with shallow soils, to around 60-80 ft in birch-maple forests in the protected valley bottoms where soils are deeper and more fertile.

Historically (prior to settlement), it is estimated that more than 50% of the forest landscape of northern Maine was more than 150 years old at any given time on average, and that more than 25% of the forested landscape was more than 300 years old (Lorimer, 1977). Local strains of brook trout evolved in forest streams flanked by these mature and old growth forests. Today, in the northern portion of the Upper Androscoggin Watershed, probably no more than 1% of the riparian stands are more than 150 years old. Undoubtedly, this has an effect on the micro and macro-habitat conditions found in brook trout streams. For example, the maximum and average diameters of large woody debris (LWD) inputs to brook trout streams would have been larger historically.

As a result of being in the upper portion of the Androscoggin watershed, with elevations generally in excess of 1,500 ft, the subject streams are not able to rely to a large degree on upstream inputs of carbon (*e.g.,* leaves, twigs, LWD). The Androscoggin River itself, for example, likely receives enough organic matter input from upstream so that even if it completely lacked a forested riparian buffer along a particular stretch, instream leaves and wood (acting as structure and food for macroinvertebrates) would be plentiful. If a high elevation, headwater area were cut heavily, however, recruitment of LWD and fine organic matter would be impacted more significantly. A high grading approach to harvests on some parcels, or repeated heavy harvesting in general, can lead to deficient quantities of LWD (important for brook trout) as well as snags and cavity trees important for other species such as owls (Bryan, 2003).

Photo 3.1-1. Photo showing an old log across a brook trout stream that has influenced the riffle-pool sequence and stream morphology.

Photo by Alan Haberstock

- <u>Brook Trout Natural History</u>

The brook trout is a coldwater species whose native range extends throughout Maine, from the Western mountains to the lowlands of Downeast. Brook trout inhabit both lentic (ponds and lakes) and lotic (streams and rivers) water bodies that are characterized by cold, well oxygenated waters (Raleigh, 1982). First and second order streams are used for year-round habitat; seasonal refugia from high flows, turbidity, or high water temperatures; and spawning by trout inhabiting adjacent lakes, ponds, rivers, or larger streams (Scott and Crossman, 1973).

Brook trout spawning occurs in the fall, October and November, when water temperatures range between 4.5 and 10°C, with females digging redds in gravel. Redd construction typically occurs at the downstream end of riffles, in the tail section of pools or at upwellings of groundwater in gravel. Low gradient (<5%) sections of tributary or 1st order streams are frequently used. Eggs incubate over winter in gravel interstices, with hatching occurring in the late winter/early spring (February to April). After hatching alevin remain buried in the gravel until the yolk sac is depleted. Juvenile trout then leave the protection of the gravel to feed on a variety of invertebrates drifting in the water column and inhabiting the benthos. The preferred water temperature range for juvenile and adult brook trout is 11 to 16°C with temperatures above 20°C detrimental to growth and survival (Scott and Crossman, 1973). Preferred dissolved oxygen levels for all life stages are $\geq$7mg/l at temperatures $\leq$15°C and $\geq$9mg/l at temperatures $\geq$ 15°C (Raleigh, 1982).

Scientists have developed habitat suitability criteria for brook trout (Raleigh, 1982) that point to the specific riparian buffer functions that influence trout habitat (see Section 3.3). The growth of trout is affected by a variety of micro and macro-habitat parameters, including food availability, interspecific and intraspecific competition, channel morphology, substrate, cover, and water depth, clarity, temperature, dissolved oxygen, and velocity.

Naturally vegetated riparian areas are an important aspect of brook trout habitat. Human disturbance that significantly alters riparian buffer areas adjacent to or upstream of brook trout streams can result in degradation of critical habitat. Since brook trout lay their eggs in gravel nests in areas exposed to flowing waters, any land use that results in sedimentation can fill-in gravel beds. This can reduce suitable breeding substrate and smother trout eggs as well as the many invertebrate species that inhabit the interstices between gravel and serve as important forage items for trout. Increased turbidity (over background rates) associated with increased erosion and sedimentation can also injure the gills of trout in all life stages and limit foraging success since this species hunts by sight. Water quantity is important with respect to suitable breeding and rearing habitat. Cool, well-oxygenated water maintained by canopy shading is another important aspect of trout habitat. Trees, coarse woody debris, and leaf litter inputs to trout streams help create and maintain habitat and provide food items for invertebrates as well as provide instream cover which all life stages of brook trout require (Raleigh, 1982). Such woody debris inputs also help to create pools and riffles by influencing flow patterns and provide diverse structural habitat important for trout.

- Forested Riparian Buffer Functions that Promote Brook Trout Habitat

Forested riparian buffer functions that are important with respect to brook trout habitat protection, as identified in the literature, are:

- ***Water quality protection***. Buffers filter sediment and pollutants from upslope areas. Mature forests promote infiltration relative to open cover types, and over time develop a complex microtopography (*i.e.,* pit and mound topography, dead-and-down wood) that traps runoff and promotes sediment settling (many pollutants like phosphorous are sediment-bound) and force runoff to infiltrate into the root zone. Through a process called "denitrification," bacteria in the riparian forest floor convert nitrate from runoff to nitrogen gas, which is then harmlessly released into the air.
- ***Stream bank stabilization***. Forested riparian buffers stabilize stream banks through large roots at the stream edge and peak flow attenuation.
- ***Shading and temperature regulation***. Canopy cover helps maintain cool temperatures during the summer, and promotes a detritus-based (as opposed to algal-based) system, which supports the types of macroinvertebrates important for brook trout. Overhanging canopies also help northern streams (especially streams small enough that the canopy is continuous across the stream) retain warmth in the winter.
- ***Regulation of streamflows***. Forested buffers attenuate peak flows and maintain base flows through the storage and slow release of runoff.
- ***Large woody debris and other organic matter inputs***. Forested buffers provide wood inputs that are important for salmonid habitat structure/cover. Large-diameter wood from fallen trees promotes instream structure and habitat complexity by promoting the formation of

riffle-pool-run complexes. Litter inputs are also an important energy source for the detritus-based community of aquatic macro-invertebrates and the entire aquatic food chain.

Riparian buffers provide the entire influence on in-stream habitat functions such as shading and organic matter inputs, whereas functions such as stream flow regulation and water quality protection are provided by the entire watershed (*i.e.,* not just the immediate buffer). Therefore, an overall watershed management approach is required. Note too that effects are cumulative. For example, overall water temperature through a river system is influenced by percent canopy cover over the entire riparian system, not just the specific buffer being evaluated (Spence *et al.,* 1996).

- Buffer Attributes that Affect Buffer Function

The effectiveness of forested riparian buffers is related to a range of biotic and abiotic variables including topography, vegetation, soils, hydrology, and landscape position (Haberstock, *et al.,* 2000). Specific factors affecting buffer effectiveness include slope, percent canopy closure, hydrologic soil group (this grouping reflects the runoff-producing characteristics of the soils or the ability of the soils to permit infiltration), surface water features, surface roughness (*e.g.,* the degree to which certain features such as large wood, boulders and pit-and-mound topography occur on the landscape), groundwater seepage/springs, sand and gravel aquifers, floodplains and wetlands, and stream order. All else being equal, wider buffers are more effective at performing desired functions than narrower buffers, and the width of a buffer necessary to achieve a certain degree of effectiveness for a given function is affected by attributes such as those listed above.

As slope increases, the width of a given buffer must increase in order to realize a given level of buffer effectiveness. Slope has a strong relationship with erosion potential and other water quality factors such as retention or conversion of nutrients and chemical pollutants (US ACOE, 1991; Phillips, et al., 2000). Factors related to erosion such as elevated sedimentation and reduced water quality decrease the quality of salmonid habitat. Among all variables, slope has one of the most important influences on the width required for a given level of buffer effectiveness.

A high degree of canopy closure adjacent to streams is necessary for buffers to function at optimal levels. A high degree of canopy closure is associated with several functions important for salmonid habitat including shading and organic matter inputs, nutrient and sediment retention, and wind-firm conditions (Chesapeake Bay Program, 1995; Spence *et al.*, 1996; Mitchell, 1996; Kahl, 1996; Correll, 1997; Jacobson *et al.*, 1997). Cut forests with disturbed duff layers are not able to perform these functions as well. Effective buffer width and percent canopy closure are, therefore, inversely related. For example, a 20 ft buffer along a stream margin with 100% canopy closure may perform shading and LWD recruitment functions similar to a 30 ft buffer with 70% canopy closure. Forest age-class is an additional forest characteristic that relates to functional capacity (*i.e.,* mature forests are responsible for more/different LWD inputs than very young, early-successional forests).

Wooded buffers with a high degree of canopy closure, intact duff layers, and well developed shrub and herb strata generally provide greater uptake or retention of runoff and associated pollutants than do systems which have been selectively cut or disturbed (ME DEP, 1992; Sweeney, 1992; Chesapeake Bay Program, 1995; Kahl, 1996; Jacobson *et al.*, 1997).

Some of the literature indicates, however, that non-forested systems perform better than forested systems for sediment retention and uptake and retention of sediment-bound nutrients (Welsch, 1991; Chesapeake Bay Program, 1995; Lyons, *et al.*, 2000), which is why some riparian buffer prescriptions call-for a zone of low, dense grass-dominated vegetation upgradient from forest at the stream edge (Welsch, 1991). Grass-dominated zones may make sense in some regions but are not recommended in the target region of Maine and New Hampshire because: agriculture (pasture and hay operations) are impractical due to infertile soils and rugged terrain, shallow-rooted vegetation such as spruce and fir and trees over shallow-to-bedrock soils are susceptible to wind throw when long term openings occur adjacent to them, and the surface roughness of the forest floor (boulders, pit-and-mound topography, and dead-and-down wood) likely does trap sediment as well as rough pasture.

Intact forested riparian areas also provide organic debris inputs which directly enhance brook trout habitat through the provision of in-stream structure like tree boles, root wads, and large branches, and indirectly enhance salmon habitat since wood and leaves provide food and habitat for detritus-based aquatic macroinvertebrates (Dolloff, 1998). Large woody debris inputs promote "hydraulic heterogeneity" and support the development of varied instream habitat conditions such as pools, runs, and riffles (Ohio EPA, 1994; Jacobson *et al.,* 1997). Large woody debris also provides an energy source for denitrification and provides a mechanism for increasing buffer zone surface roughness in terrestrial areas, thereby limiting concentrated surface runoff patterns and enhancing the ability of the buffer to perform optimal water quality maintenance functions (Chesapeake Bay Program, 1995; Correll, 1997).

Areas dominated by soils with low infiltration capacities and high runoff potentials (*i.e.*, hydrologic group D soils as determined by USDA NRCS soils mapping) generally require greater buffer widths for a given level of protection, than soils with high infiltration capacities and low runoff potentials (*i.e.*, group A and B soils). In general, the greater the infiltration capacity of the soils, the greater the ability of the buffer to perform water quality and water quantity functions (Welsch, 1991). Soils with a high infiltration capacity discourage concentrated, erosive flows, thereby reducing sediment and sediment-bound nutrient (*i.e.*, phosphorous) export. Such soils are also well suited to providing a flow de-synchronization function. A caveat to the benefits of infiltration capacity is that extremely permeable soils such as sand and gravel outwash can be leaky with regard to nutrients (especially nitrogen) (Chesapeake Bay Program, 1995; Grantham, 1996; Speirman *et al*, 1997) and chemical pollutants.

Where surface water features such as intermittent streams are present in the buffer of a perennial stream, these smaller drainage features should also be buffered since they can allow contaminants to quickly bypass the soils and root zone of the riparian buffer (Adamik *et al.*, 1987; Ohio EPA, 1994; Murphy, 1995; Chesapeake Bay Program, 1997; Correll, 1997). Such surface water features include intermittent streams, ditches and gullies. The presence of surface water features provides increased potential for "leaky" or ineffective buffers since they provide a potential concentrated flow path whereby sediments, dissolved nutrients and other potential pollutants can effectively circumvent the buffer. Conversely, diffuse flow (*e.g.,* sheetflow) through a buffer encourages infiltration and energy dissipation, allowing sediments and nutrients to be trapped. Intermittent streams surrounded by forested buffers are more effective at trapping sediments and pollutants, in part because coarse woody debris inputs can increase channel roughness, deflect flows to the adjacent forest, and prevent channel incision.

Buffers and watersheds with less surface roughness are more susceptible to potential impacts from tree removal or other disturbances, and therefore warrant wider buffers to achieve a given level of effectiveness with regard to water quality functions. Higher degrees of surface roughness (as function of micro-topography, coarse woody debris, herbaceous vegetation, and forest floor) encourage infiltration and discourage concentrated flows (Murphy, 1995). Features such as pit-and-mound topography, dense herbaceous vegetation, dead-and-down wood, and a thick duff layer increase surface roughness. Surface roughness is typically lacking on landscapes that were recently cultivated for crops, because plowing smoothed out the pit-and-mound topography. Similarly, repeated cutting can "starve" a forest of the large diameter trees that promote pit-and-mound topography.

Spring or groundwater discharge is a habitat characteristic important to brook trout. Springs provide important base flow inputs in the summer and help moderate stream temperatures, and can also enhance spawning habitat when located in the stream channel. Springs can indicate a close relationship between the water table and the buffer soils/vegetation. Where groundwater is near the surface as it flows through the buffer, undisturbed soils and root systems play an important role in removing nutrients and other pollutants from groundwater prior to discharge to the stream (Caswell, 1987; Sweeney, 1993; Correll, 1997; Lowrance *et al.*, 1997; Speirman *et al.*, 1997). Identifiable spring-discharge areas, both riparian and in-stream, should be mapped if possible, and stream crossings (whether permanent or temporary haul roads) should be located away from these locations.

The presence of sand and gravel aquifers may increase the sensitivity of an area to anthropogenic disturbances since these features are highly permeable and allow nutrients and other contaminants to enter the groundwater more easily than with less permeable surficial deposits such as tills (Caswell, 1987; Weddle, *et al*, 1988; Correll, 1997; Lowrance *et al.*, 1997; Speirman *et al.*, 1997). Groundwater in riparian sand and gravel deposits is assumed to discharge to the adjacent stream (USDOI, 1993). Potential water quality impacts to aquifers are associated more with residential and agricultural development than with forestry activities.

Streamside floodplains (defined as areas with alluvial soils) and open wetlands (emergent & scrub-shrub) adjacent to streams, no matter how wide, should be considered part of the stream resource being protected. The baseline for buffer width measurement should begin at their landward edge. Some streams meander over time and the main channel could potentially occupy any part of the floodplain in the future. Floodplains are of vital importance in terms of accommodating and attenuating overbank flows during high flow periods, and perform some of the same water quality and quantity functions as wetlands (Poff *et al.*, 1997). Where there are wide floodplains, large wood and fine forest litter recruitment may come from areas further than the equivalent of a mature tree height from the stream edge because wood is carried by water in addition to gravity.

Wetlands are functionally-important landscape features in riparian buffers, as well as at the watershed-scale, that are particularly sensitive to impacts from forestry and other land uses. Riparian wetlands are typically connected by surface and/or subsurface hydrology to streams, and perform important water quality functions (Chase *et al.,* 1997; Spence *et al.*, 1996; Correll, 1997; Lowrence, 1997). Wetlands typically have water tables within the root zone and are more effective than uplands at converting potentially available nitrogen to a gaseous form through denitrification. Wetlands are often effective at trapping sediments and pollutants adsorbed to sediments. Disturbance to wetland soils may compromise wetland functions. Wetland preservation in the riparian zone and in the larger watershed enhances buffer function and watershed function. Any surface water connecting the wetland and the brook trout stream (*e.g.*, wetland has intermittent stream outlet) increases the potential risk of sedimentation related to inadequate buffer width or wetland protection. Forested wetlands adjacent to streams provide important functions such as shading, and woody debris and litter inputs that are not provided by open-canopy wetlands to the same degree. In Maine, timber removal is permitted in forested wetlands as long as sediments are not mobilized.

Buffer widths or other protective management measures should not be lessened for smaller, first order streams since spawning and early life stage rearing habitat can be concentrated in smaller headwater stream reaches that are often more sensitive to water quality and quantity impacts (Davies and Sowles, 1984; Murphy, 1995; Chesapeake Bay Program, 1995; Kahl, 1996). Small streams can also serve as refuge for brook trout during floods or during warm periods (where smaller, tributary streams are cooler or groundwater fed). In most cases, smaller streams are afforded less regulatory protection than are larger streams (USFS, 1997). For many functions, such as the provision of wildlife corridors and terrestrial wildlife habitat, this makes sense. However, smaller headwater streams are typically more vulnerable to water quality and quantity impacts as they are less able to dilute or buffer impacts such as sedimentation, solar heating, nutrient loading, or base flow alterations (*e.g.* water withdrawal). One reason that smaller streams are not afforded greater buffer widths is that larger streams have a greater potential floodplain and more energy available for bank cutting, wood recruitment, and sediment and debris transport (Murphy, 1995).

- <u>Regional Considerations for Developing Recommendations</u>

Management recommendations such as buffer prescriptions and BMP recommendations should consider the unique regional conditions (Section 3.1) of the target protection area. Table 3.5-1 summarizes some factors that should be taken into account in management recommendations (Section 4).

Table 3.5-1. Characteristics of the Magalloway* and Kennebago River Subwatersheds and Associated Management Considerations

Characteristic	Associated Management Consideration(s)
The area includes a large proportion of steeply sloping, hilly to mountainous terrain. The majority of the land i characterized by slopes that are >10%, and slopes of >25% are common.	All else being equal, buffers should be wider (as compared to more gently sloping landscapes), and watershed and forestry BMPs should be more rigorously pursued.
The area is typified by hydrologic group C and D soils (soils that are shallow-to-bedrock, are derived from compact basal tills, or are on wetlands). These soils have a high runoff potential and low infiltration rates.	All else being equal, buffers should be wider (as compared to landscapes dominated by hydrologic group A and B soils), and watershed and forestry BMPs should be more rigorously pursued.
Target resource (brook trout) utilizes very small 1st order streams. Plus, due to the rugged terrain, the smallest streams tend to occur on the more rugged, erodable, upper portions of the landscape (as opposed to the major stream valleys).	Apply buffer widths and BMPs on small streams at least as rigorously as on large streams.
Shallow-rooted trees are common in the area. This is because two of the dominant species (spruce and fir) are shallow-rooted, and the shallow soils and rugged topography result in many forest trees being shallow-rooted by necessity.	Maintain wind-firm conditions by limiting the size of cuts, especially near streams. Heavy cuts should not occur adjacent to forested riparian buffers, as this can result in elevated wind-throw and a "pulse" of LWD inputs to the stream (and in later decades a deficit).
Heavy logging occurred in the area beginning around 1850. Larger streams (such as the Magalloway) likely suffered from habitat simplification as large boulders and LWD were removed from the channel to accommodate log drives. In the absence of humans LWD typically enters the stream as a result of localized, natural disturbance events. Heavy logging also changes the input of LWD because it results in the removal of large boles and limits the percent of the watershed in mature growth at any given time. Heavy logging may also have left a legacy of fine sediments in some of the low gradient streams.	The best tree growth conditions and most valuable trees are concentrated in the river valleys and lower slopes. However, a no-cut zone should be maintained adjacent to streams to help sustain long term LWD recruitment, and help regain lost instream habitat complexity. Heavy logging of the valleys, even many decades ago, would still have a legacy today as instream LWD structure takes many decades to decay. LWD from a very large tree can provide important micro-habitat for macro-invertebrates for more than a century after initial recruitment.
Most of the target streams are small, 1st order headwater streams in the upper portion of the watershed. As such, they do not receive organic matter inputs from area far upstream.	Riparian forest removal along small headwater streams will directly impact organic matter inputs. The further up in the watershed a stream is the more it relies on its immediate riparian buffer instead of the larger contributing watershed to supply wood and leaves for energy (carbon) and structure. Apply buffer widths and BMPs on small streams at least as rigorously as large streams.
The area has very few residents, and there is little agriculture. The timber industry is the dominant use of the land.	At this time, buffer designs do not need to specifically protect streams from significant amounts of non-point-source pollution from farm runoff or residential/commercia development (*e.g.*, fertilizers, hydrocarbons). Forestry is th primary potential source of sediments and nutrients. So BMPs and management recommendations should be geared more to forestry than other land uses.

* Includes Little Magalloway

IV. RECOMMENDATIONS

This section outlines the riparian buffer and watershed management recommendations for the focus watersheds. Section 4.1 details a recommended 3-zone riparian buffer management approach. Section 4.2 considers stream size and type. Watershed-level recommendations are included in Section 4.3. A watershed approach is critical because even wide no-cut zones don't entirely protect the instream habitat. Forestry and stream crossing BMP recommendations are included as Sections 4.4 and 4.5 respectively. BMPs include a wide range of techniques and recommended procedures that, when used properly, will protect targeted resources.

- 4.1 Protective Riparian Buffers

In order to maintain brook trout habitat at optimal levels, while at the same time allowing for timber harvesting, a zoned management approach is recommended. Other zoned approaches have been developed and used in the northeast. Welsch (1991) of the U.S. Forest Service advocated a 3-zone approach where Zone 1 is a no-cut zone (generally about 15 ft wide), zone 2 is a managed forest zone (generally about 60 ft wide), and zone 3 is a non-forested zone where controlled haying or pasture occur. Kleinschmidt (1999) recommended a 2-Zone approach where Zone 1 is a 35 ft wide no-cut zone, and Zone 2 is a limited harvest zone of variable width where no soil disturbance is permitted. This variable-width approach results in buffers ranging from 70 ft to several hundred feet depending on buffer characteristics, but only the first 35 ft is no-cut. Lansky (2004) recommends a 3-Zone approach where Zone 1 is of variable-width (35 ft for gentle slopes and more for steep slopes), Zone 2 is a fixed width of 75 ft (based on the length of a cable on winch) in which limited harvesting can occur, and Zone 3 (all remaining areas) is a controlled harvest zone where some level of soil disturbance for haul roads and landings can occur. All of these methods apply to even the smallest 1st order streams, whereas some other unpublished methods used by the private forest industry, as well as state regulations in Maine, designate more restrictive buffers on the larger streams and have little to no buffer for small streams.

Based on the goals and objectives of this project, and the characteristics of the target region, it is recommended that a 3-Zone approach be used. The recommended zones are summarized in Table 4.1-1, along with the management recommendations for the three zones. It is recognized that no two riparian buffer zones are alike and that the width required to achieve a given level of functional effectiveness is variable from buffer to buffer depending on a variety of biotic and abiotic variables (Section 3.4). There is therefore good justification for recommending variable-width buffers. However, fixed-width buffers are much simpler to implement and more practical for applications such as regulations, easement terms, and private-sector policies. Variable width buffers also require field work to determine the width because GIS data on slope, wetlands and soils, is typically too coarse to work for an area as narrow as 75 feet. As long as fixed-width zones take into account the typical conditions of the watershed, are sufficiently wide to address the range of conditions, and have adjustments to take into account special characteristics (e.g., springs or intermittent drainage features), a fixed-width approach accomplishes the stated objective of protecting native brook trout habitat.

The recommendations in this report build upon the earlier recommendations, discussed above (Welsch, 1991; Kleinschmidt, 1999; Lansky, 2004). A comparatively wider, fixed width, no-cut zone (Zone 1) of 75 feet is recommended for this target region and objective to reflect that:

- The target resource (brook trout habitat) is extremely sensitive to the effects of sedimentation, stream warming, dissolved oxygen levels, and other in-stream and shoreline habitat characteristics.
- There are certain physical characteristics that make the subject watersheds more prone to erosion and stream damage, such as rugged terrain and thin soils.
- The science and literature base has progressed and many recent references recommend no-cut zones as wide as 100 feet or more. Because the recommendations in this report include a Zone 2 that is also 75 feet in width (totaling a 150 foot minimum width of no soil disturbance) 100 feet of no-cut was considered excessive.

The recommended width of Zone 2 is 75 feet, where no soil disturbance or pesticide use is permitted. Skidders should be kept out of this zone this zone to avoid tree damage or soil disturbance, and to permit wind-firm stocking levels. Cables or other methods can be used to carefully remove tree boles from this zone. Slash should be left in place. Guideline for minimum stocking levels are 60 sq ft of basal area for hardwoods, 80 sq ft for mixed-wood, and 100 sq ft for softwood to ensure wind-firm conditions (Lansky, 2004). No harvesting should occur in Zones 2 wetlands, springs, areas with slopes of $\geq$25%, or hydrologic group D soils. Lastly, harvesting should not occur within 25 feet of intermittent streams in this zone.

Zone 3 should be 300 ft wide, extending from 150 ft to 450 ft from the stream. Well-planned haul roads and skidder trails may occur in this zone, but to the maximum extent possible should be located outside this zone. Strict adherence to BMPs (Sections 4.4 & 4.5) here and in the remaining portions of the watershed is critical, because even wide buffers can't protect streams from inadequate BMP use. The recommended guidelines for minimum stocking levels are 50 sq ft of basal area for hardwoods, 70 sq ft for mixed-wood, and 80 sq ft for softwood. As with Zone 2, no harvesting should occur in Zones 2 or 3 in wetlands, springs, areas with slopes of $\geq$25%, or hydrologic group D soils. Again, as with Zone 2, no herbicides or insecticides should be used in this zone, and harvesting should not occur within 25 feet of intermittent streams.

Table 4.1-1. Three-Zone Riparian Management Approach

Zone	Extent	Prescription
Zone 1	Fixed 75 ft	No-cut zone. Mature and old growth forest allowed to develop over time. Only disturbance regime is natural.
Zone 2	Fixed 75 ft beyond Zone 1	No soil disturbance. No haul roads (except existing or permitted crossings). Timber may be extracted by cable only. Guidelines for minimum stocking levels are 60 sq ft of basal area for hardwoods, 80 sq ft for mixed-wood, and 100 sq ft for softwood. No harvesting should occur in Zones 2 or 3 in wetlands, springs, areas with slopes of ≥25%, or hydrologic group D soils. Further harvesting should not occur within 25 feet of intermittent streams in this zone. No herbicides or insecticides.
Zone 3	Fixed 300 ft beyond Zone 2	Well-planned skidder trails and haul roads. Strict adherence to BMPs (Sections 4.4 & 4.5). Guidelines for minimum stocking levels are 50 sq ft of basal area for hardwoods, 70 sq ft for mixed-wood, and 80 sq ft for softwood. No harvesting should occur in Zones 2 or 3 in wetlands, springs, areas with slopes of ≥25%, or hydrologic group D soils. Further harvesting should not occur within 25 feet of intermittent streams in this zone. No herbicides or insecticides.
Remaining Area	Remaining Area	Regular commercial management and harvests, with well-planned haul roads and strict adherence to BMPs (Sections 4.4 & 4.5). To the extent possible leave a 25 ft limited harvest or no-cut zone adjacent to intermittent streams.
Watershed as a Whole	Entire Watershed	No more than 20% of any subwatershed should be in age classes less than 15 years at any given time (Section 4.3).

The primary scientific justification or rationale for the width and the management prescriptions recommended for each zone is:

- Zone 1 should be as wide as a site potential tree height to achieve close to 100% of the potential shading and LWD inputs. 50 ft would capture the majority of these functions. However, buffers of 100 ft or more may be required to protect streams form the majority of potential water quality impacts (Kleinschmidt, 1999), and some literature shows that BMPs are not always followed (ME DOC, 2002) so that sedimentation occurs despite otherwise adequate buffers. A width of 75 ft addresses the range of conditions in the region (steep slopes, shallow soils, historic logging effects) since Zones 2 and 3 provide further protection. Some literature shows that LWD recruitment can occur beyond one site potential tree height away from the stream because of the common occurrence of one tree falling into another and knocking it in the same direction (Reid and Hilton, 1998), however, the relatively high stocking levels for Zone 2 will result in much of this potential recruiting path remaining.
- Zone 2 width is largely a function of the reach of a cable skidder and the desire to prevent any disturbance at all to the duff layer.

- The width of Zone 3 is designed to ensure wind firm conditions in Zones 1 and 2 and act as an additional filter for water quality functions while allowing forestry and some haul roads and trails to occur. Since seeps and intermittent streams do not have their own no-cut zones (Zone 1) or special harvest guidelines (Zones 2 and 3), Zone 2 and 3 will protect these resources relative to full commercial cuts and will be able to filter most sediments coming from outside Zone 3.

As detailed in Section 4.2, the target region can be divided into two basic stream corridor types. One is the small (usually 1st order), high gradient stream corridors that occur in the more mountainous terrain. The other is the larger (usually 2nd and 3rd order), low gradient stream corridors that occur in the protected valleys. There are several factors that would suggest wider buffers be applied to the smaller, high-gradient streams. However, there are also several factors that would suggest wider buffers be applied to the larger, low-gradient streams. These factors more or less cancel each other out (see Section 4.2). As such it was felt that a fixed-width 75 ft no-cut zone (Zone 1) would accomplish the functional objectives desired for the range of stream types found in the region. The recommended three-zone approach protects a riparian area that is 450 wide including: 1) no harvesting in the first 75 ft (Zone 1), 2) no soil disturbance (*i.e.,* no haul roads, skidders, or other disturbance that would expose mineral soil) in the first 150 ft (Zones 1 and 2 combined), and 3) limited harvesting and road/trial construction between 150 and 450 ft. The limited harvesting in Zones 2 and 3, if proper use of BMPs is adhered to (Sections 4.4 and 4.5), is considered consistent with maintaining healthy brook trout habitat.

The 3-zone approach should be applied to all perennial streams. Intermittent streams are protected by the use of careful BMPs, and are also further protected in those places where they flow through Zones 1-3. Zone 1 is measured from the normal high water mark of the stream if there are no streamside wetlands or floodplains. If there are wetlands or floodplains, these are considered part of the resource being protected, and the measurement begins at the landward edge of these features.

- <u>4.2 Stream Order</u>

Small, 1st order, headwater streams are more sensitive to potential impacts than are larger/higher order streams (Kahl, 1996). For example, small streams are less able to handle elevated sediment inputs and warm more readily following canopy removal. Small streams also rely heavily on the adjacent riparian area for LWD and leaf litter inputs, whereas larger streams receive a large proportion of these inputs from the smaller streams that feed them. The health of large streams is directly related to the health of the small intermittent streams, 1st order streams, and wetlands in the contributing watershed (American Rivers and the Sierra Club, 2003). There are several compelling reasons to afford more protection for smaller streams (Table 4.2-1). However, there are several equally compelling reasons, pertinent to brook trout habitat, to afford more protection for larger streams. An additional reason to have more protection (wider buffers) on larger streams is that these corridors are used more extensively by wildlife such as cavity nesting birds and riparian-specific species like mink and otter that benefit from buffers that are several hundred feet wide (USDA Forest Service, 1997; Chase *et al.,* 1997). This factor is not listed in Table 4.2-1 because it is not directly relevant for brook trout habitat. The factors in Table 4.2-1 were concluded to cancel each other out to the point where a single, fixed Zone 1 buffer width of 100 ft (justification for this width in Section 4.4) would be simple to implement and would make sense scientifically.

potential (steep slopes and preponderance of shallow to bedrock soils and basal till soils), and also because the effect on they annual hydrograph from cutting is accentuated where softwoods are dominant (Kahl, 1996). Spruce and fir are very common in this region (Section 3.1).

Land uses (*e.g.*, forest clearing, soil disturbance) that occur as little as 50-100 feet from a main-stem river can sometimes have less of an effect on instream structure and function than land uses occurring a mile or more upstream affecting small, headwater streams. Therefore, watershed-wide BMPs such as summarized in Sections 4.4 and 4.5 are important.

As indicated by Table 4.3-1, individual functions are important in different parts of the watershed and at varying distances from the stream.

Table 4.3-1. Functions of Zones

Function	Zone 1	Zone 2[1]	Zone 3 and Entire Watershed
Shading and Temperature Regulation	Primary	*Secondary*	*Insignificant*
Large Woody Debris and Organic Matter Inputs	Primary	*Secondary*	*Insignificant*
Water Quality Functions (other than shading)	Primary	Primary[2]	Primary[2]
Water Quantity Functions	*Secondary*[3]	*Secondary*[3]	Primary[3]
Bank Stabilization	Primary	*Insignificant*[4]	*Secondary*[4]

[1] An additional function of Zone 2 is to provide wind-firm conditions in Zone 1.
[2] As a result of intermittent streams, wetlands, and stormwater runoff (surface and shallow subsurface), the entire watershed provides water quality functions, although Zone 1 is often the most important zone for this function.
[3] Baseflow maintenance and peak flow attenuation is provided by the entire watershed, not primarily by the immediate riparian buffer. Flood storage during overbank flows is a primary function of riparian buffers. However, this report recommends that floodplains be included as part of the resource to be buffered. Zone 1 begins at the landward edge of floodplains.
[4] The entire watershed is relevant to bank stability. Zone 3 and watershed management affects the annual hydrograph (*i.e.*, cutting a large percentage of the watershed increases peak flows), which affects bank stability.

- 4.4 Forestry BMPs (Non-Crossing)

BMPs are generally developed by state and federal government agencies such as the Maine Forest Service and the USDA Natural Resources Conservation Service and are designed to protect water quality during all stages of forestry operations. This includes pre-harvest planning, buffers (Section 4.1), watershed management (Section 4.3), streamside and wetland area management, road construction and maintenance, stream crossings (Section 4.5), timber harvesting, revegetation, and chemical management. This section briefly summarizes recommended BMPs as gleaned from several recently developed references (VDF, 2002; ME FS, 2004; PSRWG, 2004). The majority of sedimentation that occurs during and after timber harvesting operations results from improperly constructed or maintained haul roads, skid trails and landings (VDF, 2002).

Table 4.4-1 is a summary of the forestry and road crossing BMPs recommended. Section 4.5 provides greater detail regarding fish-friendly crossings.

Table 4.4-1. Recommended Forestry BMPs.

Recommendation	Rationale
A pre-harvest or **forest management plan** should be developed before each harvest operation. The pre-harvest plan should identify the BMPs that will be followed before, during and after the harvest. The plan should: clearly identify the area to be harvested, locate special areas of protection (such as wetlands), specify proper timing of forestry activities, describe the road layout, design, construction, and maintenance, and identify harvest methods and forest regeneration.	Natural drainage features, sensitive landscape features like wetlands and springs, threatened and endangered species habitat, topography, and soil types need to be considered if impacts related to haul roads, trails, and harvest areas are to be avoided or minimized.
No herbicide or insecticides in Zones 1-3	Although glyphosate-based herbicides are not thought to be toxic, the surfactant mixed with it can be toxic to aquatic organisms. Insecticides pose a more serious threat to fish and macroinvertebrates than herbicides.
No spraying anywhere when winds are >5 mph	Spraying in moderate or high winds can result in inputs to streams, and can directly or indirectly (through damage to shoreline vegetation and to the macroinvertebrate community) stress salmonids
Conduct winter harvests only, when the ground is frozen solid (generally December 1 until March 15 in northern Maine)	Winter harvests are the least damaging to forest floors and pose the least risk for erosion and sedimentation.
Use appropriate stream crossing BMPs (Section 4.5) **for even small, intermittent streams and temporary crossings** (Maine FS, 2004; PSRWG, 2004). Avoid culverts for temporary crossings. Use temporary bridges instead of fords where there is flow or potential flow (PSRWG, 2004).	Stream crossings at very small headwater streams are a primary potential source of sedimentation.
Use appropriate stream crossing BMPs (Section 4.5) **for permanent crossings or crossings of perennial streams.** Do not perch culverts, undersize culverts or otherwise create passage barriers or unstable banks (Maine FS, 2004; Kleinschmidt, 2004)	Stream crossings at very small headwater streams is a primary potential source of sedimentation

Landings should be located in dry areas with gentle slopes, well outside streamside management zones or wetlands. The number and size of landings should be planned along with the harvest road system. There should be adequate drainage on haul trails to the landing and a mechanism to divert water away from the landing. After completion of harvesting operations, landings and access roads must be stabilized and revegetated.	Poorly planned and located landings, and landings that are not stabilized after use, can impact streams in the watershed by erosion and sedimentation, including gully and sheet and rill erosion. Landings can also concentrate surface runoff through compacted soils and altered drainage patterns.
Haul roads and skid trails should be properly constructed and located. Recommended road system layout recommendations are: minimize the total road length, use existing roads where possible, avoid Zones 1-2 always and Zone 3 as much as possible, avoid changes to natural drainage patterns, avoid concentrated runoff patterns and promote diffuse runoff and infiltration, use BMPs like turnouts and broad-based dips to distribute runoff to upland areas where it can infiltrate, locate roads on uplands, the road should follow the natural contours to minimize cut and fill, keep road gradient as low as possible (the steeper the road, the greater the velocity of the runoff), if steep grades are needed for short distances, follow by gentle stretches to reduce runoff velocity, select the appropriate road surfacing material to minimize erosion and reduce maintenance costs, and use outsloped, crowned or in-sloped roads to drain water directly to forest floor depending on topography and stream locations.	Well-located, constructed, and maintained forest roads and skid trails can minimize the major source of erosion and sedimentation associated with silvicultural activities. A poorly designed road system can result in significant impacts such as increased sediment load reaching the stream, and altered and concentrated surface runoff, as well as increased maintenance costs.
Minimize and stabilize exposed soil where the duff layer has been scraped down to mineral soil using mulching and revegetation techniques.	Exposed mineral soil is far more susceptible to erosion and sedimentation than vegetated areas and areas with a thick forest floor or mulch cover.
Handle fuel and oil properly. If oil changes are necessary on-site, oil should be properly recycled. Fuel should be stored properly to prevent spills and contain spills that do occur.	Fuel or oil reaching brook trout streams can damage macroinvertebrates and water quality.
Maintain 25 ft forested **buffers along intermittent streams** as much as possible.	It is recognized that intermittent streams are too numerous to avoid crossing and harvesting along without severely impacting the economics of harvest operations,

- 4.5 Stream Crossing BMPs

New road crossings should preferably be located in straight, stable stream sections, and away from known important spawning areas. Although new crossings should be avoided if possible, if a crossing must be developed, culverts or bridges that promote unimpeded bank to bank flow should be used. Permanent logging roads usually cross streams via culverts. If culverts are used, they must be satisfactorily sized and designed to minimize stream impacts. Culverts should accommodate flood flows and base flows, and address factors such as hydraulics and stream slope (PSRWG, 2004). This can be accomplished by calculating and designing for specific criteria such as a specific flood event, or installing a no-slope design that is as wide as the stream channel. No-bottom arch culvert designs are typically superior to conventional culverts with respect to maintaining natural substrate and accommodating flood flows. Culvert and bridge crossings should be oriented perpendicular (culverts themselves should be parallel) to flow whenever possible. Temporary crossings are not preferred and should be avoided if possible. Bridges should be designed with piers positioned above bankfull elevation to avoid debris buildup, bank erosion and downstream channel degradation.

Road and culvert construction practices must be properly timed and designed to avoid impacting brook trout or their habitat. This requires timing construction or maintenance activities to avoid times when soils are wet, loose and difficult to control and/or when spawning is occurring. Habitat characteristics (such as shading, large woody debris recruitment) should be emphasized in all BMP designs in brook trout watersheds.

When to Cross

Maine regulations (Natural Resources Protection Act) specify that stream crossings occur between July 15 and October 1 to minimize impacts to spawning or migrating fish, and to avoid work in saturated soils or during high flows. The Maine Department of Inland Fisheries and Wildlife (DIFW) reviews permit applications submitted to the Maine Department of Environmental Protection or US Army Corps of Engineers for crossings, and depending on the particular stream and region, there is some flexibility in these dates. Northern and high elevation portions of Maine, such as the subject watersheds, experience earlier brook trout spawning (Steve Timpano and Forrest Bonney, DIFW, personal communication, March 24, 2005). The cooler climate and higher elevations of the subject watersheds also result in a shorter growing season so soils stay saturated longer into the summer and become saturated again earlier in the fall. For these reasons, **it is recommended that the stream crossing window be narrowed to July 15 to September 15 in the subject watersheds** (Steve Timpano and Forrest Bonney, DIFW, personal communication with Alan Haberstock, Kleinschmidt Associates, March 24, 2005).

Where to Cross

Crossings should avoid important high density spawning areas where these are known or can be identified in advance of a crossing project (the DIFW Regional Biologist should be consulted for new crossing locations). Brook trout females are selective compared to other salmonid species with regard to where they deposit their eggs, and this selectivity may lead to a high degree of site fidelity from year to year.

Other factors that should be considered when siting a culvert or bridge crossing include: flow direction relative to culvert orientation, flow velocity, lateral stream migration potential,

potential vertical stream bed changes, bedload and debris transport dynamics, channel width and gradient, and bank characteristics (California Department of Fish and Game, IFD, 2003; PSRWG, 2004). Figure 4.5-1 illustrates a few crossing considerations.

Bridges or arch culverts are preferable to conventional culverts as long as they are constructed in such a way that flow is not affected. Because conventional culverts channel water within the stream, special care must be taken to orient and size these structures (PSRWG, 2004). The axis of a culvert should be oriented parallel to channel flow as much as possible. Roads should be as close to perpendicular to the stream as possible. Culverts that are skewed more than 30 degrees to the channel flow are not recommended since they can increase inlet turbulence at high flows, make the culvert less efficient at sediment and flood flow transport, result in bank erosion and in-channel deposition upstream, and result in downstream bank erosion and bed degradation (Washington DFW, 2003).

Potential lateral channel migration should also be considered. For example, a meander bend is a poor crossing location, and locations along relatively straight reaches with stable banks are good choices. Site specific conditions (*e.g.,* whether the subject stream is a meandering low gradient steam or a relatively straight high gradient stream) will dictate the potential to find straight and stable stream reaches. Stream crossings should be placed in sections of the waterway that are relatively straight above and below the crossing, as a general guideline. Alluvial reaches are poor locations for stream crossing locations, as they typically have floodplains, extensive areas of alluvial sediments (sediment sorted and deposited by over bank flows), oxbows, or other indications of potential lateral stream channel movement. Lastly, reaches that flow through non-cohesive soils (*e.g.,* loose sediments, such as outwash sands that do not hold together well) may be problematic with regard to lateral stream migration.

High gradient stream reaches (>4%) may cause problems for culvert crossings. Although the channel beds tend to be more stable along high gradient reaches, large debris (boulders and large woody debris) is more mobile in high gradient reaches, and debris damming at a culvert crossing may occur. In addition, high stream velocities increase the chances of structural damage and erosion, and can magnify design flaws such as undersized or misaligned culverts. Bridges and over-sized culvert designs can minimize problems with high velocities and debris jams. Many high gradient reaches are headwater streams, however, the contributing watershed is often smaller and flooding potential is often less as compared to low gradient reaches further downstream.

Culvert crossing designs along low gradient streams (<1%) with fines (*i.e.,* organics, clay, silt, and fine sand) for substrate should take into account that these are typically depositional areas. If the subject reach is prone to aggradation, culvert size should be increased to allow deposited material to pass and prevent build-up that could result in fish passage impacts such as low flow barriers, and debris dams. Flow constrictions from undersized culverts could also deepen the channel downstream and create a perched culvert during low flows (or velocity barrier during high flows).

Insert Figure 4 (separate file)

A bridge is recommended instead of a culvert crossing if the crossing is unavoidably located along steep banks (approximately >20%). Such locations increase the chances of bank erosion and sedimentation from riparian vegetation removal, road runoff, and high velocities during high flows. Moderately steep banks (>10%) also require careful planning and design with regard to stormwater management and culvert parameters. Steep banks are associated with fast-rising streams during floods and increase the chances of overtopping structures. Bedrock or well-consolidated/cohesive (*e.g.,* holds together well) bank materials provide a stable base for structure placement, whereas non-cohesive materials require more attention to bank stabilization measures and may require an oversized culvert design or bridge.

How to Cross

Permanent Crossings

Culverts and bridges should be constructed in a manner that facilitates fish passage and avoids habitat degradation. There are several organizations and references that provide detailed information and calculations for properly sizing and locating culverts and bridges, including some recently developed manuals (Maine DOT, 2002; Washington DFW, 2003; PSRWG, 2004). In addition, professional engineers can be hired to complete designs that avoid fish passage barriers or habitat degradation. Listed below are some general guidelines. Other sources, such as those listed above, should be used to determine more detailed calculations and criteria.

For bridges and culverts fish passage at a stream crossing should meet the following criteria:

- The stream crossing should be selected and placed in a manner that allows fish to swim both up and down stream. Flow velocity should not be increased by the crossing, as can occur with undersized culverts, so as to not create velocity barriers and erosion. Further, culverts should not be perched or allowed to become overly embedded.
- The stream crossing must accommodate peak flow (or flood) conditions. The stream crossing must pass the design storm as specified by applicable regulations. Agencies vary in their design storm guidance so it is necessary to contact all potentially jurisdictional agencies. For example, if the crossing is in an area where only Land Use Regulation Commission (LURC) regulations apply, this flow will likely be equal to the highest flow that would occur in a typical 10-year period (*i.e.,* Q_{10}).
- The stream crossing must maintain existing stream channel slopes above and below the stream crossing.
- Materials selected for construction of fish passage structures shall be non-toxic to fish and other aquatic life.
- Stream crossings shall not be configured such that they will change the natural geomorphic processes up and down stream of the crossing.
- Design criteria that are specific to culvert crossings include:
  - Hanging or perched culverts are not acceptable in any flow situations.
  - New culverts should be installed with the culvert bottom below streambed elevation. At a minimum, pipes less than 48 in. across should be embedded 6 in.; and pipes 48 in. across or more should be embedded 12

in. into the stream bottom. Embedded pipes should be allowed to fill with natural substrate.

- For culvert crossings with multiple pipes at the same location, the lowest pipe should be sized and located to allow fish passage during low flow periods of regular movement; size and locate the additional pipe(s) to collectively pass the design peak flows. Multi-pipe installations are prone to unintended consequences and should only be designed by experienced hydraulic engineers.
- There are many types, styles, configurations, and materials for culverts. Culverts with natural bottoms are consistent with optimal brook trout habitat. An open bottomed culvert is preferred over a solid bottom culvert since it helps ensure that a natural stream bottom will be maintained.

Photo 4.5.2-1 Example of a perched culvert; notice the upper culvert designed to accommodate higher spring flows. Perched culverts block upstream fish migration.

Photo 2.2-2 Another two-culvert design. Severe embededdness has resulted in reduced flow and passage.

Photos by Alan Haberstock

Temporary Crossings

Temporary crossing options for small (intermittent and small 1st order) streams such as pole fords, ice bridges, and slash crossings can result in little to no impact if implemented correctly, however they are often misused and do result in substantial stream damage. Temporary stream crossings have the potential to produce streamside erosion, and degrade brook trout habitat and water quality through increased turbidity and sedimentation. Further, some recommended approaches for stream fords specify that crossings should occur in the most stable, coarse-textured substrates of a stream in low gradient reaches so that bed damage and turbidity are minimized. This, however, can result in stream fords right on valuable brook trout spawning habitat (*i.e.*, gravel and cobble areas in low gradient stretches). Temporary crossings can also create passage barriers, especially if they are left in place rather than being properly removed immediately after the harvest (or other temporary access application) is complete. Temporary crossings should never be left in place for more than six months. If it is necessary to install temporary stream crossings, the number of crossings should be limited to as few as possible and the location(s) should be carefully selected.

Temporary bridges are the least intrusive temporary crossing method since they can be easily installed and easily removed and re-used with little impact to habitat if used properly. The Maine Forest Service (MFS) is a contact to obtain sources for buying, borrowing or leasing pre-manufactured, portable, temporary bridges. Large operations or large landowners typically have constant demand for them so that owning an inventory of portable bridges may be cost-effective.

Temporary bridges are most effective when a proper foundation is provided. Bridges need a log, railroad tie, or similar abutment to rest on to level the structure, minimize disturbance to the stream bank, and ease removal. Temporary bridges can be constructed of rough logs, timber, pre-manufactured metals, prestressed concrete, or other structural material. No soils disturbance should occur below the normal high water mark to install foundation materials. Temporary bridges should be removed immediately after its use has expired or six months (whichever occurs first) by removing the temporary bridge, the associated materials on the approach, and the bridge support, and immediately stabilize the exposed soil areas with hay mulch and seed.

The MFS is probably the best source for technical assistance for temporary crossing BMPs, and has recently issued a useful document on forestry BMPs including crossings (Maine Forest Service, 2004).

- <u>Forestry Certification and BMP Compliance Monitoring</u>

This report does not provide specific recommendations with regard to third-party certification programs or monitoring and enforcement of recommended BMPs. This information can be found in other references (ME DCO, 2002; Reardon, 2003). Since adequate BMPs are not routinely being implemented in the working forests of Maine or other states (ME DOC, 2002), this report does recommend that some compliance process be applied. Such "checks" are needed to ensure that regulations, easement terms, and permit conditions, which dictate BMPs and sensitive resource protection protocols, are implemented.

V. IMPLEMENTATION

The buffer and BMP recommendations outlined in this report are intended as technical recommendations. We envision that they will be implemented through a variety of means, including, but not limited to:

- Adoption into harvesting plans for forest lands owned by land trusts, government agencies, or other conservation-minded landowners for whom protection of brook trout habitat is a primary objective.
- Use as the basis for terms and conditions of conservation easements or other long-term management agreements that seek to protect brook trout habitat.
- Identification of key riparian parcels for conservation purchase (in-fee or easement).
- Evaluation of the adequacy of existing regulatory, BMP, and voluntary practices intended to protect brook trout habitat and watersheds.

GIS analysis was applied to identify the buffer recommendations in this report as they would be applied to portions of six townships adjacent to the Kennebago River, and Kennebago and Little Kennebago Lakes. This area was selected for the value of its existing brook trout fisheries, and because we believe it to be broadly representative of many similar areas in Northern New England. In addition, as a result of recent land sales and other management changes, there is growing interest in conservation within this region.

Figure 5 shows the three zones of the buffer. It should be noted that even for a medium sized watershed like Kennebago Stream, adequate protection of brook trout habitat will require application of the recommended buffers over long reaches of stream. Although these areas are, in many places, relatively narrow corridors, because they include the entire stream length, application will require coordination among multiple landowners, across several different townships, even in areas where land ownership remains in large, relatively undeveloped blocks of more or less intact forest. As the number of landowners increases, watershed scale protection will likely become exponentially more difficult to achieve.

It is also significant that in some places the inclusion of floodplain and stream-associated wetlands within Zone 1 substantially increases the protected area associated with the immediate stream bank. Conversely, not protecting these areas would open up large areas of seasonally flooded forest floor to soil disturbance and subsequent sedimentation. It would also have the potential to remove a large fraction of the large trees before they have the potential to be recruited to the stream channel as large woody debris.

Insert Figure 5

While these recommendations were developed using conditions in three particular western Maine watersheds, they are broadly applicable to protection of salmonid habitat in other regions of the northeastern United States and Canada where brook trout occur on similar landscapes—relatively undeveloped watersheds containing healthy populations of wild brook trout, where land use is dominated by timber harvest and the landscape is characterized by mixed northern forest types, steep slopes, and mountainous terrain. Even for more developed and/or less mountainous landscapes, key concepts of the buffer approach suggested here are applicable, although their relative width would likely vary with topography, stream type, and forest type. Key aspects of this approach include:

- Starting the buffer at the edge of the floodplain or any stream-associated wetlands. Regardless of width, buffers that are largely or wholly within the floodplain will not provide protection of brook trout habitat.
- Application of the buffer to all perennial streams. To protect sensitive species such as brook trout, even small first order streams must be buffered.
- A multi-zoned buffer. This should include a no disturbance Zone 1 immediately adjacent to the stream, a minimal disturbance Zone 2 that allows for limited harvest of trees, and a wider Zone 3 in which more disturbance is allowed, but such disturbance is limited and carefully planned.
- Even beyond Zone 3, activities must conform with erosion control BMPs. A healthy watershed requires a healthy forest, and no amount of buffering will compensate for harvest practices that do not pay attention to drainage patterns, erosion and sedimentation, and the overall condition of the forest and forest floor.
- Fish-friendly stream crossings. Culverts and bridges should be constructed in a manner that facilitates fish passage and avoids habitat degradation. Road and culvert construction practices must be properly timed and designed to avoid impacting brook trout or their habitat.

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LAND USE PLANNING COMMISSION

IN THE MATTER OF

CENTRAL MAINE POWER COMPANY Application for Site Location of Development Act permit and Natural Resources Protection Act permit for the New England Clean Energy Connect ("NECEC") L-27625-26- A-N L-27625-TB-B-N L-27625-2C-C-N L-27625-VP-D-N L-27625-IW-E-N SITE LAW CERTIFICATION SLC-9	PRE-FILED TESTIMONY OF DR. DAVID PUBLICOVER APPALACHIAN MOUNTAIN CLUB ON BEHALF OF INTERVENOR GROUP 4 (APPALACHIAN MOUNTAIN CLUB, NATURAL RESOURCES COUNCIL OF MAINE AND TROUT UNLIMITED) February 22, 2019

Q. State your name and current position.

A. My name is David Publicover. I am currently employed as a Senior Staff Scientist and Acting Director of Research with the Appalachian Mountain Club (AMC), a non-profit conservation and recreation organization with headquarters in Boston, MA. My business address is P.O. Box 298, Gorham, NH 03581.

Q. What are your background and qualifications?

A. I have a B.S. in Forestry from the University of New Hampshire (1978), an M.S. in Botany from the University of Vermont (1986), and a D.F. in Forest Ecology from the Yale University School of Forestry and Environmental Studies (1993).

I have been employed as a staff scientist by the AMC since 1992. My primary responsibility is to provide scientific information and analyses to AMC in support of our mission in the areas of terrestrial ecology, landscape analysis, land use and conservation planning, sustainable forestry, biological conservation and energy facility siting.

For most of my tenure at AMC I have been involved with issues related to energy facility siting. I have served as an expert witness for AMC during interventions in four commercial wind power development applications in Maine and New Hampshire as well as the Northern Pass transmission line project in New Hampshire. I served as an alternate member of the Governor's Task Force on Wind power Development in Maine (2007-08) and was actively involved in the revision of the New Hampshire Site Evaluation Committee's energy facility permitting rules (2013-15). I have conducted multiple landscape-level GIS-based analyses on conflicts between wind power siting and ecological and scenic values.

I have also been involved in debates and discussions on sustainable forestry, land management and biological conservation dating back to the Northern Forest Lands Council and the Maine Forest Biodiversity Project in the 1990s. I have served on numerous public policy committees and working groups and am currently a member of the Maine Ecological Reserves Scientific Advisory Committee and the New Hampshire Forest Advisory Board. I was a contributing author to *Good Forestry in the Granite State* and served on the steering committee overseeing the development of *Biodiversity in the Forests of Maine: Guidelines for Land Management.* I oversee forest and land management planning, Forest Stewardship Council certification and forest carbon offset project development for AMC's 75,000 acres of forest land in Piscataquis County.

My CV is attached as Appendix A.

Q. Have you previously testified before DEP or LUPC?

A. I have not testified before DEP. I have testified before the (then) Land Use Regulation Commission on three wind power project permit applications.

Q. What is the purpose of your testimony?

A. For the DEP Site Law and NRPA applications, my testimony addresses the value of the Western Maine Mountains region, the fragmenting impacts of the new corridor (Segment 1) on wildlife habitat in this region, the failure of the Applicant to adequately assess these impacts, the failure of the Applicant to adequately assess alternatives to the proposed project, and the failure of the Applicant to adequately mitigate the impacts of the proposed project on wildlife habitat.

For the LUPC certification, my testimony addresses the special exception criteria related to the crossing of the Appalachian Trail P-RR zone.

Q. Please summarize your testimony.

A. DEP Site Law and NRPA applications: The Western Maine Mountains is the heart of a globally significant forest region that is notable for its relatively natural forest composition, lack of permanent development, and high level of ecological connectivity. The proposed new corridor would be one of the largest permanent fragmenting features bisecting this region and would have an adverse effect on wildlife habitat, wildlife life cycles and travel corridors. The Applicant's assessment of these impacts is cursory, overly general, lacking in specific analyses, and inappropriately conflates the impacts of the corridor with those of timber management. The Applicant has failed to meet the burden of proof requirement of 38 MRSA §486-A.2 to demonstrate that the project will not cause an unreasonable adverse impact on the natural environment. The Applicant has also failed the burden of proof to demonstrate that there is not a practicable alternative to the proposed project that is less damaging to the natural environment. Finally, the Applicant has failed to provide adequate mitigation for the project's impacts. For these reasons the DEP should deny the permit.

LUPC certification: The proposed project would significantly degrade the experience of Appalachian Trail users at the crossing of the existing transmission line corridor by widening the corridor by 50% and installing a second much larger transmission line. As proposed the project fails the second criteria for a special exception in that this increased impact cannot be buffered from existing uses. The opportunity exists to improve rather than degrade the users' experience by relocating the trail in this area. LUPC should condition the granting of the special exemption on a resolution of this issue between the Applicant and AT trail managers. Absent such a resolution LUPC should deny the special exception.

TESTIMONY RELATED TO DEP SITE LOCATION OF DEVELOPMENT AND NATURAL RESOURCES PROTECTION ACT APPLICATIONS

Q. Please describe the values of the Western Maine Mountains region through which the new corridor would pass.

A. While the undeveloped forests of the north Maine woods (and the Western Maine Mountains region in particular) may be taken for granted by those who live, work and recreate here, they have been recognized as a regionally, nationally and even globally significant forest region by many analyses.

The values of the region have been well summarized by McMahon (2016)[1], who states:

> The five million acre Western Maine Mountains region is a landscape of superlatives. It includes all of Maine's high peaks and contains a rich diversity of ecosystems, from alpine tundra and boreal forests to ribbed fens and floodplain hardwood forests. It is home to more than 139 rare plants and animals, including 21 globally rare species and many others that are found only in the northern Appalachians. It includes more than half of the United States' largest globally important bird area, which provides crucial habitat for 34 northern woodland songbird species. It provides core habitat for marten, lynx, loon, moose and a host of other iconic Maine animals. Its cold headwater streams and lakes comprise the last stronghold for wild brook trout in the eastern United States. Its unfragmented forests and complex topography make it a highly resilient landscape in the face of climate change. It lies at the heart of the Northern Appalachian/Acadian Forest, which is the largest and most intact area of temperate forest in North America, and perhaps the world. Most importantly, the Western Maine Mountains region is the critical ecological link

[1] References are included as Appendix B.

between the forests of the Adirondacks, Vermont and New Hampshire and northern Maine, New Brunswick and the Gaspé.

The value of the Western Maine Mountains lies in both its ecological diversity (encompassing an array of mountains, lakes and ponds, rivers and streams, wetlands, and hardwood, mixed and softwood forests) and its undeveloped character. Across much of the region the primary human impact has been from timber harvesting and logging roads, and only two major fragmenting features (Routes 201 and 26) traverse the breadth of the region. It is one of the few areas in the eastern United States that is sufficiently intact and natural to maintain viable populations of almost all native species.

Globally the Western Maine Mountains lies within the Temperate Deciduous and Mixed Forest ecoregion (Olson et al. 2001). This biome encompasses some of the most heavily settled regions in the world – the eastern United States, much of Europe, and northeastern Asia (China and Japan). Within this biome the region stretching from northern New Hampshire across western and northern Maine into Maritime Canada is the largest area of relatively intact forest blocks due to the lack of permanent settlement, development and land conversion (Haselton et al. 2014; Exhibit 1).

Other sources that recognize the value of the region as a large ecologically intact forest region include:

- The Northern Maine Forest Block is the largest Globally Important Bird Area in the continental United States as identified by the National Audubon Society (NAS 2019; Exhibit 2).
- The region was identified as one of the largest areas in the eastern United States of above-average climate change "resilience" by The Nature Conservancy, due in part to the high level of "local connectedness" (i.e., the

permeability of the landscape to species movement based on fragmentation and barriers to movement). (Anderson et al. 2016; Exhibit 3).

- The region was identified as a priority ecological linkage by the Staying Connected Initiative, a regional partnership working to "conserve, restore, and enhance landscape connectivity across the Northern Appalachian/Acadian region" (SCI 2019; Exhibit 4). (Maine Department of Inland Fisheries and Wildlife and Maine Department Transportation are partners in this initiative.)

The region's values are also reflected in the Land Use Planning Commission's 2010 Comprehensive Land Use Plan (LUPC 2010) which includes the following:

– "*One of the four principle values of the Unorganized Territories is "Natural Character, which includes the uniqueness of a vast forested area that is largely undeveloped and remote from population centers. Remoteness and the relative absence of development in large parts of the jurisdiction are perhaps the most distinctive of the jurisdiction's principal values, due mainly to their increasing rarity in the Northeastern United States.*" (CLUP p. 2)

– "*Natural resources are generally enhanced when they are part of a large, relatively undeveloped area, especially one that encompasses entire watersheds or ecosystems.*" (CLUP p. 2)

– "*The forests of the jurisdiction are part of the largest contiguous block of undeveloped forestland east of the Mississippi.*" (CLUP p. 197)

– "*Scientists are increasingly aware of the value of managing forests in large blocks as part of habitat conservation efforts... However, even large habitat blocks have less value if they lack connections or corridors linking them to other* *habitat patches that allow genetic flow from one patch to another*." (CLUP p. 233)

In addition, a conservation priorities map developed by MDIFW as part of the Wildlife Action Plan (MDIFW 2010) notes that "*Northern Maine is unique as the largest area of undeveloped natural land in the eastern US. It is critically important for its economically valuable forest base and as a draw for unique outdoor recreational experiences, but especially for the habitat it provides for the species characteristic of and dependent on the Eastern Forest and especially those species that need large areas to maintain viable populations*."

Intact forests such as these are critical to the maintenance of global biodiversity, as noted by Watson et al. (2018), who stated, "*As the terrestrial human footprint continues to expand, the amount of native forest that is free from significant damaging human activities is in precipitous decline. There is emerging evidence that the remaining intact forest supports an exceptional confluence of globally significant environmental values relative to degraded forests… Retaining the integrity of intact forest ecosystems should be a central component of proactive global and national environmental strategies…*".

To summarize, the Western Maine Mountains region is the heart of a globally significant forest region that is notable for its lack of permanent development and fragmentation and high level of ecological connectivity. These are the values that would be most significantly affected by the clearing of the new NECEC corridor.

Q. Has the Applicant adequately considered the value of this region in their application?

A. They have not. Rather the Applicant consistently minimizes its value, and nowhere is there any discussion of the regional, national or global significance of the region. Instead, we find limited statements such as "*this area of the state is already intensively managed (i.e., periodically clearcut) forested land and the creation of a transmission corridor is not likely to disrupt or significantly alter existing land uses.*" (Site Law Application Chapter 7, p. 7-24; multiple similar statements may be found in Application Section 7.4.1). CMP's project website[2] states "*The new corridor section crosses through a large area of commercial woodlands laced with roadways and active areas of timber harvesting and forest management.*"

By characterizing the region as merely managed forest land, the Applicant fails to recognize that these expansive commercial forest lands are an important part of what has helped to maintain the value of the region. As noted by the Keeping Maine's Forests coalition (KMF 2010):

> Maine's forests, which include the largest unbroken tract of undeveloped forest east of the Mississippi River, sustain tens of thousands of jobs in the forest products and forest-based tourism industries. That this national resource is intact and productive today is a testament to good management by landowners and the ability of the forest-based economy to adapt, strengthen, and diversify markets for forest products and tourism

McMahon (2018) similarly notes:

> Fragmentation has already significantly degraded ecosystems in much of the eastern United States and in temperate forests throughout the world. By contrast, in large part because historical forest

[2] https://www.necleanenergyconnect.org/faqs.

management maintained vast connected forest blocks in the region, the Western Maine Mountains' biodiversity, resilience and connectivity are unparalleled in the eastern United States.

In addition, the Applicant mischaracterizes the region as "intensively managed". To a large degree these forests are managed using natural regeneration and maintain a relatively natural species composition (though the age-class structure has been significantly altered towards a younger overall condition). Only a small proportion is intensively managed as foresters understand the term, meaning the use of techniques such as planting and herbicide application to maximize timber production. This distinguishes the region from forests that are truly intensively managed such as the pine forests of the southeastern United States.

In presentations on their route selection process to AMC and others, CMP representatives described how the route was sited through working forests in a gap between higher value areas[3]. In reality no such gap exists, as can easily be seen by viewing the landscape in Google Earth – the working forests are an integral part (in fact the major component) of this vast undeveloped landscape.

It is true that the Western Maine Mountains region is not pristine wilderness. However, on a scale of human impact from natural wilderness to dense urban development, the forests of the region lie very close to the natural end of the scale. The fact that the new corridor would be carved through managed timberland rather than pristine wilderness in no way diminishes the impact of the corridor on the ecological value of the region.

[3] For example, see the recording of CMP's presentation to a forum in Lewiston, ME hosted by the Sierra Club on 8/22/18. (https://www.youtube.com/watch?v=EelQI-QCWu0 beginning at 26:30)

Q. Please describe the fragmenting impacts of the new corridor.

A. The new corridor would be one of the largest permanent fragmenting features in the Western Maine Mountains region. It would be only the third feature (other than logging roads) that completely bisects the region.

The effects of fragmentation on forests have been summarized in numerous studies, both locally (McMahan 2018) and globally (e.g., Saunders et al. 1991, Harper et al. 2005, Haddad et al. 2015). The continued loss and degradation of intact forests is one of the major threats to biodiversity and other ecosystem services worldwide; as noted by Watson et al. (2018), "*the relative value of intact forests is likely to become magnified as already-degraded forests experience further intensified pressures (including anthropogenic climate change).*"

The 53 miles of new corridor will have three types of impacts:

<u>Direct loss of habitat</u>. The 53.5-mile by 150-foot new corridor encompasses nearly 1,000 acres, the great majority of which would be permanently lost forest habitat.

<u>Edge effects</u>. The creation of extensive permanent "hard" edge along both sides of the new corridor would have significant and long-lasting adverse effects on the adjacent forest habitat. Edges alter the adjacent forest in numerous ways including increased penetration of light and wind, increased temperatures, lower humidity and soil moisture, increased blowdown, and increased growth of understory and early successional vegetation (Matlack and Litvaitis 1999, Harper et al. 2005, McMahon 2018). These effects cause significant changes in the forest within the edge zone as noted by Matlack and Litvaitis (1999, p. 227):

> One artifact of the human modification of forests has been the tremendous increase in forest edges. Historically, land managers considered the lush plant growth and diversity of animals at edges as

> beneficial. However, recent investigations have described radical changes in community structure at edges, suggesting serious problems from a biodiversity perspective. Edge habitats are advantageous to a variety of exotic plants, predators, brood parasites, and herbivores that are capable of altering the composition of local forest communities. Radical changes in the forest microclimate at edges lead to dramatic changes in plant community structure with may persist several decades, at least.

A major consequence of edge effect is the consequent decline in interior forest habitat, which is forest sufficiently removed from edge to be free of its effects. While edges are beneficial to some species, many others avoid them and require interior habitat. Pfeifer et al. (2017), in a meta-analysis of fragmentation studies from across the globe, found that while relatively equal numbers of species were attracted to or avoided edges, those that avoided edges (and were dependent on interior forest) were more likely to be habitat specialists of high conservation concern. In contrast, species attracted to edges are more likely to be common generalist species.

Mature interior forest in northern Maine comprises less than 3% of the landscape (MDIFW 2015) and some species associated with it are of high conservation concern. These include migratory songbirds such as scarlet tanager, wood thrush, veery, and various warblers as well as mammals such as American marten (Rosenberg 1999, 2003; MDIFW 2015, MAS 2017).

Different types of edge effects extend for different distances into the adjacent forest (Harper 2005, McMahon 2018). One hundred fifty to 300 feet (50-100 meters) is commonly used to define the edge zone (Rosenberg 1999), though some effects can extend farther than this. Pfeifer et al. (2017) found that the abundance of interior forest-dependent species was reduced up to 400 meters from edges.

The linear configuration of the corridor maximizes the amount of edge zone for the cleared area as compared to a more compact shape. The area within 300 feet of the new corridor encompasses nearly 4,000 acres – about four times the area that will be directly cleared. Not all of this is forest, and not all of the forest is interior forest due to the presence of roads and the shifting patterns of timber harvesting. However, in the absence of the corridor most of the forest is potential interior forest, and would be interior forest at some part of the timber management cycle. With the corridor all of this forest will be permanently subject to edge effects, reducing its ability to support interior forest species.

Reduction in connectivity. The high level of ecological connectivity is one of the most significant characteristics of the Western Maine Mountains regions, and the new corridor would be one of the most significant features impeding the connectivity, particularly because it bisects the entire region.

This impact is recognized in LUPC's 2010 Comprehensive Land Use Plan (p. 241), which states "Scientists have identified fragmentation of habitat as a serious concern. Roads, utility corridors, certain types of recreation trails, structures and clearings create breaks in the landscape. These breaks can act as barriers to animals and isolate populations of both plants and animals." Maintaining connectivity was one of three "super themes" guiding wildlife conservation actions identified in the 2015 Wildlife Action Plan (MDIFW 2015).

Not all species will be equally affected. Generalist species that use a range of habitats will likely cross the corridor with little difficulty. Some small-bodied species may find the shrubby vegetation less of a barrier than a 20' bare gravel road. The species that will be most affected are those that avoid large openings or extensive shrub or regenerating forest habitat.

For example, American marten in the Northeast avoid openings and regenerating forest, but occupy areas with forest cover at least 30' high with canopy closure of at least 30% and diverse forest structure including snags and coarse woody debris (Payer and Harrison 2000, 2003, 2004; Lambert et al. 2017). DeMaynadier and Hunter (1995, 1998) documented significant declines in amphibian populations in recent clearcuts, with red-backed, spotted and blue-spotted salamanders and wood frogs particularly sensitive. These effects can be ameliorated by the retention of microhabitat "refugia" such as patches of retained trees and coarse woody debris. However, the corridor will be maintained in a permanent early-successional condition without retained overstory cover or woody debris inputs, and thus is likely to present a significant barrier to these species.

Q. Has the Applicant adequately assessed these impacts in their application?

A. No they have not. These impacts are discussed in Site Law Application Section 7.4.1. However, this section is marred by meaningless general statements and the absence of any significant analysis of fragmentation effects. For example:

- "*Habitat conversion along transmission line corridors results in a loss of habitat types which, in turn, may adversely impact species that are reliant on the original habitat types. Conversely, such alteration provides benefits to several species*." Also, "*Impacts of habitat conversion along the proposed transmission line corridor are expected to be minimal, beneficial to some species while detrimental to other species*." (Both on Site Law Application p. 7-24.) The Applicant includes a discussion of the habitat benefits of transmission line corridors (which are irrelevant to permitting) but no discussion of which species may be adversely impacted (which is). In fact, it is mature forest habitat that is in short supply in northern Maine, not the early successional habitat that would be created by the new corridor (MDIFW 2015).

- "*Some bird species within the NECEC Project area that may be sensitive to forest fragmentation are the long distance, neotropical migrants that rely on forest interior habitats, but plentiful suitable habitat is available near the NECEC Project areas for these interior forest species. Most of the potential breeding birds that are likely to be found in the vicinity of the transmission line corridor are not dependent on mature forest stands… Most of the terrestrial mammal species that are likely to be found near the proposed transmission line corridors are likewise not dependent on mature forest*" (Site Law Application p. 7-25.) The fact that "most" species will not be affected is irrelevant. There is no assessment in the application of which species may be adversely affected, the extent of interior forest habitat in the vicinity of the project, or the effect of the project on this habitat. The Applicant wants to have it both ways – the surrounding managed landscape is already heavily fragmented by timber harvesting, but yet mature interior forest habitat is plentiful. In fact, as noted previously less than 3% of the forest in northern Maine is mature interior forest.

The Applicant also consistently and inappropriately conflates the impacts of the new corridor with the impacts of timber harvesting in the surrounding landscape. For example: "*Approximately 27 percent of the Project will require new clearing, however this area of the state is already intensively managed (i.e., periodically clearcut) forested* *land...*" and "*In general, given the existing landscape characteristics of the overall NECEC Project area, construction and maintenance of the transmission line corridors will result in habitat conversion that is already common to the area, i.e. forested to scrub-shrub.*" (Both on Site Law Application p. 7-24.) However, the new corridor is qualitatively different than timber harvesting in many ways:

Permanence. The new corridor would be an enduring feature in the landscape. In contrast, timber harvesting creates a shifting mosaic of temporary impacts which are ameliorated over time through natural succession.

Spatial configuration. The new corridor would be a linear feature extending across the entire Western Maine Mountains region; a configuration that maximizes edge effect and impediments to species movement. In contrast, timber harvest units are smaller and more compact units with lower edge-to-area ratio, and which exist in a mosaic of forest conditions that allow freer movement of species throughout the landscape.

Habitat condition. The new corridor will be permanently maintained in an herbaceous or shrubby condition, without residual overstory trees or other forest structures (snags, woody debris, etc.) that provide microhabitats or localized refugia for many species. Contrary to the Applicant's contention, most timber harvesting in the state is done by various forms of partial harvesting that retains some level of residual overstory and biological legacies. Between 2013 and 2017 clearcutting accounted for less than 7% of harvested acres in the state (MFS 2013-2017).

The Applicant's conclusions regarding the fragmenting impacts of the new corridor consist of little more than general statements such as:

- "*It is anticipated that local wildlife populations will adapt and respond to any additional alterations much as they already do to uses within the vicinity of the transmission line corridor.*" (Site Law Application p. 7-24)
- "*…the creation of a transmission corridor is not likely to disrupt or significantly alter existing land uses.*" (Site Law Application p. 7-24)
- [The new corridor] "*is located in an intensively managed timber production area and therefore not likely to significantly alter existing fragmentation.*" (Site Law Application p. 7-25)
- [The new corridor is] "*located in an intensively managed area for timber production; this transmission line segment is therefore not likely to significantly alter or increase the existing edge effect.*" (Site Law Application p. 7-26)

These statements are unsubstantiated by any analysis or evidence in the application, and are contradicted by extensive evidence on the consequences of forest fragmentation. They are also contradicted by numerous photographs of the Segment 1 landscape included in Application Chapter 6 Appendix D (Photosimulations). These photos do not show a landscape dominated by clearcuts, but rather one in which recent harvest units of various shapes, sizes and intensities exist within a matrix of relatively continuous forest. Even during leaf off snowcovered conditions, when harvesting would be most noticeable, harvest units exist as patches within a dominantly forested matrix. In addition, most harvest units retain some level of residual forest overstory. Photosimulation 44 clearly illustrates the difference in spatial configuration and habitat condition between the permanent corridor and the transient harvest units. The new corridor is not just another clearcut.

Q. Are there other impacts of the new corridor that you would like to address?

A. Yes. The new corridor would clear and fragment two occurrences of the rare Jack Pine Forest[4] natural community where it passes south of No. 5 Bog. Rare natural communities are encompassed in the definition of "unusual natural areas" under DEP rules (Chapter 375.12(B)).

Jack Pine Forest is ranked as S1 ("Critically imperiled in Maine because of extreme rarity") by the Maine Natural Areas Program. S1 communities represent the rarest of the rare in the state. The occurrences that would be impacted by the new corridor represent only the second and third occurrences in the state documented by the Maine Natural Areas Program[5]. The impact of the new corridor on this extremely rare natural community is thus of very high conservation concern.

The full extent and condition of these occurrences has not been determined, precluding a full evaluation of the impact of the new corridor. One of them is described as "*fairly extensive, extending outside of the survey area to the north and south.*"[6] However, the corridor would fragment both of these occurrences, separating portions on either side of the corridor. In addition, portions of these occurrences adjacent to the corridor would be subject to edge effects that would alter the structure and composition of this community within the edge zone.

It appears that a minor relocation of the proposed corridor would eliminate the impact to these rare natural community occurrences. However, they were only

[4] This community is distinct from the Jack Pine Woodland community, which is ranked S3. Most documented occurrences of Jack Pine Woodland are located in Hancock and Washington counties.
[5] Information on documented occurrences of Jack Pine Forest was provided by MNAP in email from Lisa St. Hillaire to David Publicover dated 2/19/19. The Applicant's Rare Plant Survey Narrative Report (September 2018) lists three occurrences, but two of these are considered a single occurrence by MNAP.
[6] Application Rare Plant Survey Narrative Report, Appendix F.

documented following a request for rare plant and natural community surveys by MNAP[7]. They were not known when the route was being identified, but only after the corridor had been delineated and purchased, precluding the opportunity to route the corridor around them. This is indicative of extremely poor planning on the part of the Applicant, as well as their total lack of understanding of or consideration for the ecological values of the region through which the new corridor would pass.

In addition, the fact that these occurrences extend beyond the corridor presents an opportunity for the Applicant to work with the adjacent landowner to conserve and manage these occurrences in a way that maintains their presence and ecological values as mitigation for these impacts. However, this was not done.

Q. Has the Applicant adequately analyzed alternatives to the location of the new corridor?

A. No they have not. Such an analysis is required under the Site Location of Development law [38 MRSA §487-A(4); specific to transmission lines] and DEP rules [Chapter 310.5(A)] [8] as well as LUPC P-WL special exception determination.

The alternatives analysis is contained in NRPA application Section 2. The Applicant describes the purpose and need of the project as delivering Quebec hydropower to the New England grid "at the lowest cost to ratepayers". While cost is a consideration in determining whether an alternative is practicable, defining the purpose and need in this way is inappropriate and cannot be a consideration for DEP. This definition of purpose

[7] MNAP memo to DEP of 12/12/17.

[8] While this requirement is specific to wetland impacts, these impacts are dispersed throughout the length of the new corridor, and such an analysis would also serve to address alternatives to other impacts described in this testimony. In addition, the requirement in 38 MRSA §487-A(4) is speaks to "impact on the environment" without limitation and thus encompasses the full range of impacts.

and need makes any but the lowest-cost alternative not practicable by definition and would render the alternatives analysis meaningless.

The Applicant assesses two alternative locations for the new corridor. Neither can be considered a reasonable alternative. Alternative 1 (1980s Quebec Corridor) was denied a permit by the PUC at that time. Subsequent developments, primarily land conservation that has taken place since that time, would make the ability to reacquire rights to this corridor uncertain and in one case "highly unlikely". Alternative 2 (Bigelow Corridor) also presents many difficulties; by CMP's own admission there are serious impediments and engineering challenges to securing this route.

However, there is another alternative that should have been analyzed - burial along existing corridors, most realistically along the Spencer Road (the primary gravel road accessing the Moose River valley; see Exhibit 5) but also potentially Route 201. The new corridor parallels and lies within two miles of the Spencer Road for a distance of over 20 miles, and for the most part lies within the ownership of the same landowner (Weyerhauser) from whom CMP acquired the proposed corridor.

Burial of HVDC lines is both technologically and financially feasible, as demonstrated by its use in two projects that were competitors to NECEC in the Massachusetts RFP process. Eversource's Northern Pass project in New Hampshire proposed burial of 60 miles of line along public roadways[9]. TDI's New England Clean Power Link project in Vermont would bury 56 miles of line along public roadways and railroads[10]. Burial along paved public roadways with existing development (as in these projects) would be more difficult than burial along undeveloped gravel logging roads,

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[9] http://www.northernpass.us/route-info.htm.

[10] http://www.necplink.com/about.php.

thus there is no basis to conclude that burial of the NECEC line along logging roads would be technologically or logistically unfeasible.

This alternative would almost certainly have less impact on the environment than the proposed new corridor. It would eliminate or greatly reduce the fragmentation impacts, resulting in much less clearing (just a narrow expansion of the existing road corridor), no new edge, no additional loss of existing or potential interior forest habitat, and a minimal increase in impediments to species' ability to cross the corridor. There would be wetland and stream impacts, but these resources are already impacted by the road, and burying the line next to the road would result in limited and marginal additional impacts, as opposed to the greater impacts to relatively intact streams and wetlands located within the new corridor..

We recognize that cost is a consideration in analyzing alternatives, and burial would be more expensive. That fact alone does not render an alternative as not practicable. The standard of 38 MRSA §487-A(4) is that the alternative would not "unreasonably" increase the cost. Without any financial information it is impossible to make a determination as to whether the increased cost is reasonable. However, this cost was not an impediment to the Northern Pass or Clean Power Link projects. Given that Northern Pass was the first choice in the Massachusetts RFP process, it is evident that the increased cost of burial was not an impediment to this selection. Thus it appears clear that burial is a financial feasible alternative.

To summarize, it appears that there is an alternative that is technologically, logistically and financial feasible, and which would be significantly less damaging to the environment. The failure to include an assessment of this alternative, and to demonstrate why it should not be considered practicable, is a fatal flaw in the application.

Q. In your expert opinion, do the fragmenting impacts of the new corridor constitute an adverse effect on natural resources under the Site Location of Development law sufficient to support a denial of the permit?

A. Yes they do. My reasons for this conclusion include:

Adverse impacts of fragmentation of wildlife habitat. The new corridor would be one of the largest permanent fragmenting features bisecting the largest expanse of relatively undeveloped and intact natural forest in the eastern United States and one of the largest such areas in the Temperate Deciduous and Mixed Forest biome in the world. The corridor would eliminate thousands of acres of existing and potential interior forest habitat through clearing and edge effects, adversely impacting wildlife lifecycles[11] for species dependent on this habitat. It would reduce the permeability of the landscape and impede the ability of some wildlife species to move through the region[12]. The Applicant's discussion of these impacts is extremely cursory, general and lacking in specific analyses on the adverse fragmenting impacts of the new corridor. The Applicant mischaracterizes the nature of existing timber harvesting in the region and inappropriately equates the impacts of the corridor to those of timber harvesting. The Applicant's conclusions are unsupported by any evidence in the application, are contradicted by extensive scientific evidence on the consequences of forest fragmentation, and amount to little more than "There's lots of forest, it's already heavily impacted, the new corridor is just another clearcut so it's no problem." The Applicant's

[11] As recognized in DEP rules Chapter 375 Section 15.B(2).
[12] As recognized in DEP rules Chapter 375 Section 15.B(1).

analysis does not come close to meeting the burden of proof for a demonstration of no adverse impact on the natural environment as required under 38 MRSA §486-A.2[13].

Adverse impact on unusual natural areas[14]. The new corridor would destroy portions of and fragment two occurrences of Jack Pine Forest, ranked S1 ("critically imperiled") by the Maine Natural Areas Program and one of the state's rarest natural vegetation communities. It appears that this impact could have been completely avoided by a minor relocation of the corridor, but this was not done since the ROW was fixed prior to any survey for rare plants and natural communities. This is indicative of extremely poor planning on the part of the Applicant, as well as their total lack of understanding of or consideration for the ecological values of the region through which the new corridor would pass.

Lack of adequate alternatives analysis. The Applicant's analysis of alternative routes for the new corridor considers two alternatives that cannot be considered realistic. By the Applicant's own admission both would involve significant difficulties in route acquisition and permitting. However, they failed to consider an alternative (burial along existing road corridors) that has been utilized by at least two other major transmission line projects in New England, demonstrating that this approach is both technologically and financially feasible under more difficult conditions than would occur for this project. By not analyzing an obvious and potentially practicable alternative that would have a significantly lower impact on the environment, the Applicant has failed the burden of

[13] "At the hearings held under this section, the burden is upon the person proposing the development to demonstrate affirmatively to the department that each of the criteria for approval listed in this article has been met, and that the public's health, safety and general welfare will be adequately protected."

[1414] As recognized in DEP rules Chapter 375 Section 12.

proof standard as it applies to 38 MRSA §487-A(4) and DEP rules Chapters 310.5(A) and 335.3(A).

Lack of adequate mitigation. Mitigation consists of three components: avoidance, minimization and compensation. The Applicant falls short in all three areas.

- *Avoidance.* As noted above, the Applicant has failed to demonstrate that there is not an alternative practical route that would avoid the necessity of clearing the new corridor. At a more local scale, the Applicant has failed to avoid the impact to the Jack Pine Forest occurrences by designing a route around them.
- *Minimization.* DEP rules (Chapters 375.9 and 375.15) envision buffer strips as a way to provide wildlife travel corridors between areas of habitat. However, the riparian buffers proposed by the Applicant do not sufficiently minimize the impediment to species movement created by the new corridor. As described in Application Chapter 10 Exhibit 10-2 (Post-Construction Vegetation Management Plan) vegetation within the wire zone of riparian buffers will be maintained at a height of 10 feet. This is insufficient to provide habitat for American marten and other species that require taller forest cover of minimum density. In addition, in multiple locations mapped streams are a mile or more apart. These measures do not adequately minimize the impact of the new corridor on landscape connectivity.
- *Compensation.* The Applicant's final Compensation Plan focuses on compensation for resources considered under the Natural Resources Protection Act and for which compensation is specifically required. However, the Site Law considers impacts at a broader level. 38 MRSA §484(3) addresses impacts to

"other natural resources" without limitation. In addition, DEP rules Chapter 375.15.A addresses "the need to protect wildlife and fisheries by maintaining suitable and sufficient habitat", indicating consideration of the full range of wildlife. Chapter 375.15.B(1) and (2) speak generally of "travel lanes" and "fish and wildlife lifecycles" without reference to specific species or habitats (which are considered in 375.15.B(3)). Finally, 375.15.C addresses the need for the Applicant to provide that they have made "adequate provision for the protection of wildlife and fisheries" (again without limitation), and 375.15.C(2) includes habitat preservation as a component of mitigation for adverse impacts to wildlife. In total this section makes clear that compensatory mitigation is not limited just to NRPA-protected resources but may be applied to all wildlife habitat impacts.

The new NECEC corridor would be one of the largest permanent fragmenting features in a globally significant forest region that is distinguished by its high level of ecological connectivity. It would eliminate thousands of acres of existing and potential interior forest habitat and reduce the permeability of the landscape to species movement. The landscape includes extensive streams (particularly cold water fisheries) and wetlands that exist not as isolated features but as integral and connected parts of the broader ecological system.

The new corridor is not a compact feature such as a sawmill or shopping mall impacting degraded wetlands in an already developed area. It is a sprawling feature that will impact multiple natural resource values across a broad area of high ecological value. The 13 parcels proposed as compensatory land conservation are small (averaging about 215 acres in size), scattered and have little nexus to the landscape-level fragmentation impacts of the project. The Applicant has provided compensation for the impact to individual pieces but not the cumulative impact to the whole interconnected ecosystem. Compensation for this cumulative impact should be held to a higher standard than provided by the Applicant.

Though we contend that the project should not be permitted as proposed, if it is permitted then very significant habitat protection should be required as compensation given the ecological values of this region and the magnitude of the impact of the new corridor on wildlife habitat. We support the position of The Nature Conservancy and Maine Audubon Society[15] that land conservation in the range of 75,000 to 100,000 acres is the appropriate scale to compensate for the project's very significant fragmenting impacts.

For these reasons, we believe that the proposed new corridor constitutes an unreasonable adverse impact on the environment and that DEP should deny the permit.

Q. Does this conclude your testimony relative to the issues before DEP?

A. Yes.

[15] See https://bangordailynews.com/2018/10/16/opinion/contributors/hydro-line-project-doesnt-go-far-enough-to-mitigate-conservation-concerns/.

TESTIMONY RELATED TO LAND USE PLANNING COMMISSION CERTIFICATION

Q. Please describe the situation regarding the crossing of the Appalachian Trail by the existing transmission line corridor (Segment 2).

A. Currently the Appalachian Trail (AT) crosses the existing 150-foot-wide transmission line corridor three times within a stretch of two-thirds of a mile. Hikers are exposed to an unnatural linear opening and multiple 45-foot-high transmission line structures that compromise the backcountry experience. We recognize that the transmission line corridor predates the establishment of the AT as a National Scenic Trail.

Q. What would be the impact of adding the new line to this corridor on the experience of hikers?

A. As proposed the addition of the new line would make the existing situation worse. The widening of the corridor and the addition of a second transmission line with taller towers would increase the exposure of hikers to the open corridor and intensify the experience of being in a developed rather than backcountry environment. The Applicant's Visual Impact Assessment (Application Chapter 6 pp. 6-43 to 6-44) rates the impact as "minimal to moderate". The Applicant also states (Application Chapter 25, Section 25.3.1.3) that there would be a "negligible" change in visual impact. However, these conclusions are contradicted by the revised Chapter 6 Appendix F (Scenic Resources Chart, 1/30/19) that rates the impact as "Moderate/Strong".

The Applicant also states (Application Chapter 6 p. 6-50), "*The Project should not negatively affect the hikers' experience or their continued use and enjoyment the Appalachian Trail.*" The statement that the project will not negatively affect hikers' experience is made without any supporting evidence, and is contradicted by the revised impact rating of Moderate/Strong and the Applicant's recognition of the need to mitigate this impact through vegetative screening. There is a noticeable difference between a single line with wooden towers shorter than the surrounding forest and a corridor that is 50% wider with two lines, one with steel towers considerably taller than the surrounding forest, which are experienced by hikers passing directly under the line. The change is quite noticeable in the photosimulation from this area (Application Chapter 6, Appendix E, Photosimulation B, pp. 27-28). The photosimulation of the proposed vegetative screening (Appendix D: Photosimulations – Leaf Off/Snow Cover, Photosimulation 50A) does not inspire confidence that the proposed mitigation will be adequate. Vegetative screening alone cannot mitigate the exposure of hikers to the wider corridor and an additional larger transmission line.

Q. Does the proposed project satisfy the first requirement for a special exception in the AT P-RR district that "*there is no alternative site which is both suitable to the proposed use and reasonably available to the applicant*"?

A. Yes. We accept that co-locating the new line in the existing right-of-way is the preferred solution, and that an alternate location in a new corridor would have a greater impact on the AT by creating a new crossing where none currently exists.

Q. Does the proposed project satisfy the second requirement for a special exception in the AT P-RR district that "*the use can be buffered from those other uses and resources within the subdistrict with which it is incompatible*"?

A. As proposed it does not. While the existing situation is not ideal, the addition of a second larger line in a wider corridor constitutes an additional incompatible use of moderate to strong impact that cannot be buffered from the AT. The available evidence does not support the contention that the proposed vegetation planting will be sufficient to buffer the trail from this increased impact

However, this requirement could be satisfied by a realignment of the AT that moves it away from the transmission line corridor in this area and leaves only a single crossing that minimizes exposure of hikers to the transmission line. If this were done there would be an improvement in the experience of AT hikers in this area rather than a diminishment as would occur with the project as proposed, and the increased buffering of the trail would satisfy the second requirement. This was noted as an appropriate mitigation strategy by the Applicant (Application Chapter 6 Section 6.2.2.7). We are aware that Appalachian Trail managers have had discussions with Applicant on ways to address the NECEC project impacts on trail users but we have not seen any resolution or conclusions from these discussions.

Q. Are there any conditions that the Commission should impose under Part (c) of the special exception criteria?

A. Yes. The Commission should condition the granting of the special exception on the Applicant reaching an agreement with AT managers on the relocation of the trail and providing funding for the relocation. As noted by the Applicant this would be an appropriate mitigation strategy for the increased impact on the AT experience in this area. In the absence of such an agreement the Applicant should provide funding for off-site mitigation that would be used to protect other AT viewsheds.

Q. Does that conclude your testimony relative to the LUPC certification?

A. Yes.

APPENDIX A: CURRICULUM VITAE

DAVID A. PUBLICOVER
Appalachian Mountain Club
PO Box 298
Gorham, NH 03581
(603) 466-8140, email: dpublicover@outdoors.org

Education:

Massachusetts Institute of Technology, Cambridge, MA.		1972-74
University of New Hampshire, Durham, NH	B.S. (Forestry)	1978
University of Vermont, Burlington, VT	M.S. (Botany)	1986
Yale School of Forestry & Env. Studies, New Haven, CT	D.F. (Forest Ecology)	1993

DF Thesis: *Nutrient Cycling and Conservation Mechanisms in an Oligotrophic Pine-Oak Forest in the New Jersey Pine Barrens.*

Employment History:

2001- present: Senior Staff Scientist/Assistant Director of Research, Appalachian Mountain Club, Gorham, NH.
1992-2000: Senior Staff Scientist, Appalachian Mountain Club, Gorham, NH.
1987-92: Research Assistant, Yale School of Forestry and Environmental Studies, New Haven, CT.
1979-84: Forester, USDOI, Bureau of Indian Affairs, Yakima Agency, Toppenish, WA.
1976-78: Park Technician, USDOI, National Park Service, Glacier National Park, West Glacier, MT (summers).

Publications:

- Publicover, D., K. Kimball, C. Poppenwimer and D. Weihrauch. 2018. *Ecological Atlas of the Upper Androscoggin River Watershed 2nd Edition* (Appalachian Mountain Club, Gorham, NH).
- Publicover, D.A., C.J. Poppenwimer and K. D. Kimball. *Northeastern High Elevation Areas: An Assessment of Ecological Value and Conservation Priorities. (AMC Technical Report in prep).*
- Publicover, D.A. and K. D. Kimball. *High-Elevation Spruce-Fir Forest in the Northern Forest: An Assessment of Ecological Value and Conservation Priorities* (submitted to proceedings of 2012 ECANUSA Forest Science Conference).
- Publicover, D.A., K.D. Kimball and C.J. Poppenwimer. 2011. *Ridgeline Windpower Development in Maine: An Analysis of Potential Natural Resource Conflicts* (AMC Technical Report 2011-1).
- Publicover, D.A. and C.J. Poppenwimer. 2006. *Roadless Areas in the Northern Forest of New England: An Updated Inventory* (AMC Technical Report 2006-1).
- Publicover, D. 2004. *A Methodology for Assessing Conflicts Between Windpower Development and Other Land Uses* (AMC Technical Report 2004-2).
- Publicover, D. and D. Weihrauch. 2003. *Ecological Atlas of the Upper Androscoggin River Watershed* (Appalachian Mountain Club, Gorham, NH).
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- Vogt, K.A., D.A. Publicover, J. Bloomfield, J.M. Perez, D.J. Vogt, and W.L. Silver. 1992. *Belowground responses as indicators of environmental change.* Env. Exp. Bot. 33:189-205.

- Publicover, D.A. and K.A. Vogt. 1992. *Belowground ecology of forests.* Pp 427-429 in: McGraw-Hill Yearbook of Science and Technology. McGraw-Hill, Inc., New York.
- Publicover, D.A. and K.A. Vogt. 1991. *Canopy stereogeometry of non-gaps in tropical forests: a comment.* Ecology 72:1507-1510.

Public Policy

Service on numerous public policy technical committees and working groups addressing issues of biological conservation, sustainable forest management and renewable energy development, including:

- Appointed alternate member of Governor's Task Force on Windpower Development in Maine (2007-08), a year-long effort which compiled information on and developed recommendations for the appropriate development of this technology in the state. My GIS-based research (Publicover *et al.* 2011) was instrumental in the development of a recommendation for the designation of an "expedited wind power permitting area" that guided development to more suitable areas of the state. The Task Force's recommendations were subsequently enacted into law by the Maine legislature.
- Member of Maine Ecological Reserves Scientific Advisory Committee (1996-present), which developed information and recommendations for a legislatively-established system of ecological reserves on state land. On-going work with the committee includes evaluating research proposals within the reserves and advising the Maine Natural Areas Program on long-term monitoring protocols.
- Member of New Hampshire Forest Sustainability Standards Work Team (1995-97), which provided guidance to the State Forester on methods for evaluating and promoting sustainable forest management within the state. In this role I served as a primary author of multiple sections of the first edition of *Good Forestry in the Granite State: Recommended Voluntary Forest Management Practices for New Hampshire* (1997). Subsequently I served on the Good Forestry in the Granite State Steering Committee and served as a reviewer of the second edition of this document (2010).
- Member of the New Hampshire Forest Advisory Board (2000-present), which provides guidance to the State Forester on the management of state forest lands and issues of public policy affecting the forests of the state.
- Active participant in the Maine Forest Biodiversity Project (1994-98), a multi-year collaboration between the scientific community, state agencies, private forest landowners and environmental NGOs that provided a forum for information sharing and mutual education on issues related to forest land management and the conservation of the state's biodiversity. I served as a member of the Working Forest Committee which oversaw the development and publication of the Cooperative Extension publication *Biodiversity in the Forests of Maine: Guidelines for Land Management.*
- Member of the Forest Stewardship Council Northeast Regional Working Group that developed the first regional standards for FSC certification in the Northeast.
- Member of the Forest Guild Northeast Biomass Retention and Harvesting Guidelines Working Group that developed *Forest Biomass Retention and Harvesting Guidelines for the Northeast.*
- Participant in other forest policy working groups and technical committees including New Hampshire Forest Law Recodification Roundtable, New Hampshire Ecological Reserves Scientific Advisory Committee, Nash Stream Forest Citizens' Advisory Committee, and Maine Bureau of Parks and Lands Integrated Resource Policy working group.

APPENDIX B: REFERENCES

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Dated: 2/22/19

by: [signature]
David Publicover

Date: 2/22/19

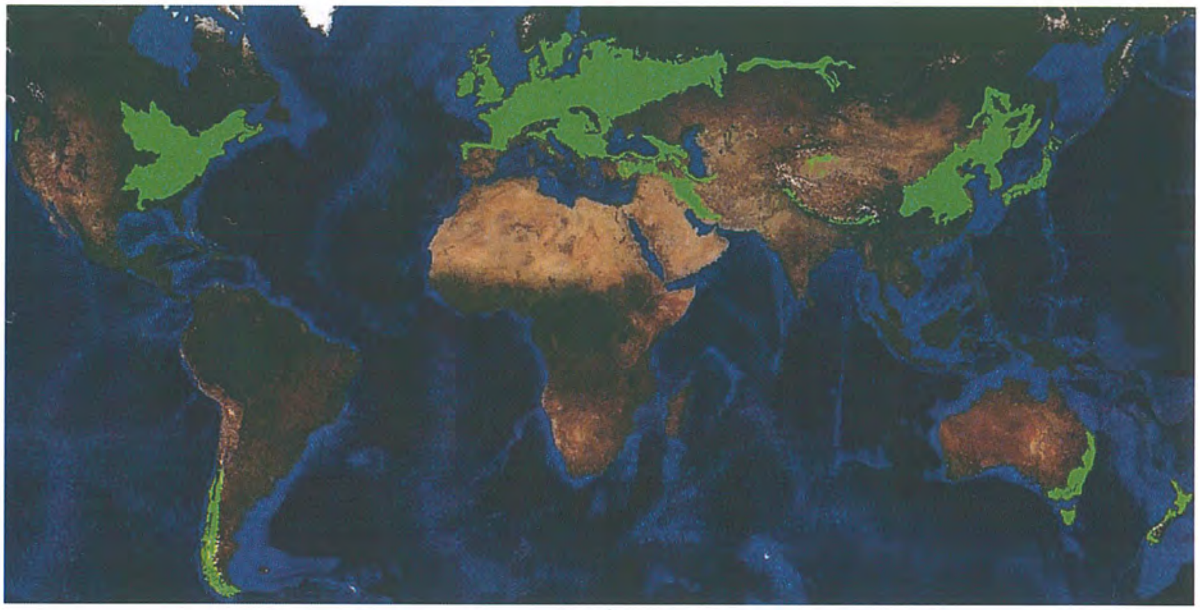
The above-named David Publicover did personally appear before me and made oath as to the truth of the foregoing pre-filed testimony.

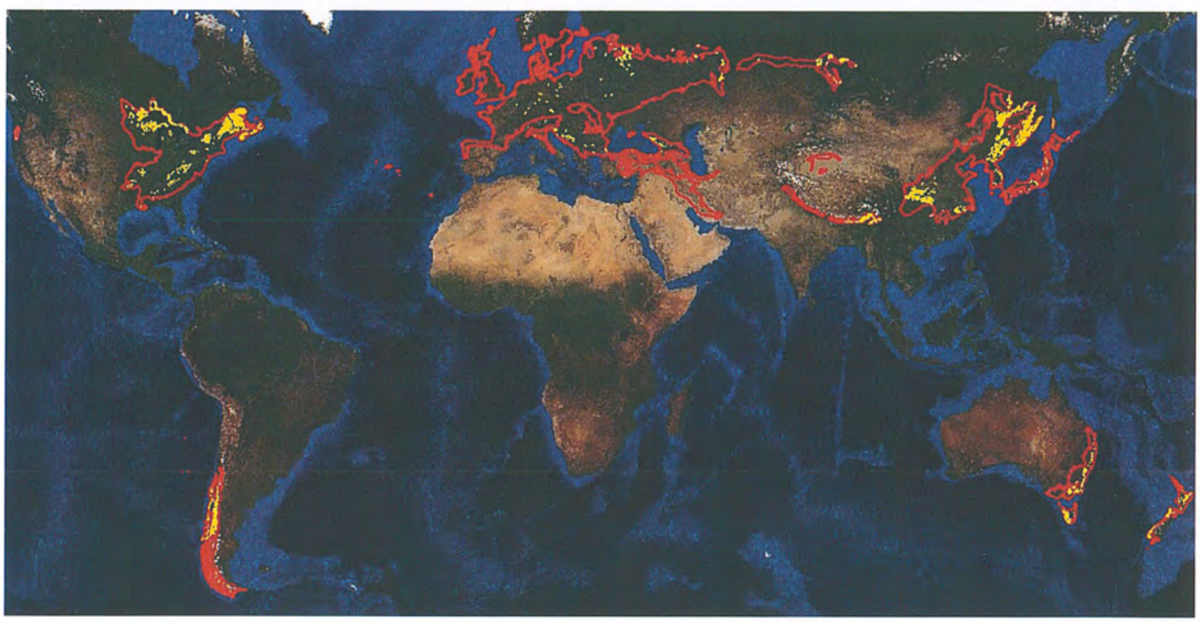
[signature]
Notary Public
My Commission Expires

DENISE M. HORNE
Notary Public - New Hampshire
My Commission Expires April 19, 2022

Group 4
Exhibit 14-DP

EXHIBIT 1





(Top) The Temperate Broadleaf and Mixed Forest ecoregion.

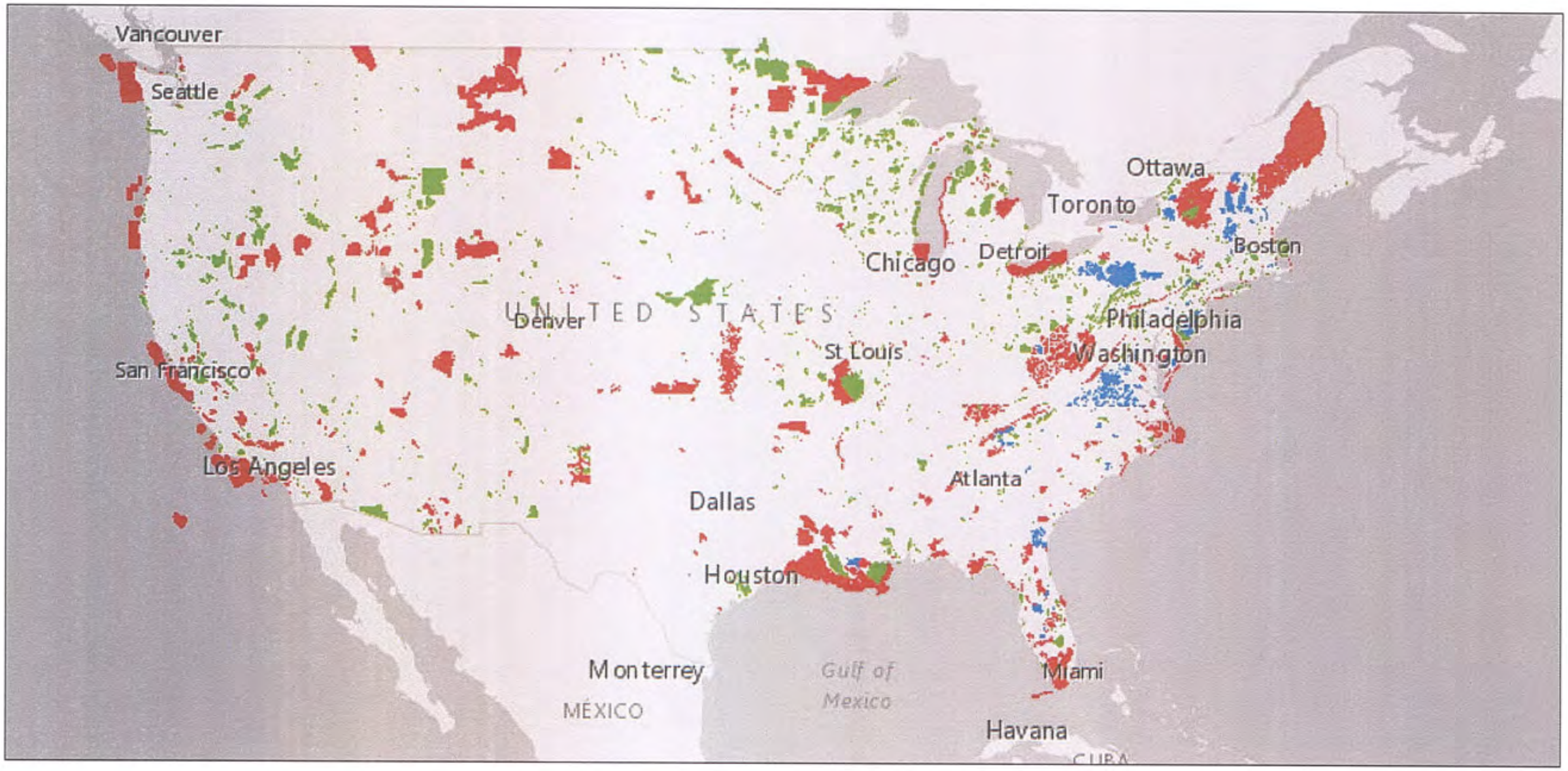
(Bottom) Relatively intact large forest blocks within the Temperate Broadleaf and Mixed Forest Ecoregion.

Source: Haselton et al. 2014.

6372

Group 4
Exhibit 15-DP

EXHIBIT 2



Important Bird Areas (red – global priority, blue – continental priority, green – state priority).

Source: National Audubon Society (2019).

Group 4 Exhibit 16-DP

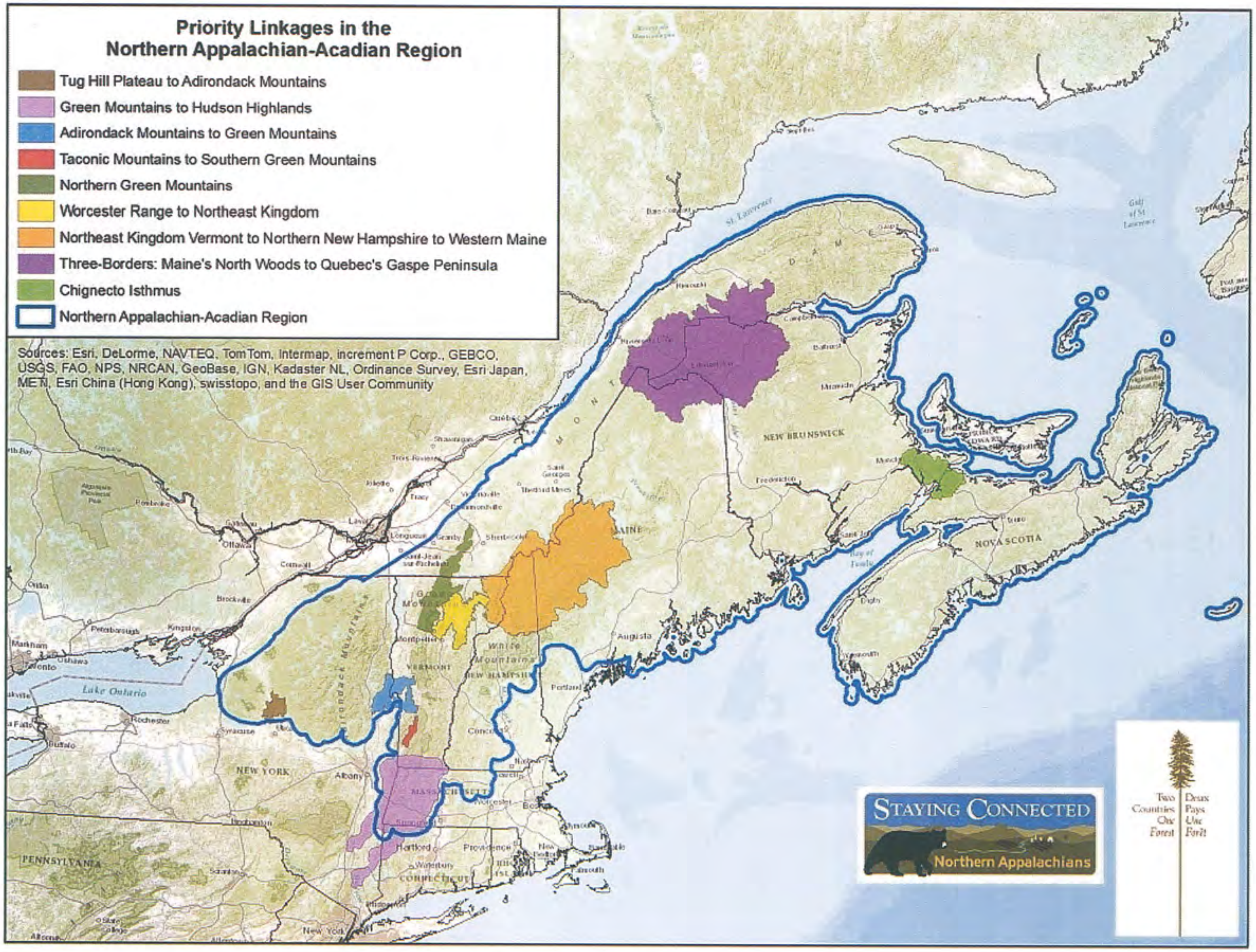
EXHIBIT 3

Source: Anderson et al. (2016), Map 3.31.

6374

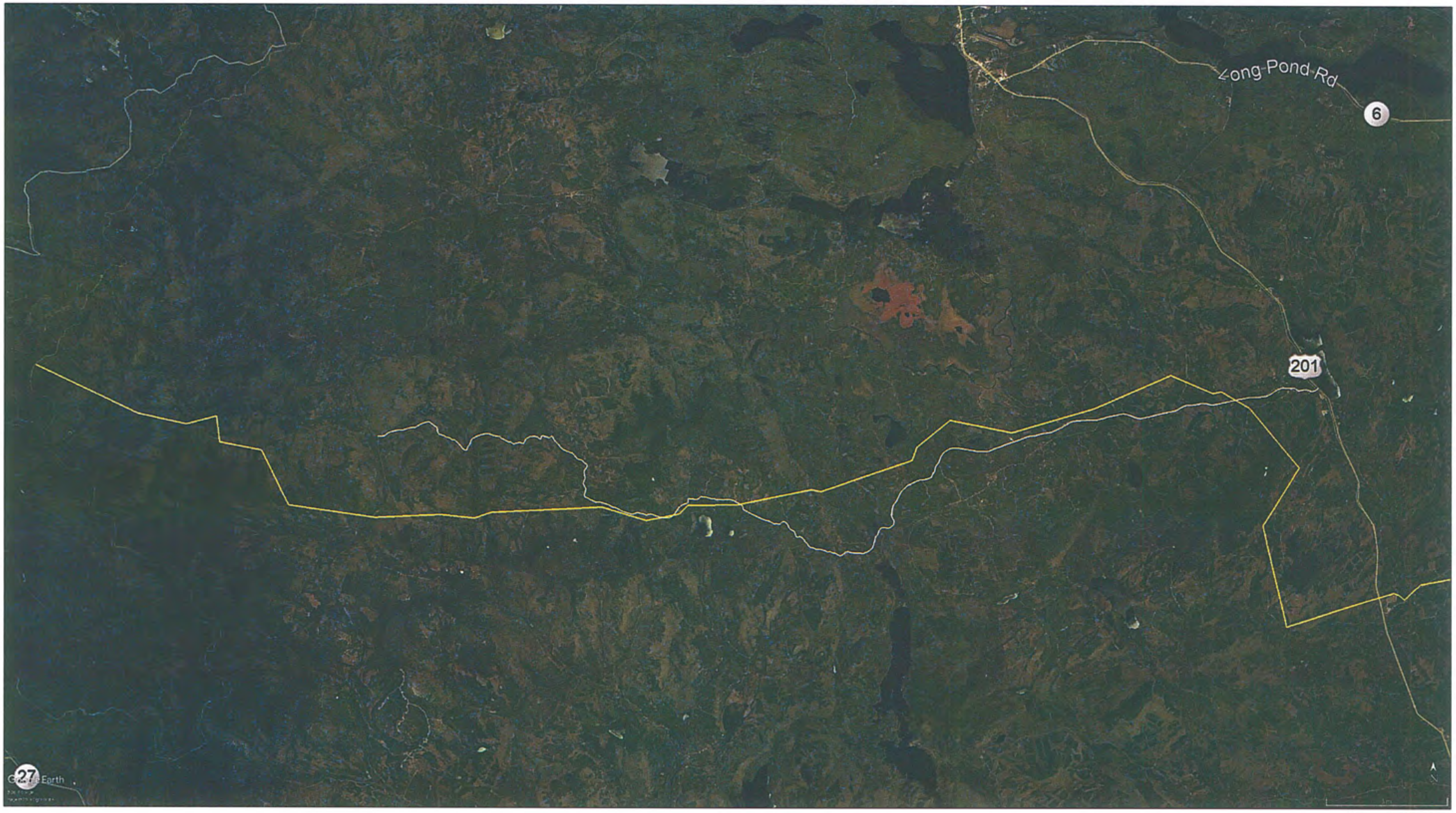
Group 4
Exhibit 17-DP

EXHIBIT 4



Source: SCI (2019); http://stayingconnectedinitiative.org/our-region/geography/.

EXHIBIT 5



The new corridor (yellow) parallels the Spencer Road (white) for over 20 miles.

6375

Group 4 Exhibit 18-DP

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STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

and

STATE OF MAINE
LAND USE PLANNING COMMISSION

IN THE MATTER OF

CENTRAL MAINE POWER COMPANY Application for Site Location of Development Act permit and Natural Resources Protection Act permit for the New England Clean Energy Connect ("NECEC") L-27625-26- A-N L-27625-TB-B-N L-27625-2C-C-N L-27625-VP-D-N L-27625-IW-E-N SITE LAW CERTIFICATION SLC-9	REBUTTAL TESTIMONY OF GROUP 4 WITNESS NAME: Jeffrey Reardon DATE: March 18, 2019

This testimony is presented in rebuttal to pre-filed testimony presented by CMP witness Mark Goodwin regarding brook trout habitat and riparian buffers. This includes Issue 2 covered in Mr. Goodwin's testimony: Wildlife Habitat and Fisheries. This rebuttal testimony focuses on the discussion of impacts to brook trout habitat in Goodwin's testimony Sections IV, C, ii: Brook Trout Habitat; IV, C, iv: Buffer Strips Around Coldwater Fisheries, and Section IV, C, v: Issue 2: Conclusion. It is related solely to the issues before DEP.

Goodwin concludes that:

- *[I]t is my opinion that there will be no unreasonable disturbance to or unreasonable impact on . . . Brook Trout habitat and the project will not result in unreasonable habitat fragmentation. . .. CMP has made adequate provision for buffer strips around cold-water fisheries.* (Goodwin testimony, page 22.)

In reaching this conclusion, Goodwin relies heavily on two studies that assessed impacts of cleared transmission rights of way on cold-water fish habitat and populations: (1) Gleason, N.C. 2008. Impacts of Powerline Rights of Way on Forested Stream Habitat Western Washington, Environmental Symposium in Rights of Way Management, 8th International Symposium, pages 665-678; and (2) Peterson, A.M. 1993 Effects of Electric Transmission Rights-of-Way on Trout in Forested Headwater Streams in New York. North American Journal of Fisheries Management, vol. 13 pp. 581-585.

I was not able to find a complete copy of the Gleason study. A colleague, TU's Senior Scientist Helen Neville, did find a copy of its abstract, which is provided below in the text of my rebuttal comments. The Peterson study is attached.

With respect to the Gleason study, Goodwin states:

- *"A study by N.C. Gleason on the impacts of power line rights of way ("ROW") on forested stream habitat found that despite the open canopy condition, water temperatures were slightly lower than in off-ROW areas and that none of the water quality parameters was significantly different between the on-ROW and off-ROW study areas. Gleeson's study also found no correlation between percent canopy cover and mean percentage of fines and found no significant difference in the Benthic Index of Biotic Integrity scores between on-ROW and upstream areas."* (Goodwin testimony, page 14.)

Gleason's study did not assess the immediate impacts of ROW construction, but instead investigated existing conditions on 30-50-year-old ROWs, noting that "It is likely that the streams intersected by rights-of-way have recovered from the initial disturbances that occurred 30 to 50 years ago." The study addressed impacts on Pacific salmon species, a suite of anadromous fish in the Pacific basin with very different habitat needs and patterns of habitat use than brook trout in inland streams in Maine. Although Goodwin accurately cites some of Gleason's findings that certain parameters were not significantly different between ROW and non-ROW sites, he does not disclose Gleason's finding that canopy cover was significantly lower in ROW sites (29%) compared to non-ROW sites (75%). More importantly, he does not state Gleason's conclusion:

- *Overall, the elements show a decrease from ideal salmonid habitat conditions.* (Gleason, 2008, Abstract.)

Here is the full abstract of Gleason's study (emphasis added):

- *Abstract: Pacific Salmon* Oncorhynchus *spp. have inhabited streams of the Pacific Northwest for thousands of years. In the past century, however, many populations have suffered severe declines and even extinction, largely due to settlement of the West Coast. Hydroelectric dams, an artifact of industrialization, necessitate swaths through forests to extend powerlines from generating facilities to consumers.* ***<u>Rights-of-way are cleared of trees, and roads are built for equipment access. Many rights-of-way that cross streams in forested areas cause disturbances to riparian zones.</u>*** *Salmonids are sensitive to disturbances that lead to altered temperatures, lack of dissolved oxygen, and* *increased sedimentation. This project's objective was to quantify effects of rights-of-way on forested streams by comparing right-of-way and paired upstream habitat. Measurements included benthic macroinvertebrates, canopy cover, fish presence, water quality, and percentage of fine particles (<0.85 mm) in streambed gravel to determine suitability as spawning habitat.* ***The only parameter that was significantly different was canopy cover with a mean of 29% in rights-of-way and 75% upstream. The parameters were expected to show degradation in the right-of-way due to opened canopy and gravel roads. Overall, the elements show a decrease from ideal salmonid habitat conditions.*** *It is likely that the streams intersected by rights-of-way have recovered from the initial disturbances that occurred 30 to 50 years ago and have restabilized to a natural regime. It is also possible that any degradation caused by rights-of-way is masked by wider scale disturbances such as timber harvest and off-road vehicle activities.*

Similarly, Mr. Goodwin selectively reports findings from the Peterson study. Goodwin writes:

- *A.M. Peterson has reported that removal of tree canopy (on new transmission line corridors) increases stream insolation during the short term, but within two years the areas are bordered by dense shrubs and emergent vegetation and water temperatures are not significantly higher than upstream forested reaches. Similarly, Peterson found that stream reaches in electric transmission ROWs were exposed to more light, had denser stream bank vegetation, were deeper and narrower, and had a greater area composed of pools. Peterson's study found that trout were more abundant in stream reaches within ROWs . . ..* (Goodwin testimony, page 15.)

This summary obscures some critical details of Peterson's study. The full study as published is attached below. Among the concerns:

- This study was funded by the New York State Electric and Gas Corporation, for whom Peterson worked. This does not negate the study's findings but does call into question their interpretation and discussion by Peterson.
- Goodwin does not note Peterson's finding of a highly significant difference in physical attributes between the ROW and forest stream reaches—that Mean Shade was 83.3% in forested reaches and only 31.5% in ROW reaches.
- The results regarding stream temperatures are suspect because warm streams were omitted from the study. The Methods section of the study notes that "Intermittent, warm or polluted streams were not selected." This could significantly skew the results, if, for example, sites with groundwater inputs that maintained cool stream temperatures were kept in the study and sites without groundwater influence with warmer stream temperatures were excluded. In my professional judgement, the relatively cool stream temperatures (mean 17.0 for forested streams and 17.4 for ROW streams) recorded

during mid-day, summer conditions would strongly suggest groundwater influence if recorded under similar conditions in Maine. It should also be noted that, although the difference was not statistically significant, forested streams averaged 0.4 degrees cooler than ROW streams.

- The data and conclusions regarding trout numbers and biomass are difficult to interpret. The abstract of the study reports collection of data at 15 headwater stream crossings, but only 10 of these streams were electro fished to collect fish population data. Trout numbers were higher within the ROW reaches than in forested reaches, but trout biomass was not significantly higher. Peterson reports that a very high proportion of the fish collected were young of year (57.7%) or juveniles (39.6%), with very few adult trout (2.7%). A relatively small shift in habitat suitability towards juvenile trout vs. adult trout —for example, due to the documented reduction in mean shade (83.3% in forested reaches vs. 31.5% in ROWs)—could significantly skew trout numbers when these reaches were compared in a population so dominated by young-of-year and juvenile trout. Peterson in fact reports that this shift towards younger age classes was observed in the ROW reaches and may account for the increase in trout numbers there.
- It is of concern that while trout biomass was not significantly higher in ROW reaches than in forested reaches, total fish numbers and total fish biomass were both significantly higher. This indicates that abundance and biomass of non-trout species was significantly higher within ROWs. Peterson did not report the species of fish other than trout collected in New York, but in Maine this would likely reflect a shift to species, many of them non-native, that are significant competitors with brook trout and have been identified as a long-term threat.

Goodwin also fails to acknowledge an extensive literature that documents the importance of intact, forested riparian buffers for brook trout and other fish and wildlife. Much of this literature is specific to Maine. For example, in a review by the Maine Natural Areas Program citing six different "ecological" buffer treatments applies in Maine and New Hampshire, deMaynadier *et al*[1] emphasize the need to maintain greater than 70% canopy closure within the riparian zone, and to include 25-100-foot no-cut zones immediately adjacent to streams. The Maine Department of Inland Fisheries and Wildlife recommends "limiting the harvest of trees and alteration of other vegetation within 100 feet of streams and their associated fringe and floodplain wetlands to maintain an intact and stable mature stand of trees, characterized by heavy crown closure (at least 60 – 70%)" to protect brook trout habitat.[2] Similarly, Haberstock[3] notes

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[1] deMaynadier, P., T. Hodgman, and B. Vickery. 2007. Forest Management Recommendations for Maine's Riparian Ecosystems. Technical report submitted to the Maine Department of Inland Fisheries and Wildlife, Bangor, ME.
[2] ME DIFW, undated. Forest Management Recommendations for Brook Trout.
https://www.maine.gov/ifw/docs/brook_trout_factsheet_forestry.pdf
[3] Trout Unlimited. 2005. Riparian Buffer and Watershed Management Recommendations for Brook Trout Habitat Conservation. Focus: Mountainous Brook Trout Watersheds of Maine and Northern New Hampshire. Report Prepared for Trout Unlimited, Augusta, Maine, by Kleinschmidt Associates, Pittsfield, Maine. Page 9.

that "a high degree of canopy closure adjacent to streams is necessary for buffers to function at optimal levels" and "is associated with several functions important for salmonid habitat including shading and organic matter inputs." Haberstock also notes that "Intact forested riparian areas also provide organic debris inputs which directly enhance brook trout habitat through the provision of in-stream structure like tree boles, root wads and large branches."[4] Two of these references were attached to my pre-filed testimony. The third is attached here.

Goodwin's testimony on buffers emphasizes CMP's concession to allow 75-100-foot buffers to stream crossings. But this focus on width, rather than on the nature of vegetation allowed to remain within the buffer, ignores the importance of canopy closure, presence of mature tree, forested buffers, and inputs of large woody debris to instream habitat. He emphasizes buffer functions that can be provided by low ground cover or even grasses, like sediment and nutrient removal, but ignores buffer functions like large woody debris and organic matter inputs that are provided by mature trees that will not be allowed within CMPs buffers. He also exaggerates the degree to which the non-capable vegetation allowed to remain within CMPs proposed buffers will provide functions like shade. For example, Goodwin states:

- *Allowing non-capable vegetation to remain as described within the appropriate buffer will provide shading and reduce the warming effect of direct sunlight (insolation). Low ground cover will also remain within these buffers to filter any sediment or other pollutants in surface runoff. These conditions will allow the stream buffers to provide functions and values similar to those prior to transmission line construction.* (Goodwin testimony, p 21.)

This statement is directly contradicted by the only two references Goodwin cites. Gleason noted that:

- *The only parameter that was significantly different was canopy cover with a mean of 29% in rights-of-way and 75% upstream. . .. Overall, the elements show a decrease from ideal salmonid habitat conditions.*

Similarly, Peterson documented that reaches in ROWS had significantly less shade than nearby forested reaches. Exhibit CMP-3-I, "Vegetation Maintenance—High Voltage Direct Current Tangent Structure Detail" clearly shows that no woody vegetation will be allowed within the 54-foot width of the "wire zone", and that even beyond the wire zone, vegetation heights will be no more than about 15 feet. Shading from vegetation at these heights will be minimal, and large

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[4] Trout Unlimited. 2005. Riparian Buffer and Watershed Management Recommendations for Brook Trout Habitat Conservation. Focus: Mountainous Brook Trout Watersheds of Maine and Northern New Hampshire. Report Prepared for Trout Unlimited, Augusta, Maine, by Kleinschmidt Associates, Pittsfield, Maine. P. 10.

wood and other organic inputs will not occur because woody vegetation will not reach maturity, die, and be recruited into the stream channel before it is cut on the proposed 4-year cycle.

The riparian buffers proposed by CMP will be substantially reduced in function from their current status, with shading greatly reduced and large wood inputs to the stream eliminated within CMPs buffer zones. CMP significantly understates the impacts of its riparian clearing on brook trout habitat and has not made adequate provisions for buffer strips around cold-water fisheries. Indeed, in Mr. Goodwin's testimony regarding Issue IV: Compensation and Mitigation, he acknowledges these impacts:

- *The NECEC will have 11.02 linear miles of streams that will be subject to forested conversion impact.* (Goodwin testimony, p. 23.)

In evaluating the degree of impact to those 11 miles, the DEP should consider that:

(1) The studies cited by CMP suggest that these buffers will provide far less shade than forested streams—a reduction of 75% shaded to 29% shaded in Gleason's study and 83.3% shade to 31.5% shade in Peterson;
(2) The proposed initial clearing will remove all woody vegetation taller than 10 feet from the 150-foot width of the ROW;
(3) The routine vegetation maintenance that will occur on a 4-year cycle will periodically cut all woody vegetation taller than 10 feet to ground level and remove this "slash" from the riparian zone. All "capable" trees within the ROW will be similarly hand cut and removed; and
(4) Because of #2 and #3, all buffer functions that rely on large mature trees—canopy closure and related shading and temperature regulation; large woody debris recruitments; organic inputs from leaf litter—will be severely compromised.

Attachments

1. Peterson, A.M. 1993 Effects of Electric Transmission Rights-of-Way on Trout in Forested Headwater Streams in New York. North American Journal of Fisheries Management, vol. 13 pp. 581-585.
2. ME DIFW, undated. Forest Management Recommendations for Brook Trout. https://www.maine.gov/ifw/docs/brook_trout_factsheet_forestry.pdf

Notarization

I, Jeffrey Reardon, being first duly sworn, affirm that the above testimony is true and accurate to the best of my knowledge.

Jeff M. Reardon — 3/18/2019

Name — Date

Maine Brook Trout Project Director

Title

Personally appeared the above-named Jeffrey Reardon and made affirmation that the above testimony is true and accurate to the best of his knowledge.

Date: 3/18/19 Notary: Ann Y

Ann Young
Notary Public, State of Maine
My Commission Expires July 10, 2025

Group 4
Exhibit
19-JR
Rebuttal

North American Journal of Fisheries Management 13:581–585, 1993

Effects of Electric Transmission Rights-of-Way on Trout in Forested Headwater Streams in New York

ALLEN M. PETERSON

New York State Electric and Gas Corp.
Kirkwood Industrial Park, Post Office Box 5226, Binghamton, New York 13902, USA

Abstract.—Fifteen crossings of headwater streams by electric transmission rights-of-way (ROWs) in forested areas of New York State were studied to determine the effects of ROWs on habitat and populations of brook trout *Salvelinus fontinalis* and rainbow trout *Oncorhynchus mykiss*. Trout habitat and abundance in ROWs were compared with those in adjacent upstream reaches within the forest. The stream reaches in the ROWs were exposed to more light, had more dense streambank vegetation, were deeper and narrower, and had greater area composed of pools; water temperature was not significantly greater. Trout were more abundant in reaches within ROWs. The greater mean depth and more numerous pools within ROWs were believed to have caused higher densities of trout.

Headwater streams with brook trout *Salvelinus fontinalis* and rainbow trout *Oncorhynchus mykiss* are vulnerable to adverse effects from logging and road building (Chapman 1962; Burns 1972; Lynch et al. 1977). The crossing of headwater streams with electric transmission rights-of-way (ROWs) may also degrade trout streams. Such crossings usually involve the permanent removal of trees and construction of an equipment access road across the stream channel. These changes may affect water temperature, the stream channel's cross-sectional geometry, instream cover, fish food availability, and fine sediment deposition.

This study was conducted to determine (1) the effect of electric transmission ROWs upon the physical characteristics of headwater trout streams in forested areas, and (2) the effect of these changes upon trout abundance.

Study Area

This study was conducted in south-central New York State, in Delaware, Sullivan, and Chenango counties, within the Delaware Hills and Catskill Mountains of the Appalachian Uplands. Bedrock was primarily sandstone. Elevation varied from 300 to 1,000 m above mean sea level. The entire area has been glaciated, and soils are thin glacial tills except along major river valleys, where alluvial deposits occur (Thompson 1966). The area lies within the northern hardwoods section of the Laurentian mixed forest province (Bailey 1976). Forest cover is primarily sugar maple *Acer saccharum*, yellow birch *Betula allegheniensis*, American beech *Fagus grandifolia*, and eastern hemlock *Tsuga canadensis*. The area was heavily logged in the 1800s; however, mature second-growth forest now covers approximately 75% of the land (Brooks 1981). Headwater streams tend to be clear, cold, and relatively unproductive.

ROW description.—The physical characteristics of the ROWs studied were variable. Lower-voltage lines (34 and 46 kV) were in cleared ROWs 10–30 m wide; higher-voltage lines (115, 230, and 345 kV) were in cleared ROWs 30–50 m wide. Where parallel sets of lines were constructed, ROW width was as wide as 130 m. Although ROWs usually crossed the streams at a right angle, they sometimes paralleled a stream for up to 450 m. The ROWs were 10–50 years old, and most no longer had active road access.

The vegetation among the ROWs was similar. Trees were absent or limited to scattered saplings, but there was dense growth of forbs and shrubs. Common taxa included hay-scented fern *Dennstaedtia punctilobula*, goldenrod *Solidago* spp., blackberry *Rubus* spp., and grasses. Alders *Alnus* spp. frequently occurred along the streambanks. Hardwood sprouts frequently grew from cut stumps on the streambanks.

Methods

Stream survey.—Stream surveys were conducted during July and August 1988 and 1989. Fifteen ROW crossings of forested headwater streams (first- or second-order) were selected. Care was taken to select stream crossings with no impacts from cattle grazing, logging, or beaver activity. Intermittent, warm, or polluted streams were not selected. The entire cleared ROW stream reach was studied. However, at one reach that flowed parallel to the ROW for 450 m, only the lower 30 m was studied. This was done as a practicality—to keep the reaches of generally equal lengths, and to detect a worst-case increase in stream temperature and other potential ROW effects. The ROW reaches averaged 29 m long but varied from 15 to 45 m long. An upstream reach of the same length and morphology (i.e., gradient, discharge, and channel pattern) was located in the forest immediately (<10 m) adjacent to the ROW edge for comparison. However, one ROW reach was 44% longer than the upstream reach due to the presence of a long, deep pool in the ROW.

The intent of the design was to enable an extensive posttreatment sample from which the effects of the ROWs on trout habitat and abundance could be assessed. One goal of this posttreatment sample was to detect not only mean habitat changes but also also the "worst cases" to help identify potential adverse effects of future ROW clearing, construction, and maintenance. This is why polluted, logged, or otherwise already disturbed stream reaches were not selected. It is also why stream temperature, riffle fines, and shade were sampled in such a manner as to detect maximum differences, not mean differences.

The habitat variables selected for study were chosen from the brook trout habitat suitability index (HSI) model (Raleigh 1982). The model contains suggested methods for measurement of the variables along with more detailed descriptions of sampling procedures.

Sampling transects were established systematically across each stream reach, usually at 3-m intervals, 7–16 transects were sampled per reach depending on the length of the reach. On three shorter reaches (15, 15, and 20 m), the distance between transects was reduced to 2 m. Water velocity was measured with a Montedoro-Whitney PVM-2A velocity monitor at the middepth and midchannel of each transect. The measurements for all transects were summarized as mean velocity (m/s) for each stream reach. Wetted width was measured to the nearest 0.25 m. Water depth was measured at 0.25, 0.50, and 0.75 the width on each transect. The deepest measurement was considered to be the thalweg depth. Mean wetted width and mean water depth were computed for each stream reach. At each point where stream depth was measured (three locations per transect) the presence or absence of shade at the water's surface was recorded. A reach with 10 transects would then have 30 shade readings. The percent of points that were shaded for each reach was then calculated. All shade readings were collected between 1000 and 1600 hours, when the sun was high in the sky. Within paired reaches, shade readings were taken within one hour of each other to minimize variation due to change in the sun's angle.

The surface area of pools and riffles was measured and mapped to scale on planform maps. The percentage of the stream reach that was pool or riffle was calculated for each reach.

Dominant substrate size was visually categorized at each transect following Raleigh (1982): 1.0 = rubble or small boulders dominant, with limited fines, large boulders, or bedrock; 0.6 = boulders, rubble, gravel, and fines equally present, or gravel is dominant; or 0.3 = large boulders, bedrock, or fines dominant, little rubble or gravel. The mean numeric values for all transects were then calculated.

Fines in riffles were sampled in the first riffle upstream and downstream from each ROW; the upstream sample represented forest conditions; the downstream sample, though in forest, represented the effects of ROWs. At each riffle, 10 samples of the top 5 cm of substrate were collected in 250-mL wide-mouthed jars. Each jar was filled in a single upstream sweep. The generally low water velocities and depths prevented significant loss of fines. These samples were returned to the laboratory, where they were passed through a 3-mm sieve. The percent of fines (<3 mm) was then determined for each sample by volume displacement, and the mean was computed.

The length of streambank and stump and tree undercuts that were greater than 5 cm and had an underlying water depth of at least 5 cm were measured within each reach and mapped to scale on planform maps. The undercuts' lengths were summed to determine the percentage of overhead bank cover within each reach.

The presence and location of streambank vegetation (grasses, shrubs, and trees) were mapped to scale on planform maps. The percentage of the stream reach dominated by grasses and shrubs, as opposed to trees, was calculated for each reach.

Water temperature was measured with a Corning PS-15 probe. One reading was taken midstream at the farthest downstream sampling transect of each ROW and upstream reach between 1000 and 1600 hours and during sunny weather. Preliminary sampling indicated that worst-case increases in water temperature occurred midchannel at the downstream end of the ROW reach.

The trout were sampled by electrofishing during August 1989. Only 10 of the 15 study streams were sampled because access restrictions prohibited sampling the remaining five streams. At each reach,

TABLE 1.—Average electrofishing trout catches as percentages of total population estimates of age-0 and older trout in seven streams in New York, 1989. Reach was designated as either on or off an electric transmission right-of-way (ROW).

Stream	Reach	Catch (% of total)	
		Grams	Numbers
Denman Brook	On ROW	99	97
	Off ROW	60	80
Lybolt Brook	On ROW	96	79
Neversink Tributary	On ROW	98	93
	Off ROW	97	96
Ward Road Brook	On ROW	91	73
	Off ROW	99	80
Average		91	85

block nets were placed at the upstream and downstream ends. Three upstream passes were made with a Smith-Root pulsed-DC backpack shocker. All stunned fish were netted, counted, identified to species, measured to the nearest millimeter (total length), and weighed to the nearest 0.1 g.

All electrofishing data were corrected to standard 30-m reaches. Three-pass depletion estimates of trout standing stock (g/reach) and population (number/reach) were calculated (DeLury 1951) based upon results from 7 of the 20 sites. Sampling efficiency often exceeded 90% (Table 1).

A paired t-test was used to detect significant ($P \leq 0.05$) changes between habitat variables in ROWs and off and significant changes in the fish population characteristics in ROWs and off. Because the substrate value data were discontinuous, they were analyzed with the Wilcoxon signed-rank test (Snedecor and Cochran 1967). Paired t-tests were performed with the Statistical Analysis System (SAS Institute 1985a, 1985b).

Results

Stream Survey

Five of the 10 stream habitat variables differed significantly between the ROWs and the upstream forested reach (Table 2). The reaches in the ROWs received more direct sunlight, had more low streambank vegetation, were narrower and deeper, and had more pool area. The greater mean depth in ROWs resulted from a higher average minimum depth recorded at each transect (8.4 cm for ROW transects versus 6.4 cm for forest transects), whereas thalweg (maximum) depth was not different (13.6 cm versus 13.5 cm). Although the amount of bank cover did not differ between forested and ROW reaches, its composition did. There were significantly more undercut earthen banks in the ROW than in the forested reaches, yet no significant difference in undercut stumps, trees, and logs (Table 2).

TABLE 2.—Mean physical attributes of 15 headwater trout streams in New York, 1989. Thirty-meter reaches in cleared electric transmission ROWs were compared with adjacent upstream 30-m reaches in the forest by paired t-tests. The P-values represent the probability that the mean difference between the forested and ROW reaches was equal to zero.

Variable	Stream reach		P
	Forest	ROW	
Mean velocity (m/s)	0.19	0.21	0.40
Mean width (m)	3.6	2.8	0.04
Mean depth (cm)	9.5	12.1	0.02
Area of pools (%)	25.7	38.3	0.02
Substrate size	0.80	0.82	0.80[a]
Mean riffle fines (%)	23.4	20.5[b]	0.09
Mean shade (%)	83.3	31.5	0.01
Bank cover (%)	14.7	23.3	0.26
Earthen portion	10.1	19.5	0.05
Woody portion	4.6	3.8	0.75
Bank shrubs and grass (%)	4.6	91.8	0.01
Temperature (°C)	17.0	17.4	0.24

[a] Wilcoxon signed-rank test.
[b] Collected from first riffle in forest downstream of ROW edge.

Trout abundance estimates were significantly higher in ROWs than in forested reaches (Table 3). Nine of 10 streams had more trout in the ROW than in upstream reaches. Although the difference in trout standing stock estimates between forested and ROW reaches was not significant, the difference in the standing stock of all fish (trout and nonsalmonids combined) per reach was significant (Table 3). The trout population structure was weighted heavily towards small fish in both ROW and forested reaches. Young-of-year trout (≤9.9

TABLE 3.—Mean population and standing stock estimates of 10 headwater stream fish communities in New York, 1989. Fishes in 30-m reaches in cleared electric transmission ROWs were compared with those in adjacent upstream 30-m reaches in the forest by paired t-tests.

Variable	Stream reach		P
	ROW	Forest	
Number of trout/reach[a]	30.8	18.9	0.01
Grams of trout/reach	342	228	0.12
Number of all fish/reach[b]	118.5	62.8	0.03
Grams of all fish/reach	585	368	0.04

[a] All were brook trout except for nine rainbow trout in one ROW reach and five in the paired forested reach.
[b] Includes all brook and rainbow trout.

cm) constituted 57.7% of the sample; 39.6% of the trout were juveniles (10–17.3 cm) and only 2.7% were adults (≥17.4 cm).

Discussion

Removal of the forest canopy in ROWs caused a significant increase in incident sunshine, which in turn encouraged a dense growth of low streambank vegetation. The ROWs were always bordered by a robust forb and shrub layer, and vegetation often overhung the stream channel. The grasses approached 1 m in height and usually obscured the ground completely. The darkened forest streambanks, in contrast, usually held only scattered herbs and an occasional sapling or mature tree.

The added root mass of the forb and shrub layer appears to have stabilized the streambanks and increased their resistance to erosion. In addition, the channel point bars, which were normally unvegetated even when exposed at low flows, became covered with a dense growth of tall grasses and forbs. This combination of bank and bar stabilization restricted increases in stream width during peak flows and probably resulted in increased bed erosion instead. The increased bed erosion is the probable cause of the observed increases in depth and areas of pools. This interpretation is consistent with the hydraulic geometry demonstrated by Leopold and Maddock (1953) whereby, at a constant discharge and velocity (which were present between paired reaches), any decrease in channel width must be compensated for by a corresponding increase in depth.

These changes in streambank vegetation and hydraulic geometry appear to have caused the significant difference in the nature of the bank cover. The dense root mass of the ROWs' forb and shrub layer apparently prevented the undercut upper soil horizons from sloughing off into the current as they tended to do in the forested reaches. However, the initial ROW clearing removed large streambank trees. Time and floods removed the stumps, and ROW vegetation management insured that large trees did not reappear. As a result, the relatively few undercut trees in the ROW reaches tended to be replaced with a greater amount of undercut banks.

The differences observed in trout abundance between forested and ROW reaches were likely caused by the greater water depth and pool area in the ROWs. Many of the riffle areas in the forested reaches were too shallow for fish. However, the riffles in the ROWs were deeper and yielded large numbers of fish during the electrofishing effort. Smith (1980) noted a similar relationship in populations of brown trout *Salmo trutta* between forest and meadow reaches of a small tributary of the River Tweed, Scotland. Scarnecchia and Bergersen (1987) also found that narrower and deeper small streams yielded increased salmonid production. The ROW reach trout populations consisted of greater numbers of small trout compared with the forested reaches. This suggests that ROW stream reaches may be better habitat for young fish, perhaps increasing their survival.

Electric transmission ROWs need not constitute an adverse effect on headwater trout population densities in forested basins. They can generate positive effects as long as they do not cause stream warming to greater than 20°C and as long as long-term damage by construction equipment is avoided. The data herein suggest that the selective removal of riparian trees may increase the amount of habitable area for trout by increasing mean water depth. The greatest advantages of selective tree removal may be seen if riffles are opened to sunlight but pools are left shaded. Most of the trout in the streams studied were young of year and juveniles, and the major fishery benefit to such streams may be increased downstream recruitment to the fishery. Trees that are undercut and provide bank cover for adult trout should not be cut. Stream temperatures in managed reaches should be monitored to ensure that opening of the riparian canopy does not cause significant stream warming.

Acknowledgments

Funding for this project was provided by New York State Electric and Gas Corp. Doug Cerretani, Dale Madison, John Titus, and Dick Andrus provided many helpful comments; field assistance was provided by Tim Sienkiewicz and Mark Lindberg. I also thank Wayne Hubert, Steve Miranda, and anonymous reviewers for their encouragement and assistance with manuscript preparation.

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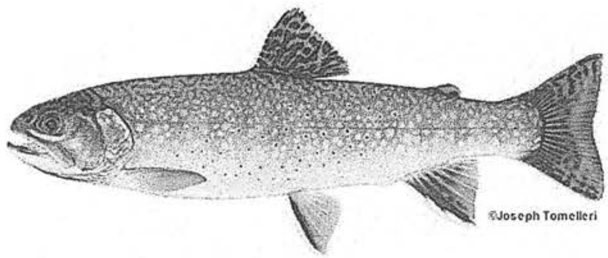
Group 4 Exhibit 20-JR Rebuttal

MAINE DEPARTMENT OF
INLAND FISHERIES AND WILDLIFE



Forest Management Recommendations for Brook Trout

Background

Brook trout (*Salvelinus fontinalis*), commonly referred to as squaretail, brookie, and speckled trout, are native to Maine and are the most preferred sport fish sought by Maine anglers. Size may vary, depending on water temperature, productivity, and food sources, but 3 year-old brook trout in Maine lakes may range from 7.5 to 17.5 inches long. Stream populations are typically slower growing, and lengths of 6 to 10 inches are more common place, although some populations mature and reproduce at lengths smaller than 6 inches.

Maine is the last stronghold for wild brook trout in the eastern United States. There are more than twice as many watersheds supporting wild populations in Maine than all of the other 16 states within the historical eastern brook trout range combined. Maine is also the only remaining state with extensive intact lake and pond dwelling populations of wild brook trout.

Brook trout require clean, cool, well oxygenated water and are very sensitive to changes in habitat and water quality. Rivers and streams typically provide spawning and nursery habitat. Adults are commonly resident in streams, but migrate throughout and between drainages to meet seasonal life history requirements.

Stream habitat suitability is maintained by the presence of intact, mature wooded riparian corridors that conserve forest soils, provide shade to reduce stream warming, protect stream water quality, provide cover for fish, and provide a source of woody debris and leaf litter from mature trees that maintain in-stream habitat for fish and the aquatic insects they feed upon. Floodplain and fringe wetlands associated with streams can be a significant source of springs and groundwater discharge that maintain stream flows and cool temperatures during warm low flow summer periods. Protection of these important riparian and wetland functions ensures that the overall health of the stream habitat and watershed is maintained.

Maine brook trout fisheries are unique and highly valuable, but they are vulnerable to habitat alteration that may be caused by poorly planned and implemented land management activities. Well planned forestry operations can protect habitat and help ensure that forests remain as forest; a compatible land use for brook trout and many other fish and wildlife.

Forest Management Recommendations
Brook trout are not afforded any special state or federal regulatory protection for forestry operations, and as such management recommendations are advisory.

The MDIFW recommends following Best Management Practices (BMPs) during all road and trail building activities, as well as timber harvesting. BMPs are detailed in the booklet titled *Best Management Practices for Forestry*, which offers guidance on managing and protecting water quality, installing road-stream crossings, and providing fish passage. This booklet is available at: http://www.maine.gov/doc/mfs/pubs/bmp_manual.htm or contact the Maine Forest Service at 1-800-367-0223.

Potential harmful impacts to fish and wildlife may be further minimized by designating low impact "riparian management zones" adjacent to streams and stream-associated fringe and floodplain wetlands in forest management and harvest plans. Smaller streams may be greatly influenced by land management practices; these systems benefit the most from well-managed and intact riparian corridors.

The MDIFW also recommends limiting the harvest of trees and alteration of other vegetation within 100 feet of streams and their associated fringe and floodplain wetlands to maintain an intact and stable mature stand of trees, characterized by heavy crown closure (at least 60 – 70%) and resistance to wind-throw. In some situations wider buffers should be considered where severe site conditions (e.g., steep slope, vulnerable soils, poor drainage, etc) increase risk to soil and stand stability. Any harvest within the riparian management zone should be selective with a goal of maintaining relatively uniform crown closure.

Roast beef

Horseradish

Dijon mustard

Fresh rosemary

Fresh Thyme

Parsnips

Cauliflower

Celery root

Cooking greens

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STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

and
STATE OF MAINE
LAND USE PLANNING COMMISSION

IN THE MATTER OF

CENTRAL MAINE POWER COMPANY Application for Site Location of Development Act permit and Natural Resources Protection Act permit for the New England Clean Energy Connect ("NECEC") L-27625-26- A-N L-27625-TB-B-N L-27625-2C-C-N L-27625-VP-D-N L-27625-IW-E-N SITE LAW CERTIFICATION SLC-9	REBUTTAL TESTIMONY OF GROUP 4 WITNESS DR. DAVID PUBLICOVER March 18, 2019

This testimony is presented in rebuttal to pre-filed testimony presented by CMP witnesses Gerry Mirabile, Mark Goodwin and Lauren Johnston (by adoption of Goodwin testimony). Specifically, this rebuttal testimony focuses on the issue of habitat fragmentation (Mirabile and Goodwin sections IV.c.iii). This rebuttal is relevant solely to issues before the DEP.

The testimony of these witnesses reflects the approach taken in the application, and consists of broad general statements, mischaracterization of the surrounding managed forest landscape, incorrect assumptions about the habitat benefits of the new corridor, lack of any assessment of the adverse effects of the new corridor, and unsupported conclusions that are contradicted by the extensive literature on the adverse effects of habitat fragmentation. The testimony consists of little more than feel-good statements that do not come close to satisfying the burden of proof required by 38 MRSA §486-A.2.

Specific examples include:

- "*CMP sited the NECEC Project to minimize habitat fragmentation. CMP accomplished this by co-locating more than 70% of the new transmission line within or immediately adjacent to existing transmission line corridors, rather than creating a new corridor for the entire transmission line*." (Mirabile p.11)
- "*Co-location of energy infrastructure is a primary consideration when minimizing impacts to existing land uses and the environment. The proposed development minimizes habitat fragmentation in this manner by utilizing existing transmission line corridors for approximately 73% of the Project*." (Goodwin p. 15)

The fact that the majority of the line is located within existing corridors is irrelevant to assessing whether the 53.5 miles of new corridor creates an unreasonable adverse effect on the natural environment. The impact of the new corridor would be exactly the same even if it terminated at, and connected to, existing lines without any construction of new co-located line. The fact that additional line was constructed beyond the connection point with the existing corridor does not constitute minimization of impact. By this standard, construction of even more line within existing corridors would constitute even greater minimization.

- "*While this conversion of vegetation from forested to scrub/shrub will favor some species over others, the transmission line corridor will not generally impede the movement or migration of wildlife or plant species*." (Mirabile p. 12)

The statement that the corridor will not act as a barrier to species movement is made without any supporting evidence and is directly contradicted by other sources. For example, LUPC's 2010 Comprehensive Land Use Plan states (p. 241)[1], "*Scientists have identified fragmentation of habitat as a serious concern. Roads, utility corridors, certain types of recreation trails, structures and clearings create breaks in the landscape. These breaks can act as barriers to animals and isolate populations of both plants and animals*." The US Fish and Wildlife Service states[2] that transmission lines "*act as barriers to wildlife movement and affect migration routes*." A report by Manitoba Hydro[3] stated (p. 49), "*Rights-of-way may displace or impede movements of some birds, marten and other small mammals that inhabit small territories or home ranges in mature forest or that have difficulty crossing nonforested gaps*." The statement is even contradicted by the Applicant's own application, which states (Section 7.4.1), "*Transmission line corridors present potential direct impacts, as they may affect species movement,...*"

The fact that most species will not be affected, or that the corridor will not "generally" impede species movement, is insufficient. The failure to assess and provide evidence on which species will be adversely affected constitutes a serious flaw in the application.

- "*CMP's vegetation management practices... establishes areas of dense shrubby vegetation and taller vegetation where topographic conditions allow (e.g., steep ravines), thereby providing a vegetation bridge for wildlife movement across the NECEC corridor*." (Goodwin p. 17)

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[1] LUPC. 2010. Comprehensive Land Use Plan. Maine Department of Agriculture, Conservation and Forestry, Land Use Planning Commission, Augusta, ME.
[2] See https://www.fws.gov/ecological-services/energy-development/electric-transmission.html.
[3] Manitoba Hydro. 2010. Fur, Feathers, Fins & Transmission Lines: How Transmission Lines and Rights-of-Way Affect Wildlife, 3rd Edition.

Neither the application nor the witness's testimony provides any information as to where or to what extent such topographic conditions will allow taller vegetation to be maintained. Without such information there is no factual basis for this statement.

- "*CMP's vegetation management practices require riparian buffers, ranging from 75 to 100 feet in width measured from the top of bank, to be maintained at all stream crossings in a manner that will allow taller non-capable vegetation to persist, promoting the movement of wildlife across the corridor and increasing habitat connectivity in these areas*." (Goodwin p. 17)

Mr. Goodwin's Exhibit 3-I provides a diagrammatic representation of how vegetation will be managed within the riparian buffer zones. The diagram makes clear that even though slightly taller vegetation will be maintained outside of the wire zone, capable species (i.e. trees) will be removed and the retained vegetation will be considerably shorter than the surrounding forest. While these buffers may allow for movement of many species across the corridor, they are insufficient to provide habitat for species that avoid areas without forest cover of adequate height and density, such as marten.[4] There is no discussion of which species may find these buffers inadequate. (In fact, there is no reference to marten, the primary umbrella species associated with mature forest habitat, anywhere in either Application Chapter 7 or CMP's pre-filed testimony.)

- "*In many cases, edge effect results in greater species diversity, and greater population density of certain species, than that observed within individual habitats*." (Mirabile p. 12)

[44] See pre-filed testimony of David Publicover (p. 13)

While true, this statement completely ignores the context of which species benefit and which species do not. The idea that the greater species diversity in edge habitats constitutes a benefit to wildlife is outmoded and contradicted by current understanding of the adverse impacts of forest edges (especially permanent high-contrast edges such as will be created and maintained by the corridor).

For example, Matlack and Litvaitis (1999, p. 210-211) [5]state, "*For decades, forest managers emphasized edge creation in response to the observation that some forms of wildlife (notably popular game species) were abundant at edges. Now, however, edge habitat is recognized as being incompatible with the requirements of many forest species, and the proliferation of forest edges has threatened the diversity of many forest communities.*" They also state (p. 222), "*Protection of most forest species is best served by uncut forest, well away from the peculiar dynamics of human-generated forest edges.*" Hunter (1990, p. 107)[6] notes that "*Some wildlife biologists have pointed out that even if edges are zones of high diversity and density, this does not necessarily make them ideal wildlife habitat.*"

The Applicant completely fails to provide any assessment of which species may be adversely affected by the creation of extensive permanent edge. This is critical information; Pfeifer (2017)[7] found that species that avoided edges (and were dependent on interior forest) were more likely to be habitat specialists of high conservation concern, while species attracted to edges were more likely to be common generalist species.

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[5] Matlack, G.R. and J.A. Litvaitis. 1999. Chapter 6: Forest edges. Pp 210- 227 in: Maintaining Biodiversity in Forested Ecosystems (M.L. Hunter Jr., ed.). Cambridge University Press, Cambridge, UK.
[6] Hunter, M.L. Jr. 1999. Wildlife, Forests and Forestry: Principles of Managing Forests for Biological Diversity. Prentiss Hall, Inc., Englewood Cliffs, NJ.
[7] Pfeifer, M. et al. 2017. Creation of forest edges has a global impact on forest vertebrates. Nature 551: 187-191.

- "*In summary, the NECEC Project will create a swath of permanently maintained scrub-shrub habitat in an area with a scarcity of such habitat, and characterized by a patchwork of clearcuts, and young and older tree (primarily softwood) regrowth. The inclusion of scrub-shrub habitat within the larger landscape, while it will advantage some plant and animal species over others, will not adversely impact overall habitat and species diversity, and may improve it.*" (Mirabile p. 13-14)

The idea that clearing one of the largest permanent fragmenting features through a region that is globally significant because of its high level of ecological connectivity[8] would improve overall habitat and species diversity is, to be blunt, ridiculous, and is contradicted by the extensive scientific literature on the adverse impacts of fragmentation.

There is not a scarcity of early successional habitat in the western Maine Mountains region, and the Applicant provides no evidence or analysis to support this statement. The state's Wildlife Conservation Plan makes clear in multiple places that the type of habitat that would be maintained in the corridor (classified as Grassland-Shrubland-Early Successional) is limited in southern Maine where timber harvesting is limited and most forest is in a more mature condition. In contrast, it is mature forest that is limiting in the forests of northern and western Maine that are dominated by large actively managed commercial ownerships.

Data derived from the US Forest Service Forest Inventory and Analysis shows that over one-third of the forest in the vicinity of the new corridor consists of seedling and sapling stands (reflecting the high level of timber harvesting in the region) while less than 8% consists of sawtimber stands more than 100 years old (supporting the Wildlife Action Plan contention that

[8] See pre-filed testimony of David Publicover, Janet McMahon (Group 1), and Rob Wood/Andy Cutko/Bryan Emerson (Group 6).

mature forest habitat is scarce in northern Maine).[9] However, neither the Applicant nor their witnesses' testimony provide any assessment of the project's impact on mature forest habitat.

The Applicant wants to have it both ways – the project will not have a significant fragmenting impact because the region is already subject to heavy timber harvesting, but will provide a benefit through the maintenance of early successional habitat (which is already common in the region).

- "*According to the EPA 'the IVM approach can create natural, diverse, and sustaining ecosystems, such as a meadow transition habitat. These transition landscapes, in turn, reduce wildlife habitat fragmentation and allow species to be geographically diverse, remaining in areas from which they might otherwise be excluded. A variety of wildlife species (including threatened and endangered species) consider these habitats home, such as butterflies, songbirds, small mammals, and deer. These habitats also encourage the growth of native plant species and can increase plant diversity.*'" (Goodwin p. 17)

Mr. Goodwin quotes the EPA[10] in support of the habitat benefits of the new corridor. However, he conveniently excludes the opening sentences of this paragraph from the EPA web page, which read, "*While vegetation management on ROW is essential for providing safe and reliable electric power, these ROW also provide important wildlife habitats. <u>As wildlife habitats in the United States are lost to development</u>, these ROW become increasingly important*." (emphasis added)

[9] These figures were derived from the USFS FIA Evalidator web site. They reflect FIA plots within an 18-mile radius of the approximate center of the new corridor between the Canadian border and Route 201 about 1 mile east of Whipple Pond. Because of the relatively small area these figures have a high margin of error but reflect the relative proportions of these types of habitats.

[10] https://www.epa.gov/pesp/benefits-integrated-vegetation-management-ivm-rights-way#benefit.

This excluded sentence, as well as the phrase that Mr. Goodwin did include ("*from which they might otherwise be excluded*") make clear that the habitat benefits cited by the EPA are intended to refer to developed landscapes where natural habitat is being lost and is increasingly limited. In these landscapes transmission line corridors can provide habitat benefits. However, it is not applicable to the landscape through which the new corridor would pass, which is comprised of extensive relatively natural forest that is not being lost to development and from which species are not being excluded. In this landscape it is the corridor that will cause the loss of habitat for native species. This omission by Mr. Goodwin creates an inappropriate impression of habitat benefits that do not apply to this landscape.

Dated: 3/18/19 by: [signature]
David Publicover

Date: 3-18-19

The above-named David Publicover did personally appear before me and made oath as to the truth of the foregoing rebuttal testimony.

Denise M Horne
Notary Public
My Commission Expires 4-19-22

DENISE M. HORNE
Notary Public - New Hampshire
My Commission Expires April 19, 2022

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For all three of these crossings—and for crossings of the West Branch and South Branch Moose River and Piel Brook, neither of which are discussed by Mr. Freye—even if CMP could not identify alternative routes with fewer impacts in streams that are important to brook trout, alternatives were available that could have maintained full forest canopy vegetation over the streams. As noted above, CMP used taller poles to reduce impacts to Gold Brook. CMP also proposed taller poles that maintain full canopy vegetation at the Mountain Brook crossing and proposed alternative pole locations to maintain full canopy vegetation on both banks of the Kennebec River. There is no indication that these or other alternatives were considered for these high-impact stream crossings.

Brook Trout Habitat Values of Compensation Parcels: Mr. Freye points out that conservation completed in the past by the Western Mountain Charitable Foundation abuts CMP's proposed Lower Enchanted Tract on the north shore of the Dead River and is across the river from the proposed Basin Tract. This is true, but it misses my larger point—that protection of lands adjacent to the Dead River does not protect habitat for brook trout that is remotely like the smaller, colder, and higher elevation streams that are impacted by the proposed stream crossings. The Dead River in the vicinity of Lower Enchanted, Basin, and Grand Falls tracts—and the abutting lands conserved by the Western Mountain Charitable Foundation—has a brook trout and landlocked salmon fishery supported by annual stocking. CMP has provided no information on the suitability of this habitat for wild brook trout spawning and rearing. The Dead River flows out of Flagstaff Lake, a large, shallow, warm lake, and as a result the Dead River has summer water temperatures that are high enough that brook trout must seek thermal refuge in cold water tributaries. None of these coldwater tributaries are provided any protection by CMP's

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STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

and
STATE OF MAINE
LAND USE PLANNING COMMISSION

IN THE MATTER OF

CENTRAL MAINE POWER COMPANY Application for Site Location of Development Act permit and Natural Resources Protection Act permit for the New England Clean Energy Connect ("NECEC") L-27625-26- A-N L-27625-TB-B-N L-27625-2C-C-N L-27625-VP-D-N L-27625-IW-E-N SITE LAW CERTIFICATION SLC-9	SUPPLEMENTAL TESTIMONY OF GROUP 4 WITNESS DR. DAVID PUBLICOVER April 26, 2019

This supplemental testimony is offered in response to questions posed in DEP's 10th Procedural Order.

The Department is requesting supplemental testimony as to "*whether any of these techniques* [i.e., undergrounding, tapering, or taller pole structures in areas identified during the hearing as environmentally sensitive or of special concern] *would satisfy concerns raised at the hearing or be a preferred alternative*."

While these techniques have been proposed by the Applicant in a small number of places[1], none have been proposed by the Applicant for any of the environmentally sensitive areas identified during the hearing. Instead, discussion of the potential use of these techniques has

[1] e.g., undergrounding at the Kennebec Gorge, taller structures at Gold Brook and Mountain Brook, and tapered vegetation at Coburn Mountain and Gold Brook.

arisen in the course of intervenor testimony, cross-examination, or questioning by the Department. The information in the record primarily consists of suggestions as to potential expanded use of these techniques that might reduce the environmental impacts of the project. There is no specific information in the record as to where or how these techniques would be used (other than TNC's proposal for burial in specific locations), and limited information or analysis as to their effectiveness.

As a witness for an intervenor group, my responsibility is to evaluate and render an opinion on information in the record within my area of expertise. Because CMP has not amended its application to include these alternative techniques, with the requisite location-specific information, I am not willing to hypothesize on the potential impacts of a not-yet-proposed alternative mitigation strategy or alternative route. If the Applicant amends its application to include alternate techniques I would welcome the opportunity to evaluate and respond to these modifications. In the absence of a site-specific application from CMP, the remainder of my testimony is confined to a general discussion of the likely impacts of the proposed mitigation strategies on fragmentation.

As a general opinion I do not believe that any of the proposed techniques would adequately correct the fatal flaws in the application. Direct burial (trenching) within the proposed corridor (either in short sections or for long distances) is an inadequate solution to the issue of fragmentation, as it would still require the clearing of a new corridor through this undeveloped forest region. Horizontal direct drilling (HDD) would allow short portions of the line to remain forested but would still result in significant disturbance in the areas near the injection point and there would still be extensive sections of aboveground line with the associated corridor. As I testified before, it is not the aboveground line that is the concern but rather the permanently deforested corridor. In addition, the new impacts created by the use of either of these burial techniques would have to be thoroughly described and analyzed in an amended application.

While a narrower corridor is better than a wider one, we maintain that the appropriate technique is burial along existing disturbed corridors (as has been done in other projects), which would eliminate the need for a major new fragmenting corridor. Importantly, it is highly unlikely that a properly designed alternative underground route would be proposed in a remote undeveloped location due to the numerous environmental and logistical challenges identified by both CMP and Group 3 witness Gil Paquette. It should not be surprising that the evaluation of undergrounding along a route not selected with this technique in mind indicates that is not well-suited for this location. This post-hoc rationalization is a poor substitute for properly selecting an appropriate underground route and related technology in the first place.

As for tapering or taller vegetation, they are merely band aids on a very serious wound, and would have limited value for reasons described below.

The value of tapered vegetation. Tapering was proposed as a way to mitigate the scenic impact of the corridor in certain locations, not as mitigation for fragmentation impacts, and it would have limited benefit for the latter purpose. Tapering would maintain a 20-foot wide band of trees that would grow up to 35 feet high along the edge of the corridor.[2] Twenty feet is barely one tree crown wide. In addition, trees capable of exceeding this height between maintenance cycles would be cut every four years. Because trees of this size can easily grow a foot or more per year the actual height of vegetation would have to be less than 35 feet.

Taller vegetation adjacent to the forest edge would have some limited benefit in reducing edge effects by reducing (though not eliminating) the penetration of light and wind into the

[2] Applicant Exhibit 10-2, Post-Construction Vegetation Management Plan (revised 1/30/19).

adjacent forest. However, given the height and density of the tapered vegetation (which would be only about half the height of adjacent mature forest), there would still be a change in the environment in the adjacent forest, and the vegetation would have limited benefit in preventing blowdown along the forest edge.

Tapered vegetation would also have little benefit for maintaining connectivity across the corridor for species requiring mature forest habitat such as marten. The habitat requirements of marten have been thoroughly studied by researchers at the University of Maine (Payer and Harrison 2000, 2003, 2004; Fuller and Harrison 2005). Minimum requirements for marten use are at least 80 ft^2/acre of basal in trees at least 30 feet tall with minimum 30% crown closure in all seasons and structure provided by standing and downed dead wood. These conditions would not be maintained within the area of tapered vegetation, and tapering as described in CMP's application would provide little to no habitat connectivity for marten or other mature forest species.

<u>The value of taller vegetation</u>. Utilizing taller poles has been proposed as a way to maintain taller vegetation in some areas as wildlife travel corridors across the larger corridor. It is difficult to comment on this technique as there is no specific proposal to analyze, just a general potential concept. The value of this technique would depend on specific factors including the height of the vegetation, the width of the wildlife travel corridors, and the species composition of the maintained forest vegetation.

Height. Wildlife travel corridors maintained with full-height mature vegetation (60-70 feet) would be most effective, as it would allow for the presence of larger trees as well as natural mortality and recruitment of woody debris, which would increase the effectiveness of these corridors. Shorter vegetation (30-40 feet) would meet the minimum height and density requirements for marten, but would require the removal of trees taller than this, thus eliminating the presence of larger trees and the recruitment of woody debris. Without these structures the value of taller vegetation as a wildlife travel corridor would be greatly reduced. This approach would be much less effective. Anything shorter than this would have very little benefit.

Width. Wildlife corridors of only a few hundred feet wide (such as the proposed riparian buffers) would consist entirely of edge habitat and would have limited effectiveness for species requiring interior forest. Edge effects can extend several hundred feet into forest adjacent to edges (300 feet is often used as a standard estimate of edge effects), thus corridors would need to be a minimum of 600-1000 feet wide to provide some interior forest in the middle. The proposed riparian buffers are all narrower than this so would provide little benefit as travel corridors for species requiring interior forest

Species composition. Published habitat requirements for marten specify at least 30% crown closure in all seasons, which in winter would be provided by softwood species. Corridors consisting of dominantly deciduous vegetation would not meet the minimum requirements for marten in winter.

In addition, it is not clear whether the taller vegetation would be maintained during construction. It is likely that a corridor of some width would need to be cleared to allow access for construction, thus the full value of taller vegetation (which would need to regrow following clearing) would not be realized for many decades.

Finally, there is a serious additional consideration with utilizing taller vegetation as a mitigation technique. In the current proposal the 100' towers extend 90' above the 10' high vegetation that would be maintained in the wire zone. Maintaining taller vegetation would require towers of 120-150' high – about twice the height of the surrounding forest vegetation.

This would significantly increase the visibility of the towers and require an amendment to the Visual Impact Analysis. Allowing this technique to be implemented without an amended VIA and full opportunity for parties to assess this increased visual impact should not be considered.

To summarize, in my opinion none of the proposed techniques (undergrounding, tapering or taller vegetation) would adequately address the fragmenting impacts of the project. They are inadequate fixes proposed to salvage a project that was improperly located in the first place, and are a poor substitute for burying the project along existing and already disturbed corridors.

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Payer, D. and D.J. Harrison. 2003. Influence of forest structure on habitat use by American marten in an industrial forest. Forest Ecology and Management 179:145-156.

Payer, D. and D.J. Harrison. 2004. Relationships between Forest Structure and Habitat Use by American Martens in Maine, USA. Pp. 173-186 in: Harrison, D.J., A.K. Fuller and G. Proulx (eds), Martens and Fishers (*Martes*) in Human-Altered Environments. Springer, Boston, MA.

Notarization

I, _David Publicover_, being first duly sworn, affirm that the above testimony is true and accurate to the best of my knowledge.

Date: 4/26/19

David Publicover
Senior Staff Scientist

The above-named _David Publicover_ made affirmation that the above testimony is true and accurate to the best of his knowledge.

Date: 4/26/19

Notary
Catherine B. Johnson
Attorney-at-law

STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

and
STATE OF MAINE
LAND USE PLANNING COMMISSION

IN THE MATTER OF

CENTRAL MAINE POWER COMPANY Application for Site Location of Development Act permit and Natural Resources Protection Act permit for the New England Clean Energy Connect ("NECEC") L-27625-26- A-N L-27625-TB-B-N L-27625-2C-C-N L-27625-VP-D-N L-27625-IW-E-N SITE LAW CERTIFICATION SLC-9	SUPPLEMENTAL TESTIMONY OF GROUP 4 WITNESS JEFF REARDON April 30, 2019

This supplemental testimony is offered in response to questions posed in DEP's 10th Procedural Order. The Department has requested supplemental testimony on the following topics:

> *Whether undergrounding, tapering, or taller pole structures in areas identified during the hearing as environmentally sensitive or of special concern (for example, The Nature Conservancy's nine identified areas, Trout Unlimited's mention of Tomhegan Stream, and other specific wildlife corridors identified by parties) are technically feasible and economically viable minimization or mitigation measures. Also, whether any of these techniques would satisfy concerns raised at the hearing or be a preferred alternative. Information and*

> *evidence on these environmentally sensitive or special concern areas must include specific locations, such as GPS coordinates, latitude/longitude, or locations between existing pole structures to allow all parties and the Department to pinpoint the locations.*

The Department goes on to request that "The applicant and the parties should be prepared to discuss the following more specific topics at the May 9 hearing, and identifies 12 questions regarding construction details, five questions regarding environmental issues, seven questions regarding costs, and two questions about routing. The volume of this request by itself indicates that the application was insufficient to answer these questions.

My testimony is limited to those issues identified in the 10th Procedural Order where we have been asked to provide evidence on the NECEC proposal as described in the Application, and on whether some modifications identified in the 10th Procedural Order would minimize or mitigate the impacts of the NECEC on coldwater fisheries resources and riparian buffers. This encompasses the following specific requests in the 10th Procedural Order:

1. Specific locations, such as GPS coordinates, latitude/longitude, or locations between existing pole structures to allow all parties and the Department to pinpoint the locations where undergrounding, tapering or taller pole structures would be beneficial.[1]
2. Whether undergrounding, tapering, or taller pole structures in areas identified during the hearing as environmentally sensitive or of special concern (for example, The Nature Conservancy's nine identified areas, Trout Unlimited's mention of Tomhegan Stream, and other specific wildlife corridors identified by parties) are technically feasible and economically viable minimization or mitigation measures.[2]

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[1] 10th Procedural Order, Page 1.
[2] 10th Procedural Order, Page 1.

3. Whether tapering within the 100-foot buffers around streams would provide adequate large woody vegetation for streams in segment 1 which are typically less than 10 feet wide.

Specific Locations Where Undergrounding, Tapering, or Taller Pole Structures Would Minimize Impacts on Brook Trout Habitat. As discussed in more detail below, I do not have enough information to assess any potential benefits of undergrounding, and I do not believe that tapering will provide much benefit to brook trout or replace the buffer functions provided by an intact canopy of trees. My response here therefore identifies those places where I believe taller pole structures, which would maintain an intact canopy, would have benefits for brook trout and other coldwater fish. In my prefiled testimony and Exhibits, I identified four sets of crossings—typically a crossing of a perennial stream and several associated intermittent streams—where I believed there was both a high level of impact due to multiple crossings in a small area, and, based on my knowledge of these resources, particularly high value habitat for brook trout. The sites I identified were:

- *In Skinner TWP, the route includes 18 separate crossings (3 on permanent streams, 12 on intermittent streams, and 3 on ephemeral streams) that impact the West Branch and South Branch of the Moose River near their confluence just east of Moose Mountain. The combination of multiple crossings, each of which will be maintained without a closed canopy cover, in a relatively small area risks cumulative impacts on the headwaters of one of Maine's most remote wilderness trout rivers. (Exhibit 3A)*
- *On Piel Brook near the four corners of Bradstreet, Parlin Pond, Upper Enchanted and Johnson Mountain TWPs, a total of 10 crossings (3 on permanent streams, 5 on intermittent streams, and 2 on ephemeral streams) impact the headwaters. (Exhibit 3B)*

- *The Cold Stream crossing in Johnson Mountain TWP is an especially important site for brook trout. (See additional discussion about the special value of Cold Stream for brook trout below.) It's also a particularly impactful crossing. In this case, the issue is not so much the number of crossings in close proximity to each other within a single watershed, but the fact that in addition to a crossing of Cold Stream, the NECEC ROW parallels two small perennial tributaries that have their confluence essentially at the NECEC crossing of Cold Stream. This results in an extended reach—about 1400 feet of stream—that closely parallels the cleared ROW. These impacts are increased because the NECEC ROW abuts an existing cleared ROW at the Capital Road. The ROW also has direct impacts on BPL's Cold Stream Forest Unit, which abuts the ROW to both the north and south. Lack of shade and warming are likely exacerbated by this long parallel impact of road and utility ROW. (Exhibit 3C)*
- *The Tomhegan Stream crossing in West Forks Plantation is another example where there are multiple crossings of permanent streams, all of which are either tributaries to or braided channels of Tomhegan Stream, in a very short section. In this case, there are 9 crossings—8 of permanent streams and 1 of an intermittent stream—within about 1200 feet. Like Cold Stream, Tomhegan Stream and its importance to brook trout conservation is discussed in more detail below. (Exhibit 3D)* [3]

Group 4 Exhibit 3-JR, attached to my pre-filed testimony, identifies the specific crossings involved. Considering impacts on fish habitat <u>only</u>, I continue to believe these are particularly problematic crossings, but they were intended only as examples of areas where an alternative

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[3] Reardon Prefiled Testimony, Page 10-12. Exhibits 3A, 3B, 3C and 3D are on pages 33-42, labeled collectively as "Group 4 Exhibit 3-JR".

that would leave an intact forest canopy should have been considered but was not. I did not intend to provide a comprehensive list of all such crossings.

If a comprehensive list of crossings where intact canopy would be important were to be developed, I'd suggest that the initial screening to select them would begin with the Maine Department of Inland Fisheries and Wildlife's comments and edited Waterbody Crossing Tables, provided to the DEP as a series of emails in January. On January 22, 2019, MDIFW's Bob Stratton sent a message to DEP's Jim Beyer stating that: *"Region E Fisheries indicates, "I'm quite certain that all the perennial streams in Region E contain wild BKT. All those brooks in Beattie, Appleton, Johnson Mtn, and Bradstreet Twps. are full of BKT. I'm not sure about the intermittent streams, but anything connected to the Moose River, Gold Bk, Barrett Bk, Cold Stream, Baker Bk, Tomhegan Stream, Bog Bk, Smart Bk, Number One Bk, Mill Bk, and Piel Bk would have potential. I really think we are safe ground by assuming all the Region E streams (all headwaters) have BKT."*[4]

Bob Stratton also forwarded updated Water Body Crossing Tables indicating which streams should be considered as "Likely Brook Trout Habitat."[5] For Segment 1 of the NECEC Corridor, the "greenfield" section, this would include 232 brook trout habitat crossings; 45 brook trout habitat crossings for Segment 2; 71 crossings for Segment 3; 2 brook trout habitat crossings for Segment 4; and 19 brook trout habitat crossings for Segment 5. Those identified crossings could then be screened based on available data to determine which would be the highest priorities to maintain intact riparian buffers.[6]

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[4] Email from Bob Stratton, ME DIFW, to Jim Beyer, ME DEP, dated January 22, 2019. Attached as Attachment 1 to this testimony.

[5] These were attachments to two emails sent by Bob Stratton, ME DIFW, to Jim Beyer, ME DEP, on January 24, 2019. They are attached as Attachment 2 to this testimony.

[6] The crossings of Gold Stream and Mountain Brook do have full canopy buffers, provided by taller poles, to protect other resources.

Whether undergrounding, tapering, or taller pole structures in areas identified during the hearing as environmentally sensitive or of special concern (for example, The Nature Conservancy's nine identified areas, Trout Unlimited's mention of Tomhegan Stream, and other specific wildlife corridors identified by parties) are technically feasible and economically viable minimization or mitigation measures.

Based on the fact that they have been proposed for several sites to avoid impacts to Roaring Brook Mayfly and Northern Spotted Salamander, taller pole structures are clearly feasible and would reduce impacts on stream habitat by maintaining intact canopy cover. This would have substantial benefits for brook trout and other aquatic life in the affected streams. However, these measures might have unacceptable visual or other impacts that would need to be assessed. Visual impacts might be reduced if taller structures were located adjacent to stream crossings because the structures would installed adjacent to streams and therefore be screened by higher topography on either side of the stream. Careful location of structures could maximize this. Additional analysis of visual impacts at these sites would be required.

I have no way to assess to the potential environmental benefits and impacts of undergrounding. The details would matter. I would have substantial concerns about the impacts on stream habitat of trenching at or near the stream crossings, particularly on the proposed greenfield ROW. Directionally-drilled stream crossings, especially if they allowed full canopy vegetation on both stream crossings as the proposed Kennebec River crossing does, could have little or no impact on streams. But if an underground line required a 75-foot-width cleared corridor, the impacts of the cleared corridor would be similar to what is currently proposed, although with less linear impact on each affected stream. Undergrounding along an existing corridor—for example, the Spencer Road or Route 201—could substantially reduce the impacts of a new cleared corridor.

I do not believe that tapering, as proposed in CMP's Exhibit 10-2, would have much benefit for streams. With respect to clearing and shading, there would be a bit more shade provided at the edges of the corridor by vegetation allowed to grow to 35 feet rather than 15-25 feet. But this would only occur at the two edges of the 150' wide corridor; the trees would be cut and removed as soon as they reached 35 feet in height; and in any case most of the corridor would be maintained as currently proposed with vegetation of 5-10' height in the wire zone and 15-25' in the rest of the corridor. Large woody debris inputs are discussed below.

Whether tapering within the 100-foot buffers around streams would provide adequate large woody vegetation for streams in segment 1 which are typically less than 10 feet wide.

I do not believe tapering would provide much additional large woody vegetation recruitment to streams. First, the 35' high vegetation would likely not grow large enough to provide the most important functions of large wood in streams. Trees that reached this height would be cut and removed every four years, limiting the maximum height and—more importantly—the maximum diameter of the trees that would grow in the tapered section. The Maine Forest Services Chapter 25 Standards for Placing Wood Into Stream Channels to Enhance Cold Water Fisheries Habitat[7] calls for "key pieces" of wood to be a minimum diameter of 10" on streams of 0-10' bankfull width. For slightly larger streams of 10-20' bankfull width, the minimum diameter of key pieces would be 16". Even for the smallest channels, the Chapter 25 standards require that 40-60% of

[7] Maine Forest Service (MFS) Rule Chapter 25 Standards for Placing Wood Into Stream Channels to Enhance Cold Water Fisheries Habitat Effective Date: December 25, 2012. Available at: https://www.maine.gov/dacf/mfs/publications/rules_and_regs/chap_25_rules.pdf

the added wood—key pieces and other pieces—have diameters larger than 12", which would be even rarer.

Very few of the fast-growing trees that can be expected to colonize the continuously disturbed habitat at the edge of the cleared corridor would reach these diameters. For example, at study sites in central Indiana, Kershaw et al. found that white oaks of 10 meters (32.8 feet) in height had diameters ranging from about 5-15 cm (1.9 to 5.9 inches). Aspen were slightly smaller.[8] Because trees will be cut, rather allowed to grow and be recruited into the stream by windthrow, ice storms, and other natural processes, even if the cut trees are left in the riparian zone, they will not have attached root wads, reducing the likelihood they will remain in place in stream channels. Finally, because trees will only be allowed to grow to 35' in height at the two edges of the corridor, the amount of wood available to be recruited, even if these trees do grow to sufficient sizes, will be very small. The 20 feet of tapered taller vegetation is essentially one tree width at each edge of the 150' corridor. Even if 100% of these trees grew to 10" or more in diameter, and even if they all get recruited into the stream, the maximum recruitment of wood from the 150' wide corridor would be very limited.

Similarly, the presence of a few streamside trees of 35' in height will provide little additional shade, bank stabilization, leaf litter and insect fall inputs or other important buffer functions. At best the tapering, will result in a slight improvement at the two edges, with slightly taller trees casting slightly more shade and supporting slightly larger canopies to provide organic inputs.

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[8] Kershaw, John A Jr, Robert C. Morrisey, Douglass F. Jacobs, John R. Seifer and James B. McCarter, undated. DOMINANT HEIGHT-BASED HEIGHT-DIAMETER EQUATIONS FOR TREES IN SOUTHERN INDIANA. Proceedings of the 16th Central Hardwoods Forest Conference. See Figure 1. Accessed at: https://www.nrs.fs.fed.us/pubs/gtr/gtr-p-24%20papers/39kershaw-p-24.pdf

Notarization

I, Jeffrey Reardon, being first duly sworn, affirm that the above testimony is true and accurate to the best of my knowledge.

______________________________ 5/01/2019
Name Date

Maine Brook Trout Project Director

Title

Personally appeared the above-named Jeffrey Reardon and made affirmation that the above testimony is true and accurate to the best of his knowledge.

Date: 5-01-2019 Notary: Debora Southiere

DEBORA SOUTHIERE
NOTARY PUBLIC
KENNEBEC COUNTY
MAINE
MY COMMISSION EXPIRES APRIL 2, 2022

Attachments

1. Email from Bob Stratton, ME DIFW, to Jim Beyer, ME DEP, dated January 22, 2019
2. Water Body Crossing Table, ME DIFW Mark Up

Group 4
Exhibit 22-JR

Beyer, Jim R

From: Stratton, Robert D
Sent: Tuesday, January 22, 2019 4:23 PM
To: Beyer, Jim R
Cc: Connolly, James; Overlock, Joe; Perry, John
Subject: Region E brook trout streams

Jim,

Region E Fisheries indicates, "I'm quite certain that all the perennial streams in Region E contain wild BKT. All those brooks in Beattie, Appleton, Johnson Mtn, and Bradstreet Twps are full of BKT. I'm not sure about the intermittent streams, but anything connected to the Moose River, Gold Bk, Barrett Bk, Cold Stream, Baker Bk, Tomhegan Stream, Bog Bk, Smart Bk, Number One Bk, Mill Bk, and Piel Bk would have potential. I really think we are safe ground by assuming all the Region E streams (all headwaters) have BKT. South of The Forks might be a different story..."

By my review of CMP's table, this adds brook trout information for 154 streams, forty-six of them are perennial streams within the "greenfield" section which would not be affected by increased buffer impact calculations. The remaining 108 streams would be affected however.

Thank you,

Bob Stratton
Environmental Program Manager
Fisheries and Wildlife Program Support Section Supervisor
Maine Department of Inland Fisheries & Wildlife
284 State Street; 41 State House Station
Augusta, Maine 04333-0041
Tel: (207) 287-5659; Cell: (207) 592-5446
mefishwildlife.com

Group 4
Exhibit 23-JR

Footnotes for the NECEC Waterbody Crossing Table (Exhibit 7-7)

General Notes: The waterbody crossing table is based on data collected in the field, input from agency representatives during consultation, USGS National Hydrography dataset and ESRI ArcGIS mapping services.

1. Stream names are based on the USGS National Hydrography dataset. Tributary names were assigned based on review of watershed areas and drainage patterns.
2. Waterbody crossings widths were based on field data collected in 2015, 2016 and 2017.
3. Stream types: Perennial (PER) or Intermittent (INT). Open Water (Open Water). Stream types were based on field data collected in 2015, 2016 and 2017.
4. State of Maine Water Quality Classifications
   Source: The Bureaus of Land Resources and Water Quality- Waterbody Statutory Classification dataset
   http://www.maine.gov/dep/gis/datamaps/

Class

AA Class AA shall be the highest classification and shall be applied to waters which are outstanding natural resources and which should be preserved because of their ecological, social, scenic, or recreational importance. Class AA waters shall be of such quality that they are suitable for the designated uses of drinking water after disinfection, fishing, recreation in and on the water and navigation and as habitat for fish and other aquatic life. The habitat shall be characterized as free flowing and natural.

A Class A waters shall be of such quality that they are suitable for the designated uses of drinking water after disinfection; fishing; recreation in or on the water; industrial power generation, except as prohibited under Title 12, section 403; and navigation; and as habitat for fish and other aquatic life. The habitat shall be characterized as natural.

B Class B waters shall be of such quality that they are suitable for the designated uses of drinking water supply after treatment; fishing; recreation in and on the water; industrial processes and cooling water supply; 403; and navigation; and as habitat for fish and other aquatic life. The habitat shall be characterized as unimpaired.

C Class C waters shall be of such quality that they are suitable for the designated uses of drinking water supply after treatment; fishing; recreation in and on the water; industrial process and cooling water supply; hydroelectric power generation, except as prohibited under Title 12, section 403; and navigation; and as a habitat for fish and other aquatic life.

GPA Class GPA shall be the sole classification of great ponds and natural ponds and lakes less than 10 acres in size. Class GPA waters shall be of such quality that they are suitable for the designated uses of drinking water after disinfection, recreation in and on the water, fishing, industrial process and cooling water supply, hydroelectric power generation and navigation, and as habitat for fish and other aquatic life. The habitat shall be characterized as natural.

Revisions to brook trout presence based on MDIFW regional fisheries staff input 1/22/19

N/A or "Not Available" indicates that a classification for this waterbody was not available from the referenced source.

5. Source: Cushing, E. Atlantic Salmon: Critical Habitat dataset. 1994. National Oceanic Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS). http://www.nmfs.noaa.gov/gis/data/critical.htm#ne. Accessed May 16, 2017.
   a. This dataset represents critical habitat for the Gulf of Maine distinct population segment of Atlantic salmon as designated by *Federal Register* Vol. 74, page 29300, June 19, 2009.
6. Source: Bruchs, C. Atlantic salmon habitat. GISVIEW.MEGIS.Ashab3_new. 2016. Maine Office of GIS Data Catalog. Edition 2016-03-31. http://www.maine.gov/megis/catalog/. Accessed May 16, 2017.
   a. This dataset is meant to be used in tracking general Atlantic salmon habitat survey work on selected Maine streams by staff of the Maine Dept. of Marine Resources - Division of Sea Run Fisheries and Habitat as well as others involved in Atlantic Salmon research, management and conservation. This dataset is designed to be used in a variety of management and planning activities including habitat protection efforts.
7. The Brook Trout classifications were provided as a GIS shapefile by MDIFW. "Y" or "YES" = "Likely Brook Trout Habitat" which identifies waterbodies which have been surveyed and mapped by the MDIFW. "N/A" or "Not Available" identifies waterbodies that have not been surveyed or mapped by the resource agency.
8. The width of the additional corridor clearing required is the average width of tree clearing required for that associated Segment.
9. Where temporary equipment crossings are proposed, no in-stream work will take place. The bridges will be designed to span the entire width to avoid in-stream work.

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
1	Beattie Twp	E	ISTR-01-02	Trib. to West Branch Mill Brook	2	INT	N/A	N	N	~~N/A~~ Y	439	150	Y	3
1	Skinner Twp	E	ISTR-08-01	Trib. to West Branch Moose River	4	INT	A	N	N	~~N/A~~ Y	382	150	Y	20, 21
1	Appleton Twp	E	WB-16-101	Water body assoc. with trib. to Gold Brook	30	Open Water	N/A	N	N	~~N/A~~ Y	131	150	N	37
1	Bradstreet Twp	E	ISTR-24-01	Trib. to Bitter Brook	2	INT	A	N	N	N/A	435	150	Y	56
1	Johnson Mountain Twp	E	ISTR-39-01	Trib. to Cold Stream	4	INT	N/A	Y	N	~~N/A~~ Y	220	150	N	89
1	Johnson Mountain Twp	E	ISTR-39-03	Trib. to East Branch Salmon Stream	4	INT	N/A	Y	N	N/A	274	150	N	88
1	Johnson Mountain Twp	E	ISTR-42-09	Trib. to Tomhegan Stream	5	INT	N/A	Y	N	~~N/A~~ Y	133	150	N	94
1	West Forks Plt	D	ISTR-45-02-02	Trib. to Tomhegan Stream	3	INT	N/A	Y	N	~~N/A~~	317	150	N	100
1	West Forks Plt	D	ISTR-46-05	Trib. to Cold Stream	4	INT	N/A	Y	N	~~N/A~~	43	150	N	103
1	West Forks Plt	D	ISTR-48-02	Trib. To Kennebec River	3	INT	N/A	Y	N	N/A	89	150	N	108, 109
1	Moxie Gore	D	ISTR-49-01	Trib. to Moxie Stream	5	INT	N/A	Y	N	~~N/A~~ Y	375	150	N	111
1	Moxie Gore	D	ISTR-51-07	Trib. to Moxie Stream	2	INT	N/A	Y	N	N/A	269	150	N	114
1	Moxie Gore	D	ISTR-51-15	Trib. to Moxie Stream	1.5	INT	N/A	Y	N	N/A	353	150	N	115

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
1	Moxie Gore	D	ISTR-51-16	Trib. to Moxie Stream	3	INT	N/A	Y	N	N/A	320	150	N	115
1	The Forks Plt	D	ISTR-52-07	Trib. to Moxie Stream	3	INT	N/A	Y	N	N/A	394	150	N	116
1	Moxie Gore/The Forks Plt	D	ISTR-52-08	Trib. to Moxie Stream	1	INT	N/A	Y	N	N/A	227	150	N	116
1	The Forks Plt	D	ISTR-52-12	Trib. to Moxie Stream	2	INT	N/A	Y	N	N/A	258	150	N	116, 117
1	Appleton Twp	E	ISTR-RR-11-01	Trib. to Bog Brook	5	INT	A	N	N	~~N/A~~ Y	517	150	N	27
1	Appleton Twp/Skinner Twp	E	ISTR-RR-11-3-RR1	Trib. to Bog Brook	3	INT	N/A	N	N	~~N/A~~ Y	328	150	N	27
1	Appleton Twp/Skinner Twp	E	ISTR-RR1-1	Trib. to Bog Brook	5	INT	N/A	N	N	~~N/A~~ Y	348	150	N	27
1	Appleton Twp	E	ISTR-RR1-2	Trib. to Bog Brook	2	INT	N/A	N	N	~~N/A~~ Y	230	150	N	27
1	Beattie Twp	E	PSTR-00-10	Trib. to West Branch Mill Brook	3	PER	A	N	N	~~N/A~~ Y	21	150	N	3
1	Skinner Twp	E	PSTR-09-11	South Branch Moose River	46	PER	A	N	N	~~N/A~~ Y	524	150	N	21
1	Appleton Twp	E	PSTR-11-07-RR1	Trib. to Bog Brook	6	PER	A	N	N	~~N/A~~ Y	378	150	N	27
1	Appleton Twp	E	PSTR-11-08-RR1	Trib. to Bog Brook	4	PER	A	N	N	~~N/A~~ Y	353	150	N	27
1	Appleton Twp	E	PSTR-15-06	Gold Brook	25	PER	A	Y	N	Y	187	150	N	36
1	Appleton Twp	E	PSTR-17R-03	Baker Stream	12	PER	A	Y	N	Y	159	150	N	39
1	T5 R7 BKP WKR	E	PSTR-23-02	Whipple Brook	60	PER	A	Y	N	Y	128	150	N	52
1	Bradstreet Twp	E	PSTR-24-03	Bitter Brook	45	PER	A	N	N	~~N/A~~ Y	462	150	N	55

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
1	Johnson Mountain Twp	E	PSTR-39-02	Trib. to Cold Stream	2	PER	N/A	Y	N	Y	128	150	N	88, 89
1	Appleton Twp	E	PSTR-RR1-3	Trib. to Bog Brook	4	PER	A	N	N	~~N/A~~ Y	389	150	Y	27
1	West Forks Plt/Moxie Gore	D	PSTR-48-03	Kennebec River	300	PER	AA	Y	N	Y	399	150	N	109
1	Moxie Gore	D	STRM-50-01	Moxie Stream	80	PER	AA	Y	N	Y	401	150	N	113
1	Moxie Gore	D	ISTR-50-02	Trib. to Moxie Stream	1.5	INT	N/A	Y	N	Y	37	150	N	113
1	Moxie Gore	D	ISTR-51-01	Trib. to Moxie Stream	80	INT	N/A	Y	N	Y	331	150	N	113
1	Moxie Gore	D	ISTR-51-02	Trib. to Moxie Stream	5	INT	N/A	Y	N	Y	279	150	N	113
1	Moxie Gore	D	ISTR-51-03	Trib. to Moxie Stream	4	INT	N/A	Y	N	Y	292	150	N	113
1	Moxie Gore	D	ISTR-51-04	Trib. to Moxie Stream	2	INT	N/A	Y	N	Y	325	150	N	113
1	Moxie Gore	D	ISTR-51-05	Trib. to Moxie Stream	8	INT	N/A	Y	N	Y	361	150	N	113
1	Moxie Gore	D	ISTR-51-06	Trib. to Moxie Stream	3	INT	N/A	Y	N	Y	383	150	N	113, 114
1	Moxie Gore	D	ISTR-51-08	Trib. to Moxie Stream	1.5	INT	N/A	Y	N	Y	244	150	N	114, 115
1	Moxie Gore	D	ISTR-51-09	Trib. to Moxie Stream	3	INT	N/A	Y	N	Y	267	150	N	114, 115
1	Moxie Gore	D	ISTR-51-10	Trib. to Moxie Stream	6	INT	N/A	Y	N	Y	312	150	N	114, 115

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
1	Moxie Gore	D	ISTR-51-11	Trib. to Moxie Stream	4	INT	N/A	Y	N	Y	307	150	N	114, 115
1	Moxie Gore	D	ISTR-51-12	Trib. to Moxie Stream	3	INT	N/A	Y	N	Y	522	150	N	114, 115
1	Moxie Gore	D	ISTR-51-13	Trib. to Moxie Stream	6	INT	N/A	Y	N	Y	333	150	N	115
1	Moxie Gore	D	ISTR-51-14	Trib. to Moxie Stream	5	INT	N/A	Y	N	Y	3	150	N	115
1	Moxie Gore	D	ISTR-51-17	Trib. to Moxie Stream	2	INT	N/A	Y	N	Y	235	150	N	115
1	Moxie Gore	D	ISTR-51-18	Trib. to Moxie Stream	2	INT	N/A	Y	N	Y	226	150	N	115
1	Moxie Gore	D	ISTR-51-19	Trib. to Moxie Stream	2	INT	N/A	Y	N	Y	251	150	N	115
1	Moxie Gore	D	ISTR-51-20	Trib. to Moxie Stream	1.5	INT	N/A	Y	N	Y	215	150	N	115
1	Moxie Gore	D	ISTR-51-21	Trib. to Moxie Stream	3	INT	N/A	Y	N	Y	416	150	N	115
1	Moxie Gore	D	ISTR-52-01	Trib. to Moxie Stream	5	INT	N/A	Y	N	Y	337	150	N	115, 116
1	Moxie Gore	D	ISTR-52-02	Trib. to Moxie Stream	3	INT	N/A	Y	N	Y	317	150	N	115, 116
1	Moxie Gore	D	ISTR-52-03	Trib. to Moxie Stream	3	INT	N/A	Y	N	Y	295	150	N	115, 116
1	Moxie Gore	D	ISTR-52-04	Trib. to Moxie Stream	5	INT	N/A	Y	N	Y	304	150	N	116
1	Moxie Gore	D	ISTR-52-05	Trib. to Moxie Stream	5	INT	N/A	Y	N	Y	299	150	N	116

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
1	Moxie Gore	D	ISTR-52-06	Trib. to Moxie Stream	2	INT	N/A	Y	N	Y	379	150	N	116
1	The Forks Plt	D	ISTR-52-09	Trib. to Moxie Stream	2	INT	N/A	Y	N	Y	192	150	N	116
1	The Forks Plt	D	ISTR-52-10	Trib. to Moxie Stream	3	INT	N/A	Y	N	Y	62	150	N	116, 117
1	The Forks Plt	D	ISTR-52-11	Trib. to Moxie Stream	4	INT	N/A	Y	N	Y	195	150	N	116, 117
1	The Forks Plt	D	ISTR-52-13	Trib. to Moxie Stream	8	INT	N/A	Y	N	Y	518	150	N	117
1	The Forks Plt	D	ISTR-52-14	Trib. to Moxie Stream	6	INT	N/A	Y	N	Y	419	150	N	117
1	The Forks Plt	D	ISTR-52-15	Trib. to Moxie Stream	5	INT	N/A	Y	N	Y	486	150	N	117
1	The Forks Plt	D	ISTR-52-16	Trib. to Moxie Stream	2	INT	N/A	Y	N	Y	288	150	N	117
1	The Forks Plt	D	ISTR-52-17	Trib. to Moxie Stream	2	INT	N/A	Y	N	Y	399	150	N	117
1	Beattie Twp	E	ISTR-00-07	Trib. to West Branch Mill Brook	1	INT	N/A	N	N	~~N/A~~ Y	408	150	N	1
1	Beattie Twp	E	ISTR-01-11	Trib. to Mill Brook	1	INT	N/A	N	N	~~N/A~~ Y	644	150	N	5
1	Skinner Twp	E	ISTR-05-05	Trib. to Smart Brook	1	INT	N/A	N	N	~~N/A~~ Y	103	150	N	13
1	Skinner Twp	E	ISTR-10-04	Trib. to Bog Brook	1	INT	N/A	N	N	~~N/A~~ Y	108	150	N	25
1	Appleton Twp	E	ISTR-12-02	Trib. to Bog Brook	1	INT	N/A	N	N	~~N/A~~ Y	510	150	N	29
1	Appleton Twp	E	ISTR-12-12	Trib. to Bog Brook	1	INT	N/A	N	N	~~N/A~~ Y	348	150	N	30

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
1	Appleton Twp	E	ISTR-14-11	Trib. to Gold Brook	1	INT	N/A	N	N	~~N/A~~ Y	293	150	N	34
1	Johnson Mountain Twp	E	ISTR-41-02	Trib. to Tomhegan Stream	1	INT	N/A	Y	N	~~N/A~~ Y	484	150	Y	94
1	Johnson Mountain Twp	E	ISTR-41-04	Trib. to Cold Stream	2	PER	N/A	Y	N	Y	342	150	N	92, 93
1	Beattie Twp	E	ISTR-01-12	Trib. to Mill Brook	1.5	INT	N/A	N	N	~~N/A~~ Y	668	150	N	5
1	Beattie Twp	E	ISTR-02-09	Trib. to Number One Brook	1.5	INT	N/A	N	N	~~N/A~~ Y	464	150	N	7
1	Skinner Twp	E	ISTR-05-09	Trib. to Smart Brook	1.5	INT	N/A	N	N	~~N/A~~ Y	99	150	N	12
1	Skinner Twp	E	ISTR-06-04	Trib. to Smart Brook	1.5	INT	N/A	N	N	~~N/A~~ Y	52	150	N	16
1	Appleton Twp	E	ISTR-12-09	Trib. to Bog Brook	1.5	INT	N/A	N	N	~~N/A~~ Y	368	150	N	28
1	Appleton Twp	E	ISTR-12-11	Trib. to Bog Brook	1.5	INT	N/A	N	N	~~N/A~~ Y	321	150	N	30
1	Appleton Twp	E	ISTR-14-37	Trib. to Barrett Brook	1.5	INT	N/A	N	N	~~N/A~~ Y	416	150	N	33
1	Johnson Mountain Twp	E	ISTR-33-02	Trib. to MountainBrook	1.5	INT	N/A	Y	N	N/A	214	150	N	76
1	Johnson Mountain Twp	E	ISTR-36-05	Trib. to Salmon Stream	1.5	INT	N/A	Y	N	N/A	393	150	N	83
1	Johnson Mountain Twp	E	ISTR-38-11	Trib. to East Branch Salmon Stream	1.5	INT	A	Y	N	N/A	144	150	N	85, 86
1	Johnson Mountain Twp	E	ISTR-38-13	Trib. to East Branch Salmon Stream	1.5	INT	N/A	Y	N	N/A	206	150	N	85, 86
1	Johnson Mountain Twp	E	ISTR-38-14	Trib. to East Branch Salmon Stream	1.5	INT	A	Y	N	N/A	82	150	N	85, 86

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
1	Beattie Twp	E	ISTR-02-13	Trib. to Number One Brook	2	INT	N/A	N	N	~~N/A~~ y	115	150	N	7
1	Skinner Twp	E	ISTR-05-03	Trib. to Smart Brook	2	INT	N/A	N	N	~~N/A~~ y	40	150	Y	13
1	Skinner Twp	E	ISTR-05-04	Trib. to Smart Brook	2	INT	N/A	N	N	~~N/A~~ y	58	150	N	13
1	Skinner Twp	E	ISTR-05-10	Trib. to Smart Brook	2	INT	N/A	N	N	~~N/A~~ y	336	150	N	12
1	Skinner Twp	E	ISTR-06-01	Trib. to Smart Brook	2	INT	A	N	N	~~N/A~~ y	331	150	N	16
1	Skinner Twp	E	ISTR-06-02	Trib. to Smart Brook	2	INT	N/A	N	N	~~N/A~~ y	361	150	N	16
1	Skinner Twp	E	ISTR-06-03	Trib. to Smart Brook	2	INT	A	N	N	~~N/A~~ y	249	150	N	16
1	Skinner Twp	E	ISTR-06-07	Trib. to Smart Brook	2	INT	N/A	N	N	~~N/A~~ y	277	150	Y	15, 16
1	Skinner Twp	E	ISTR-07-03	Trib. to West Branch Moose River	2	INT	A	N	N	~~N/A~~ y	133	150	N	18
1	Skinner Twp	E	ISTR-07-04	Trib. to West Branch Moose River	2	INT	N/A	N	N	~~N/A~~ y	365	150	N	18
1	Skinner Twp	E	ISTR-07-08	Trib. to Hay Bog Brook	2	INT	N/A	N	N	N/A	169	150	N	17
1	Skinner Twp	E	ISTR-09-03	Trib. to South Branch Moose River	2	INT	N/A	N	N	~~N/A~~ y	549	150	N	22
1	Skinner Twp	E	ISTR-09-04	Trib. to South Branch Moose River	2	INT	A	N	N	~~N/A~~ y	267	150	N	22

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
1	Skinner Twp	E	ISTR-09-07	Trib. to South Branch Moose River	2	INT	N/A	N	N	~~N/A~~ Y	271	150	N	22, 23
1	Skinner Twp	E	ISTR-09-08	Trib. to South Branch Moose River	2	INT	N/A	N	N	~~N/A~~ Y	235	150	N	23
1	Skinner Twp	E	ISTR-09-09	Trib. to South Branch Moose River	2	INT	N/A	N	N	~~N/A~~ Y	183	150	N	22
1	Skinner Twp	E	ISTR-10-09	Trib. to Bog Brook	2	INT	N/A	N	N	~~N/A~~ Y	60	150	N	25
1	Appleton Twp	E	ISTR-12-01	Trib. to Bog Brook	2	INT	N/A	N	N	~~N/A~~ Y	451	150	N	29
1	Appleton Twp	E	ISTR-12-05	Trib. to Bog Brook	2	INT	N/A	N	N	~~N/A~~ Y	380	150	N	29, 30
1	Appleton Twp	E	ISTR-13-01	Trib. to Barrett Brook	2	INT	N/A	N	N	~~N/A~~ Y	166	150	N	32
1	Appleton Twp	E	ISTR-13-02	Trib. to Barrett Brook	2	INT	N/A	N	N	~~N/A~~ Y	149	150	N	32
1	Appleton Twp	E	ISTR-13-08	Trib. to Barrett Brook	2	INT	N/A	N	N	~~N/A~~ Y	485	150	N	31
1	Appleton Twp	E	ISTR-13-10	Trib. to Barrett Brook	2	INT	N/A	N	N	~~N/A~~ Y	90	150	N	31
1	Appleton Twp	E	ISTR-13-15	Trib. to Bog Brook	2	INT	N/A	N	N	~~N/A~~ Y	242	150	Y	30, 31
1	Appleton Twp	E	ISTR-13-16	Trib. to Bog Brook	2	INT	N/A	N	N	~~N/A~~ Y	257	150	N	30, 31
1	Appleton Twp	E	ISTR-14-03	Trib. to Gold Brook	2	INT	N/A	N	N	~~N/A~~ Y	205	150	N	34
1	Appleton Twp	E	ISTR-14-04	Trib. to Gold Brook	2	INT	N/A	N	N	~~N/A~~ Y	170	150	N	34

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
1	Appleton Twp	E	ISTR-14-05	Trib. to Gold Brook	2	INT	N/A	N	N	~~N/A~~ y	284	150	N	34
1	Appleton Twp	E	ISTR-14-08	Trib. to Gold Brook	2	INT	N/A	N	N	~~N/A~~ y	194	150	N	34
1	Appleton Twp	E	ISTR-14-09	Trib. to Gold Brook	2	INT	N/A	N	N	~~N/A~~ y	173	150	N	34
1	Appleton Twp	E	ISTR-14-10	Trib. to Gold Brook	2	INT	N/A	N	N	~~N/A~~ y	120	150	N	34
1	Appleton Twp	E	ISTR-14-23	Trib. to Barrett Brook	2	INT	N/A	N	N	~~N/A~~ y	443	150	N	33
1	Appleton Twp	E	ISTR-14-27	Trib. to Barrett Brook	2	INT	N/A	N	N	~~N/A~~ y	339	150	N	33
1	Appleton Twp	E	ISTR-14-45	Trib. to Barrett Brook	2	INT	N/A	N	N	~~N/A~~ y	512	150	N	33
1	Appleton Twp	E	ISTR-14-46	Trib. to Barrett Brook	2	INT	N/A	N	N	~~N/A~~ y	639	150	N	33
1	Appleton Twp	E	ISTR-14-51	Trib. to Barrett Brook	2	INT	N/A	N	N	~~N/A~~ y	114	150	N	33
1	Appleton Twp	E	ISTR-14-62	Trib. to Barrett Brook	2	INT	N/A	N	N	~~N/A~~ y	206	150	Y	32
1	Appleton Twp	E	ISTR-14-66	Trib. to Barrett Brook	2	INT	N/A	N	N	~~N/A~~ y	512	150	N	32
1	Appleton Twp	E	ISTR-15-02	Trib. to Gold Brook	2	INT	N/A	Y	N	~~N/A~~ y	178	150	Y	35
1	Appleton Twp	E	ISTR-15-05	Trib. to Gold Brook	2	INT	N/A	Y	N	~~N/A~~ y	12	150	N	35
1	Appleton Twp	E	ISTR-15-09	Trib. to Gold Brook	2	INT	A	Y	N	Y	223	150	N	36
1	Appleton Twp	E	ISTR-15-12	Trib. to Gold Brook	2	INT	N/A	Y	N	~~N/A~~ y	297	150	N	36
1	Appleton Twp	E	ISTR-15-18	Trib. to Gold Brook	2	INT	N/A	N	N	~~N/A~~ y	382	150	N	34
1	Appleton Twp	E	ISTR-16-16	Trib. to Gold Brook	2	INT	A	Y	N	Y	52	150	N	37

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
1	Appleton Twp	E	ISTR-17-04	Trib. To Rock Pond	2	INT	N/A	Y	N	N/A	424	150	N	40
1	Appleton Twp	E	ISTR-17R-05	Trib. To Rock Pond	2	INT	N/A	Y	N	N/A	554	150	N	40
1	Parlin Pond Twp	E	ISTR-30-02	Trib. to Piel Brook	2	INT	N/A	N	N	~~N/A~~ y	227	150	N	69
1	Johnson Mountain Twp	E	ISTR-35-02	Trib. to Salmon Stream	2	INT	A	Y	N	N/A	423	150	N	80
1	Johnson Mountain Twp	E	ISTR-36-01	Trib. to Salmon Stream	2	INT	N/A	Y	N	N/A	379	150	N	83
1	Johnson Mountain Twp	E	ISTR-36-04	Trib. to Salmon Stream	2	INT	N/A	Y	N	N/A	440	150	N	83
1	Johnson Mountain Twp	E	ISTR-38-01	Trib. to East Branch Salmon Stream	2	INT	N/A	Y	N	N/A	213	150	N	87
1	Johnson Mountain Twp	E	ISTR-38-08	Trib. to East Branch Salmon Stream	2	INT	N/A	Y	N	N/A	131	150	N	86
1	Johnson Mountain Twp	E	ISTR-38-12	Trib. to East Branch Salmon Stream	2	INT	A	Y	N	N/A	99	150	N	85, 86
1	Johnson Mountain Twp	E	ISTR-41-04	Trib. to Cold Stream	2	INT	N/A	Y	N	~~N/A~~ y	140	150	N	92, 93
1	Johnson Mountain Twp	E	ISTR-42-10	Trib. to Tomhegan Stream	2	INT	N/A	Y	N	~~N/A~~ y	124	150	N	94
1	Appleton Twp	E	ISTR-RR-11-03	Trib. to Bog Brook	2	INT	N/A	N	N	~~N/A~~ y	343	150	N	27
1	Appleton Twp	E	ISTR-RR-12-01	Trib. to Bog Brook	2	INT	A	N	N	~~N/A~~ y	174	150	N	27, 28
1	Bradstreet Twp	E	ISTR-SR-29-03	Trib. To Fourmile Brook	2	INT	N/A	N	N	N/A	174	150	N	66

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
1	Appleton Twp	E	PSTR-14-28	Trib. to Barrett Brook	2	PER	N/A	N	N	~~N/A~~ Y	142	150	Y	33
1	Appleton Twp	E	PSTR-14-34	Trib. to Barrett Brook	2	PER	N/A	N	N	~~N/A~~ Y	257	150	N	33
1	Johnson Mountain Twp	E	PSTR-40-08	Trib. to Cold Stream	2	PER	N/A	Y	N	Y	353	150	N	91
1	Johnson Mountain Twp	E	PSTR-40-09	Trib. to Cold Stream	2	PER	N/A	Y	N	Y	300	150	N	91
1	Beattie Twp	E	ISTR-01-10	Trib. to Mill Brook	2.5	INT	A	N	N	~~N/A~~ Y	663	150	N	5
1	Skinner Twp	E	ISTR-05-08	Trib. to Smart Brook	2.5	INT	N/A	N	N	~~N/A~~ Y	163	150	N	12
1	Johnson Mountain Twp	E	ISTR-36-02	Trib. to Salmon Stream	2.5	INT	A	Y	N	N/A	254	150	Y	82, 83
1	Johnson Mountain Twp	E	ISTR-37-01	Trib. to East Branch Salmon Stream	2.5	INT	N/A	Y	N	N/A	223	150	N	84
1	Beattie Twp	E	ISTR-MS-02-10	Trib. to Number One Brook	2.5	INT	N/A	N	N	~~N/A~~ Y	272	150	N	7
1	Beattie Twp	E	PSTR-01-09	Trib. To Mill Brook	2.5	PER	A	N	N	~~N/A~~ Y	726	150	N	5
1	Beattie Twp	E	ISTR-00-01	Trib. to West Branch Mill Brook	3	INT	N/A	N	N	~~N/A~~ Y	402	150	N	1
1	Beattie Twp	E	ISTR-00-08	Trib. to West Branch Mill Brook	3	INT	N/A	N	N	~~N/A~~ Y	176	150	N	1
1	Beattie Twp	E	ISTR-02-04	Trib. to Number One Brook	3	INT	N/A	N	N	~~N/A~~ Y	310	150	N	7
1	Beattie Twp	E	ISTR-02-08	Trib. to Number One Brook	3	INT	N/A	N	N	~~N/A~~ Y	429	150	N	7

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
1	Skinner Twp	E	ISTR-05-06	Trib. to Smart Brook	3	INT	N/A	N	N	~~N/A~~ Y	328	150	N	12, 13
1	Skinner Twp	E	ISTR-05-07	Trib. to Smart Brook	3	INT	N/A	N	N	~~N/A~~ Y	454	150	N	12, 13
1	Skinner Twp	E	ISTR-06-05	Trib. to Smart Brook	3	INT	N/A	N	N	~~N/A~~ Y	152	150	Y	16
1	Skinner Twp	E	ISTR-06-08	Trib. to Smart Brook	3	INT	N/A	N	N	~~N/A~~ Y	65	150	N	15
1	Skinner Twp	E	ISTR-07-01	Trib. to West Branch Moose River	3	INT	N/A	N	N	~~N/A~~ Y	73	150	N	18, 19
1	Skinner Twp	E	ISTR-07-07	Trib. to Hay Bog Brook	3	INT	N/A	N	N	N/A	417	150	N	17
1	Skinner Twp	E	ISTR-09-10	Trib. to South Branch Moose River	3	INT	N/A	N	N	~~N/A~~ Y	376	150	N	21, 22
1	Skinner Twp	E	ISTR-10-10	Trib. to Bog Brook	3	INT	N/A	N	N	~~N/A~~ Y	190	150	N	25
1	Appleton Twp	E	ISTR-12-04	Trib. to Bog Brook	3	INT	N/A	N	N	~~N/A~~ Y	408	150	N	29, 30
1	Appleton Twp	E	ISTR-14-06	Trib. to Gold Brook	3	INT 150	N/A	N	N	~~N/A~~ Y	287	150	N	34
1	Appleton Twp	E	ISTR-14-67	Trib. to Barrett Brook	3	INT	N/A	N	N	~~N/A~~ Y	361	150	Y	32
1	Appleton Twp	E	ISTR-15-10	Trib. to Gold Brook	3	INT	N/A	Y	N	~~N/A~~ Y	257	150	N	36
1	Appleton Twp	E	PSTR-16-01	Trib. to Baker Stream	25	INT	N/A	Y	N	~~N/A~~ Y	285	150	N	37
1	Appleton Twp	E	ISTR-17-02	Trib. to Baker Stream	3	INT	N/A	Y	N	N/A	20	150	Y	39
1	T5 R7 BKP WKR	E	ISTR-18-08	Trib. to Fish Pond	3	INT	N/A	Y	N	N/A	429	150	N	41, 42
1	T5 R7 BKP WKR/Hobbstown Twp	E	ISTR-18-11	Trib. to Fish Pond	3	INT	N/A	Y	N	N/A	405	150	N	42

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
1	Bradstreet Twp	E	ISTR-26-03	Trib. to Horse Brook	3	INT	N/A	N	N	N/A	60	150	N	60
1	Bradstreet Twp	E	ISTR-26-04	Trib. to Horse Brook	3	INT	N/A	N	N	N/A	45	150	N	60
1	Johnson Mountain Twp	E	ISTR-38-03	Trib. to East Branch Salmon Stream	3	INT	N/A	Y	N	N/A	528	150	N	87
1	Johnson Mountain Twp	E	ISTR-38-07	East Branch Salmon Stream	3	INT	A	Y	N	N/A	115	150	N	86, 87
1	Johnson Mountain Twp	E	ISTR-42-08	Trib. to Tomhegan Stream	3	INT	N/A	Y	N	~~N/A~~ Y	221	150	N	94
1	West Forks Plt	D	ISTR-44-08	Tomhegan Stream	3	INT	A	Y	N	~~N/A~~ Y	231	150	N	100
1	West Forks Plt	D	ISTR-45-04	Trib. to Tomhegan Stream	3	INT	N/A	Y	N	~~N/A~~ Y	311	150	N	100, 101
1	Beattie Twp	E	ISTR-MS-02-08	Trib. to Number One Brook	3	INT	N/A	N	N	~~N/A~~ Y	359	150	N	7
1	Beattie Twp	E	ISTR-MS-02-09	Trib. to Number One Brook	3	INT	N/A	N	N	~~N/A~~ Y	359	150	N	7
1	Skinner Twp	E	ISTR-RR-11-04	Trib. to Bog Brook	3	INT	A	N	N	~~N/A~~ Y	8	150	N	26
1	Beattie Twp	E	PSTR-00-06	Trib. to West Branch Mill Brook	3	PER	A	N	N	~~N/A~~ Y	398	150	N	1
1	Appleton Twp	E	PSTR-16-10	Trib. to Gold Brook	3	PER	A	Y	N	Y	313	150	N	37
1	Appleton Twp	E	PSTR-16-101	Trib. to Gold Brook	3	PER	A	Y	N	Y	226	150	N	37
1	T5 R7 BKP WKR	E	PSTR-18-15	Trib. to Fish Pond	3	PER	A	Y	N	Y	198	150	N	41

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
1	Hobbstown Twp	E	PSTR-20-01	Trib. to Little Spencer Stream	3	PER	A	Y	N	Y	443	150	N	46
1	T5 R7 BKP WKR	E	PSTR-23-01	Trib. to Whipple Brook	3	PER	N/A	Y	N	Y	258	150	N	52
1	Bradstreet Twp	E	PSTR-26-05	Trib. to Horse Brook	3	PER		N	N	~~N/A~~ Y	298	150	N	60
1	West Forks Plt	D	PSTR-44-07	Tomhegan Stream	3	PER	N/A	Y	N	~~N/A~~	37	150	N	100
1	Beattie Twp	E	ISTR-MS-02-11	Trib. to Number One Brook	3.5	INT	N/A	N	N	~~N/A~~ Y	512	150	N	7
1	Beattie Twp	E	ISTR-02-01	Trib. to Number One Brook	4	INT	N/A	N	N	~~N/A~~ Y	505	150	N	7
1	Skinner Twp	E	ISTR-08-02	Trib. to West Branch Moose River	4	INT	A	N	N	~~N/A~~ Y	421	150	N	20, 21
1	Skinner Twp	E	ISTR-09-05	Trib. to South Branch Moose River	4	INT	A	N	N	~~N/A~~ Y	199	150	N	22, 23
1	Appleton Twp	E	ISTR-12-06	Trib. to Bog Brook	4	INT	N/A	N	N	~~N/A~~ Y	409	150	N	29, 30
1	Appleton Twp	E	ISTR-14-01	Trib. to Gold Brook	4	INT	N/A	N	N	~~N/A~~ Y	328	150	N	34
1	Appleton Twp	E	ISTR-16-04	Trib. to Gold Brook	4	INT	A	Y	N	Y	465	150	N	37
1	Appleton Twp	E	ISTR-16-05	Trib. to Gold Brook	4	INT	A	Y	N	Y	182	150	N	37
1	T5 R7 BKP WKR	E	ISTR-18-16	Trib. to Fish Pond	4	INT	A	Y	N	Y	48	150	N	41
1	Johnson Mountain Twp	E	PSTR-31-02	Trib. to Piel Brook	3	INT	N/A	N	N	~~N/A~~ Y	214	150	N	68, 69

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
1	Johnson Mountain Twp	E	ISTR-38-05	Trib. to East Branch Salmon Stream	4	INT	A	Y	N	N/A	72	150	Y	86, 87
1	Johnson Mountain Twp	E	ISTR-41-05	Trib. to Cold Stream	4	INT	N/A	Y	N	~~N/A~~ Y	466	150	N	93
1	Johnson Mountain Twp	E	ISTR-42-02	Trib. to Tomhegan Stream	4	INT	N/A	Y	N	~~N/A~~ Y	279	150	N	96
1	Johnson Mountain Twp	E	ISTR-42-13	Trib. To Little Wilson Hill Pond	4	INT	N/A	Y	N	N/A	329	150	Y	94
1	West Forks Plt	D	ISTR-45-02	Trib. to Tomhegan Stream	4	INT	N/A	Y	N	N/A	281	150	N	100
1	Bradstreet Twp	E	ISTR-SRD1-28-03	Fourmile Brook	4	INT	A	N	N	N/A	5	150	Y	63
1	Skinner Twp	E	PSTR-05-02	Smart Brook	4	PER	A	N	N	~~N/A~~ Y	8	150	N	13
1	Skinner Twp	E	PSTR-09-06	Trib. to South Branch Moose River	4	PER	A	N	N	~~N/A~~ Y	100	150	N	22, 23
1	Appleton Twp	E	PSTR-14-30	Trib. to Barrett Brook	4	PER	N/A	N	N	~~N/A~~ Y	185	150	N	33
1	Appleton Twp	E	PSTR-14-36	Trib. to Barrett Brook	4	PER	N/A	N	N	~~N/A~~ Y	329	150	N	33
1	Appleton Twp	E	PSTR-14-68	Trib. to Barrett Brook	4	PER	N/A	N	N	~~N/A~~ Y	109	150	Y	32
1	Appleton Twp	E	PSTR-15-04	Trib. to Gold Brook	4	PER	N/A	Y	N	Y	93	150	N	35, 36
1	Appleton Twp	E	PSTR-16-14	Trib. to Gold Brook	4	PER	A	Y	N	Y	176	150	N	37
1	T5 R7 BKP WKR/Hobbstown Twp	E	PSTR-18-06	Trib. to Fish Pond	4	PER	A	Y	N	Y	527	150	N	42

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
1	Johnson Mountain Twp	E	PSTR-38-02	Trib. to East Branch Salmon Stream	4	PER	A	Y	N	~~N/A~~ Y	441	150	N	87
1	Johnson Mountain Twp	E	PSTR-38-15	Trib. to East Branch Salmon Stream	4	PER	A	Y	N	~~N/A~~ Y	146	150	N	85
1	West Forks Plt	D	PSTR-44-09	Tomhegan Stream	4	PER	A	Y	N	~~N/A~~ Y	440	150	N	100
1	Bradstreet Twp	E	PSTR-SR-29-05	Trib. to Piel Brook	4	PER	N/A	N	N	~~N/A~~ Y	213	150	N	66, 67
1	Johnson Mountain Twp	E	ISTR-31-01	Trib. to Piel Brook	5	INT	N/A	N	N	~~N/A~~ Y	388	150	N	68
1	Johnson Mountain Twp	E	ISTR-32-01	Trib. to Piel Brook	5	INT	A	N	N	~~N/A~~ Y	198	150	N	74
1	Johnson Mountain Twp	E	ISTR-32-02	Trib. to Piel Brook	5	INT	A	N	N	~~N/A~~ Y	163	150	N	74
1	Johnson Mountain Twp	E	ISTR-42-07	Trib. to Tomhegan Stream	5	INT	N/A	Y	N	~~N/A~~ Y	177	150	N	94
1	Johnson Mountain Twp	E	ISTR-EM-33-01	Trib. To Twomile Brook	5	INT	N/A	Y	N	N/A	170	150	N	75
1	Johnson Mountain Twp	E	ISTR-EM-34-03	Trib. To Mountain	5	INT	N/A	Y	N	N/A	58	150	N	77
1	Johnson Mountain Twp	E	ISTR-EM-34-05	Trib. To Mountain	5	INT	N/A	Y	N	N/A	142	150	N	77
1	Appleton Twp	E	PSTR-14-24	Trib. to Barrett Brook	5	PER	N/A	N	N	~~N/A~~ Y	255	150	Y	33
1	Appleton Twp	E	PSTR-14-47	Trib. to Barrett Brook	5	PER	N/A	N	N	~~N/A~~ Y	509	150	N	33
1	T5 R7 BKP WKR/Hobbstown Twp	E	PSTR-18-05	Trib. to Fish Pond	5	PER	A	Y	N	Y	421	150	Y	42

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
1	T5 R7 BKP WKR	E	PSTR-21-02	Trib. to Little Spencer Stream	5	PER	A	Y	N	Y	454	150	N	48, 49
1	T5 R7 BKP WKR	E	PSTR-21-2A	Trib. to Little Spencer Stream	5	PER	A	Y	N	Y	544	150	N	48, 49
1	Johnson Mountain Twp	E	PSTR-40-07	Trib. to Cold Stream	5	PER	N/A	Y	N	Y	268	150	N	91, 92
1	West Forks Plt	D	PSTR-44-05	Tomhegan Stream	5	PER	A	Y	N	~~N/A~~ Y	278	150	N	100
1	West Forks Plt	D	PSTR-44-06	Tomhegan Stream	5	PER	A	Y	N	~~N/A~~ Y	167	150	N	100
1	West Forks Plt	D	PSTR-45-03	Trib. to Tomhegan Stream	5	PER	N/A	Y	N	~~N/A~~ Y	7	150	Y	100
1	Bradstreet Twp	E	PSTR-SRD1-02	Trib. to Piel Brook	5	PER	N/A	N	N	~~N/A~~ Y	274	150	N	66
1	West Forks Plt	D	PSTR-45-3	Tomhegan Stream	6	PER	A	Y	N	~~N/A~~ Y	249	150	N	100
1	Skinner Twp	E	PSTR-05-01	Smart Brook	6	PER	A	N	N	N/A	80	150	N	13
1	Skinner Twp	E	PSTR-07-02	Trib. to West Branch Moose River	6	PER	A	N	N	~~N/A~~ Y	54	150	N	18
1	Skinner Twp	E	PSTR-08-04	Trib. to West Branch Moose River	6	PER	A	N	N	~~N/A~~ Y	27	150	Y	20
1	Appleton Twp	E	PSTR-11-07	Trib. to Bog Brook	6	PER	A	N	N	~~N/A~~ Y	583	150	N	27
1	Appleton Twp	E	PSTR-14-49	Trib. to Barrett Brook	6	PER	N/A	N	N	~~N/A~~ Y	458	150	N	33
1	Johnson Mountain Twp	E	PSTR-38-06	Trib. to East Branch Salmon Stream	6	PER	A	Y	N	~~N/A~~ Y	8	150	Y	86, 87

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Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
1	Johnson Mountain Twp	E	PSTR-38-10	Trib. to East Branch Salmon Stream	6	PER	A	Y	N	~~N/A~~ Y	41	150	N	86
1	Merrill Strip Twp/Beattie Twp	E	PSTR-LT-1	Trib. to Number One Brook	6	PER	A	N	N	~~N/A~~ Y	190	150	Y	10
1	Appleton Twp	E	PSTR-14-33	Trib. to Barrett Brook	7	PER	N/A	N	N	~~N/A~~ Y	298	150	N	33
1	Bradstreet Twp	E	ISTR-27-02	Trib. To Fourmile Brook	8	INT	N/A	N	N	N/A	233	150	N	61, 62
1	T5 R7 BKP WKR	E	PSTR-18-14	Trib. to Fish Pond	8	PER	A	Y	N	Y	123	150	N	41
1	Johnson Mountain Twp	E	PSTR-31-06	Trib. to Piel Brook	8	PER	A	N	N	~~N/A~~ Y	100	150	Y	71
1	Bradstreet Twp	E	PSTR-SRD1-28-04	Fourmile Brook	8	PER	A	N	N	~~N/A~~ Y	17	150	N	63
1	Johnson Mountain Twp	E	PSTR-EM-34-01	Mountain Brook	9	PER	A	Y	N	~~N/A~~ Y	31	150	N	76
1	Appleton Twp	E	PSTR-12-07	Trib. to Bog Brook	10	PER	A	N	N	~~N/A~~ Y	264	150	N	28
1	Appleton Twp	E	PSTR-16-07	Trib. to Gold Brook	10	PER	A	Y	N	Y	178	150	N	37
1	Bradstreet Twp	E	PSTR-26-01	Trib. to Moose River	10	PER	A	N	N	~~N/A~~ Y	326	150	N	59
1	Johnson Mountain Twp	E	PSTR-31-SRD2-01	Piel Brook	0	PER	A	N	N	~~N/A~~ Y	239	150	N	70
1	West Forks Plt	D	PSTR-45-01	Trib. to Cold stream	10	PER	N/A	Y	N	Y	150	150	N	102
1	West Forks Plt	D	PSTR-46-04	Trib. To Kennebec River	10	PER	N/A	Y	N	Y	201	150	N	104
1	Appleton Twp	E	PSTR-11-07-RR1	Trib. to Bog Brook	6	PER	A	N	N	~~N/A~~ Y	583	150	N	27

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
1	Johnson Mountain Twp	E	PSTR-SR-31-01	Piel Brook	10	PER	A	N	N	~~N/A~~ Y	219	150	N	70
1	Bradstreet Twp	E	PSTR-SRD1-28-01	Fourmile Brook	10	PER	A	N	N	~~N/A~~ Y	6	150	N	63
1	T5 R7 BKP WKR/Hobbstown Twp	E	PSTR-21-03	Trib. to Little Spencer Stream	12	PER	AA	Y	N	Y	221	150	N	48
1	Bradstreet Twp	E	ISTR-30-01	Piel Brook	1	PER	A	N	N	~~N/A~~ Y	261	150	N	
1	Johnson Mountain Twp	E	ISTR-35-02	Trib. to Salmon Stream	2	PER	A	Y	N	N/A	524	150	N	80
1	Appleton Twp	E	ISTR-15-07	Gold Brook	15	INT	A	Y	N	Y	248	150	N	36
1	Beattie Twp	E	PSTR-01-05	Mill Brook	15	PER	A	N	N	~~N/A~~ Y	612	150	N	4
1	Skinner Twp	E	PSTR-11-01	Trib. to Bog Brook	15	PER	A	N	N	~~N/A~~ Y	125	150	N	26
1	Appleton Twp	E	PSTR-17R-04	Baker Stream	15	PER	A	Y	N	Y	390	150	N	39
1	West Forks Plt	D	PSTR-44-01 (TOB)	Tomhegan Stream	15	PER	A	Y	N	~~N/A~~ ✓	414	150	N	100
1	West Forks Plt	D	PSTR-44-01 EAST	Tomhegan Stream	15	PER	A	Y	N	~~N/A~~ ✓	290	150	N	100
1	West Forks Plt	D	PSTR-44-01 WEST	Tomhegan Stream	15	PER	A	Y	N	~~N/A~~ ✓	301	150	N	99, 100
1	West Forks Plt	D	PSTR-44-02	Tomhegan Stream	15	PER	N/A	Y	N	~~N/A~~ ✓	355	150	N	100
1	West Forks Plt	D	PSTR-44-04	Tomhegan Stream	15	PER	A	Y	N	~~N/A~~ ✓	228	150	N	100
1	Johnson Mountain Twp	E	PSTR-33-01	Mountain Brook	18	PER	A	Y	N	~~N/A~~ Y	33	150	N	76
1	Appleton Twp	E	PSTR-17-07	Baker Stream	20	PER	A	Y	N	Y	354	150	N	39
1	Appleton Twp	E	PSTR-16-01	Gold Brook	25	PER	A	Y	N	Y	32	150	N	37
1	T5 R7 BKP WKR/Hobbstown Twp	E	PSTR-21-04	Little Spencer Stream	25	PER	AA	Y	N	Y	358	150	N	48

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← Co-located Section | "Greenfield" Section →

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
1	Johnson Mountain Twp	E	PSTR-40-06	Cold Stream	25	PER	AA	Y	N	Y	391	150	N	91
1	Bradstreet Twp	E	PSTR-25-01	Horse Brook	30	PER	A	N	N	~~N/A~~ Y	119	150	Y	58
1	Johnson Mountain Twp	E	PSTR-42-03 (TOB)	Trib. to Tomhegan Stream	40	PER	A	Y	N	~~N/A~~ Y	121	150	N	95
2	Bald Mountain Twp T2 R3	D	ISTR-60-08	Trib. to Joes Hole	2	INT	N/A	Y	N	N/A	212	75	N	133
2	Moscow	D	ISTR-71-101	Trib. to Austin Stream	1	INT	N/A	Y	N	N/A	120	75	N	158
2	Moscow	D	ISTR-72-101	Trib. to Chase Stream	3	INT	N/A	Y	N	N/A	228	75	N	159, 160
2	Moscow	D	ISTR-72-102	Trib. to Chase Stream	3	INT	N/A	Y	N	N/A	405	75	N	159
2	Moscow	D	ISTR-72-106	Trib. to Chase Stream	2	INT	N/A	Y	N	N/A	209	75	N	160
2	Moscow	D	ISTR-73-02	Mink Brook	1.5	INT	A	Y	N	Y	416	75	N	161
2	Moscow	D	ISTR-73-03	Mink Brook	2	INT	A	Y	N	Y	574	75	N	
2	Moscow	D	ISTR-73-05	Trib. to Mink Brook	2	INT	A	Y	N	Y	15	75	Y	161, 162
2	Moscow	D	ISTR-73-06	Trib. to Mink Brook	3	INT	N/A	Y	N	N/A	20	75	Y	162
2	Moscow	D	ISTR-73-07	Mink Brook	3	INT	A	Y	N	Y	341	75	N	
2	Moscow	D	ISTR-73-08	Trib. to Austin Stream	2	INT	N/A	Y	N	N/A	461	75	N	163
2	Bald Mountain Twp T2 R3	D	POND-59-05	Joes Hole	100	Open Water	N/A	Y	N	~~N/A~~ Y	118	75	N	131, 132
2	Bald Mountain Twp T2 R3	D	POND-60-01	Joes Hole	180	Open Water	A	Y	N	Y	109	75	N	133, 134
2	The Forks Plt	D	ISTR-54-01	Trib. to Moxie Pond	9	PER	A	Y	N	Y	397	75	N	120

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
2	Moscow	D	PSTR-71-102	Trib. to Austin Stream	4	PER	N/A	Y	N	~~N/A~~ Y	378	75	N	157
2	Moscow	D	PSTR-72-103	Chase Stream	30	PER	A	Y	N	Y	1	75	Y	159, 160
2	Moscow	D	PSTR-72-104	Trib. to Chase Stream	3.5	PER	A	Y	N	Y	40	75	N	159, 160
2	Moscow	D	PSTR-72-105	Trib. to Chase Stream	2	PER	A	Y	N	Y	124	75	N	159, 160
2	Moscow	D	ISTR-73-01	Mink Brook	2	PER	A	Y	N	Y	139	75	N	
2	Moscow	D	ISTR-73-04	Trib. to Mink Brook	2	PER	A	Y	N	Y	21	75	N	
2	Moscow	D	PSTR-74-01	Trib. to Kennebec River	2	PER	B	Y	N	Y	172	75	N	164, 165
2	Bald Mountain Twp T2 R3	D	ISTR-61-05	Trib. to Wild Brook	1	INT	N/A	Y	N	N/A	295	75	N	136
2	The Forks Plt	D	ISTR-55-03	Trib. to Moxie Pond	1.5	INT	N/A	Y	N	N/A	297	75	N	123
2	Moscow	D	ESTR-66-12	Trib. to Heald Stream	2	INT	N/A	Y	N	N/A	520	75	N	148, 149
2	The Forks Plt	D	ISTR-53-01	Trib. to Moxie Pond	2	INT	N/A	Y	N	N/A	59	75	N	119
2	The Forks Plt	D	ISTR-55-02	Trib. to Moxie Pond	2	INT	N/A	Y	N	N/A	274	75	N	123
2	The Forks Plt	D	ISTR-56-03	Trib. to Moxie Pond	2	INT	N/A	Y	N	N/A	442	75	N	125
2	Bald Mountain Twp T2 R3	D	ISTR-63-07	Trib. to Wild Brook	2	INT	N/A	Y	N	N/A	467	75	N	141
2	Bald Mountain Twp T2 R3	D	PSTR-60-02	Trib. to Baker Stream	2	PER	N/A	Y	N	~~N/A~~ Y	124	75	Y	135
2	Bald Mountain Twp T2 R3	D	ISTR-60-05	Trib. to Joes Hole	2.5	INT	N/A	Y	N	N/A	119	75	N	134

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
2	Bald Mountain Twp T2 R3	D	ISTR-63-05	Trib. to Wild Brook	2.5	INT	N/A	Y	N	N/A	446	75	N	140
2	Bald Mountain Twp T2 R3	D	ISTR-64-03	Trib. to Wild Brook	2.5	INT	N/A	Y	N	N/A	368	75	N	142, 143
2	Moscow	D	ISTR-65-04	Trib. to Little Heald Brook	2.5	INT	A	Y	N	Y	217	75	N	146
2	Bald Mountain Twp T2 R3	D	PSTR-60-07	Trib. to Joes Hole	2.5	PER	A	Y	N	Y	314	75	N	133
2	Moscow	D	PSTR-65-03	Little Heald Stream	2.5	PER	A	Y	N	Y	136	75	N	146
2	The Forks Plt	D	ISTR-54-02	Trib. to Moxie Pond	3	INT	A	Y	N	Y	322	75	N	120
2	Bald Mountain Twp T2 R3	D	ISTR-62-01	Trib. to Wild Brook	3	INT	N/A	Y	N	N/A	267	75	N	139
2	Bald Mountain Twp T2 R3	D	ISTR-62-02	Trib. to Wild Brook	3	INT	N/A	Y	N	N/A	342	75	N	139
2	Bald Mountain Twp T2 R3	D	ISTR-62-03	Trib. to Wild Brook	3	INT	N/A	Y	N	N/A	330	75	N	140
2	Bald Mountain Twp T2 R3	D	ISTR-63-08	Trib. to Wild Brook	3	INT	N/A	Y	N	N/A	438	75	N	141
2	Bald Mountain Twp T2 R3	D	ISTR-63-09	Trib. to Wild Brook	3	INT	N/A	Y	N	N/A	322	75	N	141
2	Bald Mountain Twp T2 R3	D	ISTR-64-05	Trib. to Wild Brook	3	INT	N/A	Y	N	N/A	288	75	N	142
2	Moscow	D	ISTR-66-05	Heald Stream	3	INT	A	Y	N	Y	454	75	N	147
2	Moscow	D	PSTR-65-01	Trib. to Little Heald Brook	3	PER	N/A	Y	N	Y	119	75	Y	145
2	Bald Mountain Twp T2 R3	D	PSTR-61-08	Trib. to Baker Stream	3.5	PER	N/A	Y	N	~~N/A~~ Y	191	75	N	136

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
2	Moscow	D	ISTR-66-07	Trib. to Heald Stream	4	INT	N/A	Y	N	N/A	238	75	Y	147
2	Bald Mountain Twp T2 R3	D	PSTR-60-01	Trib. to Baker Stream	4	PER	N/A	Y	N	~~N/A~~ Y	161	75	N	135
2	Bald Mountain Twp T2 R3	D	PSTR-63-06	Trib. to Wild Brook	4	PER	N/A	Y	N	Y	333	75	N	141
2	Bald Mountain Twp T2 R3	D	PSTR-63-11	Trib. to Wild Brook	4	PER	N/A	Y	N	Y	283	75	N	142
2	Bald Mountain Twp T2 R3	D	PSTR-64-06	Trib. to Wild Brook	4	PER	N/A	Y	N	Y	118	75	Y	143
2	The Forks Plt	D	ISTR-57-02	Trib. to Mosquito Stream	5	INT	A	Y	N	Y	532	75	N	127
2	Moscow	D	ISTR-66-08	Trib. to Heald Stream	5	INT	N/A	Y	N	~~N/A~~ Y	416	75	N	148
2	Moscow	D	ISTR-66-09	Trib. to Heald Stream	5	INT	N/A	Y	N	~~N/A~~ Y	3	75	Y	148
2	Moscow	D	ISTR-66-10	Trib. to Heald Stream	5	INT	N/A	Y	N	~~N/A~~ Y	5	75	Y	148, 149
2	Bald Mountain Twp T2 R3	D	PSTR-60-06	Trib. to Joes Hole	5	PER	A	Y	N	Y	316	75	N	133
2	Bald Mountain Twp T2 R3	D	PSTR-61-01	Wild Brook	5	PER	A	Y	N	Y	511	75	Y	137
2	Bald Mountain Twp T2 R3	D	PSTR-64-02	Trib. to Wild Brook	5	PER	N/A	Y	N	Y	413	75	N	142, 143
2	The Forks Plt	D	ISTR-55-01	Trib. to Moxie Pond	6	INT	N/A	Y	N	~~N/A~~ Y	212	75	N	123
2	Bald Mountain Twp T2 R3	D	ISTR-59-02	Trib. to Little Sandy Stream	6	INT	A	Y	N	Y	16	75	Y	131

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
2	Moscow	D	ISTR-66-06	Trib. to Heald Stream	6	INT	N/A	Y	N	~~N/A~~ Y	258	75	Y	147
2	Moscow	D	ISTR-67-01	Trib. to Austin Stream	6	INT	N/A	Y	N	~~N/A~~ Y	120	75	Y	149
2	Bald Mountain Twp T2 R3	D	PSTR-63-10	Trib. to Wild Brook	6	PER	N/A	Y	N	Y	215	75	N	142
2	Moscow	D	ISTR-69-01	Trib. to Austin Stream	7	INT	N/A	Y	N	~~N/A~~ Y	155	75	N	156, 157
2	Bald Mountain Twp T2 R3	D	PSTR-63-03	Wild Brook	7	PER	A	Y	N	Y	380	75	N	140
2	Bald Mountain Twp T2 R3	D	PSTR-63-04	Wild Brook	7	PER	A	Y	N	Y	284	75	N	140
2	Moscow	D	ISTR-72-107	Trib. to Chase Stream	8	INT	A	Y	N	Y	66	75	Y	160
2	The Forks Plt	D	PSTR-57-01	Mosquito Stream	10	PER	A	Y	N	Y	470	75	N	127
2	Bald Mountain Twp T2 R3	D	PSTR-59-01	Little Sandy Stream	15	PER	A	Y	N	Y	107	75	Y	131
2	Moscow	D	PSTR-66-02	Heald Stream	15	PER	A	Y	N	Y	459	75	N	146, 147
2	Moscow	D	PSTR-65-02	Little Heald Brook	25	PER	A	Y	N	Y	82	75	N	146
3	Industry	D	ISTR-101-01	Trib. to Josiah Brook	5	INT	N/A	Y	Y	~~N/A~~ Y	272	75	N	223
3	Industry	D	ISTR-101-02	Trib. to Josiah Brook	2	INT	N/A	Y	Y	N/A	219	75	N	223
3	Industry	D	ISTR-102-01	Trib. to Josiah Brook	8	INT	B	Y	Y	~~N/A~~ Y	294	75	N	225
3	Industry	D	ISTR-103-01	Trib. to Goodrich Brook	5	INT	N/A	Y	Y	~~N/A~~ Y	349	75	N	229

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
3	Industry	D	ISTR-103-02	Trib. to Goodrich Brook	1.5	INT	N/A	Y	Y	N/A	302	75	N	229
3	Industry	D	ISTR-103-03	Trib. to Goodrich Brook	3	INT	N/A	Y	Y	N/A	72	75	N	228, 229
3	Industry	D	ISTR-103-04	Trib. to Goodrich Brook	3	INT	N/A	Y	Y	N/A	102	75	N	228, 229
3	Industry	D	ISTR-103-05	Trib. to Goodrich Brook	3	INT	N/A	Y	Y	N/A	195	75	N	228
3	Industry	D	ISTR-103-06	Trib. to Goodrich Brook	1.5	INT 50	N/A	Y	Y	N/A	375	75	N	228
3	Industry	D	ISTR-103-07	Trib. to Goodrich Brook	5	INT	B	Y	Y	~~N/A~~ Y	330	75	N	228
3	Industry	D	ISTR-103-08	Trib. to Goodrich Brook	4	INT	N/A	Y	Y	N/A	209	75	N	227, 228
3	Industry	D	ISTR-103-09	Trib. to Goodrich Brook	5	INT	N/A	Y	Y	~~N/A~~ Y	274	75	N	227, 228
3	Farmington	D	ISTR-107-01	Trib. to Beales Brook	1.5	INT	B	Y	Y	N/A	299	75	N	238
3	Farmington	D	ISTR-108-01	Trib. to Cascade Brook	3	INT	N/A	Y	Y	N/A	200	75	N	240
3	Farmington	D	ISTR-108-02	Trib. to Cascade Brook	2.5	INT	B	Y	Y	N/A	246	75	N	240
3	Farmington	D	ISTR-108-03	Trib. to Cascade Brook	1.5	INT	B	Y	Y	N/A	275	75	N	240
3	Farmington	D	ISTR-108-04	Trib. to Cascade Brook	1	INT	B	Y	Y	N/A	196	75	N	239
3	Farmington	D	ISTR-111-01	Trib. to Wilson Stream	2	INT	N/A	Y	Y	N/A	162	75	N	246

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Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
3	Jay	D	ISTR-114-02	Trib. to Wilson Stream	3	INT	N/A	Y	Y	N/A	107	75	N	253
3	Chesterville	D	ISTR-114-03	Trib. to Wilson Stream	6	INT	N/A	Y	Y	~~N/A~~ Y	349	75	Y	253
3	Jay	D	ISTR-116-02	Trib. To Sugar Brook	8	INT	N/A	Y	Y	~~N/A~~ Y	140	75	Y	256
3	Jay	D	ISTR-117-01	Trib. to Fuller Brook	2	INT	N/A	Y	Y	N/A	86	75	Y	259
3	Livermore Falls	B	ISTR-127-01	Trib. to Androscoggin River	10	INT	N/A	Y	N	N/A	411	75	Y	280, 281
3	Leeds	B	ISTR-132-02	Trib. To Dead River	3	INT	B	Y	N	N/A	277	75	N	292
3	Leeds	B	ISTR-135-04	Trib. to Allen Stream	4	INT	B	Y	N	N/A	201	75	N	299
3	Concord Twp	D	ISTR-75-03	Trib. to Kennebec River	4	INT	N/A	Y	N	N/A	287	75	Y	167
3	Concord Twp	D	ISTR-76-02	Trib. to Kennebec River	1	INT	N/A	Y	N	N/A	251	75	N	
3	Concord Twp	D	ISTR-76-03	Trib. to Kennebec River	20	INT	B	Y	N	~~N/A~~ Y	536	75	N	
3	Concord Twp	D	ISTR-76-04	Trib. to Kennebec River	2	INT	B	Y	N	N/A	366	75	N	
3	Concord Twp	D	ISTR-76-05	Trib. to Kennebec River	15	INT	N/A	Y	N	~~N/A~~ Y	247	75	N	
3	Concord Twp	D	ISTR-76-06	Trib. to Kennebec River	20	INT	N/A	Y	N	~~N/A~~ Y	238	75	N	
3	Concord Twp	D	ISTR-77-03	Trib. to Kennebec River	2.5	INT	N/A	Y	N	N/A	228	75	N	171
3	Concord Twp	D	ISTR-78-01	Trib. To Mill Stream	3	INT	N/A	Y	N	N/A	204	75	Y	173

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
3	Concord Twp	D	ISTR-78-02	Trib. To Mill Stream	3	INT	N/A	Y	N	N/A	254	75	N	173
3	Concord Twp	D	ISTR-80-01	Trib. to Kennebec River	2	INT	N/A	Y	N	N/A	480	75	N	177
3	Concord Twp	D	ISTR-80-02	Trib. to Kennebec River	3	INT	N/A	Y	N	N/A	267	75	N	176
3	Concord Twp	D	ISTR-80-03	Trib. to Kennebec River	2	INT	N/A	Y	N	N/A	93	75	N	176
3	Concord Twp	D	ISTR-80-04	Trib. to Kennebec River	1.5	INT	N/A	Y	N	N/A	468	75	N	177
3	Concord Twp	D	ISTR-80-05	Trib. to Kennebec River	3	INT	N/A	Y	N	N/A	247	75	N	177
3	Concord Twp	D	ISTR-81-01	Trib. to Kennebec River	4	INT	N/A	Y	N	N/A	256	75	N	178, 179
3	Concord Twp	D	ISTR-81-02	Trib. to Kennebec River	4	INT	N/A	Y	N	N/A	243	75	N	178, 179
3	Embden	D	ISTR-82-01	Trib. to Alder Brook	5	INT	N/A	Y	N	~~N/A~~ Y	330	75	N	182, 183
3	Embden	D	ISTR-83-02	Trib. to Alder Brook	4	INT	N/A	Y	N	N/A	429	75	N	184
3	Embden	D	ISTR-83-05	Trib. to Alder Brook	3	INT	B	Y	N	Y	327	75	N	184
3	Embden	D	ISTR-83-06	Trib. to Alder Brook	2	INT	B	Y	N	Y	281	75	Y	183, 184
3	Embden	D	ISTR-84-01	Trib. to Alder Brook	4	INT	N/A	Y	N	N/A	312	75	N	185
3	Embden	D	ISTR-85-01	Jackin Brook	2	INT	B	Y	N	Y	232	75	N	187
3	Starks	D	ISTR-96-07	Trib. to Pelton Brook	3	INT	N/A	Y	Y	N/A +	374	75	N	213
3	Starks	D	ISTR-96-08	Trib. to Pelton Brook	4	INT	N/A	Y	Y	N/A +	245	75	N	213

+ = brook trout present, but NO need to increase buffer to 100' (small int. trib)

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
3	Starks	D	ISTR-96-09	Trib. to Pelton Brook	2	INT	N/A	Y	Y	N/A	251	75	N	213
3	Starks	D	ISTR-96-10	Trib. to Pelton Brook	5	INT	N/A	Y	Y	~~N/A~~ Y	319	75	N	213
3	Starks	D	ISTR-96-11	Trib. to Pelton Brook	2	INT	N/A	Y	Y	N/A	335	75	N	213
3	Starks	D	ISTR-96-12	Trib. to Pelton Brook	2	INT	N/A	Y	Y	N/A	260	75	N	213
3	Starks	D	ISTR-97-02	Trib. to Pelton Brook	100	INT	N/A	Y	Y	~~N/A~~ Y	460	75	N	214, 215
3	Starks	D	ISTR-97-03	Trib. to Pelton Brook	2.5	INT	N/A	Y	Y	N/A	494	75	N	214, 215
3	Starks	D	ISTR-97-04	Trib. to Pelton Brook	3	INT	N/A	Y	Y	N/A	341	75	N	214, 215
3	Starks	D	ISTR-97-06	Trib. to Cold Pond/Hilton Brook	4	INT	N/A	Y	Y	N/A	533	75	N	216
3	Starks	D	ISTR-97-07	Trib. to Cold Pond/Hilton Brook	2	INT	N/A	Y	Y	N/A	562	75	N	216
3	Starks	D	ISTR-98-01	Trib. to Lemon Stream	2	INT	N/A	Y	Y	N/A	110	75	N	217, 218
3	Starks	D	ISTR-99-01	Trib. to Lemon Stream	2	INT	B	Y	Y	Y	193	75	N	219
3	Lewiston	A	ISTR-PERRON-1	Trib. to Stetson Brook	0	INT	N/A	Y	N	N/A	353	75	N	320
3	Farmington	D	PSTR-112-01	Trib. to Wilson Stream	2	PER	B	Y	Y	Y	290	75	N	249

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Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
3	Chesterville	D	PSTR-114-01	Trib. to Wilson Stream	8	PER	N/A	Y	Y	Y	352	75	N	253
3	Chesterville	D	PSTR-114-04	Trib. to Wilson Stream	1	PER	N/A	Y	Y	Y	354	75	N	252
3	Greene	A	PSTR-141-01	Trib. to Daggett Bog	3	PER	B	Y	N	N/A	92	75	N	312
3	Moscow/ Concord Twp	D	ISTR-75-01	Kennebec River	3	PER	A	Y	N	Y	218	75	N	
3	Concord Twp	D	ISTR-75-02	Trib. to Kennebec River	2	PER	B	Y	N	Y	206	75	N	
3	Concord Twp	D	ISTR-76-01	Trib. to Kennebec River	0	PER	B	Y	N	Y	192	75	N	
3	Concord Twp	D	PSTR-77-01	Trib. to Kennebec River	30	PER	N/A	Y	N	Y	209	75	N	171
3	Concord Twp	D	PSTR-77-02	Trib. to Kennebec River	2	PER	B	Y	N	Y	293	75	N	171
3	Embden	D	PSTR-83-01	Trib. to Alder Brook	6	PER	N/A	Y	N	Y	364	75	Y	184
3	Embden	D	PSTR-83-03	Alder Brook	35	PER	B	Y	N	Y	81	75	Y	183
3	Embden	D	PSTR-83-04	Alder Brook	8	PER	B	Y	N	Y	615	75	N	184
3	Embden	D	PSTR-83-07	Trib. to Alder Brook	2.5	PER	B	Y	N	Y	93	75	N	183
3	Embden	D	PSTR-83-08	Trib. to Alder Brook	6	PER	N/A	Y	N	Y	107	75	N	182, 183
3	Anson	D	PSTR-89-01	Jackin Brook	4.5	PER	N/A	Y	N	Y	348	75	N	196
3	Anson	D	PSTR-90-02	Carrabassett River	400	PER	B	Y	N	Y	193	75	N	199, 200
3	Anson	D	PSTR-91-01	Gilbert Brook	190	PER	B	Y	Y	N/A	242	75	N	201
3	Starks	D	PSTR-96-01	Trib. to Pelton Brook	20	PER	B	Y	Y	Y	340	75	Y	212
3	Starks	D	PSTR-96-05	Pelton Brook	30	PER	B	Y	Y	Y	300	75	N	213

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
3	Starks	D	PSTR-97-01	Trib. to Pelton Brook	85	PER	B	Y	Y	Y	125	75	Y	214
3	Starks	D	PSTR-97-05	Trib. to Cold Pond/Hilton Brook	20	PER 40	N/A	Y	Y	~~N/A~~ Y	424	75	N	216
3	Starks	D	ISTR-100-01	Trib. To Meadow Brook	2	PER	B	Y	Y	N/A	499	75	N	220
3	Starks	D	ISTR-100-02	Trib. To Meadow Brook	2	INT	N/A	Y	Y	N/A	454	75	N	221
3	Starks	D	ISTR-100-03	Trib. To Meadow Brook	1	INT	B	Y	Y	N/A	310	75	N	221
3	Industry	D	PSTR-101-03	Trib. to Josiah Brook	6	PER	N/A	Y	Y	~~N/A~~ Y	312	75	N	223
3	Industry	D	ISTR-101-04	Trib. to Josiah Brook	4	PER	N/A	Y	Y	~~N/A~~ Y	334	75	N	223
3	Industry	D	PSTR-101-05	Josiah Brook	3	PER	B	Y	Y	~~N/A~~ Y	208	75	Y	224
3	Industry	D	ISTR-101-06	Trib. to Josiah Brook	3	INT	N/A	Y	Y	N/A	469	75	Y	224
3	Industry	D	ISTR-102-01	Trib. to Josiah Brook	8	PER	B	Y	Y	~~N/A~~ Y	216	75	N	225
3	Industry	D	ISTR-102-02	Trib. to Josiah Brook	5	INT	B	Y	Y	~~N/A~~ Y	270	75	Y	225
3	Industry	D	ISTR-102-03	Trib. to Goodrich Brook	3	UNK	N/A	Y	Y	N/A	367	75	N	227
3	Industry	D	ISTR-103-10	Trib. to Goodrich Brook	4	UNK	N/A	Y	Y	N/A	321	75	N	227
3	Industry	D	PSTR-103-11	Trib. to Goodrich Brook	7	UNK	B	Y	Y	~~N/A~~ Y	349	75	N	228

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
3	Industry	D	PSTR-103-12	Goodrich Brook	15	PER	B	Y	Y	~~N/A~~ Y	245	75	N	229
3	Industry	D	PSTR-103-13	Trib. to Goodrich Brook	7	UNK	B	Y	Y	~~N/A~~ Y	104	75	N	229
3	Industry	D	PSTR-103-14	Trib. to Goodrich Brook	8	UNK	B	Y	Y	~~N/A~~ Y	131	75	N	229
3	Industry	D	ISTR-103-15	Trib. to Goodrich Brook	3	UNK	N/A	Y	Y	N/A	38	75	N	227
3	Industry	D	ISTR-103-16	Trib. to Goodrich Brook	5	UNK	N/A	Y	Y	~~N/A~~ Y	362	75	N	227
3	Industry	D	ISTR-104-02	Trib. to Goodrich Brook	4	UNK	B	Y	Y	N/A	146	75	N	230
3	Industry	D	PSTR-104-04	Trib. to Goodrich Brook	6	UNK	B	Y	Y	~~N/A~~ Y	135	75	Y	230
3	New Sharon	D	PSTR-105-01	Muddy Brook	40	PER	B	Y	Y	~~N/A~~ Y	521	75	N	232
3	Farmington	D	ISTR-107-01	Trib. to Beales Brook	1.5	UNK	N/A	Y	Y	N/A	280	75	N	238
3	Farmington	D	PSTR-107-02	Trib. to Beales Brook	3.5	UNK	B	Y	Y	N/A	116	75	Y	237
3	Farmington	D	ISTR-107-03	Trib. to Beales Brook	1	UNK	N/A	Y	Y	N/A	275	75	N	236, 237
3	Farmington	D	PSTR-107-04	Beales Brook	5	PER	B	Y	Y	~~N/A~~ Y	335	75	N	236
3	Farmington	D	ISTR-108-05	Trib. to Cascade Brook	1.5	UNK	N/A	Y	Y	N/A	29	75	N	239
3	Farmington	D	ISTR-108-06	Trib. to Cascade Brook	1.5	UNK	B	Y	Y	N/A	317	75	N	239
3	Farmington	D	ISTR-108-07	Trib. to Cascade Brook	4	UNK	B	Y	Y	N/A	91	75	N	239, 240

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
3	Farmington	D	ISTR-108-08	Trib. to Cascade Brook	1.5	UNK	B	Y	Y	N/A	62	75	N	239
3	Farmington	D	ISTR-108-09	Trib. to Cascade Brook	1	UNK	B	Y	Y	N/A	404	75	N	239
3	Farmington	D	ISTR-109-01	Trib. to Cascade Brook	3	UNK	B	Y	Y	N/A	162	75	N	241
3	Farmington	D	PSTR-109-02	Cascade Brook	8	PER	B	Y	Y	N/A	113	75	N	242
3	Farmington	D	ISTR-109-03	Trib. to Cascade Brook	3	UNK	N/A	Y	Y	N/A	386	75	Y	241
3	Farmington	D	PSTR-110-	Sandy River	70	PER	B	Y	Y	~~N/A~~ Y	136	75	N	242, 243
3	Farmington	D	ISTR-111-02	Trib. to Wilson Stream	3.5	UNK	N/A	Y	Y	Y	240	75	N	246, 247
3	Farmington	D	ISTR-111-03	Trib. to Wilson Stream	4	UNK	N/A	Y	Y	Y	51	75	N	246
3	Farmington	D	PSTR-112-02	Trib. to Wilson Stream	6	UNK	N/A	Y	Y	Y	77	75	N	247, 248
3	Farmington	D	PSTR-112-03	Wilson Stream	40	UNK	C	Y	Y	Y	61	75	N	247
3	Jay	D	PSTR-114-01	Trib. to Wilson Stream	8	UNK	B	Y	Y	Y	169	75	Y	253
3	Chesterville	D	PSTR-114-05	Trib. to Wilson Stream	25	UNK	B	Y	Y	Y	243	75	Y	252
3	Chesterville	D	ISTR-114-06	Trib. to Wilson Stream	5	UNK	B	Y	Y	Y	391	75	N	252
3	Chesterville	D	PSTR-114-07	Trib. to Wilson Stream	5	PER	B	Y	Y	Y	85	75	Y	252, 253
3	Jay	D	ISTR-116-03	Trib. to Sugar Brook	2	UNK	N/A	Y	Y	N/A	35	75	Y	256

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
3	Jay	D	PSTR-116-04	Sugar Brook	3.5	PER	B	Y	Y	N/A	302	75	Y	257
3	Jay	D	PSTR-117-02	Trib. To Fuller Brook	5	UNK	N/A	Y	Y	N/A	98	75	N	258, 259
3	Jay	D	ISTR-117-03	Trib. To Fuller Brook	4	UNK	N/A	Y	Y	N/A	53	75	N	259
3	Jay	D	PSTR-117-	Fuller Brook	3	PER	B	Y	Y	N/A	37	75	N	260
3	Jay	D	PSTR-118-	Fuller Brook	15	PER	B	Y	Y	N/A	492	75	N	262
3	Jay	D	PSTR-119-01	James Brook	15	PER	B	Y	Y	N/A	130	75	Y	263
3	Embden	D	ISTR-85-01	Trib. to Jackin Brook	2	UNK	B	Y	N	Y	175	75	N	187
3	Anson	D	ISTR-89-03	Trib. to Fahi Brook	3.5	INT	B	Y	N	N/A	328	75	N	196
3	Anson	D	PSTR-90-01	Trib. to Carrabassett River	5.5	UNK	B	Y	N	~~N/A~~ Y	373	75	N	198
3	Anson	D	ISTR-90-04	Trib. to Carrabassett River	1.5	UNK	N/A	Y	Y	N/A	165	75	N	200
3	Anson	D	ISTR-92-01	Trib. to Carrabassett River	2	INT	N/A	Y	Y	N/A	332	75	N	204
3	Anson	D	ISTR-92-02	Trib. to Carrabassett River	1.5	INT	N/A	Y	Y	N/A	307	75	N	204
3	Anson	D	PSTR-92-03	Gilman Brook	20	UNK	B	Y	Y	~~N/A~~ Y	305	75	N	205
3	Anson	D	ISTR-92-05	Trib. to Gilman Brook	4.5	UNK	N/A	Y	Y	N/A	365	75	N	205
3	Anson	D	PSTR-93-01	Getchell Brook	15	INT	B	Y	Y	N/A	59	75	N	207, 208
3	Anson	D	ISTR-93-02	Trib. to Getchell Brook	4	INT	B	Y	Y	N/A	162	75	N	208
3	Anson	D	PSTR-93-03	Trib. to Getchell Brook	2	UNK	B	Y	Y	N/A	413	75	N	208

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
3	Anson	D	ISTR-95-01	Trib. to Kennebec River	2.5	INT	B	Y	Y	N/A	123	75	N	209, 210
3	Anson	D	ISTR-95-02	Trib. to Kennebec River	6	INT	N/A	Y	Y	~~N/A~~ Y	416	75	N	209, 210
3	Anson	D	ISTR-95-03	Trib. to Kennebec River	1	UNK	N/A	Y	Y	N/A	504	75	N	210
3	Anson	D	ISTR-95-04	Trib. to Kennebec River	1	UNK	B	Y	Y	N/A	412	75	N	210
3	Starks	D	PSTR-95-05	Trib. to Kennebec River	2	UNK	B	Y	Y	N/A	119	75	N	210
3	Starks	D	PSTR-99-02	Trib. to Lemon Stream	6	UNK	B	Y	Y	Y	43	75	Y	219
3	Starks	D	ISTR-99-03	Trib. to Lemon Stream	1	UNK	B	Y	Y	Y	128	75	Y	219
3	Starks	D	ISTR-99-04	Trib. to Lemon Stream	3	UNK	B	Y	Y	Y	125	75	N	219
3	Starks	D	PSTR-99-05	Lemon Stream	55	PER	B	Y	Y	Y	116	75	N	219, 220
3	Starks	D	PSTR-99-06	Trib. to Lemon Stream	6	UNK	B	Y	Y	Y	406	75	N	219
3	Starks	D	ISTR-99-07	Lemon Stream	1	UNK	N/A	Y	Y	Y	206	75	N	220
3	Anson	D	WB-94-01	Trib. to Getchell Brook	85	Open Water	B	Y	Y	N/A	299	75	N	208
3	Anson	D	ISTR-88-01	Trib. to Fahi Brook	1	INT	B	Y	N	N/A	444	75	N	196
3	Industry	D	ISTR-104-01	Trib. to Goodrich Brook	2	INT	N/A	Y	Y	N/A	426	75	N	229
3	Livermore Falls	B	ISTR-123-03	Trib. to Clay Brook	4	INT	B	Y	N	N/A	150	75	N	272

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
3	Livermore Falls	B	ISTR-128-02	Trib. to Androscoggin River	2	INT	C	Y	N	N/A	196	75	N	283
3	Livermore Falls	B	ISTR-128-03	Trib. to Androscoggin River	2	INT	C	Y	N	N/A	157	75	N	283
3	Leeds	B	ISTR-135-02	Trib. to Allen Stream	2	INT	B	Y	N	N/A	54	75	N	299
3	Leeds	B	ISTR-135-03	Trib. to Allen Stream	2	INT	B	Y	N	N/A	153	75	N	299, 300
3	Greene	A	ISTR-139-03	Trib. to Allen Pond	2	INT	B	Y	N	N/A	366	75	N	309
3	Greene	A	ISTR-140-02	Trib. to Allen Pond	1.5	INT	B	Y	N	N/A	228	75	N	309
3	Greene	A	ISTR-140-07	Trib. to Allen Pond	2	INT	B	Y	N	N/A	153	75	N	310, 311
3	Lewiston	A	ISTR-145-02	Trib. to Stetson Brook	2	INT	C	Y	N	Y	157	75	N	322
3	Lewiston	A	ISTR-145-03	Trib. to Stetson Brook	8	INT	C	Y	N	N/A	170	75	N	321
3	Lewiston	A	ISTR-146-04	Trib. to Stetson Brook	2	INT	C	Y	N	Y	482	75	N	323
3	Starks	D	ISTR-96-03	Trib. to Pelton Brook	2	INT	N/A	Y	Y	N/A +	186	75	N	212
3	Livermore Falls	B	PSTR-121-03	Trib. to Clay Brook	2	PER	B	Y	N	N/A	318	0	N	269
3	Livermore Falls	B	PSTR-122-04	Trib. to Clay Brook	2	PER	B	Y	N	N/A	271	75	N	269, 270
3	Livermore Falls	B	PSTR-122-05	Trib. to Clay Brook	6	PER	B	Y	N	N/A	295	0	N	269
3	Livermore Falls	B	PSTR-122-06	Trib. to Clay Brook	2	PER	B	Y	N	N/A	250	0	N	269
3	Livermore Falls	B	PSTR-125-01	Trib. to Androscoggin River	2	PER	C	Y	N	N/A	303	75	N	276

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
3	Leeds	B	PSTR-135-01	Trib. to Allen Stream	2	PER	B	Y	N	N/A	333	75	N	299
3	Greene	A	PSTR-144-02	Trib. to Daggett Bog	2	PER	B	Y	N	N/A	76	75	N	319
3	Livermore Falls	B	ISTR-125-06	Trib. to Androscoggin River	2	UNK	C	Y	N	N/A	244	75	N	277
3	Livermore Falls	B	ISTR-126-06	Trib. to Androscoggin River	2	UNK	C	Y	N	N/A	422	75	N	279
3	Leeds	B	ISTR-134-01	Trib. to Allen Stream	2	UNK	B	Y	N	N/A	131	75	N	298
3	Leeds	B	ISTR-134-02	Trib. to Allen Stream	2.5	INT	B	Y	N	N/A	116	75	N	297
3	Leeds	B	ISTR-134-03	Trib. to Allen Stream	2.5	INT	B	Y	N	N/A	51	75	N	297
3	Jay	D	ISTR-121-01	Trib. to Clay Brook	3	INT	B	Y	N	N/A	227	0	N	268
3	Livermore Falls	B	ISTR-123-02	Trib. to Clay Brook	3	INT	B	Y	N	N/A	146	75	N	272
3	Livermore Falls	B	ISTR-124-01	Trib. to Androscoggin River	3	INT	C	Y	N	N/A	279	75	N	274
3	Livermore Falls	B	ISTR-124-02	Trib. to Androscoggin River	3	INT	C	Y	N	N/A	459	75	N	274
3	Livermore Falls	B	ISTR-126-01	Trib. to Androscoggin River	3	INT	C	Y	N	N/A	297	75	N	279
3	Livermore Falls	B	ISTR-127-03	Trib. to Hunton Brook	30	INT	B	Y	N	N/A	539	75	N	282
3	Leeds	B	ISTR-130-02	Trib. to Androscoggin River	3	INT	C	Y	N	N/A	58	75	N	287

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
3	Leeds	B	ISTR-130-03	Trib. to Androscoggin River	3	INT	C	Y	N	N/A	330	75	Y	287, 288
3	Leeds	B	ISTR-131-02	Trib. To Dead River	3	INT	B	Y	N	N/A	142	75	N	291
3	Leeds	B	ISTR-132-01	Trib. To Dead River	3	INT	B	Y	N	N/A	190	75	N	292
3	Greene	A	ISTR-138-03	Trib. to Allen Stream	3	INT	B	Y	N	N/A	295	75	N	306
3	Greene	A	ISTR-140-04	Trib. to Allen Pond	3	INT	B	Y	N	N/A	215	75	N	309
3	Greene	A	ISTR-140-05	Trib. to Allen Pond	3	INT	B	Y	N	N/A	199	75	N	309
3	Starks	D	ISTR-96-04	Trib. to Pelton Brook	3	INT	N/A	Y	Y	N/A	524	75	N	212
3	Jay/Livermore Falls	D	PSTR-121-02	Trib. to Clay Brook	3	PER	B	Y	N	N/A	138	0	N	268, 269
3	Jay	D	PSTR-121-04	Trib. to Clay Brook	3	PER	B	Y	N	N/A	92	0	N	267, 268, 269
3	Livermore Falls	B	PSTR-128-01	Trib. to Androscoggin River	3	PER	C	Y	N	N/A	108	75	Y	282, 283
3	Leeds	B	PSTR-133-01	Trib. to Allen Stream	3	PER	B	Y	N	N/A	113	75	Y	295
3	Starks	D	PSTR-96-02	Trib. to Pelton Brook	3	PER	B	Y	Y	Y	334	75	N	212
3	Livermore Falls	B	ISTR-123-01	Trib. to Clay Brook	4	INT	B	Y	N	N/A	110	75	N	272
3	Livermore Falls	B	PSTR-125-02	Trib. to Androscoggin River	2	INT	C	Y	N	N/A	295	75	Y	277
3	Livermore Falls	B	ISTR-125-05	Trib. to Androscoggin River	4	INT	C	Y	N	N/A	319	75	N	277
3	Leeds	B	ISTR-131-01	Trib. to Dead River	4	INT	B	Y	N	N/A	15	75	Y	289
3	Greene	A	ISTR-138-01	Trib. to Allen Pond	4	INT	B	Y	N	N/A	24	75	N	307

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
3	Greene	A	ISTR-138-02	Trib. to Allen Pond	4	INT	B	Y	N	N/A	194	75	N	307
3	Greene	A	ISTR-140-03	Trib. to Allen Pond	6	INT	B	Y	N	N/A	174	75	Y	310
3	Greene	A	ISTR-141-02	Trib. to Daggett Bog	4	INT	B	Y	N	N/A	200	75	N	312
3	Livermore Falls	B	PSTR-126-02	Trib. to Androscoggin River	4	PER	C	Y	N	N/A	333	75	N	279
3	Livermore Falls	B	PSTR-126-05	Trib. to Androscoggin River	4	PER	C	Y	N	N/A	346	75	N	279
3	Livermore Falls	B	PSTR-127-02	Trib. to Hunton Brook	30	PER	B	Y	N	N/A	426	75	N	281
3	Greene	A	PSTR-139-01	Trib. to Allen Stream	4	PER	B	Y	N	N/A	351	75	Y	307
3	Greene	A	PSTR-139-02	Trib. to Allen Stream	4	PER	B	Y	N	N/A	373	75	N	307
3	Greene	A	PSTR-140-06	Trib to Allen Pond	4	PER	B	Y	N	N/A	354	75	N	310
3	Greene	A	PSTR-140-08	Trib. to Allen Pond	4	PER	B	Y	N	N/A	139	75	Y	309
3	Greene	A	PSTR-140-09	Trib. to Allen Pond	4	PER	B	Y	N	N/A	142	75	N	309
3	Lewiston	A	PSTR-145-01	Trib. to Stetson Brook	4	PER	C	Y	N	Y	8	75	Y	321, 322
3	Anson	D	PSTR-89-02	Trib. to Fahi Brook	5	PER	B	Y	N	N/A	503	75	N	196
3	Livermore Falls	B	PSTR-122-02	Trib. to Clay Brook	5	PER	B	Y	N	N/A	208	75	N	270
3	Livermore Falls	B	PSTR-122-03	Clay Brook/Redwater Brook	5	PER	B	Y	N	N/A	60	75	N	270, 271
3	Livermore Falls	B	PSTR-126-03	Trib. to Androscoggin River	5	PER	C	Y	N	N/A	141	75	N	280

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
3	Lewiston	A	PSTR-146-03	Trib. to Androscoggin River	2	PER	C	Y	N	N/A	419	75	N	323
3	Lewiston	A	PSTR-146-05	Trib. to Androscoggin River	1	PER	C	Y	N	N/A	35	75	N	323
3	Starks	D	PSTR-96-06	Pelton Brook	5	PER	B	Y	Y	Y	336	75	N	213
3	Leeds	B	PSTR-136-01	Trib. to Androscoggin River	6	PER	B	Y	N	N/A	194	75	Y	302
3	Greene	A	PSTR-140-01	Allen Stream	6	PER	B	Y	N	N/A	323	75	N	310
3	Greene	A	PSTR-143-01	Stetson Brook	6	PER	B	Y	N	N/A	26	75	Y	318
3	Greene	A	PSTR-144-01	Trib. to Stetson Brook	6	PER	B	Y	N	Y	32	75	Y	318
3	Livermore Falls	B	ISTR-126-04	Trib. to Androscoggin River	3	INT	C	Y	N	N/A	132	75	Y	280
3	Leeds	B	ISTR-130-01	Trib. to Dead River	8	INT	B	Y	N	N/A	296	75	N	289
3	Leeds	B	PSTR-130-	Dead River	60	INT	B	Y	N	N/A	91	75	N	289
3	Livermore Falls	B	PSTR-122-01	Trib. to Clay Brook	5	PER 100	B	Y	N	N/A	466	0	N	269, 270
3	Livermore Falls	B	PSTR-122-07	Trib. to Clay Brook	5	PER	B	Y	N	N/A	311	0	N	270
3	Greene	A	PSTR-143-02	Stetson Brook	10	PER	B	Y	N	N/A	210	75	N	318
3	Livermore Falls	B	PSTR-125-03	Trib. to Androscoggin River	2	PER	C	Y	N	N/A	42	75	N	277, 278
3	Livermore Falls	B	PSTR-125-04	Trib. to Androscoggin River	4	PER	C	Y	N	N/A	191	75	N	277, 278
3	Livermore Falls	B	PSTR-129-01	Scott Brook	20	PER	B	Y	N	N/A	166	75	N	285, 286
3	Livermore Falls	B	PSTR-127-04	Hunton Brook	4	PER	B	Y	N	N/A	106	75	N	281

clearing needed

- no clearing needed

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
4	Lewiston	A	ISTR-153-01	Trib. to Androscoggin River	3	UNK	C	Y	Y	N/A	120	0	N	340
4	Durham	A	ISTR-156-02	Trib. to Androscoggin River	1	INT	C	Y	Y	N/A	103	0	N	346
4	Durham	A	ISTR-158-01	Trib. to Libby Brook	15	INT	B	N	N	N/A	143	0	N	351
4	Durham	A	ISTR-158-02	Trib. to Libby Brook	2	INT	B	N	N	N/A	134	0	N	351
4	Lewiston	A	ISTR-155-01	Trib. to Androscoggin River	2	INT	C	Y	Y	N/A	127	0	N	343
4	Durham	A	ISTR-157-01	Trib. to House Brook	1.5	INT	B	Y	Y	N/A	116	0	Y	348
4	Pownal	A	ISTR-161-04	Trib. to Runaround Brook	6	INT	B	N	N	N/A	66	0	N	
4	Auburn	A	PSTR-156-01	Trib. to Androscoggin River	2	PER	C	Y	Y	N/A	211	0	N	345
4	Auburn	A	PSTR-156-03	Trib. to Androscoggin River	1	PER	C	Y	Y	N/A	91	0	N	346
4	Auburn	A	PSTR-156-04	Trib. to Androscoggin River	2	PER	C	Y	Y	N/A	165	0	Y	345
4	Auburn	A	PSTR-156-05	Trib. to Androscoggin River	2	PER	C	Y	Y	N/A	90	0	N	346
4	Auburn	A	PSTR-156-06	Trib. to Androscoggin River	2	PER	C	Y	Y	N/A	178	0	N	345
4	Auburn	A	PSTR-156-07	Trib. to Androscoggin River	2	PER	C	Y	Y	N/A	85	0	N	346
4	Durham	A	PSTR-157-02	House Brook	2	PER	B	Y	Y	N/A	105	0	Y	348

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
4	Lewiston	A	ISTR-150-02	Trib. to No Name Brook	3	INT	B	Y	Y	N/A	197	0	Y	333
4	Pownal	A	ISTR-161-02	Trib. to Runaround Brook	3	INT	B	N	N	N/A	117	0	Y	356
4	Lewiston	A	PSTR-146-01	Trib. to Stetson Brook	4	PER	B	Y	N	Y	87	0	N	324
4	Lewiston	A	PSTR-146-02	Trib. to Stetson Brook	4	PER	B	Y	N	Y	144	0	N	324
4	Lewiston	A	PSTR-152-01	Trib. to No Name Brook	3	PER	B	Y	Y	N/A	58	0	N	337
4	Lewiston	A	PSTR-147-01	Trib. to No Name Brook	3.5	PER	C	Y	Y	N/A	80	0	Y	326, 327
4	Lewiston	A	PSTR-148-01	Trib. to No Name Pond	3.5	PER	B	Y	Y	N/A	87	0	Y	329
4	Lewiston	A	ISTR-150-01	Trib. to No Name Brook	4	INT	B	Y	Y	N/A	106	0	Y	332
4	Lewiston	A	PSTR-148-02	Trib. to No Name Pond	4.5	PER	B	Y	Y	N/A	81	0	Y	329
4	Pownal	A	PSTR-161-01	Runaround Brook	5	PER	B	N	N	N/A	15	0	N	358
4	Pownal	A	PSTR-161-03	Runaround Brook	5	PER	B	N	N	N/A	472	0	N	358
4	Auburn	A	PSTR-155-02	House Brook	8	PER	B	Y	Y	N/A	160	0	N	345
4	Durham	A	PSTR-160-01	Runaround Brook	9	PER	B	N	N	N/A	108	0	Y	355
4	Durham	A	PSTR-160-03	Trib. to Runaround Brook	12	PER	B	N	N	N/A	105	0	N	355
4	Durham	A	PSTR-158-03	Libby Brook	15	PER	B	N	N	N/A	47	0	Y	351, 352
4	Lewiston	A	PSTR-151-01	No Name Brook	25	PER	B	Y	Y	N/A	83	0	N	334, 335
4	Lewiston	A	PSTR-147-02	Stetson Brook	50	PER	B	Y	N	Y	86	0	N	325
4	Lewiston	A	PSTR-149-01	No Name Brook	50	PER	B	Y	Y	N/A	90	0	N	330
4	Auburn/ Lewiston	A	PSTR-155-03	Androscoggin River	645	PER	C	Y	Y	N/A	104	0	N	344

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
5	Wiscasset	B	ISTR-183-01	Trib. to Montsweag Brook	2	INT	B	Y	Y	N/A	140	0	N	370
5	Wiscasset	B	ISTR-188-09	Trib. to Back River/Monstweag Bay	3	INT	B	Y	Y	N/A	15,281	0	N	359
5	Whitefield	B	PSTR-171-01	Trib. to Sheespcot River	40	PER	B	Y	Y	Y	355	0	Y	397
5	Whitefield	B	PSTR-172-02	Trib. to Sheespcot River	20	PER	B	Y	Y	Y	101	0	N	395
5	Whitefield	B	ISTR-166-01	Trib. To Finn Brook	2	UNK	N/A	Y	Y	N/A	140	0	N	408
5	Whitefield	B	PSTR-166-	Finn Brook	5	PER	A	Y	Y	Y	395	0	Y	408
5	Whitefield	B	PSTR-168-01	East Branch Eastern River	11	PER	B	Y	Y	N/A	206	0	N	403
5	Whitefield	B	PSTR-168-02	East Branch Eastern River	3	PER	B	Y	Y	N/A	58	0	Y	403
5	Whitefield	B	PSTR-169-01	East Branch Eastern River	5	PER	B	Y	Y	N/A	149	0	Y	402
5	Whitefield	B	ISTR-169-02	Trib. to East Branch Eastern River	2	UNK	B	Y	Y	N/A	296	0	N	402
5	Whitefield	B	ISTR-169-03	Trib. to East Branch Eastern River	2	UNK	N/A	Y	Y	N/A	178	0	Y	402
5	Whitefield	B	ISTR-169-04	Trib. to East Branch Eastern River	1	UNK	N/A	Y	Y	N/A	136	0	N	402
5	Whitefield	B	PSTR-170-01	East Branch Eastern River	9	PER	B	Y	Y	N/A	189	0	Y	399, 400

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
5	Whitefield	B	ISTR-170-02	Trib. to East Branch Eastern River	2	INT	N/A	Y	Y	N/A	129	0	N	400
5	Whitefield	B	PSTR-172-01	Trib. to Sheepscot River	6	PER	B	Y	Y	Y	226	0	N	394
5	Whitefield	B	PSTR-172-03	Trib. to Sheepscot River	2	UNK	N/A	Y	Y	N/A	320	0	N	396
5	Whitefield	B	ISTR-173-01	Trib. to Sheepscot River	3	UNK	N/A	Y	Y	N/A	285	0	Y	392
5	Whitefield	B	PSTR-174-01	Trib. to Sheepscot River	6	PER	B	Y	Y	Y	333	0	Y	391
5	Whitefield	B	ISTR-174-02	Trib. to Sheepscot River	3	UNK	B	Y	Y	Y	385	0	Y	391
5	Whitefield	B	PSTR-174-03	Trib. to Sheepscot River	7	PER	B	Y	Y	Y	366	0	Y	389
5	Whitefield	B	ISTR-174-04	Trib. to Sheepscot River	1	UNK	B	Y	Y	Y	366	0	N	389
5	Whitefield	B	ISTR-175-01	Trib. to Sheepscot River	1	UNK	N/A	Y	Y	N/A	218	0	Y	388
5	Whitefield	B	PSTR-175-02	Trib. to Sheepscot River	3	UNK	B	Y	Y	Y	201	0	Y	388
5	Alna	B	PSTR-176-01	Trib. to Sheepscot River	5	INT	B	Y	Y	Y	209	0	Y	387
5	Alna	B	PSTR-177-01	Trib. to Trout Brook	25	PER	B	Y	Y	Y	107	0	N	383
5	Alna	B	PSTR-178-	Trout Brook	8	PER	A	Y	Y	Y	264	0	N	381, 382
5	Alna	B	PSTR-178-	Trout Brook	15	PER	A	Y	Y	Y	133	0	N	381, 382
5	Alna	B	PSTR-179-02	Trib. to Trout Brook	6	INT	B	Y	Y	N/A	119	0	Y	379, 380
5	Alna	B	PSTR-179-03	Trib. to Trout Brook	6	PER	B	Y	Y	Y	198	0	N	379

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
5	Alna	B	ISTR-180-01	Trib. to Trout Brook	1	INT	B	Y	Y	N/A	112	0	N	377
5	Wiscasset	B	ISTR-181-01	Trib. to Ward Brook	3	UNK	N/A	Y	Y	N/A	82	0	Y	374
5	Wiscasset	B	ISTR-181-02	Ward Brook	2	UNK	B	Y	Y	N/A	114	0	Y	374, 375
5	Wiscasset	B	ISTR-182-01	Trib. Ward Brook	4	UNK	N/A	Y	Y	N/A	247	0	N	373
5	Wiscasset	B	PSTR-183-02	Trib. to Montsweag Brook	0.5	UNK	B	Y	Y	N/A	39	0	Y	370
5	Wiscasset	B	ISTR-183-03	Trib. to Montsweag Brook	2	UNK	B	Y	Y	N/A	94	0	N	370
5	Wiscasset	B	ISTR-184-01	Trib. to Montsweag Brook	1.5	INT	B	Y	Y	N/A	140	0	N	369
5	Woolwich	B	ISTR-184-02	Trib. to Montsweag Brook	2.5	UNK	N/A	Y	Y	N/A	318	0	Y	367
5	Woolwich	B	ISTR-184-03	Trib. To Montsweag Brook	150	UNK	B	Y	Y	N/A	113	0	N	367, 368
5	Woolwich	B	ISTR-184-04	Trib. to Montsweag Brook	2.5	UNK	B	Y	Y	N/A	209	0	Y	367, 368
5	Wiscasset	B	ISTR-184-05	Trib. to Montsweag Brook	3	UNK	B	Y	Y	N/A	253	0	N	369
5	Wiscasset	B	ISTR-184-06	Trib. to Montsweag Brook	2	UNK	B	Y	Y	N/A	195	0	N	369
5	Wiscasset	B	ISTR-184-08	Montsweag Brook	25	UNK	B	Y	Y	N/A	55	0	Y	369
5	Wiscasset	B	ISTR-184-09	Montsweag Brook	30	PER	B	Y	Y	N/A	45	0	N	368, 369
5	Wiscasset	B	ISTR-184-10	Montsweag Brook	2.5	PER	B	Y	Y	N/A	66	0	N	368
5	Woolwich	B	ISTR-185-02	Trib. to Montsweag Brook	2.5	UNK	B	Y	Y	N/A	28	0	N	366

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
5	Woolwich	B	ISTR-185-03	Trib. to Montsweag Brook	1	UNK	B	Y	Y	N/A	23	0	N	366
5	Woolwich	B	ISTR-185-04	Trib. to Montsweag Brook	1	UNK	B	Y	Y	N/A	37	0	N	366
5	Woolwich	B	ISTR-185-05	Trib. to Montsweag Brook	1	UNK	B	Y	Y	N/A	62	0	Y	366
5	Woolwich	B	ISTR-185-06	Trib. to Montsweag Brook	3	UNK	B	Y	Y	N/A	312	0	N	
5	Wiscasset	B	ISTR-186-02	Trib. to Chewonki Creek	1	INT	B	Y	Y	N/A	4,335	0	N	364
5	Wiscasset	B	ISTR-187-01	Trib. to Chewonki Creek	2.5	INT	B	Y	Y	N/A	6,250	0	N	363
5	Wiscasset	B	ISTR-187-02	Trib. to Chewonki Creek	1.5	INT	B	Y	Y	N/A	6,262	0	N	363
5	Wiscasset	B	ISTR-187-03	Trib. to Chewonki Creek	1.5	INT	B	Y	Y	N/A	6,300	0	N	363
5	Wiscasset	B	ISTR-187-05	Trib. to Chewonki Creek	1	INT	B	Y	Y	N/A	6,728	0	N	362, 363
5	Wiscasset	B	ISTR-187-07	Trib. to Chewonki Creek	1	INT	B	Y	Y	N/A	7,099	0	N	362
5	Wiscasset	B	ISTR-187-15	Trib. to Back River/ Monstsweag Bay	1	INT	B	Y	Y	N/A	10,413	0	N	361
5	Wiscasset	B	ISTR-187-16	Trib. to Back River/ Monstsweag Bay	1	INT	B	Y	Y	N/A	10,248	0	N	361
5	Wiscasset	B	ISTR-187-17	Trib. to Back River/ Monstsweag Bay	1	INT	B	Y	Y	N/A	10,265	0	N	361

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
5	Wiscasset	B	PSTR-187-24	Trib. to Chewonki Creek	1.5	PER	B	Y	Y	N/A	8,911	0	N	361, 362
5	Windsor	B	ISTR-162-03	Trib. to West Branch Sheepscot River	2	INT	B	Y	Y	N/A	339	0	N	417
5	Windsor	B	ISTR-162-04	Trib. to West Branch Sheepscot River	2	INT	B	Y	Y	N/A	566	0	N	417
5	Windsor	B	ISTR-162-05	Trib. to West Branch Sheepscot River	2	INT	B	Y	Y	N/A	628	0	N	417
5	Windsor	B	ISTR-162-08	Trib. to West Branch Sheepscot River	2	INT	B	Y	Y	N/A	1,664	0	N	
5	Wiscasset	B	ISTR-187-06	Trib. to Chewonki Creek	2	INT	B	Y	Y	N/A	8,231	0	N	362
5	Wiscasset	B	ISTR-187-08	Trib. to Chewonki Creek	2	INT	B	Y	Y	N/A	7,599	0	N	362
5	Wiscasset	B	ISTR-187-09	Trib. to Chewonki Creek	2	INT	B	Y	Y	N/A	7,709	0	N	362
5	Wiscasset	B	ISTR-187-10	Trib. to Chewonki Creek	2	INT	B	Y	Y	N/A	7,607	0	N	362
5	Wiscasset	B	ISTR-187-11	Trib. to Chewonki Creek	2	INT	B	Y	Y	N/A	7,490	0	N	362
5	Wiscasset	B	ISTR-187-12	Trib. to Chewonki Creek	2	INT	B	Y	Y	N/A	7,409	0	N	362

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
5	Wiscasset	B	ISTR-187-14	Trib. to Chewonki Creek	2	INT	B	Y	Y	N/A	7,906	0	N	362
5	Wiscasset	B	ISTR-188-02	Trib. to Back River/ Monstsweag Bay	2	INT	B	Y	Y	N/A	14,492	0	N	359
5	Wiscasset	B	ISTR-188-03	Trib. to Back River/ Monstsweag Bay	2	INT	B	Y	Y	N/A	13,444	0	N	359, 360
5	Wiscasset	B	ISTR-188-07	Trib. to Back River/ Monstsweag Bay	2	INT	B	Y	Y	N/A	14,547	0	N	359
5	Windsor	B	PSTR-162-02	Trib. to West Branch Sheepscot River	2	PER	B	Y	Y	Y	291	0	N	417
5	Windsor	B	PSTR-162-06	Trib. to West Branch of Sheepscot River	1.5	PER	B	Y	Y	Y	1,595	0	N	
5	Wiscasset	B	ISTR-186-05	Trib. to Montsweag Brook	1.5	INT	B	Y	Y	N/A	2,386	0	N	364, 365
5	Wiscasset	B	ISTR-186-07	Trib. to Montsweag Brook	3	INT	B	Y	Y	N/A	2,193	0	N	365
5	Wiscasset	B	ISTR-188-01	Trib. to Back River/ Monstweag Bay	3	INT	B	Y	Y	N/A	15,388	0	N	359
5	Wiscasset	B	ISTR-188-08	Trib. to Back River/ Monstsweag Bay	3	INT	B	Y	Y	N/A	12,829	0	N	360
5	Wiscasset	B	ISTR-186-01	Trib. to Chewonki Creek	4	INT	B	Y	Y	N/A	5,614	0	N	363

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
5	Wiscasset	B	PSTR-188-04	Trib. to Back River/ Monstsweag Bay	1	PER	B	Y	Y	N/A	12,450	0	Y	360
5	Wiscasset	B	ISTR-187-04	Trib. to Chewonki Creek	5	INT	B	Y	Y	N/A	6,112	0	N	363
5	Windsor	B	PSTR-162-01	Trib. to West Branch Sheepscot River	8	PER	B	Y	Y	Y	265	0	N	417
5	Windsor	B	PSTR-162-09	Trib. to West Branch Sheepscot River	3	PER	B	Y	Y	Y	158	0	N	416, 417
5	Windsor	B	PSTR-162-13	Trib. to West Branch Sheepscot River	1.5	PER	B	Y	Y	Y	778	0	N	417
5	Windsor	B	ISTR-162-07	Trib. to West Branch Sheepscot River	8	INT	B	Y	Y	N/A	268	0	N	417
5	Windsor	B	ISTR-162-14	Trib. to West Branch Sheepscot River	8	INT	B	Y	Y	N/A	53	0	N	416
5	Windsor	B	PSTR-163-01	Trib. to West Branch Sheepscot River	40	PER	AA	Y	Y	Y	319	0	N	415
5	Woolwich	B	PSTR-185-01	Trib. to Montsweag Brook	9.5	PER	B	Y	Y	N/A	559	0	N	365
5	Wiscasset/Woolwich	B	PSTR-186-08	Montsweag Brook	17.5	PER	B	Y	Y	N/A	1,219	0	N	365

Exhibit 7-7: NECEC Waterbody Crossing Table

Segment	Town	MDIFW Region	Feature ID	Stream Name[1]	Ave. Stream Width (ft)[2]	Stream Type (PER/ INT)[3]	State Water Quality Classification[4]	Atlantic Salmon GOM DPS Critical Habitat (Y/N)[5]	Atlantic Salmon Habitat (Y/N)[6]	Brook Trout[7] (Y/N)	Nearest New Structure Location (ft)	Width of Additional Corridor Clearing[8] (ft)	Temp. Equip. Crossing[9] (Y/N)	Natural Resource Map/Sheet Number
5	Windsor	B	PSTR-162-12	Trib. to West Branch Sheepscot River	40	PER	B	Y	Y	Y	362	0	N	416
5	Windsor	B	PSTR-163-02	West Branch Sheepscot River	40	PER	AA	Y	Y	Y	51	0	N	414, 415, 416

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Testimony before the Maine Department of Environmental Protection

By
Malcolm L. Hunter Jr., PhD.
Serving as an Expert Witness for
The Nature Conservancy in Maine

February 25, 2019

RE: Central Maine Power's New England Clean Energy Connect Transmission Proposal

Contents

1. **Background and Credentials**

My name is Malcom L. Hunter, Jr., and I am the Libra Professor of Conservation Biology at the University of Maine, where I have taught for the last 40 years. I was born and raised in Damariscotta, Maine, and I received my Bachelor of Science degree in Wildlife Science from the University of Maine. I received my PhD. in Zoology from Oxford University, where I was a Rhodes Scholar. I am the past president of the Society for Conservation Biology, a global professional organization, and have served on the Editorial Board of the Ecological Society of America.

I have been the lead author or co-author in over 200 professional publications on wildlife and conservation biology, including 47 peer-reviewed journal papers and three books that specifically address the issue of fragmentation. My research has covered a variety of ecosystems and organisms – birds, amphibians, mammals, reptiles, insects, vascular plants, rivers, lakes, wetlands, grasslands, and more – but my major focus is on forest ecosystems and the maintenance of their biological diversity. I am a member of a research team that has studied one forest and the evolving interactions among its vascular plants, amphibians, birds, and small mammals through nearly 40 years. Perhaps most relevant to this project, I also work with ecosystems at large spatial and temporal scales, studying the effects of landscape structure and climate change on global ecosystems. My interests are geographically broad, and I have worked in 30 countries and on every continent except Antarctica. As a researcher and advisor, I interact with a broad spectrum of organizations including the Society for Conservation Biology, The Nature Conservancy, the U.S. Fish and Wildlife Service and U.S. Forest Service, and I have had three gubernatorial appointments to various natural resource advisory groups.

2. **Role in this Project**

I have followed the progression of this project over the past year. As a former Trustee of The Nature Conservancy of Maine, I have been in discussion with Conservancy staff over the past few months about their concerns regarding potential impacts to wildlife habitat. As an intervenor in the DEP proceedings, The Nature Conservancy has taken a neither 'for' nor 'against' position on this project. However, the Conservancy strongly asserts that the project will have significant cumulative and long-term impacts on the region's wildlife, and that the compensation and mitigation currently proposed are inadequate and not commensurate with those impacts. I understand that DEP provides significant latitude for the Department to consider cumulative, landscape-level impacts that extend beyond isolated impacts to specific resources, and I am providing testimony in support of The Nature Conservancy's concerns about these issues.

My testimony represents my own research and perspective and does not reflect the University of Maine. I have received no compensation for this testimony.

3. Habitat Fragmentation and NECEC

Stated simply, ecosystem fragmentation is the gradual breaking apart of a natural landscape into smaller blocks of native vegetation.[1] The impacts of fragmentation have been widely evaluated in the scientific literature, and there are at least hundreds, probably thousands, of peer reviewed publications on this topic. In short, it is widely recognized that fragmentation is one of the leading causes of biodiversity decline across the globe, but its role is context-dependent.

Thus, it's important to carefully consider the landscape in which NECEC is planned. Unlike some characterizations of the region, it is not pristine "wilderness." On the other hand, it is not an intensively managed industrial forest landscape with monoculture crops grown on short rotations, such as characterizes much of New Brunswick's forest. It is an extensively managed, working forest, traversed by logging roads and marked by a patchwork of forests in various age classes and harvest conditions. In multiple parts of its application, CMP argues that in a working landscape such as this, the additional impacts from a powerline corridor are inconsequential. However, it is important to recognize that with the exception of major haul roads, clearing from forest management is ***temporary***, and even industrial forest management requires forests to grow back to maturity before they are harvested again. The results of forest management across the western Maine landscape create a patchwork of age classes that shift over time. Although these shifts are more frequent, and the patches larger, than would occur in a totally natural forest setting (i.e., under a regime of natural disturbance such as windstorm and insect damage), because of the largely intact and connected landscape, over time Maine's wildlife are able to move among these patches. In contrast to these temporary and shifting impacts of forest management, ***the proposed NECEC corridor would be a permanent fragmenting feature, much like the few major forest roads in the region.***

It is also important to note that the *type, orientation,* and *spatial scale* of a fragmenting feature are instrumental in determining the level of impact. A 150-foot wide powerline will create a wider barrier to movement than a typical woods logging road (which may be one-fifth the width of the powerline), and both linear features will create far more edge and have a different impact than a similar area of widely spaced clear cuts.

In addition, we often ask, is a road, pasture, or utility line fragmenting to *what species*? A highly mobile, generalist species such as a black bear will react to a utility corridor very differently than a smaller species that strongly prefers a shaded forest floor, like a spotted salamander or wood frog.

There are no known examples of comparable development projects in Maine that traverse lands mapped as "Resilient and Connected" by The Nature Conservancy. ("Resilient and Connected" lands are those that have been identified, based on land form and land cover, as being most capable of supporting biodiversity as the climate changes.) As a result, because of the scale and location of this project, there are no studies I'm aware of that have assessed impacts in a landscape such as this. Thus, it can be challenging to apply academic studies to specific cases of

[1] Hunter, M.L., Jr., and J. Gibbs. 2007. *Fundamentals of conservation biology* (3rd ed.). Blackwell Publishing. 482 pp.

fragmentation, but I have attempted to draw primarily from those factors and studies that are likely to have implications for the NECEC corridor project.

3.1 Types of Impacts

Fragmentation results in at least three related impacts: immediate loss of forest vegetation, increase in "edge" (i.e., the border between a forest and an opening), and a decrease in the overall amount of "interior" forest. These impacts can have both short-term and long-term impacts.

3.1.1. Habitat Loss and Alteration:

Loss and alteration of ecosystems are the leading causes of biodiversity declines in Maine and worldwide, and climate change is exacerbating these impacts. While the proposed NECEC corridor will retain shrub and herbaceous vegetation cover, Segment 1 is nonetheless a direct loss of nearly 1,000 acres of habitat for forest-dwelling species. According to the 2015 Maine State Wildlife Action plan, Maine is home to more than 800 species of vertebrate wildlife, including more than 200 that are listed as Species of Greatest Conservation Need.[2] For species that have small home ranges, such as the red-backed salamander whose populations can reach one per square yard in northern New England forests[3], the loss of 1,000 acres of forested habitat could impact millions of individuals. Even for larger species, the altered habitat in a utility corridor may serve as a barrier to movement. Biasotto and Kindel[4] report that, "Many studies suggested that the distribution and density of ungulates are affected by powerline RoW, especially when combined with roads. This response may be caused by a higher risk of predation, poor foraging conditions, hindered movement and decreased habitat quality."

3.1.2 Increased Edge and Reduced Interior:

Forest loss associated with a transmission line and associated construction roads is amplified by the edge effects that extend the corridor's impact far into the adjacent forest. At the global scale, forest edges influence more than half of the world's forests and contribute to worldwide declines in biodiversity and ecosystem functions.[5] These changes occur as a result of differences in light and wind exposure at forest edges, associated changes in plant community composition and structure (e.g., forest vs. shrub), introductions of invasive species, and changes in predator/prey relationships. ***Segment 1 of the NECEC will create more than 100 linear miles of permanent new edge habitat in Segment 1 alone.***

Forest edge microclimates are typically windier, warmer, and drier than forest interiors.[6] Because of simple rules of geometry (i.e., a circle has the lowest perimeter to area ratio) the

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[2] https://www.maine.gov/ifw/fish-wildlife/wildlife/wildlife-action-plan.html#greatestneed

[3] Burton, T.M., and G.E. Likens. 1975. Salamander populations and biomass in the Hubbard Brook Experimental Forest, New Hampshire Copeia. 1975:541-546.

[4] Biasotto, L., and A. Kindel, 2018. Power lines and impacts on biodiversity: A systematic review. Environmental Impact Review Assessment 71:110-119.

[5] Pfiefer, M., V. Lefebvre, C.A. Peres, et al. 2017. Creation of forest edges has a global impact on forest vertebrates. *Nature 551*: 187–191.

[6] Hunter, M., and F. Schmiegelow. 2011. Wildlife, Forests, and Forestry: Principles of Managing Forests for Biological Diversity. Prentice Hall, Upper Saddle River, New Jersey, USA. 259 pp

amount of edge is also far greater for long narrow clearings, such as roads and utility corridors, than for more compact clearings of the same size, such as harvested areas. Forest edges are often more favorable to "generalist" species that can adapt to a wide variety of conditions, including raccoons, brown-headed cowbirds, blue jays, and others. As a result, some studies have found greater species richness and abundance in habitat fragments and edges compared to forest interiors.[7] These studies have been used to suggest that the impacts of habitat fragmentation on biodiversity may not be as significant as once considered.

However, generalist species are typically more common, and thus of lower conservation concern, than many species that are restricted to the specific habitat of interior forest. Depending on the species in question the edge impact may extend hundreds of feet into the forest.[8,9] At the global scale, species that live in interior forest and are more likely to be listed as threatened by the International Union for Conservation of Nature (IUCN), reached peak abundances only at sites farther than 200–400 m from forest edges. [10] In particular, smaller-bodied amphibians, larger reptiles, and some medium-sized mammals experience greater reduction from edge effects than other forest-core species.[11] Moreover, "distance from power lines has also been demonstrated as the most important factor determining the choice of nest and rest sites, influencing the movement of migratory birds and acting as a barrier to populations."[12]

In the Northeast U.S., the decline of many ground-nesting forest interior birds has been attributed to increased predation or competition from generalist species.[13] In Maine there are more than two dozen bird speciese.g., black-throated blue warbler, Canada warbler, black-throated green warbler, and wood thrush-- that are associated with forest interiors and are listed as Species of Greatest Conservation Need.[14] Typically these species tend to avoid forest edges and require hundreds of acres of continuous, relatively interior forest to reproduce, as do some mammals with large home ranges, such as American marten.[15] Northeastern forests have been shown to support important breeding grounds for many of these species, and these area-sensitive habitat specialists will decline if the size of habitat blocks falls.[16,17,18]

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[7] Fahrig, L., Arroyo-Rodríguez, V., Bennett, J., et al. 2019. Is habitat fragmentation bad for biodiversity? Biological Conservation 230.

[8] Laurance, W.F., T.E. Lovejoy, H.L. Vasconcelow, et al. 2002. Ecosystem decay of Amazonian forest fragments: A 22 year investigation. *Conservation Biology 16*: 605–618.

[9] Laurance, W.F., J.L.C. Camargo, P.M. Fearnside,et al. 2017. An Amazonian rainforest and its fragments as a laboratory of
global change. *Biological Reviews, 93*(1). 25 pp.

[10] Pfeifer et al 2017.

[11] Pfeifer et al 2017.

[12] Biasotto and Kindel 2018.

[13] Ortega, Y.K., and D.E. Capen. 1999. Effects of forest roads on habitat quality for ovenbirds in a forested landscape. *The Auk, 116*(4): 937–94.

[14] https://www.maine.gov/ifw/fish-wildlife/wildlife/wildlife-action-plan.html#greatestneed

[15] Chapin, T.G., D.J. Harrison, and D.D. Katnik, 1998. Influence of landscape pattern on habitat use by American marten in an industrial forest. *Conservation Biology, 12*: 1327–1337.

[16] Askins, R.A. 2002. Restoring North America's birds: lessons from landscape ecology. Yale University Press, New Haven, Connecticut.

[17] Blake, J.G., and J.R. Karr. 1984. Species composition of bird communities and the conservation benefit of large versus small forests. *Biological Conservation, 30*: 173–187.

As previously noted, most of the land surrounding Segment 1 is privately-owned working forest, traversed by logging roads and marked by a patchwork of forests in various age classes and harvest conditions. Nonetheless, approximately 48% of the forest in the Western Mountains is more than 3,300 feet from a public road or major logging road, which is beyond the distance of most edge effects (McMahon 2018). By contrast, only 5% of forestland in southern Maine is beyond this threshold[19], and globally this figure is about 30%[20]. ***Assuming an edge effect of just 330 feet, the acreage affected by Segment 1 of NECEC jumps roughly five-fold to 5,000 acres, and assuming an edge effect of 1,000 feet, the acreage affected increases nearly fifteen-fold.***

3.1.3 Introduction of Invasive Species

Utility corridors may serve as conduits for the movement and spread of invasive exotic species.[21] Most invasive plant species in Maine thrive on disturbed and early successional sites, such as old fields, roadsides, and utility corridors. Invasive plants such as Japanese honeysuckle, glossy buckthorn, Japanese barberry, and Japanese knotweed have the potential to profoundly alter forest ecosystems by colonizing forest edges, and they may penetrate far into the forest interior, degrading or eliminating habitat for native plants.[22] There are a number of locations in southern Maine such as the Rachel Carson National Wildlife Refuge where this alteration is already occurring.

Overall the region surrounding the proposed NECEC corridor has few invasive species documented, probably because large forest blocks resist woody plant invasions better than land that has a history of agricultural or residential use.[23] The current rarity of invasive plants in the region increases the importance of keeping them out, because after new populations establish in remote locations, they may go undetected or controlled for many years, and control becomes virtually impossible once populations have gained a strong foothold.

3.1.4. Other Impacts

In addition to impacts associated with forest loss and creation of edge, other impacts from utility corridors may include bird and bat collisions with transmission lines, and electromagnetic radiation on wildlife. This is not my area of expertise but I would note that Fernie and Reynolds[24] have reported that exposure of birds to electromagnetic radiation "altered the behavior, physiology, endocrine system, and the immune function of birds, which generally

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[18] Whitcomb, R.F., C.S. Robbins, J.F. Lynch, et al. 1981. Effects of forest fragmentation on avifauna of the eastern deciduous forest. Page 125-205 in R.L. Burgess and D.M. Sharpe (eds.), Springer-Verlag, New York.

[19] McMahon, J. 2018. The Environmental Consequences of Forest Fragmentation in the Western Maine Mountains. Occasional Paper #2 for the Maine Mountain Collaborative.

[20] Haddad, N.M., L.A. Brudvig, J. Clobert, et al. 2015. Habitat fragmentation and its lasting impacts on Earth's ecosystems. American Association for the Advancement of Science. *Science Advances, 1*, 9 pp

[21] Forman, R.T.T., and L.E. Alexander. 1998. Roads and their major ecological effects. *Annual Review of Ecological Systematics 29*: 207–231.

[22] Charry, B. 1996. *Conserving wildlife in Maine's developing landscape*. Maine Audubon Society, Falmouth, Maine.

[23] Mosher, E.S., J.A. Silander, Jr., and A.M. Latimer. 2009. The role of land-use history in major invasions by woody plant species in the northeastern North American landscape. *Biological Invasions 11*: 2317.

[24] Fernie, K.J., and J. Reynolds. 2005. The effects of electromagnetic fields from power lines on avian reproductive biology and physiology: A review. *Journal of Toxicology and Environmental Health, Part B, 8*: 127–140.

resulted in negative repercussions on their reproduction or development. Such effects were observed in multiple species, including passerines, birds of prey, and chickens in laboratory and field situations, and in North America and Europe."

3.2 Cumulative, Long Term Consequences

Many forest fragmentation impacts are not immediate and may in fact take years, or even decades, to fully play out on the landscape. Tere and Parasharya[25] note that, "the cumulative effects of power lines and other sources of mortality might be noticed only after a few decades, making it difficult to reverse population declines." If, for example, is the edge effect of a powerline causes just a 10% decline in reproduction rate of a population deterred from crossing a powerline each year, over many years the cumulative impact of this may have a significant lag time, whereby impacts created today set in motion a population decline that is not fully manifested for years to come. The regulatory framework often falls short in acknowledging cumulative impacts. Bisotto and Kindel[26] note that most impact assessments neglect the long-term effects of transmission lines on biodiversity.

Immediate impacts from fragmentation may be deceiving. In one relevant study in Maine's working forestlands, Hagan et al.[27] found that densities of some forest-dwelling bird species actually increased within a forest patch soon after the onset of fragmentation, reflecting displaced individuals packing into remaining habitat. However, because many forest songbirds are highly territorial during the breeding season, nesting productivity was actually lower in these densely populated habitats.

As noted previously, pine marten in Maine prefer mature forests, and much prior work has focused on quantifying their habitat requirements. Studying marten populations in northern Maine, Legaard et al[28] and Simons-Legaard et al[29] suggest that forest harvest practices on much of Maine's commercial forestland are creating young habitat that no longer serves the needs of marten. As a result, the forest management practices of today are likely to have a detrimental impact on pine marten in the future.[30,31] Indeed, given that marten is an "umbrella species" (i.e., a species whose habitat overlaps the habitat of many other species), we should be concerned that the cumulative impact of logging roads, harvest practices, and powerlines may be creating a challenging future for many other species that use similar habitat.

[25] Tere, A., & Parasharya, B. M., 2011. Flamingo mortality due to collision with high tension electric wires in Gujarat, India. Journal of Threatened Taxa 3: 2192–2201

[26] Biasotto and Kindel 2018.

[27] Hagan, J.M., W.M. Vander Haegen, and P.S. McKinley. 1996. The early development of forest fragmentation effects on birds. *Conservation Biology, 10*: 188–202.

[28] Legaard, K.R., S.A. Sader, and E.M. Simons-Legaard. 2015. Evaluating the impact of abrupt changes in forest policy and management practices on landscape dynamics: Analysis of a Landsat image time series in the Atlantic Northern Forest. *PLoS ONE, 10*(6): e0130428.

[29] Simons-Legaard, E.M., D.J. Harrison, and K.R. Legaard. 2018. Ineffectiveness of local zoning to reduce regional loss and fragmentation of deer wintering habitat for white-tailed deer. *Forest Ecology and Management, 427*: 78–85.

[30] Simons-Legaard, E.M., D.J. Harrison, W.B. Krohn, and J.H. Vashon. 2013. Canada Lynx occurrence and forest management in the Acadian Forest. *The Journal of Wildlife Management, 77*: 567–578.

[31] Simons-Legaard 2018.

In addition to the cumulative impacts cited above, forest fragmentation likely increases the vulnerability of Maine's native flora and fauna to climate change.[32,33] This is true because movements of individuals and ultimately entire populations is the main ways that species respond to climate change. According to McMahon, "The resiliency of the Western Maine Mountains in the face of climate change is largely due to the extent and connectivity of the region's forests."[34] In short, when we consider the long-term, cumulative nature of fragmentation impacts, the forest of western Maine may already be stressed by forestry roads and the addition of the NECEC could, while not the "straw that breaks the camel's back", still be a log that significantly weakens the camel.

4. Shortcomings of the Proposed Mitigation Plan

The NECEC corridor would be one of the largest fragmenting features in the region, and as previously noted, there really is no comparable precedent for assessing the impacts to wildlife connectivity. CMP has made adjustments to its original compensation plan to accommodate for corridor impacts to white-tailed deer (particularly wintering habitat) and a few selected rare species (roaring brook mayfly and northern spring salamander). While deer have been identified in this process because of their regulatory standing, there are approximately 800 species of vertebrate wildlife in Maine and thousands of species of invertebrates, and many hundreds of species are present in the region affected by this corridor. Although habitat fragmentation affects different species in different ways, it is clear that many other species would be affected in addition to deer. These include birds such as scarlet tanager and black-throated blue warbler, mammals including pine marten and Canada lynx, amphibians such as spotted salamander and wood frog, and reptiles such as the wood turtle. ***The proposed mitigation and compensation plan does not adequately address the cumulative impacts to the full array of Maine's wildlife***.

5. Conclusion

Because of the global ecological importance of this region and the substantial length of new corridor, it is challenging to find comparable examples of regulatory review and commensurate mitigation and compensation. It is my contention that, based on the evidence presented above, CMP has not made adequate provisions for the protection of wildlife and fisheries. If in fact the project is permitted, I believe that the DEP should recommend that either: A) the proposed mitigation package needs to be substantially increased (by significantly expanding some of the existing strategies proposed for Segment 1), and/or B) the compensation package needs to be considerably increased to conserve land commensurate with the impacts, as outlined by TNC.

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[32] Fernandez, I.J., C.V. Schmitt, S.D. Birkel, et al. 2015. *Maine's climate future: 2015 update*. University of Maine, Orono, Maine. 24 pp.

[33] Rustad, L., J. Campbell, J.S. Dukes, et al. 2012. *Changing climate, changing forests: The impacts of climate change on forests of the northeastern United States and eastern Canada. Gen. Tech. Rep. NRS-99. USDA Forest Service, Northern Research Station. Newtown Square, Pennsylvania. 48 pp.*

[34] McMahon 2018

By: ________________________
Malcolm L. Hunter, Jr., PhD.

Date: 25 Feb 2019

The above-named Malcolm L. Hunter Jr. did personally appear before me and made oath as to the truth of the foregoing pre-filed testimony.

____
Notary Public/Attorney at Law

Date: 02/25/2019.

My Commission Expires: Althea Tibbetts
Notary Public, State of Maine
My Commission Expires August 12, 2025

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Testimony before the Maine Department of Environmental Protection

By
Rob Wood, Energy Policy and Projects Advisor,
Andy Cutko, Director of Science, and
Bryan Emerson, Mitigation Program Manager, for
The Nature Conservancy in Maine

February 26, 2019

Re: Central Maine Power's New England Clean Energy Connect transmission proposal
DEP Application: L-27625-26-A-N

Thank you for the opportunity to provide testimony on the proposed Central Maine Power (CMP or "the applicant") New England Clean Energy Connect (NECEC) transmission corridor. This testimony is provided by The Nature Conservancy in Maine staff Rob Wood, Energy Policy and Projects Advisor, Andy Cutko, Director of Science, and Bryan Emerson, Mitigation Program Manager.

The Nature Conservancy ("the Conservancy") is a science-based, global conservation organization dedicated to conserving the lands and waters on which all life depends. The Conservancy has been working in Maine for more than 60 years and is the 12th largest landowner in the state. We own and manage some 300,000 acres, all of which are open to the public for a wide variety of uses, including hiking, hunting, canoeing and fishing. We work across the state to restore rivers and streams, rebuild groundfish populations in the Gulf of Maine, and develop solutions to climate change. In 2017, we paid more than $450,000 in property taxes statewide.

One of our properties, the Leuthold Forest Preserve, is directly adjacent to the proposed NECEC corridor. The Leuthold Preserve encompasses 16,934 acres of forest land southwest of Jackman, including Number 5 Mountain and the shorelines of seven ponds. Among the wildlife species found in the Leuthold Preserve are pine marten, Bicknell's thrush, gray jay, boreal chickadee, Blackburnian warbler, and blackpoll warbler. The proposed corridor would run along the southern border of our preserve.

In general, when new energy infrastructure is proposed, the Conservancy seeks to ensure that the planned infrastructure is well-sited and that projected impacts are appropriately addressed through the mitigation hierarchy, which includes avoidance, minimization, and compensation for unavoidable impacts. Although our position in this proceeding is "neither for nor against" a permit being issued, it is our contention that if NECEC is permitted, it must be accompanied by mitigation measures that are commensurate with the projected impacts.

In our testimony below, we address three topics that speak to the siting of the proposed project and the applicant's proposed mitigation actions:

1. Wildlife Habitat and Fisheries (Habitat Fragmentation)
2. Alternatives Analysis
3. Compensation and Mitigation

I. Wildlife Habitat and Fisheries (Habitat Fragmentation)

The Department's second procedural order states that 38 M.R.S. § 480-D (3) and DEP Chapter 375 § 15 are within the scope of the NECEC hearing. DEP Chapter 375 § 15 provides significant latitude for the Department to consider cumulative, landscape-level impacts that extend beyond isolated impacts to specific resources. The relevant Chapter 375 § 15 language is:

> "B) Scope of Review. In determining whether the developer has made adequate provision for the protection of wildlife and fisheries, the Department shall consider **all relevant evidence to that effect**, **such as evidence that**: … **(2) Proposed alterations and activities will not adversely affect wildlife and fisheries lifecycles**." (Emphasis added.)

The phrase "all relevant evidence to that effect" is inclusive of the evidence we present below on the issue of habitat fragmentation. We also believe that the scale and cumulative impact of the habitat fragmentation caused by Segment 1 of the proposed NECEC corridor could potentially "adversely affect wildlife and fisheries lifecycles" for many years into the future.

38 M.R.S. § 480-D (3) provides additional direction to the Department to consider habitat fragmentation. Specifically:

> "3. Harm to habitats; fisheries. The activity will not unreasonably harm any significant wildlife habitat, freshwater wetland plant habitat, threatened or endangered plant habitat, aquatic or adjacent upland habitat, **travel corridor**, freshwater, estuarine or marine fisheries or other aquatic life." (Emphasis added.)

Although the term "travel corridor" can sometimes refer to MDIFW-mapped deer travel corridors, we interpret the term to be applied here more broadly. 38 M.R.S. § 480-D (3) mentions "significant wildlife habitat" and "travel corridors" separately, suggesting that mapped deer travel corridors fall under the definition of "significant wildlife habitat," and the term "travel corridors" is referring to travel corridors for wildlife more generally. As is detailed below, as well as in the expert witness testimony of Dr. Hunter, there are hundreds of fish and wildlife species that use the forests and waters of the region, and many of these species (in addition to deer) would be affected by the cleared NECEC transmission corridor. Habitat fragmentation can deter movement of specific species and therefore consideration of fragmentation is also warranted under this provision.

The global importance of western Maine

Maine's western forest is unique in the eastern United States for its concentration of well-connected and climate-resilient wildlife habitat. The Conservancy is concerned about the potential of NECEC Segment 1 to contribute to new and unprecedented fragmentation of this connected and resilient landscape. In a suburban or developed area, we would be less concerned about habitat fragmentation.

TNC Exhibit 1 displays Conservancy data on the connectedness of landscapes in eastern North America. Landscape connectedness is a measure of how easily wildlife may move from one place to another. It is determined through remote imagery and is strongly influenced by the lack of permanent fragmenting features such as paved roads and development. Western Maine is unique in the eastern United States for lands with above-average to high-connectivity scores. Additional details on these factors, including the data used to create Exhibit 1, is available in Anderson et al (2016).[1]

TNC Exhibit 2 provides the Conservancy's base data layer for connected and resilient lands in the northern Appalachian region, again demonstrating the concentration of well-connected landscapes in western Maine.[2]

TNC Exhibit 3 shows unfragmented forest block data from the State of Maine (the proposed NECEC route is superimposed). At more than 500,000 acres, the forest block through which NECEC would traverse is one of the largest unfragmented forest blocks in the region.

Moreover, western Maine is the core of one of the world's last remaining contiguous temperate broadleaf-mixed forests. **TNC Exhibits 4 and 5** show the original extent (pre-colonization-era) and the current extent of broadleaf-mixed forests globally. This work was informed by a global assessment, using remote imagery, of land uses, forest loss and conversion, and forest cover.[3] Maine has successfully maintained forest connectivity over time while other regions have become increasingly fragmented. The western Maine mountains remain approximately 97 percent forested, well-above the statewide and national average.[4]

Largely for this reason, the western Maine region supports exceptional biodiversity.[5] It contains a diverse range of connected forest ecosystems—including floodplain hardwood forests, boreal forests, alpine tundra, ribbed fens—that provide habitat for roughly 140 rare species and the last stronghold for wild native brook trout in the eastern U.S. As shown in **TNC Exhibit 6**, the

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[1] Anderson, M.G., Barnett, A., Clark, M., Prince, J., Olivero Sheldon, A. and Vickery B. 2016. Resilient and Connected Landscapes for Terrestrial Conservation. The Nature Conservancy, Eastern Conservation Science, Eastern Regional Office. Boston, MA.

[2] Anderson et al. 2016.

[3] Haselon, B, Bryant, D., Brown, M and C. Cheeseman. 2014. Assessing Relatively Intact Large Forest Blocks in the Temperate Broadleaf & Mixed Forests Major Habitat Type. The Nature Conservancy, NY.

[4] New England Forestry Foundation (NEFF) (in press). *Landscape scale resource inventory and wildlife habitat assessment for the Mountains of the Dawn*. New England Forestry Foundation, Littleton, Massachusetts.

[5] McMahon, J. 2018. The Environmental Consequences of Forest Fragmentation in the Western Maine Mountains. Occasional Paper No. 2. Maine Mountains Collaborative, Phillips, Maine.

region has also been mapped by the National Audubon Society as a globally important bird area, providing crucial nesting habitat for more than 30 northern woodland songbird species.

Western Maine is expected to be especially effective at maintaining biodiversity as the climate changes. This resilience to climate change is a function of the region's connectedness, as well as its topographical diversity and resulting diversity of landforms, such as wetlands, floodplains, mountaintops, and steep slopes. These diverse landforms create a variety of microclimates (a range of microclimates will allow species to persist by moving to adjacent microclimates as temperatures change).[6,7] Connected forests allow for greater species movement over time in response to climate change, and western Maine will serve as a key wildlife linkage in the northern Appalachian region.[8]

Habitat fragmentation effects of the proposed NECEC corridor

Habitat fragmentation occurs when continuous habitat is broken into smaller, more isolated patches. Segment 1 of the proposed NECEC corridor would create a new linear fragmenting feature in what is currently a large, mostly unfragmented forest block. We contend that this new fragmentation will have unpredictable implications for the health and viability of wildlife and plant species over time, and that such implications could be significant.

A growing body of research presents findings on the negative impacts of habitat fragmentation, ranging from edge effects (caused by sharp transitions from one habitat to another), to spread of invasive species, to increased pressure from associated uses (such as motorized vehicle use), to changes in species composition and behavior over time from reduced habitat patch sizes.[9] Fragmentation is of particular concern for wildlife species that require mature, closed-canopy forest cover, such as the American marten and many interior forest nesting birds. (Additional information on habitat fragmentation effects is provided in Dr. Hunter's expert witness testimony).

The applicant acknowledges the potential for habitat fragmentation and associated impacts on page 7-23 of the NECEC Site Location of Development Application. The application cites numerous studies and states that, "Transmission line corridors present potential direct impacts, as they may affect species movement, dispersal, density, nesting success and/or survival… For the undeveloped corridor of Segment 1, impact may include fragmentation and creation of new linear edges… Habitat conversion along transmission line corridors results in a loss of habitat types which, in turn, may adversely impact species that are reliant on the original habitat types." ***However, the applicant does not propose any measures to avoid, minimize, or compensate for these impacts***.

[6] Anderson, M.G., M. Clark, and A. Olivero Sheldon. 2012. *Resilient sites for terrestrial conservation in the Northeast and Mid-Atlantic Region*. The Nature Conservancy, Eastern Conservation Science.
[7] Anderson, M.G., M. Clark, C.E. Ferree, A. Jospe, and A. Olivero Sheldon. 2013. *Condition of the northeast terrestrial and aquatic habitats: A geospatial analysis and tool set*. The Nature Conservancy, Eastern Conservation Science. Boston, Massachusetts.
[8] Trombulak, S.C., and R.F. Baldwin (eds.). 2010. *Landscape-scale conservation planning*. Springer, New York.
[9] See *McMahon, J. 2018* references for a full literature review.

On page 7-25 of the Site Location of Development Application, the applicant suggests several reasons for choosing not to address habitat fragmentation. For example, the applicant states, "Some bird species within the NECEC Project area that may be sensitive to forest fragmentation are the long distance, neotropical migrants that rely on forest interior habitats, but plentiful suitable habitat is available near the NECEC Project areas for these interior forest species." While it is true that suitable habitat would remain for these species regionally, our concern is that the linear nature of the cleared right-of-way, coupled with the edge effects that may extend hundreds of feet into the forest, create a permanent area of unsuitable habitat that is several hundred feet wide and more than 53 miles long.

Furthermore, several of the bird species in question that require interior forest—specifically the wood thrush, Canada warbler, black throated blue warbler, and Blackburnian warbler—have been listed as Species of Greatest Conservation Need in the Maine State Wildlife Action Plan due to regional declines in populations, the importance of Maine in the overall breeding range of the species, or both.[10] Therefore, special attention is warranted to impacts to these species' habitat.

Additionally, the applicant states, "Most of the terrestrial mammal species that are likely to be found near the proposed transmission line corridors are likewise not dependent on mature forest." This is partly true; however, as noted in Dr. Hunter's testimony, the American marten does require mature forest and is particularly susceptible to forest clearing,[11] and the marten is considered an "umbrella species" that requires a large home range.[12] Therefore, it is reasonable to assume that a linear corridor, over time, could have negative effects on marten populations.

Finally, the applicant states, "[Segment 1] is located in an intensively managed timber production area and therefore not likely to significantly alter existing fragmentation." The right-of-way will indeed traverse working forest; however, our concerns about habitat fragmentation stem from the linear and permanent nature of the corridor. While there are long-term forest management roads in proximity to the project, these roads are much narrower (typically 20-40 feet wide) than the proposed transmission line. As a result, sustainable forestry does not fragment large forest blocks in the same manner as a wide, linear corridor, which bisects the landscape. A 53.5-mile corridor would create 107 miles of new habitat edge, while business-as-usual timber harvesting will result in significantly less edge—and, moreover, timber harvesting edge will change over time, whereas edge from a new transmission corridor will likely be permanent.

Ultimately, the Conservancy is most concerned about the unknown and largely unpredictable long-term impact of linear habitat fragmentation across a currently well-connected and resilient landscape. The fragmenting effects of utility corridors are less certain, in general, than the effects of paved highways, whose impacts are more readily studied (e.g., species mortality from

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[10] Maine Dept. of Inland Fisheries and Wildlife. 2015. Maine's wildlife action plan. Maine Dept. of Inland Fisheries and Wildlife, Augusta, ME.

[11] Legaard K.R., Sader, S.A., and E.M. Simons-Legaard. 2015. Evaluating the impact of abrupt changes in forest policy and management practices on landscape dynamics: analysis of a Landsat image time series in the Atlantic Northern Forest. PLoS ONE 10(6): e0130428. https://doi.org/10.1371/journal.pone.0130428.

[12] Hunter, M.L., Jr., and J. Gibbs. 2007. *Fundamentals of conservation biology* (3rd ed.). Blackwell Publishing. 482 pp.

automobile collisions). Furthermore, there have been few (if any) projects like the proposed NECEC corridor (53.5 miles through well-connected forest), so there have been few opportunities to study long-term impacts. However, there is ample evidence that habitat fragmentation from a variety of fragmenting features can have cumulative, and significant, negative effects on ecosystems over time, as well as ample research on specific species (e.g., American marten) that are averse to forest edges. Moreover, NECEC could potentially allow for new fragmenting features to develop in the future that could exacerbate habitat fragmentation—for example, new roads to access and service the NECEC line or new energy infrastructure development in the additional 150’ of the Segment 1 right-of-way.

We recommend that the Department consider the full scope of potential habitat fragmentation impacts in its review of the NECEC application. We also recommend that the Department consider approaches to mitigating habitat fragmentation impacts to the maximum extent practicable. For example:

1. Edge effects could be minimized by significantly narrowing the cleared width of the corridor or portions of the corridor. This could be accomplished, for example, by burying additional sections of line and/or using vegetation management techniques to create a narrower, V-shaped corridor (as required for the Bingham Wind Project, DEP application L-25973-24-A-N/L-25973-TG-B-N). Co-location of the corridor or portions of the corridor with the Spencer Road could also reduce new habitat edge.

2. Fragmentation could be minimized using additional wildlife travel corridors similar to those proposed in the Segment 1 Deer Wintering Area. The applicant has proposed allowing 25-35’ vegetation to grow under the wires in this Deer Wintering Area and has proposed raising pole heights in Roaring Brook Mayfly and Northern Spring Salamander habitat to allow forest canopy under the wires. We recommend that these measures be extended to other portions of the corridor. Using remote imagery and in consultation with other wildlife biologists, the Conservancy has identified nine areas totaling 21 miles within Segment 1 where habitat connectivity is a high priority. These high-priority connectivity areas are shown in **TNC Exhibit 7**.

3. Remaining habitat fragmentation could be compensated for through additional land conservation in the affected region (beyond what is proposed as compensation for wetland and other natural resource impacts). Land conservation could minimize the effects of existing habitat fragmentation and/or prevent future fragmentation.

II. Alternatives Analysis

Among the three action alternatives presented in the NRPA Application, the applicant makes a reasonable case that NECEC would be the least damaging. We especially appreciate that the applicant explicitly considers habitat fragmentation in its analysis. On page 2-4, the applicant states:

> CMP’s analysis identified the total length, in miles, of previously-undeveloped transmission line corridor to be developed and considered. To minimize wildlife habitat

> conversion, loss, or fragmentation, the analysis favored transmission line routes that minimized previously undeveloped land requiring clearing and development as a transmission line corridor.

To this point, Alternative 1 was rejected partly based on the projected magnitude of habitat fragmentation impacts (see NRPA Application page 2-10). The applicant also considered total acreage of tree clearing required within the proposed NECEC corridor versus alternatives when conducting its analysis.

We believe the applicant's emphasis on habitat fragmentation in its Alternatives Analysis provides additional rationale for the Department to consider mitigation measures for NECEC's potential habitat fragmentation impacts. In this vein, we believe that it would be reasonable for the Department to request an alternative to be analyzed that includes additional line burial in Segment 1 of the corridor, particularly if line burial were administered in conjunction with alignment of the corridor more closely with the Spencer Road. The Alternatives Analysis already contains an "underground transmission alternative" specific to the Kennebec Gorge; understanding the practicability[13] of underground transmission in Segment 1 of the corridor more generally could be useful in evaluating the proposed NECEC route, especially given that other proposed corridors in northern New England—such as Northern Pass and New England Clean Power Link—have included significant portions of buried line, suggesting that line burial may be logistically, technologically and financially practicable.

Finally, the Conservancy notes that there is an inconsistency in the delineation of the project's "purpose and need." On page 2-1 of the NRPA application, the "purpose and need" is framed in terms of the general purpose to deliver clean energy from Quebec to New England: "The purpose of the NECEC Project is to deliver up to 1,200 MW of Clean Energy Generation from Québec to the New England Control Area1 via a High Voltage Direct Current (HVDC) transmission line, at the lowest cost to ratepayers." On page 2-2, however, the framing shifts from a general purpose to a specific purpose of CMP delivering the energy:

> The no-action alternative, however, would not meet the NECEC Project's purpose of allowing CMP to deliver 1,200 MW of the clean energy generation from Quebec to the New England Control Area at the lowest cost to ratepayers. In addition, even if a non-CMP project could be permitted elsewhere and could economically deliver 1,200 MW of clean energy generation from Quebec to the New England Control Area, such a project would not meet CMP's need to deliver that energy, and such a project would have unknown environmental impacts.

On page 2-3, the frame shifts back to a general purpose: "The three HVDC transmission line routes, which have been considered as part of this analysis, would all meet the purpose and need to deliver clean energy generation from Québec to the New England Control Area." This discrepancy also arose in correspondence between the applicant and the Army Corps of

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[13] DEP Chapter 310, section 5, paragraph A requires, "The activity will be considered to result in an unreasonable impact if the activity will cause a loss in wetland area, functions, or values, and there is a practicable alternative to the activity that would be less damaging to the environment. The applicant shall provide an analysis of alternatives (see Section 9(A)) in order to demonstrate that a practicable alternative does not exist."

Engineers (March 23, 2018 Response to February 23, 2018 USACE Information Request). Clarification of the purpose and need could be useful in evaluating the application and fully understanding the alternatives analysis.

III. Compensation and Mitigation

The Nature Conservancy administers the Maine Natural Resource Conservation Program (MNRCP) under contract with DEP; therefore, we cannot comment on the applicant's proposed compensation and mitigation for wetland and vernal pool impacts. Below we provide testimony on the applicant's proposed mitigation and compensation for cold water fisheries habitat, as well as additional testimony on mitigation pertaining to habitat fragmentation.

Cold Water Fisheries Habitat

Replacing undersized culverts with Stream Smart culverts, as proposed by the applicant, can improve aquatic habitat connectivity. We appreciate the applicant's recognition of the benefits of Stream Smart culvert projects and their proposed funding for such projects.

However, based on our experience, the proposed funding amount of $200,000 will not go as far as the applicant estimates. The applicant's Revised Compensation Plan states that this amount will be "sufficient to replace approximately 20-35 culverts on lands outside of CMP's ownership." The cost of one Stream Smart replacement can range from $50,000 (on logging roads) to several hundred thousand (in high-traffic areas), with an average cost around $120,000. Therefore, if funds are applied directly, the applicant could expect $200,000 to cover a maximum of four culvert replacement projects (or eight if matching funds are leveraged). Achieving the desired number of culvert replacements (20-35) would realistically require a minimum commitment of $1 million, and likely a higher commitment.

The Conservancy also appreciates the applicant's proposal to allow vegetation to grow up to 10 feet in stream buffers (Site Location of Development Application, Exhibit 10-1, pp. 8-9). However, we encourage the applicant to follow MDIFW's recommendation that a "100-foot buffer be maintained along all streams, including perennial, intermittent, and ephemeral streams, within the Project area." (March 15, 2018 MDIFW project review comments, p. 12). The applicant currently proposes riparian buffers within 100 feet of "all perennial streams within the greenfield (Segment 1) portion of the Project, outstanding river segments, or rivers, streams, or brooks containing Threatened or Endangered species… (Site Location of Development Application, Exhibit 10-1, p. 8). At a minimum, more information on the practicability of 100-foot buffers along all streams should be provided.

Extending the scope of the applicant's compensation plan

Page 1 of the applicant's revised Compensation Plan states, "This Plan achieves a *no-net-loss* of ecological functions and values…" (Emphasis added by the applicant.) The Conservancy believes that for no-net-loss of ecological functions and values to be achieved for the proposed project, habitat fragmentation impacts must be addressed alongside impacts to protected natural resources regulated under NRPA.

We believe it is within the Department's discretion to apply the mitigation hierarchy to habitat fragmentation. The Department, in consultation with MDIFW, has required that the applicant propose mitigation for impacts for which mitigation and compensation are not explicitly required in law or regulation, for example impacts to cold water fisheries.

There are approximately 800 species of vertebrate wildlife in Maine and thousands of species of invertebrates, and most of these are present in the region affected by this corridor. While habitat fragmentation affects different species in different ways, many other species would be affected in addition to those specified in the applicant's Compensation Plan.

It is notable that the applicant's proposed mitigation strategies acknowledge that NECEC would impact habitat connectivity. Specifically, the Compensation Plan proposes allowing 25- to 35-foot softwood stands to grow under the lines in the Segment 1 Deer Wintering Area and raising pole heights to allow for greater forest growth in Roaring Brook Mayfly and Northern Spring Salamander habitat. These strategies are certainly a step in the right direction. However, these strategies apply only to a very small portion of the 53.5-mile Segment 1 corridor.

Accounting for habitat edge effects, we estimate that Segment 1 of the proposed NECEC corridor could directly and permanently impact more than 5,000 linear acres of habitat for species that require mature forest. Steps could potentially be taken to avoid, minimize and compensate for this habitat fragmentation impact. As mentioned above, the Conservancy recommends that the Department consider approaches to mitigating habitat fragmentation impacts to the maximum extent practicable. For example:

1. Reducing edge effects by significantly narrowing the cleared width of the corridor or portions of the corridor, either by burying additional sections of line or changing vegetation management practices to narrow the corridor. For example, the Bingham Wind Project was required to narrow its transmission corridor in places and to use V-shaped vegetation management (See DEP application L-25973-24-A-N/L-25973-TG-B-N, Final Order, page 18). Requiring co-location of the line or portions of the line with the Spencer Road would also significantly reduce new habitat edge.

2. Minimizing habitat fragmentation by requiring additional wildlife travel corridors. These would be similar to the applicant's proposed areas of increased vegetation height under the wires in the Segment 1 Deer Wintering Area and Roaring Brook Mayfly and Northern Spring Salamander habitat. We recommend that these measures be extended to other sections of corridor identified as high-priority habitat connectivity areas in **TNC Exhibit 7**.

3. Compensating for remaining habitat fragmentation by reducing or preventing fragmentation elsewhere in the affected region through land conservation. Conservation could come in the form of preservation, working forest conservation easements, or a combination of the two. Applying a 8:1 multiplier for the approximately 5,000 affected acres would indicate compensation of approximately 40,000 acres, and applying a 20:1 multiplier would suggest compensation of approximately 100,000 acres.

Thank you again for the opportunity to provide testimony on the proposed NECEC transmission project. We are happy to answer any questions now or in the future.

Dated: 2/26/19

By: ______________________
Rob Wood

____
Andrew Cutko

____
Bryan Emerson

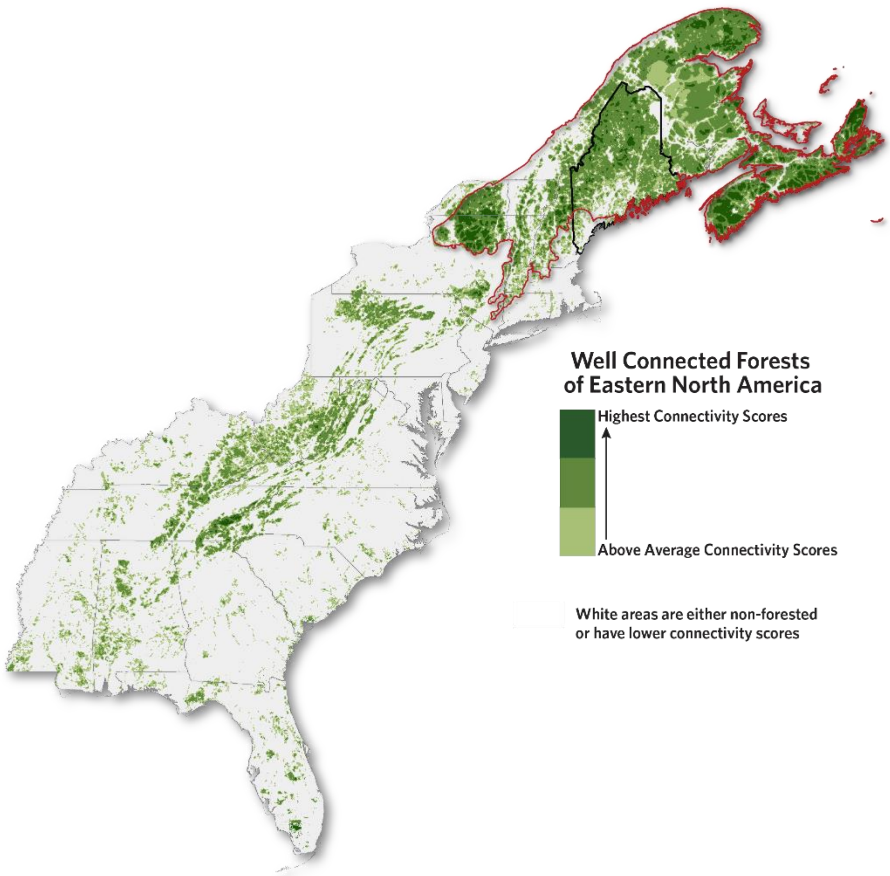
Date: 2/24/2019

The above-named Rob Wood, Andrew Cutko, and Bryan Emerson did personally appear before me and made oath as to the truth of the foregoing pre-filed testimony.

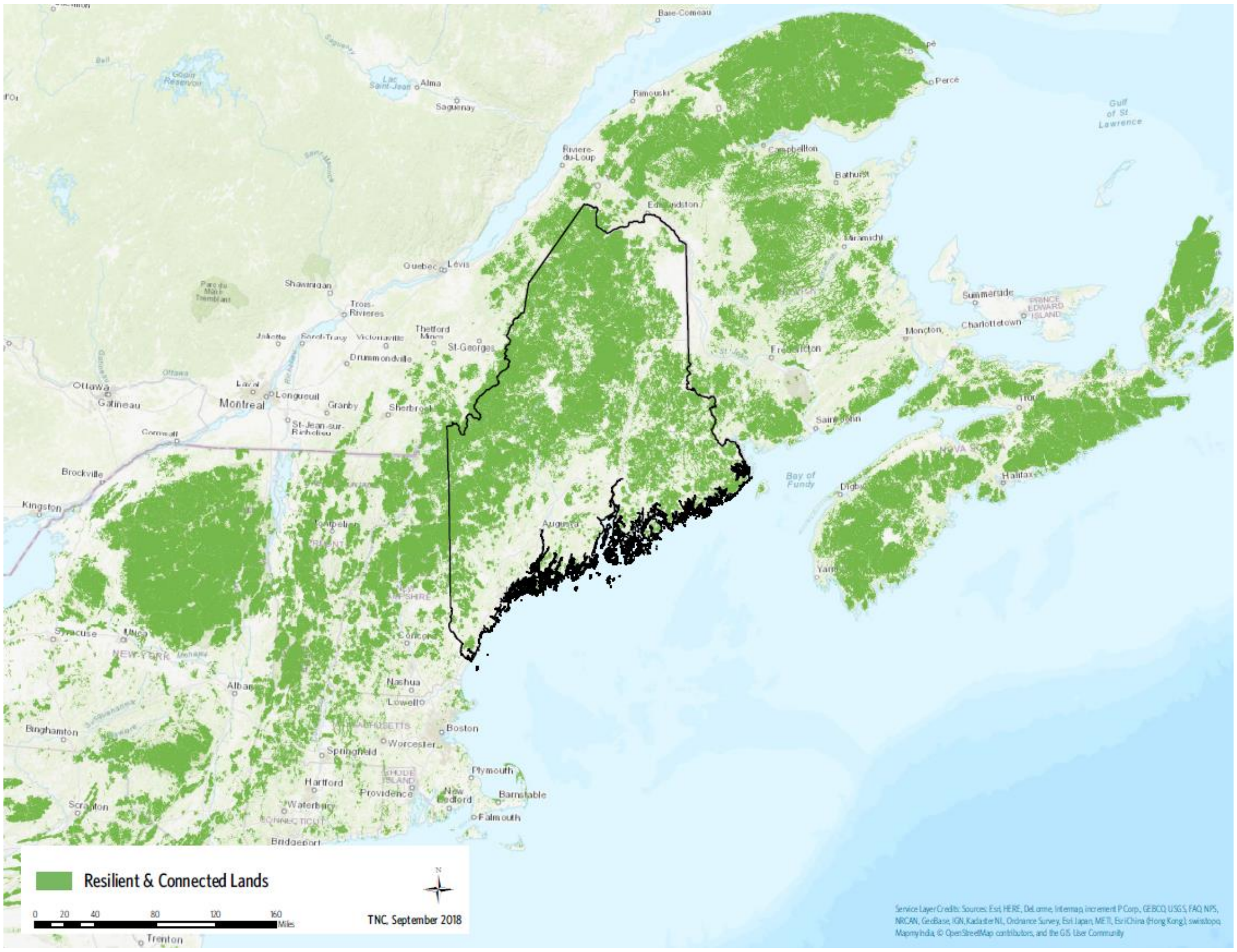
____
Notary Public/Attorney at Law
My Commission Expires: ______

DANIEL J. GRENIER
NOTARY PUBLIC
SAGADAHOC COUNTY
MAINE
MY COMMISSION EXPIRES NOVEMBER 9, 2023

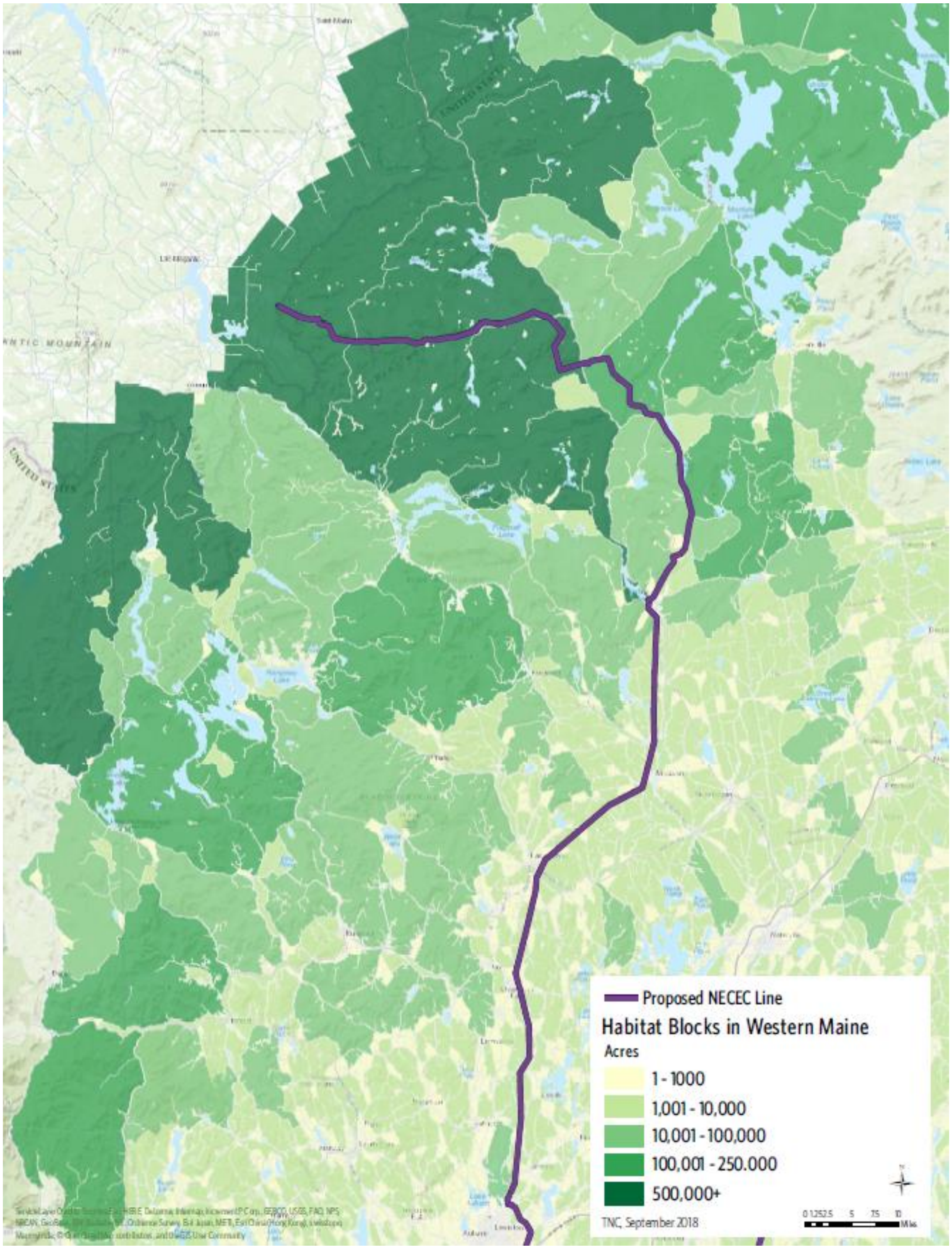
TNC Exhibit 1: Connected and resilient forests of eastern North America (The Nature Conservancy)



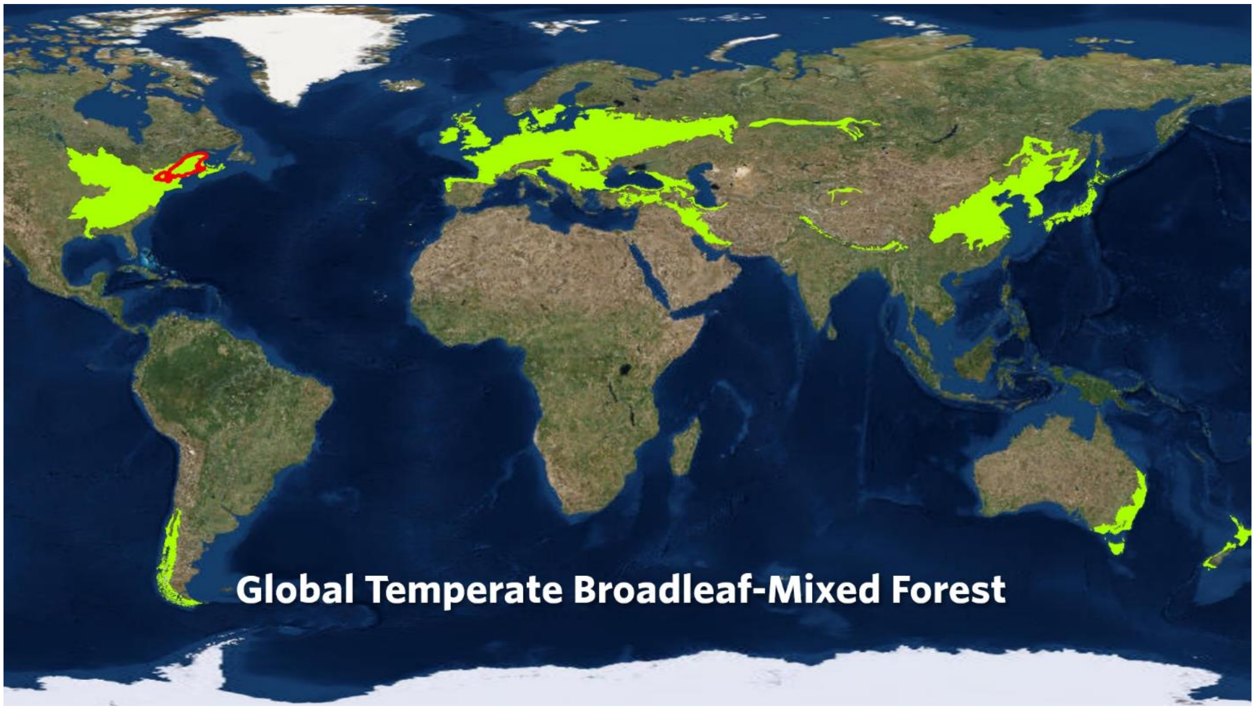
TNC Exhibit 2: Connected and resilient forests of the northern Appalachian region (The Nature Conservancy)



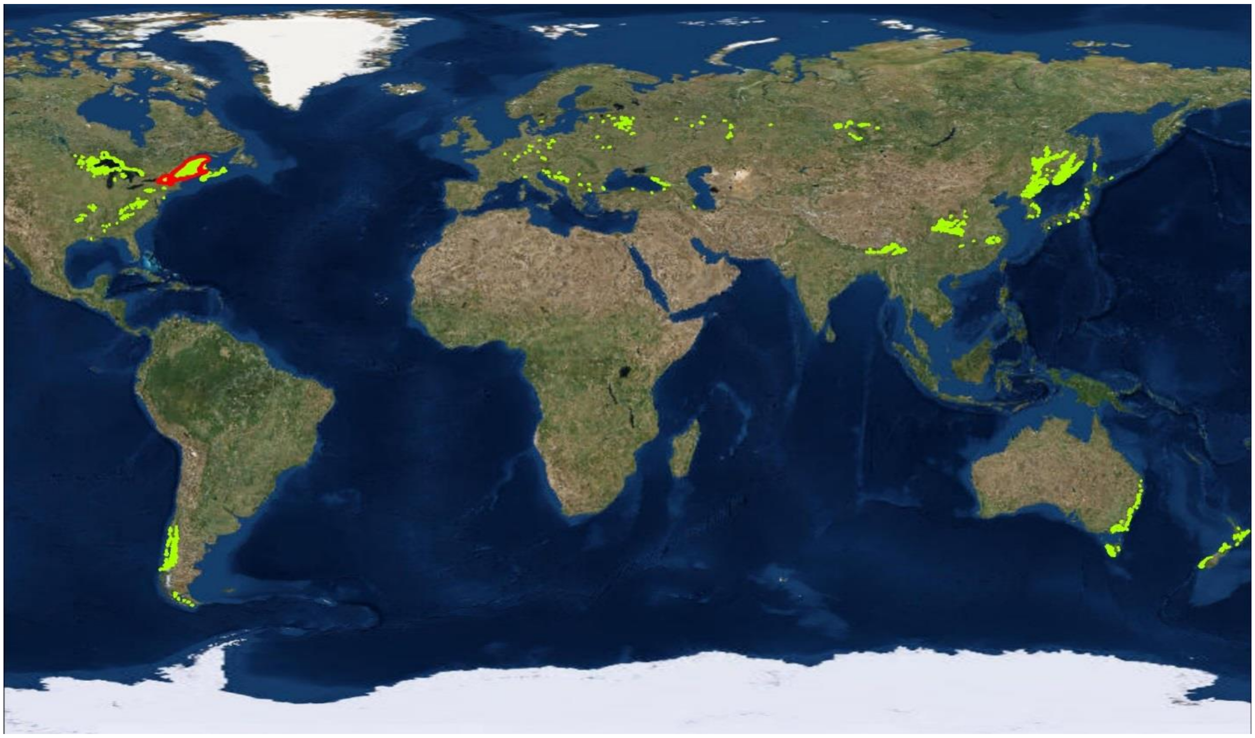
TNC Exhibit 3: Forest blocks in western Maine (State of Maine)



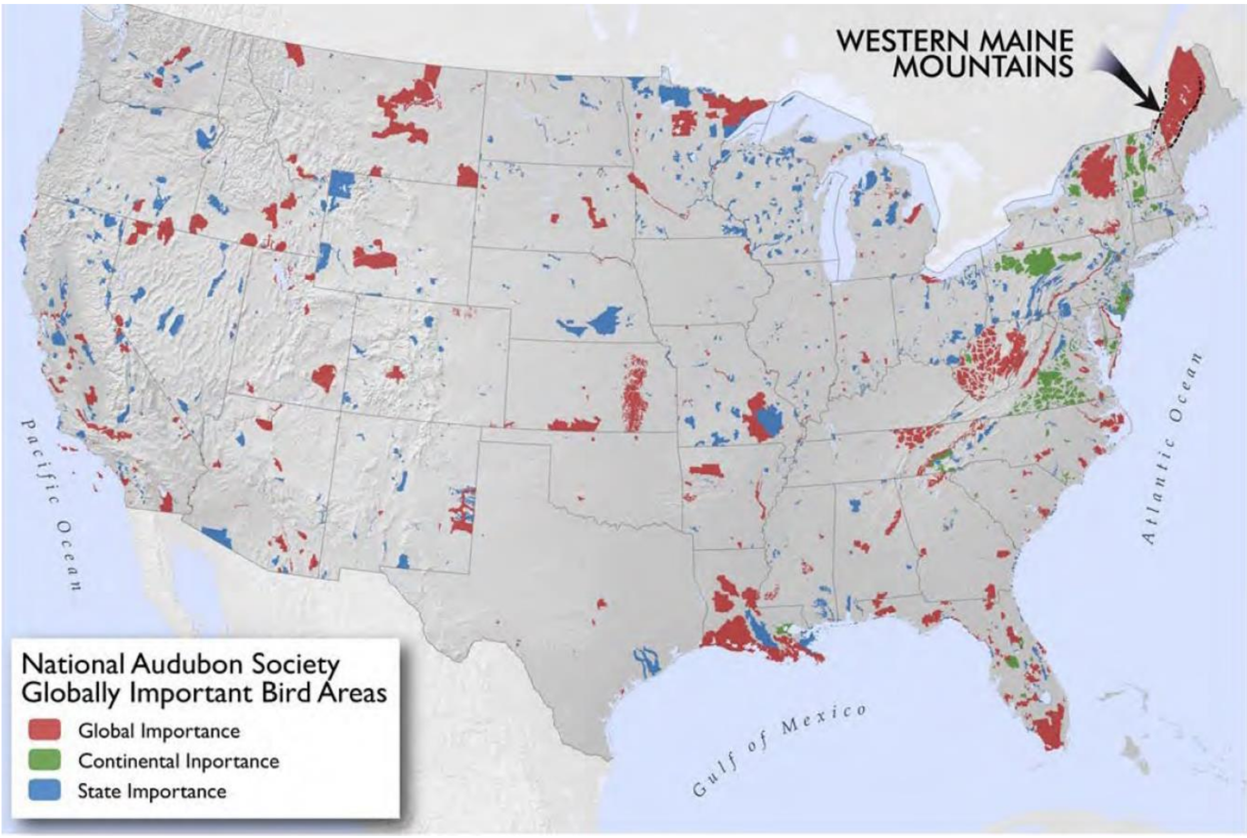
TNC Exhibit 4: Global temperate broadleaf-mixed forests, original extent (The Nature Conservancy)



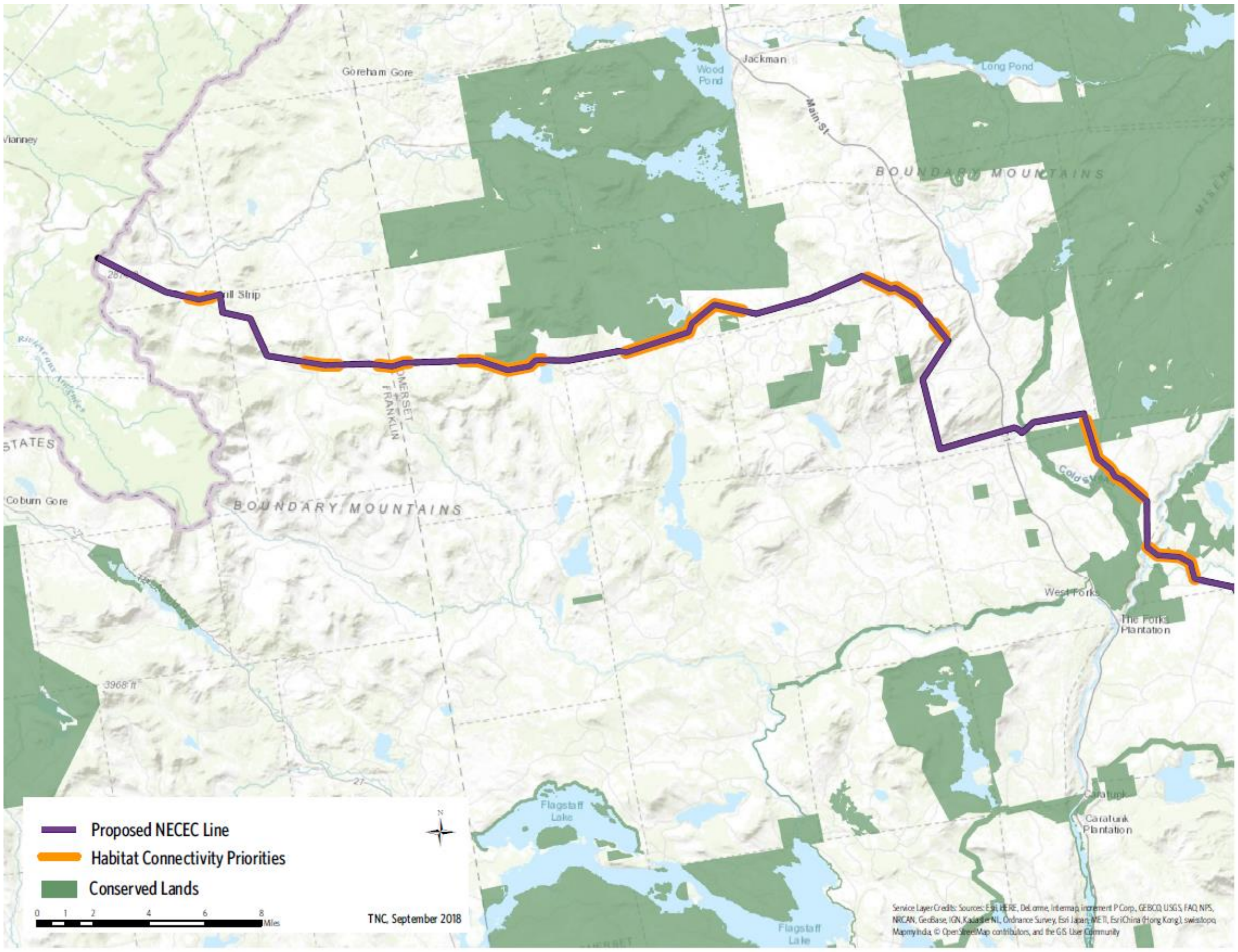
TNC Exhibit 5: Global temperate broadleaf-mixed forests, current extent (The Nature Conservancy)



TNC Exhibit 6: Globally Important Bird Areas in the United States (National Audubon Society)



TNC Exhibit 7: Priority areas for habitat connectivity in the proposed NECEC corridor (The Nature Conservancy)



Testimony before the Maine Department of Environmental Protection

by Dr. Erin Simons-Legaard
Serving as an expert witness for The Nature Conservancy in Maine

May 1, 2019

RE: Central Maine Power's New England Clean Energy Connect Transmission Proposal

Thank you for the opportunity to provide additional testimony on the proposed Central Maine Power New England Clean Energy Connect (NECEC) transmission corridor. My name is Erin Simons-Legaard and I have been a Research Assistant Professor of Forest Landscape Modeling in the University of Maine School of Forest Resources since 2014. I earned my Ph.D. in Wildlife Ecology from the University of Maine in 2009, and my research has focused on understanding the cumulative effects of landscape change and forest management on wildlife habitat and other natural resources.

In response to questions from the Tenth Procedural Order, I have been in discussion with University of Maine colleagues Dan Harrison and Mac Hunter and Nature Conservancy staff regarding further information on pine marten habitat requirements and habitat connectivity. Based on those discussions, I will address five questions from the Procedural Order below. I have also presented an option for a short-term landscape-scale study that could (a) provide further useful information on priority areas of connectivity, and (b) attempt to quantify landscape scale impacts to pine marten habitat.

13. Whether taller poles and travel corridors could provide enough of a link between the habitat on both sides of the corridor for species like the pine marten.

Based on research at the University of Maine and other sources, optimal habitat for pine marten consists of large patches of mature that are greater than 370 acres in area, contain a minimum basal area if 80 ft^2/acre, and are comprised of trees at least 30 feet tall (preferably >40 feet tall) with at least 30% canopy closure in all seasons and frequent snags (dead trees). Because many other wildlife species prefer mature forests with similar characteristics, pine marten are often considered an 'umbrella species', and planning for pine marten habitat often serves the purpose of planning for a wide range of other wildlife. Martens can den in hollow logs, but they prefer to house their young in tree hollows high off the ground. The use of mature forests by martens enables tree-to-tree movement and offers protection from predators including coyotes, foxes, and raptors. Although martens will cross openings and habitat edges including utility corridors, they are typically absent from areas where home ranges would need to comprise >30% unsuitable habitat, such as large forest openings, regenerating forest, roads and road edges, and utility corridors. As a result, taller poles and travel corridors that would allow mature forest conditions to persist would be more favorable to marten and other species that prefer mature, closed-canopy forests.

It is important to note, however, that the dominant influence on pine marten populations in Maine is the condition of the larger forested landscape. In Maine, martens occupy large home ranges, averaging about 650 acres for females and 1150 acres for males. Individuals occupying intensively harvested landscapes experience an elevated risk of mortality due to increased energetic costs of long-distance movement among suitable habitat patches, and in some parts of Maine and the northeast region martens have experienced dramatic population declines over the last few decades because of the cumulative impacts of intensive forest management.

Because the NECEC line represents a long, linear, fragmenting feature that adds considerably to the cumulative impacts of forest harvesting and roads in the region, it is important to emphasize that the optimal siting would involve alignment along existing roads (i.e. Spencer Road and Route 201) to the maximum extent possible. Such alignment along roads could be coupled with burial, raised pole heights, or tapering to further minimize impacts. Absent co-location with existing roads, the next best alternative is raising pole heights to maintain mature forest canopy in the proposed right-of-way.

14. In TNC's nine areas of concern, whether travel corridors must be located within a certain distance of the structures (poles), and what the minimum width would be of the travel corridors in order for species like the pine marten to use them.

Regarding the width of travel corridors, there is no set minimum width threshold for the variety of species that use mature forests. In general, wider is always better for wildlife. However, for species sensitive to edge effects, such as amphibians, a narrow travel corridor would be less likely to be used because much of this forest would essentially be 'edge'. The research literature is clear that pine marten avoid using narrow strips of forest generally, and the most relevant study suggests that marten would avoid habitat corridors less than ~400 feet wide (assuming the corridor otherwise contains appropriate marten habitat conditions). Moreover, narrow strips of conifer forest are more likely to experience wind damage than wider strips.

15. In TNC's nine areas of concern, whether tapering would adequately reduce the forest fragmentation of any clearing.

From a habitat standpoint, taller poles that would allow mature forest would be preferable to tapering in almost all locations. In fact, tapering that resulted in 15' tall forest under the wires (a width of ~70 feet across the corridor) could potentially result in an 'ecological trap' for pine marten, attracting them into sub-optimal habitat and exposing them to predators as noted above. Tapering, combined with wildlife travel corridors, could be somewhat beneficial for interior forest nesting birds—especially if applied in areas that are primarily coniferous—as well as for some amphibians. However, raising pole heights to allow for full forest canopy would be even more beneficial for these species. Tapering may be a reasonable alternative in areas with existing young forest coupled with scenic/visibility concerns. Standard pole heights and vegetation management may be appropriate in areas where the transmission line crosses open wetlands.

16. Locations where tapering vs. taller overhead poles would be preferred

As noted above, from an ecological standpoint, taller poles would be preferable to tapering in almost all locations. Tapering may be preferable in areas with strong visual concerns. It is important to note that because of the need for multiple large patches of mature forest, the condition of the forest adjacent to the transmission lines is critical for species such as pine marten. This condition of the adjacent forest has two implications:

- First, mitigation aimed at maintaining mature forest within the corridor should be targeted to locations more likely to retain mature forest on either side of the corridor. These locations include (a) areas adjacent to conserved lands, and (b) areas that cross stream/riparian zones with statutory restrictions on harvest intensity. These considerations align with most of the nine priority areas for connectivity identified by TNC as well as priority streams and crossing areas identified by Group 4.

- Second, the landscape-scale impacts of the project provide further support for the fact that the cumulative impacts of the transmission line cannot be entirely mitigated by on-site actions. Regardless of the avoidance and minimization measures utilized, there will be unavoidable impacts that should be compensated through a fund for land conservation in the region, and that compensation should include considerations for retaining large patches of mature forestland.

26. *Whether an underground route co-located with Route 201 would be technically feasible, economically viable, and/or a satisfactory option to mitigate concerns raised during the hearing.*

As noted above, my colleagues and I believe that an underground route co-located with Route 201 would be a preferable alternative to mitigate habitat fragmentation concerns. Similarly, an underground route adjacent to the Spencer Road would be preferable to the proposed route.

An Option for Additional Study

In the last several years, my University of Maine colleagues and I have developed sophisticated procedures of using remote imagery (e.g., LANDSAT) to map wildlife habitats and track changes over time[1], and forest landscape models to project habitat changes in the future. We would be interested in discussing ways to incorporate this type of landscape-scale analysis into the overall assessment of NECEC project impacts. Such an analysis could both further inform the mapping of high priority areas for connectivity as well as quantify the impacts on habitat specialists like the pine marten.

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[1] Simons-Legaard, E.M., D.J. Harrison & K. Legaard. 2016. Habitat monitoring and projections for Canada lynx: linking the Landsat archive with carnivore occurrence and prey density. Journal of Applied Ecology 53: 1260-1269. Simons-Legaard, E.M., D.J. Harrison & K. Legaard. 2018. Ineffectiveness of local zoning to reduce regional loss and fragmentation of wintering habitat for white-tailed deer. Forest Ecology and Management 427: 78-85.

By: ______________
Erin Simons-Legaard, Ph.D.

Date: 5/1/19

The above-named Erin Simons-Legaard did personally appear before me and made oath as to the truth of the foregoing pre-filed testimony.

____
Notary Public/~~Attorney at Law~~

Date: May 1, 2019

Althea Tibbetts
Notary Public, State of Maine
My Commission Expires August 12, 2025

My Commission Expires: ________

The Nature Conservancy
Protecting nature. Preserving life.™

Supplemental Testimony before the Maine Department of Environmental Protection

By
Rob Wood, Energy Policy and Projects Advisor,
The Nature Conservancy in Maine

May 1, 2019

Re: Central Maine Power's New England Clean Energy Connect transmission proposal
File Number: NAE-2017-01342

Thank you for the opportunity to provide supplemental testimony in the proceeding on the proposed Central Maine Power (CMP or "the applicant") New England Clean Energy Connect (NECEC) transmission corridor. This testimony addresses alternatives and mitigation, including specific questions posed in the Department's Tenth Procedural Order.

Mitigation priorities

Based on the evidence presented in the hearing to date, The Nature Conservancy (TNC) has developed a general priority order for alternatives and mitigation that reflects the likelihood of avoiding and minimizing habitat fragmentation. Starting with the most effective fragmentation mitigation measures and moving toward less effective, this list is as follows:

1) Co-location with Rte. 201, including undergrounding. This would avoid all new habitat fragmentation impacts.
2) Co-location with the Spencer Road, including undergrounding. This would minimize new habitat fragmentation impacts.
3) Using taller pole structures in the existing right-of-way to allow mature forest (trees at least 30-feet high) to grow under the wires. This could avoid most new impacts by minimizing forest clearing, although the location and size of pole-access roads is an important variable. Any residual impacts could be compensated for with additional land conservation in the affected region. As noted below, in areas of scenic concern, the use of taller pole structures would need to be evaluated against visual impacts.
4) Tapering vegetation and creating wildlife travel corridors in the right-of-way, combined with new land conservation in the affected region. This approach would minimize fragmentation impacts for certain species, but it would still result in significant fragmentation for pine marten, a key umbrella species in this region, and other species that require mature forest. As

such, we would recommend compensation in the form of land conservation to offset any residual fragmentation and protect marten habitat in the region.

We consider all of Segment 1 to be a resource of particular concern and significance. Therefore, **we strongly support mitigation measures for *all of Segment 1*.** As noted in our pre-filed direct testimony, western Maine as whole—including all of Segment 1—is a resource of regional and global significance.

If it is determined infeasible to address all of Segment 1, the areas identified in TNC Supplemental Exhibit 1 are our top priorities for mitigation. This exhibit includes the nine priority areas identified in our pre-filed direct testimony, as well as additional areas identified by Group 4 during the public hearing on April 4, 2019. For the nine areas identified in our pre-filed direct testimony, Universal Transverse Mercator (UTM) coordinates are listed in TNC Supplemental Exhibit 2. The variables used to determine these nine areas include:

- hydrology (rivers and streams);
- wetlands from the National Wetlands Inventory;
- land cover (2018 NAIP imagery);
- Inland waterfowl and wading bird habitats;
- conserved lands; and
- TNC's 'Resilient and Connected' lands coverage.

It is important to note that these nine areas were identified by TNC staff in consultation with other scientists from other conservation organizations. It would be useful to have additional review and input from knowledgeable staff within the Maine Department of Inland Fisheries and Wildlife.

15. In TNC's nine areas of concern, whether tapering would adequately reduce the forest fragmentation of any clearing.

Tapering, combined with wildlife travel corridors, would be preferable to a 150' cleared right-of-way and could benefit certain species. However, as noted by Dr. Simons-Legaard, tapering and wildlife travel corridors—as described in the revised compensation plan—would not meet the habitat needs of the pine marten. Using taller pole structures to allow for mature forest canopy across the right-of-way, or co-locating the line with existing roads (and potentially undergrounding), would better meet marten habitat needs and the needs of interior forest species more generally. If tapering were applied throughout all of Segment 1, we would still recommend significant additional compensation in the form of land conservation in the region to offset residual habitat fragmentation impacts.

16. Locations where tapering vs. taller overhead poles would be preferred.

To avoid and minimize habitat fragmentation, taller overhead poles would always be preferred to tapering. The best method for avoiding and minimizing habitat fragmentation is to allow for mature forest canopy in the right-of-way. Taller overhead poles throughout Segment 1, as described by the applicant for the Mountain Brook and Gold Brook crossings, would largely accomplish this objective.

There are two caveats. First, the location of the roads used to access the poles is an important variable. Even with taller poles in place, if there is a 10-foot wide road running down the length of the corridor, this road would still be a fragmenting feature (especially for marten), albeit a minor one. To the extent that taller poles can be combined with modifications to the access roads, such that more poles are accessed from an angle perpendicular to the ROW (rather than establishing a continuous road within the ROW), this could result in significant stretches where mature forest canopy is fully retained in the ROW. A good example of this preferable outcome is illustrated in Exhibit CMP-3-F of the applicant's pre-filed direct testimony, which shows two short access roads coming off Spencer Road to access poles 3006-732 and 3006-731, allowing for mature forest canopy to be retained across the full right-of-way near these poles. (Note that the same exhibit also demonstrates the residual linear fragmentation caused by the access road that connects poles 3006-735, 3006-734 and 3006-733).

Second, TNC acknowledges and is sensitive to the fact using taller structures could alter the visual impacts of the proposed project. Although we are focused on wildlife and habitat impacts in this permitting process, we understand that scenic impacts are a core concern of other parties, and therefore we encourage the Department to consider additional visual impact analysis incorporating taller pole structures, if necessary. Tapering may be preferred where taller poles would be especially visible, particularly if the corridor would also be crossing early successional forest or wetlands (i.e., not mature forest) in that stretch of corridor.

Relatedly, it is important to understand in more detail how raising pole heights would work in practice. For example, is there a standard pole height, or are poles custom-built for the needed height such that they are no taller than necessary?

We also believe that if a variety of mitigation measures are under consideration, it may be beneficial to conduct additional detailed evaluation of the proposed corridor, in consultation with MDIFW and other parties, that considers variables such as existing forest cover, topography and scenic concerns.

26. Whether an underground route co-located with Route 201 would be technically feasible, economically viable, and/or a satisfactory option to mitigate concerns raised during the hearing.

Yes, an underground route co-located with Route 201 would be a preferable option to mitigate habitat fragmentation concerns raised during the hearing. Regarding whether it is technically feasible and economically viable, TNC does not have the expertise to answer these questions. These are precisely the types of questions that should be answered in a full alternatives analysis.

Additional considerations

Based on the information provided in the applicant's pre-filed rebuttal testimony by Mr. Bardwell and in Group 3's pre-filed sur-rebuttal testimony by Mr. Paquette, we believe that trenching within the existing Segment 1 right-of-way would not be environmentally preferable, as it would result in significant disturbance during line construction and significant permanent clearing in the ROW. However, if it is found feasible to use horizontal directional drilling over significant distances in the existing Segment 1 right-of-way (without termination stations every several thousand feet), we would still encourage further consideration of this technique.

Finally, we note that mitigation measures designed to maintain mature forest canopy in the right-of-way would likely minimize the need for pesticide use. This could be an important co-benefit of these measures.

Thank you again for the opportunity to provide supplemental testimony.

By: ______________________
Rob Wood

Date: 5/1/19

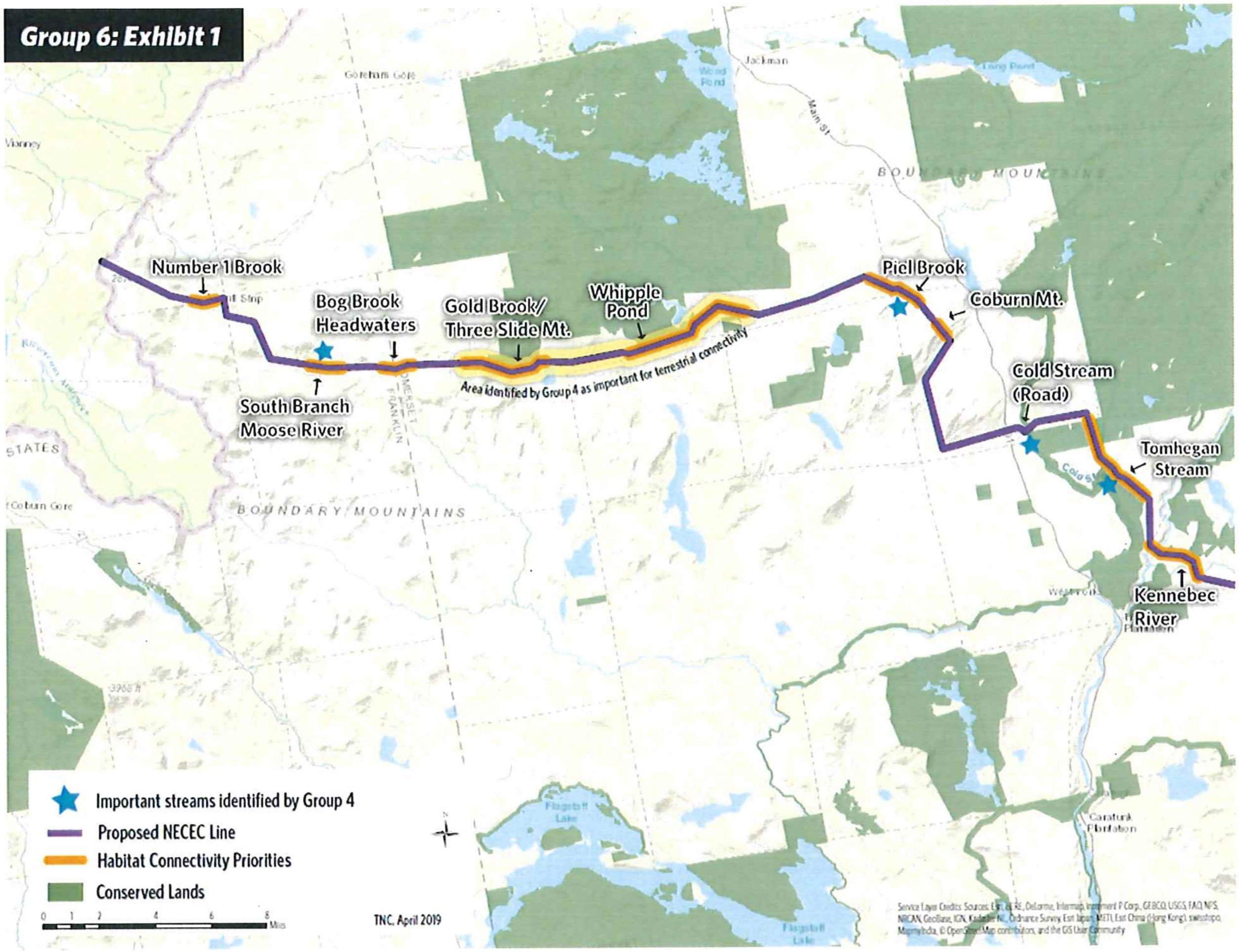
The above-named Rob Wood did personally appear before me and made oath as to the truth of the foregoing pre-filed testimony.

____
Notary Public/Attorney at Law

Date: 1 MAY 2019

My Commission Expires: N/A

TNC Supplemental Exhibit 1: Revised priority connectivity areas map



TNC Supplemental Exhibit 2: UTM coordinates for TNC-identified connectivity areas

Area	POINT_X	POINT_Y
Bog Brook Headwaters - western point	381705.0002	5035531.798
Bog Brook Headwaters - eastern point	383393.5418	5035673.454
Whipple Pond - western point	395911.4481	5036268.186
Whipple Pond - eastern point	402555.1709	5038644.645
Piel Brook - western point	409762.2505	5040509.549
Piel Brook - eastern point	412572.5583	5039175.624
Coburn Mtn. - western point	413628.0425	5037880.552
Coburn Mtn. - eastern point	414152.547	5037226.54
Tomhegan Stream - western point	422282.8985	5032355.803
Tomhegan Stream - eastern point	425510.8216	5027984.878
Number 1 Brook - western point	370814.0355	5039410.288
Number 1 Brook - eastern point	372085.4133	5039441.914
Gold Brook/ Three Slide Mtn. - eastern point	391066.7409	5035834.8
Gold Brook/ Three Slide Mtn. - western point	386475.5749	5035772.419
South Branch Moose River - western point	377527.0164	5035690.695
South Branch Moose River - eastern point	379352.8315	5035529.837
Kennebec River - western point	425839.5454	5025091.18
Kennebec River - eastern point	428548.5968	5023299.963

Relevant Review Criteria

- <u>Site Location of Development Law (Site Law) 38 M.R.S. §§ 481-489-E</u>

  - 38 M.R.S. § 484-1 **Financial capacity and technical ability**. The developer has the financial capacity and technical ability to develop the project in a manner consistent with state environmental standards and with the provisions of this article. The commissioner may issue a permit under this article that conditions any site alterations upon a developer providing the commissioner with evidence that the developer has been granted a line of credit or a loan by a financial institution authorized to do business in the State as defined in Title 9-B, section 131, subsection 17-A or with evidence of any other form of financial assurance the board determines by rule to be adequate.

  - 38 M.R.S. § 484-3. **No adverse effect on the natural environment**. The developer has made adequate provision for fitting the development harmoniously into the existing natural environment and that the development will not adversely affect existing uses, scenic character, air quality, water quality or other natural resources in the municipality or in neighboring municipality.

    F. In making a determination under this subsection regarding a structure to facilitate withdrawal of groundwater, the department shall consider the effects of the proposed withdrawal on waters of the State, as defined by section 361-A, subsection 7; water-related natural resources; and existing uses, including, but not limited to, public or private wells, within the anticipated zone of contribution to the withdrawal. In making findings under this paragraph, the department shall consider both the direct effects of the proposed water withdrawal and its effects in combination with existing water withdrawals.

    G. In making a determination under this subsection regarding an expedited wind energy development, as defined in Title 35-A, section 3451, subsection 4, or an offshore wind power project with an aggregate generating capacity of 3 megawatts or more, the department shall consider the development's or project's effects on scenic character and existing uses related to scenic character in accordance with Title 35-A, section 3452.

    H. In making a determination under this subsection regarding a development's effects on significant vernal pool habitat, the department shall apply the same standards applied to significant vernal pool habitat under rules adopted pursuant to the Natural Resources Protection Act. The department may not require a buffer strip adjacent to significant vernal pool habitat unless the buffer strip is established for another protected natural resource as defined in section 480-B, subsection 8.

- <u>Department Rules Chapter 373: Financial and Technical Capacity Standards of the Site Location of Development Act.</u>

- 2. Financial Capacity

  A. Standard. The applicant shall have financial capacity to design, construct, operate, and maintain the development in a manner consistent with state environmental standards and the provisions of the Site Law. The applicant must have the financial capacity for all aspects of the development, and not solely the environmental protection aspects. Evidence of financial capacity must be provided prior to a decision on an application, except, pursuant to 38 M.R.S. §484(1), the Department may defer a final finding on financial capacity by placing a condition on a permit that requires the permittee to provide final evidence of financial capacity before the start of any site alterations.

- Department Rules Chapter 375: No Adverse Environmental Effect Standards of the Site Location of Development Act.
  - 2. No Unreasonable Alteration of Climate

    A. Preamble. The Department recognizes the potential of large-scale, heavy industrial facilities, such as power generating plants, to affect the climate in the vicinity of their location by causing changes in climatic characteristics such as rainfall, fog, and relative humidity patterns.

    B. Scope of Review. In determining whether the proposed development will cause an unreasonable alteration of climate, the Department shall consider all relevant evidence to that effect.

  - 9. Buffer Strips

    A. Preamble. The Department recognizes the importance of natural buffer strips in protecting water quality and wildlife habitat. The Department also recognizes that buffer strips can serve as visual screens which can serve to lessen the visual impact of incompatible or undesirable land uses. The width and nature of buffer strips, if required, shall be determined by the Department on a case-by-case basis.

    B. Scope of Review. In determining whether the developer has made adequate provision for buffer strips, when appropriate, the Department shall consider all relevant evidence to that effect, such as evidence that:

    (1) Water bodies within or adjacent to the development will be adequately protected from sedimentation and surface runoff by buffer strips.

    (2) Buffer strips will provide adequate space for movement of wildlife between important habitats.

  - 14. No Unreasonable Effect on Scenic Character

A. Preamble. The Department considers scenic character to be one of Maine's most important assets. The Department also feels that visual surroundings strongly influence people's behavior.

B. Scope of Review. In determining whether the proposed development will have an unreasonable adverse effect on the scenic character of the surrounding area, the Department shall consider all relevant evidence to that effect, such as evidence that:

(1) The design of the proposed development takes into account the scenic character of the surrounding area.

(2) A development which is not in keeping with the surrounding scenic character will be located, designed and landscaped to minimize its visual impact to the fullest extent possible.

(3) Structures will be designed and landscaped to minimize their visual impact on the surrounding area.

- **15. Protection of Wildlife and Fisheries**

A. Preamble. The Department recognizes the need to protect wildlife and fisheries by maintaining suitable and sufficient habitat and the susceptibility of certain species to disruption and interference of lifecycles by construction activities.

B. Scope of Review. In determining whether the developer has made adequate provision for the protection of wildlife and fisheries, the Department shall consider all relevant evidence to that effect, such as evidence that:

(1) A buffer strip of sufficient area will be established to provide wildlife with travel lanes between areas of available habitat.

(2) Proposed alterations and activities will not adversely affect wildlife and fisheries lifecycles.

(3) There will be no unreasonable disturbance to:

(a) High and moderate value deer wintering areas.

(b) Habitat of any species declared threatened or endangered by the Commissioner, Maine Department of Inland Fisheries and Wildlife or the Director of the U.S. Fish and Wildlife Service.

(d) Significant vernal pools;

(e) High and moderate value waterfowl and wading bird habitat; and

- The Natural Resources Protection Act (NRPA), 38 M.R.S. §§ 480-A through 480-JJ

  o 38 M.R.S. § 480-D(1): **Existing uses**. The activity will not unreasonably interfere with existing scenic, aesthetic, recreational or navigational uses.

  o 38 M.R.S. § 480-D(3): **Harm to habitats; fisheries.** The activity will not unreasonably harm any significant wildlife habitat, freshwater wetland plant habitat, threatened or endangered plant habitat, aquatic or adjacent upland habitat, travel corridor, freshwater, estuarine or marine fisheries or other aquatic life.

  o 38 M.R.S. § 480-D(8): **Outstanding river segments**. If the proposed activity is a crossing of any outstanding river segment as identified in section 480-P, the applicant shall demonstrate that no reasonable alternative exists which would have less adverse effect upon the natural and recreational features of the river segment.

o Department Rules Chapter 310, Wetlands and Waterbodies Protection

  o Chapter 310, § 4: **Wetlands of Special Significance.** All coastal wetlands and great ponds are considered wetlands of special significance. In addition, certain freshwater wetlands are considered wetlands of special significance.

  o Chapter 310, § 5: **General Standards.** The following standards apply to all projects as described in Section 2.

    A. Avoidance. The activity will be considered to result in an unreasonable impact if the activity will cause a loss in wetland area, functions, or values, and there is a practicable alternative to the activity that would be less damaging to the environment. The applicant shall provide an analysis of alternatives (see Section 9(A)) in order to demonstrate that a practicable alternative does not exist.

    B. Minimal Alteration. The amount of wetland to be altered must be kept to the minimum amount necessary.

    C. Compensation. Compensation is the off-setting of a lost wetland function with a function of equal or greater value. The goal of compensation is to achieve no net loss of wetland functions and values. Every case where compensation may be applied is unique due to differences in wetland type and geographic location. For this reason, the method, location and amount of compensation work necessary is variable.

    In some instances, a specific impact may require compensation on-site or within very close proximity to the affected wetland. For example, altering a wetland that is providing stormwater retention which reduces the risk of flooding downstream will likely require compensation work to ensure no net increase in flooding potential. In other cases, it may not be necessary to compensate on-site in order to off-set project impacts. Where wetland priorities have been established at a local, regional or state level, these priorities should be considered in devising a compensation plan in the area to allow the applicant to look beyond on-site and in-kind compensation possibilities.

(1) When required. Compensation is required when the department determines that a wetland alteration will cause a wetland function or functions to be lost or degraded as identified by a functional assessment (see paragraph 2 below) or by the department's evaluation of the project. If a functional assessment is not required under this rule, no compensation will be required unless the department identifies wetland functions that will be lost or degraded.

(2) Functional assessment. Resource functions that will be lost or degraded are identified by the department based upon a functional assessment done by the applicant and by the department's evaluation of the project. The functional assessment must be conducted in accordance with Section 9(B)(3) for all activities except for those listed in Section 5(C)(6) below.

(3) Location of compensation projects. The compensation must take place in a location:

(a) On or close to a project site as necessary to off-set direct impacts to an aquatic ecosystem;

(b) Otherwise, compensation may occur in an off-site location where it will satisfy wetland priority needs as established at the local, regional or state level to achieve an equal or higher net benefit for wetland systems, if approved by the department.

(4) Types of compensation. Compensation may occur in the form of:

(a) Restoration of previously degraded wetlands;

(b) Enhancement of existing wetlands;

(c) Preservation of existing wetlands or adjacent uplands where the site to be preserved provides significant wetland functions and might otherwise be degraded by unregulated activity; or

(d) Creation of wetland from upland.

More than one method of compensation may be allowed on a single project. Preference is generally given to restoration projects that will off-set lost functions within, or in close proximity to, the affected wetland. However, other types of compensation may be allowed by the department if the result is an equal or higher overall net benefit for wetland systems.

- Chapter 310, § 9(A): **Alternatives Analysis.** A report that analyzes whether a less environmentally damaging practicable alternative to the proposed alteration, which meets the project purpose, exists. Determining whether a practicable alternative exists includes:
  (1) Utilizing, managing or expanding one or more other sites that would avoid the wetland impact;
  (2) Reducing the size, scope, configuration or density of the project as proposed, thereby avoiding or reducing the wetland impact;
  (3) Developing alternative project designs, such as cluster development, that avoid or lessen the wetland impact; and
  (4) Demonstrating the need, whether public or private, for the proposed alteration.

(5) Compensation amounts. The amount of compensation required to replace lost functions depends on a number of factors including: the size of the alteration activity; the functions of the wetland to be altered; the type of compensation to be used; and the characteristics of the compensation site. Compensation shall be performed to meet the following ratios at a minimum, unless the department finds that a different ratio is appropriate to directly off-set wetland functions to achieve an equal or higher net benefit for wetlands:

(a) 1:1 for restoration, enhancement or creation to compensate for impacts in wetlands not of special significance;

(b) 2:1 for restoration, enhancement or creation to compensate for impacts in wetlands of special significance;

(c) 8:1 for preservation, including adjacent upland areas, to compensate for impacts in all wetlands.

- **D. No Unreasonable Impact**

(1) Even if a project has no practicable alternative and the applicant has minimized the proposed alteration as much as possible, the application will be denied if the activity will have an unreasonable impact on the wetland. "Unreasonable impact" means that one or more of the standards of the Natural Resources Protection Act, 38 M.R.S. §480-D, will not be met. In making this determination, the department considers:

(a) The area of wetland that will be affected by the alteration and the degree to which the wetland is altered, including wetland beyond the physical boundaries of the project;

(b) The functions and values provided by the wetland;

(c) Any proposed compensation and the level of uncertainty regarding it; and

(d) Cumulative effects of frequent minor alterations on the wetland.

(2) Activities may not occur in, on or over any wetland of special significance containing threatened or endangered species unless the applicant demonstrates that:

(a) The wetland alteration will not disturb the threatened or endangered species; and

(b) The overall project will not affect the continued use or habitation of the site by the species.

When considering whether a single activity is reasonable in relation to the direct and cumulative impacts on the resource, the department considers factors such as the degree of harm or benefit to the resource; the frequency of similar impacts; the duration of the activity and ability of the resource to recover; the proximity of the activity to protected or highly developed areas; traditional uses; the ability of the activity to perform as intended; public health or safety concerns addressed by the activity; and the type and degree of benefit from the activity (public, commercial or personal).

- <u>Department Rules Chapter 315, Assessing and Mitigating Impacts to Existing Scenic and Aesthetic Uses</u>

    - Chapter 315, § 4: **Scope of Review.** The potential impacts of a proposed activity will be determined by the Department considering the presence of a scenic resource listed in Section 10, the significance of the scenic resource, the existing character of the surrounding area, the expectations of the typical viewer, the extent and intransience of the activity, the project purpose, and the context of the proposed activity. Unreasonable adverse visual impacts are those that are expected to unreasonably interfere with the general public's visual enjoyment and appreciation of a scenic resource, or those that otherwise unreasonably impair the character or quality of such a place.

    - Chapter 315, § 5(H): **Scenic Resource.** Public natural resources or public lands visited by the general public , in part for the use, observation, enjoyment, and appreciation of natural or cultural visual qualities. The attributes, characteristics, and features of the landscape of a scenic resource provide varying responses from, and varying degrees of benefits to, humans.

    - Chapter 315, § 7: **Visual impact assessments.** The Department may require a visual impact assessment if a proposed activity appears to be located within the viewshed of, and has the potential to have an unreasonable adverse impact on, a scenic resource listed in Section 10. An applicant's visual impact assessment should visualize the proposed activity and evaluate potential adverse impacts of that activity on existing scenic and aesthetic uses of a protected natural resource within the viewshed of a scenic resource, and to determine effective mitigation strategies, if appropriate. If required, a visual impact assessment must be prepared by a design professional trained in visual assessment procedures, or as otherwise directed by the Department.

In all visual impact assessments, scenic resources within the viewshed of the proposed activity must be identified and the existing surrounding landscape must be described. The assessment must be completed following standard professional practices to illustrate the proposed change to the visual environment and the effectiveness of any proposed mitigation measures. The radius of the impact area to be analyzed must be based on the relative size and scope of the proposed activity given the specific location. Areas of the scenic resource from which the activity will be visible, including representative and worst-case viewpoints, must be identified. Line-of-sight profiles constitute the simplest acceptable method of illustrating the potential visual impact of the proposed activity from viewpoints within the context of its viewshed. A line-of-sight profile represents the path, real or imagined, that the eye follows from a specific point to another point when viewing the landscape. See Appendix A for guidance on line-of-sight profiles. For activities with more sensitive conditions, photosimulations and computer-generated graphics may be required.

A visual impact assessment must also include narratives to describe the significance of any potential impacts, the level of use and viewer expectations, measures taken to avoid and minimize visual impacts, and steps that have been incorporated into the activity design that may mitigate any potential adverse visual impacts to scenic resources.

- **8. Mitigation.** In the case where the Department determines that the proposed activity will have an adverse visual impact on a scenic resource, applicants may be required to employ appropriate measures to mitigate the adverse impacts to the extent practicable. Mitigation should reduce or eliminate the visibility of the proposed activity or alter the effect of the activity on the scenic or aesthetic use in some way. The Department will determine when mitigation should be proposed and whether the applicant's mitigation strategies are reasonable. The Department may require mitigation by requesting that the applicant submit a design that includes the required mitigation or by imposing permit conditions consistent with specified mitigation requirements.

  In its determination whether adverse impacts to existing scenic and aesthetic uses are unreasonable, the Department will consider whether the applicant's activity design is visually compatible with its surroundings, incorporating environmentally sensitive design principles and components according to the strategies described below.

  A. Planning and siting**.** Properly siting an activity may be the most effective way to mitigate potential visual impacts. Applicants are encouraged, and may be required, to site a proposed activity in a location that limits its adverse visual impacts within the viewshed of a scenic resource.

  B. Design. When circumstances do not allow siting to avoid visual impacts on a scenic resource, elements of particular concern should be designed in such a way that reduces or eliminates visual impacts to the area in which an activity is located, as viewed from a scenic resource. Applicants should consider a variety of design methods to mitigate potential impacts, including screening, buffers, earthen berms, camouflage, low profile, downsizing, non-standard materials, lighting, and other alternate technologies.

- **Scenic resources.** The following public natural resources and public lands are usually visited by the general public, in part with the purpose of enjoying their visual quality. Under this rule, the Department considers a scenic resource as the typical point from which an activity in, on, over, or adjacent to a protected natural resource is viewed. This list of scenic resources includes, but is not limited to, locations of national, State, or local scenic significance. A scenic resource visited by large numbers who come from across the country or state is generally considered to have national or statewide significance. A scenic resource visited primarily by people of local origin is generally of local significance. Unvisited places either have no designated significance or are "no trespass" places. Sources for information regarding specific scenic resources are found as part of the MDEP Visual Evaluation Field Survey Checklist (doc. #DEPLW0540) provided in the application.

A. National Natural Landmarks and other outstanding natural and cultural features (e.g., Orono Bog, Meddybemps Heath);

B. State or National Wildlife Refuges, Sanctuaries, or Preserves and State Game Refuges (e.g., Rachael Carson Salt Pond Preserve in Bristol, Petit Manan National Wildlife Refuge, the Wells National Estuarine Research Reserve);

C. A State or federally designated trail (e.g., the Appalachian Trail, East Coast Greenway);

D. A property on or eligible for inclusion in the National Register of Historic Places pursuant to the National Historic Preservation Act of 1966, as amended (e.g., the Rockland Breakwater Light, Fort Knox);

E. National or State Parks (e.g., Acadia National Park, Sebago Lakes State Park);

F. Public natural resources or public lands visited by the general public, in part for the use, observation, enjoyment and appreciation of natural or cultural visual qualities.(e.g., great ponds, the Atlantic Ocean).

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