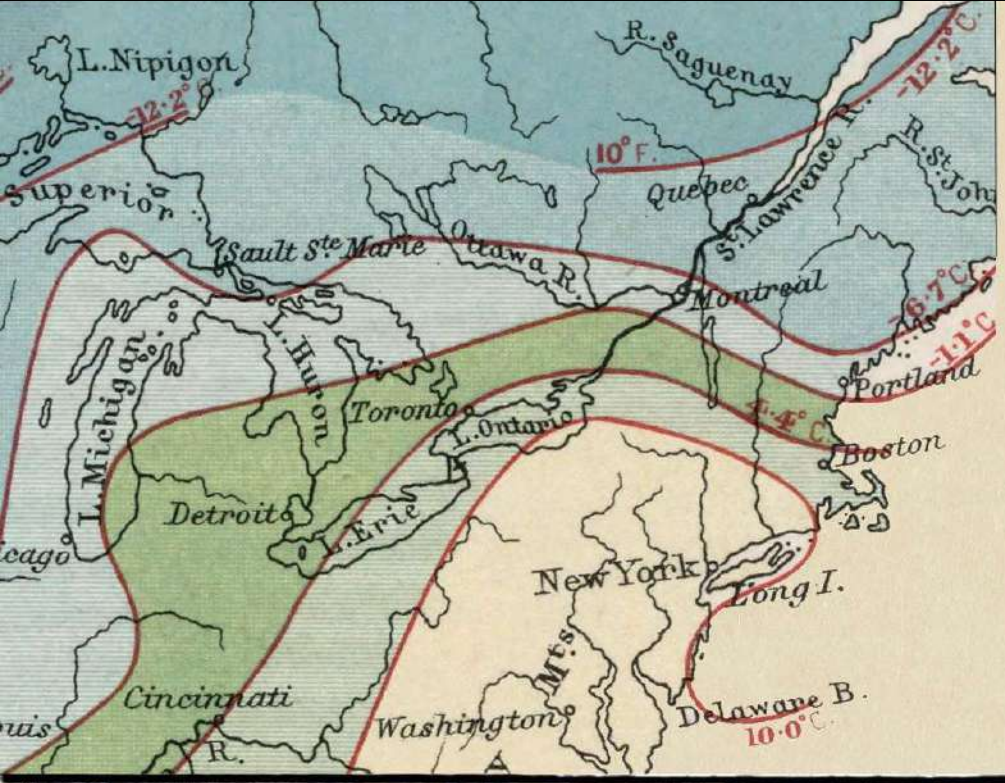
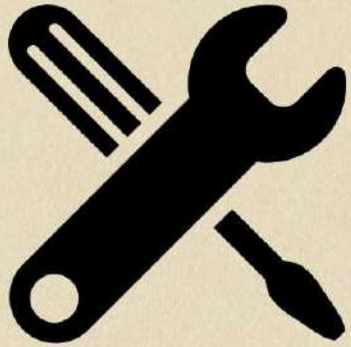


Northeastern Forest Products Supply Chain Climate Adaptation Toolkit



- Introduction
- Climate Changes
- Climate Risks
- Harvest Scheduling
- Best Management Practices
- Roads
- Timber Harvesting
- Wood Procurement
- Forest Pests & Invasives

FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE

WOODLAND RESOURCES

NORTHEAST FORESTS, LLC

Northeastern Forest Products Supply Chain Climate Adaptation Toolkit

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Introduction

Warmer and wetter conditions are affecting the forest products supply chain at every stage – from forest owners and managers, to loggers and wood processing mills. In much of the Northeastern United States, average December and January temperatures are over four degrees warmer than they were in the 1980s. June receives a full inch more of precipitation, on average, than in the past, and the month of October receives 1.5 inches more precipitation.

These changing climatic patterns create real challenges for the forest products industry. The winter logging season—historically the most productive time of the year—is shorter, and frozen conditions are less reliable. Wet ground conditions are more common, due to periods of intense precipitation and unexpected thaws. Climate unpredictability creates start-stop patterns in forest operations, resulting in altered harvesting schedules and wood procurement challenges.

This toolkit showcases adaptations and support throughout the forest supply chain in climate-influenced decision-making. Information presented here was garnered from interviews and focus group sessions with landowners, foresters, loggers and mills from throughout the Northeastern United States.

The following topics are addressed:

- Harvest scheduling
- Best Management Practices for Water Quality
- Roads
- Timber Harvesting
- Wood Procurement
- Forest Pests and Invasive Species

Additional information for each of these factors at each link in the supply chain is available in the companion report, *Climate Adaptions in the Northeast's Forest Products Supply Chain: A Vulnerability Assessment of the Primary Forest Products Sector.*

The toolkit tables are organized into three distinct links in the supply chain – forests, logging and mills. The forest link refers to both the forest resource itself and the planning and management activities that arise from landowner goals and the work of

foresters. Logging includes both the timber harvesting process and the entrepreneurship of logging small businesses. Mills include all those entities and processes that use primary forest products harvested from the forest.

Climate dilemmas are identified for each of the six topics listed above. In some cases, these dilemmas are shared across the entire supply chain and in others they are specific to individual links in the supply chain. Dilemmas, actions and support activities are listed for each link. Communication plays a vital role in adaptation. The interdependence of the links that form the supply chain require cooperative relationships for both actions and support activities.

General Climate Associated Supply Chain Risks

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Forests	Logging	Mills
Ability to schedule and complete timber harvests following acceptable standards	Ability to produce enough to be financially viable	Ability to procure sufficient volume and quality of wood on a timely basis

Changes in average monthly temperatures and precipitation levels have caused shifts in traditional seasonal expectations for harvest scheduling, ground conditions for logging and resulting availability of wood for mills. The monthly changes in temperature and precipitation for various Northeastern States between the 1980s and the 2010s and shown in Table 1. A summary of these differences by state is shown in Table 1.

In addition to changes in seasonal weather patterns, the region is experiencing storms of greater intensity that impact the flow of wood products through the supply chain.

Table 1. Differences in monthly average temperatures and precipitiation in the Northeast between the 2010's and the 1980's.

Northern Forest States (ME, NH, NY & VT)

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temp (°F)	2010's	19.0	21.3	29.5	41.8	55.5	62.0	68.5	66.4	59.9	48.2	35.5	25.7
	1980's	15.4	20.4	28.8	41.9	53.6	60.9	66.9	64.6	56.4	45.0	34.5	21.1
	Change	**3.6**	**0.9**	**0.7**	**-0.1**	**1.9**	**1.1**	**1.6**	**1.8**	**3.5**	**3.2**	**1.0**	**4.6**
Prec (")	2010's	3.0	2.9	3.1	3.6	4.0	5.1	4.1	4.4	3.9	5.0	3.2	4.2
	1980's	2.4	2.6	3.1	3.6	4.0	4.1	4.0	4.1	3.8	3.5	4.4	2.9
	Change	***0.6***	***0.3***	***0.0***	***0.0***	***0.0***	***1.0***	***0.1***	***0.3***	***0.1***	***1.5***	***-1.2***	***1.3***
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Southern New England (CT, MA, RI) & Pennsylvania

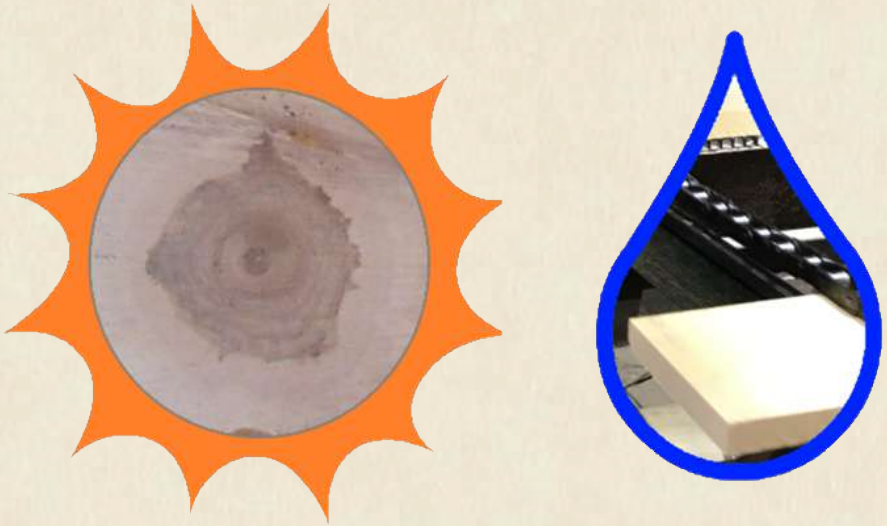
		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temp (°F)	2010's	27.0	29.2	37.1	48.0	59.6	66.7	73.0	70.6	64.6	53.4	41.6	33.8
	1980's	24.0	28.4	36.0	46.7	57.3	65.0	70.9	69.0	61.4	50.1	40.9	29.3
	Change	**3.0**	**0.8**	**1.1**	**1.3**	**2.3**	**1.7**	**2.1**	**1.6**	**3.2**	**3.3**	**0.7**	**4.5**
Prec (")	2010's	3.4	3.5	4.0	3.7	3.8	4.6	3.9	4.2	4.2	4.8	3.5	4.1
	1980's	2.8	3.3	3.9	4.5	4.1	4.5	4.2	3.5	3.1	3.7	4.9	3.0
	Change	***0.6***	***0.2***	***0.1***	***-0.8***	***-0.3***	***0.1***	***-0.3***	***0.7***	***1.1***	***1.1***	***-1.4***	***1.1***

Table 2. Monthly average temperature and precipitation differences between the 2010's and the 1980's for eight northeastern states.

State	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		State
	°F	"	°F	"	°F	"	°F	"	°F	"	°F	"	°F	"	°F	"	°F	"	°F	"	°F	"	°F	"	
CT	3.4	0.0	0.7	0.0	1.0	-0.3	1.0	-1.5	2.0	-0.8	1.5	0.1	2.3	-0.6	1.8	1.0	3.5	1.0	3.7	0.4	0.8	-1.7	4.6	1.1	CT
MA	3.5	0.5	0.9	0.2	0.9	0.1	1.3	-1.1	2.3	-0.4	1.6	0.2	2.3	-0.6	1.9	1.0	3.6	1.1	3.4	1.3	0.9	-1.3	4.6	1.2	MA
ME	4.4	0.4	0.5	0.5	1.0	0.2	-0.3	-0.1	1.3	0.1	0.7	1.2	1.7	-0.2	2.1	0.0	3.7	0.1	3.0	1.9	1.2	-1.1	4.5	1.6	ME
NH	3.8	0.3	1.0	0.1	0.8	0.1	0.4	-0.5	1.9	-0.2	1.2	0.7	1.7	0.2	1.9	0.6	3.7	0.4	3.4	1.6	1.1	-1.3	2.8	1.5	NH
NY	2.9	0.5	0.9	0.4	0.7	0.0	0.0	0.2	2.6	0.3	1.5	0.7	1.5	0.3	1.3	0.6	3.0	0.0	3.1	1.4	0.8	-1.0	4.4	0.8	NY
PA	1.9	0.9	0.6	0.2	1.0	0.0	1.4	0.1	2.6	0.1	1.9	0.1	1.4	0.6	0.8	0.8	2.6	1.6	2.6	1.5	0.0	-1.0	4.1	1.1	PA
RI	3.3	3.7	0.8	3.9	1.2	4.8	1.6	3.9	2.3	3.4	1.5	4.2	2.4	3.3	1.9	3.7	3.2	4.0	3.6	5.0	1.1	4.1	4.8	4.5	RI
VT	4.0	0.2	1.4	0.2	0.7	0.0	-0.4	0.4	2.0	0.2	1.2	1.4	1.5	0.4	1.9	0.0	3.5	0.0	3.3	1.1	1.1	-1.5	4.9	1.1	VT
	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		

Toolkit Tables

The toolkit tables presented in each topic area show climate -related dilemmas, decisions, actions and support activities, segmented by links in the supply chain. The supply chain itself is simplified to three linear links - forests, logging and mills. Forest -based decisions, actions and support activities are may be conducted by landowners, foresters or both. Logging decisions, actions and support activities are done by individual loggers at the firm level. Decisions, actions and support activities by mills or done by wood procurement staff members, often at the direction of ownership or higher level management.



Harvest Scheduling

Climate Risk: Altered and unpredictable seasonal weather patterns cause landowners to postpone or forego scheduled harvests, disrupting logging opportunities and the supply of wood to mills.

Forest	Logging	Mills
Dilemma(s)	**Dilemma(s)**	**Dilemma(s)**
Schedule harvest in year(s) and seasons that accomplishes silvicultural goals, protects the site and residual stand and accommodates regeneration goals, in the face of uncertain weather and soil moisture patterns.	Harvest timber profitably while adhering to landowner harvesting schedule, minimizing down time and balancing weather-related start-stop patterns in demand for services and products.	Meet wood procurement needs with purchased timber while adhering to publicly approved standards and balancing short term needs for fiber and long term needs for supply viability.
Actions	**Actions**	**Actions**
● Determine suitable weather and ground conditions for access and operability; ● Address constraints with suitable conditions, rather than limit by season; ● Provide suitable contract length and extension provisions to ensure time windows providing suitable conditions.	● Invest in harvesting system best suited to available timber and harvest types; ● Minimize time lost in job transitions; ●Timely administration of requirements; ● Segment harvesting sites by ground conditions and work accordingly; ● Alternate work among multiple harvesting sites, when possible.	● Request/require long windows for harvesting when possible (1.5-2 years); ● Prioritize harvests of purchased timber by ground conditions; ● Schedule to meet seasonal demand limitations; ● Store harvested inventory with space, timing and safeguards.
Support Activities	**Support Activities**	**Support Activities**
● Communicate requirements to loggers and mills well in advance; ●Process contracts and related contractual requirements quickly; ● Be open to discussion of changes in seasonal realities and requirements.	● Provide required certificates, bonds and other documents prior to anticipated start dates; ● Demonstrate readiness to meet contractual requirements;	● Provide required certificates, bonds and other documents prior to anticipated start dates; ● Provide site preparation services for loggers, when appropriate; ● Do not allow trucking to cause delays in job transitions.

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Best Management Practices for Water Quality (BMPs)

Climate Risk: Wet ground conditions for longer periods of time than in the past increase direct BMP costs and may require suspending harvesting operations, making logging unprofitable and limiting the supply of wood to mills.

Forest	Logging	Mills
Dilemma(s)	**Dilemma(s)**	**Dilemma(s)**
Require BMP compliance while maintaining relationships with other supply chain stakeholders and maintaining harvesting schedules, despite constraints imposed by climate realities.	Require BMP compliance while maintaining relationships with other supply chain stakeholders and maintaining harvesting schedules, despite constraints imposed by climate realities.	Require BMP compliance while maintaining relationships with other supply chain stakeholders and maintaining harvesting schedules, despite constraints imposed by climate realities.
Actions	**Actions**	**Actions**
● Make BMP compliance a timber sale contract requirement; ● Make field inspections and enforce relevant contract requirements; ● Large landowners may allow movement to alternative harvesting sites during job suspensions;	● Keep excavation equipment on harvesting sites for compliance work; ● Install BMP structures in advance of harvesting; ● Maintain structures during harvesting; ● Schedule to minimize start-stop patterns for compliance; ● Innovate BMP structures and practices.	● Provide bridges and other structures to suppliers to facilitate BMP compliance; ● Do not source wood from harvesting sites where BMPs are not used; ● Schedule harvests of purchased timber during appropriate ground conditions; ● Stockpile against non-productive periods.
Support Activities	**Support Activities**	**Support Activities**
● Learn in-depth BMP compliance methods and demonstrate flexibility in both the use of structures and approval of limited productive activities during wet conditions; ● Host and facilitate BMP compliance training; ● Provide technical assistance.	● Build or obtain portable bridges, steel pipes and wood mats during work suspensions so they are available when ground conditions are suitable. ● Attend BMP training sessions; ● Take advantage of technical assistance.	● Build or obtain portable bridges, steel pipes and wood mats or facilitate building workshops for suppliers; ● Host and facilitate BMP compliance training; ● Provide technical assistance.

Roads

Climate Risks: Extended wet periods and greater storm intensity increase maintenance costs; local officials may limit public road access at critical times; warmer winters curtail or rule out the use of frozen winter roads in some locations.

Forest	Logging	Mills
Dilemma(s)	**Dilemma(s)**	**Dilemma(s)**
Gravel roads systems that were adequate in the past now require upgrades and a higher level of maintenance to provide the access necessary for current climate realities. Winter roads systems are more challenging to put in service.	Accept the expense of road upgrades in order to work or forego harvesting opportunities. Post bonds ensure road damage will be repaired or forego harvesting opportunities. Learn and apply winter road skills in shorter winters.	Contribute to road upgrade expenses brought on by changes in the climate in order to access wood supplies or postpone or forego supply opportunities.
Actions	**Actions**	**Actions**
● Upgrade culverts as they are replaced; ● Upgrade all water diversions; ● Add crushed stone to road surfaces in problem areas; ● Close and gate roads against vehicle access during maintenance suspensions; ● Create permanent winter road installations for fast deployment when needed.	● Weather-conscious trucking decisions and scheduling; ● Coordinate access and operability issues in planning and scheduling work. ● Cooperative participation in minor road improvements that enhance access to harvesting sites.	● Weather-conscious trucking decisions and scheduling; ● Plan for alternative routes during and after storm events, when possible; ● Accept road improvements and repair as a necessary condition for procuring timber.
Dilemma(s)	**Dilemma(s)**	**Dilemma(s)**
● Pair needed road upgrades with timber sale contracts; ● Hold performance bonds during road use to ensure protection and repairs.	● Share information with landowners on observed requirements for road maintenance; ● Share information with landowners and town officials on climate-smart road maintenance and improvements. ● Add road construction and maintenance services to business model.	● Share information with landowners on observed requirements for road maintenance; ● Share information with landowners and town officials on climate-smart road maintenance and improvements.

Timber Harvesting

Climate Risk: Changes in soil moisture patterns limit logging productivity, undermining the financial sustainability of logging businesses, depriving landowners of harvesting opportunities and limiting the supply of wood to mills.

Forest

Dilemma(s)

Select and contract for harvesting with a system best suited to the harvesting prescription, ground conditions and financial requirements.

Actions

- Set contract requirements for harvesting safeguards;
- Enforce contract requirements before, during and after harvesting;
- Evaluate results and adjust future expectations accordingly.

Support Activities

- Process contracts and related contractual requirements quickly;
- Manage expectations for results with communication, education and monitoring.

Logging

Dilemma(s)

Select and invest in a business model and harvesting system(s) that are suitable for the range of harvesting prescriptions and climate-influenced ground conditions, while producing enough to be financially viable.

Actions

- Invest in and maintain equipment;
- Emphasize planning and project management;
- Operate using methods that guarantee both short term and long term financial results;
- Advance the art of production and contract compliance.

Support Activities

- Repair and maintenance system and readiness that minimizes down time;
- Prompt and thorough administrative support;

Mills

Dilemma(s)

Contract for harvesting by systems suitable for sites and harvest types purchased in procurement, taking evolving seasonal weather patterns into account in timing of supply needs.

Actions

- Planning and project management to ensure short term results and long term supply;
- Start/stop BMP decisions on harvesting purchased timber;
- Monitor contract harvesting for compliance with contracts and standards;

Support Activities

- Process contracts and related contractual requirements quickly;
- Manage landowner expectations with communication, education and monitoring.
- Facilitate training and technical assistance for suppliers

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Wood Procurement

Climate Risk: The cumulative impacts of climate change limit harvesting opportunities, timing and production, constraining the supply of wood supply to mills and requiring an expanded portfolio of procurement methods.

Forest	Logging	Mills
Dilemma(s)	**Dilemma(s)**	**Dilemma(s)**
Allow or suspend harvesting activities in ways that meet mill supply needs, matches silvicultural goals and protect harvesting sites and road networks from operations when weather and ground conditions are unsuitable.	Take advantage of market opportunities and build reliable supply relationships with mills, while at the same time adhering to best management practices and matching work schedules to climate realities.	Changes in seasonal weather patterns make traditional procurement methods less reliable. Mills must fulfill supply needs from sporadic suppliers who are working to ensure that harvests meet acceptable standards.
Actions	**Actions**	**Actions**
• Monitor weather and ground conditions to make informed decisions on suspending or allowing harvest to commence or restart; • Hold sufficient bond funds to ensure both protection of resources and timely restoration work.	• Schedule work to meet seasonal product demands (e.g. hardwood logs in winter and pulpwood in spring or fall); • Maximize site productivity by matching ground conditions to weather patterns; • Communicate with suppliers and ask questions about supply needs.	• Create spatial menu of supply options that take advantage of variable conditions (trucking, backhaul, remote yards); • Leverage supply relationships with other mills using complementary products (e.g. logs and wood chips); • Provide technical assistance and BMP structures to suppliers.
Support Activities	**Support Activities**	**Support Activities**
• Host or facilitate training programs that emphasize project management, productivity and protection of natural resources.	• Pursue training and adopt methods that allow productive operations to continue under challenging weather and ground conditions; • Match equipment choices to climate and wood market realities.	• Bolster training programs that recruit new loggers to the workforce; • Host or facilitate training programs that emphasize project management, productivity and protection of natural resources.

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Forest Pests and Invasive Species

Climate Risk: Changes in the climate have hastened the spread of forest pests and invasive species, shifting harvesting priorities and opportunities and creating an added stewardship burden for forest landowners and public agencies.

Forest	Logging	Mills
Dilemma(s)	**Dilemma(s)**	**Dilemma(s)**
Threats to timber values from forests pests, diseases and invasive species exacerbated by climate change and influence management decisions. Tick-borne illnesses are an increasing threat to landowners and forest workers.	Climate-accelerated pests and invasive species can be hastened by logging and spread by moving logging equipment. Dead trees pose work hazards. The threat of tick-borne illnesses is spreading in the region.	Climate-accelerated threats from to forest from pests, diseases and invasive species from climate change pose contractual challenges to purchasing timber and impact the availability of some species of wood.
Actions	**Actions**	**Actions**
Prevention and control of threats with pesticide applications; Pre-emptive and salvage harvesting; Timber sale contract requirements for preventive work and threat minimization; Seasonal alterations in forest operations; Tick awareness and preventative actions.	• Equipment cleaning and washes between harvesting sites to remove invasive species; • Altered methods or priorities for salvage and pre-emptive harvests; • Pro-active adaptation to species loss; • Tick awareness and preventative actions.	• Procurement staff awareness of locations of forest pest infestations; • Adhere to species quarantines; • Supplier requirements for preventative actions; • Pro-active adaptation to species loss; • Tick awareness and preventative actions.
Support Activities	**Support Activities**	**Support Activities**
• Cooperation with state and federal officials in reporting infestations; • Provide information on forest pests, invasive species and related regulations to forest workers.	• Cooperation with state and federal officials in reporting infestations; • Provide information on forest pests, invasive species and related regulations to forest workers and landowners.	• Cooperation with state and federal officials in reporting infestations; • Provide information on forest pests, invasive species and related regulations to suppliers, including landowners.

Conclusion

Changes in the climate are having a significant influence on the Northeast's forest products supply chain, from forest to mill and every step in between. In summary:

- Harvest scheduling has become more challenging, often requiring longer contract terms to ensure that suitable weather conditions will arise;
- BMP compliance has forced innovation among forest products professionals, but also sometimes results in temporary work stoppages, increasing costs while reducing profits;
- Road maintenance and improvements are necessary to accommodate supply chain demands and climate challenges;
- Timber Harvesting systems are being adapted in response to climate impacts and threats, embracing local and regional conditions as required;
- In Wood Procurement, mills have taken creative steps to ensure ample supply during periods when unsuitable harvesting conditions are limiting; and
- A proliferation of Forest Pests and Invasive Species has forced adaptation at every link in the forest products supply chain, including mitigation and preventative measures.