

Historic and Predicted Wood Costs in Maine for Selected Species and Products

Prepared for:

FOR/Maine (Forest Opportunity Roadmap/Maine)

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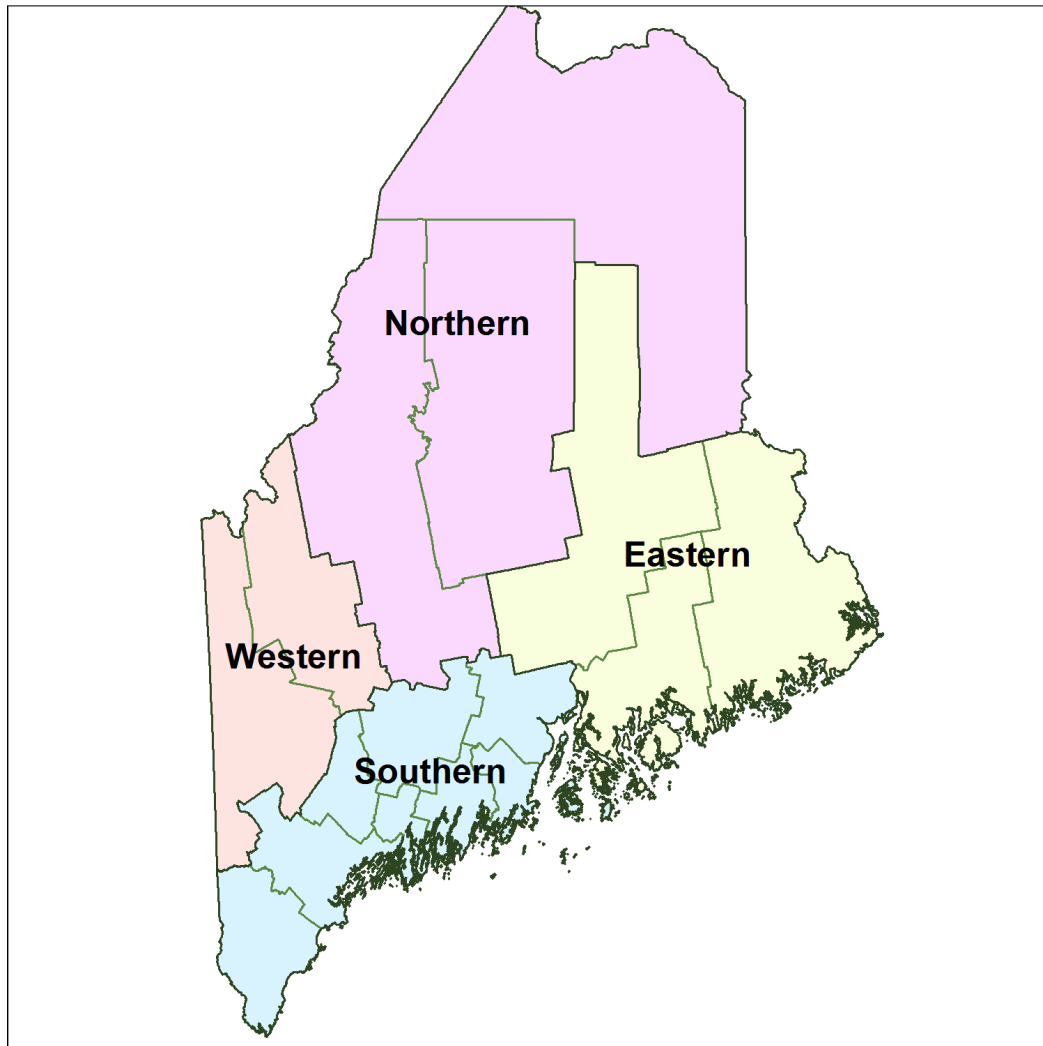
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1. EXECUTIVE SUMMARY

This report was prepared by James W. Sewall Company (Sewall) using Federal funds under award number 01 69 14749 from the Economic Development Agency of the United States Department of Commerce. The statements, findings, conclusions and recommendations are those of the author(s) and do not necessarily reflect the views of the Economic Development Agency or the United States Department of Commerce.

The State of Maine is going through significant change in its forest industry. A consortium of forest industry organizations (FOR/Maine) is working together to develop a long-term vision and roadmap for the Maine forest products sector. As part of that process they contracted with Sewall to assess current delivered prices of wood products in Maine and formulate delivered wood cost projections for major commercial species groupings on which to base their planning. This report articulates the major findings of that study.

Figure 1.1 Four Megaregions of Maine



With prior endorsement from the Maine Forest Products Council (MFPC), Sewall contacted 56 destination points for wood fiber (primary wood processors) and invited them to participate in a voluntary survey of five-year historical delivered wood costs to their organizations.

Despite much initial interest, Sewall received comprehensive data from only fifteen of these organizations. There was adequate data to examine the following species/products:

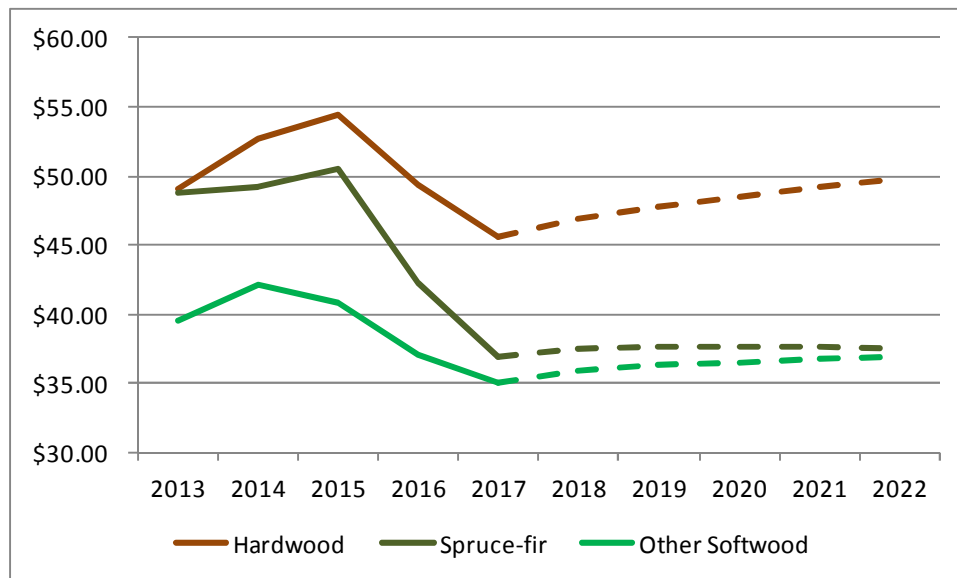
- Hardwood pulpwood
- Spruce and other softwood pulpwood
- Spruce /fir studwood and treelength (destined for sawmills)
- Pine logs – all grades mixed
- Hardwood logs – separated into two categories: grade (woods run) and pallet
- Biomass – statewide basis

Sewall divided the data (by geographic source) into one of four megaregions utilizing the U.S. Forest Service geographic areas (see figure 1.1).¹ Analysts then formulated historic price series/curves by megaregion on all species/products that had adequate data to be statistically supportable. From these, Sewall utilized these historic trends and interviews with procurement representatives to project prices five years forward, based on 2017 estimated harvest levels.

HISTORIC AND PREDICTED TRENDS

Pulpwood

Figure 1.2 Average Delivered Wood Cost of Pulpwood in Maine (unweighted average of the average for each megaregion)



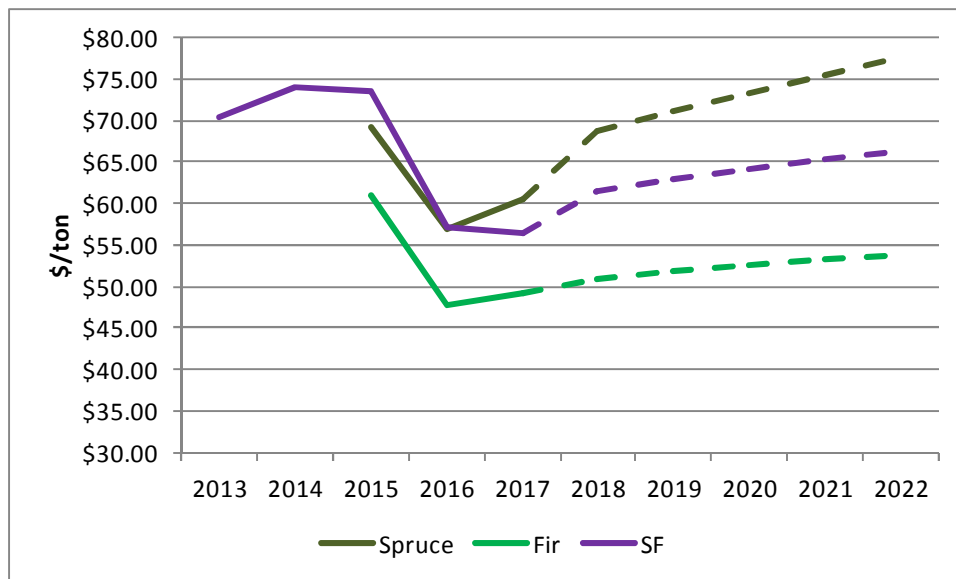
¹ Approximately half of the timberlands are in the Northern region, one-quarter in the Eastern megaregion and about an eighth in each of the Southern and Western megaregions.

Figure 1.2 depicts historic and predicted average delivered wood costs for the three species of pulpwood for which Sewall received adequate data to report. These averages reflect an unweighted average of the mean wood cost for each of four megaregions. Detail by megaregion follows in the body of the report. Average wood cost increased through late 2014 (other softwood) or early 2015 (hardwood and spruce-fir) and then significantly declined through 2017. Sewall's steady-state (no change in demand) future predictions call for spruce-fir and softwood to be relatively flat, while hardwood creeps back up to around \$50/ton near the end of the five-year period.

Spruce and Fir in Long Form (Treelength and Studwood)

As can be seen in figure 1.3, spruce and fir long length delivered cost to sawmills had a similar trend over the five-year study period. Sewall predicts that average wood cost of spruce will return to \$70-75/ton over the next five years, while fir will likely lag behind. We expect the wood cost differential to grow between the two species due to mill preference for spruce, and supply and demand factors.

Figure 1.3 Average Delivered Wood Cost of Spruce and Fir Treelength in Northern and Eastern Maine



Logs

Figure 1.4 Average Delivered Wood Cost of Logs in Maine

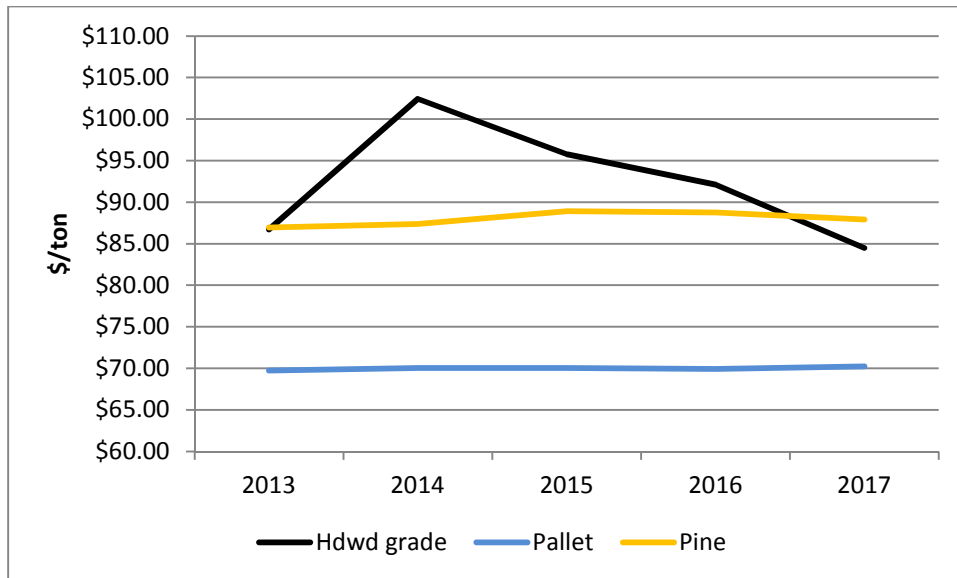
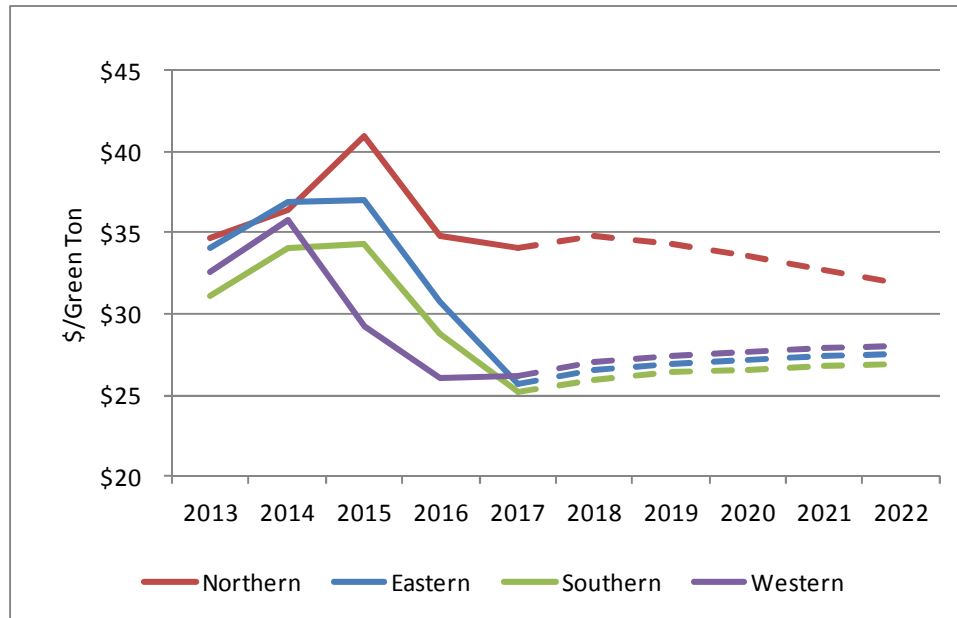


Figure 1.4 illustrates the average delivered wood cost of hardwood, pallet and pine logs in Maine. All three types of logs have had fairly stable prices by grade. A difference in hardwood log wood cost is primarily due to differences in grade and distance across the various years.

Pine has had a slight increase, mostly reflective of higher prices in the better quality grades (select and #1 grades).

Biomass

Average biomass wood cost (delivered) followed a trend similar to most commodity products over the five-year study period; increasing in the early years and then significantly decreasing as several pulpmills curtailed or closed. Figure 1.5 depicts this trend by megaregion and Sewall's prediction over the next five years.

Figure 1.5 Average Wood Cost of Biomass across the Four Megaregions in Maine

Scenarios

Sewall collaborated with the FOR/Maine wood cost project steering committee to generate four scenarios to test price sensitivity. Projected volumes were added to 2017 volumes in four increments of 250,000 tons/increment. The scenarios are as follows:

1. Softwood pulpwood in the southern megaregion
2. Spruce fir pulpwood in the eastern megaregion
3. Spruce fir sawable material in the northern megaregion
4. Hardwood pulpwood in the southern portion of the state (Skowhegan/Bangor/Ellsworth and south)

Table 1.1 depicts the 2022 predicted increment in average wood cost above the steady state prediction.

Table 1.1 Increment in Average Scenario Wood Cost in 2022 for each Level of Demand Expansion (\$/ton)

Expansion	Scenario 1	Scenario 2	Scenario 3	Scenario 4
MR/Area	Southern	Eastern	Northern	Southern half
Species/Product	Sftwd Pulp	SF Pulp	SF Sawable	Hdwd Pulp
250,000	\$ 1.55	\$ 1.55	\$ 1.91	\$ 1.53
500,000	\$ 3.36	\$ 3.36	\$ 4.59	\$ 4.88
750,000	\$ 6.26	\$ 6.26	\$ 7.89	\$ 9.89
1,000,000	\$ 8.68	\$ 8.68	\$ 12.49	\$ 13.55

Conclusion

This study, coupled with the other studies that FOR/Maine contracted to be conducted in 2017/18 should provide sound general guidance for any forest products company/investor looking at Maine.

Combined with the volume study, also conducted by Sewall, we assess that at the time of study (2017 harvest removal data) there was a significant opportunity for additional volume of biomass, spruce-fir and other softwood pulpwood in several megaregions of Maine at favorable prices. This is less the case with hardwood pulpwood and most grade products. The significant exception to this is hardwood pulpwood in some parts of northern Maine and portions of New Hampshire.

With that as the summary conclusion from both studies, the reader should be aware of the following items that were not a specific point of investigation under the scope of either study:

- Contractor capacity,
- Any expansions announced or executed while this study was being conducted or thereafter,
- Variations within a given megaregion due to local or regional influence.

Sewall recommends a more specific study of wood inventories, logging and trucking capacity and regional prices be conducted as investors get interested in specific sites in Maine.

Lastly, an unexpected finding of this study was the impact sudden expansion in one species/product (i.e.: spruce-fir pulpwood) has on most other species/products within the procurement zone. We expect this is due to the capacity limits of the contractor and trucking force. What this likely indicates is that most significant expansions will not only tend to raise wood costs of the species/products in question (i.e.: Sewall's predicted wood costs), but will also increase delivered costs to other mills in the procurement zone (at least in the short-term).

2. INTRODUCTION

BACKGROUND AND PURPOSE

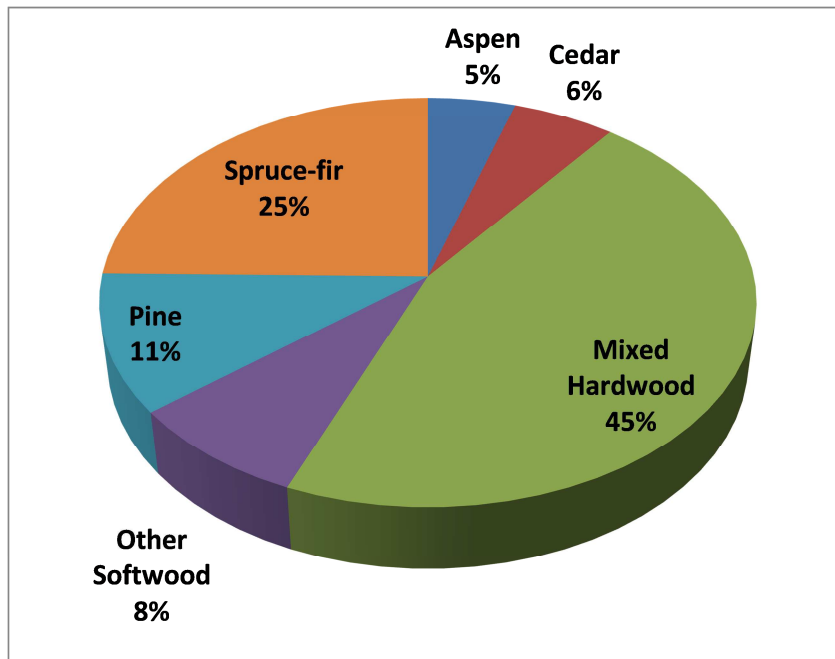
The State of Maine is going through significant change in its forest industry. A consortium of forest industry organizations (FOR/Maine) are working together to develop a long-term vision and roadmap for the Maine forest products sector. As part of that process they contracted with James W. Sewall Company (Sewall) to assess current delivered prices of wood products in Maine and formulate delivered wood cost projections for major commercial species groupings on which to base their planning. This report articulates the major findings of that study. All prices presented are on a delivered basis.

With prior endorsement from the Maine Forest Products Council (MFPC), Sewall contacted 56 destination points for wood fiber (primary wood processors) and invited them to participate in a voluntary survey of five-year historical wood costs to their organizations.

Despite much initial interest, Sewall received comprehensive data from only fifteen of these organizations. There was adequate data to examine the following species/products:

- Hardwood pulpwood
- Spruce and other softwood pulpwood
- Spruce/fir studwood and treelength
- Pine logs – all grades mixed
- Hardwood logs – grade (woods run) and pallet
- Biomass – statewide basis

Figure 2.1 Relative Size of Resource by Species Group



The majority of the price data received was on hardwood, spruce-fir and pine species, which is understandable when one compares it to the current estimate of standing volume depicted in figure 2.1.

METHODOLOGY - HISTORIC PRICES

Sewall utilized the five-year data set received from the 15 facilities to create average historic price series/curves by megaregion on all species/products that had adequate data to be statistically supportable. This was done by creating a combined data set with all the data merged into categories of price, volume, distance or zone, and megaregion of source and destination. Utilizing pivot tables, it was then possible to analyze the data to get statewide, megaregion summaries and trends. These are reported to the extent that they are statistically reliable and from numerous sources. Other (less comprehensive) price data was utilized by the analysts to confirm purchasing and sourcing strategies, but this is not reported out to protect the confidentiality of the sources.

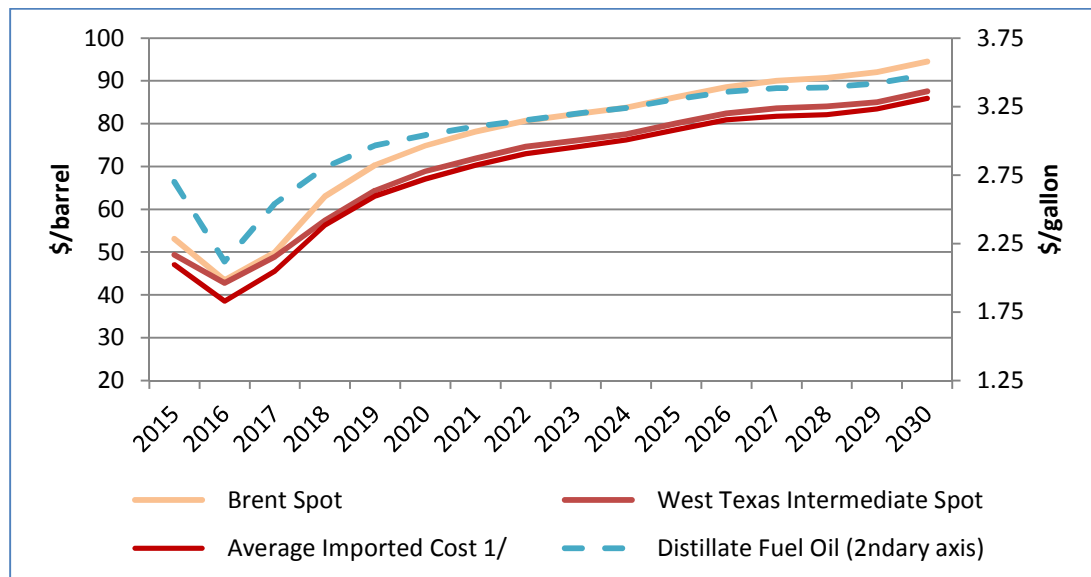
METHODOLOGY - FUTURE PRICING

Utilizing the 2017 data sets, the trends, and interviews with numerous procurement representatives, Sewall projected prices five years forward based on the assumption of no changes in market or harvest levels from 2017 (steady state). Sewall escalated these prices using a two-factor approach:

- Cost of diesel, and
- Anticipated changes in stumpage due to supply and demand factors

Said another way, there is no general inflation built into these projections (other than oil related costs).

Figure 2.2 U.S. Energy Information Administration Annual Energy Outlook



Early in the decade, Sewall worked with a Maine forest products company to develop a harvest costing model. As a result of that work, it was ascertained that on average

approximately 40% of the cost of delivered wood could be tied to the price of fuel oil (diesel, rubber, some parts, etc.). Sewall utilized this result to escalate a portion of wood costs (40%) by tying them to the U.S. Government prediction for oil price (figure 1.2). Typically in predicting prices there is an inflation factor to cover such items as labor, stumpage, administrative overheads, non-oil related parts and repairs, and profit. In this case, the sponsor committee decided not to include this as historically wood costs have not tended to follow these patterns. As an alternative, Sewall made a best estimate of how stumpage price would likely be impacted in each prediction and imbedded that in the predicted cost curves. Sewall would advise the readers of this report to think of the predicted costs in terms of 2018 dollars.

As a result of the detailed cost data that we received from several mills, a study of three factors related to wood cost was possible.

- Relative to trucking distance, the regression analysis predicted an increase over close zone wood cost of \$0.07/mile, or \$3.54/50-mile zone. The predictive value (R^2) was 0.57 and is significant at the 99% level.
- Relative to volume of purchase, the regression predicted an increase over base price of \$0.30/10,000 tons. This was significant at the 98% level.
- Lastly, there is a clear relationship between the percentage of wood procured from various zones and the competitive price in that year. The lower the relative price, the higher the amount of zone 1 and zone 2 deliveries. In years of heavier competition and higher cost structure to the mills, one sees an expansion of percentages of wood hauled from the further zones and in extremes the opening of wood yards and deliveries by rail and additional chips to the pulpmills. On the log side we see the same patterns of purchasing, plus the innovative log buying with backhauls on lumber trucks and more "fitted" (cut-to length) logs.

Finally, Sewall collaborated with the steering committee to generate four scenarios to test price sensitivity under conditions of demand expansion. Projected volumes were added to estimated 2017 volumes in four increments of 250,000 tons/increment. The scenarios are as follows:

1. Softwood pulpwood in the southern megaregion
2. Spruce fir pulpwood in the eastern megaregion
3. Spruce fir sawable material in the northern megaregion
4. Hardwood pulpwood in the southern portion of the state (Skowhegan/Bangor/Ellsworth and south)

For each of these scenarios, Sewall utilized the following prices to build projected pricing:

- Base 2017 average wood cost for the species/product and megaregion in question.
- Perceived level of competition generated by the additional demand. Two sources of competition were contemplated: competition for the stumpage (money back to the landowner), and competition for the logger/trucker (money back to the contractor).

- Zone mix of deliveries. For each incremental level of competition we increased the percentage of deliveries from further zones (therefore increasing transportation costs).
- Amount of secured wood purchased in closer-distance zones. As competition increased and delivery distances expanded we factored in a larger amount of "secured wood" (larger volumes at a premium).

3. STUDY RESULTS

OVERVIEW

As reported above, Sewall received adequate data to do historical delivered pricing on the following:

- Hardwood pulpwood
- Spruce and other softwood pulpwood
- Spruce/fir studwood and treelength
- Pine logs – all grades mixed
- Hardwood logs – grade logs (woods run) and pallet
- Biomass – statewide basis

As a reminder, historical prices are an average of all useable data that we received in the category. Steady state predictive pricing assumes no changes in future volumes or market conditions (increases or decreases) over 2017 levels. 2017 pricing is adjusted in future years for diesel and anticipated stumpage changes only (no other inflation factors).

It should be noted that none of this data is meant to assume any particular price negotiated between a contractor/landowner and destination mill. Each transaction has numerous different components and this study is a result of averaging hundreds (if not thousands) of individual transactions. Wood procurement and sales are a negotiated art, as compared to this study which is a rendering using mathematical tools after the fact. In the end, price is probably set more by how willing the buyer and seller are to transact, than by any post-analyses formula this study could devise.

HARDWOOD PULPWOOD

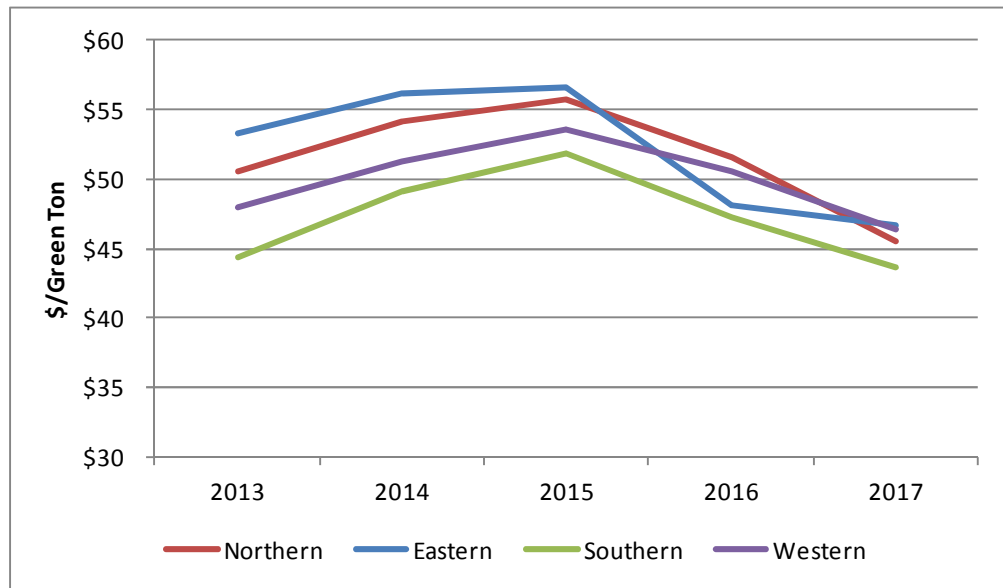
Figure 3.1 depicts the historic average cost by reporting entities for hardwood pulpwood by megaregion. Average overall costs/ton delivered to the reporting mills were between \$44 and \$47/ton in 2017, a decline over 2014, 2015 and 2016, and about equal to 2013 costs. This reflects the overall market for pulpwood in Maine over this period: a fairly average competitive year in 2013; heavier competition in 2014 and early 2015; then a closure of mills in 2015 and 2016. Hardwood price was not only impacted by a modest decrease in volume, but also by a significant reduction in delivered volume of spruce-fir pulpwood and to some degree logs. This meant contractors shifted into hardwood stands and trucking became more available to the pulpmills receiving hardwood.

While only a small amount of data was received on treelength firewood fiber costs, enough was received to ascertain that deliveries were at, or slightly less, than the going price per ton of the alternative pulpwood markets (after adjusting for transportation differences). Distances delivered for treelength firewood tend to be shorter than for pulpwood.

There were two exceptions in the hardwood pulpwood market and both were because of adequate supply without corresponding market capacity: northern Maine and portions of New Hampshire. Much of northern Maine has fewer outlets for hardwood pulpwood, therefore pricing tends to be a bit depressed at the job site. The prices reflected in figure

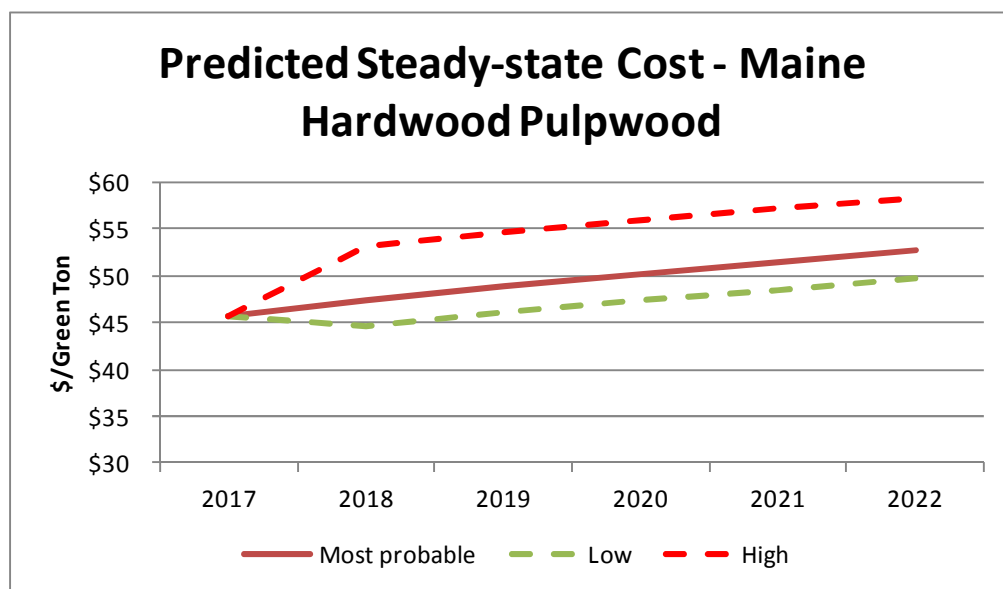
3.1 reflect the additional cost of transportation to get this wood to the mills in southern and eastern Maine. We heard the same recently from a number of operators in central and southern New Hampshire - the majority of their wood reportedly now going to firewood with the only alternative being biomass to energy plants.

Figure 3.1 Historic Average Costs of Hardwood Pulpwood by Maine Megaregion



On a statewide basis (weighted by reported volumes delivered) hardwood pulpwood costs were just under \$47/delivered ton. Under steady-state conditions (no change in market conditions) this escalates slowly through 2022 due to fairly unusual (favorable) procurement conditions.

Figure 3.2 Predicted Steady-state Costs of Maine Hardwood Pulpwood Statewide



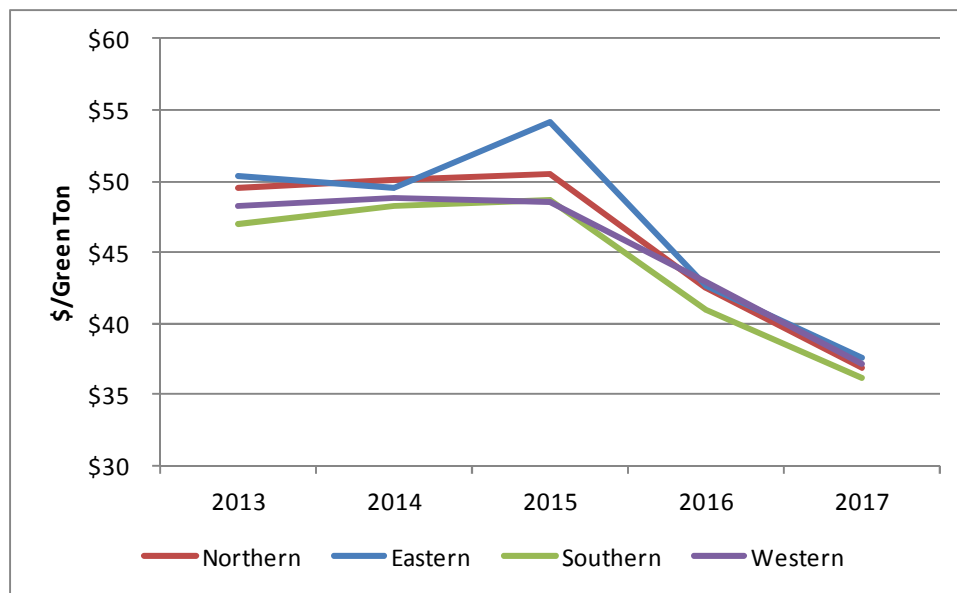
A reminder that the escalators are ONLY for predicted cost of diesel and anticipated changes in stumpage. The solid line indicates the most probable prediction, and the dashed lines indicate the probable bounds of the high and low pricing.²

SPRUCE-FIR PULPWOOD

Average spruce-fir (SF) historic costs had a similar, yet more dramatic, trend as hardwood pulpwood. We see a slight increase through 2015, with a dramatic drop in overall cost as the numerous spruce-fir using mills either closed or curtailed operations in late 2014 - early 2016. Reported volumes declined to less than 50% over the five-year period, and this does not include all of the mills that were closed.

Interestingly, average delivered costs were very consistent across the megaregions in all years except 2015 for the eastern megaregion. Until 2016, the northern region costs reflect a higher reality of trucking expense due to distance.

Figure 3.3 Historic Average Costs of Spruce-fir Pulpwood by Maine Megaregion

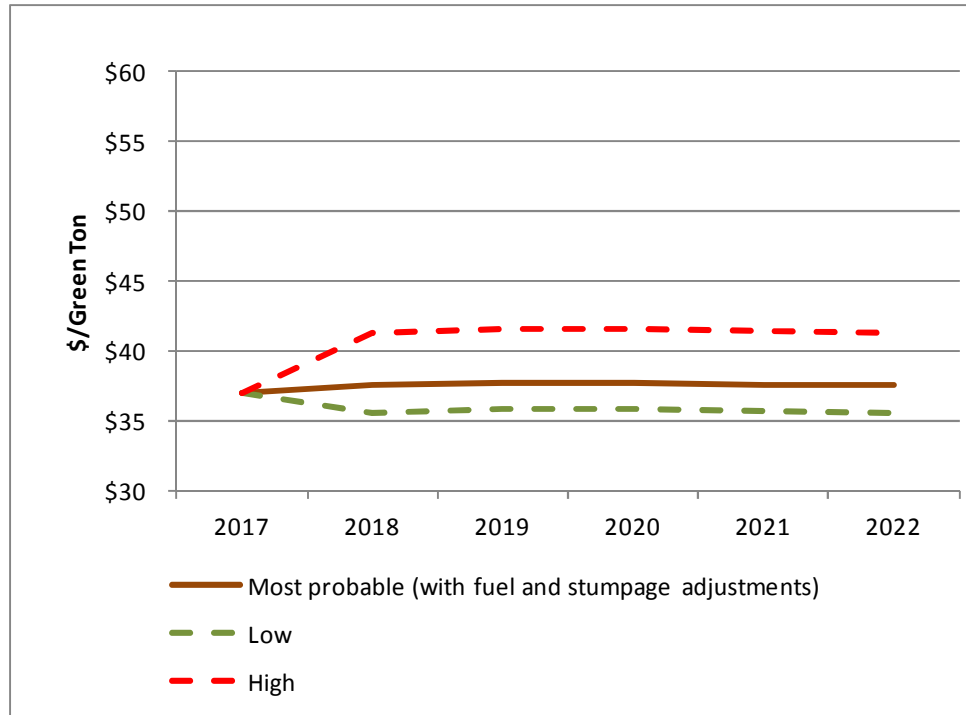


Current supply of spruce-fir pulpwood is in excess of the current market demand and is expected to continue to increase over the next twenty years. Much of the "new SF forest" is in smaller diameter classes. While the majority of solid wood mills are now able to handle smaller stems, they still prefer and need the larger diameter spruce-fir. Overall, this will tend to keep spruce-fir pulpwood wood costs depressed until additional capacity is added to utilize the "wall of wood" coming over the next 20 years.

² The higher price bound (red dashed line) represents two standard deviations (SD) from the mean or a 95% confidence interval. The lower price was set at only one SD because the 2017 prices were at a five year low.

In our steady-state predictions (figure 3.4), we again escalated for predicted oil prices, yet decreased stumpage at a slight rate to reflect increased supply with constant (low) demand. These tended to cancel each other out and gave us a fairly flat prediction.

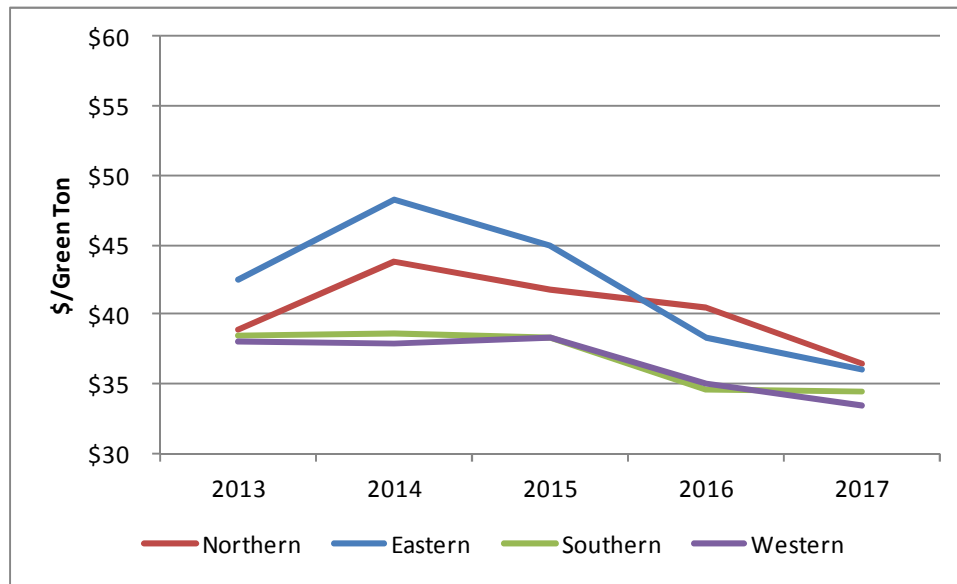
Figure 3.4 Predicted Steady-state Costs of Maine Spruce-fir Pulpwood Statewide



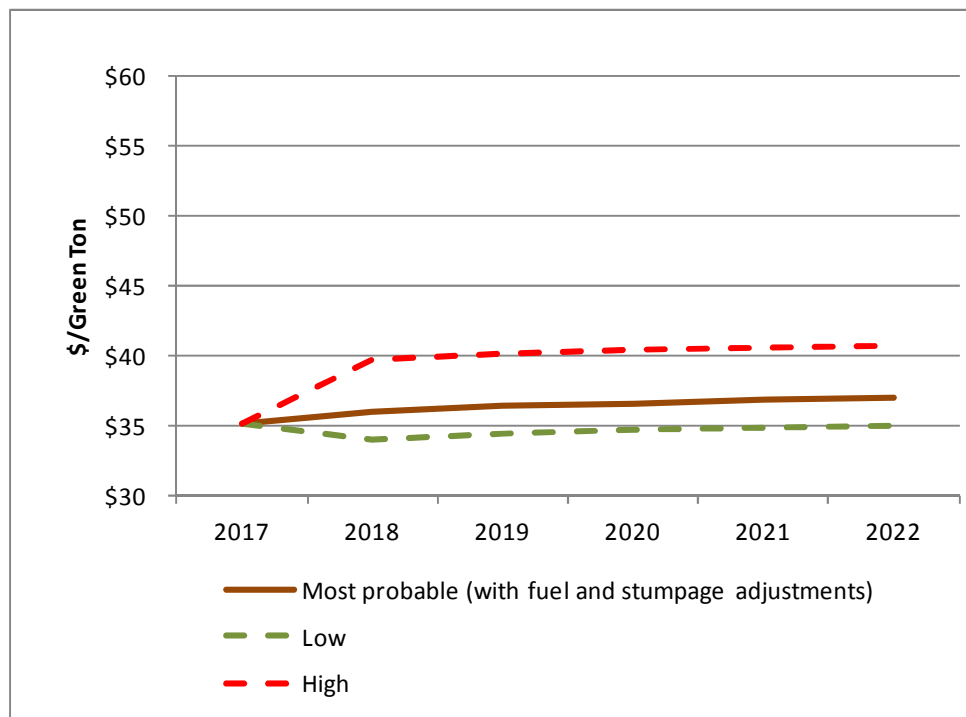
Again, the steady-state upper and lower bounds reflect two standard deviations (SD) above the average and one SD below the mean.

OTHER SOFTWOOD PULPWOOD (HEMLOCK, PINE AND LARCH)

Historic costs for other softwood pulpwood tend to mirror hardwood and SF over the period.

Figure 3.5 Historic Average Costs of Other Softwood Pulpwood by Maine Megaregion

Average wood costs in the eastern and northern megaregions tend to reflect the higher cost of transportation due to distance to prevailing markets.

Figure 3.6 Predicted Steady-state Costs of Maine Other Softwood Pulpwood Statewide

Sewall analysts felt that stumpage prices for Other Softwoods would be stable over the period, so escalation is from the impact of predicted increases in oil alone.

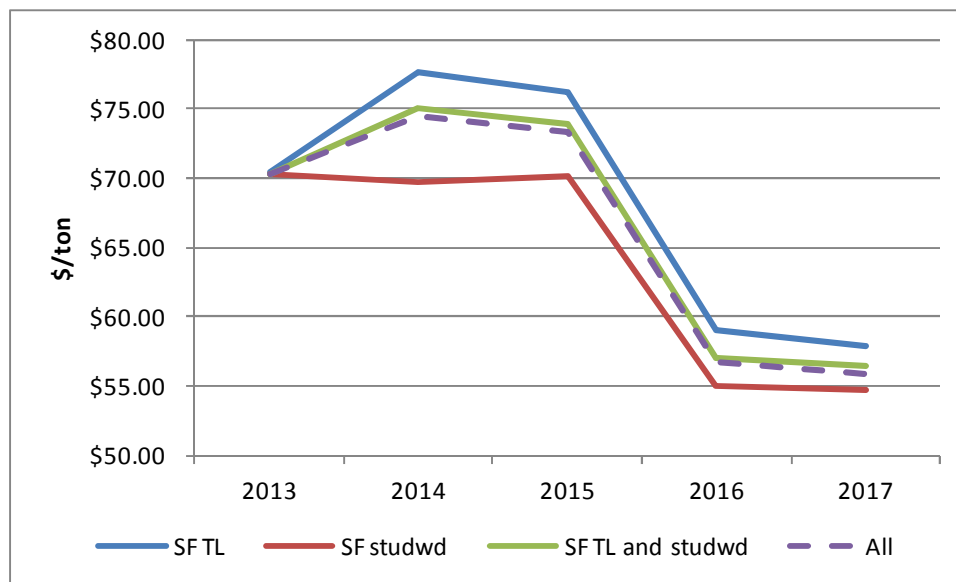
SPRUCE-FIR SAWABLE

Spruce-fir for sawmills is sold in numerous different forms and there is not uniform consistency of specifications or nomenclature. Reporting mills utilized the following classifications: treelength, studwood, logs, and higrade logs³.

The majority of the reported data came from the northern megaregion of Maine, with a minority from the eastern megaregion. There was inadequate data to separate out by megaregion.

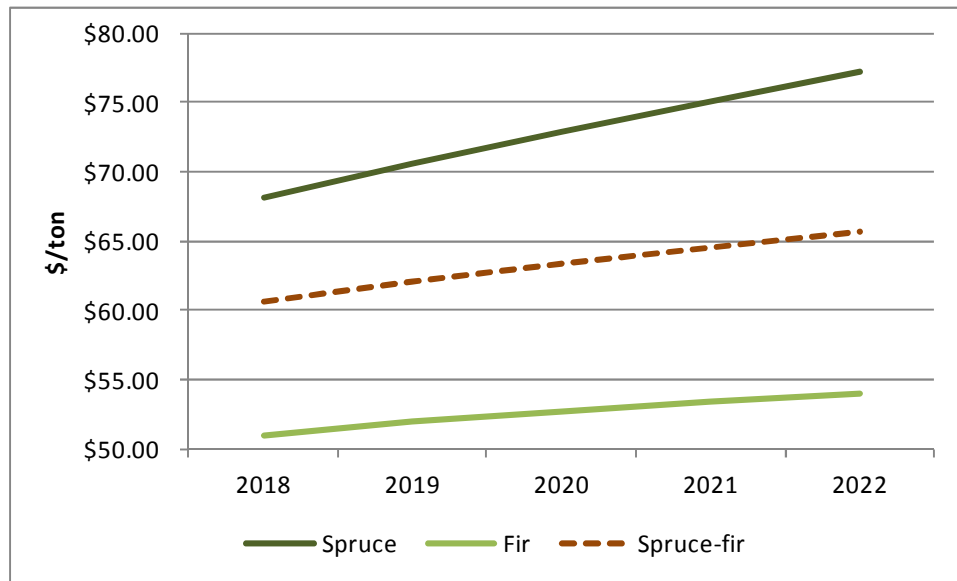
Figure 3.7 depicts the reported results over the period by the classifications the mills utilized, plus an overall average. As can be seen, spruce-fir sawable material had a similar trend to spruce-fir pulpwood - rising through 2014, leveling off and then declining significantly in 2016. Unlike spruce-fir pulpwood, spruce-fir sawable leveled off in 2017.

Figure 3.7 Historic Average Costs of Spruce-fir Sawable in Northern and Eastern Megaregions



Although East Coast spruce-fir (composite) lumber prices fell in the first quarter of 2018, they have been at relatively historic highs from 2013 to present. This level of demand was reflected in the wood pricing until pulpmills closed in late 2014 and early 2015, which eased competition for the sawmills. Prices fell commensurate with competition, but they have increased in 2018. How far they will recover is difficult to ascertain because of the unknown of additional sawmill capacity and lumber demand. Numerous mills have spent capital over the last five years to increase capacity and throughput, and the spruce-fir resource, though expanding, is largely in smaller diameter stems.

³ Mills reported similar, but slightly diverse, specifications for higrade logs. They tended to have larger diameter smaller-end diameters and were often backhauled considerable distances on lumber trucks returning to the mills.

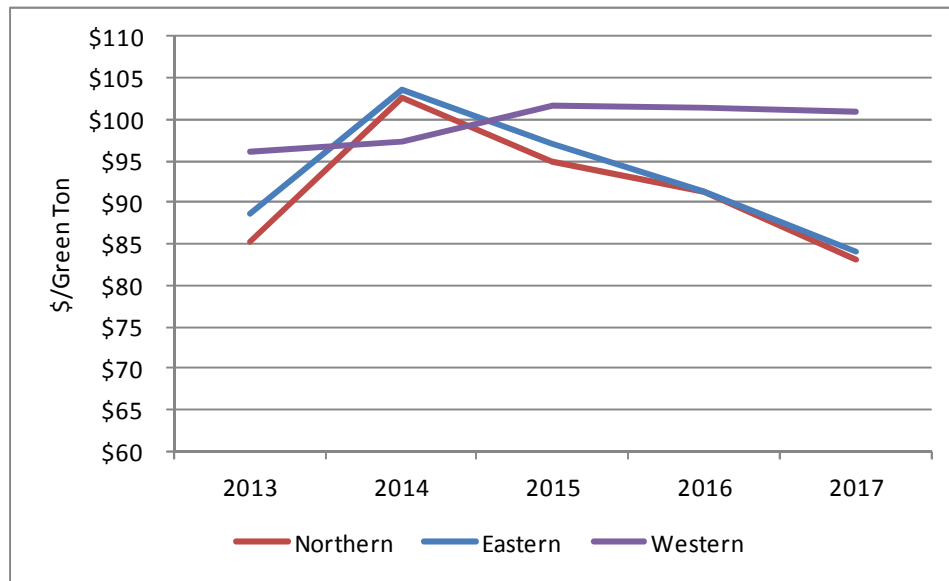
Figure 3.8 Predicted Steady-state Costs of Maine Sawable (non-log) Stems – Maine⁴

Sewall's best estimate of steady-state analysis (figure 3.8) over the next five years is broken down by species rather than tree form. In 2017, loads of pure spruce were priced on average \$11/ton over pure loads of fir, the differential having grown from \$8/ton two years earlier. Mixed loads of SF were discounted by an average of \$5.75/ton over pure spruce loads in 2017. We believe that this spread will continue to increase because fir takes longer and is more difficult to dry than spruce.

HARDWOOD LOGS

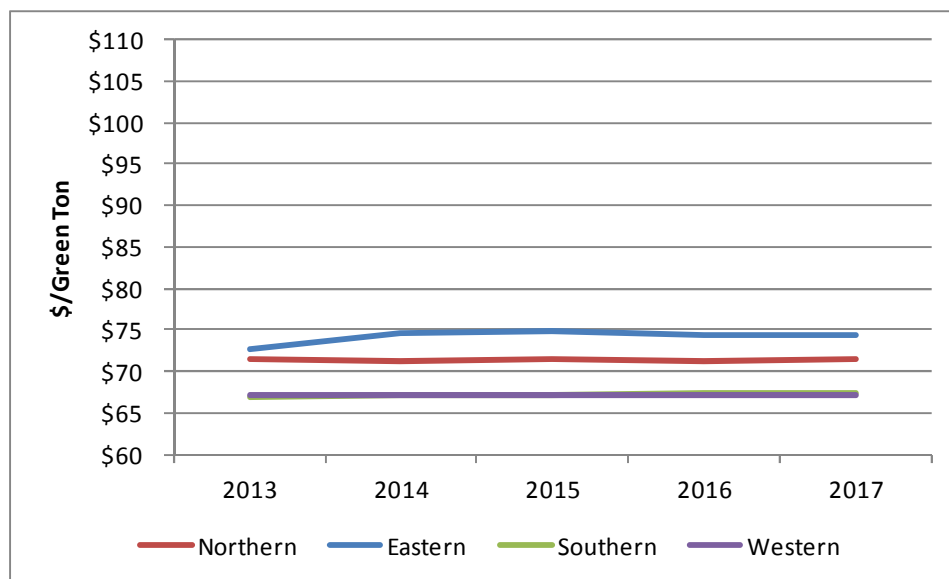
Sewall received less data on hardwood logs than other species/products. While some of it was segregated by grade and length there was not adequate data to do trend analysis except at the combined level for three of the megaregions. This data is presented in figure 3.9. It is important to remember that these are average prices of all log grades, except pallet logs. Therefore any differences between years and megaregions could be related to mix as well as other factors (transportation and log price trends).

⁴ Represents Bangor north.

Figure 3.9 Historic Average Costs of Hardwood Grade Logs - Maine Sourced

Pallet logs were reported as a separate entity. The market appears stable around \$65 - 70/ton with some modification for size, specifications and distance. Our limited data is presented in figure 3.10.

Sewall did not receive adequate data to allow statistical projection of prices into the future for either type of hardwood logs. In general, we would expect prices of lower grades to be stable, with a modest increase in higher grade logs as supplies continue to tighten. Oak might be the exception, as it is more plentiful (especially in the southern megaregion), and it is not normally in as high a demand in the fancy grades.

Figure 3.10 Historic Average Costs of Hardwood Pallet Logs - Maine Sourced

SPRUCE AND FIR LOGS

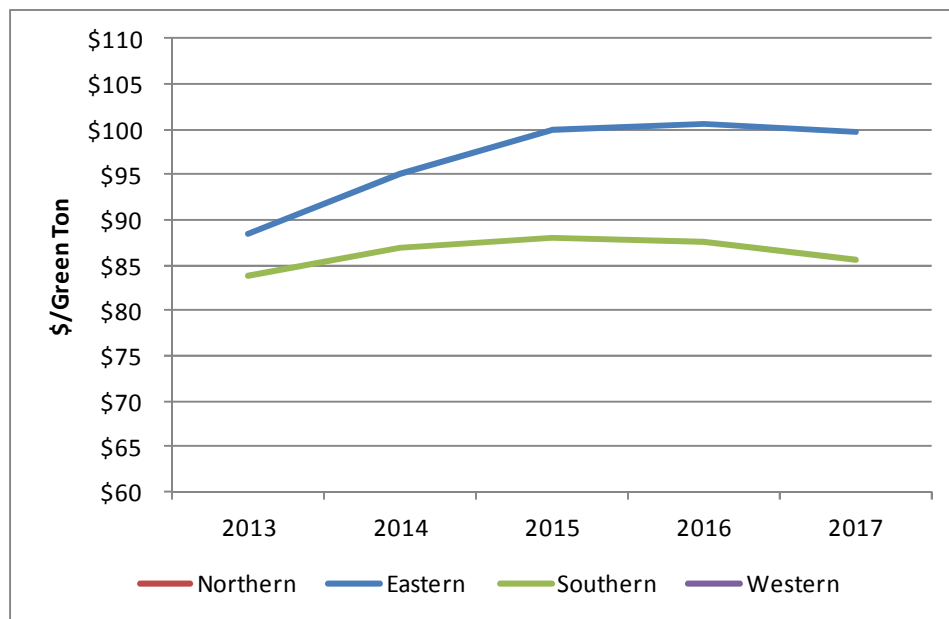
The study did not receive adequate data to do a separate analysis of spruce, fir or spruce-fir logs by megaregion. Adequate data was received to ascertain that many mills pay the same equivalent price⁵ for logs as they do wood-run treelength to the top size or length of their specification. Readers should look to the treelength spruce and fir portion of this report for a sense of trends. Studwood specifications are normally for a smaller stem than treelength.

PINE LOGS

The vast majority of pine logs in Maine are purchased on grade and a per thousand board foot (Mbf) basis. Scalers scale and grade each log according to the mill's own grade sheet. While we did receive a significant amount of data for two megaregions, there is no clear way to reconcile the grade differences between the mills, so we were forced into using an average cost per Mbf for each mill by year. While the results do little to demonstrate prices for grade difference, it does present a very good representation of what "woods-run" pine logs will net at the mills. Figure 3.11 depicts this data. It is estimated that the costs in the eastern megaregion are higher due to transportation differences. Unlike numerous other species/products, pine prices being paid are readily available from most of the pine mills - some online. Published prices for select grade are between \$540 and \$600/Mbf and it reduces by grade increment to #3 (pallet) that is currently \$125-\$135/Mbf.

Prices have been fairly stable over the five-year period and are expected to continue in this trend.

Figure 3.11 Historic Average Costs of Pine Logs (all grades) - Maine Sourced

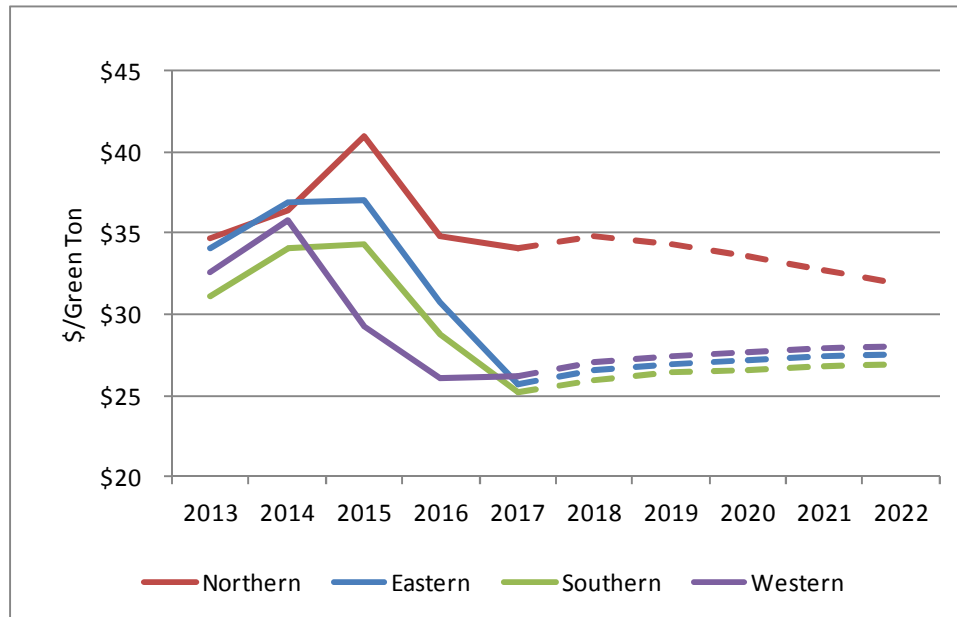


⁵ Mills typically purchase treelength on weight basis, and logs on a per thousand board foot (Mbf) basis. One must understand the mills scaling rule and assumptions of weight/Mbf to convert price.

BIOMASS

Sewall received a significant amount of biomass data from all megaregions, although the western megaregion had less volume reported than all other regions.

Figure 3.12 Historic and Predicted Average Costs of Biomass - Maine Sourced



Biomass, like other commodity products, rose in average cost from 2013 to 2015 and then significantly decreased through 2017. At least in this data set, the northern region held price more than the other three regions. This might have been due to longer-term contracts or transportation differences, but over time it is expected to mirror other regions. There is more than adequate supply of biomass and markets have been weak in recent years. For our future cost predictions we added only the anticipated additional cost of diesel to the 2017 average cost.

4. HYPOTHETICAL SCENARIOS

OVERVIEW

Sewall collaborated with the steering committee to generate four scenarios to predict price sensitivity under conditions of demand expansion. Projected volumes were added to estimated 2017 volumes in four increments of 250,000 tons/increment. The scenarios are as follows:

1. Softwood pulpwood in the southern megaregion
2. Spruce fir pulpwood in the eastern megaregion
3. Spruce fir sawable material (including logs) in the northern megaregion
4. Hardwood pulpwood in the southern portion of the state (south of a line from Skowhegan to Bangor to Ellsworth)

For each of these scenarios, Sewall utilized the following components to build average projected cost curves:

- Steady-state average wood cost for the species/product and megaregion in question.
- Perceived level of competition generated by the additional demand. Two sources of competition were contemplated: competition for the stumpage (money back to the landowner), and competition for the logger/trucker (money back to the contractor).
- Zone mix of deliveries. For each incremental level of competition we increased the percentage of deliveries from further zones utilizing average percentages from this data set over the five years (therefore increasing transportation costs).
- Amount of secured wood purchased in closer-distance zones. As competition increased and delivery distances expanded we factored in a larger amount of "secured wood" (larger volumes at a premium).

SCENARIO 1 - EXPANSION OF DEMAND FOR SOFTWOOD PULPWOOD IN THE SOUTHERN MEGAREGION

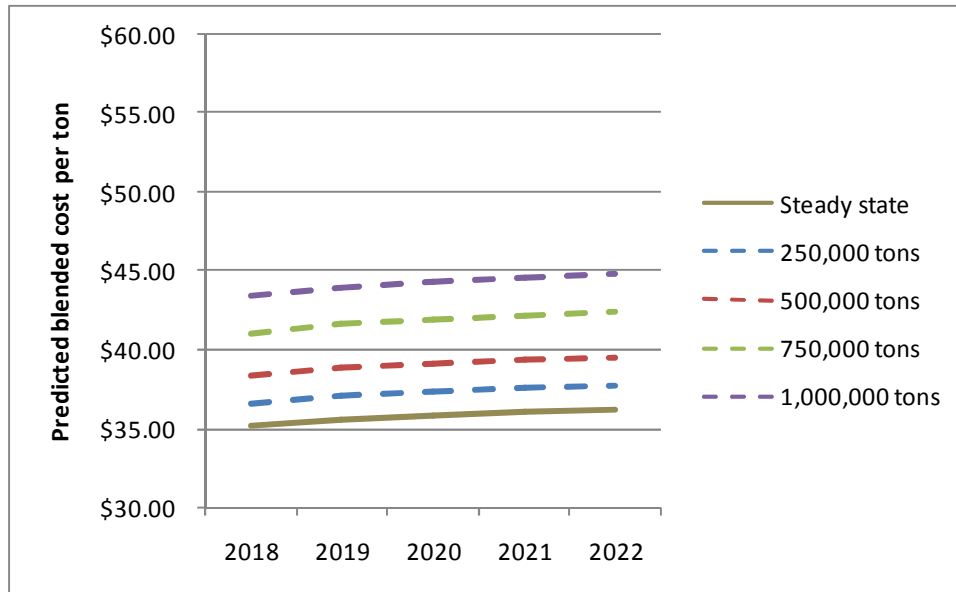
Softwood pulpwood is plentiful in the southern megaregion, while demand is rather soft. This is an area where Sewall and the committee thought that capacity could be added above 2017 levels⁶. Figure 4.1 depicts the predicted average cost curve for four levels of expansion in this scenario. As mentioned in a previous section, our steady state prediction is fairly flat. Adding modest incremental volumes to this steady state should require only modest increases in price as numerous contractors report looking for markets for this material. As demand grows however both the contractors and the landowners will utilize the opportunity to increase prices. At the highest volumes in the scenario, transportation and purchasing bulk volumes will impact overall cost.

Average cost over the five-year period is only slightly increasing at all expansion levels considered - primarily due to the impact of predicted oil pricing.

⁶ As such, these predictions do not take into account any volume changes that might have been announced or happened in 2018.

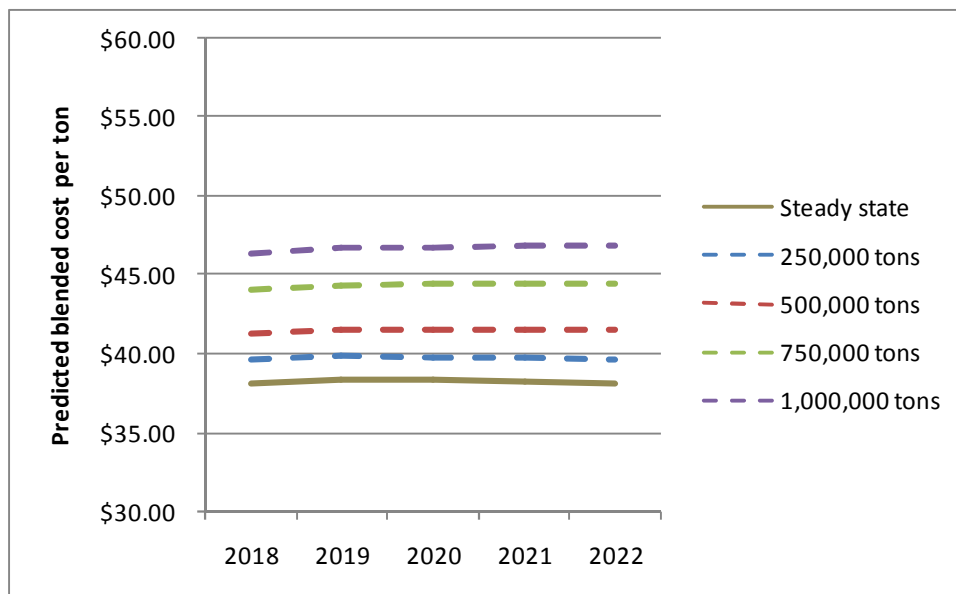
It is important to remind the reader that these are average predicted wood costs at the mill site and not an indicator of any specific negotiated price. These predictions are intended to reflect a mix of volumes from various distances, quality and volumes.

Figure 4.1 Predicted Average Cost Curves for Expanded Demand for Mixed Softwood Pulpwood in the Southern Megaregion



SCENARIO 2 - EXPANSION OF DEMAND FOR SPRUCE-FIR PULPWOOD IN THE SOUTHEASTERN MEGAREGION

Figure 4.2 Predicted Average Cost Curves for Expanded Demand for Spruce-fir Pulpwood in the Eastern Megaregion

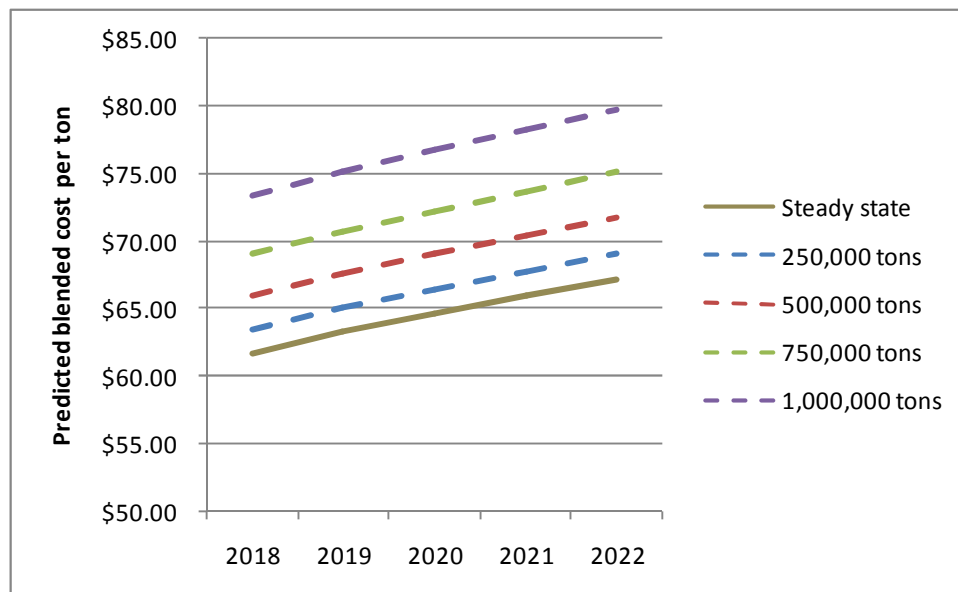


Our predictions for spruce-fir pulpwood expansion in the eastern megaregion follow a similar trend to softwood pulpwood in scenario 1 for similar reasons. Spruce-fir pulpwood is abundant in the eastern region and demand is weak. In our steady state prediction earlier in the report we expected average costs to remain relatively flat. We hold this prediction for all levels of increased expansion considered. We reason that each level of increased demand will necessitate increased average cost for distance, to draw contractor capacity and a slight amount for larger volumes of secured stumpage (larger volume purchases).⁷

SCENARIO 3 - EXPANSION OF DEMAND FOR SPRUCE-FIR SAWABLE IN THE NORTHERN MEGAREGION

In scenario 3, we start with steady-state average costs of a typical mill mix of treelength/studwood, and logs⁸ in the northern megaregion.

Figure 4.3 Predicted Average Cost Curves for Expanded Demand for Spruce-fir Sawable in the Northern Megaregion



While we do not want to be specific about site location, it does need to be stated that northern Maine has regions with distinct differences in the competitiveness of spruce-fir sawable material. Western and northern Maine have higher prices and more competitive demand than eastern and southern areas of the megaregion. These predictions strive to represent an overall average for the region, but are not suitable estimates for any expansion within 150 miles of an existing operating facility.

In these predictions, there is a greater impact of increased volume due to most components that make up wood cost: contractor and stumpage competition, distance, secured volumes,

⁷ Again, a reminder that these average cost predictions are on top of 2017 volumes and do not consider any volume changes announced or discussed in 2018.

⁸ Our scenario mix is as follows: 52.6% SF treelength (TL), 15.5% spruce TL, 10% fir TL, 16.5% SF logs, 3% spruce logs, 2% for logs, and 0.4% higrade logs on backhauls.

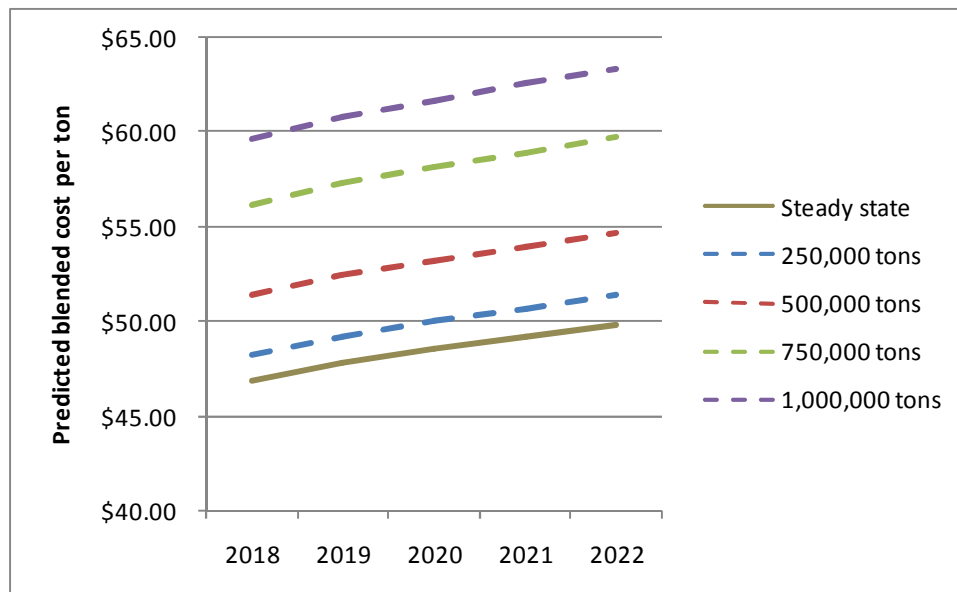
and the standard increases in oil and related products. While we did NOT include a general inflation factor in ANY of our predictions, northern Maine might be one place to consider increased labor cost over the period. If one believes that labor will continue to be in shortage in northern Maine, then these predictions may be slightly understated.

SCENARIO 4 - EXPANSION OF DEMAND FOR HARDWOOD PULPWOOD IN THE SOUTHERN HALF OF MAINE

The southern half of Maine hosts three large operating pulpmills utilizing larger volumes of hardwood pulpwood. Discounting oak pulpwood (not desired by any of the mills), the region is fairly in balance of market and harvest of hardwood. For this fourth scenario, we looked at the potential impact on wood cost of an additional expansion of demand in hardwood pulpwood in the region.

Figure 4.1 illustrates our average wood cost curves for the various expansion levels. Our prediction of steady state from early in the report was already one of the steepest increases over the period. Adding incremental demand will only increase both the average cost and the steepness of the increases year over year.

Figure 4.4 Predicted Average Cost Curves for Expanded Demand for Hardwood Pulpwood in Southern Half of Maine



Once one tops the 750,000 ton/ year expansion we are basically back to the reality of wood costs in late 2013/early 2014, and it is no surprise that simulated prices in the scenario look similar to costs during that period.

CROSS IMPACT OF EXPANSION(S)

Sewall had an unexpected finding during the course of this study, which is the impact sudden expansion or contraction of demand of one species/product has on most other

species/products within the procurement zone. We expect this is due to the capacity limits of the contractor and trucking force. What this is likely to indicate is that most significant expansions will not only tend to raise wood costs of the species/products in question (as estimated in Sewall's predicted wood costs), but will also increase delivered costs to other mills in the procurement zone (at least in the short-term). While there was not enough data to complete a statistically accurate prediction, anecdotal evidence seems to indicate that at least in the short-term, cross impact might be the majority of the same incremental increases as direct impact (see table 1.1, scenario 1 or 2). Whatever the amount of the impact, it will be exacerbated if the expansion first occurs in one of the busier times of the year (winter or after breakup).



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