BDO Zone Rating: **'AA'**

Biofuel Development Opportunity Zone Risk Rating

'AA'

The Greenbrier Valley Biofuel Development Opportunity Zone is rated 'AA'. There is a significant amount of woody biomass within the BDO Zone that can be utilized by new bio-projects, with low risk of feedstock shortage.

Rating Parameters:

Category	Rated Quantity	Delivered Cost	BDO Zone Size
Pulpwood	600,000 gt/yr	$40-$60/gt	75-mile maximum road distance from Renick, WV
Sawmill Residuals	150,000 gt/yr	$30-$60/gt	
Forest Residues	100,000 gt/yr	$40-$60/gt	

BDO Zone Assets

- **600,000 gt/yr of pulp-quality roundwood potentially available at low risk**
- **A high density of sawmills with a combined residual availability of at least 150,000 gt/yr**
- **A skilled and experienced forest industry interested in supplying feedstock**
- **Four business parks suitable for industrial biomass-based projects**

BDO Zone Liabilities

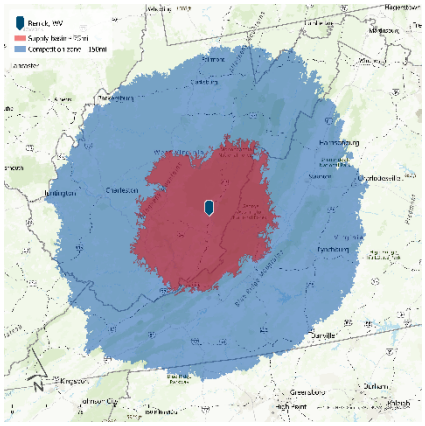
- **A large competitor with long-standing ties to suppliers is situated within the supply basin**
- **Logging capacity in the region is significantly reduced relative to pre-2007/08 levels**
- **Supply chain scale up is necessary to meet additional demand for feedstock**

BDO Zone Risk Rating

The Greenbrier Valley Biofuel Development Opportunity Zone is rated 'AA', or very high quality.

Risk Rating Grades are defined as follows: AAA (*highest quality*), AA (*very high quality*), A (*high quality*), and BBB (*good quality*).

Greenbrier Valley BDO Zone



Scoring and Rating Methodology

In assessing the biomass supply chain risk for the Biofuel Development Opportunity (BDO) Zone, 52 Risk Indicators from the Canadian Standards for Biomass Supply Chain Risk (BSCR) were applied. These BDO Zone Risk Indicators are the subset of BSCR Risk Indicators applicable to evaluating feedstock risk within a BDO Zone.

Feedstock quantities are expressed in green tons per year (gt/yr), while feedstock costs are expressed in United States (USD) dollars. Maximum transport distance is based on a 75-mile driving distance from the center point (Renick, WV).

The BDO Zone rating is based on an aggregation of the scores assigned to each BDO Zone Risk Indicator (RI) assessed in this report. First, each BDO Zone Risk Indicator is given a **Raw RI** score based on the research and analysis conducted on the feedstock supply chain in the region. Raw RI Scores are scaled between 1 (*low risk*) and 10 (*high risk*).

Next, each Risk Indicator is discounted, or "notched," based on the degree to which the uncertainty drivers are deemed addressable and whether there are reasonable expectations that mitigation measures could be put into place within the price parameters for this rating.

The **Notched Salience score** corresponds to the likelihood of

each Risk Indicator's described risk materializing given the implementation of reasonable mitigation measures. To arrive at the Notched Salience score, Raw RI scores are reduced based on the efficacy of the likely mitigation measures. If applicable, notching occurs at one of 3 levels: 25%, 50%, or 75%.

Finally, the potential impact of each Risk Indicator on the supply chain is assessed and scored on a 10-point **Impact Level** scale as either *low (3.33), moderate (6.66), or high (9.99).* Impact level scores are based on assumptions that key measures were implemented to mitigate uncertainty drivers in the BDO Zone but failed to do so.

The **Loaded RI** score for each Risk Indicator is calculated as the product of Notched Salience and Impact Level scores. For example, if the Risk Indicator 'Competitor Price and Price Sensitivity' is scored at a Raw Score of 4, a Notched Salience of 2, and the Impact Level is high (i.e., 9.99). The final Loaded RI score for this risk indicator is $2 \times 9.99 = 19.98$ (out of 100).

Loaded RI scores of 33.33 or less are deemed *low risk*; scores greater than 33.33 and less than 66.66 are deemed *moderate risk*; and those that score 66.66 to 100 are deemed *high risk*.

The total risk rating for the BDO Zone is the average of all Loaded RI scores. The BDO Zone score for the Greenbrier Valley BDO Zone is ***14.18 out of 100, resulting in an 'AA' designation.*** All scoring and rationale for each Risk Indicator are provided in Appendix A.

Analyst Notes

The Greenbrier Valley BDO Zone centers in the town of Renick, WV. The supply basin for the analysis (max. 75-mile road distance from Renick) encompasses a ~7,000 square mile area that includes parts of 15 counties in southeastern West Virginia and 9 counties in western Virginia. The competition basin (max. 150-mile road distance from Renick) encompasses a ~36,500 square mile area that extends to Huntington, WV in the west, Keyser, WV in the north, Charlottesville, VA in the east, and Galax, VA in the south.

The land area within the BDO Zone is densely forested, supporting a large forest industry with annual sales of over $1 billion and a workforce exceeding 5,000. The forest growth-to-removal ratio is between 2.0 and 2.5, meaning that every ton of forest biomass removed annually is replaced by 2-2.5 tons of biomass growth. FIA data for pulpwood (i.e., small-diameter trees of between 5 and 11 inches at breast height) indicates a growth-to-removal ratio as high as 14:1 in the Greenbrier Valley region (Table B-1, Appendix B). Major commercial tree species utilized for lumber and solid wood product manufacturing include red oak, black cherry, and sugar maple. Significant yellow poplar and basswood populations are also present in the region and are utilized by pulp, paper, and composite manufacturers.

Timberland ownership in the supply basin is predominantly private and includes large tracts owned by corporations (e.g., Weyerhaeuser and Penn Virginia Corporation) and smaller privately-owned properties. The supply and competition basins include a substantial acreage of public forest lands where logging is limited or prohibited.

West Virginia Division of Forestry (WVDOF) harvesting notification data indicates that logging activity within the supply basin has averaged approx. 40,000 – 50,000 acres/year over the last five years. Logging activity is driven largely by the dense network of sawmills in the region. At least twenty hardwood sawmills operate within the supply basin, ranging in capacity from 2 million board feet (MMBF) to 60 MMBF (average of 15 MMBF per sawmill). A conservative estimate of annual sawmill residual production in the supply basin is ~800,000 gt/yr. In the early-to-mid 2000s, lumber and residual production in the supply

basin were likely double the current levels (e.g., 1.6 million gt/yr of residuals).

USFS Forest Inventory and Analysis (FIA) data indicates that pulpwood production within a 75-mile radius of Renick, WV averaged approx. 375,000 gt/yr between 2016 and 2020 (Appendix B). This annual quantity is utilized by a large paperboard mill in Covington, VA (WestRock), by Weyerhaeuser OSB mills in Heaters, WV and Buckhannon, WV, and to a lesser extent by local firewood producers.

We identified twenty facilities that utilize woody biomass within or on the outskirts of the competition basin (a maximum 150-mile driving distance from Renick). This includes eight pellet mills with a combined intake of ~600,000 gt/yr of sawdust, two Weyerhaeuser OSB mills with demands of at least 200,000 gt/yr of soft hardwood pulpwood, and the Covington, VA paperboard mill, which intakes over 3 million gt/yr of sawmill residuals, pulpwood, and forest residue. Another paper mill located within the competition basin (Georgia-Pacific – Big Island VA) procures negligible quantities of wood from the BDO Zone owing to the more favorable geographic position of the Covington mill.

US Department of Energy data (Billion-Ton Report) indicates that the total quantity of standing small-diameter roundwood (pulpwood) available for a new entrant in the region is approx. 850,000 gt/yr. This estimate is corroborated by WVDOF harvesting notification data, assuming a production rate for pulp-quality roundwood of 20-30 gt/acre (Appendix B). We estimate that approx. 70% of this amount (600,000 gt/yr) could be felled, extracted, and delivered to a new project within the supply basin for the rated price of $40/gt to $60/gt. Although pulpwood prices over the past three years have temporarily reached highs of $75/gt, the price range in recent history has been between $30/gt to $45/gt. Buyers of pulpwood in the region frequently impose restrictions on the weekly or monthly quantities they are willing to accept, indicating that there is room in the market.

Logging capacity will require significant scale-up for procurement of the rated quantity of pulpwood. At a price of $40/gt - $60/gt, it is likely that the productivity of existing logging contractors would improve, and new logging capacity would enter the market. However, there are concerns regarding the time required to achieve full scale-up and the challenges in accessing financing for equipment purchases. An additional 150,000 gt/yr of sawmill residuals (~80,000 gt/yr of wood chips, ~35,000 gt/yr of sawdust, and ~35,000 gt/yr of bark) are also available at low risk within the supply basin (Appendix C).

Approximately 225,000 gt/yr of forest residues (tree branches, bottoms, and tops normally discarded during conventional logging operations) are available within the supply basin. However, most logging contractors currently operating in Greenbrier Valley have neither the experience nor the equipment required to recover this material successfully. Forest residue recovery and in-woods chipping were regularly occurring on the industrial lands west of Renick under the ownership of WestRock – Covington's predecessor (Westvaco). The acquisition of these timberlands by Weyerhaeuser put an end to forest residue production (not compatible with OSB production). In-woods chipping still occurs regularly in Virginia in support of the Covington mill operations but Virginian loggers rarely operate in West Virginia owing to regulatory barriers (e.g., restrictions on number of days of work allowed, business licensing requirements, and certification requirements).

The rated quantity of forest residues (100,000 gt/yr) is reflective of this uncertainty. It is expected that there is a high likelihood of success in procuring

100,000 gt/yr over a scale-up period of five years, given a pricing of $40/gt - $60/gt. This would provide sufficient time for the required investments in equipment and logistics improvements. Assuming a residue production of 10 gt/acre, this would require integrated harvesting and in-woods chipping on just 10,000 acres of timberland per year, or less than 20% of the annually harvested acreage.

Key Risk Indicators

We have identified competitor pricing, demand for competitors' products, and competitor locations as the most significant risks to a new project in the BDO Zone. The Covington paperboard mill, with a feedstock demand of over 3 million gt/yr, is located within the supply basin. The mill produces paperboard and activated carbon. Markets for these products are projected to grow in the medium term (e.g., 5-10 years).

Although there has been recent volatility in accepted quantities and pricing, the Covington, VA mill has been willing to pay a premium for pulpwood when required (up to $75/gt), often paying above market stumpage prices for pulpwood. The mill is known to regularly procure sawmill residuals from up to 150 miles away and is located within short hauling distances of many sawmills in the supply basin.

A new biomass-based project could mitigate these competition risks by focusing procurement efforts in areas located at distance from Covington and by securing supply contracts with logging contractors and sawmills. We estimate that the rated quantities are less than 50% of the total available biomass supply for new projects in the supply basin, indicating the likely success of strategic procurement. The situation is also mitigated to some extent by the trend of pulp and paper mill closures in the region; the Covington mill may be subject to the same forces in the medium term.

Other significant risks are associated with the labor force, the supply chain, and the ability to scale-up operations to procure the rated quantities of forest biomass. Logging contractors operating in the supply basin number approximately 100 and typically consist of a single crew composed of three to four men. A proficient crew utilizing a feller buncher for tree felling and delimbing has the potential to produce up to 25,000 gt/yr of pulp-quality roundwood.

However, a considerable number of contractors in the region do not own feller bunchers and instead rely on chainsaw felling and delimbing methods. In addition, cable skidders are commonly used in many areas, significantly limiting the recovery potential of small-diameter roundwood unless operated by experienced crews. For inexperienced crews, pulpwood production in operations with low mechanization could be as low as 5,000 gt/yr.

The reliance on manual labor and outdated equipment poses a moderate to high risk to the overall productivity and efficiency of the labor force. The limited mechanization and lower productivity levels associated with chainsaw felling and delimbing, along with the restricted recovery capacity of cable skidders, contribute to potential supply chain disruptions and inefficiencies. These risks could impact the timely and consistent availability of the required pulpwood and forest residue, potentially affecting the project's profitability.

Recovering forest residue presents further challenges. The majority of logging contractors in the supply basin are not currently engaged in integrated harvesting and in-woods chipping, making the targeted quantity of forest residues (100,000 gross tons per year) a considerable risk. Successful residue recovery would require adequate financing to support the purchase of mobile chippers and adequate logistics management on approx. 20% of the annually harvested area in the supply basin (Appendix B).

There are a number of measures that could be taken to overcome these challenges. With respect to financing and logistics management, industry and/or government could sponsor equipment financing arrangements or coordinate operations among multiple crews to improve logistics. To address potential labor shortages, logging crews from neighboring counties in West Virginia could be involved in logging activities within the supply basin.

Additional labor supply is unlikely to come from out-of-state regions without special arrangements. There are significant barriers to the movement of loggers from Virginia where forest residue recovery equipment and experience is more prevalent. Barriers to entry include the requirement for a West Virginia logging certificate, a West Virginia business license, and a workers' compensation policy. This issue is mitigated to some extent by the fact that ~45% of the supply basin lies in Virginia. Virginian loggers would have no difficulty operating within-state and trucking roundwood and chipped forest residues into West Virginia.

Other significant risks relate to diesel prices and feedstock transportation. Diesel prices in the Lower Atlantic Region have more than doubled over the past three years and are inherently volatile. For current trucking rates in the region (inclusive of diesel, capital, and labor), feedstock transportation costs can comprise >50% of total delivered costs at distances of 100 miles for the lower end of the rated price range ($40/gt). These are risks that can only be mitigated weakly through careful logistics management and strategic procurement.

Infrastructure Profile

There are at least four potential sites within Greenbrier Valley that are suitable for bio-project development (Appendix G). The infrastructure risk evaluation was focused on the 85-acre Edray Business and Technology Park in Marlinton, WV. The site has many assets favorable to the successful construction and operation of a biomass-based project, including medium industrial zoning and building stock suitable for use in feedstock management and manufacturing. The Park also has significant location advantages, being proximal to areas with significant quantities of forest biomass and distant from major competitors. The only significant infrastructure risks relate to access to natural gas, limited commercial air service, and rail. Generally, the infrastructure in the region is complementary to forestry and new biomass-based project development.

Technical Contacts

Marcin Lewandowski
Senior Director, Operations & Risk
Ecostrat Inc.
marcin@ecostrat.com

D. Peter Wolf
Project Director
Ecostrat Inc.
peter@ecostrat.com

Bob Buckingham
Project Principal
Ecostrat Inc.
bob@ecostrat.com

Business Contact

Jordan R. Solomon
President & CEO
Ecostrat Inc.
jordan.solomon@ecostrat.com

Figure 1: Risk Indicators (Sorted by Risk Level)

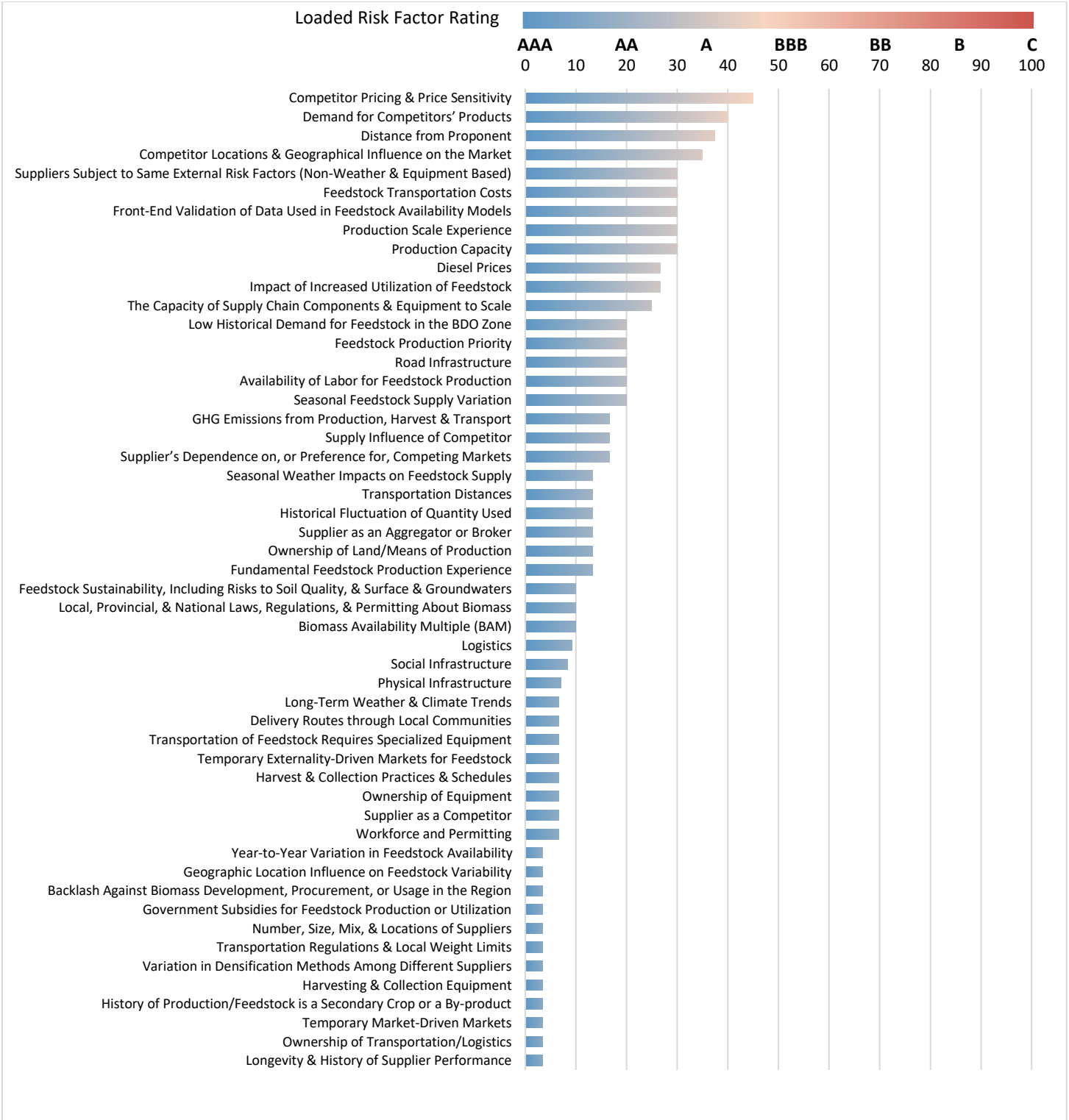


Table 1: Risk Indicators and Associated Scores

	Feedstock Supply Chain Risk Indicators	Raw RI Score	Notched Salience	Impact Level	Loaded RI Score
	Category 1: Supplier Risk				
1.1	Longevity & History of Supplier Performance	1	1.0	3.33	3.33
1.2	Production Capacity	4	3.0	9.99	29.97
1.3	Supplier's Dependence on, or Preference for, Competing Markets	5	2.5	6.66	16.65
1.4	Supplier as a Competitor	2	2.0	3.33	6.66
1.5	Ownership of Land / Means of Production	2	2.0	6.66	13.32
1.6	Ownership of Equipment	2	2.0	3.33	6.66
1.7	Ownership of Transportation/Logistics	1	1.0	3.33	3.33
1.8	Supplier as an Aggregator or Broker	2	2.0	6.66	13.32
1.9	Distance from Proponent	5	3.8	9.99	37.46
1.10	Fundamental Feedstock Production Experience	4	4.0	3.33	13.32
1.11	Production Scale Experience	6	4.5	6.66	29.97
1.12	Feedstock Production Priority	4	3.0	6.66	19.98
	Category 2: Competitor Risk				
2.1	Competitor Locations and Geographical Influence on the Market	7	3.5	9.99	34.97
2.2	Historical Fluctuation on Quantity Used	4	4.0	3.33	13.32
2.3	Competitor Pricing and Price Sensitivity	6	4.5	9.99	44.96
2.4	Supply Influence of Competitor	5	2.5	6.66	16.65
2.5	Temporary Market-Driven Markets	1	1.0	3.33	3.33
2.6	Demand for Competitors' Products	6	6.0	6.66	39.96
	Category 3: Supply Chain Risk				
3.1	Biomass Availability Multiple (BAM)	1	1.0	9.99	9.99
3.2	Impact of Increased Utilization of Feedstock	4	4.0	6.66	26.64
3.3	Seasonal Feedstock Supply Variation	3	3.0	6.66	19.98
3.4	Year-to-Year Variation in Feedstock Availability	1	1.0	3.33	3.33
3.5	Front-End Validation of Data used in Feedstock Availability Models	3	3.0	9.99	29.97
3.6	Low Historical Demand for Feedstock in the BDO Zone	4	3.0	6.66	19.98
3.7	History of Production/Feedstock in a New/Secondary Crop or a By-Product	1	1.0	3.33	3.33
3.8	Diesel Prices	4	4.0	6.66	26.64
3.9	Harvest & Collection Practices & Schedules	2	2.0	3.33	6.66
3.10	Harvesting and Collection Equipment	1	1.0	3.33	3.33
3.11	Temporary Externality-Driven Markets for Feedstock	2	2.0	3.33	6.66
3.12	Variation in Densification among Different Suppliers	1	1.0	3.33	3.33
3.13	Availability of Labor for Feedstock Production	4	3.0	6.66	19.98
3.14	Feedstock Transportation Costs	6	4.5	6.66	29.97
3.15	Transportation Distances	2	2.0	6.66	13.32
3.16	Transportation of Feedstock Requires Specialized Equipment	2	2.0	3.33	6.66
3.17	Delivery through Local Communities	2	2.0	3.33	6.66
3.18	Transportation Regulations & Local Weight Limits	1	1.0	3.33	3.33
3.19	Road Infrastructure	3	3.0	6.66	19.98
3.20	Number, Size, Mix, and Locations of Suppliers	1	1.0	3.33	3.33
3.21	Suppliers Subject to Same External Risk Factors	3	3.0	9.99	29.97
3.22	Seasonal Weather Impacts on Feedstock Supply	2	2.0	6.66	13.32
3.23	Long-Term Weather and Climate Trends	1	1.0	6.66	6.66
3.24	Government Subsidies for Feedstock Production or Utilization	1	1.0	3.33	3.33
3.25	Local, Provincial, and National Laws, Regulations, and Permitting pertaining to Biomass	3	3.0	3.33	9.99
3.26	Backlash against Biomass Development, Procurement or Usage in the Region	1	1.0	3.33	3.33
3.27	Feedstock Sustainability, including risks to soil quality and surface and groundwaters.	1	1.0	9.99	9.99
3.28	GHG Emissions from Production, Harvest and Transport	5	2.5	6.66	16.65
3.29	Geographic Location Influence on Feedstock Variability	1	1.0	3.33	3.33
3.30	Capacity of Supply Chain Components and Equipment to Scale	5	3.8	6.66	24.98
	Category 4: Infrastructure				
4.1	Physical Infrastructure	2.1	1.9	3.33	6.99
4.2	Logistics	2.75	2.8	3.33	9.16
4.3	Social Infrastructure	2.5	2.5	3.33	8.33
4.4	Workforce and Permitting	2	2.0	3.33	6.66
				Average	**14.18**



Greenbrier Valley BDO Zone Independent Review Committee (IRC)

Ruthana Beezley – Greenbrier Valley EDC
Charlie Sheets – Greenbrier Valley EDC
Andrew Robinson – Senator Joe Manchin
Joe McNeel – WVU Appalachian Hardwood Center
Eric Carlson – WV Forestry Association
Danny Woods – Beckwith Lumber
Todd Hooker – WV Department of Economic Development
Matt Borror – WV Department of Economic Development
Allen Sisler – Inter-State Hardwoods
Tammy Tincher – Greenbrier County Commission.

APPENDIX A: RISK INDICATOR SCORING METRICS

CATEGORY 1: SUPPLIER RISK

1.1. Longevity & History of Supplier Performance

Rationale: Number of years in business is a positive indicator of future solvency. Historical performance is an indicator of future performance.	
Raw RI Score: At least 20 sawmills and 100 logging crews operate within the supply basin. Most sawmills and logging companies have at least 10 years of operational experience, and the individuals who own and operate equipment possess knowledge and experience spanning several generations. Variation in sawmill and contractor performance tracks with variation in forest product demand, as determined by market shifts and business cycles. Following a period of high growth and output in the early-to-mid 2000s, the number of suppliers in the region declined as demand for lumber and forest products declined. However, the experience and density of suppliers in the supply basin remain significant relative to other regions of North America. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustment. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score 1.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33.	**Score 3.33**

1.2. Production Capacity

Rationale: Supplier production capacity can be a strong indicator of long-term credit worthiness and future solvency. Higher production capacities denote strength of operational elements, including cash flows, which are important to future solvency.	
Raw RI Score: Logging contractors in the region (suppliers of pulpwood and forest residue) tend to be small, consisting of a single crew of three to four men. A single experienced crew using a feller buncher for tree felling and delimbing could produce up to 25,000 gt of pulp-quality roundwood annually (assuming a weekly production of over 20 x 25-ton truckloads of pulpwood). However, many contractors in the region do not own feller bunchers, instead relying on chainsaw felling and delimbing. Cable skidders are also common in many areas, significantly limiting the potential for the recovery of small diameter roundwood. These experienced unmechanized crews would likely have productivities as low as 5,000 gt/yr of pulpwood, assuming a weekly production of 5 x 25-ton truckloads. With respect to forest residue recovery, the majority of logging contractors in the supply basin are not currently involved in integrated harvesting and in-woods chipping therefore, the rated quantity of forest residues (100,000 gt/yr) is associated with significant risk as regards production capacity. There is no production capacity risk associated with sawmills in the supply basin, which have an average lumber production capacity of 15 million board feet (MMBF) per year and an average sawmill residuals production of ~40,000 gt/yr. Overall, production capacity risk is assessed as moderate.	**Score 4**

Raw RI Score is 4 out of 10.	
Notched Salience: The rate at which additional equipment is purchased can be increased through a number of measures, including proponent- or government-backed financing arrangements favorable to logging contractors and vertical integration by a proponent. Raw RI Score is notched down by 25%. Notched salience is 3.0.	**Score 3.0**
Impact Level: RI Impact level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 29.97.	**Score 29.97**

1.3. Suppliers' Dependence on, or Preference for, Competing Markets

Rationale: Suppliers may have a vested interest in or preference for supplying specific competitors for biomass feedstock. Preferences may be due to historical, long-term, or personal relationships, less stringent feedstock quality requirements, more flexible operating hours by competing markets, or suppliers' dependences on competing markets to accept or purchase other products/by-products. Consequently, during periods of feedstock shortage, such suppliers may be more likely to allocate the scarce supply to a competitor, resulting in supply disruptions for the Proponent.	
Raw RI Score: Sawmills and logging contractors in the region have a long history of supplying the WestRock – Covington paperboard mill with residuals and pulpwood. Quantities are also supplied to two Weyerhaeuser OSB mills, four pellet mills, and other value-added manufacturers located within the 150-mile competition basin (Appendix E). Although a dependence on the Covington mill exists, sawmill owner-operators and logging contractors contacted by Ecostrat indicated that the rated quantities of biomass could become available to a new entrant for the rated prices. While markets for residuals have been relatively steady over the past few years, pulpwood prices have fluctuated considerably ($30/gt – $75/gt) and quotas limiting the weekly number of acceptable truckloads are not uncommon. Risk is deemed to be moderate. Raw RI Score is 5 out of 10.	**Score 5**
Notched Salience: Supply agreements with sawmills and logging contractors would reduce risk related to supplier dependency and/or preference. Raw RI Score is notched down by 50%. Notched salience is 2.5.	**Score 2.5**
Impact Level: RI Impact level is deemed *moderate.*	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 16.65.	**Score 16.65**

1.4. Supplier as a Competitor

Rationale: The risks of feedstock costs going up and availability going down increase if a supplier is also a competitor to the Proponent. In times of feedstock shortage, the risk that supply commitments will not be met increases.	
Raw RI Score: Sawmills in the region typically use some proportion of residuals (particularly bark) for internal energy needs (e.g., kiln drying, space heating). There are also a few examples of sawmills that have added pellet production capacity in recent years. It is unlikely that sawmills will significantly increase	**Score 2**

their use of residuals for these purposes, therefore, there is high confidence in the availability of the rated quantity of sawmill residuals (150,000 gt/yr) and low risk of competition with suppliers. Raw RI Score is 2 out of 10.	
Notched Salience: No adjustment.	**Score 2.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

1.5. Ownership of Land/Means of Production

Rationale: Suppliers that own land where feedstock is produced, or a production facility, tend to have better control of supply chains and present lower degrees of supply risk.	
Raw RI Score: Most of the wood supply in the Zone is procured from privately owned timberlands through stumpage payments. Privately owned timberlands include large tracts >100,000 acres owned by multinational companies (Weyerhaeuser, Penn Virginia Corporation), medium-sized tracts >10,000 acres owned by sawmills and individuals, as well as smaller tracts <1,000 acres owned by individuals. Owing to the presence of potential suppliers that own large tracts of timberland and processing facilities, risk is deemed to be low. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score 2.0**
Impact Level: RI Impact level is *moderate.*	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is **13.32**.	**Score 13.32**

1.6. Ownership of Equipment

Rationale: In most cases, suppliers that own or lease equipment for harvest, collection, and processing feedstock are lower risk than those who do not. For example, third-party harvesting equipment may not be available when required. Short harvest windows may be missed if a contractor cannot schedule harvest times that are convenient and quantity shortages can result.	
Raw RI Score: Most logging contractors in the region own at least one truck, a requirement for the timely recovery and delivery of roundwood. Larger sawmills also tend to own trucks and chip vans. Other supply chain equipment critical for procurement of the rated biomass quantities also tends to be owned by suppliers. Future wood chip supplies derived from pulpwood and forest residue are a possible exception, as ownership of the required in-woods and/or stationary chippers would likely be exclusive to a few contractors. Ownership of equipment is deemed low risk. Raw RI Score is 1 out of 10.	**Score 2**

Notched Salience: No adjustment.	**Score 2.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

1.7. Ownership of Transportation/Logistics

Rationale: In most cases, suppliers that own or lease equipment necessary to transport biomass from forest or field are lower risk than those who do not. However, in some circumstances, reliance on third parties to transport biomass is a common practice and does not contribute to risk.	
Raw RI Score: Ownership of logging trucks and chip vans is distributed relatively evenly among logging contractors, sawmills, and third-party transportation service providers. No transportation ownership risks are foreseen. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustment.	**Score 1.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33.	**Score 3.33**

1.8. Supplier as an Aggregator

Rationale: Aggregators may effectively provide supply chain redundancy, eliminating the risk and complexity of dealing with multiple sources of supply by combining supplies into a single master contact. Aggregators can add much needed stability in BDO Zones by increasing offtake stability for both suppliers and markets. An aggregator can be a more reliable long-term offtake for suppliers by virtue of having multiple markets and can be a more reliable long-term supplier for markets by having access to multiple suppliers. Further, when a single supplier breaches, the aggregator can source from another.	
Raw RI Score: Several aggregators are active in the region, including sawmills with large holding and satellite yards that enable stockpiling, as well as independent companies specializing in log aggregation and sale. The number of third-party log yards in Greenbrier Valley and surrounding counties has increased in recent years. Many of these companies prioritize the export of sawmill-grade (as opposed to pulpwood) roundwood to international markets (roundwood is purchased, debarked, and loaded into containers for international shipping). It is possible that these aggregators would work with a new project, allocating a portion of their storage capacity for pulpwood aggregation. However, their participation is not critical, due to the large stockpiling capacity of local sawmills. Raw RI score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score 2.0**

Impact Level: RI Impact level is deemed *moderate.*	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 13.32.	**Score 13.32**

1.9. Distance from Proponent

Rationale: The greater the distance from a supplier to a plant, the more exposure to weather and fuel cost risks and the greater the competitive pressure (to breach) that a closer competitor can exert.	
Raw RI Score: While there is no proponent identified at this stage, over half of the available supply is located at distances greater than 50 miles from the center point (Renick) (Figure F-1, Appendix F). Available pulpwood and forest residue resources are not concentrated in particular areas of the supply basin (Maps B-1 and B-2, Appendix B), implying that a new project is likely to procure the rated quantities given the Biomass Availability Multiple of >2.0 (see Risk Indicator 3.1). Outreach has determined that for a transport distance of 100 miles, pulpwood transport costs in the region are <$20/gt and therefore remain below 50% of the total delivered cost for the rated price range ($40/gt to $60/gt). There is moderate risk associated with the proximity of sawmills to competitors, as the majority of the sawmills in the supply basin are located within 75 miles of the WestRock – Covington, VA paperboard mill (Map E-1, Appendix E). Risk is deemed to be moderate. Raw RI Score is 5 out of 10.	**Score 5**
Notched Salience: The large number of log yards in the region can effectively act as a buffer against supply shocks resulting from excessive transport distances. Raw RI score is notched down by 25%. Notched Salience is 3.75.	**Score 3.75**
Impact Level: RI Impact level is deemed *high.* The distance between the supplier and the proposed bio-project is a significant variable that can influence the viability of feedstock access. The location of a future project is not known.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 37.46.	**Score 37.46**

1.10. Fundamental Feedstock Production Experience

Rationale: Risk is higher when a supplier has limited experience with harvesting/processing and/or collecting biomass. Where experience is lacking, the Proponent should show that steps have been taken to ensure proper training, knowledge dissemination, and monitoring.	
Raw RI Score: Although regional roundwood and sawmill residuals production experience is adequate, logging contractors and other forestry professionals within the Zone have limited experience with integrated harvesting and in-woods chipping. About a decade ago, some level of whole-tree harvesting and forest residue recovery was sustained on industrial lands adjacent to Renick. These lands were owned by Westvaco – Covington at the time (now WestRock – Covington). Residue recovery operations stopped when Weyerhaeuser acquired the land. One informant noted that in his experience, many of the steeper and more mountainous areas of the supply basin are not amenable to efficient in-woods chipping due to small landing sizes and narrow winding roads. Whole-tree harvesting and in-woods chipping occur regularly in Virginia as part of Covington operations; thus, it is likely that Virginian loggers located within	**Score 4**

the supply basin have access to this experience and equipment. However, the Virginia side of the supply basin is also mountainous, and contractors may experience similar problems of maneuverability. Since the rated quantity of forest residues constitutes <12% of the total rated quantity and requires integrated harvesting on <25% of the annually harvested land area, overall risk is deemed low-to-moderate.

Raw RI Score is 4 out of 10.

Notched Salience: No adjustment.	**Score 4.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 13.32.	**Score 13.32**

1.11 Production Scale Experience

Rationale: Scale-up entails risk. Risk is higher when a supplier has limited experience with the production of the quantity of feedstock required.	
Raw RI Score: Annual logging activity in the supply basin over the last five years is estimated to range from 40,000 – 50,000 acres/year. Current pulpwood harvesting in the supply basin, inferred using FIA data, is ~150,000 gt/yr. For current logging activity of 40,000 to 50,000 acres/year, pulpwood production averages <4 gt/acre, indicating a significant underutilization. This is confirmed by the FIA growth-to-removals ratio of 14:1 (Appendix B). Pulpwood underutilization was also confirmed through outreach to forestry professionals in West Virginia and Virginia. During the lumber and paper market highs of the early-to-mid 2000s, pulpwood production in the supply basin was likely comparable to the rated quantity of 600,000 gt/yr. As markets have remained depressed over the past 15-20 years, the logging contractor population has declined. Scale-up risk is moderated to some extent by the fact that many contractors operating in the Greenbrier Valley area are over the age of 40 and have experience producing quantities of roundwood comparable to those expected under a new venture in the supply basin. Therefore, the risk of scale-up for the production of the rated quantity of pulpwood is deemed to be moderate. The risk of scale-up for the rated quantity of forest residue (100,000 gt/yr) is assessed as moderate-to-high, as this would entail integrated operations on ~20% of the annually harvested area (assuming a forest residue recovery rate of 10 gt/yr). There is no risk of scale-up for sawmill residuals owing to the nature of residual production (zero cost by-product of lumber production that is easily collected and delivered).	**Score 6**

Raw RI Score is 6 out of 10.

Notched Salience: A proponent willing to assist in financing for new equipment and job training would reduce scale-up risk. There is also the potential for federal, state, or county government to reduce scale-up risk. Logging contractors must be licensed through the West Virginia Division of Forestry (WVDOF). Licensing involves first aid, safety, and environmental training and testing. Licensed logging contractors must also submit a harvesting notification to the WVDOF within three days of starting operations. The regular contact between government authorities and loggers in WV may be conducive to an organized scale-up of logging operations, including for example, the coordinated identification of sites suitable for harvesting, coordination of timing and logistics among independent logging crews to improve productivity, and equipment financing. Raw RI is notched down 25%. Notched Salience is 4.5.	**Score 4.5**

Impact Level: RI Impact level is deemed *moderate.*	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 29.97.	**Score 29.97**

1.12. Feedstock Production Priority

Rationale: When biomass feedstock is a secondary or non-core line of business, or when it is a by-product or a residual from a more valuable primary product, then suppliers may not put in sufficient effort for consistent production. Risk of breach increases when production and/or delivery of feedstock compromises a supplier's ability to make a primary product.	
Raw RI Score: Increased demand for pulpwood acts as an incentive for increased sawlog production. For the rated price of $40/gt to $60/gt, it is expected that any temporary lumber market downturns would not reduce the incentive to maximize logging activity, as there is adequate sawlog storage capacity in the supply basin. Forest residue production is unfamiliar to most logging crews in the supply basin and can reduce the efficiency of conventional logging operations, including felling/delimbing and product separation at landings. Introducing mobile chippers and chip vans to operations would decrease productivity due to the small landing sizes typical of the region. Feedstock production priority risk is therefore assessed as high for forest residue. Overall risk is moderate. Raw RI Score is 4 out of 10.	**Score 4**
Notched Salience: Careful logistics management by logging contractors, the owner-operators of a new project, and/or government authorities (e.g., WVDOF) could lead to efficient integrated harvesting and mobile chipping on smaller landings. Raw RI Score is notched down by 25%. Notched salience is 3.0.	**Score 3.0**
Impact Level: RI Impact level is deemed *moderate.*	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is **19.98**.	**Score 19.98**

CATEGORY 2: COMPETITOR RISK

2.1. Competitor Locations and Geographical Influence on the Market

Rationale: Competitors' locations relative to a Proponent plant can affect the viability of procuring feedstock and its cost. Accurate and detailed competitor mapping provides an understanding of the geographical influence a competitor may have, including competitive advantages such as short hauling.	
Raw RI Score: Twenty competitors for sawmill residuals, pulpwood, and forest residues were identified within or on the outskirts of the competition basin (Appendix E). The largest competitors include WestRock – Covington (45 miles from Renick WV), and two Weyerhaeuser OSB facilities, located 107 miles (Heaters) and 115 miles (Buckhannon) from Renick, WV. The Covington paperboard mill in particular has a major influence on the residuals and pulpwood markets, sourcing material from a 150-mile radius. When operating at nearly full capacity, the mill has an annual wood intake of over 3 million green tons. Each of the four sawmills we contacted sells most of their residuals to Covington. One sawmill contacted is located approximately 150 miles from Covington yet regularly supplies the facility with wood chips, sawdust, and bark. The regional pulpwood market is also known to center around the Covington paperboard mill. Many	**Score 7**

sawmills in the supply basin are within one-way travel times conducive to short hauling to and from the mill. Pellet mills and other smaller manufacturing facilities in the region are also significant competitors, consuming a total of about 500,000 green tons of sawdust and bark annually. In aggregate, the competitor location risk is deemed high. Raw RI Score is 7 out of 10.	
Notched Salience: With adequate planning and coordination, a new entrant could mitigate risk by focusing timber procurement efforts in directions opposite the location of the Covington paperboard mill. For example, if located near Marlinton, pulpwood procurement efforts might be focused on the east, north, and west rather than the south. Given the large quantity of standing pulpwood available in the supply basin and the large growth-to-removal ratio in West Virginia more generally (2.5:1), strategic procurement is expected to reduce the risk of competition considerably. Raw RI is notched down by 50%. Notched Salience is 3.5.	**Score 3.5**
Impact Level: RI Impact level is deemed *high.*	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 34.97.	**Score 34.97**

2.2. Historical Fluctuation of Quantity Used

Rationale: Clear understanding of key competitors' consumption of each type of feedstock utilized by the Proponent is essential to quantifying the risks associated with each competitor. Understanding historical trends of feedstock utilization can provide valuable information about feedstock price elasticity during shortages and insights into events impacting future supply conditions. It can also enable more accurate estimates of the sensitivity of feedstock availability to potential future consumption levels or to the impact of external events (e.g., weather events, structural economic changes, seasonality, or policy change).	
Raw RI Score: Our outreach suggests that the Covington paperboard mill consumes the majority of chips, sawdust, and bark produced in the Zone. Although the paperboard mill has been operating below capacity for some time, the facility has been a source of demand for residuals and pulpwood for over 50 years. All sawmills we contacted sell the Covington mill multiple types of residuals, increasing the risk that the mill could influence residual supply to a new entrant. In recent years, there have been instances when pulpwood prices have peaked briefly (e.g., to $75/gt) before falling back to the usual range of $30/gt to $45/gt. This indicates that the Covington mill has a temporary ability to pay a premium for pulpwood when required, more than what is typically paid for wood chips ($35/gt to $60/gt). While the historical record of supply and demand in the region indicates that the paperboard mill has considerable market power, the recent experience of the logging contractors we contacted suggests that the mill's ability to purchase pulpwood is limited. Quotas on the weekly number of truckloads of pulpwood that the mill is willing to accept have become common in recent years. This is also confirmed by FIA data, which indicates that pulpwood is significantly underutilized in the region (Appendix B). In summary, temporary fluctuations in market prices for residuals and pulpwood in the region occur in the context of pulpwood underutilization. Risk is therefore deemed low-to-moderate.	**Score 4**

Raw RI Score is 4 out of 10.	
Notched Salience: No mitigation measures could be identified.	**Score 4.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 13.32.	**Score 13.32**

2.3. Competitor Pricing and Price Sensitivity

Rationale: Understanding how much competitors pay for different feedstock types is an essential step in determining competitiveness of Proponent. Historical prices paid by competitors provide insights into their procurement behaviors and ability/willingness to pay premiums for feedstock and exert pressure on Proponent's suppliers during times of feedstock shortage. Competitors who are able to offer higher prices for feedstock during feedstock shortages can pose significant risks to Proponent.	
Raw RI Score: The Covington paperboard mill has been known to pay above-market prices for pulpwood when required (up to $75/gt). The mill also pays above-market stumpage prices to private landowners willing to guarantee long-term access to timber. Market intelligence suggests that paperboard markets will strengthen in the long term. The mill is also pursuing new emerging markets for pulp-quality biomass, including sustainable paper packaging, and activated carbon. The mill's willingness to pay for feedstock – while variable – does not appear to be declining. Competitor pricing risk is moderated to some extent by a recent imposition of pulpwood quotas and by the conservative rated quantity of pulpwood; the Biomass Availability Multiple (BAM) is likely greater than 2.0 when considering larger pulp-quality roundwood, which was not considered in the analysis (See Risk Indicator 3.1.). Competitor pricing risk is particularly high for sawmill residuals, as the Covington mill has been the main buyer of residuals for decades and is known to source residuals from distances of over 150 miles. Competitor pricing risk is deemed to be moderate. Raw RI Score is 6 out of 10.	**Score 6**
Notched Salience: Securing supply contracts can significantly mitigate this risk. Raw RI is notched down 25%. Notched salience is 4.5.	**Score 4.5**
Impact Level: RI Impact level is deemed *high.* There is a high degree of uncertainty related to our understanding of competitors' price sensitivity.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 44.96.	**Score 44.96**

2.4. Supply Influence of Competitor

Rationale: In some cases, competitors may be able to exert high degrees of pressure on local suppliers, effectively enabling them to control feedstock, especially during shortages. This control can derive from long previous relationships between suppliers and competitors, from verbal or "understood" agreements, or from a competitor being able to assist suppliers in times of surplus by maintaining large inventories that enable suppliers to continue supplying when other markets impose quotas. Understanding and

planning around such soft risk factors is important. If such relationships exist in the Proponent's procurement area, they may indicate an increased risk of feedstock shortage or pricing changes.	
Raw RI Score: Although suppliers have long-standing relationships with the Covington paperboard mill, all sawmill owner-operators and logging contractors contacted indicated that they are willing to sell to a new entrant at a premium. There is moderate to high risk that the rated quantities of sawmill residuals will not be available if the mill is willing to engage in a bidding war with a new entrant. The Biomass Availability Multiple for pulpwood is likely greater than 2.0 when considering the availability of larger diameter pulpwood (see Risk Indicator 3.1). Therefore, there is low risk that the rated quantities of pulpwood will not be available to a new entrant. Rated pulpwood prices are sufficient to cover the costs of harvesting low-quality stands in the region and are sufficiently high to account for the stumpage premium that the mill pays for pulpwood ($4-5/t). Raw RI Score is 5 out of 10.	**Score 5**
Notched Salience: A new project can reduce risks related to competitor supply influence by focusing procurement efforts on pulpwood and forest residue. Raw RI is notched down 50%.	**Score 2.5**
Impact Level: RI Impact level is deemed *moderate.*	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 16.65.	**Score 16.65**

2.5. Temporary Market-Driven Markets

Rationale: Alternative, non-traditional, market-driven competitors for feedstock can increase feedstock demand in unusual circumstances.	
Raw RI Score: None of the rated feedstock types are at risk of supply disruptions or sharp price increases because of non-traditional markets. Some species typically used in OSB and paper mills can be substituted for firewood, but there are no plausible circumstances where this might happen at scale. Risk is low, impact is low. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustment.	**Score 1.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33.	**Score 3.33**

2.6. Demand for Competitors' Products

Rationale: Increased demand for competitors' products can cause greater demand for feedstock by the competitor. For example, greater demand for biofuels due to a clean fuels policy can cause increased biofuel production by the competitor, thereby increasing demand for feedstock.	
Raw RI Score: General market trends for competitors' products indicate that some increase in feedstock demand is likely. Demand for products that the Covington mill manufactures or has expressed interest in	**Score 6**

manufacturing, including paperboard, raw kraft lignin (Indulin C), and sustainable paper packaging, is expected to grow in the long term. Therefore, there is moderate risk that the mill's demand for wood chips, sawdust, bark, pulpwood, and potentially forest residues, will increase. There are also risks of policy- and market-driven feedstock demand increases for other competitors in the region, including the eight identified pellet producers and the single charcoal producer (located just outside of the competition basin). Raw RI Score is 6 out of 10.	
Notched Salience: No mitigation measures could be identified.	**Score 6.0**
Impact Level: RI Impact level is deemed *moderate.*	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 39.96.	**Score 39.96**

CATEGORY 3: SUPPLY CHAIN RISK

3.1. Biomass Availability Multiple (BAM)

Rationale: Biomass Availability Multiple (BAM) indicates the degree of redundancy in a Proponent's supply chain. BAM is the ratio of biomass feedstock available to a project, at costs, timing, and in quality feasible for the Proponent, divided by the project's feedstock requirement. BAM is a strong indicator of supply chain resilience when stressed by a supply shortage and/or supplier breach.	
Raw RI Score: The total quantity of pulpwood (roundwood sectioned from trees with 5-11 inches diameter at breast height) that could be recovered from additional logging activity in the supply basin was estimated to be 844,714 gt/yr using the US DOE Billion-Ton Report dataset (Appendix B). The rated quantity of pulpwood (600,000 gt/yr) results in a Biomass Availability Multiple (BAM) of ~1.4. If considering low grade roundwood derived from trees larger than 11 inches diameter at breast height, the BAM is likely larger than 2.0. Forest residue availability in the supply basin was estimated as 227,695 gt/yr. Assuming a BAM of 2.0, which we think provides a high redundancy factor mitigating feedstock shortage risk, the potential availability of forest residue at low risk is 113,848 gt/yr. The final rated quantity of forest residue (100,000 gt/yr) results in a BAM of 2.3. Methods used to estimate annual residuals production from sawmills in the supply basin were deliberately conservative to ensure that final estimates were below what is likely (Appendix C). Therefore, no BAM is reported for sawmill residuals. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustment.	**Score 1.0**
Impact Level: RI Impact level is deemed *high.* Feedstock redundancy, or BAM, is an important variable when assessing feedstock supply feasibility, and its level can significantly impact the supply chain.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99.	**Score 9.99**

3.2. Impact of Increased Utilization of Feedstock

Rationale: Feedstock utilization can change over time owing to expansion of existing facilities. Increased utilization can lead to higher prices, feedstock disruptions, shortages, or supplier breach.	
Raw RI Score: Existing feedstock demands for pellet production in the competition basin exceed 500,000 gt/yr. There has been no growth in wood pellet production capacity in West Virginia since at least 2016, and there are no plans for capacity expansions. Therefore, pellet plant capacity growth in the competition basin is expected to be marginal in the near term (< 5 years) and does not constitute a serious price or supply risk to a new project given the large availability of pulpwood in the region. Other potential capacity expansions in the BDO Zone, including for paperboard, biochar, and bioelectricity, are only considered a low-to-moderate risk in the near term. Risk increases slightly due to expectations for the continued growth of biomass-based facility capacity in the long term. The BAM of >2.0 indicates that gradual capacity expansions are unlikely to pose a major risk to a new project. Raw RI Score is 4 out of 10.	**Score 4**
Notched Salience: No mitigation measures could be identified.	**Score 4.0**
Impact Level: RI Impact level is deemed *moderate.*	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 26.64.	**Score 26.64**

3.3. Seasonal Feedstock Supply Variation

Rationale: Biomass supply can present significant seasonal supply variations; combined with limitations associated with longer-distance transportation and storage, can lead to regional biomass supply imbalances and manifest in shortages and higher costs for Proponents.	
Raw RI Score: Lumber markets can exhibit strong seasonality, which leads to variation in sawmilling activity and residuals production. There are no other seasonal variations in feedstock supply that are not already buffered by the storage capacities of sawmills, the WestRock paperboard mill, and regional log yards. Risk is deemed low-to-moderate. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience: No adjustment.	**Score 3.0**
Impact Level: RI Impact level is deemed *moderate.*	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 19.98.	**Score 19.98**

3.4. Year-to-Year Variation in Feedstock Availability

Rationale: Biomass can have significant fluctuations in year-to-year supply due to variability in yield from biomass harvesting operations.

Raw RI Score: Year-to-year variation in roundwood yield is not expected to be significant in the study region. Roundwood yield per acre ranges from approx. 50 – 100 gt/acre in West Virginia. As in other regions of North America, there has been a long-term decline in roundwood yield per acre, but this has stabilized under modern forestry practices. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustment.	**Score 1.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is **3.33**.	**Score 3.33**

3.5. Front-End Validation of Data Used in Feedstock Availability Models

Rationale: Feedstock supply models can be complex. Lack of clarity about model assumptions and baseline data can result in confusion on the part of the capital markets and drive financing costs for biomass projects. The adequacy and credibility of assumptions and baseline data is paramount to credible model outputs.	
Raw RI Score: The model used to estimate pulpwood and forest residue availability (the US DOE Billion-Ton Report dataset and associated ForSEAM model) applies several assumptions to project forest biomass availability over time (2015-2040; Appendix B). Assumptions/parameters include the future demand for lumber (housing starts), bioenergy, and biofuels, proportions of available biomass that are recovered versus retained during forest operations, and harvesting equipment, for example. Given the purpose of the model (to estimate biomass availability for the coterminous United States), assumptions are necessarily coarse and could involve error of up to ±20% (estimated recovered biomass / actual recovered biomass). Baseline data used in the model consists of the USFS FIA dataset, which is expected to overestimate the available biomass unless adjusted/filtered. In this respect, the ForSEAM model produces more conservative estimates by restricting the timberlands considered to include only those within 0.5 miles of existing road networks and with slopes <40%. Due to these factors and to the estimated pulpwood BAM of >2.0, the model is considered to be a low risk. The spreadsheet model used to estimate sawmill residuals production is highly simplified, involving the use of generic arithmetic factors that convert milled quantities of sawlogs to wood chips, sawdust, and bark. The model outputs were calibrated using an approach that is expected to result in underestimates of residuals availability (Appendix C). The model is deemed to be low risk. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience: No adjustment.	**Score 3.0**
Impact Level: RI Impact level is deemed *high.* Because most of our conclusions in this assessment are based on biomass availability modelling, model errors can significantly impact supply chain risk.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 29.97.	**Score 29.97**

3.6. Low Historical Demand for Feedstock in the BDO Zone

Rationale: If the Proponent does not have a history of developing large-scale feedstock procurement, suppliers may not have sufficient expertise in feedstock production to ensure reliable supply, especially early on.	
Raw RI Score: Forest processing facilities (e.g., sawmills, paper mills) and supporting pulpwood and residual supply chains have been operating in the Greenbrier Valley region for over 100 years. Shortly before the financial crisis of 2007/08, roundwood and residuals production were roughly double that of current levels. Forest residue recovery is more recent (1970s) and has been inconsistent over time. No current examples of integrated harvesting within the BDO Zone were discovered through outreach. The lack of recent experience recovering forest residues in the supply basin constitutes a moderate-to-high risk. Aggregate risk for this indicator is considered moderate. Raw RI Score is 4 out of 10.	**Score 4**
Notched Salience: There is some forest residue recovery capacity and experience in northern West Virginia and neighboring states (e.g., Virginia). Technology and knowledge transfer from the individuals and organizations involved in broader regional forest residue recovery could increase the speed of scale-up. Raw RI is notched down by 25%. Notched Salience is 3.0.	**Score 3.0**
Impact Level: RI Impact level is deemed *moderate.*	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is **19.98**.	**Score 19.98**

3.7. History of Production/Feedstock is a Secondary Crop or a Byproduct

Rationale: If the feedstock is a new/secondary crop or a by-product, suppliers may either lack sufficient experience to mitigate risk or be unable to react to such risk, and producers may be less likely to prioritize production. If the feedstock is a secondary crop, then production can be subject to variables beyond suppliers' control.	
Raw RI Score: We do not anticipate any risks related to this risk indicator. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustment.	**Score 1.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33.	**Score 3.33**

3.8. Diesel Prices

Rationale: Diesel, oil, and PPI can impact feedstock cost of harvest and collection over time. Sensitivities to worst case scenarios should be run.	

Raw RI Score: Nominal prices for No.2 diesel in the Lower Atlantic Petroleum Administration Defense District (PADD) 1C (which includes West Virginia) reached historic highs in 2022 (Figure F-2, Appendix F). After adjusting for inflation using the CPI, average monthly prices have ranged from a high of $6.79/gallon in June 2008 to a low of $2.52/gallon in February 2016 (Figure F-3, Appendix F). In 2022, the highest average monthly price was $6.06/gallon (June 2022), which remains below the CPI-adjusted historic high of $6.79/gallon (June 2008). Inherent diesel price volatility reduces confidence in a stable or downward trend over the long-term, particularly under climate-related policies. The risk that diesel prices will push actual delivered feedstock prices in the BDO Zone beyond the upper limits of the rated price ranges is deemed moderate. Raw RI Score is 4 out of 10.	**Score 4**
Notched Salience: No mitigation measures could be identified.	**Score 4.0**
Impact Level: RI Impact level is deemed *moderate.*	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 26.64.	**Score 26.64**

3.9. Harvest & Collection Practices & Schedules

Rationale: Differences in harvest timing and practices can create risks for both the quantity and quality of the feedstock. For example, feedstock harvested by different suppliers in different windows can undergo varying levels of exposure to sun, wind, and moisture, leading to variations in delivered feedstock quality.	
Raw RI Score: Pulpwood and sawmill residual supply chains operate continuously throughout the year with few weather-related interruptions. Idle periods tend to be during winter and are specific to the more northern areas of WV. Following felling, delimbing, and extraction to roadside, tree-lengths are sectioned into logs (roundwood) and piled at the roadside within forest operating areas (cut blocks). Logs are then trucked to manufacturing facilities (e.g., sawmills, paper mills) or to log yards for temporary storage. Regional soft standards of log handling and storage ensure that variation in delivered feedstock quality and moisture content is within a range acceptable to buyers. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score 2.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

3.10. Harvesting & Collection Equipment

Rationale: Different types of harvesting and collection equipment suppliers use can significantly impact the quality and availability of feedstock. The use of different types and combinations of harvesting, collection, and processing equipment can lead to non-homogeneous feedstock. In addition, equipment not designed specifically for biomass cultivation, harvesting, and collection can increase feedstock quality risks.	
Raw RI Score: None of the equipment used in the regional forestry supply chain constitutes a risk to feedstock quality and availability. Trees are felled and partially delimbed with chainsaws, feller bunchers, or modified excavators. Felled trees are extracted to the roadside with grapple skidders, cable skidders, or cable yarding systems (on steep sites). Logs and sawmill residuals are delivered to the destination using conventional trucks. None of this equipment poses a feedstock quality or availability risk when managed and operated properly. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustment.	**Score 1.0**
Impact Level: RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33.	**Score 3.33**

3.11. Temporary Externality-Driven Markets for Feedstock

Rationale: Alternative, non-traditional, externality-driven competitors for feedstock can drive feedstock demand and cost in unusual circumstances.	
Raw RI Score: None of the rated feedstock types are at risk of supply disruptions or sharp price increases resulting from shifts in alternative or non-traditional markets. Pulpwood (5-11 inches in diameter) can be substituted for firewood if hardwood roundwood becomes scarce, but there are no plausible circumstances where this might happen. There are no indications that alternative, externality-driven markets for sawmill residuals, including animal bedding and landscaping mulch, pose a significant risk in the region. Raw RI score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score 2.0**
Impact Level: RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

3.12. Variation in Densification Methods Among Different Suppliers

Rationale: The shape and density of the unit in which feedstock is supplied can impact feedstock cost and quality.	

Raw RI Score: Sawmill residuals are not densified for transportation. Pulpwood can be densified when a terminal chipping approach is taken; in the event that this occurs, significant variation in densification methods is not expected. If forest residue is to be recovered, it is expected that in-woods chippers will be used (rather than a mixture of chippers and grinders). Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustment.	**Score 1.0**
Impact Level: RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33.	**Score 3.33**

3.13. Availability of Labor for Feedstock Production

Rationale: Skilled labor shortages can be difficult to remedy in the short term. Availability of suitable labor in an area can impact the ability to procure sufficient feedstock quantities on schedule. Labor risks are higher for facilities where supply chains are not yet active; or for Proponents for whom large feedstock requirements, or development of new (or expanded) supply chains, demand significant additions to the local labor force.	
Raw RI Score: There is a low-to-moderate risk that the existing labor force is of inadequate size to recover the rated quantity of 600,000 tons of pulpwood per year (Appendix B). Pulpwood tends to be left behind during conventional operations due to lack of markets; recovering this material would require no additional labor. Risk of labor shortages is deemed moderate. Raw RI Score is 4 out of 10.	**Score 4**
Notched Salience: If pulpwood recovery from existing operations is inadequate for the rated supply, logging crews from neighboring counties in West Virginia could contribute to logging activity but there are significant barriers to the movement of loggers from out-of-state regions with a higher density of loggers such as Virginia. Barriers to entry include the need for a WV logging certificate, WV business license, and a workers' compensation policy. This situation is mitigated to some extent by the fact that a sizeable proportion of the supply basin exists in Virginia. Thus, Virginian loggers would have no difficulty operating within-state and trucking roundwood into West Virginia. Raw RI Score is notched down by 25%. Notched Salience is 3.0.	**Score 3.0**
Impact Level: RI Impact Level is deemed *moderate.*	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 19.98.	**Score 19.98**

3.14. Feedstock Transportation Costs

Rationale: Transportation can be one of the most significant cost components of biomass supply chains. The average transportation cost and percentage of total feedstock cost attributable to transportation should be known.

Raw RI Score: Feedstock transportation costs are a universal risk to biomass-based projects owing to the relatively low spatial and energy distribution density of biomass resources. Inherent diesel price volatility compounds this risk. At present, transportation costs in the supply basin are approximately $0.20/gt/loaded mile, which works out to $15/gt for the maximum transport distance of 75 miles. As of May 2023, this pricing is typical for many regions in the United States. Depending on transport distance and final pricing, transportation costs in the region can comprise as much as 50% of total delivered costs. This is not unusual but entails a significant risk given diesel price volatility and the dependence of biomass-based projects on a reliably priced biomass supply. Risk is assessed as moderate-to-high. Raw RI Score is 6 out of 10.	**Score 6**
Notched Salience: Feedstock transportation costs can be managed with proper logistics management and spatially explicit biomass resource assessment. Raw RI Score is notched down by 25%. Notched Salience is 4.5.	**Score 4.5**
Impact Level: RI Impact Level is deemed *moderate.*	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 29.97.	**Score 29.97**

3.15. Transportation Distances

Rationale: Transport distances of 50-100 km for biomass feedstocks are typical, but larger distances can be common. When the average transport distance from suppliers to the Proponent is high, the supply chain is subject to greater sensitivities to risks, such as increases in diesel cost, weather impacts, mechanical breakdown, and the demand for feedstock from competitors closer to the source.	
Raw RI Score: There is no identifiable pattern in the concentration of pulpwood and forest residue resources across the counties included within the supply basin (Maps B-1 and B-2, Appendix B). Sawmills are also distributed relatively widely throughout the supply basin (Map D-1, Appendix D). Given the high BAM for pulpwood and forest residues, and the density and wide distribution of sawmills within the supply basin, risk associated with transport distance (and distance relative to major competitors in the BDO Zone) is assessed as low-to-moderate. Raw RI score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score 2.0**
Impact Level: RI Impact level is deemed *moderate.*	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 13.32.	**Score 13.32**

3.16. Transportation of Feedstock Requires Specialized Equipment

Rationale: Requirements for specialized transport equipment can increase supply chain risk. Where there is low availability in required transportation equipment, equipment owners have increased leverage over transportation prices and supply chain resiliency can be lower.	

Raw RI Score: Increasing annual pulpwood production in the region by 600,000 gt/yr will require the purchase of additional trucks. Assuming 25 gt per truckload, 24,000 additional two-way pulpwood trips will be required annually. Further estimating two trips per day and a 50-week work year, approximately 10 additional trucks would need to be added to the transport fleet in the supply basin to deliver the rated quantities of biomass. Given the total number of sawmills, logging contractors, and third-party trucking companies in the region (>70), an additional truck would be required for every seven businesses involved in the supply chain. Therefore, trucking scale-up is considered low risk. In addition, for the rated quantities of sawmill residuals and forest residues, no chip van scale-up risk is foreseen. Raw RI score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score 2.0**
Impact Level: RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

3.17. Delivery Routes through Local Communities

Rationale: Biomass transportation can become a nuisance to local communities, especially if large numbers of trucks pass through residential and school areas. Local communities often have the power to force regulations regarding truck transport, impeding a Proponent's ability to transport feedstock. This risk is greater in greenfield projects than operational ones.	
Raw RI Score: The public within Greenbrier Valley, and in the surrounding counties encompassed by the BDO Zone generally view forestry favorably. There is a high density of forest processing facilities and logging operations in the Zone. There is a low risk that regulations impeding truck transport through particular areas will materialize as a result of public discontent with truck traffic and noise levels. Raw RI score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score 2.0**
Impact Level: RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

3.18. Transportation Regulations & Local Weight Limits

Rationale: In many regions, transportation is regulated based on seasonal road conditions. These regulations (e.g., "frost laws") often take the form of weight restrictions or limits on the number of trucks allowed on roads. Such regulations can impede the Project's ability to source sufficient feedstock or increase the cost of doing so at certain times of the year.	
Raw RI Score: Aside from tertiary roads with special weight restrictions (e.g., roads with smaller bridges), the main feedstock transport bottleneck in the state is the Interstate Highway System. The standard	**Score 1**

weight limit for interstate highways, including Interstate 64, which runs east-west through the southern portion of the BDO Zone, is 80,000 pounds. No exemptions are available for logging trucks and chip vans. The West Virginia state highway system is more lenient, permitting a 10-percent tolerance on West Virginia roads, such that a GVW of 88,000 pounds is possible. There have even been instances where 93,000 pounds GVW were allowed. The West Virginia Legislature members are actively working to increase GVW limits on interstate highways. One informant noted that more favorable GVW limits on state highways have contributed to the region's growth of log yards.

Raw RI Score is 1 out of 10.

Notched Salience: No adjustment.	**Score 1.0**
Impact Level: RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33.	**Score 3.33**

3.19. Road Infrastructure

Rationale: Feedstock cost and availability can be a function of the accessibility of road infrastructure**.** Problems with road networks will translate directly to risks to feedstock supply.

Raw RI Score: Forest residue recovery will likely be affected by narrow roads in some areas of the supply basin. Transport of chippers into operating areas and chip van access may be constrained. We could not identify any other irregularities in road infrastructure regarding transport supply routes or meteorological effects on road conditions beyond what is deemed manageable. Risk is assessed as low-to-moderate.	**Score 3**

Raw RI Score is 3 out of 10.

Notched Salience: No adjustment.	**Score 3.0**
Impact Level: RI Impact Level is deemed *moderate.*	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 19.98.	**Score 19.98**

3.20. Number, Size, Mix, & Locations of Suppliers

Rationale: In general, a portfolio of multiple suppliers of various sizes is important for ensuring steady and uninterrupted feedstock supply with minimal price fluctuations. If a small number of large suppliers provide a high proportion of total feedstock, a disruption or supplier breach will have a greater impact on the supply chain. In such cases, the risk of disruption is lower, but the impact of those disruptions is higher. Conversely, a large number of small suppliers is less likely to have the capacity to withstand internal disruptions and may be more likely to breach. Here, the risk of disruption is higher, but the likely impact is lower. The number of suppliers and the ratio of small to large suppliers should be optimized. There is

no pre-determined number or optimal ratio of suppliers—either too many or too few can pose higher degrees of risk.	
Raw RI Score: The estimated lumber production capacity of the twenty sawmills in the supply basin ranges from 2 to 60 MMBF (with an average of 15 MMBF). As estimated using the Ecostrat sawmill model and adjusted using local data, the corresponding residuals production capacity ranges from 5,500 gt/yr to 160,000 gt/yr per sawmill (average of 40,000 gt/yr). The logging contractor population in the area is estimated at approximately 100 crews or 300 to 400 operators. There are a few larger contractors available with multiple crews. Therefore, no risk associated with supplier size is foreseen. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustment.	**Score 1.0**
Impact Level: RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33.	**Score 3.33**

3.21. Suppliers Subject to Same External Risk Factors (Non-Weather & Equipment Based)

Rationale: When a single risk event can impact the feedstock production ability of all (or most) suppliers, then feedstock risk is higher and supply chain resiliency is lower. Resilience is maximized when biomass supply chains exhibit diversity in their locations, production practices, and other elements of supply chain structure such that the impact of single, high-risk events have varying impacts on suppliers.	
Raw RI Score: Suppliers operating in the Greenbrier Valley BDO Zone are exposed to various common external risks relating to inputs (e.g., energy) and outputs (e.g., final product markets). These risks are common to all areas of North America and are considered low-to-moderate. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience: No adjustment.	**Score 3.0**
Impact Level: RI Impact Level is deemed *high.* Although unlikely, major economic shifts can have significant impact on the entire forest products industry in the BDO Zone.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 29.97.	**Score 29.97**

3.22. Seasonal Weather Impacts on Feedstock Supply

Rationale: Seasonal weather impacts are defined as deriving from natural weather variations (e.g., spring thaws, rainy seasons, or dry seasons) as opposed to singular weather events (like fires, droughts, or hurricanes). Seasonal weather changes can be a significant risk factor affecting feedstock availability, quality, and price.	
Raw RI Score: There are no significant seasonal weather impacts on feedstock supply in the Greenbrier Valley BDO Zone. Operations slow down slightly in the winter months and during periods of heavy rainfall, but this constitutes a low risk.	**Score 2**

Raw RI score is 2 out of 10.

Notched Salience: No adjustment.	**Score 2.0**
Impact Level: RI Impact Level is deemed *moderate.*	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 13.32.	**Score 13.32**

3.23. Long-Term Weather and Climate Trends

Rationale: In certain regions, climate trends and significant potential changes to future weather patterns can create feedstock risk.

Raw RI Score: No significant weather and climate risks are foreseen.	**Score 1**

Raw RI Score is 1 out of 10.

Notched Salience: No adjustment.	**Score 1.0**
Impact Level: RI Impact Level is deemed *moderate.*	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

3.24. Government Subsidies for Feedstock Production or Utilization

Rationale: Feedstock that is directly subsidized through government programs can pose greater long-term risks than feedstock that is not. Subsidies may be subject to amendment or repeal, sometimes with minimal notice. This risk indicator refers to direct feedstock subsides only; it does not apply to government subsidies that pertain indirectly to the operations of the Proponent, such as Loan Guarantees, or to the markets for products produced by the Proponent.

Raw RI Score: No direct subsidies for feedstock production/utilization were identified.	**Score 1**

Raw RI Score is 1 out of 10.

Notched Salience: No adjustment.	**Score 1.0**
Impact Level: Raw RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33.	**Score 3.33**

3.25. Local, Provincial, & National Laws, Regulations, & Permitting Pertaining to Biomass

Rationale: Feedstock production directly dependent on local, provincial, or national laws or government regulations can pose greater long-term risk than feedstock that is not, since laws and regulations may be

subject to amendment or repeal. If utilization of biomass requires specific permits (e.g., percentage removal of Forest Residues or corn stover, allowable cut limits, air emission, storage permits, rights-of-way, overweight permits for trucks, cross-border permitting for shipment of biomass, a chain of custody, or certification of sustainability), the likelihood of obtaining such permits and/or complying with permitting requirements should be examined.	
Raw RI Score: Forest harvesting regulations in West Virginia include the requirement to notify the WV Division of Forestry of harvesting activity (harvested acreage, harvesting method, and planned starting and completion dates) and a mandatory logging licensing/certification system. Neither requirement impedes productivity, as harvesting notifications can be registered online or by phone. Mandatory first aid and other required training courses for loggers can also be completed online or in local offices. However, loggers from neighboring states must contend with significant regulatory hurdles to gain access to West Virginian timber, including the requirement for a WV logging certificate, WV business license, and a workers' compensation policy. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience: No adjustment.	**Score 3.0**
Impact Level: RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99.	**Score 9.99**

3.26. Backlash Against Biomass Development, Procurement or Usage in the Region

Rationale: Public backlash against biomass development in the Proponent region can directly impact Proponent's ability to procure, transport, trans-load, store, or utilize feedstock by affecting local policies, regulations, and Proponent's ability to obtain necessary permitting.	
Raw RI Score: There were no indications during outreach that this constitutes a risk. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustment.	**Score 1.0**
Impact Level: RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33.	**Score 3.33**

3.27. Feedstock Sustainability, Including Risks to Soil Quality, & Surface & Groundwaters

Rationale: Public concerns about the sustainability of feedstock production can jeopardize biomass feedstock operations. Sustainability certification schemes should be utilized where applicable to ensure that feedstock comes from sustainable sources. Soil sustainability can be defined as the management of soil in a way that does not exert any negative or irreparable effects on the soil or any other systems. There is a diversity of approaches to soil sustainability in jurisdictional guidelines for biomass harvesting and production. Different feedstock types have unique thresholds at which feedstock removal causes significant negative consequences on the soil. Excessive nutrient runoff from biomass feedstock production can accumulate in surface waters and result in algal blooms and hypoxia, which can lead to habitat loss for aquatic species higher up the food chain and alter aquatic ecosystem food webs. Damage to aquatic ecosystems can cause a social and regulatory backlash. Water intake issues can also increase risk.	
Raw RI Score: Outreach did not detect public concerns around the environmental sustainability of biomass procurement. The licensing system, close regulatory oversight by the WVDOF (e.g., harvesting notification system), and the large acreage of protected areas within the BDO Zone mitigate against any future potential public concerns. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustment.	**Score 1.0**
Impact Level: RI Impact Level is deemed *high.*	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99.	**Score 9.99**

3.28. GHG Emissions from Production, Harvest, & Transport

Rationale: Understanding a project's overall emissions and the carbon intensity throughout the feedstock supply chain is essential to reducing risks related to carbon pricing mechanisms and related regulations. Greenhouse gas (GHG) emissions from production, harvest, and transportation can be a significant challenge to Proponent claims of carbon neutrality for biomass projects. Carbon emissions from harvested soils, as well as emissions from harvesting machinery or delivery trucks, can make it difficult to achievement net-zero GHG emissions. If a Proponent's financial model relies on carbon neutrality/GHG regulatory pricing frameworks, it is essential to investigate the feedstock's carbon emission status.	

Raw RI Score: The GHG impacts of a biomass-based project depend largely on the product produced. Assuming that bioenergy is produced, forest carbon accounting methods that account for changes in the carbon balance of managed forests over time typically penalize using stemwood (i.e., pulpwood) for energy purposes. This is because it can take as long as 100 years for a seedling to grow into a tree suitable for harvesting (i.e., a size comparable to that previously harvested). Studies have shown that it can take over 100 years for the carbon balance of an energy production system fueled with stemwood to become carbon neutral/negative. In contrast, it typically takes less than 20 years for systems fueled with forest residues or sawmill residues to become carbon neutral/negative because waste products do not require accounting for the re-growth of the trees from which they are procured. Due to the project's dependence on stemwood, there is a risk that the project will be unable to classify as carbon neutral. Raw RI Score is 5 out of 10.	**Score 5**
Notched Salience: There is significant uncertainty associated with carbon accounting and pricing frameworks. Sustainable forest management schemes are often sufficient to incent project development. Raw RI is notched down by 50%. Notched Salience is 2.5.	**Score 2.5**
Impact Level: RI Impact Level is deemed *moderate.*	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 16.65.	**Score 16.65**

3.29. Geographic Location Influence on Feedstock Variability

Rationale: Feedstock from different regions may differ in quality due to variations in soil quality, topography, harvest practices, weather, fertilizer applied, etc.	
Raw RI Score: There is no significant risk associated with feedstock quality variability as a result of geographic factors. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustment.	**Score 1.0**
Impact Level: RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33.	**Score 3.33**

3.30. Capacity of Supply Chain Components & Equipment to Scale

Rationale: Scale-up risk increases if supply chain components or underlying feedstock infrastructure necessary for these components cannot scale to handle Proponent feedstock requirements and throughput capacity. Capacity to scale should be demonstrated.	
Raw RI Score: To scale up the supply chain equipment in the Greenbrier Valley BDO Zone for potential projects utilizing the rated quantity of pulpwood would require investment in additional feller bunchers and grapple skidders. Currently, there is an over-reliance on chainsaws and cable skidders, which tend to have lower productivity unless operated by experienced crews. Equipment scale-up is not a significant	**Score 5**

risk for sawmill residuals and only a low-to-moderate risk for forest residue owing to the low rated quantity.

Raw RI Score is 5 out of 10.

Notched Salience: The proponent of a new biomass-based project, or logging companies with experience in multi-crew supply chain management, could reduce the risks of scale-up through financing and logistics management. The regular contact between government authorities and loggers in WV may also enable an organized scale-up of logging operations, including for example, coordinated identification of sites suitable for harvesting, coordination of timing and logistics among independent logging crews to improve productivity, and equipment financing. Raw RI is notched down 25%. Notched Salience is 3.75.	**Score 3.75**
Impact Level: RI Impact Level is deemed *moderate.*	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 24.98.	**Score 24.98**

CATEGORY 4.0: INFRASTRUCTURE RISKS

4.1 RISK FACTOR: PHYSICAL INFRASTRUCTURE

4.1.1 Land Parcel

Raw RI Score: Greenbrier Valley has a number of industrial sites suitable for biomass-based project development. At this time, we have chosen to focus on the 90-acre Edray Business and Technology Park (Edray site) located at 291 Edray Business Park Drive, Marlinton, Pocahontas County, WV. The Edray site has a ready-to-occupy 30,000-square-foot building suitable for industrial, commercial, and warehouse use, with 25,000 square feet of manufacturing space and 5,000 square feet of office area. Other potential locations for industrial development include the 90-acre Greenbrier Valley Airport Business Park, located on Airport Road, Maxwelton, Greenbrier County; the 25-acre Fountain Springs Technology and Business Park located at 3 Park Dr, Peterstown, Monroe County; and the 99-acre East Fork Industrial Site located in 118 Industrial Park Road, Durbin, Pocahontas County (Appendix G).	**Score 1**

Raw RI Score is 1 out of 10.

Notched Salience: No adjustment.	**Score 1.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33.	**Score 3.33**

4.1.2 City Ownership

Raw RI Score: The Greenbrier Valley Economic Development Corporation (EDC) owns the Edray Business and Technology Park in Marlinton. The land in the surrounding area is primarily privately owned.	**Score 1**

Raw RI Score is 1 out of 10.	
Notched Salience: No adjustment.	**Score 1.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33.	**Score 3.33**

4.1.3 Industrial Land Use Zone

Raw RI Score: Currently there is no zoning within the Edray site. However, governing bodies in the area have been supportive of new developments. There are no restrictions on private land areas regarding industrial zoning, and no unusual environmental concerns for land in the area. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience: No adjustment.	**Score 3.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99.	**Score 9.99**

4.1.4 Natural Gas Line

Raw RI Score: The Edray Business and Technology Park in Marlinton has no natural gas distribution line on-site. Industries are currently using either propane or electricity for heat. Raw RI Score is 4 out of 10.	**Score 4**
Notched Salience: No adjustment.	**Score 4.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is **13.32**.	**Score 13.32**

4.1.5 Electrical

Raw RI Score: The Edray site has electric service provided by the Monongahela Power Company with 277/480 Voltage 3-Phase, good capacity. High voltage lines (345KV and 138KV) cross the area with available capacity. WV ranks 4th in the US for power production with 49% of the power produced being exported. Average industrial power rates are $7.05/KWh locally with the national average at $7.26/KWh. 95% of the state's power production comes from coal, 5% from renewables, and 4% from natural gas. Raw RI Score is 1 out of 10.	**Score 2**

Notched Salience: No adjustment.	**Score 2.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.1.6 Fresh Water Supply

Raw RI Score: Water at the Edray site is provided by the Town of Marlinton; with an 8" main line, 71,500 gallons per day peak capacity, and 78 psi pressure. Most rivers in the Area are running at 90%+ of capacity and hydro dams are generating at over 85%. Water quality tests for the area rate the drinking water as "good". The Area is experiencing only mild to normal drought conditions. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustment.	**Score 1.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33.	**Score 3.33**

4.1.7 Sewage Disposal Trunk Line

Raw RI Score: Wastewater in the Edray site is managed by the Town of Marlinton with an 8" main. Four sanitary sewage treatment facilities exist within the broader. Recycled water is available to commercial and industrial customers. Rivers and lakes are highly protected from industrial dumping and pollution. There are no environmentally sensitive areas regarding sewage disposal. Raw RI score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score 2.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.1.8 Drainage and Stormwater Management

Raw RI Score: The industrial site in Marlinton holds a stormwater permit issued by the West Virginia Department of Environmental Protection (WVDEP). This permit ensures the site complies with regulations and guidelines related to stormwater management and pollution prevention. The mountainous terrain provides its own natural drainage into the area's rivers and lakes. Aside from seasonal spring rising of water levels, there are no flood plain issues in the Area. Raw RI score is 2 out of 10.	**Score 3**
Notched Salience: No adjustment.	**Score 3.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99.	**Score 9.99**

4.1.9 Available ICT (Information & Communication Technology) Services

Raw RI Score: The Edray site has broadband service provided by Shentel via coaxial cable up to 500M/25M; and Fiber optic up to 1 Gbps. Raw RI score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score 2.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.1.10 Infrastructure – Landfill/Alternative Markets for Waste Disposal

Raw RI Score: The Greenbrier Valley has several landfills and waste disposal facilities serving the area. The Pocahontas County Landfill in Marlinton, Greenbrier County Landfill in Lewisburg, and the Monroe County Landfill accept household, commercial and construction waste. The Greenbrier Valley Landfill prices range from $48 – $75 per load + $8.25 per ton. Hazardous materials require a special permit and approval. In addition, the Greenbrier County Recycling Center and Lewisburg Recycling Center accept recyclable materials such as paper, cardboard, plastic, and metal. Raw RI score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score 2.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.2 Risk Factor: Logistics

4.2.1 Road and Highway Access and Intersection

Raw RI Score: Primary roads in the area are US Highways 219 and 60. Interstate 64 runs through Greenbrier County and connects several north-south Interstates, including I-77, I-79, and I-81. The Edray site is 30 miles from Interstate-64, which has a standard weight limit of 80,000 lbs. for transport vehicles., with select highways allowing up to 93,000 pounds. Standard allowable lengths are 40' and 70' for doubles. No triple trailers are allowed in West Virginia. There are seldom any weather-related or seasonal road closures. Raw RI score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score 2.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.2.2 Ocean/River Access

Raw RI Score: Greenbrier Valley is close to Norfolk's deepwater ports, which feature 14 cranes capable of handling post-Panamax vessels. In West Virginia, there are three commercially navigable waterways: the Ohio River, the Monongahela, and the Kanawha. The nearest barge loading point is located 30 miles upriver from Charleston, which translates to about 100 road miles from the Greenbrier area. For deep-water ports, the closest options include Cincinnati, OH (210 miles), Huntington, WV (130 miles), Richmond, VA (201 miles), and Pittsburgh, PA (270 miles). These accessible ports and waterways offer advantageous logistics for shipping and trade-related activities in the region. Raw RI score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score 2.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.2.3 Railway Service

Raw RI Score: Greenbrier Valley is served by two Class I rail systems, CSX and Norfolk Southern. CSX runs along the eastern and southern edges, connecting to Charleston, WV, and Virginia's tidewater ports, while Norfolk Southern travels along the southern edge of Monroe County. The nearest rail line is located in White Sulphur Springs 25 miles to the south. This could be a barrier for specific types of projects. While it is expensive to build a new railspur, most projects can be serviced for that short distance with trucking.	**Score 4**

To the North is a myriad of short line tracks primarily serving the coal and power industries. Historically the railroads in the State were established to haul only coal, but more recently they are moving biofuels, shale oil, and auto parts as economies and industries evolve.

Raw RI Score is 4 out of 10.

Notched Salience: No adjustment.	**Score 4.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 13.32.	**Score 13.32**

4.2.4 Accessibility to Airport

Raw RI Score: Greenbrier Valley Airport, located three miles north of Lewisburg is 43 miles from the industrial site in Marlinton and has limited commercial air service on Contour Airlines. Single-destination flights leave daily for Charlotte, NC. The runway at Greenbrier is paved, lighted and 7000' in length. The nearest commercial aviation is Yeager Airport in Charleston, WV. It's two hours by road from the Greenbrier area and has full airline and cargo operations. Major carriers are United, Delta, American and Southwest.	**Score 3**

Raw RI Score is 3 out of 10.

Notched Salience: No adjustment.	**Score 3.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99.	**Score 9.99**

4.3 Risk Factor: Social Infrastructure

4.3.1 Healthcare Facilities

Raw RI Score: Greenbrier Valley Medical Center is a 122-bed, full-service hospital. The West Virginia University Hospital is in Morgantown, 133 miles north. According to America Health Rankings, it is ranked 47 in the US. Several smaller medical centers serve outlying areas. A network of clinics is also operated in the region by Rainelle Medical Center, Inc. State-assisted healthcare is offered for both children and adults through the Children's Health Insurance Program (CHIP), the State Health Insurance Program (SHIP) for adults and the Health Insurance Premium Program (HIPP).	**Score 3**

Raw RI Score is 3 out of 10.

Notched Salience: No adjustment.	**Score 3.0**

Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99.	**Score 9.99**

4.3.2 Educational Facilities

Raw RI Score: Greenbrier Valley is served by the Greenbrier County School District, which operates 13 public schools, Pocahontas County with 5 public schools, and Monroe County with 4 public schools. There are also a few private elementary and secondary schools available, as well as several nearby universities and colleges, including New River Community and Technical College, Marshall University, Concord University, Bluefield State University, and West Virginia University. WVU Tech in Beckley offers over 30 majors, including one of the top undergraduate engineering programs in the country. Technical forestry programs are offered at the Mountain Gateway Community College in Clifton Forge, VA. Raw RI score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score 2.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.3.3. Recreational Facilities

Raw RI Score: Greenbrier Valley hosts a variety of annual events, such as the West Virginia State Fair, the Lewisburg Chocolate Festival, and the Christmas Parade of Lights. The region also offers community parks, swimming pools, playgrounds, golf courses, a sportsplex, hiking trails, rivers, and opportunities for activities like mountain biking, hunting, fishing, skiing, and snowboarding. Raw RI score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score 2.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.3.4. Cultural Facilities

Raw RI Score: There is a wide variety of cultural amenities in Greenbrier Valley including art galleries, theatres/film, music, and festivals. West Virginia has kept the Appalachian culture, which originated during the American Civil War alive throughout the years. Classic American colonial architecture can be found in many of the houses and buildings.	**Score 3**

Raw RI Score is 3 out of 10.	
Notched Salience: No adjustment.	**Score 3.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99.	**Score 9.99**

4.3.5. Public Safety Facilities

Raw RI Score: The overall crime rate in West Virginia of 18.52 per 1,000 residents, slightly below the national average. A wide network of highway patrols, Sheriffs, Marshalls, and local police provide public security. WV has six federal prisons and dozens of state and local penal facilities. The Fire/Emergency services are located 3.7 miles from the industrial site in Marlinton.	**Score 3**
Raw RI Score is 3 out of 10.	
Notched Salience: No adjustment.	**Score 3.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99.	**Score 9.99**

4.3.6 Housing

Raw RI Score: West Virginia is one of the country's most affordable states. The average single-family home is $127,800, 21% below the national average. WV also has one of the lowest property tax rates. Both single and multi-family homes and complexes are available and average rents of $750.	**Score 2**
Raw RI score is 2 out of 10.	
Notched Salience: No adjustment.	**Score 2.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.4 Risk Factor: Workforce and Permitting

4.4.1 Labor Availability

Raw RI Score: There is reasonable diversity of industries in the area, with ongoing workforce transition. Many of the forestry-related jobs and the power generation positions (coal plants) are changing – disappearing or being consolidated - which could create skilled and unskilled pools of labor that could suit bioproduct development. As of 2021, the total workforce in Greenbrier Valley was 25,438, with a median age of 48, and 56% of the population falling between the ages of 20 and 64. Unemployment in the area has dropped from nearly 6% pre-covid to 3.4%, with competition for jobs lessening in the past couple of years. Graduates from many of the vocational and technical schools are looking first for local jobs before moving out of state. Over 88% of adults over twenty-five have completed high school. Raw RI score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score 2.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.4.2 Labor Cost

Raw RI Score: The minimum wage in the area is currently $8.25/hr., but is scheduled to increase to $10/hr. at the end of 2023. The prevailing wage (semi-skilled) across several industries in the Area is $23.40/hr. According to the United States Census Bureau 2022, the average household income in Greenbrier Valley was $60,072, lower than the national average of $105,029. Similarly, the income per capita in Greenbrier Valley was $26,017, compared to the national per capita of $40,363. Raw RI score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score 2.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.4.3 Training Programs / Community College

Raw RI Score: West Virginia University in Morgantown, New River Community College in Summersville and WVU Tech in Beckley are all within the BDO Zone and provide post high school education and training opportunities. WorkForce West Virginia provides training grants and programs to support continuing education for workers, covering areas such as welding, woodworking, machinery, agriculture,	**Score 2**

engineering, and business management. The State offers several scholarship programs to support training and higher adult education. WVU Industrial Extension works with manufacturers to develop training and consulting services, while WVU Tech in Beckley offers additional higher education opportunities in Aerospace Engineering and Chemical Engineering.

Raw RI score is 2 out of 10.

Notched Salience: No adjustment.	**Score 2.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.4.4 Permit Process

Raw RI Score: Permitting process is described on the Greenbrier Valley Website. The region has a history of welcoming economic development and supporting timely processing. The Edray site is owned by the Greenbrier Valley EDC, with permitting authorities in the area ranging from local governments to county offices and state compliance departments. In general, the permitting process takes around 60 days, with general construction permits turning around in 20 days. Major permits for air and emissions are granted through the EPA nationally.	**Score 2**

Raw RI score is 2 out of 10.

Notched Salience: No adjustment.	**Score 2.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

APPENDIX B: HARVESTING ACTIVITY AND PULPWOOD PRODUCTION ESTIMATION

Current pulpwood production in the supply basin

To estimate current pulpwood production in the supply basin, USFS Forest Inventory and Analysis (FIA) data was queried for a 75-mile radius around Renick, WV using the online EVALIDator tool. Data on total removals indicates that average pulpwood removals in the area between 2016 and 2020 were approx. 375,000 gt/yr (Table B-1). For the supply basin, current pulpwood production is estimated to amount to ~148,500 gt/yr.[1] The growth-to-removals ratio for pulpwood is substantial (14.9), indicating that the regional pulpwood resource is significantly underutilized. Pulpwood underutilization in the region relative to potential was also confirmed through outreach to forestry professionals in West Virginia.

Table B-1: FIA growth-to-removal data for pulpwood (5-11 inches diameter at breast height) in the 75-mile radius around Renick, WV. Dry tonnage converted to green tonnage using moisture content assumption of 50%.

Year	Growth (green tons)	Removals (green tons)
2016	5,485,859	291,821
2017	5,641,157	297,316
2018	5,700,882	435,050
2019	5,575,540	439,765
2020	5,488,758	413,056
Average	5,578,439	375,402

Potential pulpwood and forest residue production in the supply basin

The annual quantity of unharvested, standing pulpwood and forest residue in the supply basin that could be made available to a new project was estimated using datasets available from the US Department of Energy (DOE) 2016 Billion-Ton Report (https://bioenergykdf.net/2016-billion-ton-report). The 2016 Billion-Ton Report projects biomass availability up to the year 2040 using a number of assumptions, constraints, and market demand projections (Table B-2). County-level estimates of the availability of pulpwood (logs produced from trees between 5-11 inches DBH) for all available years (2015, 2020, 2025, 2030, 2040) were downloaded using the Vol. 1 Data Download Tool for the 2016 Billion-Ton Report. Using GIS software, a polygon for the supply basin (75-mile maximum transport distance) was developed and used to estimate the percentage area of each county included in the supply basin (percentage overlap value). For each county, the percentage overlap value was then multiplied by the average annual pulpwood and forest residue availability for 2015-2040 to estimate the total quantities of standing pulpwood and forest residue in the supply basin available for a new entrant (Map B-1 and Map B-2). These quantities (844,714 gt/yr pulpwood and 227,695 gt/yr forest residue) were then used to inform the selection of the rated quantities (**600,000 gt/yr pulpwood and 100,000 gt/yr forest residue**).

To develop supply curves, the supply basin polygon was used to estimate the quantities of pulpwood and forest residue available in each county (as estimated using the Billion-Ton dataset) based on the percentage overlap value in each 5-mile

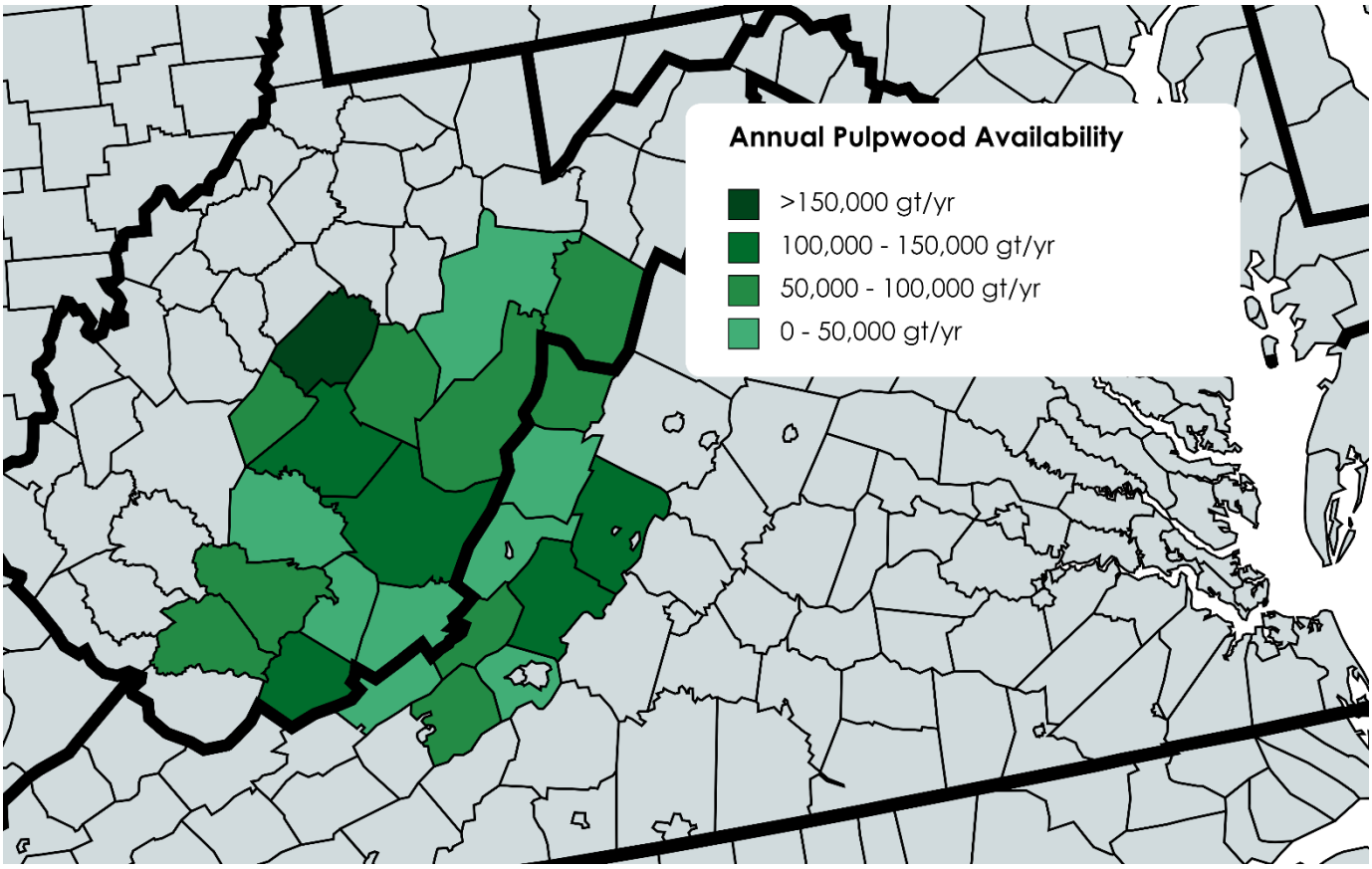
[1] FIA data indicate that average pulpwood harvesting levels in the 75-mile radius around Renick, WV are ~375,000. A 75-mile radius circle has an area of 17,671 square miles. The supply basin has a total area of 6,998 square miles. To estimate current pulpwood harvesting in the supply basin, 375,000 gt/yt was multiplied by the quotient of 17,671 sq.mi./6,998 sq.mi. (0.396) to yield 148,500 gt/yr. Further details on calculations are provided in Box B-1.

transport distance segment, up to the 75-mile maximum transport distance (Figure F-2, Appendix F). Note that the magnitude of pulpwood availability estimated using the Billion-Ton dataset (~850,000 gt/yr) is corroborated by West Virginia Division of Forestry (WVDOF) harvesting notification data (Map B-3). For a pulpwood recovery potential of 20-30 gt/acre, typical harvesting activity in the supply basin (40,000 – 50,000 acres/yr) would yield 800,000 gt/yr to 1,500,000 gt/yr of pulpwood (Box B-1).

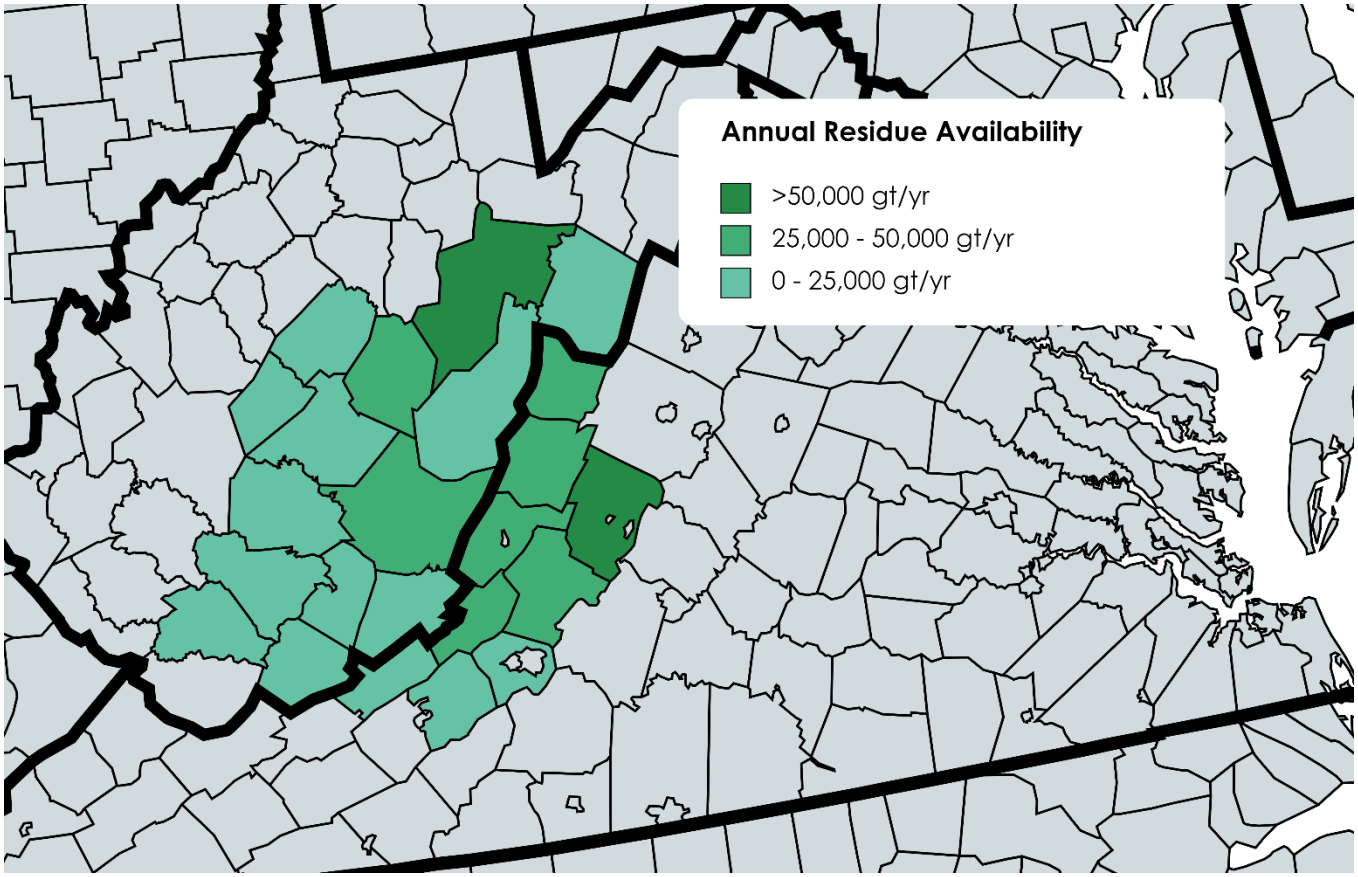
Table B-2. Billion-Ton Report assumptions and parameters included in analysis

Bioenergy – Knowledge Discovery Framework, US Department of Energy **Billion-Ton Report – 2016 Vol. 1 Data Download Tool (https://bioenergykdf.net/2016-billion-ton-report)**		
Data retrieval		County level
		Year 2015, 2020, 2025, 2030, 2035, 2040
Data presented as		Bone dry tons per year (bdt/yr)
		Average of years 2015 to 2040, with 5-year increments
Resource Category	**Forestry**	All biomass resources modeled on forestland timberland, i.e., forest residues and small-diameter trees.
Demand for feedstock		Based on 2016
Scenario	**Medium housing, medium energy demands**	**1.)** Growth in housing starts returns to long-term average by 2025. The long-term average of housing starts from 1959 through 2011 is slightly less than 1.1 million per year. **2.)** Growth in wood biomass demand for energy increases by 86% by 2040. Actual wood biomass production in 2010 was 58.2 million dry tons for all scenarios. **3.)** New plantation management intensity in the South - Based on current FIA pine plantation growth rate. Current average FIA growth rate on pine plantations across the South (all owners, all ages) is approximately 108 cubic feet/acre per year (1.6 dry ton/acre per year). Increasing management intensity by 50% only on new plantations results in an increase in the average South-wide growth rate over time up to 140 cubic feet/ac per year in 2040 (2.1 dry tons/acre per year).
Biomass price	Specified biomass price after harvest cost as applicable but before transportation costs, in 2014 dollars per dry ton equivalent. *If these prices are used within the report, they will include inflation rates and newest transportation costs.*	
Resources	Hardwood, lowland forest residues, Hardwood, lowland whole trees, Hardwood, upland forest residues, Hardwood, upland whole trees, Mixedwood forest residues, Mixedwood whole trees, Softwood, natural forest residues, Softwood, natural whole trees, Softwood, planted forest residues, Softwood, planted whole trees – logging resides = harvest/forest residues; whole trees = only small diameter trees = pulpwood	
Class	**RSDF**	Residues, forestry (i.e., forest residues)
	TREE	Small-diameter trees
Section	**PFRS**	Primary forestland resources including forest residues (i.e., Class RSDF) and small-diameter trees (i.e., class TREE).
Diameter class	**1**	Timberland trees with diameter at breast height >11 inches
	2	Timberland trees with diameter at breast height 5-11 inches
	3	Timberland trees with diameter at breast height <5 inches
Operation Type	**Clear Cut**	Clearcut harvest of small-diameter trees or production of forest residues.
	Thinning	Thinning harvest of small-diameter trees or production of forest residues.
Supply Class	**LE40**	Timberland resources harvested from slopes less than or equal to 40 degrees.

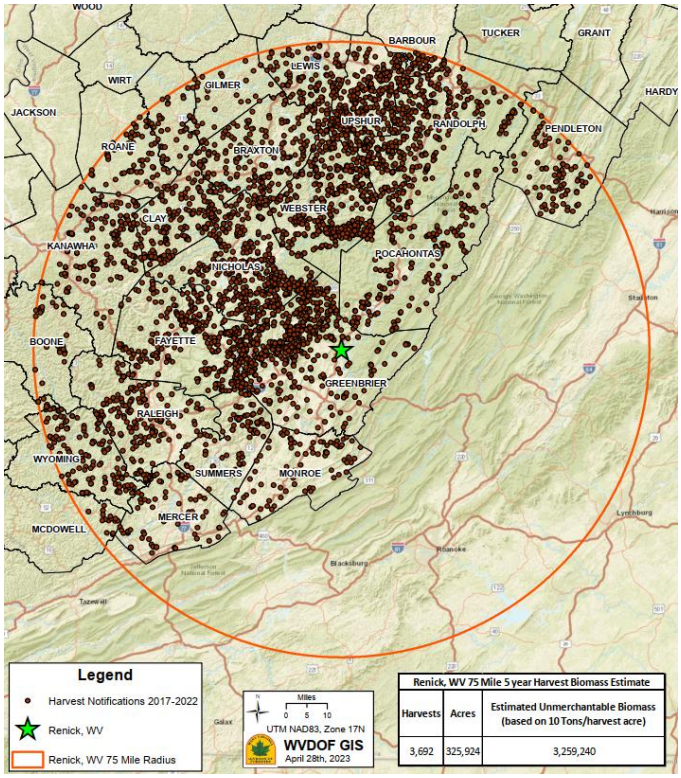
Map B-1. Annual pulpwood availability in supply basin by county



Map B-2. Annual forest residue availability in supply basin by county



Map B-3. Harvesting notifications in West Virginia within 75-mile radius around Renick (WV Division of Forestry)



Box B-1: Calculations – Harvesting Notification-Based Estimates of Harvesting Activity and Pulpwood Production:

- To extend harvesting activity in WV portion of 75-mile radius to entire 75-mile radius (WV + VA):
  - Percentage of total area of 75-mile radius located within WV: 55%
  - Acres harvested per year in total area of 75-mile radius (WV + VA):
    - 65,185 acres harvested per year in WV ÷ 0.55 = 118,518 acres harvested per year in WV and VA portions of 75-mile radius
- To convert from 75-mile radius to supply basin (75-mile road distance):
  - Total area of supply basin: 6,998 square miles
  - Total area of 75-mile radius: 17,671 square miles
  - Percentage of supply basin in 75-mile radius area: 6,998 mi^2 / 17,671 mi^2 = 39.6%
  - Total annual harvested acreage within supply basin: 118,518 acres/yr x 0.396 = 46,933 acres/yr
  - To estimate range, round down and round up to nearest 10,000: 40,000 acres/yr – 50,000 acres/yr
  - Multiply annual harvested acreage by pulpwood recovery range of 20-30 gt/acre: **800,000 – 1,500,000 gt/yr**

APPENDIX C: SAWMILL RESIDUAL ESTIMATION

Sawmill residuals production in the supply basin was estimated through outreach to sawmills and using the Ecostrat sawmill residual model, which estimates wood chip, sawdust, and bark production as a function of lumber production (MMBF/year). The model uses generic conversion factors for hardwood sawmills. The final residuals estimates must be adjusted using local data because of regional differences in log sizes, dimensions, and sawmill product output and efficiency. Four sawmill owner-operators were contacted and asked to estimate their mill's lumber production capacity (MMBF/yr) and residual output (gt/yr). This information was used to calibrate the model by calculating adjustment factors for the reporting mills (actual residuals production per year / estimated residuals production per year). The adjustment factors calculated for the four sawmills ranged from 0.53 to 0.79. A final adjustment factor of 0.5 was selected such that residual production quantities estimated by the model were reduced by half.

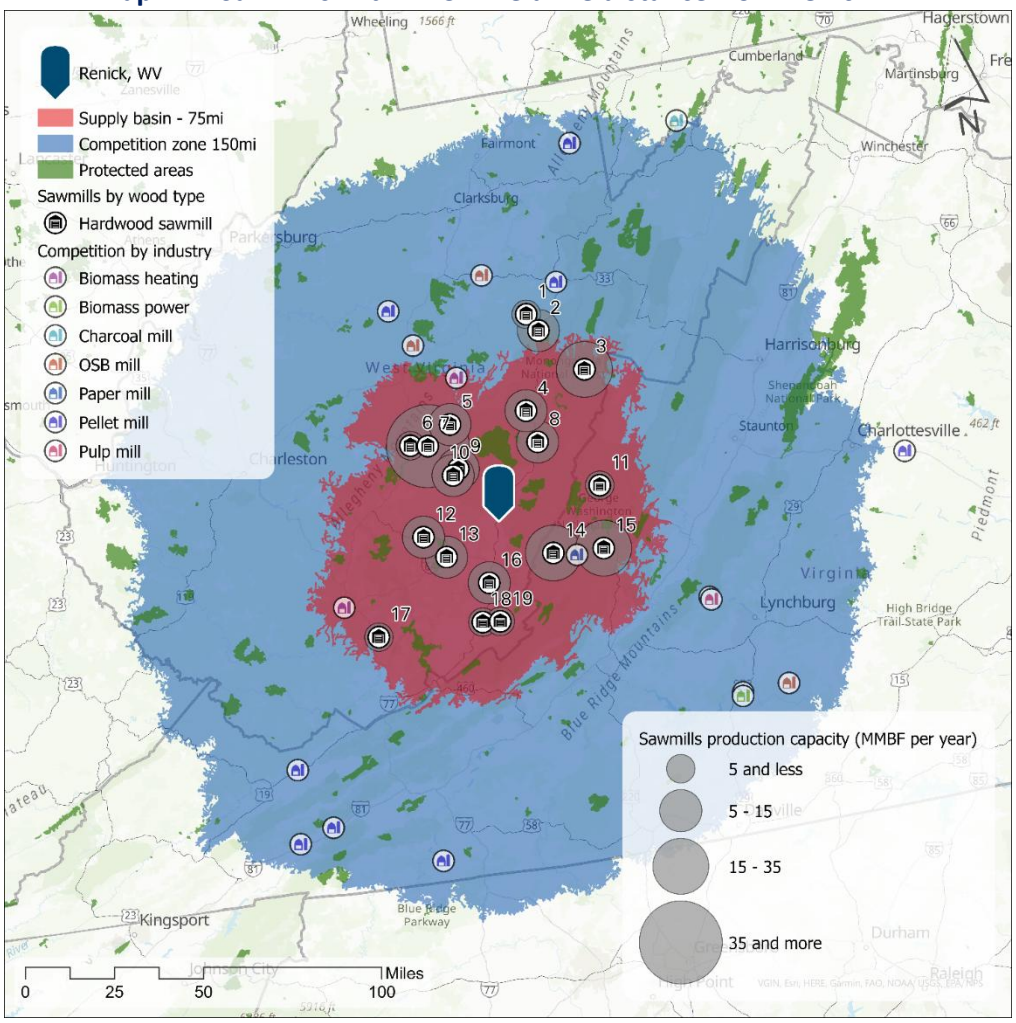
To run the Ecostrat sawmill residuals model, estimates of the lumber production capacity of each sawmill are required. If lumber production capacity could not be determined from secondary sources or interviews with local experts, satellite imagery was used to visually compare the size of sawmills with unknown lumber production capacities to those of known lumber production capacity. The model was then run, and the final adjustment factor of 0.5 was applied to the resulting residuals estimates, generating a final estimate of 820,129 gt/yr. A conservative capture rate of 20% was applied to the adjusted model estimates of sawmill residuals production, resulting in the rated quantity of 150,000 gt/yr (rounded down from 164,026 gt/yr). Note that the model was not used to estimate residuals quantities for the four sawmills contacted during outreach: in these cases, the direct estimates provided by the sawmills were used. Conversion factors and calculated and rated quantities of sawmill residuals are presented in Table C-1.

Table C-1: Sawmill residual model conversion factors and calculated and rated quantities

	Conversion factor (% of input log weight)	Estimated total quantity, gt/yr (after applying 0.5 adjustment factor)	Rated quantity, gt/yr
Wood chips	35%	236,111	82,000
Sawdust	15%	93,905	34,000
Bark	15%	97,905	34,000

APPENDIX D: SAWMILLS

Map D-1. Sawmills within 75-mile drive distance from Renick WV

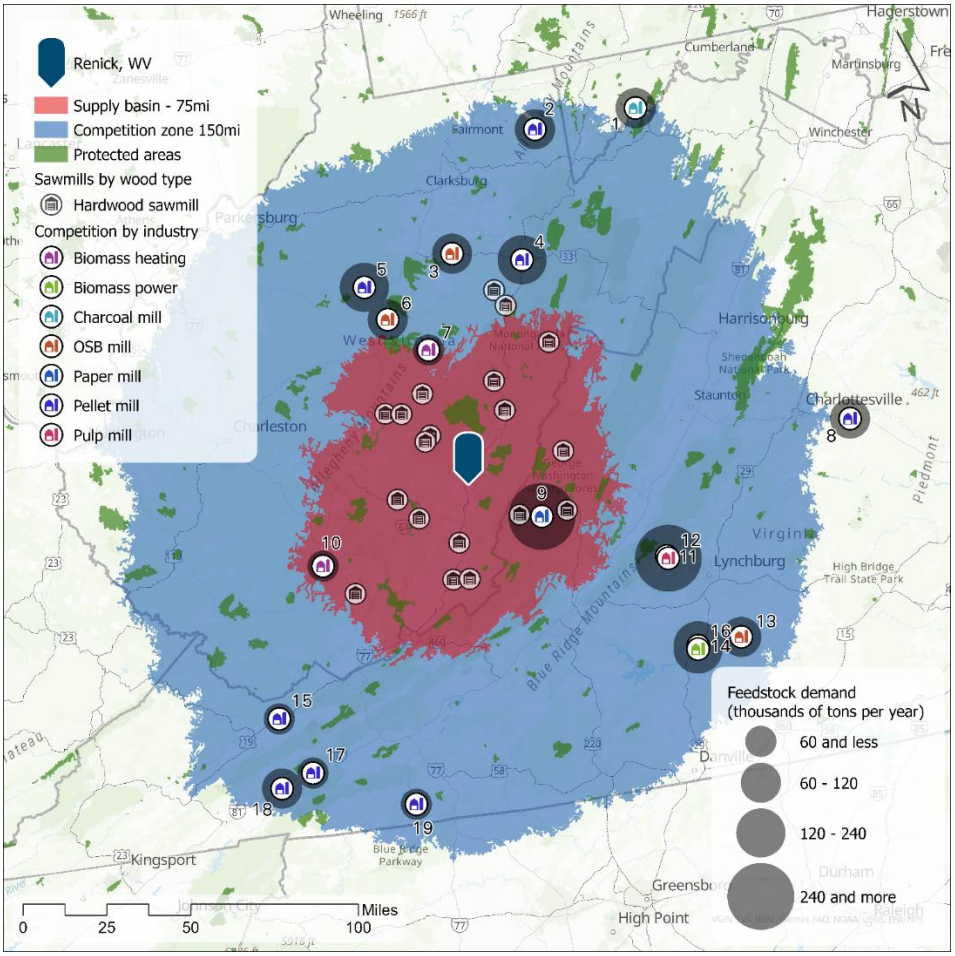


Map D-2. West Virginia's forest products industry (West Virginia Economic Development)



APPENDIX E: CURRENT COMPETITION

Map E-1. Current competitors for feedstock within 150-mile drive distance from Renick WV



APPENDIX F: OTHER CHARTS AND FIGURES

Figure F-1: Biomass supply curve: potential availability as a function of distance from Renick, WV

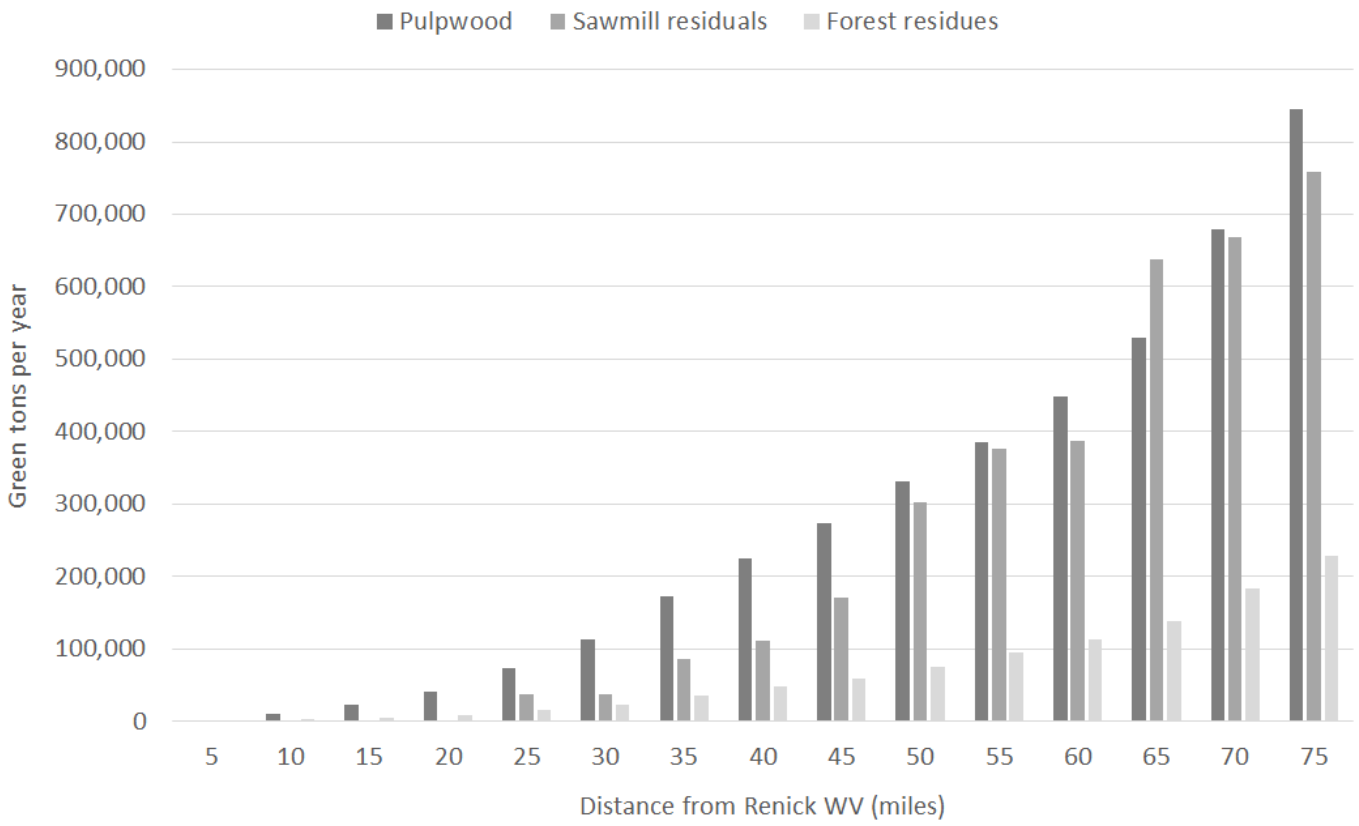


Figure F-2: Nominal No.2 diesel prices for the US Lower Atlantic region, 2007–2022

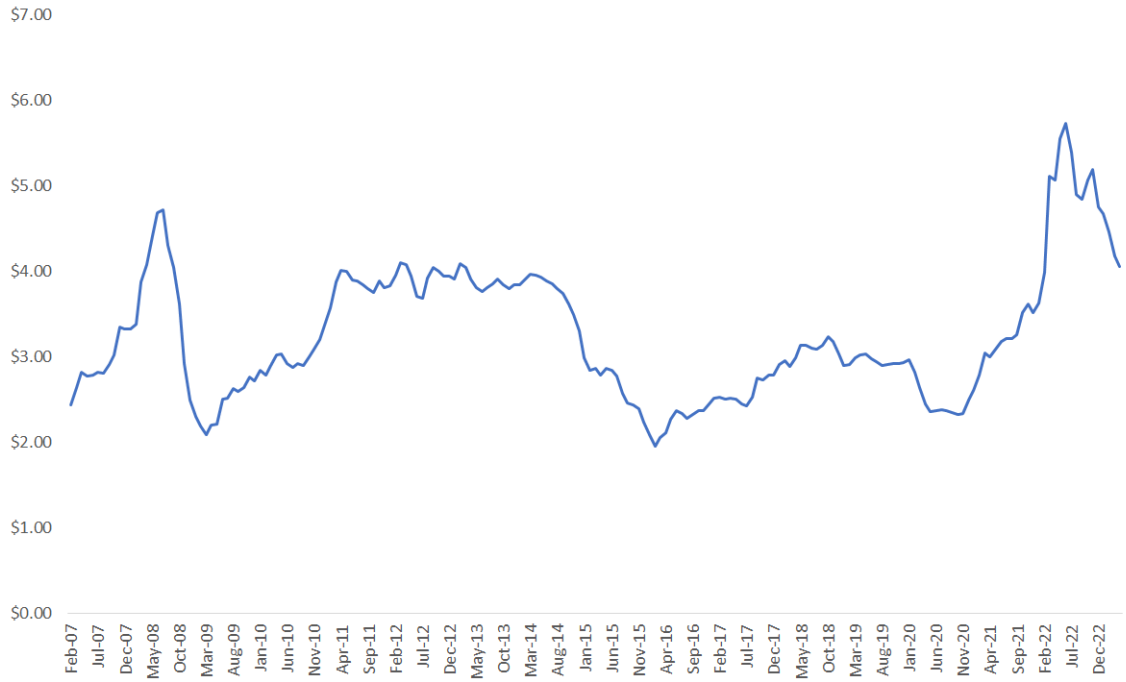
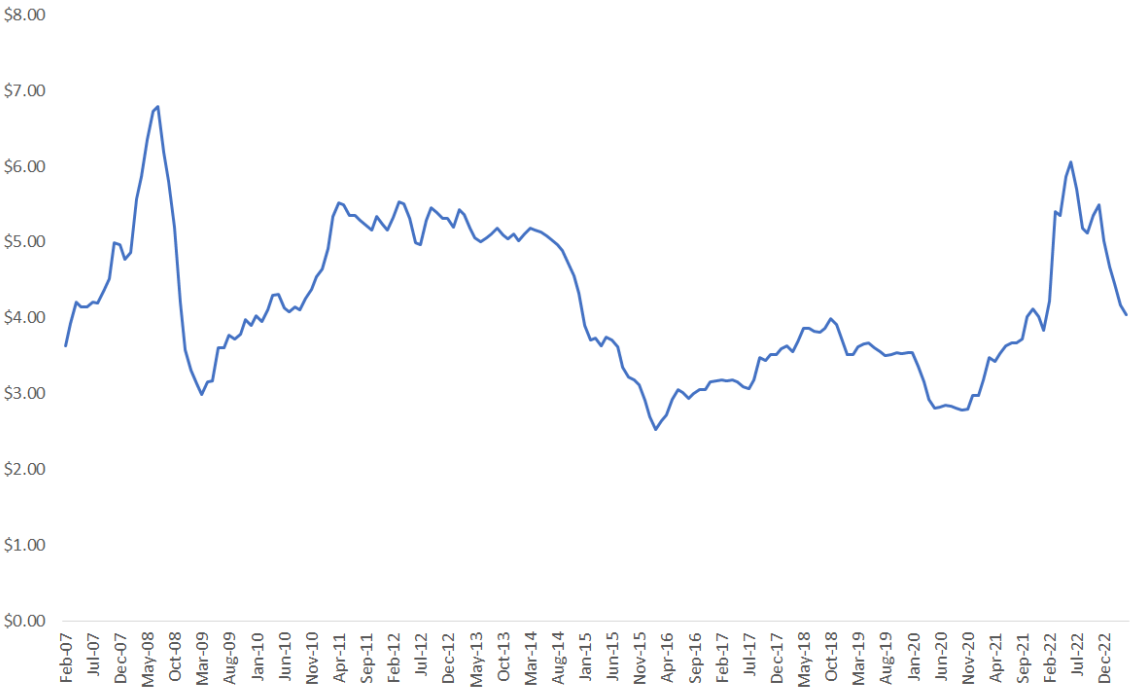


Figure F-3: Real No.2 diesel prices for the US Lower Atlantic region, 2007–2022 (2022 USD)



APPENDIX G: INFRASTRUCTURE

Site selection of Greenbrier Valley, WV

LOCATION

The Greenbrier Valley is located in southeastern West Virginia, USA, and has a total land area of approximately 1,586 square miles. It includes parts of Greenbrier, Monroe, and Pocahontas counties and is bordered by the Appalachian Mountains to the east and the Allegheny Mountains to the west. According to the United States Census Bureau, Greenbrier County has a total area of 1,025 square miles, of which 1,020 square miles is land and 4.9 square miles (0.5%) is water. Monroe County has a total area of 474 square miles, of which 473 square miles is land and 0.9 square miles (0.2%) is water; and Pocahontas County has a total area of 942 square miles, of which 940 square miles is land and 1.5 square miles (0.2%) is water.

POPULATION

According to the United States Census Bureau 2022, the population of Greenbrier Valley was estimated to be 52,198. In 2020, the total population of Greenbrier County was 32,999 with a density of 23/sq mi; Pocahontas County was 7,869 with a density of 8.4 /sq mi; and Monroe County was 12,376 with a density of 26.11/sq mi.

SITE SELECTION

Greenbrier Valley has multiple industrial sites suitable for manufacturing operations. While scoring has focused on the Edray Business and Technology Park, Greenbrier Valley has several industrial sites which, with further development, may be suitable for manufacturing operations. Summary details of Edray Business and Technology Park and three others are described below.

On-site Infrastructure:

- *Edray Business and Technology Park* is over 85 acres and is located at 291 Edray Business Park Drive, Marlinton, Pocahontas County. A ready-to-occupy 30,000-square-foot building is suitable for industrial, commercial, and warehouse use, with 25,000 sf of manufacturing space and 5,000 sf of office area. Electric Service is provided by the Monongahela Power Company, with 277/480 Voltage 3-Phase. Water is provided by the Town of Marlinton; with an 8" main line, 71,500 gallons per day Peak Capacity, and 78 psi Pressure. Wastewater is managed by the Town of Marlinton with an 8" main. Broadband is provided by Frontier and Shentel. The site is 45 miles from Interstate-64 and 43 miles from Greenbrier Valley Airport.

- *Greenbrier Valley Airport Business Park* on 8 Airport Road, Maxwelton, Greenbrier County has a ready-to-occupy 66,000-sf building suitable for a variety of uses, with 80 acres of industrial land and 10 acres for office space, with Manufacturing, Commercial and Industrial zoning. Electric Service is provided by the Monongahela Power Company. Natural Gas is provided by Mountaineer Gas; with 4" main, and 48 psi Pressure. Water is provided by the City of Lewisburg; with an 8" main line, and 80 psi Pressure. Wastewater is managed by the Greenbrier County with an 8" main. Telecommunications is provided by Optimum up to 300 Mbps speed. However, public water/sewer and gas are not available currently to the 80 acres property. The Greenbrier County Airport has one of the longest airport runways in the region, with potential hangar sites. Some of the other companies close by are Smooth Ambler Spirits, Mott Manufacturing, Jet America, and Greenbrier Valley EDC's Rahall Business &

Technology Center. The site is .25 miles from Highway 219, 3 miles from Interstate-64, and 0.2 miles from Greenbrier Valley Airport.

- *Fountain Springs Technology and Business Park* is a 25-acre park located at 3 Park Dr, Peterstown, Monroe County. The fully planned park has finished roads and on-site utilities and is home to M-Rock Stone manufacturing. Electric Service is provided by Appalachian Power Company, with 34.5 KV - 2.5MW Phase – 3. Natural Gas is provided by Mountaineer Gas; an 8" main is located within 3 miles of the site. Water and wastewater are managed by Red Sulphur Public Service District (PSD), with an 8" line, an excess water/sewer system capacity of 50,000 GPD, and a total water/sewer system capacity of 300 GPD. Telecommunications is provided by Frontier. The site has a flood plain adjacent to U.S. 219, 5.6 miles from US Route 460, 20 miles from Interstate-77, and 46 miles from Greenbrier Valley Airport.

- *East Fork industrial site* is a 99-acre site located at 118 Industrial Park Road, Durbin, Pocahontas County, with no zoning. Electric Service is provided by the Monongahela Power Company. Water is provided by the Pocahontas County Public Service District (PSD) using an 8" main line and 110 psi pressure. Wastewater is also managed by the Pocahontas County PSD. Telecommunication services are available through Frontier and Spruce Knob Seneca Rocks Telephone. The site has a floodplain, and is 70 miles from I-64 and 80 miles from Greenbrier Valley Airport.

APPENDIX H: LEGAL DISCLAIMER

This BDO Zone Rating (the "Rating") is prepared for, and provided to, Greenbrier Valley Economic Development Corporation, and is intended to be read and used in its entirety and not in parts. Separation or alteration of any section or page from the main body of this Rating is expressly forbidden. In preparing this Rating, Ecostrat has used information obtained from third parties or otherwise publicly available. All such information has not been independently validated, verified, or confirmed by Ecostrat (except where otherwise specifically indicated) and Ecostrat makes no representation or warranty as to the accuracy or completeness of any information provided by third parties or otherwise publicly available.

Neither Ecostrat nor the members of the BDO Zone Advisory Committee make any representation or warranty as to the accuracy or completeness of the information and content in this Rating and shall have and accept no liability for any statements, opinions, information or matters (expressed or implied) arising out of, contained in or derived from this Rating or any omissions from this Rating, or any other written or oral communication transmitted or made available to any other party in relation to the subject matter of this Rating. Any use which a third party makes of this Rating, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Decisions made, or actions taken based on or resulting from Ecostrat's work product shall be the responsibility of the parties directly involved in those decisions or actions. There are no third-party beneficiaries with respect to this Rating, and Ecostrat expressly disclaims any liability whatsoever (whether in contract, tort or otherwise) to any third party. Ecostrat makes no representation or warranty (express or implied) to any third party in relation to this Rating. A decision by any entity to disclose this Rating to the public or privately to a limited number of potential institutional accredited investors or other qualified investors shall not constitute any permission, waiver, or consent from Ecostrat for any third party to rely on this Rating except for informational purposes, and as such, is provided on such basis. Access to this Rating and its use by any third party implies acceptance by the third party of the terms and conditions contained in this section and other parts of this Rating.

All information included is based on information available on the date hereof and neither Ecostrat nor the members of the BDO Zone Advisory Committee are under any obligation to update the information herein. No investor, security holder, or other person should rely on the content of this report in any way in connection with the purchase or sale of any security.