Bioeconomy Development Opportunity Zone Risk Rating

'A'

The Municipal District (MD) of Greenview and the County of Grande Prairie, AB, BDO Zone is rated 'A.' There is an abundance of available woody biomass, primarily forest residues within the BDO Zone, able to accommodate new biomass projects, with low risk of feedstock shortages. However, the supporting logistics infrastructure requires scale up.

Rating Parameters:

Category	Rated Quantity	Delivered Cost	BDO Zone Size
Forest Residues	262,200 bdt/yr	$71-$84/bdt	120-km Supply Radius with 80-km average transportation distance
Urban Wood Waste	3,400 bdt/yr	$50-$70/bdt	
Total Woody Biomass	265,600 bdt/yr		

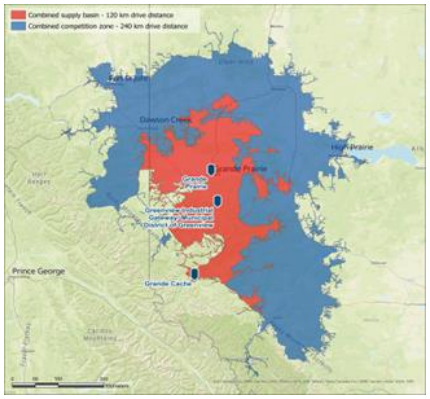
BDO Zone Assets

- **235,000-333,000 dry tonnes of forest residues are estimated to be produced annually given the historical timber harvest levels.**
- **Forest residues currently do not have established markets, and they are mainly piled up at the roadside of the logging operations and burned.**
- **Strong forestry and wood industry sectors with a long history of stable performance and co-existence.**
- **Established Sustainable Forest Management Practices dictated by the Government of Alberta and third-party Sustainability Certification Schemes.**
- **Incredible advantage in offering a closed-loop industrial system to the energy sector seeking low carbon solutions, providing the key infrastructure including access to natural gas, water, electricity, an integrated transportation network, and the ability for carbon sequestration in a carbon capture hub.**

BDO Zone Liabilities

- **The supply chains are underdeveloped for forest residues and require capital investment to scale up (both logistics equipment and the supporting infrastructure such as forest roads).**
- **New business relationships need to be established between the biomass project developers, tenure holders, harvest groups, and logging companies. If a significant increase in demand for forest residues occurs, the bio-project proponents likely need to resource their trucks and drivers without dipping into existing contractor pools.**

Woody Biomass Supply and Competition Basins for the MD of Greenview and County of Grande Prairie BDO Zone



BDO Zone Risk Rating

The Municipal District (MD) of Greenview and County of Grande Prairie, Bioeconomy Development Opportunity Zone is rated 'A,' or 'high quality.'

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

Scoring and Rating Methodology

In assessing the biomass supply chain risk for the Bioeconomy Development Opportunity (BDO) Zone, 48 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 quantity is expressed in bone dry tonne per year (bdt/yr). The feedstock cost is expressed in CAD dollars, delivered to the Proponent ($/bdt). Maximum transport distance is based on a 120-km drive distance of the supply zone with an average transportation distance of 80 km within the 120-km supply basin.

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 MD of Greenview and the County of Grande Prairie is ***16.81 out of 100, resulting in an 'A' designation***.

All scoring and rationale for each Risk Indicator is provided in Appendix A. It is important to note that this assessment is evaluated assuming that the risk related to the proposed woody biomass consuming facilities is negligible. In other words, we do not account for proposed competitors.

Analyst Notes

The forestry and wood processing industry sectors in the MD of Greenview and the County of Grande Prairie BDO Zone have a long history of performance. There are four large-scale sawmills in the BDO Zone with a total capacity of processing 3.83 million m^3 of logs. These facilities have been in operation for decades and are among the most competitive in Canada. They serve as one of the region's top industrial employers, employing over 1,100 people (including staff at the pulp mill). These sawmills are the primary producers of both sawmill and forest residues in the BDO Zone.

In addition, these facilities have experienced low volatility in the Annual Allowable Cuts (AACs) and have been able to secure their fiber needs at affordable costs, resulting in a steady state of forest industry in the BDO Zone.

Commercial quantities of unutilized woody biomass feedstock were identified within 120 km of the BDO Zone. The annual production of both sawmill and forest residues depends on annual harvested timbers and sawmill production levels, which vary from year to year. To capture the potential variability in the availability of woody biomass in the BDO Zone, we conducted a scenario analysis by looking at three supply scenarios: Scenario I – the highest potential of available woody biomass; Scenario II – the average available woody biomass; and Scenario III – the lowest potential of available woody biomass.

These scenarios were developed and evaluated based on historical timber harvest levels over the period of 2012-2021. The details of the supply scenarios are discussed in Appendix B.

The total estimated woody biomass available for new biomass projects under scenarios I, II, and III is estimated to be over 333,000 bdt, 265,000 bdt and 235,000 bdt, respectively. Even in scenario III which represents the lowest potential of available woody biomass for biomass projects, commercial quantities of underutilized woody biomass would be available.

Over 98% of the available underutilized woody biomass in the BDO Zone is forest residue, with the remainder being urban wood waste. About 63% and 37% of produced forest residues are softwood and hardwood, respectively. It is estimated that about 3,400 bdt of urban wood waste is produced annually in the BDO Zone.

Sawmill residues are currently being used up by wood processing facilities in the BDO Zone, including sawmills and the pulp mill. The four sawmills and the pulp mill in the region use a large portion of their own mill residues for internal energy generation. In addition, the large pulp mill in the BDO Zone uses wood chips produced by three local sawmills for pulp production, along with sawdust and hog fuels for steam and power generation. There are two Cogen facilities (combined heat and power (CHP) units) in the BDO Zone which use a portion of the sawmill residues supply. The consumed sawmill residues by the local sawmills and the pulp mill likely will not be available for the new biomass projects. Moreover, with the recent growth of the wood pellet industry in Alberta, a portion of the wood shavings in the supply basin is reported to be transported to the pellet plant in Entwistle.

Overall, with the operating Cogen facilities, biomass-based power plants, and the internal energy needs of the local sawmills and the pulp mill, we expect that minimal/insignificant quantities of this biomass category will be available for future biomass projects under long-term contracts. In contrast, the current use of forest residues by the wood processing facilities and the Cogen plants is very limited as they have been able to meet their woody biomass demand from the existing sawmill residues supply.

Due to the nature of forests in Alberta, which are a mix of coniferous and deciduous trees, the forest industry has evolved to exploit both species. The harvested timbers that do not meet the specifications of primary wood processing facilities, such as lumber manufacturers, are used by the pulp and paper mills and the Oriented Strand Board (OSB) plants. As mentioned before, the four sawmills in the BDO Zone have a total capacity of processing 3.83 million m^3 of logs and their allocated AACs in the BDO Zone is 3.87 million m^3. Thus, it is expected that the wood processing facilities in the region use up most of the harvested logs in the BDO Zone. Commercial quantities of low-grade logs would not be available for biomass projects from forest crownlands.

However, on some occasions, the tenure holders leave low-grade logs at the roadside of the forest cutblocks as part of logging residue piles. The primary reason is the time constraints that tenure holders have to harvest and transport logs to meet the fibre demand of their own sawmills before replanting starts. Then, they deactivate the road network for repair and maintenance, making them unable to supply other end users. Another reason is the long distance of forest cutblocks from the end users, making the transportation cost prohibitive.

In contrast, low-grade logs are available for harvesting in the private forestlands. No public data is available on the volume of harvested timbers from private forestlands in the BDO Zone. We estimated that about 118,650 to 557,250 m^3 of logs (primarily deciduous trees such as aspen)

have been harvested over the period of 2000-2020 from the private forestlands in the BDO Zone.

There has been a growing interest by local sawmills to secure wood fibres from private lands. Although logs from private forest lands in general are more expensive than logs from the public lands, with the reduced fibre available on crown lands, sawmills are required to harvest this private wood to offset the fibre loss. So, the future bio-projects need to compete with the local sawmills to secure logs from private forest lands. Due to the growing demand for logs from the private forest lands by local sawmills, we did not include them as a source of woody biomass available for the future biomass projects.

However, similar to the conventional forest industry, biomass projects can secure a portion of their woody biomass demand (if it is mostly hardwood) from private forestlands in the BDO Zone. This is especially critical at times when the bio-project deals with fiber shortages from the sawmill and forest biomass resources. The amount of secured fiber by the biomass projects depends on the price that these projects are willing to pay.

Low-grade logs are more expensive woody biomass resources compared to sawmill and forest residues, as low-grade logs incur an additional cost of harvesting which includes the stumpage fee (paid to land owners), felling the timber, skidding it to the roadside, and processing (deliming) the timber. The average delivery cost of low-grade logs is estimated to be $121/bdt, 70% greater than the cost of forest residues ($71/bdt) and over twice the delivered cost of urban wood waste and sawmill residues ($59/bdt), assuming all collected within a supply radius of 120 km with an average transportation distance of 80 km.

Overall, the local wood processing facilities, including the sawmills and the pulp mill, have been driving the demand for sawmill residues in the BDO Zone. Our analysis shows that the sawmill residues supply and demand have reached a balance, and no existing competitors from outside the BDO Zone have been major users of woody biomass in the BDO Zone.

The most common practice to manage the forest residues by the tenure holders (local wood processing facilities) is piling and burning them at the roadside of forest cutblocks. Our research and outreach indicate that the tender holders are open to entering business-to-business arrangements for the use of these materials rather than treating them as waste.

Based on these findings, while competition for woody biomass feedstock exists in the region, the impact of this competition on potential projects in the BDO Zone is relatively low, given the commercial quantities of underutilized forest residues available.

Key Low-Risk Indicators

Most Loaded RI Scores are below 33.33 and thus deemed low risk.

Most risks related to competition are scored as low. This is because the local sawmills and the pulp mill have been driving the demands for sawmill residues in the BDO Zone. As mentioned above, no competitors outside the BDO Zone have been major woody biomass users. Local sawmills are open to entering business-to-business arrangements for the use of underutilized forest residues rather than piling and burning them.

Risks related to infrastructure are also scored as low as the BDO Zone has the key infrastructure in place to support a large-scale biomass project, including physical, social, logistics, workforce and permitting infrastructure. As an industry innovator in low-carbon gas processing, the Greenview Industrial Gateway aims to be Canada's top net-zero eco-industrial site. Its significant carbon management assets stimulate bio-

based economic growth and propose potential carbon capture and storage through adjacent carbon hubs.

In addition, all risks related to supplier performance, production capacity, and dependence on (or preference for) competing markets are scored as low. The forest industry in the BDO Zone has experienced a low volatility in the Annual Allowable Cuts (AAC), and the timber harvesting volumes in the last decade have been within the sustainable limits set in Forest Management Agreements. In other words, the primary and secondary wood processing facilities, such as sawmills and pulp mills have been able to secure their fiber demands at affordable costs, resulting in a relatively steady state of the forest industry in the region. Contrary to experience in many other jurisdictions, no mills have recently closed permanently within the region. Curtailment-related activity over the past decade has almost always been rail-related (lack of rail cars or issues at the ports in British Columbia – with an outsized impact on pulp/OSB operators that tend to be more rail-dependent). There are regional fiber constraints (sawmill residues), but overall, the BDO Zone is a low-cost market to operate in, with mills remaining operational even when prices are depressed.

Finally, due to large amounts of underutilized forest residues in the BDO Zone, the risk of shortage is deemed low, meaning that suppliers' preferences for competing markets should not endanger the supply. These factors suggest that a stable feedstock supply is available for a new operator looking to enter the BDO Zone's market.

Disturbance is essential to forest health and regeneration, although it can challenge tenure holders and communities. Wildfires and insect damage are the primary sources of natural disturbance and cause significantly more temporary forest loss than timber harvesting. Forest areas impacted by natural disturbance can vary greatly between years. However, historical data published by the Government of Alberta shows that the damage caused by wildfires has been insignificant, and the insect damage by mountain pine beetle (MPB) infestations in the province is minimal compared to BC. The total cumulative affected areas by MPB in BC was over 18 million hectares compared to 2.4 million hectares in Alberta. Although both forest fires and insect damages have not been significant in the BDO Zone, these natural disturbances always threaten the wood fibre basket in the BDO Zone as being witnessed in May 2023.

In the BDO Zone, temporary disruptions may also occur during periods of heavy rain or snowfall, making it difficult for tenure holders to clear trees from timberland, causing dirt roads to become impassable. As a result, all sources of feedstock production may experience variations. However, generally, such disruptions are usually temporary and typically do not last more than a few weeks.

Key Moderate-Risk Indicators

The most significant risks in the BDO Zone are 1) production scale experience and feedstock production priority, 2) competitor pricing and price sensitivity, 3) fuel price and feedstock transportation costs, 4) seasonal feedstock supply variation and 5) transportation of feedstock requires specialized equipment.

Risks related to production scale experience and feedstock production priority

In the BDO Zone, the supply and logistics of sawlogs and sawmill residues are well-established, as evidenced by the historical harvest levels, sawmill production, and the absorption of these materials by current markets. However, the current supply of forest residues is limited, as it is rarely collected and processed in commercial quantities. A lack of significant demand for forest residues in the region has led to limited infrastructure available for its collection and processing. This is a major factor contributing to the

scale up risks associated with forest residues production and use.

Additionally, we have observed that most logging companies in the region are relatively small, limiting their ability to acquire capital and purchase the necessary equipment for forest residue processing and transportation in the short term. The collection, processing, and transportation of commercial quantities of forest residues need a close partnership with the tenure holders to minimize interference with logging operations and enable access to the road before reforestation occurs and access roads are closed. This further exacerbates the scale-up risks associated with forest residue logistics. Given the potential size and scope of large-scale projects, any issues related to feedstock production scale-up and priority could have a substantial impact on the success of the project.

Therefore, a new biomass project needs to establish cost-efficient logistics systems to collect, load, process and deliver this source of woody biomass to its facility, which may take a few years (2-4 years).

Competitor Pricing and Price Sensitivity

Since the local sawmills in the BDO Zone use most of their residues for internal energy uses and have long-term relations with the local pulp mill, the biomass project likely will not be able get access to sawmill residues. However, a portion of sawmill residues may become available to purchase but the biomass projects need to offer higher price than $60/bdt to secure a portion of the existing supply of sawmill residues from local sawmills.

The price of pulpwood/low-grade logs is dynamic and depends on the local and regional demand for logs from sawmills and pulp mills. We expect the main source of pulpwood/low-grade logs for biomass projects will be the timbers from private forestlands. However, this biomass source will be the most expensive woody biomass for biomass projects as the delivery cost includes additional operations of felling the timber, skidding it to the roadside, and processing (deliming) the timber. Overall, given the historical supply and demand for woody biomass in the BDO Zone and the source of woody biomass available for biomass projects, the pricing risk for securing large quantities of sawmill residues and pulpwood/low-grade logs deemed to be relatively high, particularly for new entrants to the market.

The existing wood processing facilities are well established and may be able to tolerate higher prices temporarily to exert pressure on new competitors. However, the risk of price competition for forest residues is low as there is no established demand for forest residues in the BDO Zone and they are currently piled and burned. The biomass projects should be able to secure this fibre basket by creating business-to-business relationships with the tenure holders and offering long-term supply and price agreements.

Fuel Price and Transportation Cost

Historical diesel price throughout 2018-2023 published by the Government of Alberta indicates that diesel prices are volatile and hard to predict, especially in light of recent global events, including the pandemic and high inflation. The transportation companies add a fuel surcharge to their trucking cost (truckload cost × (1+fuel surcharge)). The surcharge fuel cost increased from 15% in late 2020 to as high as 46% in late 2022 in the Canadian Prairies, resulting in a $4-8/bdt increase in biomass transportation costs for a range of 50km-200km. The fuel price also impacts other logistics operations, including loading and grinding, as these operations also use diesel as a fuel source and may need to be transported to forest cutblocks using flatbed trucks. The fuel price volatility and increase can significantly impact the long-term financial performance of a biomass project with small profit margins.

It is noteworthy that the volatility in fuel price and transportation

costs are relevant to biomass projects in other regions and jurisdictions not only the BDO Zone region.

Seasonal Feedstock Supply Variation

The harvest season in the BDO Zone region usually starts in September and winds down in March. There is sporadic harvest in the summer time. As a result, the local wood processing facilities have established on-site log yards and off-site satellite storage yards to hold sufficient inventories for the time periods when forest cutblocks are not available for harvesting. The same inventory strategy needs to be developed by future biomass projects using forest residues. In addition, they need to coordinate with the logging companies and tenure holders to minimize interference with the logging operations while processing and transporting forest residues. However, storing large quantities of forest residues would be more challenging than logs for future biomass projects.

Transportation of Feedstock Requires Specialized Equipment

Although open-top and live-bottom trailer trucks have been used for the transportation of sawmill residues on well-maintained roads in industrial and urban areas and highways, these trucks are not built for rough forest roads to transport forest residues. They will have challenges accessing some harvesting sites in the region, without significant additional costs. Coordination between tenure holders, logging companies, and the end users of forest residues is critical to improve transportation practices for forest residues. Such collaboration and coordination have already been established between Cogen and pellet plants with the tenure holders and logging companies, and these sectors have been able to process and transport commercial quantities of forest residues in Western Canada by using dry chip vans and B-train trucks. The use of these trucks needs to be tested and proved in the supply zone.

Notably, the input data for biomass availability modeling and analysis were collected from the Forest Management Units (FMUs) and Annual Allowable Cuts (AAC) documents and the sawmill production capacity in the BDO Zone. FMUs and AACs documents are published by the Government of Alberta. In addition to published reports, personal communications and meetings were organized with the Forestry Division of the Government of Alberta, the sawmills and the pulp mill and local experts to review our inputs, assumptions, methods, and results. We understand our input data and models come with a certain degree of inherent error.

Infrastructure Asset Profile

The BDO Zone infrastructure assets were scored on a scale of 0–10, with scores defined as follows: 0 (very good), 2 (good), 4 (reasonable), 6 (fair), 8 (poor), and 10 (insufficient). Among the top-rated assets are Land Parcels, Industrial Land Use, Highway Access, River Access, Railway Service, Airport Accessibility, Workforce and Housing Availability and Permitting.

The BDO Zone demonstrates low-risk levels across various infrastructure aspects crucial for supporting a large-scale biorefinery project. The region boasts well-established physical infrastructure, including essential utilities and transportation networks. Social infrastructure, such as educational institutions and community services, provides a supportive environment for workforce development and community engagement. Logistics infrastructure enables efficient supply chain management while permitting infrastructure ensures a streamlined process for project approvals.

Overall, the MD of Greenview and the County of Grande Prairie BDO Zone presents a profile of positively rated infrastructure assets, with an average score of

2.21 out of 10. This score supplements the MD of Greenview and the County of Grande Prairie BDO Zone rating and supports its low-risk designation. The full infrastructure asset profile is detailed in Appendix C.

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Figure 1: Risk Indicators (Sorted by Risk Level)

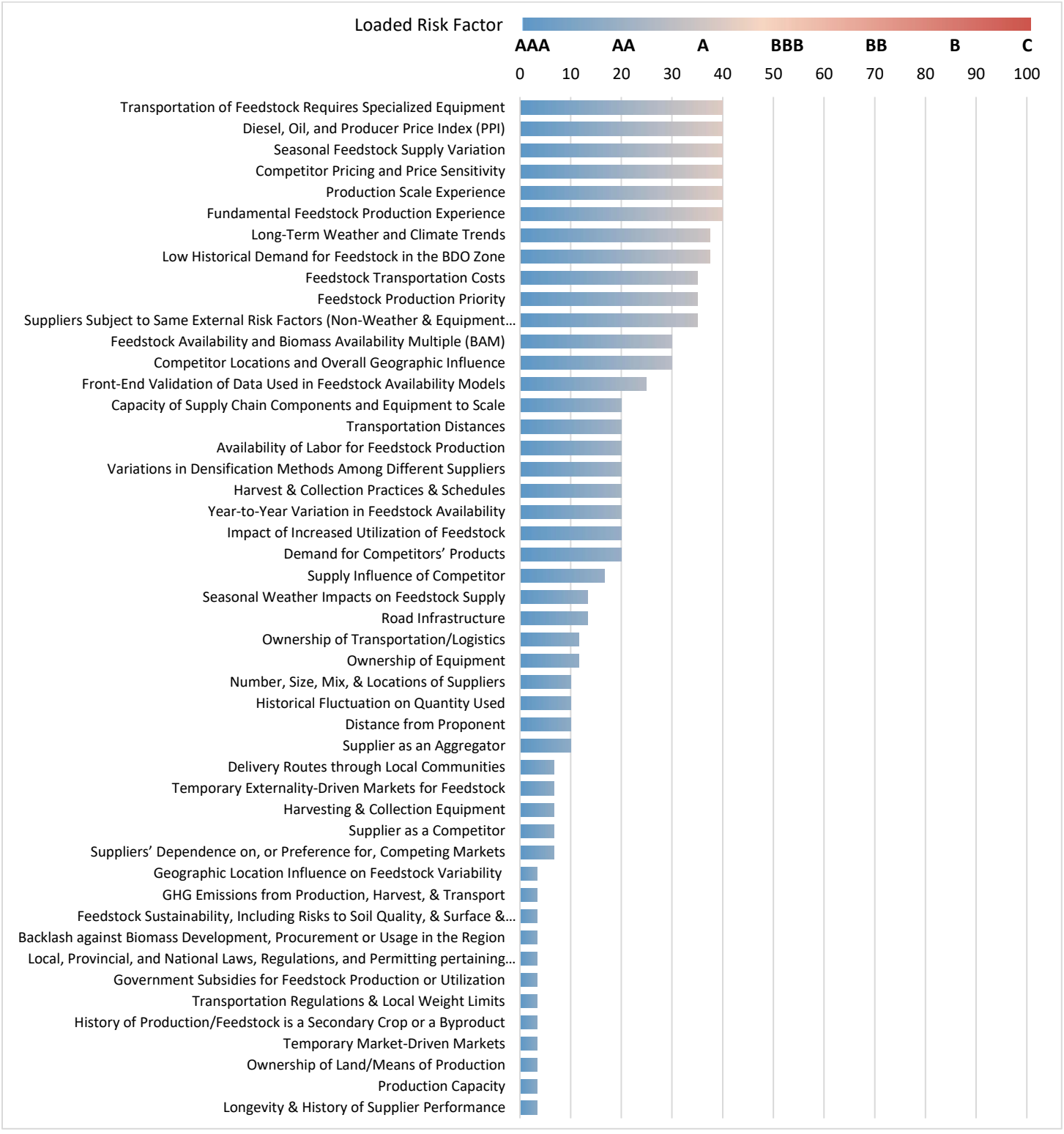


Table 1: Risk Indicators and Associated Scores

	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	3.33	3.33
1.2	Production Capacity	1	1	3.33	3.33
1.3	Suppliers' Dependence on, or Preference for, Competing Markets	2	2	3.33	6.66
1.4	Supplier as a Competitor	2	2	3.33	6.66
1.5	Ownership of Land/Means of Production	1	1	3.33	3.33
1.6	Ownership of Equipment	7	3.5	3.33	11.66
1.7	Ownership of Transportation/Logistics	7	3.5	3.33	11.66
1.8	Supplier as an Aggregator	3	3	3.33	9.99
1.9	Distance from Proponent	1	1	9.99	9.99
1.10	Fundamental Feedstock Production Experience	8	4	9.99	39.96
1.11	Production Scale Experience	8	4	9.99	39.96
1.12	Feedstock Production Priority	7	3.5	9.99	34.97
	Category 2: Competitor Risk				
2.1	Competitor Locations and Overall Geographic Influence	3	3	9.99	29.97
2.2	Historical Fluctuation on Quantity Used	3	3	3.33	9.99
2.3	Competitor Pricing and Price Sensitivity	8	4	9.99	39.96
2.4	Supply Influence of Competitor	5	2.5	6.66	16.65
2.5	Temporary Market-Driven Markets	1	1	3.33	3.33
2.6	Demand for Competitors' Products	3	3	6.66	19.98
	Category 3: Supply Chain Risk				
3.1	Feedstock Availability and Biomass Availability Multiple (BAM)	3	3	9.99	29.97
3.2	Impact of Increased Utilization of Feedstock	3	3	6.66	19.98
3.3	Seasonal Feedstock Supply Variation	8	6	6.66	39.96
3.4	Year-to-Year Variation in Feedstock Availability	3	3	6.66	19.98
3.5	Front-End Validation of Data Used in Feedstock Availability Models	5	2.5	9.99	24.98
3.6	Low Historical Demand for Feedstock in the BDO Zone	5	3.75	9.99	37.46
3.7	History of Production/Feedstock is a Secondary Crop or a Byproduct	1	1	3.33	3.33
3.8	Diesel, Oil, and Producer Price Index (PPI)	8	6	6.66	39.96
3.9	Harvest & Collection Practices & Schedules	6	3	6.66	19.98
3.10	Harvesting & Collection Equipment	2	2	3.33	6.66
3.11	Temporary Externality-Driven Markets for Feedstock	2	2	3.33	6.66
3.12	Variations in Densification Methods Among Different Suppliers	6	3	6.66	19.98
3.13	Availability of Labor for Feedstock Production	6	3	6.66	19.98
3.14	Feedstock Transportation Costs	7	5.25	6.66	34.97
3.15	Transportation Distances	4	3	6.66	19.98
3.16	Transportation of Feedstock Requires Specialized Equipment	8	6	6.66	39.96
3.17	Delivery Routes through Local Communities	1	1	6.66	6.66
3.18	Transportation Regulations & Local Weight Limits	1	1	3.33	3.33
3.19	Road Infrastructure	2	2	6.66	13.32
3.20	Number, Size, Mix, & Locations of Suppliers	3	3	3.33	9.99
3.21	Suppliers Subject to Same External Risk Factors (Non-Weather & Equipment Based)	7	3.5	9.99	34.96
3.22	Seasonal Weather Impacts on Feedstock Supply	4	2	6.66	13.32
3.23	Long-Term Weather and Climate Trends	5	3.75	9.99	37.46
3.24	Government Subsidies for Feedstock Production or Utilization	1	1	3.33	3.33
3.25	Local, Provincial, and National Laws, Regulations, and Permitting pertaining to Biomass	1	1	3.33	3.33
3.26	Backlash against Biomass Development, Procurement or Usage in the Region	1	1	3.33	3.33
3.27	Feedstock Sustainability, Including Risks to Soil Quality, & Surface & Groundwaters	1	1	3.33	3.33
3.28	GHG Emissions from Production, Harvest, & Transport	1	1	3.33	3.33
3.29	Geographic Location Influence on Feedstock Variability	1	1	3.33	3.33
3.30	Capacity of Supply Chain Components and Equipment to Scale	6	3	6.66	19.98
	Category 4: Infrastructure				
4.1	Physical Infrastructure	1.6	1.6	3.33	5.33
4.2	Logistics	3	2.5	4.16	10.4
4.3	Social Infrastructure	2	2	3.33	6.66
4.4	Workforce and Permitting	2.5	2.25	3.33	7.49
				Average	**16.81**



MD of Greenview and County of Grande Prairie BDO Zone Independent Review Committee (IRC)

Kyle Reiling – Executive Director, MD of Greenview
Hetti Huls – Economic Development Officer, County of Grande Prairie
Dennis Hussey – VP of Engineering, Beairsto Engineering
Kerrie Taylor – Economic Development Officer, MD of Greenview
Jan Sotocinal – Planner, MD of Greenview
Tom Thompson – General Manager Operations, Canadian Forest Products Ltd.
Gord Weeber – General Manager AB, OSB, West Fraser Grande Prairie
Parker Snyder – General Manager, Foothills Forest Products
Deborah Pietrusik – Senior Advisor, Prairies CAN
Jason Richards – Fibre Supply Manager, International Paper
Julianne Threlfall – Manager, Public and Government Affairs, CN Rail

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: The forest industry in Alberta has experienced low volatility in the Annual Allowable Cuts (AAC) and the timber harvesting volumes in the last decade. Timbers have been harvested within the sustainable limits set in the Forest Management Agreements (FMAs), as shown in the below Table (annual harvest levels are lower than the AACs). In other words, the primary and secondary wood processing facilities, such as sawmills and pulp and paper mills, have been able to secure their fiber demands at affordable costs, resulting in a relatively steady state of the province's forest industry. Contrary to experiences in many other jurisdictions, no major Alberta Forest product mills have closed permanently in recent years. Curtailment-related activity in Alberta over the past decade has almost always been rail-related (i.e. a lack of rail cars or issues at the ports in B.C. – with an outsized impact on pulp/OSB operators that are more rail-dependent). There are regional fiber constraints, but overall, Alberta is a low-cost market to operate in, and mills tend to remain operational when prices are depressed, although utilization rates may fall.

Score 1

Four sawmills exist in the BDO Zone with a total processing capacity of 3.83 million m^3 of logs. Their allocated AACs in the BDO Zone is 3.87 million m^3(see Appendix B for more details). These sawmills have been in operation for decades and are among the most competitive in Canada. Moreover, they serve as the region's top industrial employers, employing over 1,100 people between the sawmills and pulp mill.

Table 2. Combined AAC and timber harvested from provincial lands, by species group (cubic metres x 1,000,000) (Government of Alberta, 2021)

Harvest, by species group	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Coniferous	15.1	13.7	15.0	17.4	16.1	17.2	16.3	14.5	18.3
Deciduous	5.8	6.9	6.3	8.2	7.2	8.2	8.6	8.3	7.9
Total, harvest volume	**20.9**	**20.6**	**21.3**	**25.5**	**23.3**	**25.3**	**24.9**	**22.8**	**26.3**

AAC, by species group	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Coniferous	18.5	19.1	19.6	19.6	19.2	18.7	18.4	17.2	17.2
Deciduous	11.8	12.1	12.8	12.8	12.9	12.9	13.1	12.4	12.2
Total, AAC	**30.3**	**31.2**	**32.4**	**32.4**	**32.1**	**31.6**	**31.5**	**29.6**	**29.5**

Raw RI Score is 1 out of 10.

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 out of 100.	**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: **Score 1**

Sawmill Residues: There are four major sawmills in the BDO Zone, as listed in Table 4, Appendix B. Given their production capacity, we estimate that about 620,000 bone dry tonnes (bdt) of sawmill residues are produced annually in the BDO Zone. This includes 364,000 dry tonnes of wood chips and 256,000 dry tonnes of sawdust, wood shavings, and hog fuels. A strong demand for wood chips already exists from the regional pulp and paper industry as there is a large local pulp mill with an annual wood chip consumption of over 510,000 bdt (see Table 5, Appendix B). We expect that minimal (or no) significant quantities of this biomass category will be available for biorefinery projects.

Sawmill residues are often nearly fully utilized as most facilities either have co-generation plants and/or use residues to help provide heat/steam to support mill operations. This has been an area of intense investment over the past years, particularly as Alberta has a regulated carbon market to which many of these facilities are party to. The use of on-site residue can support meeting emission targets and creating saleable credits.

As listed in Table 5, Appendix B, the pulp mill has a 140 MW biomass-based power and stream generator. There are also two cogeneration facilities in the BDO Zone. It is expected that these facilities will use most of the sawdust, wood shaving, and hog fuels produced by local sawmills. In addition, the local sawmills use a portion of their own residues for internal energy needs specifically heat for kiln dryers. Additionally, with the recent growth of the wood pellet industry in Alberta, a portion of the wood shaving supply in the supply basin is transported to the Drax pellet plant in Entwistle, which has an annual capacity of 400,000 tonnes. With the operating CHP and biomass-based power plants in conjunction with the internal energy needs of the local sawmills, it is expected that minimal quantities of this biomass category will be available for biorefinery projects under long-term.

Forest Residues: It is estimated that 198,910 bdt and 117,647 bdt (a total of 316,557 bdt) of forest residues are functionally available (and underutilized) from Coniferous and Deciduous AACs, respectively in the BDO Zone. In discussions with the local experts from the provincial government and industry, there is no current demand for forest residues. Instead, the most common practice to manage forest residues is to pile and burn them at the roadside of forest cutblocks. In contrast to British Columbia, that has developed fire management and fibre utilization plans, presently there are no incentives provided by provincial or local governments to encourage the use of forest residues. In addition to the crown forestlands, there are private forestlands (also known as woodlots in Alberta) in the BDO Zone. According to Alberta Agriculture and Rural Development (AARD), there are more than 3.6 million hectares of privately owned forested land in Alberta. We estimated that 15% of harvested timbers in the private forestlands are supplied from the

BDO Zone, resulting in a range of 118,650 and 557,250m^3 over the period of 2000-2020 (see Appendix B for more details). These volumes of harvested timbers would generate about 10,000 bdt and 45,000 bdt of forest residues, respectively.

Pulpwood/Low-grade logs within merchantable stands: Due to the nature of forests in Alberta which are a mix of coniferous and deciduous trees, the forest industry has evolved to exploit both variants. Harvested timbers that do not meet the specifications of primary wood processing facilities such as lumber manufacturers are used by secondary sectors such as the pulp and paper mills and OSB plants. The four sawmills in the BDO Zone have a total capacity of processing 3.83 million m^3 of logs and their allocated AACs in the BDO Zone is 3.87 million m^3. Thus, it is expected that the wood processing facilities in the region use most of the harvested logs in the BDO Zone and commercial quantities of low-grade logs would not be available for biorefinery projects. On some occasions the tenure holders leave the low-grade logs at the roadside of the forest cutblocks as part of logging residues piles. The primary reason is the time constraints that tenure holders have to harvest and transport logs to meet the fiber demands of their sawmills before replanting starts, and then they deactivate the road network for repair and maintenance, and thus, they are not able to supply other end users. Another reason is the long distance of forest cutblocks from the end users, making the transportation cost prohibitive. In this report, the low-grade logs are considered as part of forest residues inventory.

In contrast, pulpwood/low-grade logs are available for harvesting from private forestlands. Occasionally some of forest product processing facilities in Alberta rely on timber harvested from private land to supplement or, substitute their Crown fiber supplies. This is especially pertinent during periods of high price and demand for forest products such as lumber and OSB. No public data exists on the volume of harvested timbers from private forestlands in the BDO Zone. Given the percentage of private forestlands presented in Table 6 (Appendix B), we assume that 15% of harvested timbers from private forestlands are supplied from the BDO Zone, resulting in a range of 118,650 and 557,250 m^3 over the period of 2000-2020. Similar to the conventional forest industry, biorefinery projects can secure a portion of their woody biomass demand from the pulpwood/low-grade logs from the forestlands in the BDO Zone. The amount of secured fiber by the biorefinery projects will depend on the price projects are willing to pay.

Overall, commercial quantities of underutilized woody biomass are available in the BDO Zone to support large-scale biorefinery projects. The primary source is expected to be forest residues.

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 out of 100.	**Score 3.33**

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 scarce supplies to a competitor, resulting in supply disruptions for the Proponent.	
Raw RI Score: The main end users of woody biomass in the BDO Zone are wood fiber producers (i.e., wood processing facilities including sawmills and the pulp mill). Sawmills and the pulp mill in the region use a portion of their own mill residues for internal energy production. The large pulp mill in the BDO Zone uses up the wood chips produced by three local sawmills for pulp production. The Canfor sawmill owns a Cogeneration unit that uses a portion of the sawdust, wood shavings and hog fuels produced by the sawmill. Thus, the consumed sawmill residues by the local sawmills and the pulp mill likely will not be available for the biorefinery projects. In contrast, the forest residues in the BDO Zone currently do not have established markets and there is no vested interest or preference for supplying specific competitors for forest residues. The most common practice to manage the forest residues by tenure holders (local wood processing facilities) is to pile and burn them at the roadside of forest cutblocks. Our research and outreach indicate that the tender holders are open to entering business-to-business arrangements for the use of these materials rather than treating them as waste. Finally, due to a large amount of underutilized forest residues in the BDO Zone, the risk of shortage is deemed low, meaning that the supply should not be endangered by any suppliers' preference for competing markets. These factors suggest that a stable supply of feedstock is available for a new operator looking to enter the market in the BDO Zone. 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 out of 100.	**Score 6.66**

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: Although the local sawmills and pulp mill use their mill residues for internal operations, forest residues historically have been piled up at the roadside of the cutblocks and burned. The tenure holders (local wood processing facilities) have shown no interest in using forest residues for their operations as they have been able to meet their internal biomass demands from their own mill residues, and using forest residues for energy production at their facilities is not cost competitive with using sawmill residues as feedstock. This indicates a stable and potentially abundant supply of forest residues available for a new operator looking to enter the market in the BDO Zone.	**Score 2**

In addition to woody biomass from crownlands, new operators can meet a portion of their biomass demands from private forestlands. Private landowners in the BDO Zone do not have wood processing facilities and are willing to sell a portion of their timber inventory new operators at the right price**.**

Generally, there are relatively no markets for forest residues and the timber inventory from the private forestlands can be available for new operators. As such, we assume that there should be no risk in terms of securing commercial quantities of woody biomass in the BDO Zone.

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 out of 100.	**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: In the BDO Zone, the producers of woody biomass are the existing wood processing facilities. These facilities have been in operation for decades and have established cost-efficient supply chains to harvest, transport, and process logs as well as transport their final wood products to the regional and international markets. The existing inbound and outbound logistics systems can be exploited by new operators through the establishment of business-to-business relationships with the established wood processing facilities. Such relationships have been successfully built between wood pellet companies and sawmills in Western Canada, which have resulted in access to commercial quantities of forest residues, low-grade logs, and sawmill residues at affordable prices for wood pellet companies. **Score 1**

In addition, the existing wood processing facilities have long-term Forest Management Agreements (up to 20 years) with the Government of Canada, making them responsible for managing timberland in a sustainable manner, as well as building and maintaining road networks and working with the local logging companies to operate the harvesting equipment.

Historical timber harvest and sawmill production data shows that harvested quantities and production levels are relatively stable from year to year, indicating that the system functions properly and should not pose a significant risk to supply chains, even with the introduction of new projects.

The existing supply chains and the historical timber harvest and sawmill production data suggest that the supply chain in the BDO Zone is stable and able to support a new operator looking to enter the market.

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 out of 100.	**Score 3.33**

1.6. Ownership of Equipment

Rationale: In most cases, suppliers that own or lease equipment for collection, loading and processing feedstock are at lower risk than those that do not. For example, third-party harvesting equipment may not be available when required. Short harvest windows may be missed if a farmer, tenue holder and contractor cannot schedule harvest times that are convenient and quantity shortages can result.	
Raw RI Score: In the BDO Zone, we see no significant risk through equipment ownership from wood processing facilities and logging contractors to produce sawmill residues and forest residues as they have historically established business relationships. There are many logging companies in the region and some of which have already invested in collection and grinding equipment for logging residues. However, they have been using their equipment in regions such as Peace River where there are demands for logging residues. However, since the forest residues are usually burned and there are no established markets for this woody biomass resource, there is a need for a commercial fleet to load, grind, and transport forest residues year-round. While introducing new equipment to collect and process forest residues introduces some risk, suppliers may be willing to invest in new equipment if proper commitments from a Proponent are in place. Due to the high capital cost of the collection and processing equipment, and the small size of logging businesses in the BDO Zone, it may take some time for the local companies to scale if the new operator needs commercial quantities of forest residues. Raw RI Score is 7 out of 10.	**Score 7**
Notched Salience: Although there is no established fleet of collection and processing equipment for forest residues in the BDO Zone, the forest industry in Western Canada have shown their willingness to invest in in new equipment if proper commitments from a Proponent are in place. Additionally, the Proponent can also invest in owning logistics equipment as some of the wood pellet companies have done in Western Canada to collect, process, and transport logging residues. Thus, Raw RI is notched down by 50%. The notched salience is 3.50.	**Score 3.5**
Impact Level: RI Impact level is deemed *low*. The proponent can reduce the impact of equipment ownership by suppliers by purchasing and managing harvest and collection equipment.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 11.66 out of 100.	**Score 11.66**

1.7. Ownership of Transportation/Logistics

Rationale: In most cases, suppliers that own or lease equipment necessary to transport biomass from forests or fields 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: In the BDO Zone, sawmills mainly use the service of local transportation companies to deliver sawmill residues to end users. Meanwhile, loggers own logging trucks for delivering harvested timbers. However, due to the lack of demand for forest residues, it is likely that a lack of transport equipment is available for this material.	**Score 7**

One of the key concerns that forest tenure holders raise with bio-project proponents (who are looking to access harvest/mill residuals) pertains to transportation. For a tenure holder to enter an arrangement, they typically want to see bio-project proponents' resource their trucks/drivers without dipping into the existing pool of contractors to the point it impacts their own operations. It requires a close partnership between the tenure holders and the bio-project proponents to be able to access the residuals in the narrow window of opportunity (before reforestation occurs and the access roads are put to bed). If a significant increase in demand for forest residues occurs, transport infrastructure would need to be significantly scaled up. However, because logging companies in the BDO Zone tend to be relatively small and lack access to significant financing, this process could take time. Raw RI Score is 7 out of 10.	
Notched Salience: Although there is no established transportation fleet for forest residues in the BDO Zone, the forest industry in Western Canada has shown their willingness and capacity to invest in new transportation equipment if proper commitments from a Proponent are in place. Thus, Raw RI is notched down by 50%. The notched salience is 3.50**.**	**Score 3.5**
Impact Level: RI Impact level is deemed *low*. The Proponent can reduce the impact of equipment ownership by suppliers by investing in purchasing and managing transportation equipment.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 11.66 out of 100.	**Score 11.66**

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: In the BDO Zone, sawmills and local logging and logistics companies move substantial amounts of logs and sawmill residues across the region. Typically, these companies prefer longer-term contracts to the spot market, which adds to the robustness of the system. Some of these local logging and logistics companies serve several tenure holders and sawmills both within and outside of the supply basin in the BDO Zone. The presence of these aggregators in the BDO Zone presents an opportunity for a new biorefinery project to work with companies that specialize both in the production and logistics of woody biomass. This can help lower supply chain risks and improve its overall efficiency. Although these aggregators do not have established experience in processing, handling, and transporting commercial quantities of forest residues, they have the capabilities to establish such expertise if established markets are created for the forest residues in the BDO Zone. Overall, the existence of biomass aggregators in the BDO Zone suggests a relatively low risk associated with feedstock supply. 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 out of 100.	**Score 9.99**

1.9. Distance from Proponent

Rationale: The greater the distance from a supplier to a plant, the subject it is to fuel cost risks, and the greater the competitive pressure (to breach) that a closer competitor can exert.	
Raw RI Score: In the BDO Zone, sawmills and local logging and logistics companies have been working together for decades to move substantial amounts of logs and sawmill residues across the region. The industry has indicated that logs and sawmill residues are transported distances over 150 km, adding to the level of certainty for the BDO Zone's 120-km supply basin. Additionally, most sawmills and forest cutblocks in the BDO Zone are located relatively close (within 100k) to Grande Prairies and the MD of Greenview. Further details on sawmill locations and timber lands can be found in Appendix B. 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*. The distance between the supplier and the future biorefinery projects is a significant variable that can influence the viability of feedstock access. Biorefinery projects need to find an optimal location that meet several criteria such as close proximity to fiber supply, easy access to the inbound and outbound logistics network, access to the skilled workforce and industrial lands, potential incentive package from the local municipalities, etc.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99 out of 100.	**Score 9.99**

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: In the BDO Zone, the supply and logistics of logs and sawmill residues is well-established, as evidenced by historical harvest levels and sawmill production, and the absorption of these materials by current markets. However, the current supply of forest residues is limited, as it is rarely collected and processed in commercial quantities. Raw RI Score is 8 out of 10.	**Score 8**
Notched Salience: In the BDO Zone, the major underutilized woody biomass is logging/forest residues. Therefore, a new biorefinery project needs to establish cost-efficient logistics systems to collect, load, process and deliver this source of woody biomass to its facility. This can be done with a combination of custom harvest groups/logging companies and owned logistics equipment by the biorefinery project. Since experience in commercial collection, processing and transporting of forest residues are lacking in the BDO Zone, the Proponent can take steps to ensure proper training, knowledge dissemination, and	**Score 4.0**

monitoring of forest residues logistics operations. Raw RI is notched down by 50%. The notched salience is 4.0.	
Impact Level: RI Impact level is deemed *high*. The experience of feedstock production can have a significant influence on projects requiring large quantities of feedstock. Having experienced suppliers and producers in the supply chain can help to ensure a reliable and stable supply of feedstock, while less experienced suppliers may face challenges in meeting the demand for feedstock.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 39.96 out of 100.	**Score 39.96**

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: *Sawmill Residues*: Our analysis indicates that the four major sawmills in the region generate approximately 620,000 dry tonnes of sawmill residues are produced in the BDO Zone, including 364,000 dry tonnes of wood chips and 256,000 dry tonnes of sawdust, wood shavings, and hog fuels. This quantity of feedstock is already produced as a by-product of existing operations, eliminating any significant concerns related to scale up. Furthermore, local sawmills in the region have been in operation for several decades, suggesting that the production scale experience is not of concern. *Forest Residues*: Our analysis indicates that a lack of significant demand for forest residues in the region has led to the limited infrastructure available for its collection and processing. This is a major factor contributing to the significant scale up risk associated with forest residue production. Additionally, we observed that most logging companies in the region are relatively small, limiting their ability to acquire capital and purchase the necessary equipment for forest residues processing and transportation in the short term. In addition, the collection, processing, and transportation of commercial quantities of forest residues need a close partnership with the tenue holders to minimize interferences with the logging operations and access to roads before reforestation occurs and they are closed. *Pulpwood/low-grade logs*: Our analysis indicates that the logging infrastructure in the region is robust and healthy, as evidenced by the ongoing operational success of local sawmilling and pulp and paper industries. This suggests that the region has significant experience and expertise in logging, and it is believed that the risks related to timber harvesting and transport scale up are low. Raw RI Score is 8 out of 10.	**Score 8**
Notched Salience: In the BDO Zone, the major underutilized woody biomass is logging/forest residues. Therefore, a new biorefinery project needs to establish cost-efficient logistics systems to collect, load, process and deliver this source of woody biomass to its facility. This can be done with a combination of custom harvest groups/logging companies and owned logistics equipment by the biorefinery project. Since experience in commercial collection, processing and transporting of forest residues is lacking in the BDO Zone, the Proponent can take steps to ensure proper training, knowledge dissemination, coordinate with the tenure holders and logging companies and monitoring of forest residues logistics operations. Raw RI is notched down by 50%. Notched Salience is 4.0.	**Score 4.0**

Impact Level: RI Impact level is deemed *high*. Given the potential size and scope of large-scale projects, any issues related to scaling production and logistics could have substantial impacts on the success of the project. Therefore, even though we are confident in our assessment of production scale up experience, we believe that it is important to consider the potential impact of this risk when evaluating potential feedstock options for large scale projects.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 39.96 out of 100.	**Score 39.96**

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 residues 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: **Score 7**

Sawmill Residues: Sawmill Residues are generated as a by-product of lumber and other wood products manufacturing, suggesting that the feedstock production priority risk associated with sawmill residues is relatively low.

Forest Residues: Like sawmill residues, forest residues are an unavoidable part of the forest industry. Our analysis suggests that forest residues are currently in low demand in the BDO Zone, resulting in limited infrastructure for their collection, processing, and transportation. While some loggers have expressed interest in harvesting and collecting forest residues, others have indicated general disinterest. A coordinated effort is needed between the tenure holders, logging companies, and new operators/biorefinery projects in the timing of collecting forest residues to minimize the interference with the logging operation, road network repair, and maintenance and silvicultural activities. Given these factors, the production priority risk related to forest residues is high.

Pulpwood/low-grade logs: Our analysis indicates that timber harvesting has been a longstanding activity in the BDO Zone to meet fiber demands of existing wood processing plants and wood processing facilities, which have been working together to trade and supply logs. As a result, we consider the production priority risk associated with timber harvesting to be relatively low.

Given that forest residues are the primary sources of underutilized woody biomass in the BDO Zone, the production priority risk is considered high.

Raw RI Score is 7 out of 10.

Notched Salience: In the BDO Zone, the major underutilized woody biomass is logging/forest residues currently left at the logging sites. Therefore, a new biorefinery project needs to work closely with the tenure holders and custom harvest groups/logging companies to pile, process, and transport them to its facility with minimal interference with logging and post-logging operations. The Proponent can take steps to ensure proper training, knowledge dissemination, and monitoring of forest residues logistics operations and the timing of forest biomass collection and transportation. Raw RI is notched down by 50%. The notched salience is 3.5.	**Score 3.5**

Impact Level: RI Impact level is deemed *high*. Given the potential size and scope of large-scale projects, any issues related to feedstock production priority could have a substantial impact on the success of the project. Therefore, even though we are confident in our assessment of feedstock production priority, we believe that it is important to consider the potential impact of this risk when evaluating potential feedstock options for large scale projects.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 34.97 out of 100.	**Score 34.97**

CATEGORY 2: COMPETITOR RISK

2.1. Competitor Locations and Overall Geographical Influence

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: **Score 3**

The main end users of woody biomass in the BDO Zone are wood fiber producers (i.e., wood processing facilities including sawmills and the pulp mill). The four sawmills and the pulp mill in the region use a portion of their own mill residues for internal energy uses. In addition, the large pulp mill in the BDO Zone uses up the wood chips produced by three local sawmills for pulp production. Two Cogen facilities are in the BDO Zone that use the existing supply of sawmill residues as feedstock for heat and power generation. Based on our conversations with the local sawmills, the only end user of sawmill residues outside of the BDO Zone is Drax. A portion of the wood shaving supply in the supply basin is transported to the Drax pellet plant in Entwistle with an annual capacity of 400,000 tonnes. This pellet plant is more than 300 km away from the BDO Zone.

As discussed in more detail in Appendix B, the local sawmills, pulp mill, and two Cogen facilities consume most of the existing supply of sawmill residues in the BDO Zone. Thus, the consumed sawmill residues by the local sawmills and pulp mill likely will not be available for the biorefinery projects. Overall, these end users have been driving the demands for sawmill residues in the BDO Zone and our analysis shows the sawmill residues supply and demand has reached a balance.

In contrast, the current use of forest residues by existing end users of woody biomass in the BDO Zone is very limited as they have been able to meet their woody biomass demand from the existing sawmill residues supply. Additionally, since additional logistics steps are required to deliver forest residues to the current end users, this source of woody biomass is not cost competitive with the sawmill residues, especially for heat, power, and pellet production.

There is no vested interest in or preference for supplying specific competitors for forest residues. The most common practice to manage the forest residues by the tenure holders (local wood processing facilities) is piling and burning them at the roadside of forest cutblocks. Our research and outreach indicate that the tenure holders are open to enter business-to-business arrangements to the use of these materials rather than treating them as waste.

Based on these findings, we believe that while there is a competition for woody biomass feedstock in the region, the impact of this competition on potential projects in the BDO Zone that targets forest residues as the main feedstock is relatively low.

Raw RI Score is 3 out of 10.

Notched Salience: No adjustment.	**Score 3.0**
Impact Level: RI Impact level is deemed *high*. Our analysis indicates that the present competition for feedstock in the region has a relatively low impact on potential feedstock availability for new biorefinery projects, based on a thorough review of local competitors. However, we recognize that in situations where a few large competitors have a significant impact on the local market for feedstock, the impact on a new biorefinery project could be substantial. Such a scenario could result in reduced availability of feedstock, higher prices, or both, which could adversely impact the financial viability of a new project.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 29.97 out of 100.	**Score 29.97**

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: **Score 3**

Sawmill Residues: Detailed historical data on sawmill residues consumption by competitors is not available. However, given the production capacity and operational history of the four sawmills and the pulp mill, we believe that much of the existing supply of sawmill residues have been used between these wood processing facilities and the two Cogen plants. Our analysis shows the sawmill residues supply and demand has reached a balanced.

Forest Residues: Our analysis indicates that historically, there has been relatively little consumption of forest residues in the BDO Zone. Given this situation, the lack of historical data related to forest residue consumption is expected and not considered a significant risk in our assessment of potential feedstock sources for biorefinery projects in the region.

Pulpwood/low-grade logs: Due to the nature of forests in Alberta (which are a mix of coniferous and deciduous trees), the forest industry has evolved to exploit both tree variants. Harvested timbers that do not meet the specifications of primary wood processing facilities such as lumber manufacturers are used by the secondary sectors such as pulp and paper mills and OSB plants. The four sawmills in the BDO Zone have a total capacity of processing 3.83 million m^3 of logs, and their allocated AACs in the BDO Zone is 3.87 million m^3. Thus, it is expected that the wood processing facilities in the region use most of the harvested logs in the BDO Zone and that commercial quantities of low-grade logs would not be available for biorefinery projects. Contrast, pulpwood/low-grade logs are available for harvesting in the private forestlands. Some forest product processing facilities in Alberta rely on timber harvested from private

land to supplement or, at times, substitute their Crown fibre supplies, especially during the periods of high price or demand for forest products such as lumber and OSB.

No public data is available on the volume of harvested timbers from private forestlands in the BDO Zone. However, given the percentage of private forestlands presented in Table 6 in Appendix B, we assume that 15% of harvested timbers in private forestlands are supplied from the BDO Zone, resulting in a range of 118,650 and 557,250 m^3 over the period of 2000-2020. Like the conventional forest industry, biorefinery projects can secure a portion of their woody biomass demand from pulpwood or low-grade logs from forestlands in the BDO Zone. The amount of secured fiber by biorefinery projects depends on the price that these projects are willing to pay.

Overall, historical timber harvest levels by wood processing facilities, their production capacity, and their biomass supply and consumption in the BDO Zone indicate a low significant risk in potential feedstock sources for biorefinery projects in the region, targeting forest residues as the main feedstock.

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 out of 100.	**Score 9.99**

2.3. Competitor Pricing and Price Sensitivity

Rationale: Understanding how much competitors pay for different feedstock types is an essential step in determining the competitiveness of the Proponent.

Historical prices paid by competitors provide insight into their procurement behaviors and ability/willingness to pay premiums for feedstock and exert pressure on the Proponent's suppliers during times of feedstock shortage. Competitors who can offer higher prices for feedstock during feedstock shortages pose significant risks to Proponent.

Raw RI Score: Our analysis indicates that the average delivered cost for the assessed types of feedstocks within the BDO Zone (a supply radius of 120 km with an average transportation distance of 80 km) is approximately $71/bdt for forest residues, $121/bdt for pulpwood/low grade logs, and $60/bdt for urban wood waste (see Appendix B for more details on woody biomass pricing). Since the four sawmills in the BDO Zone use most of their residues for internal energy and have long-term relations with the local pulp mill, the biorefinery project likely will not receive access to sawmill residues. A portion of sawmill residues could become available to purchase. However, the biorefinery projects would have to offer prices higher than $60/bdt to secure a portion of the existing supply of sawmill residues from local sawmills. In contrast, forest residues are currently underutilized and the biorefinery projects could secure this fiber basket by creating business-to-business relationships with the tenure holders and by offering long-term supply and price agreements.	**Score 8**

The price of pulpwood/low grade logs are dynamic and depends on the local and regional demand for logs from pulp and sawmills. As previously discussed, we expect the main source of pulpwood/low-grade logs for biorefinery projects will be timbers from private forestlands. This biomass source will be the most expensive woody biomass for biorefinery projects as the delivery cost includes additional operations of felling the timber, skidding it to the roadside, and processing (deliming) it. Overall, given the historical supply and demand for woody biomass in the BDO Zone and the sources of woody biomass available for biorefinery projects, we see the material risk associated with existing wood processing facilities competing for sawmill residue and pulpwood. These facilities are well established and may be able to tolerate higher prices temporarily to exert pressure on new competitors. As a result, the risk of price competition for sawmill residues and Pulpwood/Low-grade logs is relatively high, particularly for new entrants to the market. In contrast, the risk of price competition for Forest residues is low as there is no established demand for forest residues in the BDO Zone. Raw RI Score is 8 out of 10.	
Notched Salience: The main source of woody biomass for biorefinery projects are forest residues which are currently underutilized and burned. In addition, the supply and demand for sawmill residues have reached a balance in the BDO Zone. We believe the risk related to competitors' potential tolerance for short-term price increases is mitigated by the large quantity of available feedstock underutilized and stable and predictable demand for woody biomass in the BDO Zone. Raw RI is notched down by 50%. Notched Salience is 4.0.	**Score 4.0**
Impact Level: RI Impact level is deemed *high*. There is a high degree of uncertainty related to the understanding of competitors' price sensitivity in the future due to the high dynamics of the forest industry and cyclic demands for major forest products.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 39.96 out of 100.	**Score 39.96**

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: Our analysis suggests that historically, certain pulp mills used an "all-or-nothing" tactic to influence sawmills to supply all their residues. Under this approach, pulp mills would pressure sawmills to make all their residues available at a relatively low price, threatening to cease buying from the sawmill altogether if they do not comply. However, we have not identified any evidence that the pulp mill in the region is currently using this approach to influence sawmill operations, suggesting the practice is dated. The pulp mill in the BDO Zone	**Score 5**

is co-located with a major sawmill, and they have a long-term business relationship. Furthermore, we note that this approach pertains only to sawmill residues, not pulpwood or forest residues.

Overall, we believe the risk associated with this historical "all-or-nothing" tactic is currently low for potential biorefinery projects in the BDO Zone. While this approach may have impacted the availability and pricing of sawmill residues in the past, it is not currently a significant factor affecting the feedstock supplies in the region.

That being said, there is a possibility that the "all-or-nothing" approach could be reintroduced in response to the entry of a new large biorefinery project into the market. As a result, we consider the risk of this tactic to be a moderate factor for potential biorefinery projects in the region. While we cannot predict with certainty whether this practice will be used in the future, we believe that it is important for potential investors to be aware of this risk and to consider strategies to mitigate its potential impact, especially since such practices have been historically used in the forest industry.

However, this approach does not apply to forest residues, as this feedstock source has been underutilized, and the current end users of woody biomass in the BDO Zone have been able to meet their demands exclusively using sawmill residues.

Raw RI Score is 5 out of 10.

Notched Salience: The risk related to the supply influence of competitors is mitigated by the large quantity of available and underutilized forest residues. Raw RI is notched down by 50%. Notched Salience is 2.5.	**Score 2.5**
Impact Level: RI Impact level is deemed *moderate*. Risks related to competitors' influence over suppliers are limited to sawmill residues, and do not affect pulpwood or forest residues.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 16.65 out of 100.	**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: Our analysis suggests that there are small and seasonal markets for wood fiber in the BDO Zone, including firewood, landscaping, and livestock bedding. While these markets do exist, we believe that they are relatively insignificant in comparison to the overall quantity of feedstock available in the region. In addition, due to the small size of these markets, they purchase woody biomass under short-term contracts and spot markets.	**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*. The large quantity of feedstock available renders any temporary market small in comparison.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

2.6. Demand for Competitors' Products

Rationale: Increased demand for competitor's 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 demands for feedstock.

Raw RI Score: Our analysis indicates that there are no indications of increasing demand or competition for the existing supply of woody biomass in the BDO Zone in the near future. As discussed before, the sawmill residues are the primary feedstocks being used by local sawmills, the pulp mill, and the two Cogen facilities.

Score 3

Although the wood pellet industry has grown recently in the province, newly established facilities have built in close proximity sawmills in the central and northwest regions of the province where commercial quantities of underutilized sawmill residues and low-grade logs are available. There are no operating and planned wood pellet projects in the BDO Zone.

However, the global demand for wood pellets is anticipated to only increase within the next decade, especially in Europe and East Asia. Additionally, major suppliers of wood pellets to the European market, such as Russia and Belarus, have been put on import bans, which are expected to remain into the near future due to the war in Ukraine. As the pellet industry is looking for underutilized and sustainable woody biomass, the BDO Zone can accommodate the commercial production of wood pellets, mainly from forest residues.

Production of biochar and biocoal from woody biomass are other solid biofuels and bioproducts being pursued in Canada. The technology to produce these products is relatively mature but their markets are still small and not well-developed. However, carbon credit markets are accelerating the production of biochar and biocoal for value-added markets such as wastewater treatments, fertilizers, and soil amendments.

The production of liquid and gaseous biofuels from woody biomass is still at the early stages of development but is expected to develop significantly over the next five to ten years. This is predominantly due high demands driven by airlines, marine shipping companies, and road transportation sectors. Although the demand for these fuels is high, whether they can be manufactured profitably at a commercial scale is still unproven.

Finally, Bioenergy with Carbon Capture and Storage (BECCS) is a new industry being co-developed alongside Sustainable Aviation Fuel (SAF), Renewable Diesel, and Green Hydrogen industries. Although the economic feasibility of commercial-scale BECCS operations remains unproven, the demand for carbon capture and resulting carbon credits is projected to increase over the next decade.

All these pathways have the potential to be developed in the BDO Zone, given the commercial quantities of woody biomass available in the region and the well-established logistics and supply chain infrastructure.

Currently there are no incentives provided by the provincial and local governments to encourage the use of forest residues and no competition from existing and emerging end users is expected to happen in the

near future. Therefore, pioneering biorefinery projects should be able to secure their woody biomass demand with minimal competition in the short and mid-terms. Raw RI Score is 3 out of 10.	
Notched Salience: No adjustment.	**Score 3.0**
Impact Level: RI Impact level is deemed *moderate*. Once immature technology pathways in particular the high-value bioproducts become commercial, the impact in the woody biomass supply chain in the BDO Zone is expected to be significant. However, the future facilities will locate their facilities based on the current competition and availability of woody biomass in the BDO Zone.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 19.98 out of 100.	**Score 19.98**

CATEGORY 3: SUPPLY CHAIN RISK

3.1. Feedstock Availability and 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 requirements. BAM is a strong indicator of supply chain resilience when stressed by supply shortage and/or supplier breach.	
Raw RI Score: Based on our assessment of the availability of feedstock in the BDO Zone, the total estimated woody biomass available for biorefinery projects is estimated to be in a range of 235,000-333,000 bdt (see Appendix B for more details) with the average amount of about 266,000 bdt. Depending on the final bio-product type, commercial-scale biorefinery projects usually need woody biomass supplies in the range of 50,000-200,000 bdt. Thus, the Biomass Availability Multiple (BAM) is estimated to be 1.7. This multiple is derived from the fact that, on average, the available feedstock of approximately 266,000 bdt/yr is 2.7 times larger than the required feedstock of 100,000 bdt/yr (BAM = (available-required)/required)). This level of feedstock redundancy indicates a low risk of feedstock shortage for the pioneer biorefinery project in the region. 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*. Feedstock redundancy, or BAM, is an important variable when assessing feedstock supply feasibility, and its level can impact the supply chain significantly.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 29.97 out of 100.	**Score 29.97**

3.2. Impact of Increased Utilization of Feedstock

Rationale: Feedstock utilization in the BDO Zone can change over time. Existing consumers of feedstock can expand operations or new facilities can enter the market. Increased utilization puts additional pressure on feedstock and can lead to higher prices, feedstock disruptions, shortages, or supplier breach.	
Raw RI Score: The major existing users of woody biomass in the BDO Zone are local sawmills and the pulp mill. The expansion of sawmill production capacity results in greater production of sawmill residues and	**Score 3**

forest residues. However, the increased production capacity of the pulp mill would result in higher demand for wood chips (for pulp production) and sawmill residues (for heat and power generation). Given the significant capital investment needed to expand the pulp production capacity and high uncertainties in global pulp demand and price, it is unlikely that the pulp mill in the BDO Zone expands its production capacity. Thus, no significant increase in woody biomass demand is expected by existing end users in the future.

The Biomass Availability Multiple (BAM) of 1.7 indicates enough room in the market for increased feedstock utilization without risking oversaturation or upward pressure on prices for the first few biorefinery projects. However, since the main source of underutilized woody biomass is forest residues, their increased utilization of forest residues forces the biorefinery projects to collect forest residues from large supply radius, increasing the transportation cost.

Notably, logs from private forestlands were not considered in the BAM calculation. This woody biomass can be available for biorefinery projects if these projects are willing to pay for higher price of logs compared to forest residues and sawmill residues. In addition, there has been a growing interest by local sawmills to secure wood fibres from private lands mainly due to more frequent forest fires in public lands. Although logs from private forest lands in general are more expensive than logs from the public lands, with the reduced fibre available on crown land, sawmills require to harvest this private wood to offset the fibre loss. So, the future bio-projects need to compete with the local sawmills to secure logs from private forest lands. In contrast, there is no such competition for forest residues from local wood processing facilities.

Raw RI Score is 3 out of 10.

Notched Salience: No adjustment.	**Score 3.0**
Impact Level: RI Impact level is deemed *moderate*. Although we demonstrate large feedstock availability, there is uncertainty around the actual scale of increased utilization of feedstock (more detailed discussion in provided in RI 2.6).	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 19.98 out of 100.	**Score 19.98**

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, leading to regional biomass supply imbalances and manifest in shortages and higher costs for Proponents.

Raw RI Score: The harvest season usually starts in September and winds down in March. There is sporadic harvest in summer time. As a result, the local wood processing facilities have established on-site log yards and off-site satellite storage yards to hold sufficient inventories for the time periods when forest cutblocks are not available for harvesting. The same inventory strategy needs to be developed by future biomass projects using forest residues. In addition, they need to coordinate with the logging companies and tenure holders to minimize interference with the logging operations while processing and transporting forest residues. **Score 8**

Raw RI Score is **8** out of 10.

Notched Salience: Sufficient inventory would help to mitigate most of the risk associated with delays in feedstock production brought on by seasonality. Raw RI Score is notched down by 25%. Notched Salience is 1.5.	**Score 6**
Impact Level: RI Impact level is deemed ***moderate***. We observed that seasonal variations in feedstock supply have not resulted in severe operational disturbances in the BDO Zone in the past and the forest industry has been able to deal with the seasonal access to the forest cutblocks by developing inventory regimes to run their facilities year-round. However, storing large quantities of forest residues would be more challenging than logs for future biomass projects.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 39.96 out of 100.	**Score 39.96**

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: Variation in sawmill residue production follows the variation in lumber production. Anecdotal evidence indicates that lumber production is historically stable and is expected to remain so in the short- to long term. Variation in forest residue generation follows the variation in roundwood harvesting. Between 2012 and 2021, timber harvest varied from 20.9 million m^3/yr to 26.3 million m^3/yr in Alberta. 2012 and 2013 were the years with the lowest timber harvest levels and the harvest level has been in a range of 23-26 million m^3 in the last five years (not a significant Year-to-Year variation). Although the timber harvest data are unavailable for the BDO Zone, based on our discussion with local sawmills, the production of both sawmill residues and forest residues has been relatively stable given the continuous operating conditions of the four sawmills in the BDO Zone. 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*. Given the uncertainties in forest product markets, climate conditions and the occurrence of natural disturbances, there is a degree of uncertainty in forest and sawmill residues year-to-year production variability.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 19.98 out of 100.	**Score 19.98**

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

Rationale: Feedstock supply models can be complex. A 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 are paramount to credible model outputs.	
Raw RI Score: Based on our research and feedback from industry experts, we believe that the risk of inaccuracies in woody biomass availability estimates is low, as they are derived using the approved AAC volumes by the Government of Alberta (publicly available Forest Management Agreements Documents),	**Score 5**

the production capacity of the local wood processing facilities and the existing end users validated through the published reports and conversations with local sawmills and experts. However, there is a degree of risk associated with forest residue availability estimates due to their reliance on tree species, location, size of cutblocks, and capture rate assumptions, which may not fully account for variables such as topography, road network, and harvesting practices. Raw RI Score is 5 out of 10.	
Notched Salience: We have taken a scenario analysis approach in our BDO Zone assessment by estimating the woody biomass availability for three scenarios of "highest potential of available woody biomass," "average available woody biomass" and "lowest potential of available woody biomass." Such a scenario analysis allows us to estimate a range of available woody biomass rather than a fixed amount. Additionally, this approach mitigates risks associated with using broad assumptions that may be too optimistic or pessimistic, ensuring that our assessment reflects a range of possible scenarios for the availability of woody biomass. As well, the differences between the availability of woody biomass among these scenarios help the biorefinery projects understand the possible variation in the availability of underutilized woody biomass resources in the BDO Zone. Raw RI is notched down by 50%. Notched Salience is 2.5.	**Score 2.5**
Impact Level: RI Impact level is deemed *high*. Because some of our conclusions in this assessment are based on woody biomass availability modelling, errors in our assumptions can have significant impacts on supply chain risk.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 29.97 out of 100.	**Score 24.98**

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 supplies, especially early on.	
Raw RI Score: Sawmill residues and logs have a long history of extensive utilization in the BDO Zone, spanning over several decades. Therefore, from a historical demand perspective, there is no significant risk associated with these feedstock types. However, forest residues have not traditionally been utilized in large quantities, making the risks associated with this risk indicator moderate. Raw RI Score is 5 out of 10.	**Score 5**
Notched Salience: As the main source of underutilized woody biomass in the BDO Zone is forest residues which historically have been burned at the roadside of cutblocks, we expect it will take a few years for the biorefinery to establish the logistics network for commercial collection, processing, and transportation of forest residues. However, we expect that the biorefinery should be able to meet the demands of its facility during the commissioning phase using forest residues available within the close proximity of the facility. This supply can be enhanced by working with logging companies that already have loading, grinding and transportation equipment, while tandemly collaborating with local logging and logistics companies to establish the supply chains for forest residues. Raw RI is notched down by 25%. Notched Salience is 3.75.	**Score 3.75**
Impact Level: RI Impact level is deemed *high*. The lack of historical demand for forest residues in the BDO Zone suggests a potential lack of experience and expertise within the supply chain. This factor could have a significant impact on the overall supply chain.	**Score 9.99**

Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 37.46 out of 100.	**Score 37.46**

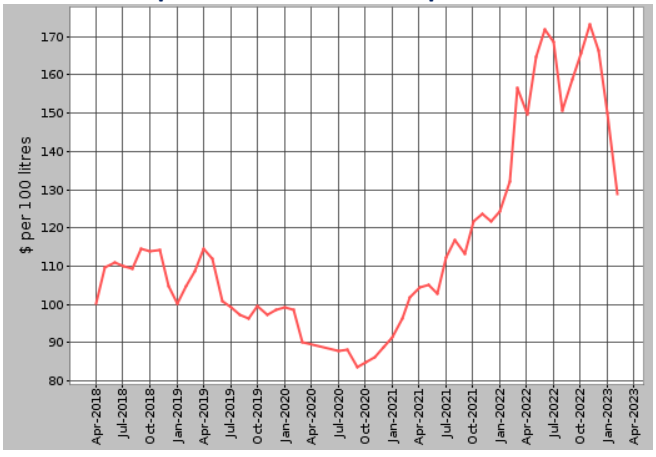
3.7. History of Production/Feedstock is a Secondary Crop or a Byproduct

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: Sawmill residues, pulpwood/low-grade logs, and forest residues have been generated as a by-product of timber logging and sawmilling operations for decades in the BDO Zone. We do not anticipate any risks related to this RI. 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 out of 100.	**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: Figure 2 shows historical diesel prices between 2018 and 2023 published by the Government of Alberta. This figure indicates that diesel prices are volatile and hard to predict, especially considering recent global events, including the pandemic and high inflation. Diesel prices are currently on a slight downward slope and are stabilizing after peaking in the summer and fall of 2022.	**Score 8**

Figure 2. Diesel price in Alberta in the period of 2018-2023[1].



[1] https://www.agric.gov.ab.ca/app21/rtw/surveyprices/graph.jsp?groupId=6&dataId=56

Transportation companies add a fuel surcharge to their trucking cost (truckload cost × (1+fuel surcharge)). The surcharge fuel cost increased from 15% in late 2020 to 46% in late 2022, resulting in a $4-8/bdt increase in biomass transportation costs for a range of 50km-200km.

Fuel prices also impact other logistics operations, including loading and grinding. These operations also use diesel as a fuel source and may need equipment to be transported to forest cutblocks using flatbed trucks. This fuel price volatility and increase can significantly impact the long-term financial performance of a biorefinery project with small profit margins.

Raw RI Score is 8 out of 10.

Notched Salience: Some of the risks associated with volatile fuel prices could be mitigated by engaging in, and favoring, contracts with suppliers closer to the biorefinery site and by optimizing the transportation of forest residues from forest cutblocks to the gate of the biorefinery. Raw RI Score is notched down by 25%. Notched Salience is 6.0.	**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 out of 100.	**Score 39.96**

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: The supply chain in the BDO Zone benefits from established and robust harvest, collection, and scheduling practices. Tenure holders have implemented standard procedures for forest management practices and timber harvest. However, the commercial collection, processing, and transportation of forest residues will be a new practice in the BDO Zone. Therefore, the development of close collaboration and coordination between the biorefinery project and the tenure holders will be essential in assuring that the harvest times of the forest residues do not interfere with the harvest, collection, and transportation of sawlogs and the post-harvest operations such as, preparing the cutblocks for replanting before access roads close. In addition, weather conditions can impact access to the forest cutblocks.	**Score 6**

Raw RI Score is 6 out of 10.

Notched Salience: Maintaining a sufficient feedstock inventory will mitigate the risk of feedstock shortages caused by unforeseen factors such as inclement weather or extended periods of impassable roads. In addition, the forest industry in Western Canada has shown the capability and interest to work with the end users of forest residues, such as the wood pellet industry to schedule forest residue collection and processing at the roadside of cutblocks and, to access the roads to transport processed forest residues to the end user sites. Raw RI Score is notched down by 50%. 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 out of 100.	**Score 19.98**

3.10. Harvesting & Collection Equipment

Rationale: Different types of harvesting and collection equipment used 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. The type of equipment should be specified for the sake of product consistency and risk reduction.	
Raw RI Score: The logistics equipment used for sawmill residues and low-grade logs in the BDO Zone adheres to industry standards. Additionally, established silviculture practices and the presence of numerous professional harvesters indicate that substandard or improper equipment is unlikely to be used. However, suppliers may need to invest in new equipment to accommodate the production of forest residues. Such new pieces of equipment are commercially available and used by the secondary wood processing facilities such as the pulp and paper mills, the wood pellet industry, and Cogen plants in Canada. 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 out of 100.	**Score 6.66**

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: The supply and demand for sawmill residues and low-grade logs have reached a balanced point and significant changes in the supply-demand equilibrium in the BDO Zone for these biomass resources have not been observed in years. In addition, the forest residues have been treated as a waste and are often piled and burned at the roadside of cutblocks as there has been no recent demand for forest residues in the BDO Zone. We have not identified any other temporary externality-driven markets for sawmill residues, forest residues, or pulpwood/low-grade logs feedstocks that can drive feedstock demand (and cost) in unusual circumstances. It is noted that there are small and seasonal markets for wood fiber in the BDO Zone, including firewood, landscaping, and livestock bedding. While these markets do exist, they are insignificant in comparison to the overall quantity of feedstock available regionally. In addition, due to the small size of these markets, they purchase woody biomass under short-term contracts and spot markets. 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 out of 100.	**Score 6.66**

3.12. Variations 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: Although the quality of feedstock can vary depending on the source and stage of processing, harvesting and collection methods are generally industry standard. However, commercial handling, grinding, and transportation of forest residues need the development of standard procedures in the BDO Zone to minimize the introduction of contamination in the delivered feedstocks and the variation in their physical properties (such as moisture content, particle size distribution, etc.). Raw RI Score is 6 out of 10.	**Score 6**
Notched Salience: The end users of forest residues such as Cogen facilities and pellet plants in other parts of Canada have been able to improve the operational efficiency and quality of forest residues delivered to their facilities. In addition, FPInnovations has worked closely with the forest industry to develop Best Management Practices for piling, handling, grinding, and transporting forest residues which can be used as guidelines for the collection, processing, and transportation of forest residues in the BDO Zone. Raw RI Score is notched down by 50%. Notched Salience is 3.0.	**Score 3.0**
Impact Level: RI Impact level is deemed *moderate*. There is no established experience with commercial collection, processing, and transportation of logging residues.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 19.98 out of 100.	**Score 19.98**

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 with large feedstock requirements, or require the development of new (or expanded) supply chains and enhanced local labor forces.	
Raw RI Score: With the presence of established oil and gas, agriculture, and forest industries, the BDO Zone has skilled a workforce ready to support future biorefinery projects. Moreover, forest industry has never experienced serious issues accessing the required workforce for logging and transportation. It is noteworthy that Northwestern Polytechnic is a highly regarded educational institution by the industry and it has been working closely with the oil and gas, agriculture, and forestry industries to train their required workforce. Northwestern Polytechnic also has continuing education courses to support the development of hands-on skills that industry employees need. The region has established road and air transportation networks for labor mobility. In addition, the county of Grande Prairie and MD of Greenview have designated programs and staff to welcome new incomers/immigrants settle in the region.	**Score 6**

That being said, the main workforce posing a challenge for future biorefineries is truck drivers due to the significant importance of on-time delivery of logs from forest cutblocks to the sawmills. For a tenure holder to enter an arrangement for future biorefineries to access forest residues, they will typically want to see the biorefinery resources its trucks/drivers without dipping into the existing pool of contractors to the point that it may impact their own operations. Raw RI Score is 6 out of 10.	
Notched Salience: With the massive closures/curtailments in the forest industry in the neighboring province, British Columbia (BC), and continuous reduction in the AAC volumes in the next 10 years in BC, we believe that the biorefinery projects should be able to secure the skilled labors they need to run and operate their biomass supply chains. In addition, competitive wages, good working conditions, and other regional economic benefits should secure an adequate workforce. Raw RI Score is notched by 50%. 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 out of 100.	**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: Transportation costs for woody biomass feedstocks are primarily driven by fuel, distance, and labor costs. Fuel costs have experienced a considerable upsurge in 2022 (the surcharge fuel cost has increased from 15% in late 2020 to as high as 40% in late 2022, as discussed in RI 3.8). The surcharge fuel cost increased from 15% in late 2020 to as high as 46% in late 2022, resulting in a $4-8/bdt increase in biomass transportation costs for a range of 50km-200km. The surcharge fuel cost increased from 15% in late 2020 to as high as 46% in late 2022, resulted in $4-8/bdt increase in the cost of biomass transportation for a range of 50km-200km. Transportation costs are estimated to be $0.24/bdt/loaded km for sawmill residues and 0.33/bdt/loaded km for forest residues. This estimate is based on analysis conducted by FPInnovations as well as verbal indications from wood pellet companies using both sawmill and forest residues as feedstock for wood pellet production. Thus, each 10-km increase in the transportation cost would add $2.4/bdt and $3.3/dt to the delivery cost of sawmill residues and forest residues, respectively. This fuel price volatility and increase in transportation costs can significantly impact the long-term financial performance of a biorefinery project with small profit margins. Figure 22, Figure 23, and Figure 24 in Appendix B, show the cost-supply curves for three scenarios considered in this report. These figures indicate that the marginal transportation cost is not significant for forest residues in the BDO Zone. However, since we did not have access to the exact locations of cutblocks where forest residues will be available and the road network, the feedstock transportation costs may be higher than our calculations.	**Score 7**

Raw RI Score is 7 out of 10.	
Notched Salience: A new biorefinery project can optimize the transportation costs when the locations of cutblocks are determined. In addition, close collaborations with the tenure holders, local logging, and transportation companies can help the biorefinery project to reduce the transportation costs of forest residues, a trend that has been observed by the growing wood pellet sector in Western Canada. Furthermore, the abundance of forest residues within 120km supply radius justifies this approach and would help mitigate potential supply chain risks associated with transportation costs. Raw RI Score is notched down by 25%. Notched Salience is 5.25.	**Score 5.25**
Impact Level: RI Impact level is deemed *moderate*. This is due to the uncertainties on the locations of cutblocks where forest residues will be available.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 34.97 out of 100.	**Score 34.97**

3.15. Transportation Distances

Rationale: Transport distances of 80-100 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. Understanding average transport distance can help flag higher-risk suppliers where transport distance materially exceeds the average.	
Raw RI Score: Based on data presented in Appendix B, commercial quantities of underutilized woody biomass are available within 120 km supply radius with no foreseen competition from existing woody biomass end users in the BDO Zone. It should be noted that some end users such as the pulp and paper mills can afford to pay for woody biomass from distances larger than the typical transportation distances. However, the pulp and paper mills within the competition zone (240 km) have been able to secure their fiber demand and we do not see a competition between the new biorefinery projects and the regional pulp and paper mills to tap into forest residues as they will likely use different woody biomass types. Raw RI Score is 4 out of 10.	**Score 4**
Notched Salience: Based on the commercial availability of feedstock in the BDO Zone, the Proponent can limit their supply basin to the closest forest cutblocks and suppliers depending on their annual biomass demand. This approach reduces the risk of high transportation costs and other supply chain risks. Raw RI Score is notched 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 out of 100.	**Score 19.98**

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: Given the well-established forestry and wood processing industry in the BDO Zone, it is highly likely that the equipment used is standardized and well-established. The nature of feedstocks hauled has remained consistent over the past several years, further indicating standardization of equipment. Open-top and live-bottom trailers are the most commonly used trailers to transport feedstock, while dump trucks, which can transport smaller volumes and are more prone to breakdowns, are used only when other trailer types are unavailable. Facilities accepting feedstock transported by live-bottom or dump trailers do not require a self-unloading ramp, providing a potential advantage. However, these trucks have been mainly used for the transportation of sawmill residues on well-maintained roads in industrial and urban areas and highways. These trucks are not built for rough forest roads to transport forest residues and they will have challenges to access to some harvesting sites in the region, without significant additional costs. Raw RI Score is 8 out of 10.	**Score 8**
Notched Salience: A well coordination between tenure holders, logging companies and the end users of forest residues is critical to improve transportation practices for forest residues. Such collaboration and coordination have already been established between Cogen and pellet plants with the tenure holders and logging companies and these sectors have been able to process and transport commercial quantities of forest residues in Western Canada by using dry chip vans and B-train trucks. The use of these trucks needs to be tested and proved in the supply zone. Raw RI Score is notched by 25%. Notched Salience is 6.	**Score 6.0**
Impact Level: RI Impact level is deemed ***moderate***. Although the dry chip vans and B-train trucks have been used successfully for the transportation of forest residues in other regions, this still needs to be examined and proved in the supply zone based on the available forest roads.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 39.96 out of 100.	**Score 39.96**

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 forestry and wood industry has been a prominent sector in the BDO Zone for several decades, with multiple generations of the workforce employed in the sector. This has resulted in well-established and accepted delivery routes that are integral to the local communities in the BDO Zone. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustment.	**Score 1.0**
Impact Level: RI Impact level is deemed ***moderate***. Depending on the size and location of the biorefinery project, biomass transportation can have negative impact on the local traffic and safety.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**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: Considering the volume and mass of timber currently transported in the BDO Zone, we deem it highly unlikely that transportation regulations could hinder feedstock acquisition or transportation. 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 out of 100.	**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: Logs and sawmill residues have been transported in the BDO Zone for decades and we believe that the road network in the BDO Zone is sufficient to support the forestry and wood industry sectors and biorefinery projects. The existing wood processing facilities are located near major highways that provide access to other regional destinations. These facilities have also established road networks in the timberlands to transport harvested timbers in cost-efficient manners. In our discussion with local sawmills and other experts, road infrastructure was not considered a limiting factor for the development of biorefinery projects in the BDO Zone due to the presence of established oil and gas, agriculture, and forest industries. 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*. Since the main source of biomass is forest residues, the existing road infrastructure in forest cutblocks may not be able to accommodate the truck traffic depending on the annual demand of biomass from the biorefinery.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 13.32 out of 100.	**Score 13.32**

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

Rationale: In general, a portfolio of multiple suppliers of various sizes is important for ensuring a 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: There are four large-scale sawmills in the BDO Zone with a total capacity of processing 3.83 million m^3 of logs (See Table 4 in Appendix B). These facilities have been in operation for decades and are among the most competitive in Canada. They also server as one of the region's top industrial employers, employing over 1,100 people including the pulp mill. These sawmills are the primary suppliers of both sawmill residues and forest residues in the BDO Zone. Additionally, these facilities have experienced a low volatility in the Annual Allowable Cuts (AAC) and have been able to secure their fiber demands at affordable costs, which has resulted in a steady state of the forest industry in the BDO Zone. Despite the small number of the sawmills in the BDO Zone, we believe their strong operating and economic status will support the development of biorefinery projects in the BDO Zone. 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 out of 100.	**Score 9.99**

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 (sawmills) in the BDO Zone are exposed to common external risks. Economic conditions have significant impacts on the performance of the forest products industry, with the industry performing better than the overall economy during good times and worse during bad times. Solid wood products, such as softwood lumber, are crucial raw materials for new construction and are closely linked to the housing market. Similarly, wood furniture, particularly wood cabinets, is closely tied to the housing market, while packaging materials like corrugated boxes, bags, and fiber drums depend on finished goods shipments. As a result, the pulp and paper sector closely track the overall economy. Logging in the BDO Zone is also subject to macroeconomic factors such as the housing market. Downturns in the market can threaten sawmill viability, which in turn, can impact the harvest of sawtimber and forest residues. As mentioned before, contrary to the experience in many other jurisdictions, no major Alberta Forest product mills closed permanently in recent years. Curtailment-related activity in Alberta over the past decade has almost always been rail-related (lack of rail cars or issues at the ports in B.C. – with an outsized	**Score 7**

impact on pulp/OSB operators that tend to be more rail-dependent). There are regional fiber constraints, but overall, Alberta is a low-cost market to operate in and mills tend to remain operational even when prices are depressed and utilization rates fall. The four sawmills in the BDO Zone have been in good economic and operational conditions for decades. In addition, natural disasters such as forest fires and insect epidemics have not had significant impact on the AAC volumes and wood fibre access for the tenure holders in the BDO Zone. However, the sawmill closures and curtailments are always a risk for the end users of sawmill residues and forest residues. Raw RI Score is 7 out of 10.	
Notched Salience: This risk indicator is mitigated by the abundance of feedstock supply in the BDO Zone. In addition, with a proper inventory strategy, the biorefinery project can mitigate the risk of fiber shortages during temporary sawmill shutdowns and curtailments. The biorefinery projects can also meet their biomass demands from the private forestlands during temporary fibre shortages. This calls for the development of a flexible fibre strategy by the biorefinery. For this reason, Raw RI Score is notched down by 50%. Notched Salience is 3.5.	**Score 3.5**
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 34.96 out of 100.	**Score 34.96**

3.22. Seasonal Weather Impacts on Feedstock Supply

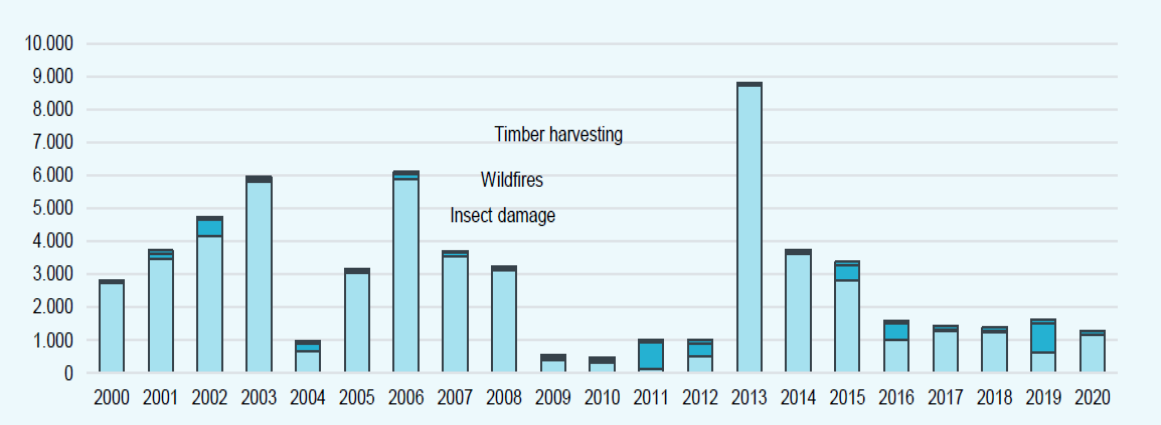
Rationale: Seasonal weather impacts are defined as deriving from natural weather variations (e.g., spring thaws, rainy seasons, or dry seasons) as opposed to singular weather events (like fires, droughts, or hurricanes). Seasonal weather changes can be a significant risk factor affecting feedstock availability, quality, and price.	
Raw RI Score: In the BDO Zone region, temporary disruptions may occur during periods of heavy rain or snowfall, making it difficult for fiber producers to clear trees from timberland, causing dirt roads to become impassable. As a result, all sources of feedstock production may experience variations. However, generally such disruptions are usually temporary and typically do not last more than a few weeks. Moreover, seasonal delays in forest residues and pulpwood generation, especially in the spring, are also possible in the region. Raw RI Score is 4 out of 10.	**Score 4**
Notched Salience: Since seasonal delays typically last days or weeks, having a modest but well-maintained feedstock reserve on site would significantly reduce the risk. Raw RI Score is notched by 50%. Notched Salience is 2.	**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 out of 100.	**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: Disturbance is essential to forest health and regeneration, although it can pose challenges to tenure holders and communities. Wildfires and insect damage are the primary sources of natural disturbance and cause significantly more temporary forest loss than timber harvesting. Figure 3, below shows the disturbances caused by insect damage, forest fires, and timber harvesting in Alberta. As shown in this figure, forest area impacted by natural disturbance can vary greatly from year-to-year. However, the damage caused by wildfires has been insignificant and the insect damage by mountain pine beetle (MPB) infestations in Alberta is very small compared to BC. The total cumulative affected areas by MPB were over 18 million hectares in BC compared to about 2.4 million hectares of Alberta Forest.**Figure 3. Disturbed areas, by type of disturbance from 2000 to 2020 (hectares ×1000).**

Score 5



Insect damages and wildfires are the primary sources of disturbance in Alberta Forests. Although both forest fires and insect damages have not been significant in the BDO Zone to date, these natural disturbances always threaten the wood fibre basket in the BDO Zone, as witnessed in May 2023.

Raw RI Score is 5 out of 10.

Notched Salience: The risk is mitigated by the sheer volume and size of the available forest resource. In addition, the provincial and local governments have developed preventative and action plans such as FireSmart and outreach events to minimize the likelihood and impact of forest fires and insect damages in the BDO Zone. Raw RI is notched down by 25%. Notched Salience is 3.75. **Score 3.75**

Impact Level: RI Impact level is deemed *high*. There is a great deal of uncertainty related to climate change and its effect on the BDO Zone. **Score 9.99**

Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 37.46 out of 100. **Score 37.46**

3.24. Government Subsidies for Feedstock Production or Utilization

Rationale: Feedstock that is directly subsidized through government programs can pose greater long-term risk than feedstock that is not. Subsidies may be subject to amendment or repeal, sometimes with minimal notice.

NOTE: 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: During discussions with the provincial and local governments and forest companies and associations, they stated that there are currently no government subsidies available to incentivize the use of woody biomass in the BDO Zone. Therefore, suppliers do not depend on government funding to produce feedstock. 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 out of 100.	**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, 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: The forest lands in the MD of Greenview and County of Grande Prairie BDO Zone are primarily under provincial ownership and are managed by the Forestry Division of the Government of Alberta, with some federally managed areas and private lands. The provincial government owns all timber located on provincial public 'Crown' lands. It allocates timbers and provides rights regarding that Crown timber to the tenure holders, such as wood processing facilities (e.g., sawmills and pulp and paper plants), and requires an approved forest management plan to be in place before any timber can be harvested. The timber allocation is managed through a forest management agreement (FMA), a long-term (up to 20 years), renewable, area-based form of forest tenure. It is the most secure tenure type of tenure in Alberta. Through the FMA, a company is given certain rights, including the right to establish, grow, harvest, and remove Crown timber. These rights are granted in exchange for various responsibilities such as forest management planning and the creation and maintenance of the forest inventory within the boundary of the FMA. Long-term FMAs provide fiber security and the sustainable harvesting of timbers on provincial lands for tenure holders. Potentially, FMAs can also be requested and secured by the biorefinery projects if they can afford to pay for timbers, and the harvested timbers are used for high-value products such as biochemicals and biomaterials.	**Score 1**

Overall, the current regulations and permits to harvest timbers are not considered a risk for biorefinery projects to access underutilized woody biomass resources. 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 out of 100.	**Score 3.33**

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

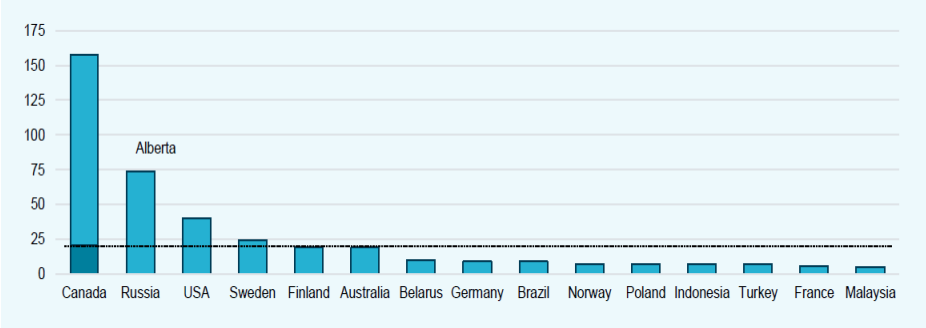
Rationale: Public backlash against biomass development in the Proponent region can directly impact Proponent's ability to procure, transport, trans-load, store, or utilize feedstock by affecting local policies, regulations, and Proponent's ability to obtain necessary permitting.	
Raw RI Score: We have not found any evidence of negative public perception or opposition towards the wood products industry in the BDO Zone. As the industry has been established in the region for a significant period, we anticipate that the local population will be supportive of any new biorefinery project. In fact, we believe that such a project will be welcomed and seen as a positive development for the community. 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 out of 100.	**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: Alongside Alberta's rigorous forest management regime, certification supports the province's reputation as a source of forest products from sustainably-manufactured forests. In Alberta,	**Score 1**

the certified forest area has expanded from two million hectares in 2000 to just under 21 million hectares in 2021. This means that the province of Alberta has more sustainable forest management ("SFM") certified forest area than most countries, as shown in Figure 4. Over 80% of Alberta's Forest lands with long-term tenure rights are third-party certified.

Figure 4. SFM-certified forest area by country in 2021 (hectares x 1,000,000).



The province of Alberta has more sustainable forest management certified forest area than most countries.

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 out of 100.	**Score 3.33**

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's claims of carbon neutrality for biomass projects. Carbon emissions from harvested soils and from harvesting machinery or delivery trucks can make it difficult to achieve 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: Given the sustainable harvest and forest management practices on the provincial lands in the BDO Zone and the fact that the biorefinery projects will mainly use underutilized forest residues as feedstock, the total GHG emissions emitted from the biomass logistics and the final bio-based products are expected to result in significant GHG emissions compared to the fossil fuels that the bio-based product will replace – for example, using woody biomass for heat and power generation to replace fossil fuels such as coal and heating oil results in up to 85% reduction in GHG emissions. In addition, incomplete combustion of forest residues piles in the open air generates abundant greenhouse gases such as CO2 CH4, N2O, etc. Burning a tone of forest residues generates about 250 kg	**Score 1**

CO2e of GHG emissions (about 15 gCOe/MJ) (Source: GHGenius LCA Model, 2022). The GHG emissions avoided from slash burning can be claimed as carbon credits by the biorefinery project that is using forest residues as feedstock. 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 out of 100.	**Score 3.33**

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: Geographic location within the BDO Zone does not impact feedstock variability. While topographic variation exists throughout the forests in the Zone, it is not expected to impact the current heterogeneity of the feedstock categories. Also, the robustness of new biomass feedstock utilization systems can compensate for potential quality inconsistencies. 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 out of 100.	**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: Scaling up the supply chain equipment in the BDO Zone for potential biorefinery projects utilizing forest residue feedstock would require significant capital investments from potential suppliers. The scaling-up process would mainly involve acquiring processing equipment, such as grinders and chippers, rather than transportation and loading equipment, as the hauling capacity in the region is robust. Equipment scale-up is not a significant risk for sawmill residues or Pulpwood/Low-grade logs supply. Raw RI Score is 6 out of 10.	**Score 6**
Notched Salience: A biorefinery project that plans to utilize forest residues needs to work closely with tenure holders and the local logging and logistics companies at the early stage of the project to establish the know-how to collect, process and transport commercial quantities of forest residues in cost-efficient manners. In the meantime, we expect the biorefinery project to negotiate with the sawmills to secure a	**Score 3.0**

portion of their residues and for the private forest land owners to purchase logs from them if they can afford to pay for them. As the supply chain expands, the risks associated with the scale-up of forest residue production equipment will decrease. Raw RI Score is notched down by 50%. Notched Salience is 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 out of 100.	**Score 19.98**

CATEGORY 4.0: INFRASTRUCTURE RISKS

4.1 RISK FACTOR: PHYSICAL INFRASTRUCTURE

4.1.1. Land Parcel

Raw RI Score: The MD of Greenview and the County of Grande Prairie have strategically positioned real estate assets, providing ample options for industrial development across diverse parcel sizes within established industrial parks. A key focus is the Greenview Industrial Gateway (GIG), a notable asset managed by the MD of Greenview, that spans a generous 2000 acres (or 809 hectares) and is strategically located in the Montney Natural Gas deposit, within Greenview's jurisdiction and 40 km south of Grande Prairie, AB. Our assessment will primarily concentrate on the potential of this site. The County of Grande Prairie also offers other noteworthy sites for industrial expansion, further broadening the range of possibilities. Notably, Big Mountain Industrial Park is a unique space providing 43.7 hectares and the added advantage of a nearby rail line facility. For a detailed exploration of the Grande Prairie site, please refer to Appendix C, where we have provided an evaluation and data breakdown. 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 out of 100.	**Score 3.33**

4.1.2. City Ownership

Raw RI Score: The Greenview Industrial Gateway (GIG) is currently in the conclusive phase of transferring land titles to the MD of Greenview, with the transaction expected to reach completion by the end of June 2023. Regarding the industrial sites mentioned previously, the majority of these are under the ownership of the City of Grande Prairie. It should be noted, that a significant portion of these industrial parks are also composed of privately-owned properties, offering a diverse and dynamic landscape for industrial development.	**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 out of 100.	**Score 3.33**

4.1.3. Industrial Land Use Zone

Raw RI Score: Approved land use and zoning within existing industrial parks is in place for light, medium and heavy industrial development. 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 out of 100.	**Score 3.33**

4.1.4. Natural Gas Line

Raw RI Score: Within the jurisdiction of the MD of Greenview, the industrial sites enjoy the strategic advantage of being near two gas plants, namely, CNRL and ARC Resources. This can potentially enhance the operational efficiency and cost-effectiveness for businesses located in these areas. In the County of Grande Prairie, ATCO emerges as the predominant provider of new natural gas installations. However, the market is further diversified by the presence of other players like Direct Energy, Enmax, and JustEnergy, all of whom extend natural gas services within this region. It is imperative to note that the capacity of natural gas supply to the industrial park needs to be verified to ensure it meets the operational requirements of the businesses situated there. 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 out of 100.	**Score 6.66**

4.1.5. Electrical

Raw RI Score: In the County of Grande Prairie, ATCO leads the market as the main supplier of new power installations. However, the energy ecosystem is also enriched by the services of other providers, including Direct Energy, Enmax, and JustEnergy, who also offer competitive power installation services. Within the MD of Greenview's jurisdiction, ATCO Electric is tasked with coordinating the distribution and servicing of	**Score 2**

electrical utilities. It is crucial, however, to ascertain the capacity of the power supply to the industrial park, ensuring it adequately meets the demands of businesses operating within the space.

Of particular interest is the presence of an ATCO Electric 100 KV power line on-site at the Greenview Industrial Gateway (GIG). In addition, GIG boasts direct access to the TC Energy Main Distribution Line, located a mere 650 meters away. These factors significantly bolster the infrastructural robustness of the site.

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 out of 100.	**Score 6.66**

4.1.6. Fresh Water Supply

Raw RI Score: The MD of Greenview oversees an impressive water infrastructure comprising of four water treatment plants. These facilities ensure a reliable water supply to the communities of DeBolt, Ridge Valley, Little Smoky, and Grande Cache via their established distribution networks. The system is further supported by six Water Points/Truck Fills and four Non-Potable Sites. The water mains under the jurisdiction of the MD of Greenview span an extensive total length of 57.47 km. Regarding potable water supply, it is important to note that lot owners will be individually accountable for their water provisions. Any prospective drilling activities for water wells will necessitate licensing, in compliance with the stipulations laid out in the Alberta Water Act. 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 out of 100.	**Score 6.66**

4.1.7. Sewage Disposal Trunk Line

Raw RI Score: The Municipal District of Greenview has a robust wastewater management infrastructure. This includes one sewer treatment facility in Grande Cache, six wastewater treatment lagoons, and five wastewater collection systems. The district's wastewater main network extends over a significant distance, totaling 69.58 kilometers. Furthermore, it is mandatory for industrial entities within the district which produce contaminants not deemed acceptable to undergo a pretreatment process for such waste before effluent 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 out of 100.	**Score 6.66**

4.1.8. Drainage and Stormwater Management

Raw RI Score: The Greenview Industrial Gateway, like other regional industrial sites, is expected to prioritize the implementation of a robust and efficient drainage and stormwater management system. Given the Municipal District of Greenview's commitment to infrastructure development, a high-standard drainage system, similar to its comprehensive wastewater management system, is essential for the Greenview Industrial Gateway. This may include water flow through ditches along an internal access road, leading to a dedicated management pond in the northeast corner of the property, ensuring effective surface water management. 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 out of 100.	**Score 6.66**

4.1.9. Available ICT (Information & Communication Technology) Services

Raw RI Score: The Greenview Industrial Gateway is designed with a robust Information and Communication Technology (ICT) infrastructure to support its operations. It maintains high-speed internet connectivity, essential for various functions such as machinery control, data analysis, and internal communications. The major fiber optics channel runs alongside Highway 43 towards Edmonton and can sustain 100/Gbps. Telecommunication towers are lacking in areas adjacent to Greenview, which can present challenges to residents more removed from the municipality. Additionally, the area has the potential for substantial data handling and storage capabilities. 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 out of 100.	**Score 6.66**

4.1.10. Infrastructure – Landfill/Alternative Markets for Waste Disposal

Raw RI Score: The Greenview Regional Landfill annually processes up to 10,000 tonnes of non-hazardous waste, facilitated by thirteen strategically located transfer stations. This region boasts experienced infrastructure for managing large-scale operations and their waste streams effectively, a valuable asset for potential biomass-dependent projects such as biorefineries. Nearby disposal sites serve the industrial areas, with industries responsible for their waste disposal. Solid waste facilities in Grande Prairie County, including the Clairmont Centre for Recycling & Waste Management and West Grande Prairie Regional Landfill, manage most waste types, except plastics and Styrofoam. In Grande Cache, the Greenview Regional Waste Management Commission operates two landfills accepting residential and select commercial waste. 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 out of 100.	**Score 3.33**

4.2 Risk Factor: Logistics

4.2.1. Road and Highway Access and Intersection

Raw RI Score: The strategic location of Greenview's MD boasts connectivity via key thoroughfares including Highways 40, 43, and 49. These roadways facilitate accessible transportation, situating Greenview just two hours from Jasper, two and a half hours from Edmonton, and five hours from Calgary. Adding to its logistical advantage, Greenview also sits on the crucial CANAMEX Trade Corridor. This pivotal provincial highway network serves as a significant commercial conduit, seamlessly connecting local enterprises with major markets throughout the United States and Mexico. 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 out of 100.	**Score 3.33**

4.2.2. Ocean/River Access

Raw RI Score: As the County of Grande Prairie and the MD of Greenview are landlocked in Alberta, immediate waterway access challenges could affect certain logistic operations. However, these regions possess a strategic advantage in their connectivity to crucial seaports in Kitimat, Vancouver, and Prince Rupert, within British Columbia, approximately 1,200 km and 1,400 km away, respectively. These ports serve as important conduits to international trade networks, offsetting the potential disadvantage of	**Score 8**

being landlocked. While the distance from these seaports presents logistical hurdles, the opportunities they provide for global trade connectivity underscore the potential for economic development and business growth in these regions.

Raw RI Score is 8 out of 10.

Notched Salience: Trucking, rail or intermodal transportation could be considered for overseas transportation of goods. Also, full rail capacity by CN Rail provides an efficient transportation route to the ports of Kitimat, Prince Rupert, Vancouver, and the Asian market. Hence, notched at 50%.	**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 out of 100.	**Score 26.64**

4.2.3. Railway Service

Raw RI Score: The Grande Prairie Station is a significant rail hub in the region, equipped with an expansive network of railway routes that facilitate freight and passenger transportation. This network, operated primarily by Canadian National (CN) and partially by Canadian Pacific (CP), expands the station's reach in all cardinal directions. To the west, CN operates a primary line stretching from Grande Prairie Station to Dawson Creek in British Columbia, extending further to Prince George. Both CN and CP maintain principal lines heading south from Grande Prairie Station, targeting key metropolitan centers such as Edmonton and Calgary. CN also manages an eastward line that connects Grande Prairie Station to Saskatoon in Saskatchewan, further extending its reach to Winnipeg in Manitoba. Northbound, a rail line under CN's operation links Grande Prairie Station with Hay River in the Northwest Territories, continuing onwards to Yellowknife. Furthermore, Canada's comprehensive rail network effectively ties Greenview's commodity sectors to the critical seaports of Kitimat, Prince Rupert, and Vancouver. This strategic connectivity offers compelling opportunities for the movement of goods, underscoring the region's potential as a robust logistics and trade platform.	**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 out of 100.	**Score 3.33**

4.2.4. Accessibility to Airport

Raw RI Score: The Grande Prairie Airport, the fourth largest in Alberta, is a pivotal transportation hub for the County of Grande Prairie, offering passenger, cargo, and medical flight services. Additionally, the county hosts various smaller airports and heliports that support industrial and medical operations. Around 513 km away, the Edmonton International Airport provides an additional access point, enhancing the region's connectivity to global supply chains.	**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 out of 100.	**Score 6.66**

4.3 Risk Factor: Social Infrastructure

4.3.1. Healthcare Facilities

Raw RI Score: The County of Grande Prairie boasts a strong healthcare system with three main hospitals and around 50 general practitioners spread across approximately 24 clinics. Similarly, the MD of Greenview maintains a solid health infrastructure, including three hospitals and 11 health centers. This robust healthcare network signifies a commitment to public health, a favorable environment for investment, and reflects the region's resilience and stability. 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 out of 100.	**Score 6.66**

4.3.2. Educational Facilities

Raw RI Score: The County of Grande Prairie has 18 schools, including elementary, middle, and secondary institutions, with 8 showcasing proficiency levels between 67% and 81%. Its high school graduation rate is 81%, slightly lower than the national average. About 30.9% of residents in the MD of Greenview and Grande Prairie hold a high school diploma. Additionally, the County hosts three colleges, with Grande Prairie Regional College ranking notably for research funding, intensity, and growth. 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 out of 100.	**Score 6.66**

4.3.3. Recreational Facilities

Raw RI Score: The County of Grande Prairie and MD of Greenview have abundant outdoor recreational amenities amidst a picturesque natural setting. Scenic byways, parks, water bodies, and trails offer diverse activities like snowmobiling, mountain biking, camping, hiking, and fishing. Key attractions cater to	**Score 1**

residents' and tourists' wide range of interests and include O'Brien Provincial Park, Big Mountain Creek Recreation Area, Grovedale Fish Pond, Grovedale Golf & Country Club, and Nitehawk Year-Round Adventure Park.

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 out of 100.	**Score 3.33**

4.3.4. Cultural Facilities

Raw RI Score: The regions of Grande Prairie and the MD of Greenview boast a rich array of cultural amenities, encompassing an engaging mix of art galleries, museums, and theaters. The vibrant film and music scene, combined with a calendar full of dynamic festivals, creates a thriving cultural tapestry that further enhances the regional appeal. A strong cultural environment typically correlates with a high quality of life, which is essential for attracting and retaining a diverse and creative workforce.	**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 out of 100.	**Score 6.66**

4.3.5. Public Safety Facilities

Raw RI Score: Grande Prairie's crime index, according to Statistics Canada, is notably higher than the national and Alberta averages. Yet, the region has shown significant progress, with a 20% decrease in crime, making it safer than 17% of Canadian cities. Essential services such as the Fire Station and civil security, managed by the Grande Prairie municipality, support the region's safety infrastructure. The MD of Greenview's emergency services, along with the federally run Royal Canadian Mounted Police, create a robust and responsive safety network.	**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 out of 100.	**Score 9.99**

4.3.6. Housing

Raw RI Score: The County of Grande Prairie offers a vibrant real estate market with median home values of $300,710, significantly lower than the national average, and high home ownership rates (90%). Average housing costs for homeowners and renters are $1,747 and $1,221, respectively, with real estate prices 28% lower than the Alberta average. Similarly, the MD of Greenview and Grand Cache display an above-national home ownership rate of 84.23%, indicative of a financially capable population and a dynamic real estate market, factors beneficial to potential businesses. 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 out of 100.	**Score 6.66**

4.4 Risk Factor: Workforce and Permitting

4.4.1. Labor Availability

Raw RI Score: Based on the latest data from Statistics Canada, the County of Grande Prairie boasts a workforce of 41,300, including a substantial number with high school diplomas, trade certificates, and bachelor's degrees. Key sectors employ over 7,500 people, including industries such as Mining, Oil and Gas, and Retail Trade. The MD of Greenview and Grande Cache host a total workforce of 74,245 with a dominant presence in Trades, Transport, Sales, and Service. The region's educational attainments show a high proportion of apprenticeships and degree holders. The County of Grande Prairie reports a median income of $52.8K and a median age of 38, indicating a diverse and skilled workforce. 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 out of 100.	**Score 9.99**

4.4.2. Labor Cost

Raw RI Score: In Alberta, the established minimum wage stands at $15.00 per hour, offering a foundational rate for the workforce. However, reflecting the region's economic vibrancy, the average hourly wage in Grande Prairie, according to the latest Statistics Canada data, outpaces this minimum at $25.92. This wage range varies depending on occupation and experience, spanning from $23 to $40 per hour.	**Score 2**

Examining median income further underscores this economic robustness. As of 2019, the County of Grande Prairie registered a median income of $52,800, while the MD of Greenview and Grande Cache reported a median income of $45,552. These wage and income metrics highlight a financially stable workforce, and signals a reliable consumer base, a competitive labor market, and overall, a thriving regional economy.

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 out of 100.	**Score 6.66**

4.4.3. Training Programs/Community College

Raw RI Score: The County of Grande Prairie houses three significant educational institutions, including the nationally recognized Grande Prairie Regional College, which is ranked 15th for research funding and 3rd for research intensity in the province. Mayfair Business College and Northwestern Polytechnic also contribute to the diverse academic environment, supplying skilled graduates to stimulate regional innovation and growth.	**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 out of 100.	**Score 6.66**

4.4.4. Permit Process

Raw RI Score: The County of Grande Prairie and the MD of Greenview offer a transparent, efficient permitting process, underscoring their commitment to economic growth. The typical permitting timeline ranges from 30 – 45 days, while rezoning and subdivision applications extend the process to 2 – 4 months. This prompt and straightforward procedure exemplifies the region's dedication to fostering business development.	**Score 2**

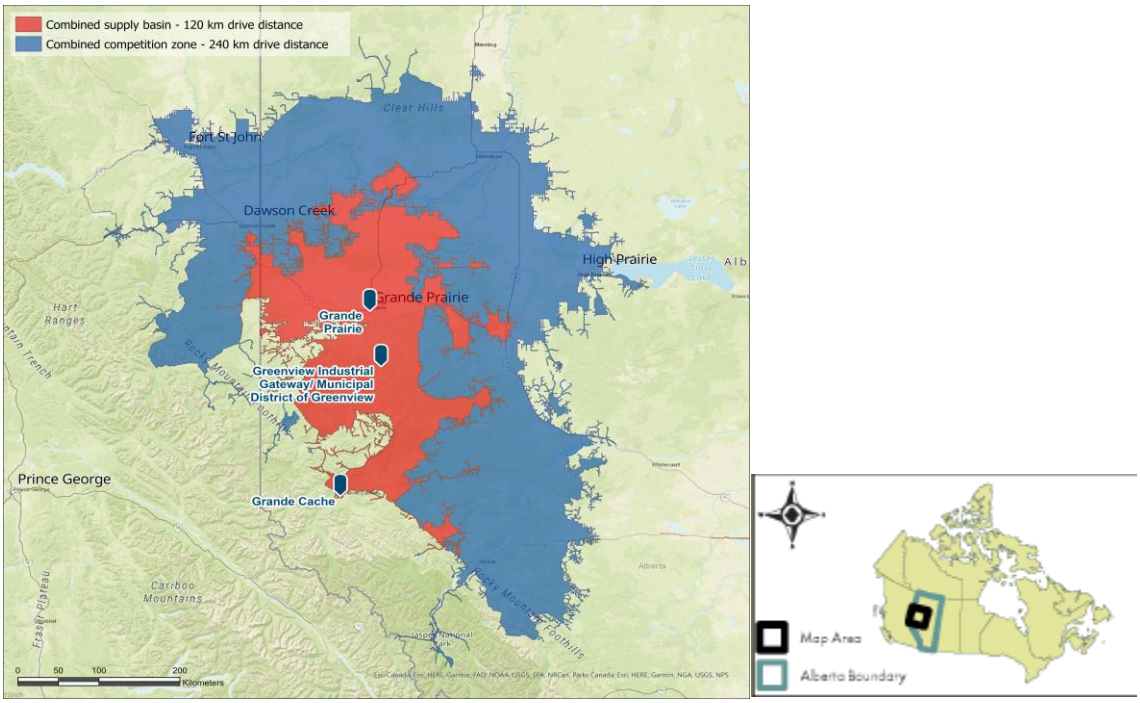
Raw RI Score is 2 out of 10.

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 out of 100.	**Score 6.66**

APPENDIX B: WOODY BIOMASS AVAILABILITY & PRICING – METHODS & ASSUMPTIONS

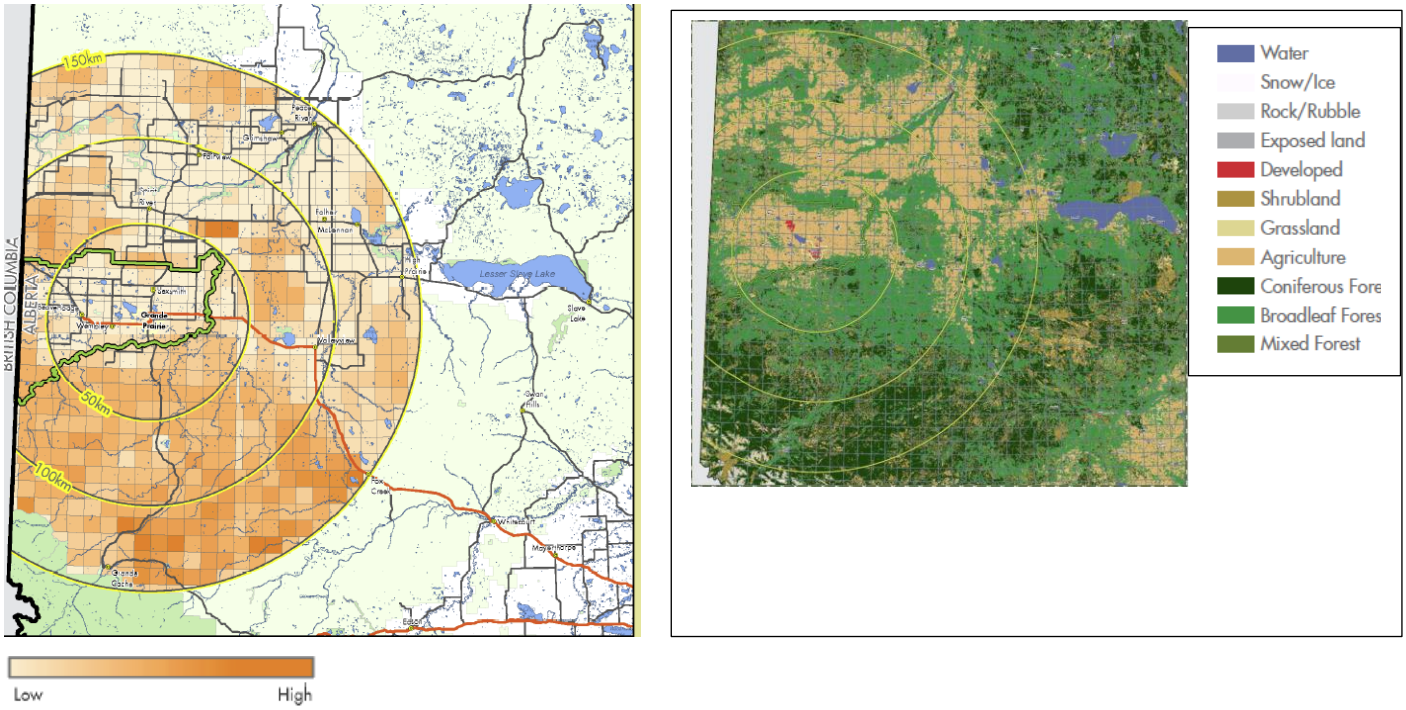
This section explains the type and availability of woody biomass in the BDO Zone. The BDO Zone is located in Northwestern Alberta, Canada, and is centered around the Greenview Industrial Gateway. It extends 120 km in all directions, covering the County of Grande Prairie, MD of Greenview, and Grande Cache, as shown in Figure 5 (Orange Area). The area has a thriving established forest industry that is the primary producer and user of the woody biomass resources in the BDO Zone. In addition, potential competing markets within a 240-km drive distance are included in the risk scoring analysis, which also includes a portion of Northeastern BC (Blue Area).

Figure 5. Woody Biomass Supply and Competition Basins for the MD of Greenview and County of Grande Prairie BDO Zone



As shown in Figure 6, the majority of woody biomass is concentrated in the area that extends from the County of Grande Prairie to Grande Cache.

Figure 6. The concentration of woody biomass in the BDO Zone[2]. A majority of woody biomass is concentrated in the area that extends from the County of Grande Prairie to Grande Cache.



As seen in Figure 7, four types of woody biomass are produced in the BDO Zone including:

- Low-grade logs within merchantable stands
- Logging/Forest residues from harvesting operations (tops, limbs, and log waste)
- Sawmill residues (woodchip, sawdust, wood shaving and hog fuel)
- Urban wood waste

Figure 7. Different Forest Biomass Resources in the BDO Zone.


Low-grade logs


Forest/forest residues


Sawmill residues

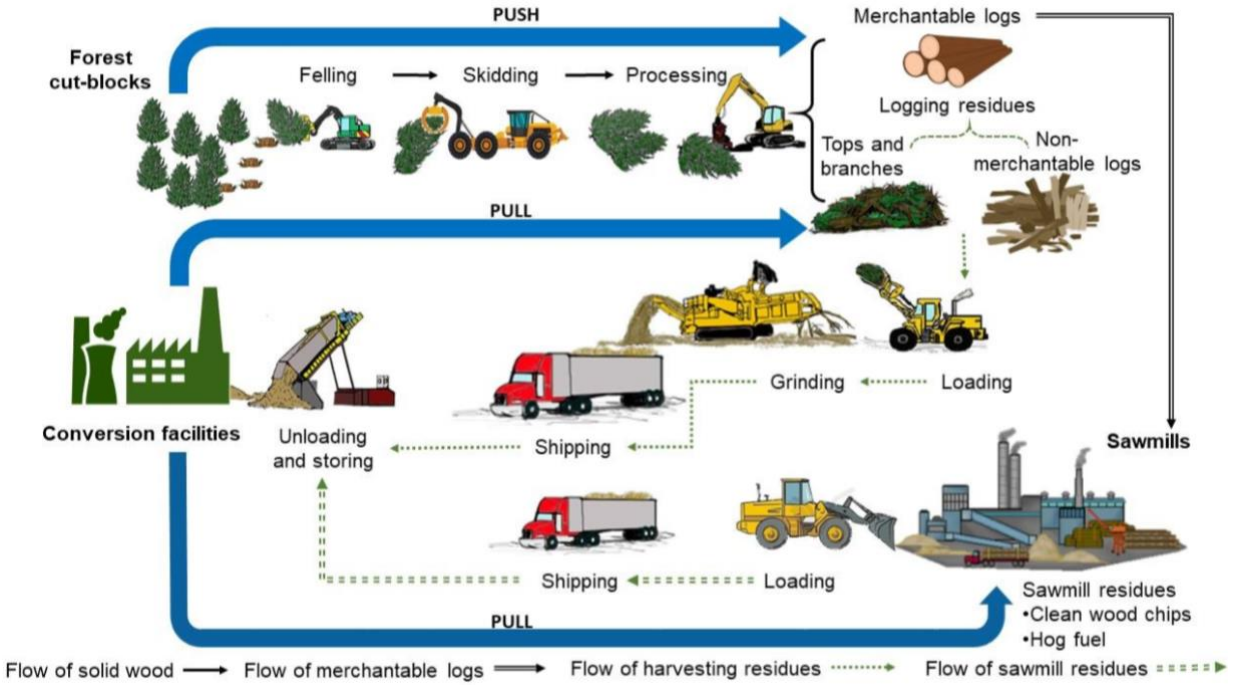

Urban wood waste

Low-grade logs and forest residues are produced at forest cutblocks,[3] while sawmill residues are produced at wood processing facilities (i.e., sawmills). Figure 8 shows the logistics of these forest biomass resources, from cutblocks and

[2] Silvacom, 2016. Reginal Pre-feasibility scan of potential biomass supply- County of Grande Prairie No. 1
[3] A cutblock is a specific area of forestland, with defined boundaries, that is authorized for harvest.

sawmills, to a biorefinery facility. In some literature, the sum of forest residues and low-grade logs piling on the roadside of a cutblock are called forest residues, as shown in Figure 8. In this report, logging/forest residues refer to both the by-products of harvesting operations at cutblocks, including tops, limbs, and log waste, as well as low-grade logs. Since the forest in the BDO Zone region is dominated by a mix of coniferous and deciduous trees, the forest industry has evolved to exploit both variants. The harvested timbers that do not meet the specifications of primary wood processing facilities, such as lumber manufacturers, are used by the pulp and paper mills and the oriented strand board (OSB) plants. However, on some occasions, the tenure holders leave the low-grade logs at the roadside of the forest cutblocks as part of logging residue piles. The primary reason for this being time constraints that tenure holders have to harvest and transport logs to meet the fibre demand of their own sawmills before replanting starts, and then they deactivate the road network for repair and maintenance. Therefore, they are not able to supply other end users. Another reason is the long distance of forest cutblocks from the end users, making the transportation cost prohibitive.

Figure 8. Forest biomass supply chains from forest cutblocks and sawmills to a bioconversion plant/biorefinery (Adopted from Akhtari, 2019[4]).



As shown at the top of Figure 8, forest residues, merchantable logs (i.e., sawlogs) and non-merchantable logs (i.e., low-grade logs) are produced at the roadside of cutblocks. The in-forest operations include felling trees using feller-bunchers, skidding harvested trees to the roadside using grapple skidders, and processing at the roadside using dangle head processors (delimbing). Sawlogs are loaded and transported directly to primary wood processing facilities such as lumber manufacturers. Low-grade logs are usually transported to the secondary wood processing facilities such as pulp and paper and OSB. Low-grade logs have insufficient quality (e.g., off-species such as aspen, small size, and damage by insects, fire, and disease) for processing into lumber or plywood. They are harvested along with the sawmill quality logs in the forest

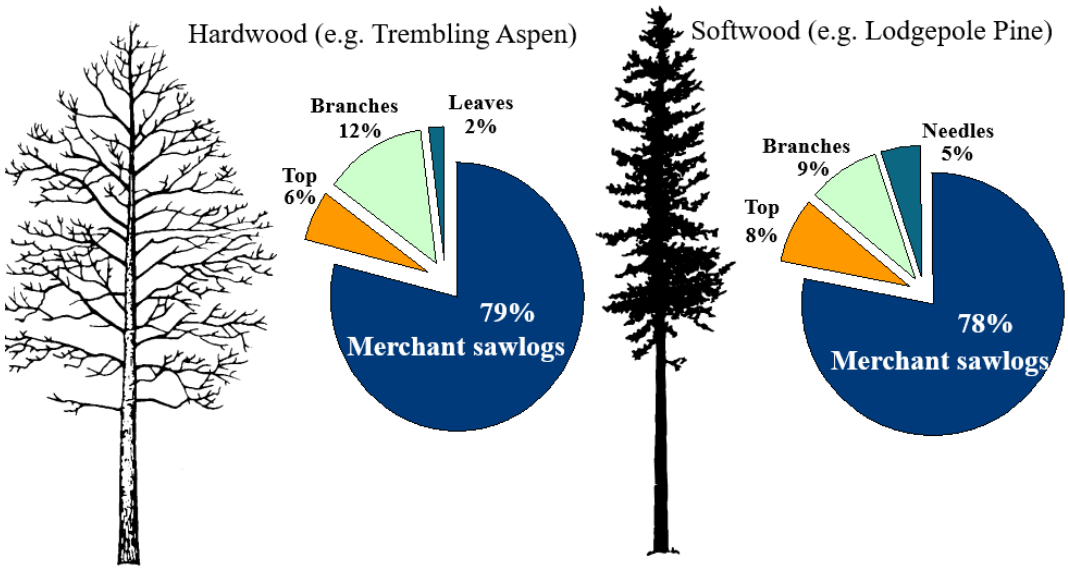
[4] Akhtari, Sh., 2019. Integrated strategics, tactical, and operational planning of forest-based biomass supply chains for bioenergy and fuel production- a hybrid optimization simulation approach. Ph.D. dissertation, The University of British Columbia.

cutblocks and then are traded or sold to pulp mills, whole log chipping facilities, and OSB plants. However, as previously mentioned, on some occasion's tenure holders leave low-grade logs at the roadside of the forest cutblocks as part of logging residues piles.

In addition to merchant sawlogs and low-grade logs, another product of harvest operations in a forest cutblock is forest residues. Forest residues, the remaining portion of harvest operations which consists of top, branches, log waste, and needles/leaves are either left in the cutblocks or collected and piled at the roadside of cutblocks and then burned to reduce the risk of fire, disease, and pest infestation. The burning of forest residues is also known as slash burning. In Alberta, the tenure holders have maximum 2 years to decide whether they want to forest residues internally, sell them to another company or burn them. In our discussions with the Office of Forestry, Parks and Tourism, Government of Alberta, they mentioned that once a tree is severed (felled), ownership is transferred from the Crown to the timber disposition holder. As such, the timber disposition holder may enter business-to-business arrangements for the use of these materials at their own discretion. The government is not party to these agreements.

Figure 9 shows the typical percentage of merchant sawlogs and forest residues for hardwood and softwood tree species in Canada. As shown in Figure 9, about 20-25% of harvested timbers end up in the forest as forest residues. Tree species and the impact of natural disturbances such as the Mountain Pine Beetle epidemic and wildfire can increase the quantities of forest residues.

Figure 9. Typical percentage of merchant sawlogs and forest residues for hardwood and softwood tree species in Canada (Ryans and Cormier, 2012[5]).



However, not all produced forest residues left at the roadside can be recovered. A portion of these forest residues are left in the forests for silvicultural and ecological retention. Another portion of forest residues are not technically available; they are widely distributed in the cutblock and thus too expensive to collect and pile (see Figure 10). The remaining portion that is technically available, can be collected and piled at the roadside of cutblocks. Figure 11 shows the forest biomass flow in a cutblock. The percentages in Figure 11 represent "typical" quantities of sawlogs and forest residues produced in

[5] Ryans, M., Cormier, D., 2012. Forest Biomass Supply. FPInnovations. CCPC Webinar

a cutblock. The reported percentages are based on a study that FPInnovations conducted in the BDO Zone in 2016. The report assumes that 20% of harvested timbers would be recovered as forest residues at the roadside of the forest cutblocks and available for delivery to a biomass processing facility.

Figure 10. Potential versus recoverable forest biomass at the roadside of forest cutblocks (Ryans and Cormier, 2012).

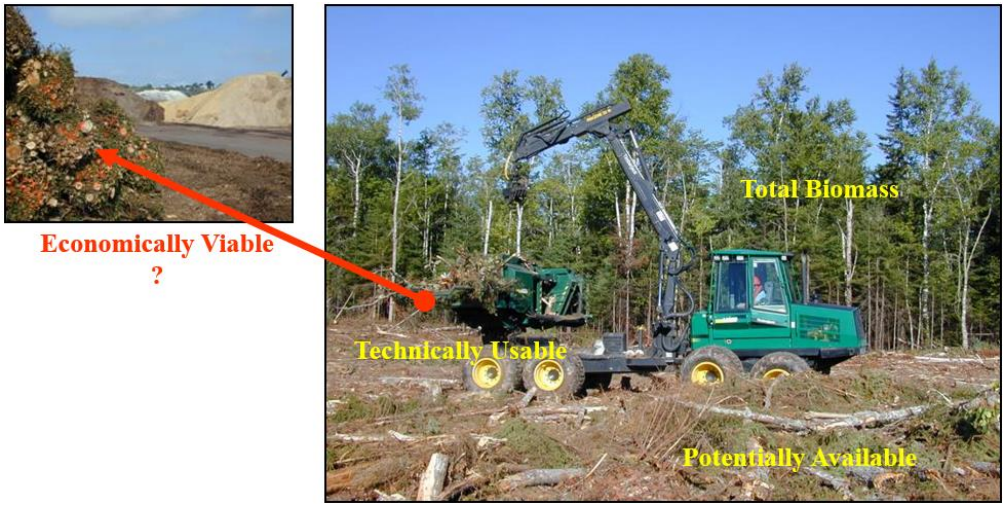
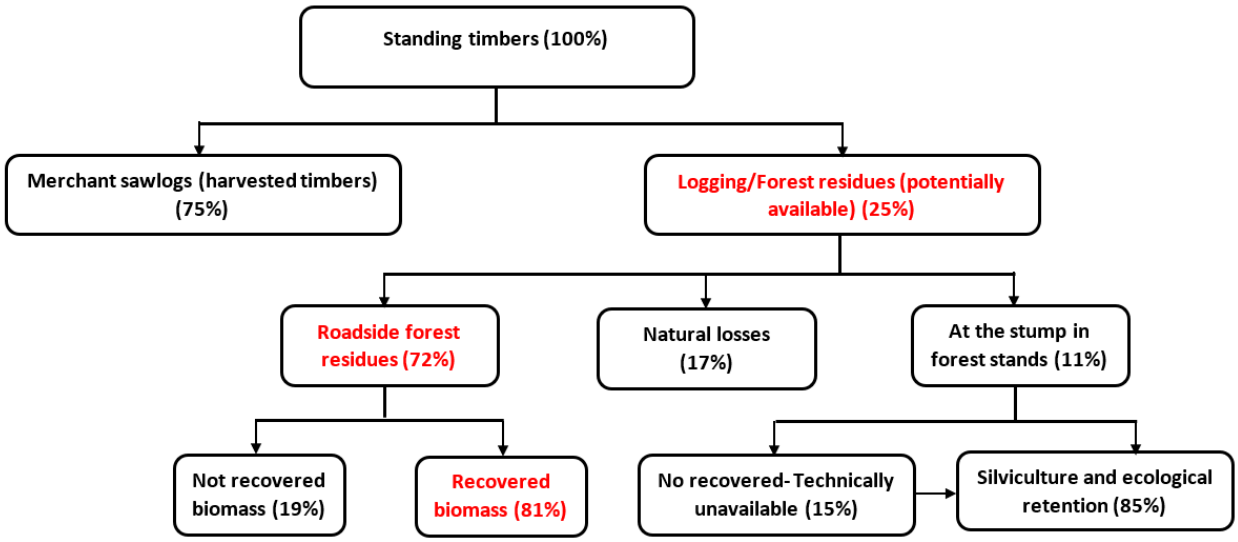
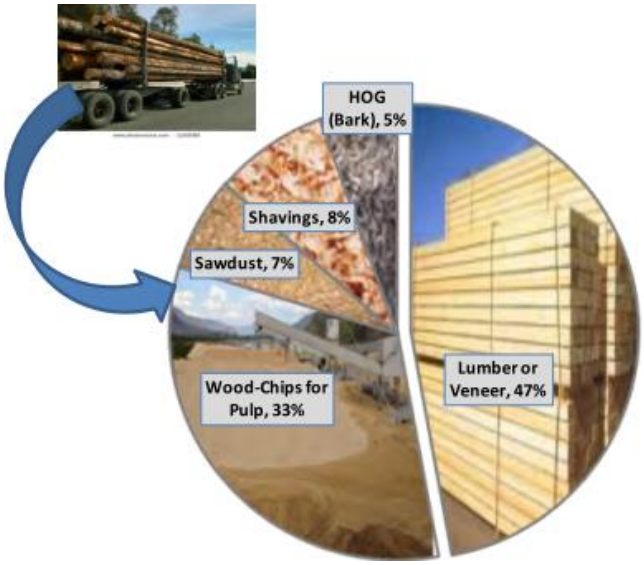


Figure 11. Biomass flow in forest cutblocks (Adopted from FPInnovations, 2016).



Sawmill residues including woodchip, sawdust, wood shaving, and hog fuel are produced at sawmills, making them an accessible source of feedstock. As shown in Figure 12, typical yield of sawlog components at a sawmill are 47% lumber, 33% woodchips, 15% sawdust and shavings, 5% hog fuel, trim ends, and lumber waste.

Figure 12. Typical yield of sawlog components at a sawmill (Industrial Forestry Service Ltd. et al., 2018[6]).



The last source of woody biomass is the BDO Zone is material from pruning or tree removal as well as the construction and demolition operations, known as urban wood waste. Depending on their quality, urban wood waste may be used as feedstock in the Cogen facilities for heat and power generation, landscaping or discarded in a landfill.

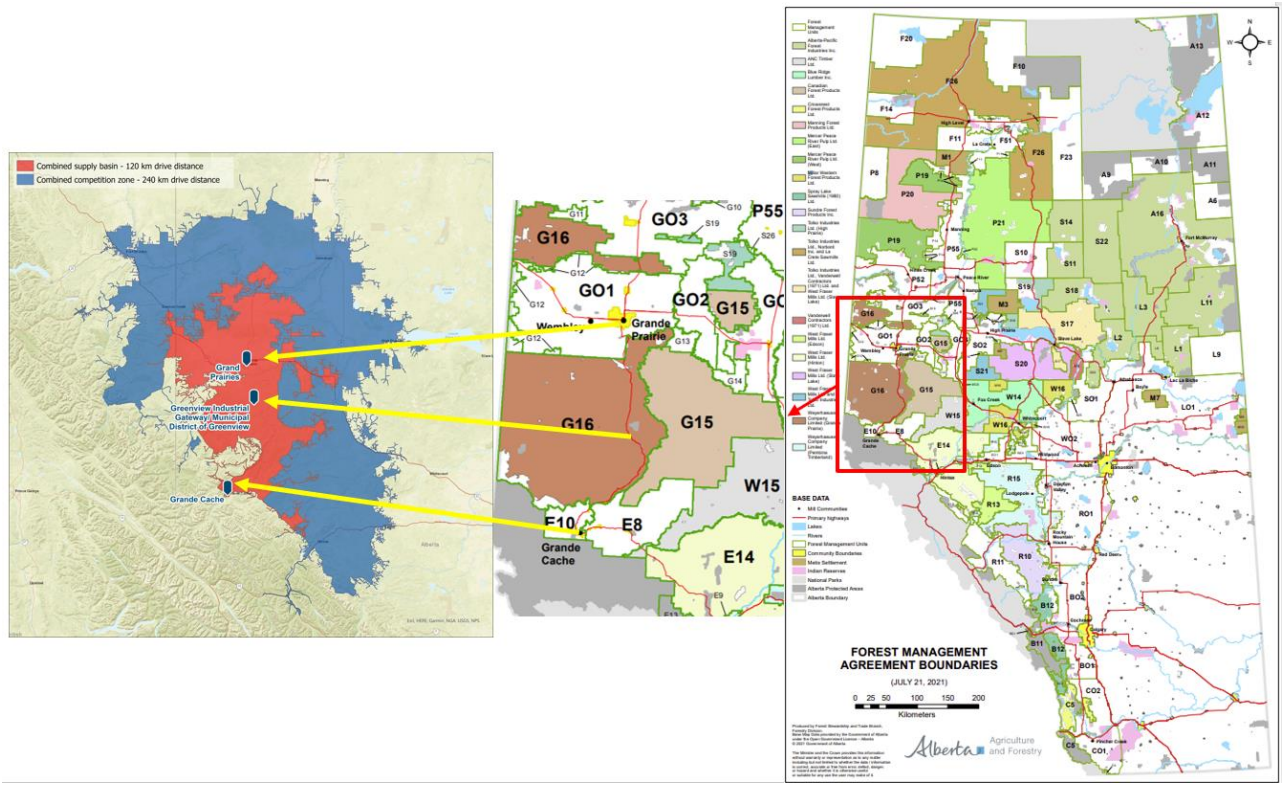
Figure 13 shows the Forest Management Units (FMUs) in the BDO Zone. In Alberta, Annual Allowable Cuts (AACs)[7] are set for in the FMUs. An FMU is an area of forested public land designated by the Government of Alberta. The provincial government owns all timber located on provincial public 'Crown' lands, and it allocates timbers and provides rights surrounding Crown timber to the tenure holders, such as wood processing facilities (e.g., sawmills and pulp and paper plants) and requires approved forest management plans to be in place before any timber can be harvested. The timber allocation is known as a forest management agreement (FMA), a long-term (up to 20 years), renewable, area-based form of forest tenure. It is the most secure tenure type of tenure in Alberta. Through the FMA, a company is given certain rights, including the right to establish, grow, harvest, and remove Crown timbers. These rights are granted in exchange for various responsibilities, such as forest management planning and the creation and maintenance of the forest inventory within the boundary of the FMA.

The primary FMUs located within the supply basin include G12, G13, G14, G15, G16 and E08, as shown in Figure 13. The published FMAs and AACs in these FMUs by the Government of Alberta are used to estimate the forest residues within the BDO Zone. The forest lands in the MD of Greenview, and County of Grande Prairie BDO Zone are primarily under provincial ownership and are managed by the Forestry Division of the Government of Alberta, with some federally managed areas and private lands. The forest region is dominated by a mix of coniferous and deciduous trees.

[6] Industrial Forestry Service Ltd. et al., 2018. Wood based biomass in British Columbia and its potential for new electricity generation. Prepared for BC Hydro's Long-Term Planning Process

[7] AAC is the annual amount of timber that can be harvested on a sustainable basis within a defined forest area. The AAC is measured in cubic meters.

Figure 13. Forest Management Units located within the BDO Zone including G12, G13, G14, G15, G16 and E08.



Forest Residues

The primary source of woody biomass in the BDO Zone is forest residues that are usually piled up at the roadside of forest cutblocks. The availability of forest residues in the BDO Zone depends on the AACs in the FMUs within the BDO Zone. Table 3 lists the FMUs and their AACs for Coniferous and Deciduous tree species. The AAC values are provided in the published FMAs by the Government of Alberta. The total Coniferous and Deciduous AACs in the BDO Zone are calculated to be 2.44 and 1.44 million m^3, respectively.

Table 3. List of FMUs and their AACs for Coniferous and Deciduous tree species in the BDO Zone.

FMU#	Merchantable Timber/Roundwood	
	Coniferous AAC (m^3)	Deciduous AAC (m^3)
FMU G12	18,500	0
FMU G13	1,795	18,257
FMU G14	21,000	0
FMU G15	714,100	452,500
FMU G16	1,230,300	956,800
FMU E08	450,951	13,621
Total	**2,436,646**	**1,441,178**

As discussed previously, about 20% of harvested timbers would be recovered as forest residues at the roadside for delivery to potential end users such as biorefineries (see Figure 11). If 2.45 cubic metres (solid wood equivalent) of wood fibre are

required to make one bone-dry tonne (BDT) of biomass fuel (Industrial Forestry Service Ltd. et al., 2018[8]), it is estimated that 198,910 bdt and 117,647 bdt of forest residues are functionally available (and underutilized) from Coniferous and Deciduous AACs, respectively in the BDO Zone (in total, 316,557 bdt).

In discussions with local experts from the provincial government and industry, it was concluded that currently no established demand for forest residues exists. Since the main use of woody biomass in the BDO Zone has been for heat and power generation by the forest industry and due to the low price of energy in the province, forest residues are not currently economical compared to sawmill residues for bioenergy production. In contrast to British Columbia that has developed fire management and fibre utilization plans, there are currently no incentives provided by the provincial and local governments to encourage the use of forest residues for bioenergy and wood pellet production.

Sawmill Residues

Sawmill Residues are produced during the primary breakdown of logs into lumber at sawmills. There are four major sawmills in the BDO Zone, as listed in Table 4. Given their production capacity, we estimate that about 620,000 dry tonnes of sawmill residues are produced in the BDO Zone, including 364,000 dry tonnes of wood chips and 256,000 dry tonnes of sawdust, wood shavings, and hog fuels. There is already a strong demand for wood chips from the pulp and paper industry in the region. There is a large pulp mill in the region with an annual wood chip consumption of over 510,000 dry tonnes (see Table 5). We expect that minimal/insignificant quantities of this biomass category will be available for future biorefinery projects.

As listed in Table 5, the pulp mill has a 140 MW biomass-based power and stream generator. There are also two cogeneration facilities in the BDO Zone. We expect these facilities use up most of the sawdust, wood shaving, and hog fuels produced by local sawmills. In addition, the local sawmills use a portion of their own sawmill residues for internal energy needs in particular heat for kiln dryers. With the recent growth of the wood pellet industry in Alberta, a portion of the wood shaving supply in the supply basin is transported to the Drax pellet plant in Entwistle with an annual capacity of 400,000 tonnes. With the operating CHP and biomass-based power plants and the internal energy needs of the local sawmills, we expect that minimal/insignificant quantities of this biomass category will be available for future biorefinery projects under long-term.

Table 4. Operational Sawmills in the BDO Zone.

Wood processing facility	Estimated Annual Capacity	Required fibre input (m^3)	Estimated sawmill residues
Weyerhaeuser lumber sawmill	340 million board feet	1,188,811	164,000 bdt of wood chips 84,000 bdt of sawdust/hog fuels and wood shavings
Canfor lumber sawmill	294 million board feet	1,026,573	142,000 bdt of wood chips 72,000 bdt of sawdust/hog fuels and wood shavings
Foothills Forest Products lumber sawmill	120 million board feet	419,580	58,000 bdt of wood chips 30,000 bdt of sawdust/hog fuels and wood shavings
Norbord Inc OSB sawmill (Now owned by West Fraser)	730 million square feet 3/8" thick	1,199,288	70,000 bdt of hog fuels

[8] Industrial Forestry Service Ltd. et al., 2018. Wood based biomass in British Columbia and its potential for new electricity generation. Prepared for BC Hydro's Long-Term Planning Process

Table 5. Operational Sawmills in the BDO Zone.

Facility name	Estimated Annual Capacity	Estimated woody biomass demand
International Paper's pulp mill	250,000 air-dried metric ton of pulp production 140 MW biomass-based electric energy and 10,323,448 GJ/yr biomass based thermal energy.	Over 510,000 bdt of wood chips for pulp production 230,000 sawdust and hog fuels for power and steam generation
TC Energy cogeneration facility	32 MW	53,000 bdt of sawdust, wood shaving and hog fuels
Canfor cogeneration facility	25 MW	42,000 bdt of sawdust, wood shaving and hog fuels

The location of existing sawmills, the pulp mill, and the cogeneration facilities in the BDO Zone are provided in Figure 14 and Figure 15.

Figure 14. Location of primary wood processing facilities (four sawmills and one pulp mill) in the BDO Zone.

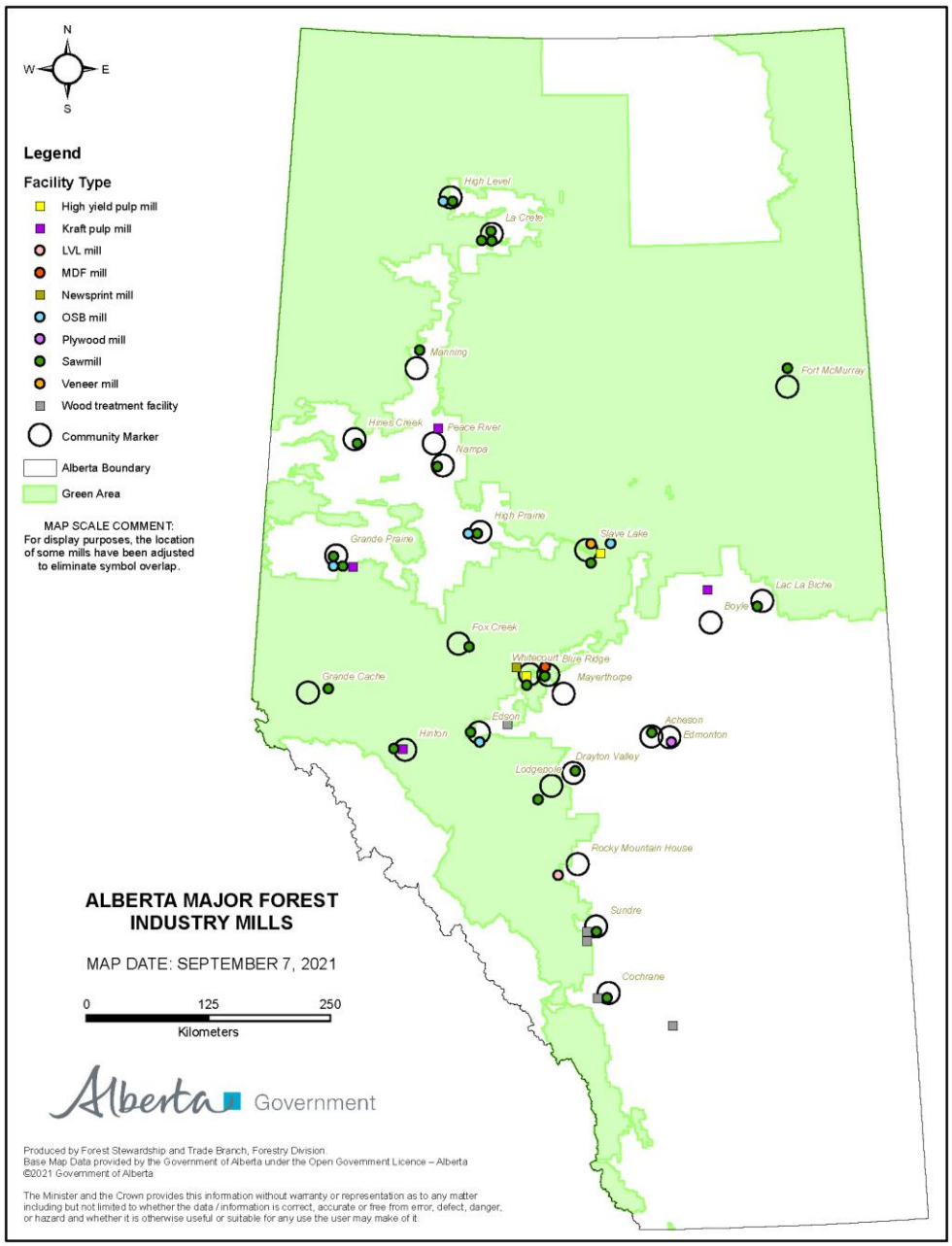
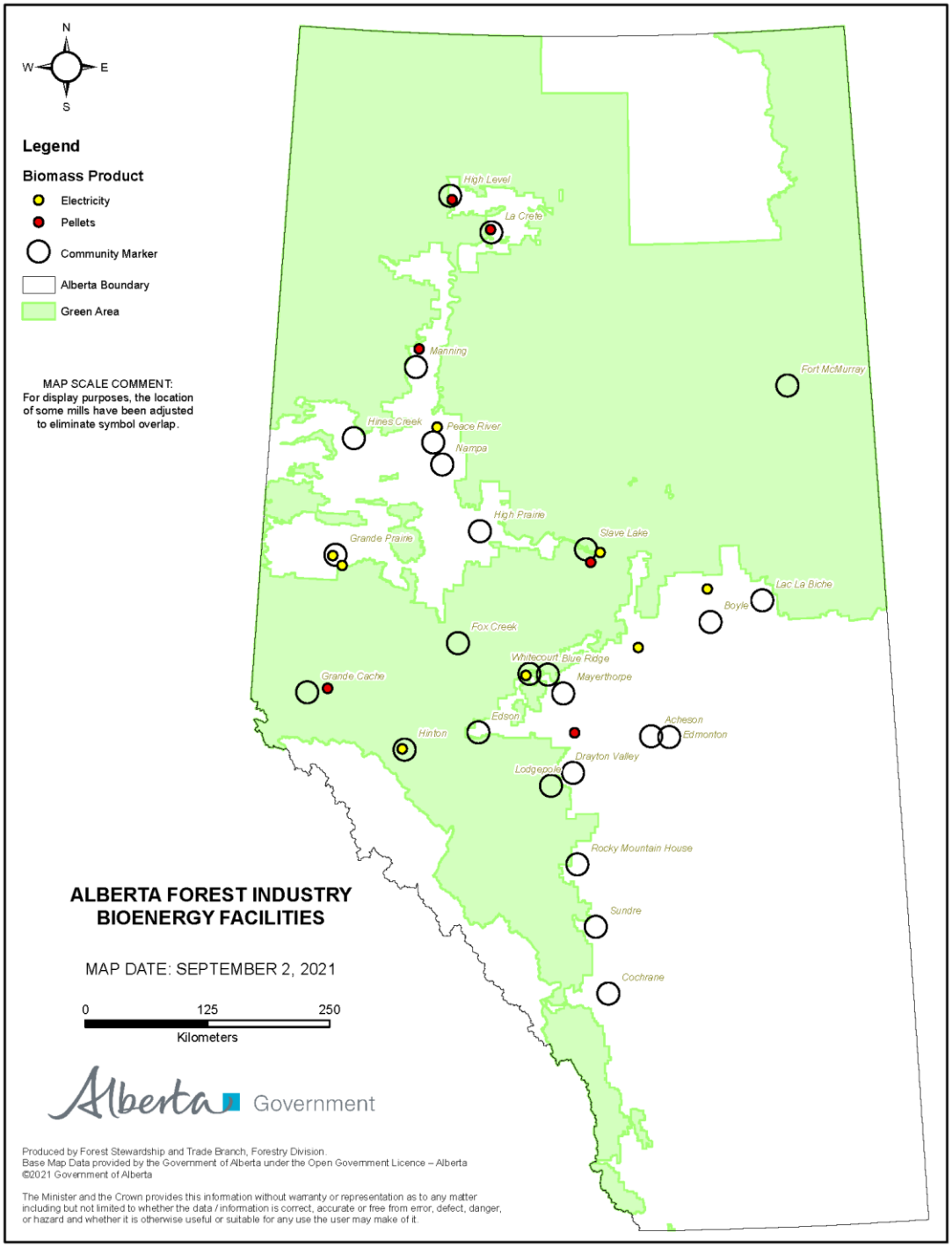


Figure 15. Location of cogeneration facilities using woody biomass as feedstock in the BDO Zone. The indicated wood pellet plant in the BDO Zone is not operational anymore.



Low-Grade Logs Within Merchantable Stands

Due to the nature of forests in Alberta, which are a mix of coniferous and deciduous trees, the forest industry has evolved to exploit both variants. The harvested timbers that do not meet the specifications of primary wood processing facilities, such as lumber manufacturers, are used by the secondary sector, such as the pulp and paper mills and the OSB plants.

Overall, the four sawmills in the BDO Zone have a total capacity of processing 3.83 million m^3 of logs, and their allocated AACs in the BDO Zone are 3.87 million m^3. Thus, it is expected that the wood processing facilities in the region use up most of the harvested logs in the BDO Zone, and commercial quantities of low-grade logs would not be available for future biorefinery projects. As mentioned before, on some occasions, the tenure holders leave the low-grade logs at the roadside of the forest cutblocks as part of logging residues piles for various reasons,0 such as time constraints to meet the fibre demand of their own sawmills and the long distance from the end users (high transportation costs). In this report, the low-grade logs are considered as part of the forest residue inventory.

Forest Residues and Low-Grade Logs in the Private Forestlands

In addition to the crown forestlands, private forestlands (also known as woodlots in Alberta) are present in the BDO Zone. According to Alberta Agriculture and Rural Development (AARD), there are more than 3.6 million hectares of privately owned forested land in Alberta. The estimate includes 1.2 million ha of coniferous, 2.2 million ha of deciduous and, 0.2 million ha of mixedwood. Figure 16 shows the map of private forestlands by municipalities in Alberta.

Figure 16. Private forest area in hectares classified by municipalities in Alberta.

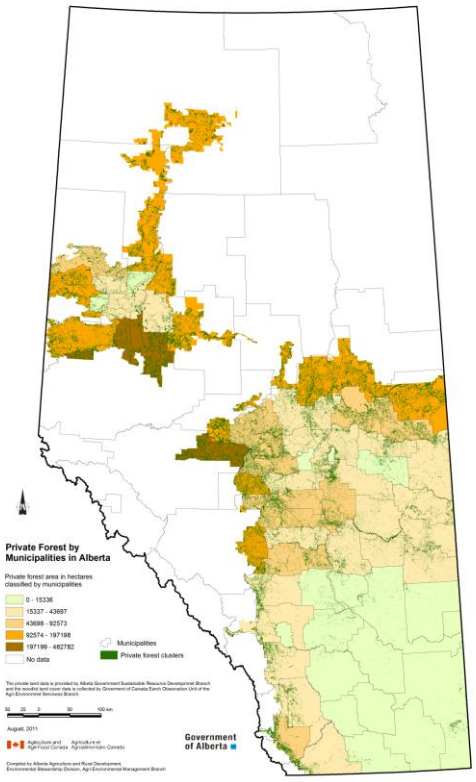


Table 6 shows the size of private forestlands in the BDO Zone. As shown in Table 6 over 521,000 hectares (ha) of private forestlands/woodlots are available in the BDO Zone including 176,660 ha of coniferous, 340,705 ha of deciduous and 3,933 ha of mixed wood lands.

Table 6. Private forest area in hectares classified by municipalities in Alberta.

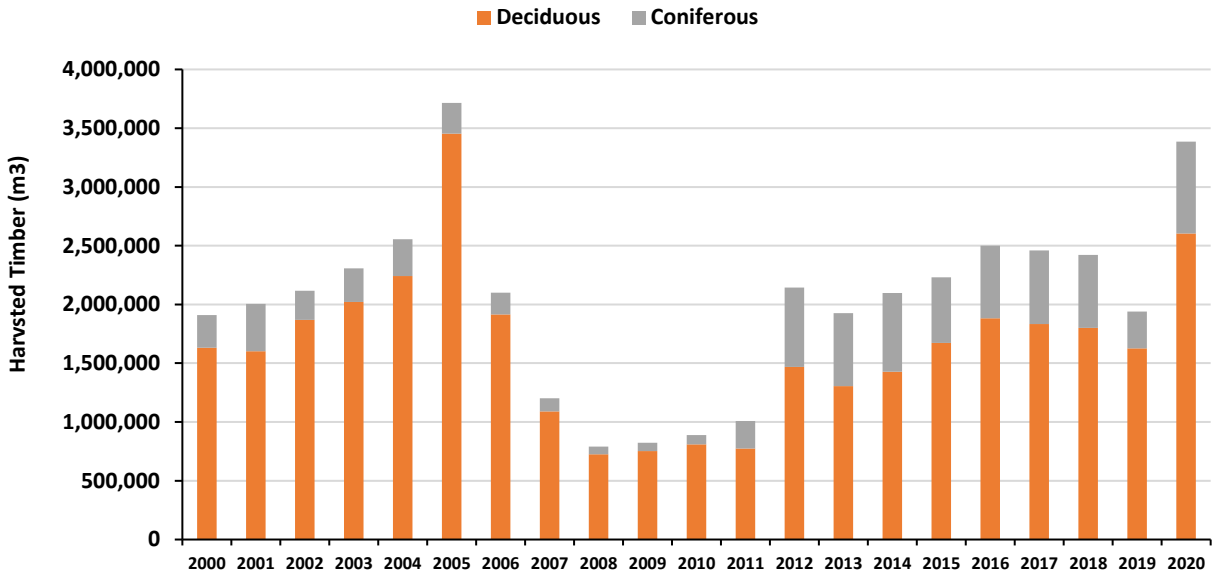
Municipality	Coniferous (ha)	Deciduous (ha)	Mixedwood (ha)
Grande Prairie	4,632	92,936	4,35
Greenview	172,028	247,769	3,498
Total	176,660	340,705	3,933
Percentage of total private forestlands in Alberta	14.72%	15.49%	1.97%

A study by Agroforestry & Woodlot Extension Society showed that the top reasons for owning a woodlot are scenery, biodiversity, watershed protection, conservation, and privacy. While the least important reasons for owning a woodlot are tax purposes, grazing, and timber production. However, some of forest product processing facilities in Alberta rely to some extent on timber harvested from private lands to supplement or substitute their Crown fiber supplies, especially during periods of high prices and demand for forest products (such as lumber and OSB).

As shown in Figure 17, the harvested timbers from private forestlands in Alberta varies from 791,000 m^3 to 3,715,000 m^3 over the period of 2000-2020. No public data exists on the volume of harvested timbers from private forestlands in the BDO Zone. Given the percentage of private forestlands presented in Table 6, we assume 15% of harvested timbers in the private forestlands are supplied from the BDO Zone, resulting in a range of 118,650 and 557,250 m^3 over the period of 2000-2020. These volumes of harvested timbers would generate about 10,000 bdt and 45,000 bdt of forest residues, respectively.

There has been a growing interest by local sawmills to secure wood fibres from private lands, mainly due to more frequent forest fires in public lands. Although logs from private forest lands in general are more expensive than logs from the public lands, with the reduced fibre available on crown land, sawmills are required to harvest this private wood to offset the fibre loss. So, the future bio-projects need to compete with the local sawmills to secure logs from private forest lands. Due to the growing demand for logs from the private forest lands by local sawmills, we did not include them as a source of woody biomass available for the future biomass projects.

Figure 17. Harvested timbers from private forestlands in Alberta over the period of 2000-2020 (data from the National Forestry Database). The harvested timbers were used for various applications, including fuelwood/firewood, logs and bolts, pulpwood, and other industrial uses.



URBAN WOOD WASTE

The main sources of urban wood waste are construction and demolition waste, as well as pruning or tree removal operations. Therefore, areas with dense populations and large commercial and industrial operations are expected to generate commercial quantities of urban wood waste. The BDO Zone has a small population of less than 50,000 people, and the quantities of generated urban wood waste are expected to be inadequate for supporting a commercial-scale biorefinery project.

Five types of municipal solid waste are generated in the BDO Zone, including wood waste from pruning or tree removal and industrial operations (e.g., broken/damaged wooden pallets), construction and demolition waste (wood components only), organic yard waste, sludge, and mixed solid waste (organic components only). Table 7 shows the estimated quantities of municipal solid waste in the BDO Zone. Not all urban wood waste supplies, particularly treated woods, are suitable feedstock for bio-based products. In addition, wood waste from pruning or tree removal operations can have high soil contamination. Whitewood waste, such as broken pallets and construction operations, usually have proper quality (low moisture content and contamination) for biorefinery projects. The quantities of urban wood waste suitable for biorefinery projects are estimated to be about 4,800 tonnes. Assuming an average moisture content of 30%, this is equivalent to about 3,400 bdt.

Table 7. Type and annual generation of municipal solid waste in the BDO Zone[9].

Wood Waste from pruning or tree removal and industrial operations	4,075 tonnes
Construction and Demolition Waste (wood components only)	716 tonnes
Mixed Waste	67,623 tonnes
Organic Yard Waste	376 tonnes
Sludge	7,355 tonnes
Total	80,145 tonnes

Woody Biomass Supply Curve

The biomass supply curve presents the amount of underutilized biomass available within a specific supply radius. For the BDO Zone, the biomass supply curve is generated for three scenarios as defined in Table 8.

Table 8. Biomass supply scenarios considered in this report to develop the biomass supply curve.

Biomass Supply Scenario	Availability of forest residues in Crown forestlands[10]	Availability of forest residues in private forestlands	Availability of sawmill residues and urban wood waste
Scenario I: this scenario represents the highest potential of available woody biomass for future biorefinery projects.	It is assumed the timber harvest level by tenure holders/existing wood processing facilities is 90% of the total AAC in the BDO Zone.	The maximum harvested timbers over the period of 2000-2020 from the private forestlands is used to estimate the forest residues availability. (557,250 m^3)	- There are no sawmill residues available for future biorefineries. - 3,400 bdt of urban wood waste would be available as feedstock for future biorefineries.
Scenario II: this scenario represents the average available woody biomass for future biorefinery projects.	It is assumed the timber harvest level by tenure holders/existing wood processing facilities is 75% of the total AAC in the BDO Zone.	The average harvested timbers over the period of 2000-2020 from the private forestlands is used to estimate the forest residues availability. (303,750 m^3)	
Scenario II: this scenario represents the lowest potential of available woody biomass for future biorefinery projects.	It is assumed the timber harvest level by tenure holders/existing wood processing facilities is 70% of the allocated AACs in the BDO Zone.	The minimum harvested timbers over the period of 2000-2020 from the private forestlands is used to estimate the forest residues availability. (118,650 m^3)	

[9] Silvacom, 2016. Reginal Pre-feasibility scan of potential biomass supply- County of Grande Prairie No. 1
[10] The minimum, average and maximum timber harvest level as a percentage of the total AAC in Alberta is 70%, 75% and 90%, respectively over the period of 2012-2021 (see Table 9)

Table 9. Harvested volumes of timbers versus the AACs in Alberta over the period of 2012-2021.

Harvest, by species group	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Coniferous	15.1	13.7	15.0	17.4	16.1	17.2	16.3	14.5	18.3
Deciduous	5.8	6.9	6.3	8.2	7.2	8.2	8.6	8.3	7.9
Total, harvest volume	**20.9**	**20.6**	**21.3**	**25.5**	**23.3**	**25.3**	**24.9**	**22.8**	**26.3**

AAC, by species group	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Coniferous	18.5	19.1	19.6	19.6	19.2	18.7	18.4	17.2	17.2
Deciduous	11.8	12.1	12.8	12.8	12.9	12.9	13.1	12.4	12.2
Total, AAC	**30.3**	**31.2**	**32.4**	**32.4**	**32.1**	**31.6**	**31.5**	**29.6**	**29.5**

Figure 18, Figure 19, and Figure 20 show the woody biomass supply curve for three scenarios defined in Table 8. The total estimated woody biomass available for the biorefinery projects is estimated to be over 333,000 bdt, 266,000 bdt and 235,000 bdt for scenarios I, II and III respectively. Even in scenario III which represents the lowest potential of available woody biomass for biorefinery projects, commercial quantities of underutilized woody biomass, mainly forest residues would be available.

Figure 18. Woody biomass supply curve for scenario I. This scenario represents the highest potential of available woody biomass for future biorefinery projects.

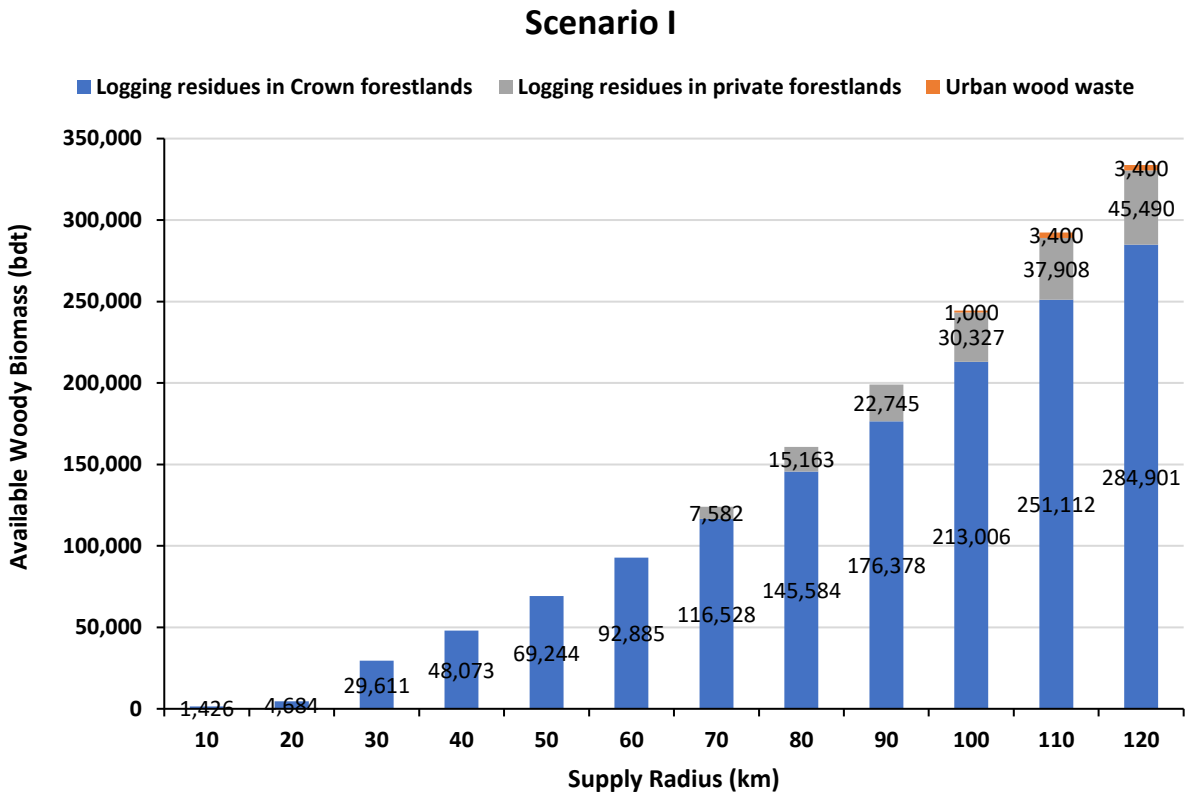


Figure 19. Woody biomass supply curve for scenario II. This scenario represents the average potential of available woody biomass for future biorefinery projects.

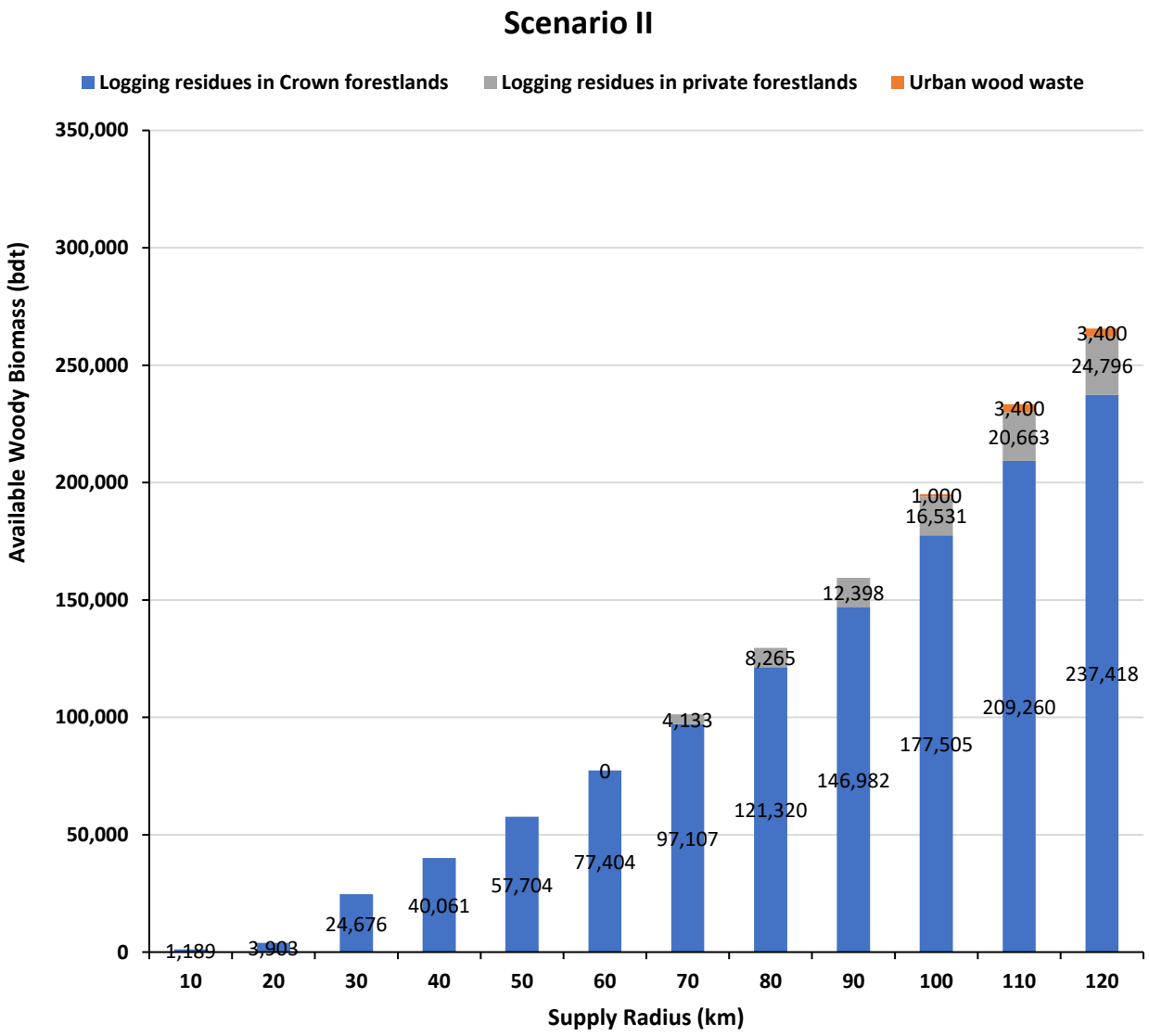
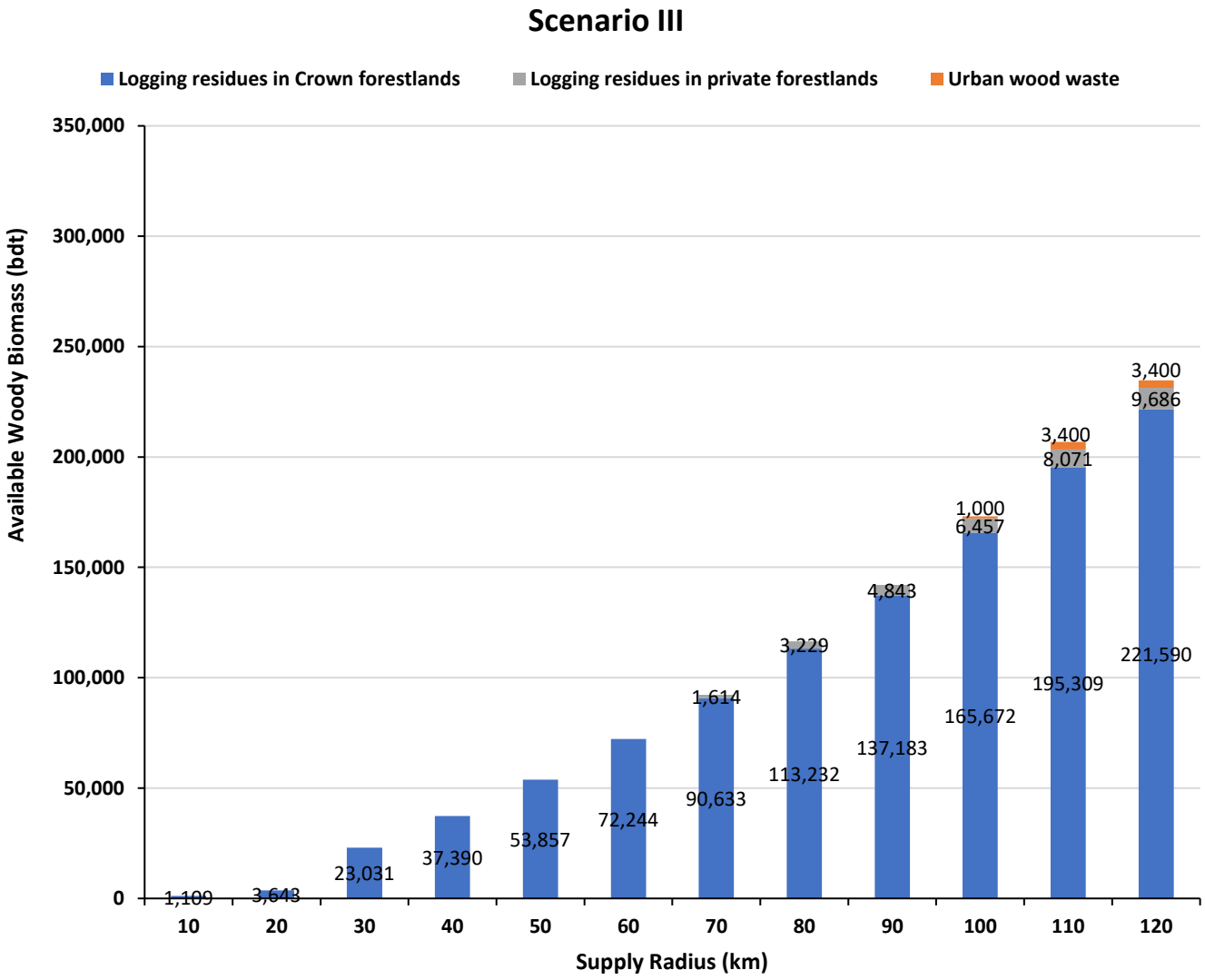


Figure 20. Woody biomass supply curve for scenario I. This scenario represents the lowest potential of available woody biomass for future biorefinery projects.



Woody Biomass Cost-Supply Curve

Figure 21 shows the logistics operations to deliver urban wood waste, sawmill residues, forest residues and low-grade logs to the gate of the biorefinery. Sawmill residues are usually the less expensive sources of woody biomass compared to other sources such as forest radiuses and low-grade sawlogs. They are the by-product of mill operations and available at sawmills. The logistics operations include loading, transportation and unloading at the biorefinery site.

Figure 21. Logistics operations for the delivery of urban wood waste, sawmill residues, forest residues and low-grade logs to the gate of the biorefinery.

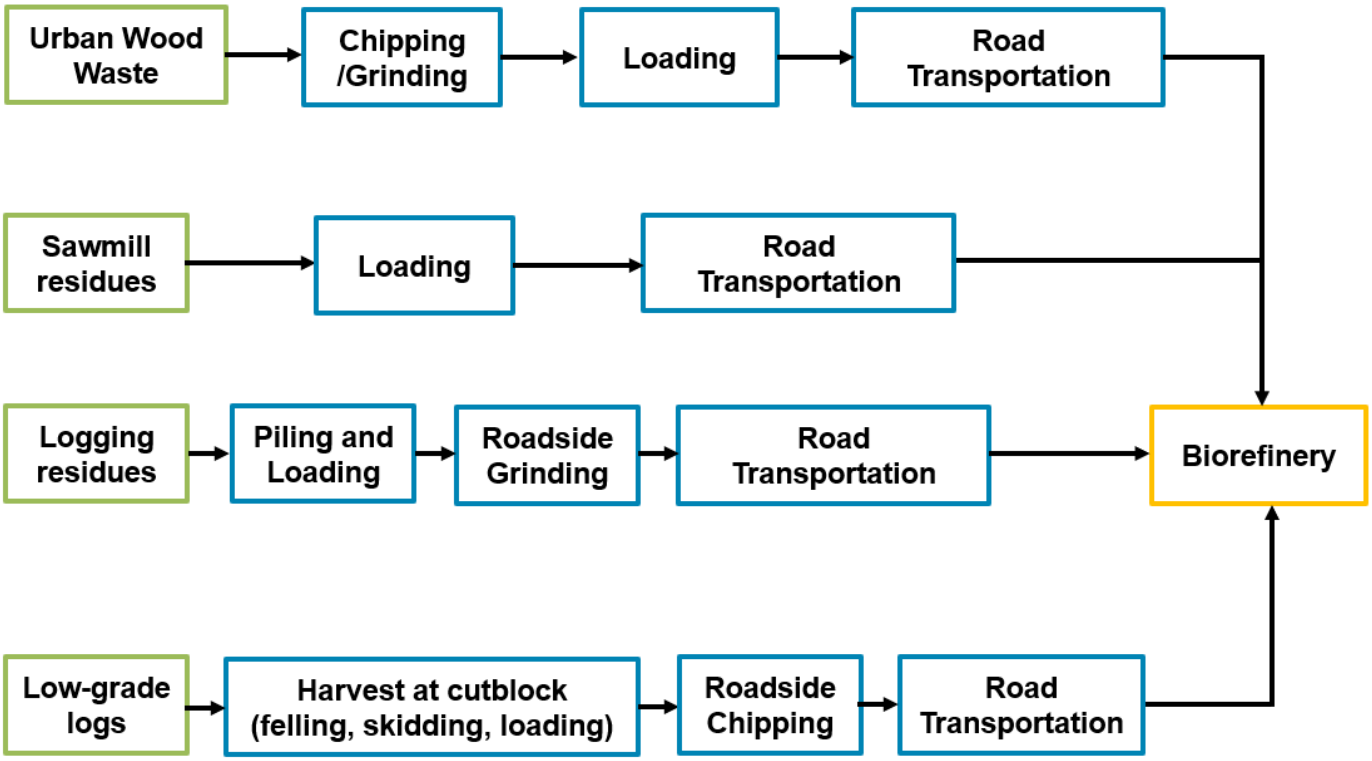


Table 10 shows the typical truck type and configuration used to transport urban wood waste and sawmill residues to end users such as Cogen facilities and wood pellet plants. Within a supply radius of 120 km and with an average transportation distance of 80 km, the hauling cycle time for a truck to load wood biomass at the supplier site, transport them to the biorefinery and unload them at the gate of the biorefinery is calculated as follows:

Truck hauling cycle time = loading time + transportation time + unloading time = ($113m^3$ / $200m^3$/hr) + (80km / 70km/hr) + ($113m^3$ / 200 m^3/hr) = 0.57 + 1.14 + 0.57 = 2.28 hr

Thus, the transportation cost is estimated to be (125$/hr × 2.28hr) / 15 bdt = 19 $/bdt or 0.24 $/bdt-km

Figure 10. Typical truck type and configuration used to transport urban wood waste and sawmill residues.

Truck configuration	Power (kW)	Payload (m^3)	Average payload (tonne)*	Average payload (bdt)	Average speed (km/hr)	Average unloading rate (m^3/hr)	Average loading rate (m^3/hr)	Cost ($/hr)
Self unloading semi-trailer chip Van	352	113	23	15	70	200	200	125

* At 30-35% moisture content

Table 11 shows the delivered cost of urban wood waste to the biorefinery within a supply radius of 120 km with an average transportation distance of 80 km.

Table 11. Delivered cost of sawmill residues to the gate of the biorefinery.

Urban wood waste	Logistics Cost	Comment
Fibre acquisition, chipping/grinding and on-site storing	30-50	The price of urban wood waste depends on the type and quality of wood waste. Wood waste, such as broken pallets, has good quality (low moisture and ash contents) and needs one-stage size reduction (grinding). On the other hand, wood Waste from pruning or tree removal and construction and demolition waste usually has higher moisture and ash contents. It may need a two-stage size reduction (chipping and grinding). We assume a mix of urban wood waste is priced at $40/bdt at the producer site.
Transportation cost ($/bdt-km)	0.24	Sawmill residues are collected within a supply radius of 120 km with an average transportation distance of 80 km
Delivered cost ($/bdt)	59.2	

The delivered cost of forest residues is comprised of four components: pre-piling, comminution, transportation and road network construction, and maintenance. Forest residues are usually dispersed at the logging site. For efficient grinding operations, they need to be collected and piled at the roadside for easy feeding into the grinder. The pre-piling is usually done by excavators and butt 'n' top loaders. This process costs $5-7/bdt.

Comminution is the process of loading forest residues into the grinding equipment at the roadside of forest stands, then grinding and loading them into a truck. The truck then transports the ground forest biomass to end users. The comminution operation is estimated at a cost of $25-32/bdt (personal communication with FPInnovations). In recent years, the industry has been able to reduce grinding costs by improving the efficiency and fuel consumption of this operation. In some regions of British Columbia, a grinding cost of $20/bdt has been reported. More development research is ongoing to integrate the forest biomass logistics system with the existing forest supply chain to reduce the biomass logistics cost further. This reduction can potentially make forest residues a more affordable feedstock for bio-based applications. Since there is no established market for forest residues and a lack of experience with commercial handling, grinding and transportation of forest residues in the BDO Zone, we assume a comminution cost of $30/bdt for forest residues.

The next cost component is transportation cost which depends on road conditions and truck configuration. Transportation costs are estimated for a B-train, the chip vans that consist of two trailers. B-trains are permitted to haul the largest loads with a maximum gross vehicle weight of 63,500 kg for trucks and trailers. The average load for comminuted biomass (chips or hog) is approximately 22.5 bdt (dependent on moisture content and particle size) (personal communication with FPInnovations). The transportation cost of comminuted forest residues amounted to a range of $0.18-1.00/but-km based on data provided by FPInnovations using their FPInterface model. Such a wide range is due to the different road classes, which can impact the speed of the truck and the associated costs. The transportation costs average $0.33/bdt-km.

The last cost component of the delivery cost is road construction, maintenance, supervision, and overhead. End users of the forest residues are usually charged for using the roads constructed by forest companies to transport sawlogs to their wood processing facilities. In addition, the logistics crew needs a supervisor for safe and coordinated operations, to minimize interference with the logging operations, replanting, and other silviculture activities. These costs are in the range of $4-9/bdt with an average amount of $8/bdt based on data provided by FPInnovations.

Table 12 shows the summary of the delivered cost of forest residues to the gate of the biorefinery.

Table 12. Delivered cost of forest residues to the gate of the biorefinery.

Forest residues	Logistics Cost	Comment
Pre-piling ($/bdt)	5-7	Forest residues are usually dispersed at the logging site. They must be collected and piled at the roadside for easy feeding into the grinder for efficient grinding operation. The pre-piling is usually done by excavators and butt 'n' top loaders. We assume a pre-piling cost of $6/bdt for the BDO Zone.
Comminution ($/bdt)	26-32	Comminution is the process of loading forest residues into the grinding equipment at the roadside of forest stands and grinding and loading them into a truck. We assume a comminution cost of $30/bdt for the BDO Zone.
Transportation cost ($/bdt-km)	0.18-1.00	Such a wide range is due to the different road classes which impact the speed of the truck and the associated costs. We assume an average transportation cost of $0.33/bdt-km for the BDO Zone.
Road construction, maintenance, supervision and overhead ($/bdt)	4-9	End users of forest residues are usually charged for using the roads constructed by forest companies to transport sawlogs to their wood processing facilities. In addition, logistics crews need a supervisor for safe and coordinated operations to minimize interference with the logging operations and replanting and other silviculture activities. These costs are in the range of $4-9/bdt with an average amount of $8/bdt.
Timber due/royalty fee ($/bdt)	0.66	Timber dues, paid by the timber disposition holder, are paid upon the timber that the disposition holder takes to their facility. Harvest residues used to produce a saleable product do attract timber dues as well. The timber dues rate for timber below the utilization standard that has not otherwise been declared as waste is $0.27 per cubic metre in most instances (Personal communication with the Forestry Division of the Government of Alberta)
Delivered cost ($/bdt)	71.06	Forest residues are collected within a supply radius of 120 km with an average transportation distance of 80 km

As shown in Figure 21, low-grade logs incur an additional cost of harvesting which includes felling the timber, skidding it to the roadside and processing (deliming) the timber. This makes low-grade logs more expensive woody biomass resources compared to sawmill residues and forest residues. The harvesting cost for the full tree stem is estimated to be in the range of $68-$87/bdt, based on data provided by FPInnovations using their FPInterface model. The delivered cost of low-grade logs is estimated to be $120/bdt, which is about twice the delivered cost of forest residues collected within a supply radius of 120 km with an average transportation distance of 80 km.

Table 13 shows the summary of the delivered cost of low-grade logs to the gate of the biorefinery.

Table 13. Delivered cost of low-grade logs to the gate of the biorefinery.

Low-grade logs	Cost	Comment
Harvesting ($/bdt)	68-87	Harvesting cost includes felling the timber, skidding it to the roadside and processing (deliming) the timber. The harvesting cost for the full tree stem is estimated to be in the range of $68-87/bdt. We assume an average harvesting cost of $75/bdt that also includes costs associated with silviculture, crown charge and road construction and maintenance.
Roadside chipping	20-25	We assume average chipping cost of $20/bdt
Transportation cost ($/bdt-km)	0.18-1.00	Such a wide range is due to the different road classes, which impact the speed of the truck and the associated costs. We assume an average transportation cost of $0.33/bdt-km for the BDO Zone.
Delivered cost ($/bdt)	121.4	Low-grade logs are collected within a supply radius of 120 km with an average transportation distance of 80 km

Figure 22, Figure 23, and Figure 24 show the cost-supply curves for the three scenarios defined in Table 8. These figures show the potential availability of woody biomass in the BDO Zone depending on how much the biorefinery is willing to pay for the wood biomass as well as the type of biomass available. These cost-supply curves also show the estimated delivery cost of biomass based on the annual demand of the biorefinery. For example, if the annual woody biomass demand of the biorefinery is 250,000 bdt, the delivered cost is estimated to be $79/bdt, $82-$84/bdt in scenarios I, II and III, respectively.

For a biorefinery that aims to capture the entire underutilized woody biomass in the BDO Zone, the estimated delivery cost is estimated to be $84/bdt.

Figure 23. The cost-supply curve for Scenario II. This scenario represents the average potential of available woody biomass for future biorefinery projects.

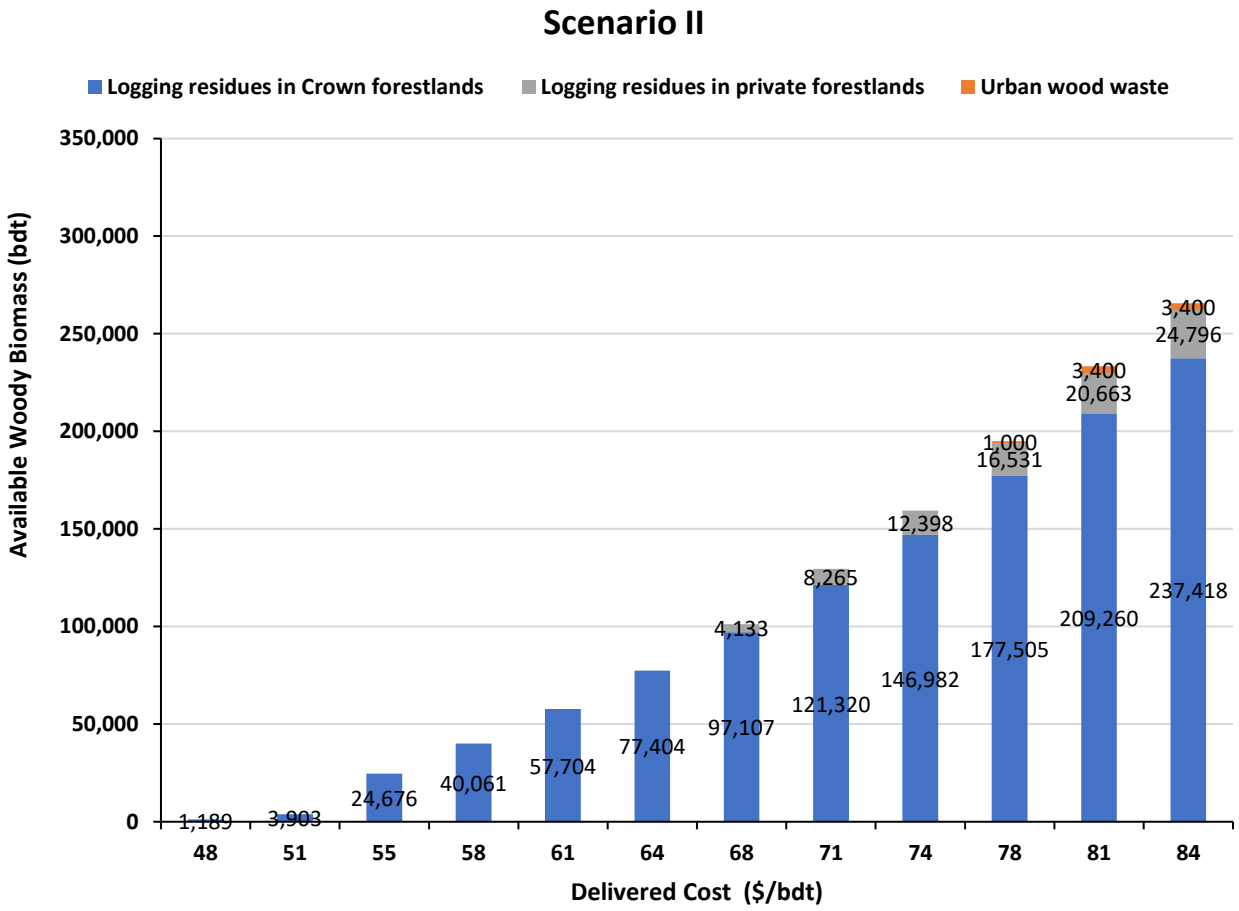
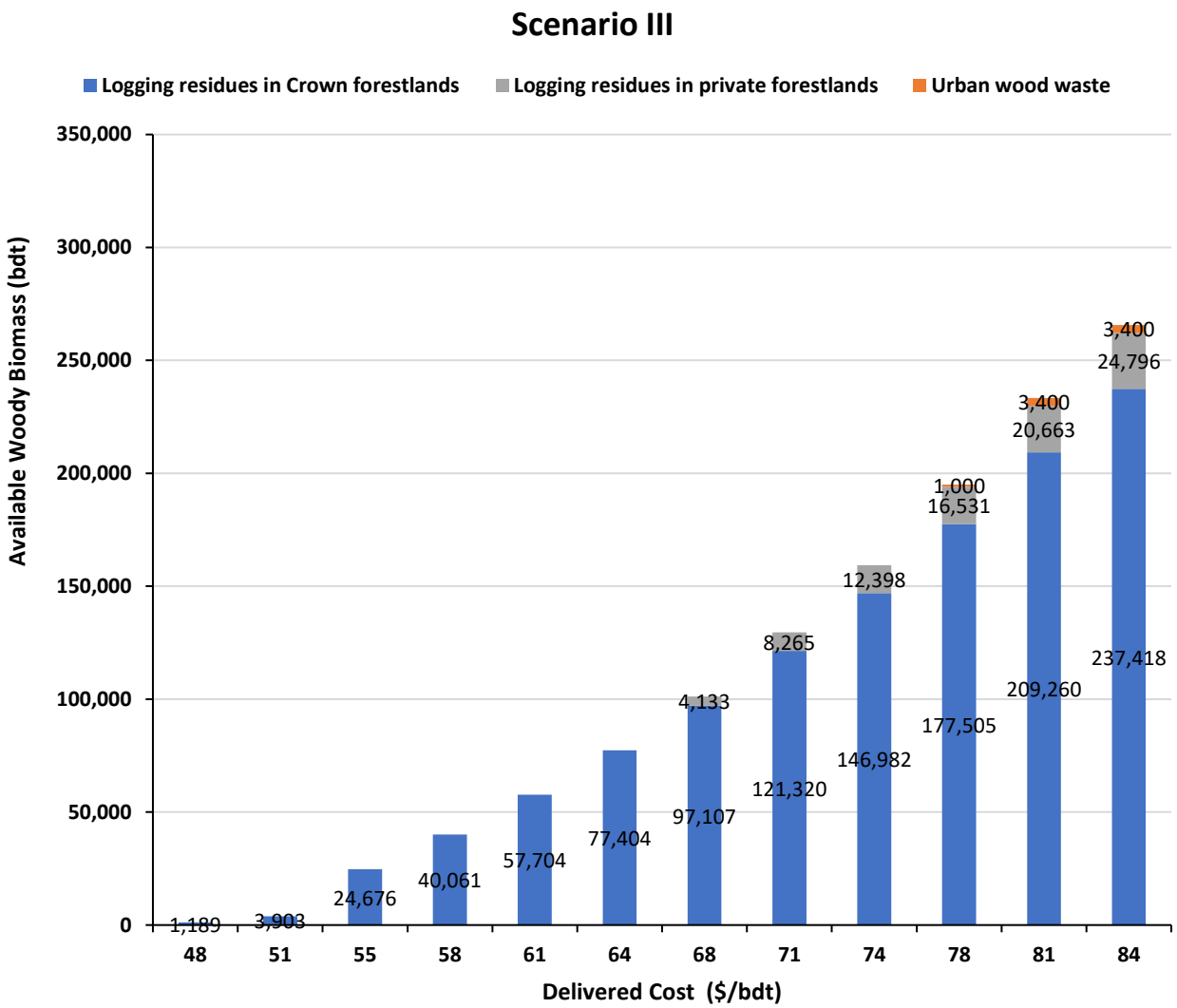


Figure 24. The cost-supply curve for Scenario II. This scenario represents the lowest potential of available woody biomass for future biorefinery projects.



APPENDIX C: INFRASTRUCTURE

Site selection of MD of Greenview and County of Grande Prairie, AB

LOCATION

Situated in northwest Alberta, the County of Grande Prairie, and the Municipal District (MD) of Greenview command expansive territories of 5,790.59 km^2 (2,235.76 sq mi) and 32,984 km^2 (12,735 sq mi) respectively. Geographical boundaries for the County of Grande Prairie are defined by the Wapiti River to the south, the Smoky River to the east, and the province of British Columbia to the west.

The MD of Greenview No. 16, conversely, is nestled in the southern portion of the Peace River Region, its western flank running along the Alberta-British Columbia border. This district stands as the third-largest rural municipality within Alberta, covering an impressive 32,915 square kilometers within the province's northwest. These expansive geographical territories present ample development opportunities for prospective investors. The sheer land area and strategic locations adjacent to provincial borders provide a unique blend of local access and cross-border proximity, a critical factor for projects requiring significant space or logistical advantages.

Map 1: Image of County of Grande Prairie and MD of Greenview.



POPULATION

Based on the 2021 Census of Population conducted by Statistics Canada, the County of Grande Prairie experienced a population expansion of 5.6% from its 2016 figure of 22,502, reaching a population of 23,769. These residents occupy 8,354 out of the region's 9,075 total private dwellings. On the other hand, the MD of Greenview recorded a population of 8,584, indicating a decrease of 6.2% from its 2016 population of 9,154. These residents are distributed across 3,230 of the total 3,955 private dwellings.

In terms of population density, the County of Grande Prairie has 4.1 individuals per square kilometer (10.6 per square mile). In comparison, the MD of Greenview has a sparser density of 0.3 individuals per square kilometer (0.7 per square mile).

This demographic data offers invaluable insight for potential investors and developers, outlining both the consumer market scale and the labor pool size in the region. The differential growth rates and population densities between the two areas highlight opportunities for tailored strategies, ranging from high-density urban projects in the County of Grande Prairie to more expansive, low-density ventures in the MD of Greenview.

EMPLOYMENT

The County of Grande Prairie reported a median income of $52.8k in 2019, with the median age recorded at 38.8. The total workforce in the County stands at 41,300, with diverse educational credentials: 24,505 individuals hold a high school diploma, 9,680 possess an apprenticeship or trade certificate, and 7,115 have attained a bachelor's degree. Key industries that drive employment in the County include Mining, Quarrying, Oil and Gas Extraction (employing 1,650 people), Construction (1,435), Retail trade (1,045), Agriculture, Forestry, and Fishing (1,005), and Transportation and Warehousing (915).

In contrast, the MD of Greenview and Grande Cache reported a median income of $45,552 in 2015, significantly higher than the national median income of $33,920. The workforce here is larger at 74,245, again with a diverse educational background: 43,920 with a high school diploma, 18,695 with an apprenticeship or trade certificate, and 11,630 with a bachelor's degree. Key sectors providing employment in this region are Trades, Transport and Equipment operations (1,210 people), Sales and service (725), Management (725), and Business, Finance, and Administration (595). To supplement the local labor pool and meet the region's current demands, approximately 5,148 workers are imported into the district.

This distinct demographic and economic landscape present numerous investment and development opportunities. The diverse workforce, rich industrial sectors, and considerable income levels are all promising indicators for potential investors and developers. The significant import of labor further underscores the region's demand for growth and expansion.

SITE SELECTION FOR GREENVIEW INDUSTRIAL GATEWAY (GIG)

The Greenview Industrial Gateway (GIG) signifies a pioneering stride in Northwestern Alberta's Clean Energy Manufacturing sector. Established as a leader in its field, GIG's goal is to develop a world-class eco-industrial complex, emphasizing the value-added petrochemical sector. This expansive project spans 2000 acres (809 hectares) nestled within the Montney Natural Gas deposit. It is strategically located in the Municipal District (MD) of Greenview, about 40 km south of Grande Prairie, AB. The GIG is primed to become Canada's first closed-loop industrial system, offering a comprehensive infrastructure suitable for manufacturing companies in the energy sector.

Capitalizing on its geographical advantage, GIG offers low-cost feedstock, critical for the processing and development of petrochemicals. Its positioning on the CANAMEX Trade Corridor opens pathways for local markets to connect with international markets in the United States and Mexico. Canada's vast rail network further enhances Greenview's logistics capabilities, connecting commodities to the ports of Kitimat, Prince Rupert, and Vancouver. Furthermore, Grande Prairie Airport, Alberta's fourth-largest airport, serves as a strategic transport node for business and leisure travelers, offering routes within Alberta and beyond. The region boasts a diverse demographic of skilled industrial workforce experienced in energy production, manufacturing, and processing.

Notably, Northern Petro Chemical Corporation has committed to purchase a 295-acre tract to establish a $2.5 billion Natural Gas to Blue Methanol and Blue Ammonia production facility. The project is projected to create 4,000 construction jobs and 400 full-time, permanent positions once completed. Moreover, the GIG is selling additional land parcels at a competitive cost.

Designed for industrial efficiency, GIG's on-site infrastructure includes access to process water, ATCO Electric, CN Rail Full Industrial Service, and a direct route to the TC Energy Main Distribution Line. Nearby gas plants, carbon-dioxide sequestration solutions, and ready pipeline access further enhance the industrial capabilities of the area.

Map 2: Image of County of Greenview Industrial Corridor.



On-site Infrastructure Overview:

- The Process-in and Exploration Centre, a pre-designed industrial park, provides a host of resources, including operational process water access, full industrial service by ATCO Electric and CN Rail, as well as a direct connection to the TC Energy Main Distribution Line, situated merely 650 meters away. It is strategically located adjacent to CNRL and ARC Resources Gas Plants.
- This site also offers a solution for carbon dioxide sequestration, incorporating a dedicated carbon capture hub. Its infrastructure facilitates efficient transport of low-cost natural gas feedstock to market.
- Greenview's Environmental Services Department oversees both the capital construction and daily operations of the region's water, wastewater, and solid waste systems. However, due to the size and population density variations within Greenview, service provisions may vary by location.

Site Selection for Greenview Industrial Gateway (GIG)

Big Mountain Industrial Park is another forward-thinking industrial hub located in the westerly portion of the MD of Greenview. It provides a light industrial district on a parcel of 43.7 ha (108 acres) for accommodating 19 industrial lots. It offers access to provincial infrastructure and a vacant, developable site in a verdant location, complete with all necessary utilities and services.

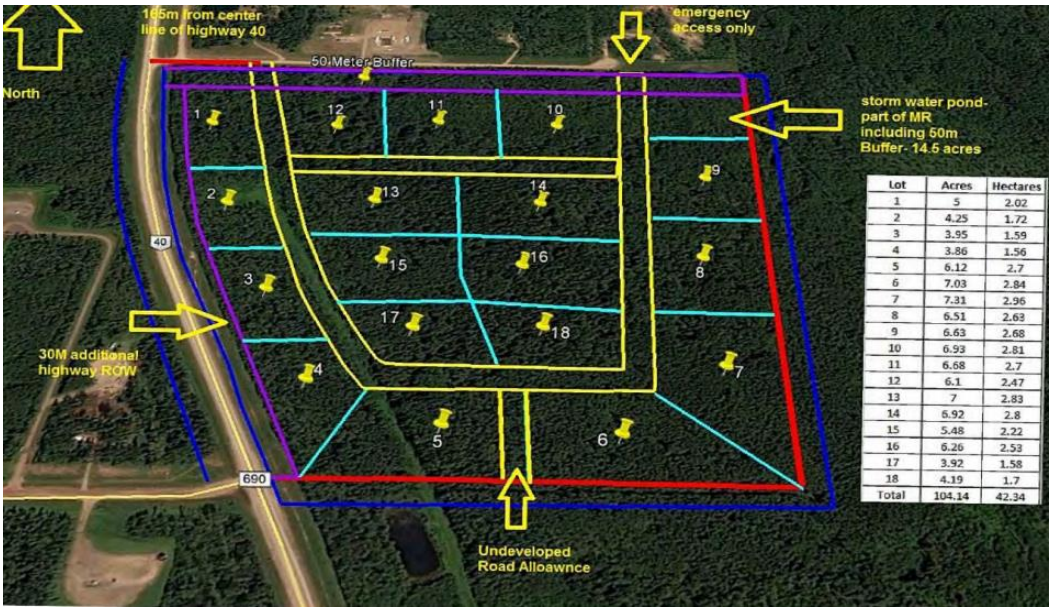
Both GIG and Big Mountain Industrial Park are ideal examples of strategic planning and collaboration between the Municipal District of Greenview and the Alberta Government. They represent the tremendous potential of Northwestern Alberta as a leader in sustainable industrial development, leveraging abundant natural resources and a skilled workforce to create opportunities for energy production and manufacturing. As such, they provide substantial opportunities for potential investors and project developers interested in contributing to the future of clean energy and industrial development in Canada.

The parcel, located southeast of Grovedale, on the east side of primary Highway 40, offers access to both the Two Lakes and Gold Creek areas, leveraging provincial infrastructure. With its landscape gently sloping 5% or less from southwest to northeast, the site is relatively flat. To ensure proper drainage, a stormwater management plan will be put in place during the subdivision application stage, if needed. Industrial operations within Big Mountain Industrial Park can also conveniently access Highway 40 through Township Road 690A.

On-site Infrastructure Overview:

- In terms of potable water supply, each lot owner will need to independently manage their water source, as the Developer will not drill any water wells onsite. Any required water wells must comply with the Alberta Water Act.
- For sanitary sewage collection, all systems will utilize sewage holding tanks. It falls on individual lot owners to oversee their sewage collection and disposal.
- Given the property's slight slope, drainage naturally flows from southwest to northeast. A stormwater pond will be set up as a public utility lot, accessible via the internal road.
- Electrical services will be managed and distributed by Atco Electric as per the Developer's request, while Atco Gas will handle natural gas distribution for the proposed properties.
- TELUS Communications will be the preferred service provider for communication services within the plan area.
- Emergency services will rely on the resources available in the MD of Greenview, with fire protection services being the responsibility of the Municipal District.

Map 3: Image of Big Mountain Industrial Park Parcel Layout.



Lot	Acres	Hectares
1	5	2.02
2	4.25	1.72
3	3.95	1.59
4	3.86	1.56
5	6.12	2.7
6	7.03	2.84
7	7.31	2.96
8	6.51	2.63
9	6.63	2.68
10	6.93	2.81
11	6.68	2.7
12	6.1	2.47
13	7	2.83
14	6.92	2.8
15	5.48	2.22
16	6.26	2.53
17	3.92	1.58
18	4.19	1.7
Total	104.14	42.34

Transportation Infrastructure Overview

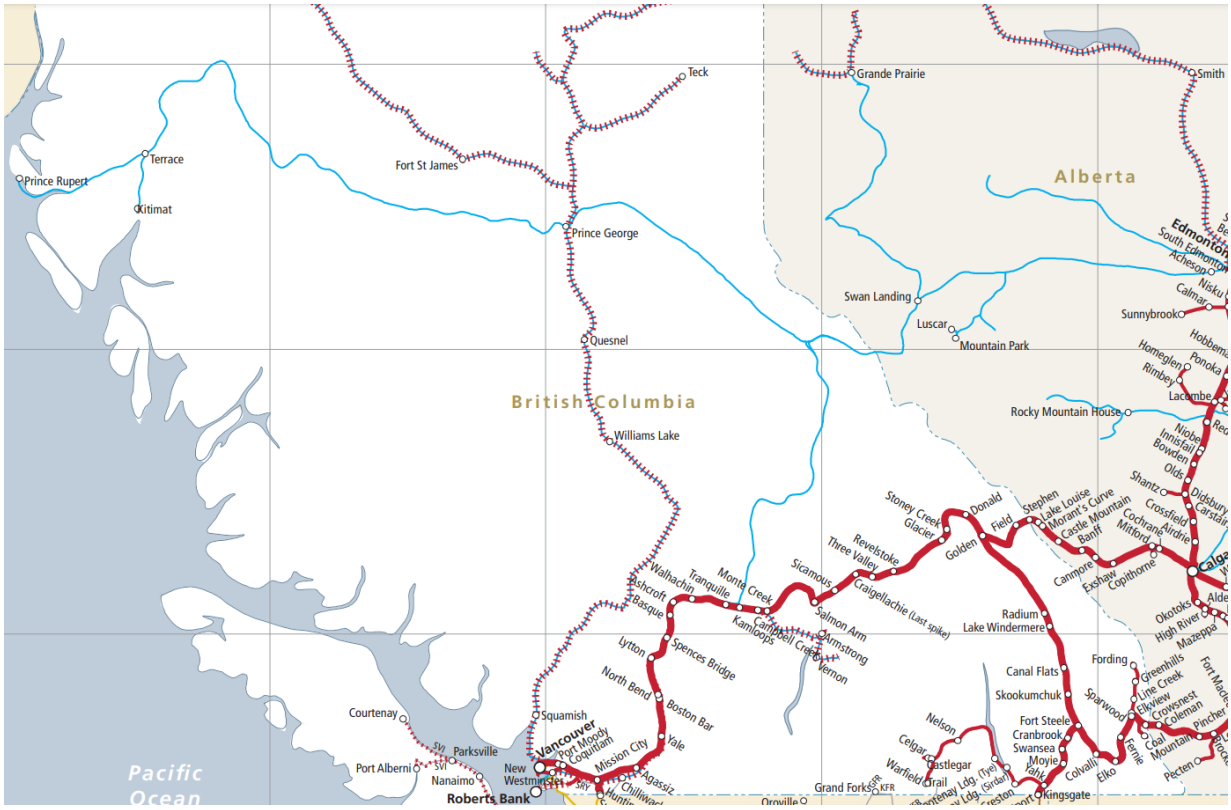
The road infrastructure in the County of Grande Prairie and the MD of Greenview is well-developed, with primary access to Highways 40, 43, and 49, offering extensive reach to various regions.

The rail system in the area is robust. The Grande Prairie Station is located 42 km and 105 km away from the County of Grande Prairie and MD of Greenview, respectively. The Northern Alberta Railway Station, situated at 98 km from the County of Grande Prairie and 230 km from the MD of Greenview, offers another reliable transportation choice. Additional rail connectivity comes from Edson Railway Station (353 km from the County of Grande Prairie and 272 km from MD of Greenview) and Edmonton Railway Station (491 km from the County of Grande Prairie and 410 km from MD of Greenview).

Ports also play a significant role in the area's transport infrastructure. The Port of Kitimat is positioned 1133 km and 1292 km away from the County of Grande Prairie and MD of Greenview, respectively. Meanwhile, the Port of Prince Rupert and the Port of Vancouver stand at distances of 1227 km and 1229 km from the County of Grande Prairie and 1379 km and 1089 km from the MD of Greenview, respectively.

In terms of air travel, the region is served by several airports. The Grande Prairie Airport is just 36 km from the County of Grande Prairie and 24 km from the MD of Greenview. Other airports include the Dawson Creek Airport (94 km from the County of Grande Prairie and 144 km from the MD of Greenview), Fort St. John Airport (168 km from the County of Grande Prairie and 300 km from the MD of Greenview), Prince George Airport (517 km from County of Grande Prairie and 669 km from MD of Greenview), and Edmonton International Airport (513 km from County of Grande Prairie and 439 km from MD of Greenview). These multiple transportation avenues make the region ideally positioned for various industrial activities.

Map 4: Rail and Ocean Transportation Network (Alberta + British Columbia).



APPENDIX D: LEGAL DISCLAIMER

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