Bioeconomy Development Opportunity Zone Rating: Quesnel, BC
Date of Issue: February 14, 2024
Rating Grade: **'A'**

A
High Quality

Rating Parameters:

Category	Rated Quantity	Delivered Cost	BDO Zone Size
Forest Residue	**100,000 odt/yr**	**$60-$110/odt**	**120-km drive distance from Quesnel, BS**

BDO Zone Assets

- **Experienced forestry contractors capable of supplying the rated quantity.**
- **A network of organizations and stakeholders interested in integrating forest residue recovery with existing value-added supply chains.**
- **Willingness of the BC Government to support the utilization of forest residue.**

BDO Zone Liabilities

- **Approximately ten additional chip vans and associated drivers would likely be required to ensure reliable supply of rated quantity.**
- **Significant decline in wood fibre availability and quality due to environmental disturbances and government policies.**
- **Long-term decline in regional forest industry productivity and workforce capacity.**

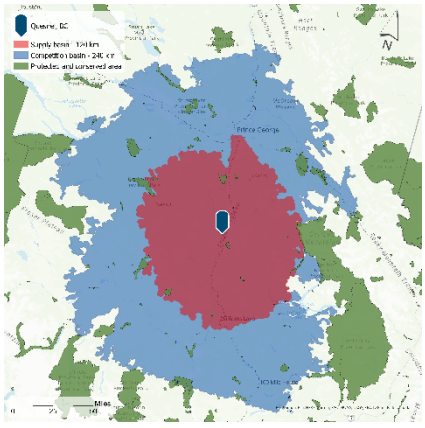
Rating Grade

The Quesnel, BC, Bioeconomy Development Opportunity Zone is rated 'A,' or 'low' risk.

Risk Rating Grades are defined as follows: AAA (*extremely low*), AA (*very low*), A (*low*), BBB (*low-moderate*), BB (*moderate*), B (*moderate-high*), and C (*high*).

'A' ratings denote high prospective viability of Feedstock Supply and Infrastructure and low expectations of default risk in the Zone. Capacity to support new biobased plant operations is considered strong. This capacity may, nevertheless, be more vulnerable to adverse weather, supply chain, economic, or infrastructure conditions than is the case for higher ratings.

Quesnel, BC BDO Zone



Scoring & Rating Methodology

In assessing the biomass supply chain risk for the Bioeconomy Development Opportunity (BDO) Zone, 72 Risk Indicators from the Canadian Standards for Biomass Supply Chain Risk (BSCR) were applied. These BDO Zone Risk Indicators are the subset of BSCR Risk Indicators applicable to evaluating feedstock risk within a BDO Zone.

Feedstock quantities are expressed in oven-dry tonne (odt) While feedstock costs are expressed in Canadian dollars (CAD). Maximum transport distance is based on a 120-km driving distance from the centre point (City of Quesnel, BC).

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 Risk Likelihood (RRL)** score which denotes the <u>likelihood</u> of a risk to future BDO Zone projects due to the Risk Indicator. RRL Scores are scaled as either *very low* (2), *low* (4), *medium* (6), *high* (8), or *very high* (10).

Each BDO Zone Risk Indicator is given a **Raw Risk Impact (RRI)** score which denotes the <u>impact</u> on a future BDO Zone project due to the Risk Indicator. RRI scores are scaled as either *very low* (2), *low* (4), *medium* (6), *high* (8), or *very*

high (10). Impact level scores are based on the impact level of a risk on the successful development and deployment of a BDO Zone project with no mitigation measures.

The **Gross Risk Indicator (GRI)** score is calculated as the product of the RRL and the RRI scores. For example, if an indicator is assigned a RRL of 2 and a RRI of 8, the GRI for this risk indicator is $2 \times 8 = 16$.

If the analyst deems that a typical bio-based project could put in place economically reasonable measures or best practices that mitigate either the likelihood (RRL) or the impact (RRI), or both, then the GRI will be notched accordingly.

The **Loaded RI** score for each Risk Indicator is calculated as the product of the Total Notch and the GRI score, which is the final score for that indicator.

Loaded RI scores of 4 or less are deemed *very low risk*; scores between 5 and 16 are deemed *low risk*; scores between 17 and 36 are deemed *medium risk*; scores between 37 and 64 are deemed *high risk*; and scores of 65 and greater are deemed *very high risk*.

The total risk rating for the BDO Zone is the average of all Loaded RI scores. The BDO Zone score for Quesnel BDO Zone is ***20.56 out of 100, resulting in an 'A' designation***.

All scoring and rationale for each Risk Indicator are provided in Appendix B.

Analyst Notes

The Quesnel BDO Zone (defined by a 120-km drive distance from the city of Quesnel) encompasses an area of 2,550 square km in central British Columbia. The Quesnel BDO Zone is located on the Interior plateau between the Coast Mountains to the west and the Cariboo Mountains to the east. Forests consist primarily of lodgepole pine (85%) and spruce (10%).

In recent years, major natural disturbance events in the form of a mountain pine beetle (MPB) outbreaks and severe wildfires have significantly reduced the availability of high value timber in the region (i.e., allowable annual cut (AAC), harvest levels, and sawlog availability has declined significantly). Further decreases are expected due to a government ban on old-growth harvesting, Indigenous land claim settlements, and continued forest fires.

Our analysis and outreach have indicated that all small diameter roundwood (i.e., pulpwood) and sawmill residue currently produced in the Quesnel BDO Zone are fully utilized by local pulp mills, pellet mills, and power/cogeneration facilities currently operating in the Competition Zone (240-km drive distance from Quesnel).

Given that the availability of forest resources is declining, no pulpwood or sawmill residue are expected to be available for new bio-projects in the foreseeable future (e.g., the next ten years). Although some forest management intensification initiatives, such as commercial thinning, are being planned in the region, resulting volumes could still be easily consumed by existing competitors. Thus, quantities of pulpwood and sawmill residue potentially available for new projects were not rated.

We conclude that proponents of new bio-projects in the BDO Zone will likely be restricted to the utilization of forest residue, including branches, stem tops, and other unmerchantable components of trees that cannot be sectioned into pulp logs or sawlogs. Given current harvesting levels, we estimate that a total of 100,000 odt/yr of forest residues could be available to new bio-projects at low risk. Much of the equipment and experience relevant to forest residue supply chains is already present in the region and can likely be scaled-up to the rated quantity over 2-3 years with investments incentivized through favorable offtake agreements. The required increase in forest residue supply capacity to obtain this quantity would be achievable over a relatively short scale-up period.

BDO Zone Assets

Many forest companies and logging/grinding contractors in the region are experienced in forest residue supply and both terminal (wood room) and in-woods comminution systems have been used. Several in-woods operations of various sizes exist today and involve the use of diesel-powered

mobile grinders with chip van transport to destination. In recent years, forest residue production in the BDO Zone has amounted to only a small quantity (15,000 - 25,000 odt/yr).

A strong network of organizations and stakeholders interested in integrating forest residue recovery with existing value-added supply chains are present in the region. This includes local First Nations, forest products companies, the City of Quesnel, the BC Pulp and Paper Coalition, and the public at large. There is a long-standing interest in maximizing utilization of harvested wood fibre via integrated one-pass operations.

Programs and institutions dedicated to the objective of increasing forest residue utilization include the Forest Enhancement Society of BC (FESBC), B.C. Centre for Innovation and Clean Energy (CICE) and the Bio-Hubs initiative. These initiatives have allocated funds for the purpose of establishing forest residue supply chains.

In addition, the Government of BC has biomass policies in place for forest slash removal that could greatly increase the likelihood of large-scale forest residue supply chains in the region. Discussions around policies and programs for promoting utilization of fire-damaged stands (approx. 600,000 m^3) are also ongoing. Recovery of sawlogs and pulpwood in salvage and thinning operations could lead to increased availability of forest residue, providing further assurances over the long-term for the rated quantity of woody biomass.

BDO Zone Liabilities

One of the most relevant liabilities is related to the reliance of the local forestry sector on the production of the highest value products: sawlogs and peeler/veneer logs. With the closing of several large sawmills in the area since 2008, the forest industry in the Prince George – Quesnel – Williams Lake forestry corridor has declined significantly.

Wood fibre availability in the region has been negatively affected by the mountain pine beetle (MPB) outbreak of the early 2000s and repeated, high intensity, large forest fires (particularly in 2017/2018). The initial large increase in the Allowable Annual Cut (AAC) levels to encourage salvaging of MPB affected or killed stands ended and, in the past decade, AAC volumes in the region have decreased by more that 30-35%. Moreover, harvest levels have declined by up to 25%. Government old growth deferrals, while currently being locally mitigated through the Forest Landscape Planning process, and severe weather events may further decrease roundwood availability. As a result, the only reliable sources of wood fibre for new bio-projects in the next 10-20 years are forest residues.

Over the past decade, diesel prices have increased by more than 50%. This increase can be greatly attributed to the Government of Canada and BC Government climate policies, including carbon taxes and global fossil fuel logistics and politics. Capital costs of equipment have also increased considerably following the COVID-19 pandemic and associated government policies. Increases in fuel and capital costs have led to increases in trucking rates and these costs are expected to continue increasing; which may have a significant impact on forest residue availability in the price range considered for the rated quantity.

Infrastructure Profile

The city of Quesnel is centrally located on the Prince George – Quesnel – Williams Lake forestry corridor and has been for several decades, since WWII, a forestry town. By 1952 there were 180 sawmills and 5 planer mills within a 30-mile radius of Quesnel. As the decade progressed, the number of mills declined, as operations were consolidated into larger companies[1].

Today, the steam plumes from the pulp and paper mills, the logging trucks, and chip vans are common daily occurrences for the citizens of Quesnel, many of which are employed in the local forestry

[1] www.quesnel.ca/our-community/about-quesnel/history-quesnel

sector. Even after years of capacity curtailments, mill closures and a global pandemic, forestry and wood processing are still the major job generators in Quesnel.

This forest-based community has developed over the years a large, sustainable, heavy industrial area on both sides of the Quesnel River. With the recent mill curtailments, several sites are available for a new entrant.

The site proposed for this study is a 52-ha brownfield located on the east bank of the Quesnel River where a former sawmill was located. The site is conveniently located beside the Cariboo Pulp and Paper Mill and could capitalize on existing infrastructure. While all utilities, including the rail spur, scales, water, electricity, and natural gas have been dismantled upon closing, they can be reconnected.

The site is privately owned by West Fraser Mills Ltd. which is open to collaborating with new entrants. As collaboration between the new entrant and this forest company may be necessary to access forest residue in the BDO Zone, securing a long-term lease and/or purchase will likely be required.

Highway 97 is 3 kilometers from the site and road access in all directions is paved and well maintained. Proximity to the pulp mill may result in availability of steam, heat, and renewable electricity from the cogeneration plant. Wastewater treatment infrastructure at the pulp mill could also be leveraged. All of the above factors make the infrastructure ideal for a new forest biomass operation.

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Figure 1: Risk Indicators (Sorted by Risk Level)

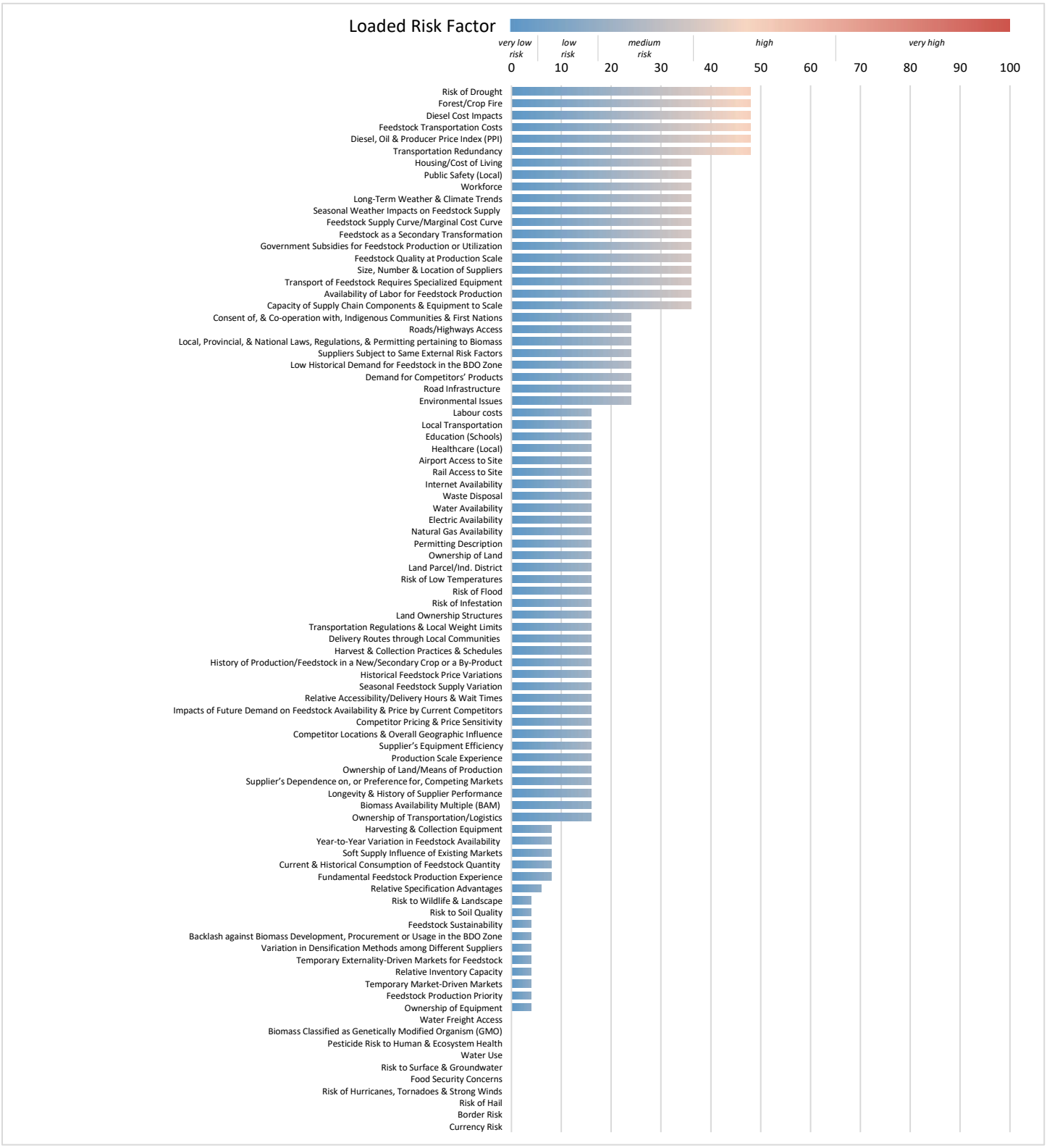

Table 1: Risk Indicators and Associated Scores

	Feedstock Supply Chain Risk Indicators	Raw Risk Likelihood	Raw Risk Impact	Gross Risk Indicator	Mitigation /Notching	Loaded RI Score
	Category 1.0: Supplier Risk					
1.1.1	Longevity & History of Supplier Performance	4	4	16	NN	16
1.2.1	Supplier's Dependence on, or Preference for, Competing Markets	4	4	16	NN	16
1.3.1	Ownership of Land / Means of Production	4	4	16	NN	16
1.3.2	Ownership of Equipment	2	2	4	NN	4
1.3.3	Ownership of Transportation/Logistics	4	4	16	NN	16
1.3.4	Feedstock as a Secondary Transformation	6	6	36	NN	36
1.4.1	Fundamental Feedstock Production Experience	4	2	8	NN	8
1.4.2	Production Scale Experience	4	4	16	NN	16
1.5.1	Supplier's Equipment Efficiency	4	4	16	NN	16
1.6.1	Feedstock Production Priority	2	2	4	NN	4
	Category 2.0: Competitor Risk					
2.1.1	Competitor Locations and Overall Geographic Influence	4	4	16	NN	16
2.1.2	Current and Historical Consumption of Feedstock Quantity	4	2	8	NN	8
2.1.3	Competitor Pricing and Price Sensitivity	4	4	16	NN	16
2.1.4	Impacts of Future Demand on Feedstock Availability and Price by Current Competitors	4	4	16	NN	16
2.1.5	Soft Supply Influence of Existing Markets	4	2	8	NN	8
2.1.6	Temporary Market-Driven Markets	2	2	4	NN	4
2.2.1	Relative Inventory Capacity	2	2	4	NN	4
2.2.2	Relative Accessibility / Delivery Hours and Wait Times	4	4	16	NN	16
2.2.3	Relative Specification Advantages	4	4	16	NN	16
2.2.4	Demand for Competitors' Products	4	6	24	NN	24
	Category 3.0: Supply Chain Risk					
3.1.1	Biomass Availability Multiple (BAM)	4	4	16	NN	16
3.1.2	Feedstock Supply Curve / Marginal Cost Curve	6	6	36	NN	36
3.1.3	Seasonal Feedstock Supply Variation	4	4	16	NN	16
3.1.4	Year-to-Year Variation in Feedstock Availability	4	2	8	NN	8
3.2.1	Historical Feedstock Price Variations	4	4	16	NN	16
3.2.2	Low Historical Demand for Feedstock in the BDO Zone	6	4	24	NN	24
3.2.3	History of Production/Feedstock in a New/Secondary Crop or a By-Product	4	4	16	NN	16
3.3.1	Diesel, Oil and Producer Price Index (PPI)	6	8	48	NN	48
3.3.2	Currency Risk	NR	NR	NR	NN	NR
3.3.3	Border Risk	NR	NR	NR	NN	NR
3.3.4	Temporary Externality-Driven Markets for Feedstock	2	2	4	NN	4
3.4.1	Harvest and Collection Practices and Schedules	4	4	16	NN	16
3.4.2	Harvesting and Collection Equipment	4	2	8	NN	8
3.4.3	Variation in Densification Methods among Different Suppliers	2	2	4	NN	4
3.4.4	Availability of Labour for Feedstock Production	6	6	36	NN	36
3.5.1	Feedstock Transportation Costs	6	8	48	NN	48
3.5.2	Diesel Cost Impacts	6	8	48	NN	48
3.5.3	Transport of Feedstock Requires Specialized Equipment	6	6	36	NN	36
3.5.4	Delivery Routes through Local Communities	4	4	16	NN	16
3.5.5	Transportation Regulations and Local Weight Limits	4	4	16	NN	16
3.5.6	Road Infrastructure	6	4	24	NN	24
3.5.7	Transportation Redundancy	8	6	48	NN	48
3.6.1	Size, Number and Location of Suppliers	6	6	36	NN	36
3.6.2	Suppliers Subject to Same External Risk Factors	4	6	24	NN	24
3.6.3	Land Ownership Structures	4	4	16	NN	16
3.7.1	Seasonal Weather Impacts on Feedstock Supply	6	6	36	NN	36
3.7.2	Long-Term Weather and Climate Trends	6	6	36	NN	36
3.7.3	Forest / Crop Fire	6	8	48	NN	48
3.7.4	Risk of Infestation	4	4	16	NN	16
3.7.5	Risk of Hail	NR	NR	NR	NN	NR
3.7.6	Risk of Flood	4	4	16	NN	16
3.7.7	Risk of Drought	6	8	48	NN	48
3.7.8	Risk of Hurricanes, Tornadoes and Strong Winds	NR	NR	NR	NN	NR
3.7.9	Risk of Low Temperatures	4	4	16	NN	16
3.8.1	Government Subsidies for Feedstock Production or Utilization	6	6	36	NN	36
3.8.2	Local, Provincial, and National Laws, Regulations, and Permitting pertaining to Biomass	4	6	24	NN	24
3.8.3	Backlash against Biomass Development, Procurement or Usage in the BDO Zone	2	2	4	NN	4
3.8.4	Consent of, and Co-operation with, Indigenous Communities and First Nations	4	6	24	NN	24

3.8.5	Food Security Concerns	NR	NR	NR	NN	NR
3.9.1	Feedstock Sustainability	2	2	4	NN	4
3.9.2	Risk to Soil Quality	2	2	4	NN	4
3.9.3	Risk to Surface and Groundwater	NR	NR	NR	NN	NR
3.9.4	Water Use	NR	NR	NR	NN	NR
3.9.5	Pesticide Risk to Human and Ecosystem Health	NR	NR	NR	NN	NR
3.9.6	Risk to Wildlife and Landscape	2	2	4	NN	4
3.9.7	Biomass Classified as Genetically Modified Organism (GMO)	NR	NR	NR	NN	NR
	Category 4.0: Feedstock Scale-up Risk					
4.1.1	Feedstock Quality at Production Scale	6	6	36	NN	36
4.1.2	Capacity of Supply Chain Components and Equipment to Scale	6	6	36	NN	36
	Category 5.0: Infrastructure					
5.1.1	Land Parcel/Ind. District	4	4	16	NN	16
5.1.2	Ownership of Land	4	4	16	NN	16
5.1.3	Permitting Description	4	4	16	NN	16
5.1.4	Environmental Issues	4	6	24	NN	24
5.2.1	Natural Gas Availability	4	4	16	NN	16
5.2.2	Electric Availability	4	4	16	NN	16
5.2.3	Water Availability	4	4	16	NN	16
5.2.4	Waste Disposal	4	4	16	NN	16
5.2.5	Internet Availability	4	4	16	NN	16
5.3.1	Roads/Highways Access	6	4	24	NN	24
5.3.2	Rail Access to Site	4	4	16	NN	16
5.3.3	Airport Access to Site	4	4	16	NN	16
5.3.4	Water Freight Access	NR	NR	NR	NN	NR
5.4.1	Healthcare (Local)	4	4	16	NN	16
5.4.2	Education (Schools)	4	4	16	NN	16
5.4.3	Local Transportation	4	4	16	NN	16
5.4.4	Public Safety (Local)	6	6	36	NN	36
5.4.5	Housing/Cost of Living	6	6	36	NN	36
5.5.1	Workforce	6	6	36	NN	36
5.5.2	Labour Costs	4	4	16	NN	16
					Average	**20.56**

Quesnel, BC BDO Zone Independent Review Committee (IRC)

Erin Robinson – Forestry Initiatives Manager, City of Quesnel
Amy Reid – Manager of Economic Development & Tourism, City of Quesnel
Sandy Ferguson – Senior Advisor, Bioeconomy Initiatives, Foresight Canada
Jacob Atherton – Manager, BC Ecosystems, Foresight Canada
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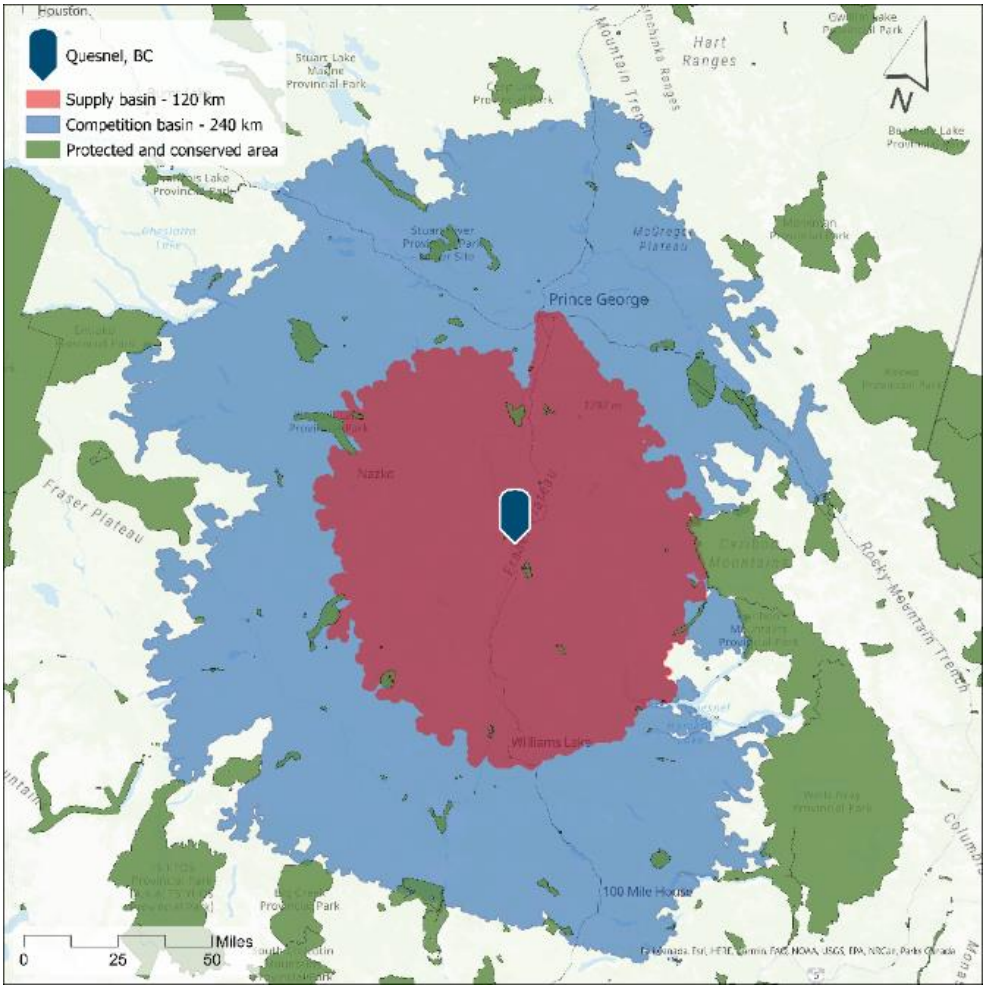
Christopher Elden – Inventory Forester, West Fraser, Quesnel BC
Stuart Lebeck – Woods Manager, West Fraser, Quesnel BC
Florian Bergoin – Natural Resources Manager, Nazko Nation
Bob Simpson – Independent Insights Consulting
Jean Christie – Jean Christie Consulting, Lhtako Dene Nation
Curtis Fenton – Chief Forester, Dunkley Lumber
Sean Fogarty – Esdilagh Nation
Ian Hannah – District Manager, Ministry of Forests
Joe Nemeth – Director, BC Pulp & Paper Coalition

APPENDIX A: BIOMASS AVAILABILITY AND PRICING

OVERVIEW

BDO Zone Risk Indicators are scored with reference to specific feedstock quantities and prices. The rated feedstock quantities are determined by estimating the potential amount of each woody biomass type (i.e., sawmill residue, forest residue, and pulpwood) that can be produced within the BDO Zone (120-km drive distance from Quesnel, BC). This estimate of total potential is reduced based on the expected demand for woody biomass in the Competition Zone (240-km drive distance from Quesnel, BC). Finally, a Biomass Availability Multiple (BAM) further reduces the estimated amount based on informed supply chain constraints (e.g., operational, accessibility, and market constraints). Consequently, the resulting rated feedstock quantities are conservative, low risk estimates of availability for new projects. The price range associated with each rated quantity is determined through outreach and market analysis in the Competition Zone and reflects the anticipated price that a new bio-project would have to pay to secure the rated quantity of biomass. The Quesnel BDO Zone/BDO Zone and Competition Zone are shown on Map A-1.

Map A-1: Map of BDO Zone (red) and Competition Zone (blue)



Woody Biomass Types Assessed in the BDO Zone

Forest residues: Components of trees that cannot be sectioned into logs (i.e., sawlogs or pulp logs), including material with a large-end diameter <1 inch as well as material that is too short or crooked to be efficiently loaded onto logging trucks. Examples include branches, stem tops, stem bottoms, and portions of merchantable stems that break during forest operations. To recover forest residues and transport them to market, mobile chippers/grinders are first employed to comminute them before transportation. Alternatively, loose forest residue can be loaded onto specialized trucks with comminution at terminal yards or at the site of end-use.

Pulpwood: Roundwood that cannot be utilized in the production of pulp and paper products, but also of lumber and other value-added wood products.

Sawmill residue: Byproducts of sawmill operations, produced from conversion of sawlogs into finished wood products such as lumber and engineered wood. A typical softwood lumber mill converts about 60% of sawlogs into finished wood products. The remaining portion (40%) of sawn timber is transformed during milling into sawmill residue, including wood chips, sawdust, shavings, and bark (also known as hog fuel).

Natural disturbance salvage: Forest biomass – including entire trees and components of trees (e.g., branches, stems) – that is affected by natural disturbance events such as wildfires, insect outbreaks, and extreme wind events.

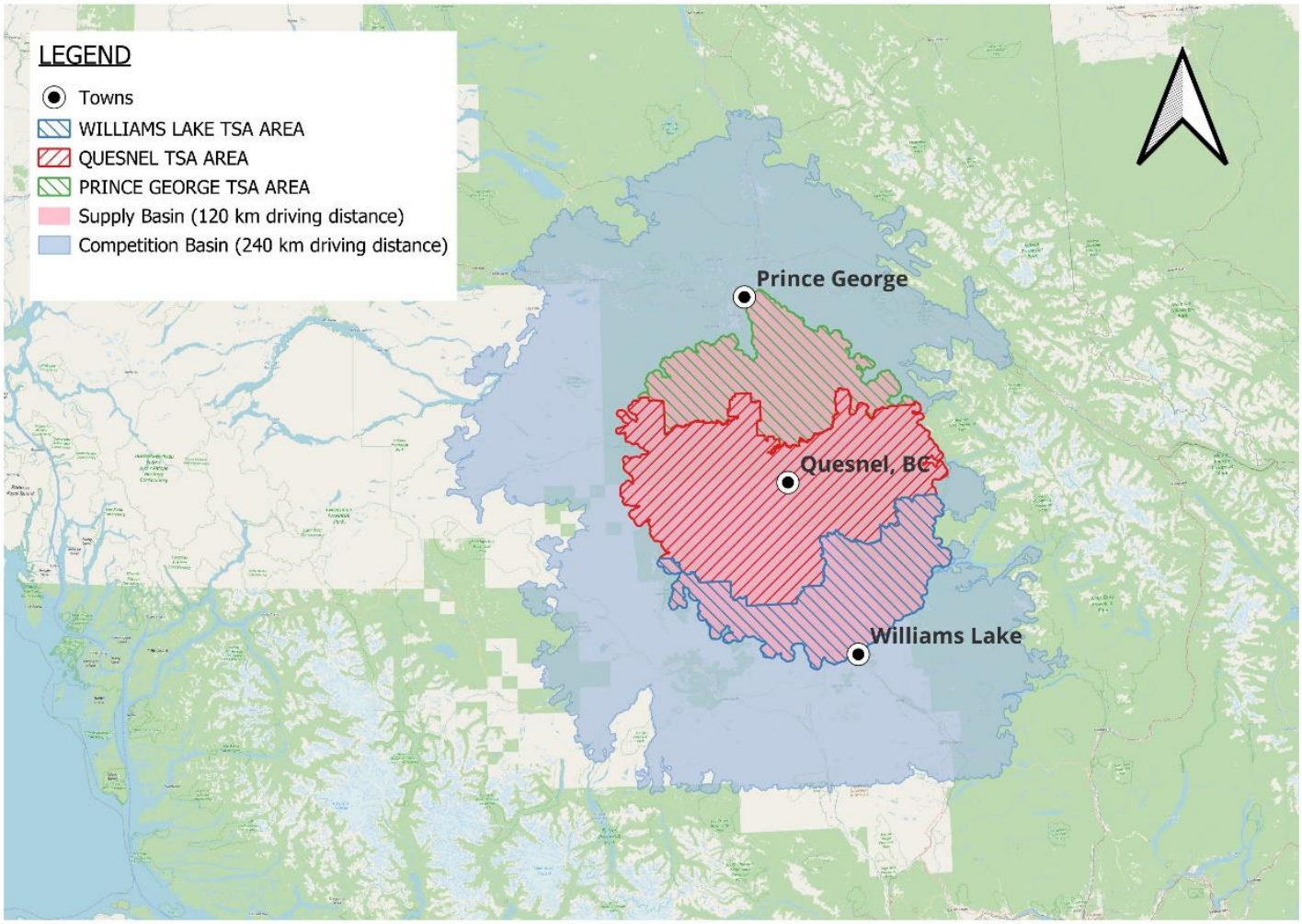
Woody Biomass Availability in the BDO Zone

Analysis and outreach confirmed that **pulpwood and sawmill residue that are produced annually as by-products of sawlog production and value-added manufacturing in the Quesnel BDO Zone are fully utilized by existing competitors**. There are opportunities to salvage sawlogs, pulp logs, and forest residue from forests that have been affected by fire and insect infestation in the region (up to 600 million m^3), but the costs of salvage operations are prohibitive. We therefore expect that **new bio-projects will be restricted to forest residue over the next 5-10 years.**

Forest residue is produced as a consequence of harvesting operations in the region. Harvesting operations occur largely within publicly owned ("Crown") forests, including in government-designated Timber Supply Areas (TSAs) and Tree Farm License (TFL) areas.[2] Three TSAs make up most of the area of the BDO Zone (Map A-2). Three TFL areas are embedded within the TSAs. Although smaller in size, the TFLs make important contributions to annual wood supply.

[2] The main difference between TFL and TSA tenures is that wood fibre allocations under TFLs are tied to specific areas over time whereas TSA allocations are not subject to specific area and time constraints.

Map A-2: Map of Timber supply areas (TSAs) within the Quesnel BDO Zone



NOTE: only the TSA areas within the BDO Zone are shown

Given recent harvesting levels (Table A-1), approximately 390,000 odt/yr of forest residue could be available from TSA and TFL areas in the Quesnel BDO Zone. With improvements in government allocation and industry performance, the utilization of the entire AAC volume could result in an annual supply of approx. 500,000 odt/yr of forest residue. The development of a new community forest (Three Rivers Community Forest) is not expected to increase the amount of forest residue available, as part of the AAC for the Quesnel TSA will be transferred to the community forest. For more detailed information on these tenure areas, AAC, and harvest volumes for different tenure types in the Quesnel BDO Zone please see Table C-1 in Appendix C.

Table A-1: Potential availability of forest residue given recent AAC and harvesting levels (2023)

Source[3]	ACC in BDO Zone (m^3/yr)	Harvest Level in BDO Zone (m^3/yr)	AAC-Based Forest Residue estimate (odt/yr)*	Harvest-based Forest Residue estimate (odt/yr)*
Quesnel TSA	1,690,000	1,200,000	226,460	160,800
TFL 52	592,500	550,000	79,395	73,700
Prince George TSA	552,000	425,000	73,968	56,950
Williams Lake TSA	440,625	275,000	59,044	36,850
TFL 53	219,000	219,000	29,346	29,346
TFL 30	330,000	250,000	44,220	33,500
TOTAL	**3,824,125**	**2,919,000**	**512,433**	**391,146**

*Assumes that 0.134 odt of forest residue are produced per m^3 of roundwood.[4]

Wood fibre availability in the region has been negatively affected by the mountain pine beetle (MPB) outbreak and repeated, high-intensity, large-area forest fires (particularly in 2017/2018). The initial large increase in AAC to encourage salvaging of MPB-affected or -killed stands ended and, in the past decade, the AAC volumes in the Quesnel, Prince George, and Williams Lake TSAs have decreased by 30-35%. Moreover, the total harvest level in 2023 was approx. 25% below the AAC level. Government old growth deferrals, while currently being locally mitigated through the Forest Landscape Planning process, and severe weather events may further decrease roundwood availability. However, this reduction is accounted for in the rated quantity.

Note that most harvesting activity in the next 10 years is expected to come from central parts of the TSA and areas east of the Fraser River. This is because (1) stands west of the Fraser River were disproportionately impacted by the 1997-2014 MPB outbreak of 2004 (peak year of MPB attack) and (2) TFL areas are concentrated east of Quesnel. TFLs are long-term, area-based tenures that guarantee future wood supply to companies in designated areas. As such, TFLs incent companies to make investments that increase growth-and-yield (G&Y). This is evidenced by the current commercial thinning potential of the TFLs in the area, which is the result of continuous silvicultural investments since the early 1990s. There is currently no incentive within TSAs for investments in G&Y optimization because tenure is not tied to specific areas. Companies are allocated harvestable timber volumes that can be procured from anywhere within the TSA. The allocated harvestable timber volume is not guaranteed year-to-year and therefore provides no incentives for G&Y optimization and associated silvicultural treatments (e.g., commercial thinning).

Woody Biomass Demand in the Competition Zone

We estimate that in recent years between 15,000 and 25,000 odt/yr of forest residue has been utilized in the BDO Zone, equivalent to < 7% of total potential forest residue supply. Forest residue is currently utilized as fuel in the cogeneration units at the Quesnel-based Cariboo Pulp & Paper mill. The pellet mill in Meadowbank (Drax) also has recent experience procuring forest residue. There are a total of thirteen potential consumers of sawmilling and forest residues in the Competition Zone that include cogeneration, bio-power, and pellet mills (Table A-2, Map A-3). Forest residue supply chains supporting the Quesnel pulp mill and Drax Meadowbank pellet mill currently involve mobile comminution and chip van

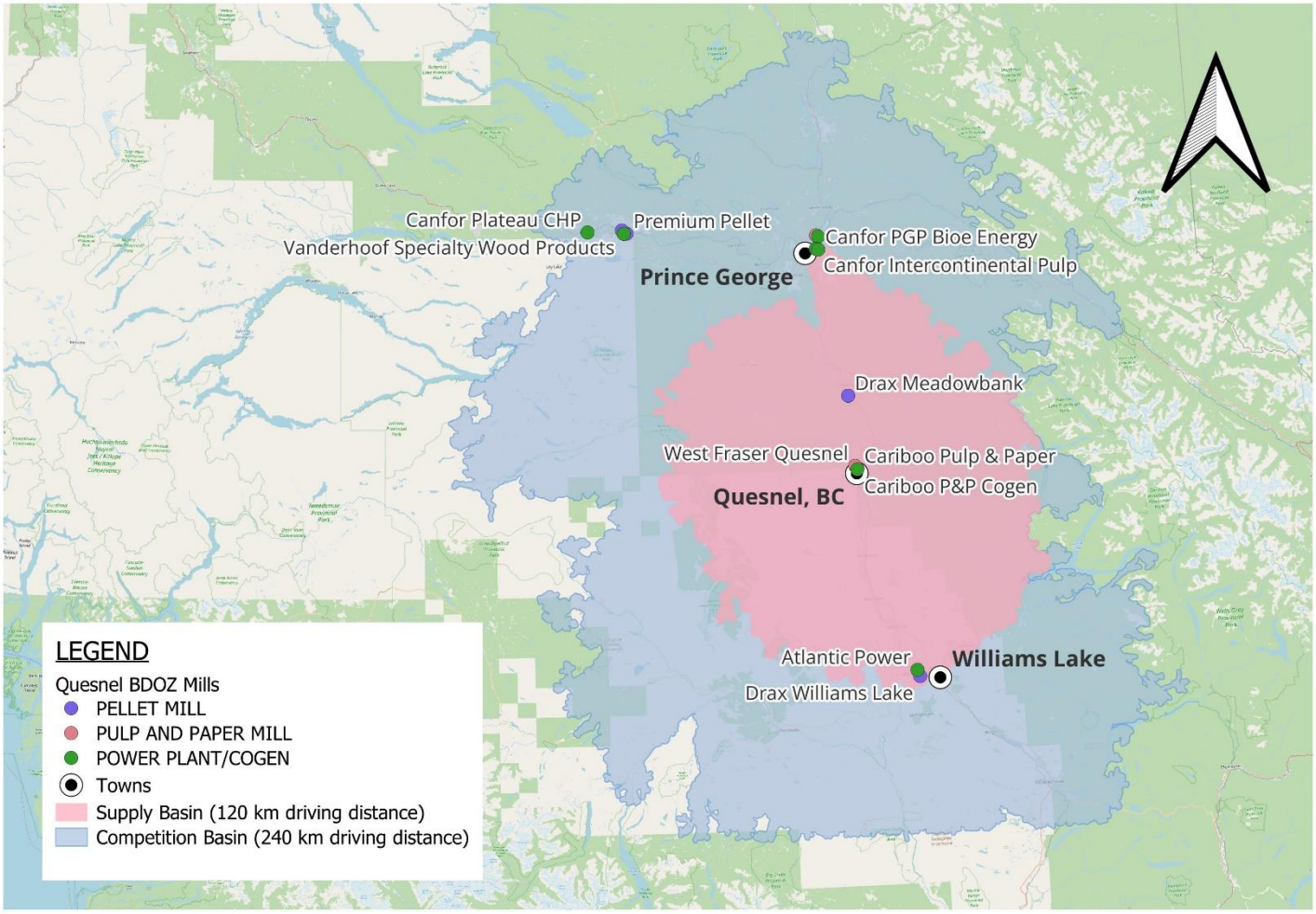
[3] AAC and harvesting levels for the Quesnel, Prince George, and Williams Lake TSAs include values for replaceable and non-replaceable forest licenses, First Nations Woodlands licenses, BC Timber Sales, Community Forest Agreement, and Forest Service Reserve.
[4] www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/timber-tenures/fibre-recovery/tr2018n7.pdf

transport. During the late 2000s/early 2010s, supply chains also involved loose residue transport in roll-off bin trucks with terminal comminution.

Table A-2. Existing and potential consumers of forest residue within a 240-km drive distance of Quesnel

Name – Location	Distance from Quesnel (km)	Type	Estimated Demand from Quesnel BDO Zone (odt/yr)
Cariboo Pulp & Paper – Quesnel	0	Cogeneration	150,000
West Fraser – Quesnel	0	Cogeneration	90,000
West Fraser – WestPine MDF	0	Cogeneration	25,000
Drax Meadowbank – Cariboo	46	Pellet mill	175,000
Atlantic Power – Williams Lake	116	Biopower	50,000
Drax – Williams Lake	120	Pellet mill	65,000
Canfor Intercontinental Pulp / Intercon Green Power – Prince George	128	Cogeneration	15,000
Canfor Intercontinental Pulp / PGP Bio Energy Project – Prince George	128	Cogeneration	30,000
Canfor Northwood Pulp / Northwood Green Power – Prince George	128	Cogeneration	40,000
Premium Pellet – Vanderhooof	218	Pellet mill	2,500
Nechako Lumber / Nechako Green Energy – Vanderhoof	218	Cogeneration	1,000
Vanderhoof Speciality Wood Products – Vanderhoof	222	Pellet mill	500
Canfor Plateau CHP – Vanderhoof	237	Cogeneration	0

Map A-3: Competitors for forest residue in the Quesnel BDO Zone (red) and broader Competition Zone (blue).



Final Rated Quantities and Pricing

The final rated quantity of forest residue selected for the analysis is **100,000 odt/yr** (Table A-3). This represents nearly a quarter of the potential supply given recent harvesting levels in the BDO Zone.[5] Assuming an average comminution productivity of 20-30 odt/PMH per crew and a transport productivity of 15 odt per chip van, approx. 2-3 grinding crews and approx. 20 chip vans would be required to procure the rated quantity.[6] The price range for comminuted residue delivered for an average transport distance of 75 km (up to 120 km) was estimated to be $60-110/odt (Table A-4).

Table A-3: Potential and rated quantities for evaluated biomass types

Biomass types	Potential quantity (odt/yr)	Rated quantity (odt/yr)
Forest residue	390,000	100,000
Sawmill residue	1,100,000	N/A (fully utilized)
Pulpwood	200,000	N/A (fully utilized)

Table A-4: Recent historic pricing and rated price ranges for evaluated biomass types

Biomass type	2010 Price range [7] ($/odt)	2024 Rated price range[8] ($/odt)
Forest residue	75-110*	60-110**

* Stem tops and log segments delivered in roll-off bins to Quesnel; electric grinding at the mill.
** In-woods grinding; chip-van delivery of comminuted material to Quesnel.

[5] Note that there are also legacy slash piles in the region that could be utilized in the near-term.
[6] This assumes that (1) a grinding crew will work 200 days per year @ 8-10 PMH per day and (2) a typical chip van will make 2 hauls per day and will operate 200 days per year.
[7] Personal communications with the local forest industry coordinator of the residue recovery program.
[8] www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/timber-tenures/fibre-recovery/tr2018n7.pdf and personal communications with local forestry professionals.

APPENDIX B: RISK INDICATOR SCORING METRICS

CATEGORY 1.0: SUPPLIER RISK

1.1 Risk Factor: Credit-Worthiness/Future Solvency of Suppliers

1.1.1 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.

Risk Information: Quesnel has had for decades an influential role in the forestry and forest products activities of the Williams Lake – Quesnel – Prince George corridor. Quesnel residents are used to observing hundreds of logging trucks and chip vans driving up and down Highway 97 that connects these three forest-based towns. There are at least seven forestry contractors in the Williams Lake-Quesnel-Prince George region that process forest residue with mobile comminution units (i.e., Arrow, Valley Carriers, Clan, Drake, Excel, TsiDelDel, Celtic, and Eldorado Construction Ltd.). Several chip vans operate in the region and could be utilized for delivery of the rated quantity of forest residue. The majority of these forestry and transport contractors are expected to have been in business for up to and sometimes more than a decade.

The continued viability of forestry contractors in the region is ultimately dependent on the health of the forest industry. Despite declines of industry capacity and forest resource availability (owing in part to natural disturbance, market developments, and policies), there are many indications that the regional industry remains strong. For a more detailed description of the state of the forest industry in the region, please see Risk Indicator 1.3.4. More detailed information relevant to the capacity and scale of the regional forest industry is presented in Tables C-1, C-2, C-3 and Map C-1 (Appendix C).

The regional industry has over 30 years of collective experience with forest residue supply chains, including both terminal and mobile variants. Productivity of any future comminution and transport operations is expected to be maintained to an acceptable level given prior experience and current capacity. We do not foresee any significant risks of forestry contractor insolvency.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

1.2 Risk Factor: Conflicts of Interest/Vested Interest with Competing Market(s)

1.2.1 Suppliers' Dependence on, or Preference for, Competing Markets

Rationale: Suppliers may have a vested interest or preference to supply to 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 supplier's dependences on competing markets to accept or purchase other products/by-products. During periods of feedstock shortage such suppliers may be more likely to allocate the scarce supply to a competitor resulting in supply disruptions for the Issuer.

Risk Information: There is low risk that the rated quantity of residue (100,000 odt/yr) will become unavailable due to the preference of forestry contractors for existing buyers. Current utilization of residue in the BDO Zone amounts to 7% of the total amount of residue that is estimated to accumulate at roadside annually. Assuming an average grinding productivity of 20-30 odt/PMH,[9] two to three additional mobile grinders would be required to ensure that existing demands do not impede the ability or willingness of forestry contractors to supply a new bio-project.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

1.3 Risk Factor: Supplier Control Over Production and Transportation

1.3.1 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.

Risk Information: Approximately 95% of timber in British Columbia is publicly owned (referred to as "Crown timber" or "Crownland"). The BC government authorizes the right to harvest Crown timber through forest tenures. Forms of tenure that exist in the Quesnel BDO Zone include three Timber Supply Areas (TSAs), three Tree Farm License (TFLs), First Nations Woodlands, BC Timber Sales, and the Three Rivers Community Forest (expected to begin operations in 2024). The vast majority of wood supply over the next 10-20 years is expected to come from the three TSAs (Quesnel, Prince George, and Willimas Lake) and three TFLs (#30, #52, and #53) (Table A-1, Appendix A).

The forest product companies that hold TSA and TFL tenures are expected to view the comminution of slash piles (i.e., forest residue) favourably if the companies that access the piles maintain roads and remove/redistribute excess wood

[9] Productive Machine Hour

waste. Procuring forest residue from the tenured TSAs and TFLs in the region will not likely pose a problem to new entrants if these standards are followed.	
Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

1.3.2 Ownership of Equipment

Rationale: In most cases, suppliers which own or lease equipment for harvest, collection and processing feedstock are lower risk than those who are not. For example, third-party harvesting equipment may not be available when required. Short harvest windows may be missed if a farmer and contractor cannot schedule harvest times that are convenient and quantity shortages can result. However, in some circumstances reliance on third-party equipment to harvest or produce feedstock can decrease supply chain risk. For example, when harvesting agricultural residues such as corn stover, the use of a third-party company with standard equipment specializing in harvesting, collection and transportation may decrease quality variations (e.g., ash content) of final feedstock.	
Risk Information: Local industry experts confirmed that many logging and grinding contractors operate in the region and can take on additional harvesting and grinding. There are at least seven grinding operations available in the Williams Lake – Quesnel – Prince George corridor: Arrow, Valley Carriers, Clan, Drake, Excel, TsiDelDel, Celtic, and Eldorado Construction Ltd. Stationary electrical comminution units and mobile units are also owned by local mills in the region.	
Raw Risk Likelihood (RRL) The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**Score** **2**
Raw Risk Impact (RRI) The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**Score** **2**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**Score** **4**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**

Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**4**

1.3.3 Ownership of Transportation/Logistics

Rationale: In most cases, suppliers that own or lease transportation equipment necessary to transport biomass from forest or field are lower risk than those who do not. However, in some circumstances, reliance on third parties to transport biomass is common practice and does not contribute to risk.

Risk Information: Chip vans necessary for the mobile comminution operations that are common in the region today are owned by forest product companies, forestry contractors that are directly involved in residue comminution operations, and independent trucking companies. Roll-off bin trucks are available in the area and could be combined with stationary comminution units to establish residue supply chains involving loose residue transport and terminal comminution using more efficient, electricity-powered grinders and chippers on paved surfaces. This type of supply chain for forest residue was present in the Quesnel area in the late 2000s and could, if needed, be re-established.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

1.3.4 Feedstock as a Secondary Transformation

Rationale: A secondary transformation dependent upon the production of primary products, e.g., forest residues, corn stover, bark, or sawmill chips (unless from a dedicated chip mill) are all secondary transformations of a primary product.

Risks are higher if feedstock is a secondary transformation of a primary, more valuable product. It may not be economical for suppliers to produce biomass on its own, in the absence of markets for the primary product. For example, a supplier may produce dimensional lumber as its primary product and wood chips as a by-product, therefore relying on the health of the housing market for production levels. If the demand for dimensional lumber drops, so can the availability of sawmill residues. In case of agricultural feedstocks such as corn stover, the feedstock is a by-product of a primary crop. Since the primary crop is significantly more lucrative than the residue, it will be a priority for the producer. If production of the primary crop requires resources to be taken away from the production of secondary crop (e.g., in case of shorter harvesting windows due to weather), the secondary feedstock supply will suffer. In times of stretched resources, suppliers may also perceive harvesting and collection of the feedstock as a nuisance, potentially decreasing production levels.

Understanding the economic drivers for suppliers' primary product can help gauge risk levels for secondary transformation biomass products.

Risk Information: Forest residue production in the Quesnel BDO Zone is highly dependent on the viability of local lumber and pulp and paper operations. Seven manufacturing facilities have permanently closed since 2008 (Table C-4, Appendix C). Many sawmills and pulp mills that remain operational have been subject to ownership changes and partial shutdowns. Industrial decline can be attributed to major natural disturbance events (i.e., the 1997-2014 MPB outbreak, severe wildfires), changes in government policies (i.e., AAC reductions of 30-35% over the past decade), and structural factors (e.g., comparative disadvantage of North American pulp and paper industry). Much of the decline in the AAC can be attributed to the legacy of the MPB outbreak which peaked in 2010; a similar event is unlikely to occur in the foreseeable future. See Table C-1, C-2, and C-3 and Map C-1 (Appendix C) for more detailed information relevant to the capacity and scale of the regional forest industry.

Risks associated with the high dependence of forest residue supply on the health of the forest industry are moderated by a Biomass Availability Multiple (BAM) of 3.9x (see Risk Indicator 3.1.1). Further major declines in harvesting activity are unlikely to increase risks associated with procuring the rated quantity. For example, the BAM associated with residue would still remain greater than 2 with a further 30% decline in harvesting activity. Risks associated with this indicator are also moderated by the apparent stabilization of industrial decline in recent years. Given the above considerations, there is moderate risk associated with this indicator.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

1.4 Risk Factor: Supplier Experience

1.4.1 Fundamental Feedstock Production Experience

Rationale: Risk is higher when suppliers have limited experience with planting/growing/harvesting/ processing and/or collecting biomass. Limited experience may be common for stover or forest residue supply chains where farmers or forestry producers may have no previous experience.

Risk Information: Forest residue supply chain experience has been present for several years in the Quesnel area. Mobile grinding of slash piles at roadside followed by chip van transport has been occurring at a level of 15,000 – 25,000 odt/yr for the last 5 years in the BDO Zone. The comminuted residue has been utilized for energy generation purposes at Cariboo Pulp and Paper, West Fraser – Quesnel Sawmill, and West Fraser – West Pine MDF mill and to augment pellet

feedstock at the Drax Meadowbank pellet mill. At least seven contractors have experience operating and maintaining mobile grinders.

Note that terminal supply chain experience is also present in the BDO Zone. In the late 2000s/early 2010s, significant quantities of forest residue were recovered from roadside using roll-off bin trucks and delivered to mill yards in the Quesnel area for terminal comminution. Operations stopped in the early 2000s due to competition with lower price sawmill residue, which became abundant in the area as a result of a ramp up in sawmill operations.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**2**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 8 out of 100.	**8**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 8 out of 100.	**8**

1.4.2 Production Scale Experience

Rationale: Scale-up entails risk. Risk is higher when suppliers have limited experience with the production of the quantity of feedstock required.

Risk Information: Although there is significant forest residue supply chain experience in the BDO Zone (see Risk Indicator 1.4.1), the maximum annual residue production did not exceed 25,000 odt/yr in recent years. The two mobile grinding units regularly operating in the BDO Zone are sufficient for this quantity. Recovering the rated quantity would likely require at least 2-3 mobile grinding units. We expect that grinding units present in the Prince George and Williams Lake TSAs would operate in the Quesnel BDO Zone if demand increased as a result of a new bio-project. This would minimize the requirement to invest in additional comminution units.

Based on past experience, it is also possible, but uncertain, that a large portion of forest residue supply could be realized using terminal comminution operations. Stationary grinders are present in the wood rooms of most pulp mills in the area owing to the decline in the availability of sawmill residue over the past decade.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

1.5 Risk Factor: Supplier Harvesting/Collection/Processing Capacity

1.5.1 Supplier's Equipment Efficiency

Rationale: Equipment efficiency significantly influences supplier's feedstock production capacity. Understanding supplier's equipment capability enables understanding of their ability to produce feedstock of suitable quality.

Risk Information: Significant quantities of forest residue accumulate in piles at roadside and on landings as a result of sawlog and pulp log production. Forest residue recovery is most likely to occur once logging operations have been completed and once all sawlogs and pulp logs have been transported off-site. There is therefore no risk that forest residue production will reduce the productivity of sawlog and pulp log operations.

The average productivity of a single mobile grinding operation is estimated at 30,000-60,000 odt/year. This assumes an average grinding productivity of 20-30 odt/PMH, approx. 200 workdays/year, and an 8-10 PMH/day. Chipping and grinding costs in the region are currently approx. 30-35 $/odt (up from approx. 20 $/odt in 2020). The capacity of a typical chip van (53' semi-trailer with moving floor, 113 m^3 bulk), which is loaded with comminuted residue at roadside and used to deliver the feedstock to a final destination, is estimated at 15 odt/load.

It is possible that terminal supply chains involving loose residue transport with bin trucks and stationary comminution with electricity-powered units on paved surfaces could increase efficiency and reduce costs. Future operational studies should consider both mobile and terminal comminution options.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

1.6 Risk Factor: Supplier Motivation

1.6.1 Feedstock Production Priority

Rationale: When biomass feedstock is a secondary or non-core line of business, or when it is a by-product or a residual from a more valuable primary product, then suppliers may not put in sufficient effort for consistent production. Risk of breach increases when production and/or delivery of feedstock compromises a supplier's ability to make a primary product.

When biomass feedstock is a by-product of another main higher margin or main product (e.g., corn stover (e.g., corn) or forest residues (e.g., pulpwood)) supply may not be a top priority for a supplier.

Risk Information: Large quantities of forest residue accumulate in piles at roadside as a result of conventional forest operations. Comminution operations will most likely occur once logging operations have been completed and once all sawlogs and pulp logs have been recovered. There is therefore no risk that forest residue production will reduce the productivity of sawlog and pulpwood operations.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**2**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**2**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**4**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**4**

CATEGORY 2.0: COMPETITOR RISK

2.1 Risk Factor: Influence on Feedstock Supply of Existing Markets

2.1.1 Competitor Locations and Overall Geographical Influence

Rationale: Competitors' locations relative to siting locations within a BDO Zone can affect the viability of procuring feedstock and the cost of that feedstock. Accurate and detailed competitor mapping provides an understanding of the geographical influence a competitor may have on new plants within a BDO Zone, including competitive advantages such as short hauling.

Risk Information: Current competitors for forest residue include the three cogeneration units in Quesnel and the Drax Meadowbank pellet mill.[10] The Drax pellet mill is located 46 km from Quesnel (the center point of the BDO Zone), whereas the pulp mill is located in Quesnel. There are nine other facilities within the Competition Zone (240-km drive distance from Quesnel) that consume approx. 500,000 odt/yr of bark, sawdust, and other lower quality forms of feedstock (referred to as "hog fuel") (see Table A-2, Appendix A). They include 3 wood pellet mills (not including Drax – Meadowbank), 5 cogeneration units (not including Cariboo Pulp and Paper – Quesnel), and 1 biopower plant.

[10] The cogeneration units are installed at Cariboo Pulp & Paper, West Frasrer – Quesnel Sawmill, and West Fraser – WestPine MDF

Each of these facilities could potentially utilize forest residue if required by market developments or reductions in the production and/or availability of sawmill residue. The recent downward trend in the regional sawmill industry increases the likelihood that demand for forest residue will increase in the future. However, the potential impact of increased demand is assessed as low because the rated quantity is associated with a biomass availability multiple (BAM) of 3.9x (see Risk Indicator 3.1.1).

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

2.1.2 Current and Historical Consumption of Feedstock Quantity

Rationale: Clear understanding of feedstock consumption by key competitors for each rated type of feedstock in the BDO Zone is essential to quantifying competitor risk.

Understanding current consumption and historical trends of feedstock utilization can provide valuable information about feedstock price elasticity during shortages, and insight into events that may impact future supply conditions. It can 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).

Risk Information: The current demand for forest residue is estimated between 15,000 odt/yr and 25,000 odt/yr. The majority of this quantity is acquired by the Cariboo Pulp & Paper mill for use in its cogeneration unit. Instances of past demand for forest residue in the BDO Zone area have been temporary and did not exceed 50,000 odt/yr. The temporary and sporadic nature of forest residue markets have led to relatively insensitive/inelastic historical prices for forest residue.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**2**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 8 out of 100.	**8**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 8 out of 100.	**8**

2.1.3 Competitor Pricing and Price Sensitivity

Rationale: Understanding how much competitors pay (or receive) for different feedstock types is an essential step to determining competitiveness of Issuer and to accurate assessment of the delivered cost range in the BDO Zone rating.

Current and historical prices paid/received by competitors provide insight into their procurement behaviors and exert pressure on suppliers in the BDO Zone. Such as ability/willingness to pay premiums for feedstock during times of feedstock shortage or reduce prices (or cut off deliveries) during gluts. Competitors that have an ability to offer higher prices for feedstock during feedstock shortages can pose significant risk to Issuer.

Knowledge of competitor pricing and price sensitivity is also an essential prerequisite to formulating a feedstock cost curve which can enable predictions of feedstock redundancy, i.e., how much feedstock could become available at different pricing levels (see Category 3–Supply Chain Risk 3.1.3).

Risk Information: Delivered prices for forest residue (comminuted) in the region reflect the prices for hog fuel, which range between $50/odt and $60/odt. At these prices, forest residue transportation is generally limited to a 50-km travel distance. Forest residue supply at this price range is made possible, in part, by the low $0.25/$m^3$ stumpage for roadside residue. Note that the rated price range ($60-$110/odt) reflects a situation where a new bio-project is capable of paying for the transport of residue over distances up to 120 km at current 2024 grinding and transportation costs.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

2.1.4 Impacts of Future Demand on Feedstock Availability and Price by Current Competitors

Rationale: Feedstock utilization in a BDO Zone can change over time. Expansion of feedstock demand by current competitors can put additional pressure on feedstock and can lead to higher prices, feedstock disruptions, shortages or supplier breach or other types of supply chain disruption.

If current markets for feedstock have been publicly signaling the potential for increased demand for feedstock (in the case of a sawmill adding a shift, or pulp mill potentially expanding into production of renewable chemicals, for example), high interest in a BDO Zone can make suppliers overconfident, leading to a supplier-controlled market where short-term contracting becomes the norm and supply chain reliability is compromised for the Issuer. If and when it occurs, increased demand on feedstock may decrease availability and increase cost for new plants within the BDO Zone.

Risk Information: The most significant potential competitor for forest residue in the BDO Zone is the pulp mill in Quesnel, which combusts up to 25,000 odt/yr of forest residue in its 60 MW boiler that has a maximum estimated intake capacity of 150,000 odt of hog fuel per year. Unless sawmill capacity declines further, forest residue will continue to make up only a small percentage of the total amount of feedstock consumed by this cogeneration unit and all other potential competitors in the region.

Assuming that all potential consumers of forest residue in the Competition Zone (biomass energy plants) source 5% of forest residue annually, a total of 26,000 odt/yr of forest residue would be procured from the BDO Zone to meet their total demand. When considering the total potential quantity (390,000 odt/yr) and the rated quantity (100,000 odt/yr), we concluded that the risk associated with developments in future demand for residue was low.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

2.1.5 Soft Supply Influence of Existing Markets

Rationale: In some cases, existing markets for feedstock may be able to exert high degrees of pressure over local suppliers, effectively enabling control feedstock, especially during times of shortage. This control can derive from qualitative or "soft" factors such as long previous relationships between local suppliers and existing markets for feedstock.

Risk Information: Despite local businesses' preference for long-term offtake agreements, risk that existing suppliers of forest residue will prioritize existing customers is low. For example, current demand for forest residue constitutes less than 7% of total potential residue production. Moreover, only approx. 40% of the potential productivity of the two grinding units that regularly operate in the BDO Zone is utilized under current demand.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**Score** **2**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 8 out of 100.	**Score** **8**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 8 out of 100.	**Score** **8**

2.1.6 Temporary Market-Driven Markets

Rationale: Alternative, non-traditional, market-driven competitors for feedstock can drive feedstock demand in unusual circumstances. A BDO Zone Rating Issuer based on corn stover as a feedstock, for example, would not typically compete with higher-end animal feed markets due to quality issues. However, in times of significant hay shortage (e.g., during drought), farmers use corn stover in place of hay, driving the price of feedstock and decreasing availability for bio-projects.[11]

Risk Information: There is no risk from temporary/non-traditional markets. Firewood markets in the PG-Quesnel-WL corridor are relatively weak. There are also no custom wood processing facilities in the region that can use forest residues as feedstock.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**Score** **2**
Raw Risk Impact (RRI) The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**Score** **2**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**Score** **4**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**Score** **4**

[11] Bergtold, 2018.

2.2 Risk Factor: Specific Competitors' Competitive Advantage

2.2.1 Relative Inventory Capacity

Rationale: The more inventory a competing biomass facility is able to store, the more competitively pressure it can exert on supply. Ability to store large inventories allows competitors to purchase inventory when the prices are low, potentially giving it an economic advantage. Additionally, the ability to store inventory during feedstock supply surpluses can enable competitors to continue to intake feedstock when the Issuers plant (with lesser inventory capacity) may be forced to put suppliers on quota. Larger inventory capacity on the part of competing markets thereby creates supplier loyalty and can make it more difficult for new projects to secure supply without paying a significant premium.

Risk Information: The existing inventory infrastructure and protocols at the pulp mills and sawmills located in the BDO Zone is sufficient for multi-month operations and could be also used for forest residue supply chains. However, current demand for forest residue is weak and the relative ability for competitors to stockpile forest residue is therefore redundant. In the event that demand for residue by competitors increases, the large inventory capacity of competitors is expected to exert only a weak effect on availability and pricing for new entrants.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**2**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**2**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**4**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**4**

2.2.2 Relative Accessibility/Delivery Hours and Wait Times

Rationale: The value attributed by suppliers to local competing markets for biomass is often directly related to the degree of flexibility the market provides in terms of delivery hours, and the more efficiently discharge can occur.

Risk Information: Due to the recent decline in harvesting levels, potential competitors for forest residue (e.g., pulp mills with cogeneration units, pellet mills) are generally capable of accommodating feedstock deliveries without imposing wait times or quotas. This is likely to provide advantages to new entrants seeking to procure residue, as the regional chip van fleet will have greater availability compared to a situation with prolonged wait times during sawmill residue/hog fuel pickups and deliveries.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

2.2.3 Relative Specification Advantages

Rationale: When choosing a market for biomass feedstock, suppliers not only look at price, but also at relative quality requirements or specifications. It is important to understand feedstock quality specifications for competing markets within the BDO Zone in order to accurately quantify the risk that competitors can exert on the Issuer's supply chain.

Risk Information: Cogeneration and biopower facilities are generally capable of utilizing forest residue without feedstock quality concerns. High moisture content and soil/rock contamination can cause problems during energy conversion but these issues are generally manageable and are normally addressed by new bio-projects in their quality control systems. For example, pellet mills have stricter feedstock quality requirements (i.e., a higher proportion of clean wood rather than bark is needed). This is likely to impose limitations on the percentage of total feedstock that can be made up of forest residues. Generally, the ability for competitors in the region to utilize forest residue is not viewed as a significant risk due to the lack of current demand for residue (i.e., the preference for lower cost sawmill residue) and the large potential supply (390,000 odt/yr) relative to the rated quantity for new projects (100,000 odt/yr).

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

2.2.4 Demand for Competitors' Products

Rationale: Increased demand for competitor's final product can cause an increased demand for feedstock by the competitor. For example, an increased demand for wood pellets due to high energy prices in Europe or for biofuels due to a favorable clean fuels policy can cause increased pellet/biofuel production by competing markets. Thereby driving demand for feedstock within a BDO Zone.

Risk Information: Final product markets of relevance to forest residue supply chains in the region include wood pellets, renewable electricity, and on-site heat and power demands of pulp mills and sawmills. Continued growth in global wood pellet markets and scarcity of low-cost pellet feedstock constitute the highest risk to new bio-projects in the region. Sustainable policies that incentivize the global pellet trade and recent announcements of new pellet mills in BC and Washington State indicate that this trend will continue into the foreseeable future, potentially leading to increased demand for forest residue. We associate low risk with markets for renewable electricity and on-site energy and medium risk for pellets.
Raw Risk Likelihood (RRL) — **Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10. — **4**
Raw Risk Impact (RRI) — **Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10. — **6**
Gross Risk Indicator (GRI) — **Score**
The Gross Risk Indicator (RRL × RRI) is 24 out of 100. — **24**
Mitigation/Notching — **Notch**
RRL Mitigation (Notch) — **NN** No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).
Loaded RI Score — **Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 24 out of 100. — **24**

CATEGORY 3.0: SUPPLY CHAIN RISK

3.1 Risk Factor: Feedstock Availability

3.1.1 Biomass Availability Multiple (BAM)

Rationale: Biomass Availability Multiple (BAM) indicates the degree of redundancy in an Issuer's supply chain in relation to the rated quantity in the BDO Zone. BAM is the mean ratio of biomass feedstock available to a project, in relation to delivered cost, divided by the Issuer's mean rated quantity. BAM is a strong indicator of supply chain resilience when stressed by supply shortage and/or supplier breach. BAMs of 1.5 or higher are generally signals of lower feedstock risk for new projects in BDO Zones.
Risk Information: A BAM value of 3.9x was calculated by dividing the total potential quantity of forest residue available for new projects in the BDO Zone (391,000 odt/yr) by the rated quantity (100,000 odt/yr). The estimate of available forest residue (391,000 odt/yr) is based on harvesting levels experienced in recent years. Harvesting levels in the BDO Zone are currently at historic lows, as are the Allowable Annual Cut (AAC) volumes. In the Quesnel TSA alone the current AAC level of 1.3 million m^3/year is down from 4 million m^3/year in 2017. In the near-term, further declines are likely. However, we expect that long-term harvesting and AAC levels will increase beyond what has been experienced recently due to declining legacy effects of recent natural disturbances (MPB, wildfires) and improvements in intensive forest management (including commercial thinning). Therefore, the total potential quantity of forest residue available in the BDO Zone is most likely to expand over time, increasing the BAM value. The BAM value is therefore deemed conservative, providing assurances of supply continuity in the event of temporary shortages, supplier breach, or increased demand by competitors.
Raw Risk Likelihood (RRL) — **Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10. — **4**

Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.1.2 Feedstock Supply Curve/Marginal Cost Curve

Rationale: The greater the feasible transport distance, the more feedstock is accessible to the Issuer, but at a higher delivered cost. The feedstock supply curve, sometimes referred to as the marginal cost curve, is a function of feedstock availability over its cost which is primarily, but not exclusively, a function of distance. The feedstock supply curve is used to determine the availability of redundant feedstock at various price points, and the cost of replacing feedstock with substitutes located at different distances.

Feedstock cost curves are useful in determining supply chain resilience; they provide information about the cost of feedstock availability in times of supply disturbance. Biomass supply chains are prone to supply disturbances over time; suppliers can become insolvent, or weather events can temporarily disrupt feedstock availability. When a disturbance occurs, the Issuer may need to source replacement feedstock from different suppliers at different locations and costs. A biomass supply curve indicates quantities of feedstock available at various price levels from suppliers generally located further away than core supplier.

Risk Information: The supply curve presented in Figure C-3 (Appendix C) indicates that the rated quantity of forest residues could be available at a delivered price range of $60-110/odt within a 120-km drive distance from Quesnel. Half of the rated quantity is located within a 70-km drive distance of Quesnel and is available at a delivered price range of $60-$90/odt. Figure C-3 also indicates that a 50% increase in diesel cost would reduce the availability of residues at a delivered price range of $60-$90/odt by 25%. However, the BAM factor of 3.9x ensures confidence that the rated quantity will be available when price fluctuations occur.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

3.1.3 Seasonal Feedstock Supply Variation

Rationale: Biomass supply can present significant seasonal supply variations. Seasonal supply variations combined with limitations associated with longer-distance transportation and storage can lead to BDO Zone biomass supply imbalances[12] and can manifest in shortages and higher costs for Issuers.

Risk Information: Operations are often shutdown temporarily for up to three months during the spring due to wetter conditions that make some forest roads inaccessible. Stockpiling is a standard response to the seasonality of operations. Seasonality in final product markets (e.g., lumber) is not expected to affect the rated quantity of forest residues.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.1.4 Year-to-Year Variation in Feedstock Availability

Rationale: Biomass can have significant year-to-year supply variations due to variability in yield from biomass harvesting operations, particularly with agricultural biomass.

Risk Information: Historically, the MPB outbreak of 1997-2010 (the MPB outbreak peaked in 2010) and repeated intense wildfires in recent years (2017-18) have increased variation in the availability and recovery of wood fibre on a per hectare basis. However, for the next 10-20 years it is expected that yield variations will not be a significant risk, especially on the east side of the Quesnel BDO Zone.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**

[12] Golecha & Gan 2016.

Raw Risk Impact (RRI) The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**Score** **2**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 8 out of 100.	**Score** **8**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 8 out of 100.	**Score** **8**

3.2 Risk Factor: Historical Issues

3.2.1 Historical Feedstock Price Variations

Rationale: If volatility is shown in the historical feedstock price, then the risk of future price fluctuation is elevated. If feedstock prices have historically exceeded the price at which the Issuer would have to cease operations or breach a financial covenant (i.e., the "red line" feedstock cost), then mitigation measures should be put in place.

Risk Information: Over the past 40 years, markets for forest residue in the region have been temporary and have not reached demand levels sufficient for price competition. Forest residue prices generally follow hog fuel prices ($50-$60/odt). At this pricing level, comminution and transportation costs generally restrict transportation distances to a 50 km radius.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

3.2.2 Low Historical Demand for Feedstock in the BDO Zone

Rationale: If Issuer BDO Zone does not have history of developed, large-scale feedstock procurement, suppliers may not have sufficient expertise in feedstock production to ensure reliable supply, especially in early years. This can be particularly true for forest residues where typically the infrastructure for collection, processing and delivery is immature.

Where supply chains are not well-established, risk can be mitigated when new bio-based plants control a higher degree of feedstock processing. For example, if a BDO Zone rating is issued for clean wood chips and the historical demand in the Zone has been exclusively for pulpwood, then supply chain risk will be decreased for new bio-based plants that intake of pulpwood and manage log debarking and chipping internally. Rather than requiring inexperienced suppliers to deliver debarked wood chips.

Risk Information: There is no recent regional experience procuring the rated quantity of forest residues (100,000 odt/yr). The current annual throughput of forest residue in the BDO Zone is 15,000 – 25,000 odt/yr. Historic levels may have reached a maximum of 50,000 odt/yr in a single year (e.g., during the period of early 2000s). Risk is moderate due to the balance between the rated quantity and the number and productivity of comminution units currently operating in the region.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 24 out of 100.	**24**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 24 out of 100.	**24**

3.2.3 History of Production/Feedstock is a New/Secondary Crop or a Byproduct

Rationale: If 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. Secondary crop or by-product producers may be less likely to prioritize production.

For new crop types, inexperience in planting, harvest, collection, and yield data may pose higher levels of risk.

If feedstock is a secondary transformation (i.e., wheat straw, corn stover, or forest residue), then production can be subject to variables beyond suppliers' control (e.g., changing demand for sawtimber, or primary crop prices).

Risk Information: The ability for new bio-projects to secure the rated quantity of forest residue is not expected to be adversely affected by changes in lumber markets due to the high BAM value of 3.9x. A further 30-35% decline in harvesting levels may reduce the BAM to 2.5, which remains acceptable, providing sufficient feedstock redundancy.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.3 Risk Factor: Non-Weather Based Externalities

3.3.1 Diesel, Oil and Producer Price Index (PPI)

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

Risk Information: Figure C-3 in Appendix C indicates that an increase of 50% of diesel costs would significantly reduce the availability of residues in the $60-90/odt price range. Likewise, transportation costs would increase drastically as the sensitivity analysis in Figure C-4 (Appendix C) suggests. While we expect fuel prices to stabilize, they pose a medium/high risk on the future availability and affordability of forest residues in the region.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 48 out of 100.	**48**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 48 out of 100.	**48**

3.3.2 Currency Risk

Rationale: Where feedstock is purchased in a currency different than that which a new bio-based plant with locate in a BDO Zone, currency exchange rates and volatility can constitute risk exposure. BDO Zones that cross the US-Canada border, for example, which intake feedstock from both countries are exposed to such currency risk.

Risk Information: Not rated.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**NR**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**NR**

Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is not rated.	**NR**
Mitigation/Notching	**Notch**
The Total Notch (RRL Notch × RRI Notch) is not rated.	**NR**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is not rated.	**NR**

3.3.3 Border Risk

Rationale: Where feedstock is transported cross-border to another country, risk exposure to border closures and crossing delays becomes present. The availability of trucks willing to do cross-border runs is limited, which can decrease supply chain flexibility and resilience. Plants near the US-Canada border which intake feedstock from both countries are exposed to these risks.

Risk Information: Not rated.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**NR**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**NR**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is not rated.	**NR**
Mitigation/Notching	**Notch**
The Total Notch (RRL Notch × RRI Notch) is not rated.	**NR**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is not rated.	**NR**

3.3.4 Temporary Externality-Driven Markets for Feedstock

Rationale: Alternative, non-traditional, externality-driven competitors for feedstock can drive feedstock demand (and cost) in unusual circumstances. For example, an Issuer using corn stover as a feedstock would not typically compete with the higher-end animal feed market. However, in times of significant hay shortage (e.g., during drought), farmers may use corn stover as hay replacement, driving the price of stover feedstock and decreasing its availability for bio-projects.[13]

Risk Information: There is no significant firewood market in the region. No other alternative markets for biomass/wood fibre were identified.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**2**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**2**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**4**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch)	**NN**
No adjustment.	

[13] Bergtold, 2018.

RRI Mitigation (Notch) No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).
Loaded RI Score **Score** The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100. **4**

3.4 Risk Factor: Risks Related to Feedstock Production, Harvest and Collection

3.4.1 Harvest & Collection Practices & Schedules

Rationale: Differences in harvest timing and practices used can create risk to both the quantity and quality of 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.

For example, agricultural feedstocks and energy crops have optimal harvesting windows to ensure minimal moisture content. In certain BDO Zones these harvesting windows may coincide with heightened weather risk such as frost or rain.

For forestry biomass, unsightly clear cuts, and slash piles (even on plantation forests and especially when located near communities) can provoke unwanted public backlash even when suitable and sustainable replanting regimes are followed.

Risk Information: Provincial policies require that slash piles are removed or burned within a certain time frame after timber harvesting to reduce the risk of fires and allow for tree planting activities to take place. Waste surveys are mandatory to ensure that roadside debris is accounted for and managed properly. Grinding operations are typically carried out within 4-12 months of harvesting operations. Variation in feedstock moisture content resulting from differential time elapsed since harvest is not expected to be significant when managed properly.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.4.2 Harvesting & Collection Equipment

Rationale: Different types of harvesting and collection equipment used by suppliers in a BDO Zone can have a significant impact on the quality and availability of feedstock. Use of different types and combinations of harvesting, collection and

processing equipment among suppliers can lead to non-homogeneous feedstock. Equipment that is not designed specifically for biomass cultivation, harvesting and collection, can increase feedstock quality risks.

Relevant equipment should be specified for the sake of product consistency and risk reduction.

Risk Information: Forest operations in the region are fully mechanized and involve the use of conventional forestry equipment, including harvesters, processors, grapple skidders, and loaders. Commercial thinning and partial cutting treatments are uncommon in the region but are expected to become more prevalent. Grinding and transportation operations/contractors of comminuted forest residues exist in the region and could be made available for the rated quantity. Equipment constraints are not expected to impact the ability of existing contractors to recover the rated quantity of forest residue at roadside.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**2**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 8 out of 100.	**8**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 8 out of 100.	**8**

3.4.3 Variation in Densification Methods Among Different Suppliers

Rationale: The shape and density of the unit in which feedstock is supplied can impact feedstock cost and quality. Standard feedstock densification modes for biomass consist of round or square bales, pellets, cubes, chips, or grindings. The size of wood fibre processed in a grinder is less homogenous than if a chipper is used.

Bales of different densities can absorb moisture at different rates. In certain cases, round bales have been viewed as problematic due to their uneven moisture content distribution.[14]

Risk Information: Any differences in feedstock quality and availability resulting from differences in comminution equipment (e.g. mobile vs. stationary, grinding vs. chipping) are not expected to be significant.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**2**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**2**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**4**

[14] Huhnke, 2018.

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**4**

3.4.4 Availability of Labour for Feedstock Production

Rationale: Skilled labour shortages can be difficult to remedy in the short-term. Availability of suitable labour in an area can impact the ability to procure sufficient feedstock quantities on required schedules. Labour risks are higher where supply chains are not yet active; or for Issuer's for whom large feedstock requirements, or development of new (or expanded) supply chains, demand significant additions to the local labour force.

Risk Information: Over the past decade, the regional workforce employed in the forestry and forest products industry has declined as a result of curtailments in harvesting and milling activities. Although workforce losses have stabilized in recent years, the availability of grinder operators and truck drivers remains a problem. Meeting the transportation workforce requirements are of particular concern. Approximately 10 new chip van drivers would likely be required to ensure timely delivery of the rated quantity.[15] Prospects for long-term labour availability are improved through on-the-job training and local community colleges, some of which may eventually offer logging equipment operator training programs.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

3.5 Risk Factor: Transportation

3.5.1 Feedstock Transportation Costs

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

[15] Based on outreach to local experts.

Transport distances of 80-120 km for biomass feedstocks are typical but larger distances can be common. Where average transport distance from suppliers to Issuer is high, the supply chain is subject to greater sensitivities to risks, such as increases in diesel cost, weather impacts, mechanical breakdown, and by the demand for scarce feedstock from competitors closer to the source.

Understanding average transport distance can help flag higher-risk BDO Zones where transport distance materially exceeds the average.

Risk Information: Feedstock transportation costs have increased considerably over recent years for reasons having to do with fuel and capital price inflation. Over the past decade, real diesel prices (adjusted for inflation) have increased by more than 50% (Figure C-5). This drastic increase can be partly attributed to the Government of Canada and BC Government climate policies, including carbon taxes (Figure C-6) and global fossil fuel logistics and politics. Capital costs of equipment have also increased considerably following the COVID-19 pandemic and associated government policies. Increases in fuel and capital cost have led to increases in trucking rates (e.g., from $120/PMH in pre-pandemic years to approx. $180/PMH today). Transportation costs are expected to continue increasing, which may have a significant impact on forest residue availability in the price range considered for the rated quantity of 100,000 odt/yr (Figure C-4).

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 48 out of 100.	**48**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 48 out of 100.	**48**

3.5.2 Diesel Cost Impacts

Rationale: Changes in diesel cost impact transport cost over time. Sensitivities to worst case scenarios should be run.

Risk Information: The price of diesel more than doubled since pre-COVID 19 years (Figure C-5). Prices have stabilized around $1.80-$2.00/L in recent months. Transportation costs in the region are beginning to reflect elevated diesel prices: while current average transportation costs for wood chips in BC is approximately $180/hr, this value may increase to $200/hr. In addition, climate change initiatives at all levels (global, national, and provincial) could lead to a steep increase in carbon taxes (Figure C-6). The combined effect of transportation and grinding cost increases could reduce the availability of forest residues delivered at a price range of $60 - 110/odt by at least 25% (Figure C-3, Figure C-4).

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 48 out of 100.	**48**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 48 out of 100.	**48**

3.5.3 Transportation of Feedstock Requires Specialized Equipment

Rationale: Requirements for specialized transport equipment (e.g., walking-floor trailers) 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.

Risk Information: We estimate that approx. 20 chip vans would be required to transport the rated quantity of comminuted forest residue to Quesnel. There are presently 8-12 chip vans regularly operating in the Quesnel area and likely over 10 chip vans in the broader region that could be made partially available. Therefore, we estimate that approximately 10 additional chip vans and drivers would be required to ensure timely and reliable delivery of the rated quantity. There is also uncertainty around the willingness of chip van owner-operators to work within cutblocks, which have rougher roads and loading conditions that can lead to increased operations and maintenance (O&M) costs. Note that roll-off container trucks would likely need to be purchased if a terminal comminution configuration was chosen (i.e., loose residue transport and stationary grinding at satellite or end-user yards).

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

3.5.4 Delivery Routes through Local Communities

Rationale: Transportation of biomass can become a nuisance to local communities, especially if a large number of trucks pass through residential and school areas. Local communities often have power to force regulations regarding truck transport, impeding the ability BDO Zone suppliers to transport feedstock.

Risk Information: A major roadway that facilitates north-south movement in the Prince George-Quesnel-Williams Lake corridor (Highway 97) runs through downtown Quesnel. This is not expected to generate public opposition, as forestry

truck traffic has been commonplace in the region since the 1940s. However, there are on-going air quality concerns in the area due in part to road dust. Although the increased truck traffic associated with the rated quantity would be marginal relative to existing traffic, air quality concerns are noteworthy.
Raw Risk Likelihood (RRL) **Score** The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10. **4**
Raw Risk Impact (RRI) **Score** The risk impact is deemed *low*, therefore the RRI is 4 out of 10. **4**
Gross Risk Indicator (GRI) **Score** The Gross Risk Indicator (RRL × RRI) is 16 out of 100. **16**
Mitigation/Notching **Notch** *RRL Mitigation (Notch)* **NN** No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).
Loaded RI Score **Score** The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100. **16**

3.5.5 Transportation Regulations & Local Weight Limits

Rationale: In many BDO Zones, 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.
Risk Information: There are no load restrictions in the Quesnel area other than a specific set of streets within the Quesnel city limits where a 70% load restriction has been in effect. In addition, some resource roads (i.e., forest roads) may be put under seasonal load restrictions of 70% or even 50% during the thaw season (i.e., spring). However, forest companies usually plan for these periods and secure feedstocks in advance in order to avoid production interruptions.
Raw Risk Likelihood (RRL) **Score** The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10. **4**
Raw Risk Impact (RRI) **Score** The risk impact is deemed *low*, therefore the RRI is 4 out of 10. **4**
Gross Risk Indicator (GRI) **Score** The Gross Risk Indicator (RRL × RRI) is 16 out of 100. **16**
Mitigation/Notching **Notch** *RRL Mitigation (Notch)* **NN** No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).
Loaded RI Score **Score** The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100. **16**

3.5.6 Road Infrastructure

Rationale: Feedstock cost and availability can be a function of road infrastructure, in particular the accessibility the infrastructure provides to feedstock. Issues with road networks will translate directly to risks to feedstock supply.

Risk Information: The primary road network – consisting of the north-south Highway 97 and branch roads in towns of Prince George, Quesnel, and Williams Lake – is in good quality. Logging trucks and chip vans have used the primary road network continuously for the past 5 decades. The need to improve bridge and highway infrastructure near Quesnel is well known, but construction of a new interchange has yet to be scheduled. Secondary roads in the region are generally in good quality as many are the only connection to Quesnel for remote communities like Kluskus and Nazko. Roads are plowed, gravelled, and graded frequently. However, many of the tertiary roads that provide chip van access to slash piles in cutblocks are often low quality, leading to increased operations and maintenance costs and a hesitancy for chip van owner-operators to enter cutblocks.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**Score** **6**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 24 out of 100.	**Score** **24**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 24 out of 100.	**Score** **24**

3.5.7 Transportation Redundancy

Rationale: Transport equipment redundancy is important for dealing with seasonally variable feedstock supplies as well as the risk of equipment breakdowns.

Risk Information: Regional transportation capacity is currently insufficient for the rated quantity. We anticipate that approx. 20 chip vans would be required. Current users of chip vans, including sellers and buyers of sawmill residue and forest residue, often encounter issues with chip van availability and scheduling. Approximately 10 new chip vans and drivers will be required to ensure timely delivery of the rated quantity. More would likely be required for capacity assurances during breakdowns.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**Score** **8**
Raw Risk Impact (RRI) The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**Score** **6**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 48 out of 100.	**Score** **48**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 48 out of 100.	**48**

3.6 Risk Factor: Supply Chain Resiliency

3.6.1 Size, Number and Location of Suppliers

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

There is no pre-determined number or optimal ratio of suppliers, although having too many or too few can both pose higher degrees of risk.

Risk Information: Two owners of mobile comminution units are located/operate regularly within the Quesnel BDO Zone, whereas three others operate in a wider area (Prince George, Williams Lake, 100 Mile House, and Kamloops). The number of chip vans in the region is estimated to be approx. 10, but some of these units are unlikely to operate in cutblocks. There is a general lack of sufficient transportation capacity (i.e., number of units) in the region: transportation companies in the region regularly travel over 200 km for pickups and deliveries of comminuted material, leading to prolonged wait times.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

3.6.2 Suppliers Subject to Same External Risk Factors

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 spatial location (i.e., geography), production practices and other elements of supply chain structures such that the impact of single high-risk events have varying impacts on suppliers.

Risk Information: The production ability of all potential suppliers of forest residue (including those involved in the comminution and transportation phase of the supply chain) is affected by harvesting levels and by the broader factors that influence harvesting levels. Declines in demand for solid wood products produced by value-added manufacturers (lumber, pulp and paper) in the region will lead to declines in annual harvesting. If future harvesting declines are greater than 30%, there is a high risk that the rated quantity will not be available at the rated price range.[16] Harvesting declines of this magnitude are unlikely but are factored into the risk assessment.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 24 out of 100.	**24**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 24 out of 100.	**24**

3.6.3 Land Ownership Structures

Rationale: The ownership (or control) of the land base on which feedstock is produced can have significant impact on Issuer's feedstock risks. Risk of long-term variation in stumpage cost for wood fibre (i.e., the cost that one pays to a landowner for the right to cut and purchase their wood fibre) for example are much higher in the US where >90% of the land is private, and thus stumpage cost is determined on a competitive auction basis. Conversely, in Canada >90% of the land is owned by the Crown and stumpage is allocated by the government.

Risk Information: Approximately 95% of the timberlands in the Quesnel BDO Zone are publicly owned ("Crown land") and are managed as both area-based and volume-based tenures. Public ownership is not a risk to the rated quantity of forest residue. While the reductions in the AAC in recent years reflect heightened natural disturbance frequency, we do foresee a continuation of the BC Government's willingness to follow a standard growth-and-yield approach to forest management on public lands.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**

[16] A 30% decline in harvesting levels would result in a biomass availability multiple of 2.5 for 100,000 odt/yr of forest residue (see RI 1.3.4 and RI 3.2.3).

Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.7 Risk Factor: Climate and Natural Risks

3.7.1 Seasonal Weather Impacts on Feedstock Supply

Rationale: Seasonal weather impacts are defined as those deriving from natural weather variations (i.e., spring thaws, rainy seasons, or dry seasons – as opposed to from singular weather events like fires, droughts, or hurricanes). Seasonal weather changes can be a significant risk factor affecting feedstock availability, quality, and price.

Given the major influence that weather has on multiple aspects of growing, harvesting, and transporting biomass, it is difficult to predict the availability of biomass at a specific location at different points in the future with a high degree of certainty. However, it is still possible, using past data and statistical models, to generate reasonable upper/lower bound estimates of biomass production in any given year in a wider BDO Zone. Such estimates are important in assessing feedstock risk and enable accurate assessment of the efficacy of Issuer's mitigation methods.

Risk Information: Over the past decade, severe wildfires during the summer have caused extensive damage to the Lodgepole pine, Douglas fir, and some mixed wood stands in the BDO Zone. Wildfires of similar extent and intensity are expected to continue over the next decade. While stockpiling is generally sufficient to mitigate seasonal weather impacts, it may not entirely be able to mitigate the effects of long and severe summer wildfires.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

3.7.2 Long-Term Weather and Climate Trends

Rationale: In certain BDO Zones, climatic trends and significant potential changes to future weather patterns can create feedstock risk.

Risk Information: Wildfires have increased in frequency and intensity over time due to a trend towards reduced precipitation in interior BC.[17] This trend is likely to continue in the coming decades. Other natural disturbances with plausible links to climate change, such as beetle population outbreaks could also increase. We associated moderate risk with this indicator.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

3.7.3 Forest/Crop Fire

Rationale: Forest/crop fires, especially when occurring at large-scale, destroy feedstock and create shortages.

Fire-prone conditions are predicted to increase across Canada. This could potentially result in a doubling of the amount of area burned by the end of this century compared with amounts burned in recent decades. Boreal forests, which have been historically greatly influenced by fire, will likely be especially affected by this change.

Other climate change impacts that could add damaged or dead-wood to the forest fuel load (e.g., as a result of insect outbreaks, ice storms, or high winds) may increase the risk of fire activity. New research is aimed at refining these climate change estimates of fire activity, and at investigating adaptation strategies and options to deal with future fire occurrence. There is growing consensus that as wildfire activity increases, fire agency suppression efforts will be increasingly strained. However, analyses of fire history suggest that it is the effect of climate variability on precipitation regimes that is the primary reason for the decreasing fire activity in the southern BDO Zone of Canada.

Risk Information: Wildfires are a significant risk to biomass supply chains in the area. Over the past decade, forest fire activity has been above normal in the region. 2017 and 2018 were record wildfire years, burning over 200,000 hectares west of Quesnel and more in the Cariboo Region. In 2017, wildfires affected 1.2 million ha in BC, of which 1 million was in the Quesnel (mainly west of the Fraser River), Williams Lake, and 100 Mile House TSAs. Major fire events in the past 5 years included the Plateau Complex (550,000 ha) and Elephant Hill (~190,000 ha).

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**

[17] https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-history/wildfire-season-summary?keyword=fires

Raw Risk Impact (RRI) The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**Score** **8**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 48 out of 100.	**Score** **48**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 48 out of 100.	**Score** **48**

3.7.4 Risk of Infestation

Rationale: Risk of future infestation, including its estimated consequences on feedstock supply, should be calculated into the overall risk profile.

Since forest insect populations are influenced by environmental conditions, future changes in climate can be expected to significantly alter the outbreak dynamics of certain forest insect species. In some cases, larger and more frequent insect outbreaks may occur, but in other cases recurring outbreaks may be disrupted or diminished. As climate continues to change, we can expect more situations, particularly at the margins of tree ranges, where sub-optimal conditions for tree growth and reduced tree vigor can lead to outbreaks of forest insects.

Risk Information: The mountain pine beetle (MPB) outbreak of 1997-2014 led to the destruction of approx. 1/6 of productive forest in BC. The lodgepole pine forests west of Quesnel have been significantly affected by MPB. Less risk of infestation is associated with forest resources located east of Quesnel as mixed species forests are more resilient to insect infestation. In future years, a low-to-moderate risk of insect infestation similar to the MPB outbreak is expected. However, if such events should occur, as was the case for the MPB outbreak, salvage operations will most likely lead to an increase in AAC and consequent increase in the availability of forest residues.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

3.7.5 Risk of Hail

Rationale: Hail has negligible impact of forestry biomass but is one of the principal destroyers of agricultural crops in North America.

There is much uncertainty about the effects of anthropogenic climate change on the frequency and severity of extreme weather events like hailstorms and their subsequent economic losses. Some studies indicate a strong positive relationship between hailstorm activity and hailstorm damage, as predicted by minimum temperatures using simple correlations. This relationship suggests that hailstorm damage may increase in the future if global warming leads to further temperature increase.

Risk Information: Not rated.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**Score** **NR**
Raw Risk Impact (RRI) The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**Score** **NR**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is not rated.	**Score** **NR**
Mitigation/Notching The Total Notch (RRL Notch × RRI Notch) is not rated.	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is not rated.	**Score** **NR**

3.7.6 Risk of Flood

Rationale: Floods can cause catastrophic disruption and delay in feedstock supply. Where there is high risk of flood and thus negative impact to feedstock supply, the BDO Zone rating should account for this risk.

Risk Information: Flooding in the region is restricted to localized areas around rivers, including the Fraser and Quesnel rivers. While flooding has occurred in the supply area, it rarely affects truck traffic or forestry operations and supply chains.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

3.7.7 Risk of Drought

Rationale: Droughts can cause significant disruptions to feedstock supplies across entire BDO Zones for extended periods of time, especially in case of agricultural residues and energy crops. Parts of Western Canada are experiencing more frequent and severe droughts, and scientists expect drought to affect new areas across Canada going forward.

Tree species are adapted to specific moisture conditions. Having less water available through drought has a range of negative impacts on the health of forest ecosystems. Direct impacts include reduced growth, increased tree mortality and failure to regenerate. Indirect impacts include reduced ability to defend against insects and disease, and increased fire risk. These impacts can affect the availability of wood fibre for an Issuer.

Risk Information: Drought conditions are common during the summer months in the BC interior. Generally, drought is unlikely to have a direct effect on wood fibre supply in the BDO Zone. However, there is a strong link between drought conditions and wildfires.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 48 out of 100.	**48**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 48 out of 100.	**48**

3.7.8 Risk of Hurricanes, Tornadoes and Strong Winds

Rationale: Hurricanes, tornadoes, and strong winds can destroy timber stands, crops, and feedstock piles. They can also delay forestry and agricultural operations. Hurricanes and tornadoes can indirectly cause temporary shortages of available transportation as available trucking moves to handle higher value disaster related contracts. For example, Katrina cleanup limited availability of live-bottom trailers in the North and South-East of the US for several months as truckers shifted operations to handle more lucrative government contracts.

Although scientists are uncertain whether climate change will lead to an increase in the number of hurricanes, warmer ocean temperatures and higher sea levels are expected to intensify their impacts.

Recent analyses conclude that the strongest hurricanes occurring in some BDO Zones including the North Atlantic have increased in intensity over the past two to three decades.

Risk Information: Not rated.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**NR**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**NR**

Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is not rated.	**Score** **NR**
Mitigation/Notching The Total Notch (RRL Notch × RRI Notch) is not rated.	**Notch** **NR**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is not rated.	**Score** **NR**

3.7.9 Risk of Low Temperatures

Rationale: Low temperatures can cause crop failure, leading to shortages of biomass. Additionally, low temperatures can have adverse impacts on the operations of feedstock processing equipment in Northern BDO Zones.

Risk Information: Low temperatures (-20 C to -30 C) are common in the region but the existing forestry and grinding operations have been capable of working with little to no negative impact on the supply chains. Risk is low.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

3.8 Risk Factor: Political and Social

3.8.1 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 subsidies only; it does not apply to government subsidies that pertain indirectly to the operations of the Issuer such as Loan Guarantees or to the markets for products produced by the Issuer.

Risk Information: There are a number of programs that support forest residue supply chains in the region. The Forest Enhancement Society of British Columbia (FESBC) is a government-funded organization that offers grants to encourage the utilization of low-grade wood fibre. Supported projects have included comminution and transport of forest residue. The Government of BC also offers reduced stumpage for residue ($0.25/$m^3$). While these subsidies provide near-term supply assurances for prospective developers, they are associated with a medium level of risk because they can be cancelled by subsequent government administrations.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**Score** **6**

Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

3.8.2 Local, Provincial, & National Laws, Regulations, & Permitting Pertaining to Biomass

Rationale: Feedstock whose production is 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 (i.e., 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) then likelihood of obtaining such permits and/or complying with permitting requirements should be examined.

Risk Information: Timber harvesting in BC has been declining in response to shortage of high-quality wood fibre (sawlog-quality roundwood) in the region. This shortage is partly attributed to delays in permitting and reductions in the AAC. It can take up to two years for cutting permits to be granted if proposed operating areas are located near ecologically sensitive areas or overlap with First Nations traditional territory (requiring consultation and approval by First Nations). Overall, we do not expect this to have a significant impact on feedstock availability for projects utilizing up to 100,000 odt/yr of forest residue.

There are also a number of regulations that are likely to encourage the utilization of forest residue, including the requirement to remove or burn slash piles within a certain time frame, penalties for not removing slash from operating areas, and a potential slash no-burn policy.[18] Overall, risk associated with this indicator is assessed as low-medium.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 24 out of 100.	**24**

[18] www2.gov.bc.ca/gov/content/industry/forestry/forest-tenures/forest-tenure-administration/residual-fibre-recovery/residual-fibre-utilization-policy

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 24 out of 100.	**24**

3.8.3 Backlash Against Biomass Development, Procurement or Usage in the Region

Rationale: Public backlash against biomass development in the Issuer BDO Zone can directly impact Issuer's ability to procure, transport, trans-load, store, or utilize feedstock by affecting local policies, regulations, and Issuer's ability to obtain necessary permitting.

Risk Information: Stakeholders in the region are generally in favour of biomass utilization, particularly forest residue. The rated quantities reflect business-as-usual operations, without an increase in the amount of aboveground biomass removed from forest stands. Therefore, risk that public opposition will develop in response to a new bio-project is assessed as very low.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**2**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**2**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**4**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**4**

3.8.4 Consent of, and Co-operation with, Indigenous Communities and First Nations

Rationale: Where new project development on or near Indigenous or First Nation land, or where near Indigenous or First Nations exert influence over feedstock producing areas, consent of, and co-operation with, Indigenous communities and First Nations decreases Issuer risk.

Risk Information: Consultation with and approval from First Nations groups is common in the Province and the Quesnel BDO Zone. There are a number of forums and government agencies that establish rules around First Nations and that streamline developer-First Nations communication. The Declaration on the Rights of Indigenous Peoples Act (DRIPA) passed unanimously in the BC Legislature on November 26, 2019, and came into effect on November 29, 2019. BC is the

first jurisdiction in Canada to have passed legislation to formally adopt the internationally recognized standards of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP).[19]

The Quesnel BDO Zone is one of the areas in BC in which an entitlement exercise with local First Nations will have significantly more access to forest land and resources than before. Thus, failure to establish a good rapport and agreement with First Nations could result in project delays or failure. However, upon previous consultations with the local First Nations, forest residue supply chains are unlikely to be affected by the above issues if First Nations consent and cooperation is sought. Generally, First Nations groups in the region have good relationships with licensees and are interested in forest health and the long-term success of the forest industry.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**Score** **6**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 24 out of 100.	**Score** **24**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 24 out of 100.	**Score** **24**

3.8.5 Food Security Concerns

Rationale: Despite the fact that any significant correlation between food prices and biofuel production is unclear, claims that biofuel production has driven up food prices, taken food from communities or had a negative impact on land use can fuel public backlash. For example, removal of biomass may raise public concerns relating to food security if Issuer feedstock requires the use of land that would otherwise be used for growing food.

Risk Information: Not rated.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**Score** **NR**
Raw Risk Impact (RRI) The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**Score** **NR**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is not rated.	**Score** **NR**
Mitigation/Notching The Total Notch (RRL Notch × RRI Notch) is not rated.	**Notch** **NR**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is not rated.	**Score** **NR**

[19] declaration.gov.bc.ca

3.9 Risk Factor: Sustainability and Environmental Concern

3.9.1 Feedstock Sustainability

Rationale: Public concerns about 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.

Canada leads all countries with 166 million hectares of certified forests, a figure that is nearly four times more than second place United States at 47 million hectares.

Risk Information: All forest companies operating in the region have sustainability certification (SFI) and are subject to strict government regulations. Certification and regulations include guidelines/requirements related to forest residue management and utilization, including the need to monitor and actively manage slash piles.

Recovery of forest residue is widely regarded as providing an environmental benefit. Forest residue utilization leads to GHG emissions savings and reductions in wildfire and insect infestation risk. It is unlikely that soil nutrient depletion will occur over time as a result of residue recovery because a significant volume (30% - 50%) remains scattered in the forest for decay and subsequent reincorporation into soil.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**2**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**2**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**4**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**4**

3.9.2 Risk to Soil Quality

Rationale: Soil sustainability can be defined as management of soil in a way that does not exert any negative or irreparable effects either on the soil itself or any other systems. There is a diversity of approaches to soil sustainability in jurisdictional guidelines for forest biomass harvesting and production. For different feedstock types, there are also different thresholds at which feedstock removal causes significant negative consequences on soil.

Poor soil quality that negatively impacts the long-term sustainability of the feedstock can entail long-term feedstock risk. Sub-optimal soil management can leave exposed soil post residue-harvest which can lead to soil wash-off and soil carbon loss from precipitation and wind. Over-harvesting of biomass also depletes the carbon stock in the soil and creates a negative feedback loop which can degrade the soil and its nutrients.

Risk Information: See 3.9.1

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**2**

Raw Risk Impact (RRI) The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**Score** **2**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**Score** **4**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**Score** **4**

3.9.3 Risk to Surface and Groundwater

Rationale: 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 social and regulatory backlash. Water intake issues can also increase risk.

Risk Information: Not rated.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**Score** **NR**
Raw Risk Impact (RRI) The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**Score** **NR**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is not rated.	**Score** **NR**
Mitigation/Notching The Total Notch (RRL Notch × RRI Notch) is not rated.	**Notch** **NR**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is not rated.	**Score** **NR**

3.9.4 Water Use

Rationale: Biomass feedstock operations can have significant impacts on the hydrological flux (infiltration, groundwater recharge, interception, and transpiration) of ecosystems. This can lead to water shortages, lower yields, and backlash from regulatory bodies if management plans are not properly instituted.

Risk Information: Not rated.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**Score** **NR**
Raw Risk Impact (RRI) The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**Score** **NR**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is not rated.	**Score** **NR**
Mitigation/Notching The Total Notch (RRL Notch × RRI Notch) is not rated.	**Notch** **NR**

Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is not rated.	**NR**

3.9.5 Pesticide Risk to Human and Ecosystem Health

Rationale: Application of pesticides (i.e., herbicides, fungicides, and insecticides) on agricultural and forest landscapes can result in adverse health effects for humans and ecosystems. If pesticide application is required in feedstock production, the impact must be considered in the BDO Zone rating.

Risk Information: Not rated.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**NR**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**NR**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is not rated.	**NR**
Mitigation/Notching	**Notch**
The Total Notch (RRL Notch × RRI Notch) is not rated.	**NR**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is not rated.	**NR**

3.9.6 Risk to Wildlife and Landscape

Rationale: Biomass production and supply chain operations with negative impacts on wildlife and landscape are at a greater long-term risk of encountering project setbacks and disruptions.

Risk Information: While there are some concerns that the removal of forest residue could affect the long-term viability of small mammal populations, soil stability, and nutrient availability, more than 30% of the total volume of forest residues is not removed from logging sites. This amount is more than sufficient to sustain both wildlife and soil health needs. Moreover, forest products companies that are licensed to cut in the Quesnel region are required by law to abide by strict sustainability harvest plans approved and enforced by the local BC Ministry of Forest Office.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**2**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**2**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**4**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**4**

3.9.7 Biomass Classified as Genetically Modified Organism (GMO)

Rationale: There are various risks associated with GMOs such as migration or dispersion across the landscape, which can generate community backlash and create supply chain risk. GMOs can also be heavily regulated. If planning to grow or procure GMO feedstocks, especially purpose-grown energy crops, it is important to understand the risks.

Risk Information: Not rated.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**Score** **NR**
Raw Risk Impact (RRI) The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**Score** **NR**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is not rated.	**Score** **NR**
Mitigation/Notching The Total Notch (RRL Notch × RRI Notch) is not rated.	**Notch** **NR**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is not rated.	**Score** **NR**

CATEGORY 4.0 FEEDSTOCK SCALE-UP RISK

4.1 Risk Factor: Feedstock Scale-Up

4.1.1 Feedstock Quality at Production Scale

Rationale: The physical and chemical properties of feedstock used in lab, pilot and field testing can fail to be representative of feedstock generated by large-scale operations.

It is important to conduct tests on feedstock representative of that which will be produced by large-scale operations. Failure to adequately test the full range of parameter values can result in severe problems during scale-up.

Risk Information: We do not foresee significant risks associated with feedstock quality if proper feedstock management practices are followed. This includes allowing residue to dry before comminution, reducing soil and rock contamination through proper handling, and careful piling/decking of residue. Local grinding operators are aware of the need to maintain feedstock quality for their clients; however, a quality control plan that incentivises maintaining and improving feedstock quality is recommended. Risk is increased slightly because forest residue generally has higher contamination and impurities than roundwood and sawmill residue, which were not rated. Risk is also increased due to the time constraints on residue removal under current regulations: licensees have limited time to remove residue to meet fire hazard abatement obligations. This could lead to comminution of residue that has not dried and subsequent delivery of fuel/feedstock with relatively high moisture content.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**Score** **6**
Raw Risk Impact (RRI) The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**Score** **6**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**Score** **36**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

4.1.2 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 Issuer feedstock requirements and throughput capacity. Capacity to scale should be demonstrated.

Risk Information: Although there are a sufficient number of mobile grinding units in the region,[20] procurement of the rated quantity of forest residue would require a slight increase in the training and recruitment of grinder operators. More importantly, reliable delivery of forest residue would require the addition of approximately 10 chip vans and associated drivers.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

CATEGORY 5.0: INFRASTRUCTURE RISKS

5.1 Risk Factor: Physical Infrastructure

5.1.1 Land Parcel/Ind. District

Risk Information: The evaluated site is located on the east bank of the Quesnel River, adjacent to West Fraser/Mercer's Cariboo Pulp and Paper mill (50 N Star Rd, Quesnel, BC). The site is a brownfield (Map D-1) with an area of approx. 52 ha. Formerly the site of a large sawmill (NorthStar, closed in 2008), the area is zoned for heavy industrial activities. While all utilities, rail spurs, and scales have been dismantled upon closing, they can be reconnected. Being conveniently

[20] There are 5 grinders operating in the region with a combined capacity of 150,000 – 300,000 odt/yr, assuming 20-30 odt/PMH, 8-10 PMH/day, and 200 workdays/year.

located beside the Cariboo Pulp and Paper mill, a new bio-project could capitalize on existing infrastructure available at the pulp mill. There are no restrictive obstacles to new bio-industry development.	
Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.1.2 Ownership of Land

Risk Information: The site is privately owned by West Fraser Mills Ltd. which uses the site sporadically to air dry lumber and store logs. West Fraser is open to collaborating with new entrants. As collaboration between the new entrant and this forest company is recommended to access forest residue in the BDO Zone, securing a long-term lease and/or purchase is likely, thus this indicator was set to low risk.	
Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.1.3 Permitting Description

Risk Information: Average permitting timeline for the brownfield/existing site was estimated at approx. 3-6 months. This property used to be a sawmill and because the surrounding land is also zoned heavy industrial and a pulp mill is located nearby, the risk was set low.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.1.4 Environmental Issues

Risk Information: The site used to be a sawmill and is located near a pulp mill. The air quality in Quesnel has been affected negatively by the small particulate matter emissions, but an Airshed Management Plan has been put in place and slow improvements were noted (2011).[21] In addition, road dust contributes to poor air quality and this would incrementally worsen with additional truck traffic. The new facility could benefit from wastewater treatment at the pulp mill. There are no existing environmental influences on the site that would represent a further risk to new development.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**Score** **6**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 24 out of 100.	**Score** **24**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 24 out of 100.	**Score** **24**

5.2 Risk Factor: Utilities

5.2.1 Natural Gas Availability

Risk Information: Natural gas is available in the City of Quesnel and is also available at the site (from the existing pulp mill located 100 meters from the site). Fortis BC is the natural gas provider in the area. For a Rate 5 customer (consuming

[21] quesnelairshed.files.wordpress.com/2010/12/qamp-review.pdf

5,000 GJ or more annually) there is a fixed delivery charge of approx. $600 and a variable rate of approx. $2.37/GJ. In addition, collaboration with the pulp mill cogeneration unit can include supply of steam/heat.	
Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.2.2 Electric Availability

Risk Information: BC Hydro customers with transmission accounts use large amounts of energy and invest in electrical infrastructure that allows them to receive service at high voltage. Most transmission accounts receive service under rate schedule 1823: a fixed demand charge of 8.812/kVA of billing demand plus a two-year energy charge of $97.6/MWh for up to 90% of baseload and $154.6/MWh for consumption above 90% of baseload. BC Hydro has programs that incentivize electricity savings and renewable power generation. Availability of three-phase electricity exists at the site, most likely through the line that connects the nearby pulp mill. In addition, collaboration with the cogeneration plant at the pulp mill may provide renewable electricity.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.2.3 Water Availability

Risk Information: Water is available at the site. The City of Quesnel water system is comprised of 6 operating groundwater wells (main system), 8 reservoirs, 5 booster pump stations, 2 main PRV stations and approximately 100 km of water main. At present there is no treatment or disinfection provided to the City's water system. Proximity to the pulp mill is beneficial.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.2.4 Waste Disposal

Risk Information: The City of Quesnel Municipal Services has a partnership with the nearby Cariboo pulp mill that treats the sewage in its treatment plant, saving the City many thousands of dollars. The landfill is located 5 minutes drive from the site.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.2.5 Internet Availability

Risk Information: Telus provides fibreoptic high speed internet in the area and could be easily connected to the site.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.3 Risk Factor: Transportation/Logistics

5.3.1 Road/Highway Access

Risk Information: Access to Hwy 97 is 3 km (5 min drive) from the site. Road access in all directions from the site is paved and well maintained as it serves the pulp mill and surrounding businesses. Surface access is no risk to new development. Risk is heightened to medium by the fact that driving North the highway passes through downtown Quesnel, causing traffic congestion. The need to improve bridge and highway infrastructure near Quesnel is well known, but construction of a new interchange has yet to be scheduled.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**Score** **6**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 24 out of 100.	**Score** **24**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 24 out of 100.	**Score** **24**

5.3.2 Rail Access

Risk Information: A former sawmill was located on this site with a dismantled rail spur that can be reactivated and connected to the pulp mill rail. CN Rail (cn.ca) has a rail yard in Quesnel that caters to the existing sawmill and pulp mills. Rail access is a great asset to a new development; thus, rated low risk.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.3.3 Airport Access

Risk Information: Quesnel Regional Airport offers 6 flights weekly to Vancouver. The airport provides private aviation terminals for business and commercial jet service including maintenance and storage. The proximity of the site (15-minute drive) to the airport is an asset to new development, thus rated low risk.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.3.4 Water Freight Access

Risk Information: Not rated.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**Score** **NR**
Raw Risk Impact (RRI) The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**Score** **NR**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is not rated.	**Score** **NR**

Mitigation/Notching The Total Notch (RRL Notch × RRI Notch) is not rated.	**Notch** **NR**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is not rated.	**Score** **NR**

5.4 Risk Factor: Social Infrastructure

5.4.1 Healthcare (Local)

Risk Information: The GR Baker Memorial Hospital and an urgent primary Care Centre are located 7 km from the site. Ambulances are available.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.4.2 Education (Schools)

Risk Information: The City of Quesnel has all levels of education: K-12 to college. The College of New Caledonia and the University of Northern BC both have programs in Quesnel. A wood processing and forestry program is currently under development. Education availability and quality is an asset to newly developing industries in the area.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.4.3 Local Transportation

Risk Information: While Quesnel has a public bus system (BC Transit) available, there is no public bus to the site. However, the closest bus stop is located approx. 3 km from the site. The vast majority of employees at the neighbouring mill drive to work. This lack of public transportation for prospective employees is a low risk to new development.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.4.4 Public Safety (Local)

Risk Information: The Quesnel RCMP is a modern police force that provides a variety of law enforcement and community services to the City of Quesnel and to specific rural areas surrounding the city. Official statistics report a total crime index (crimes/100k people) in Quesnel of 18,046/100k, 4.5 higher than the national crime index (4,223/100k). However, these statistics are known to misrepresent the situation because crime incidents are divided by the small population of the City (~10,000) rather than by the broader census area population (~23,000).[22] When properly adjusted for the actual population in the broader census area, crime rates in the region are above average but not indicative of public safety relative to more densely populated urban areas in the province.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**Score** **6**
Raw Risk Impact (RRI) The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**Score** **6**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**Score** **36**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**

[22] https://www.quesnel.ca/our-community/news-notices/news-releases/public-safety-and-policing

Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

5.4.5 Housing/Cost of Living

Risk Information: One of the barriers to population and workforce growth in the Quesnel area is the lack of housing stock availability. There are relatively few houses available and many are old. There have been at least 4 multi-unit buildings constructed in Quesnel over the past few years and construction on a 57-unit building is expected to begin in 2024. Quesnel has several programs in place to encourage new housing development, including a tax exemption for new multi-family developments and an infrastructure assessment protocol to fast-track new developments.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

5.5 Risk Factor: Labour

5.5.1 Workforce

Risk Information: Despite the closure of three mills in the past decade, the major employers in Quesnel remain the two pulp mills, a large sawmill and plywood mill, a MDF mill, and business involved in wood fibre supply activities. Many former forestry and wood processing employees found employment with mining operations that recently opened in the region. Risk is assessed as medium.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**

Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

5.5.2 Labour Costs

Risk Information: The minimum wage in BC is $16.75/hr (as of June 3, 2023). Average pay in Quesnel is approx. $35/hr which is similar to the national average. Risk is assessed as low.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

APPENDIX C: TABLES AND FIGURES

Table C-1 presents high-level estimates of allowable annual cut (AAC) and annual harvest volumes in the Quesnel BDO Zone and the resulting pulpwood and forest residue quantities (odt/yr) generated by each tenure area: Timber Supply Area (TSA) and Tree Farm License (TFL). Please note that only the harvest-based forest residue estimates were rated in this study. Pulpwood quantities were deemed unavailable (not rated) due to the existing demand in the BDO Zone for this product.

Table C-1: Current Allowable Annual Cut (AAC), harvest volumes, and pulpwood and forest residue potential by tenure in the Quesnel BDO Zone

SOURCE	Total Area (ha)	AAC (m^3/yr)	% in BDO Zone	AAC in BDO Zone (m^3)	Annual Timber Volume Harvested (m^3)	% AAC harvested	AAC-based Forest Residue Estimate* (odt/yr)	Harvest-based Forest Residue Estimate* (odt/yr)	AAC-based Pulpwood Estimate** (odt/yr)	Harvest-based Pulpwood Estimate** (odt/yr)
Quesnel TSA	1,280,000	2,600,000	65%	1,690,000	1,200,000	71%	226,460	160,800	114,075	81,000
TFL 52	260,000	592,500	100%	592,500	550,000	93%	79,395	73,700	39,994	37,125
Prince George TSA	7,970,000	6,900,000	8%	552,000	425,000	77%	73,968	56,950	37,260	28,688
Williams Lake TSA	4,930,000	2,937,500	15%	440,625	275,000	62%	59,044	36,850	29,742	18,563
TFL 53	87,800	219,000	100%	219,000	219,000	100%	29,346	29,346	14,783	14,783
TFL 30	180,350	330,000	100%	330,000	250,000	76%	44,220	33,500	22,275	16,875
TOTAL	**14,708,150**	**13,579,000**		**3,824,125**	**2,919,000**	**76%**	**512,433**	**391,146**	**258,128**	**197,033**

***** FPInnovations conversion factor of 0.134 odt/m^3 of merchanable log volume was applied[23]

** 15% of total AAC or harvested timber was assumed to fall into the pulpwood sort[24]

Table C-2 presents the estimated quantities (odt/yr) of sawmill residue generated by the sawmills operating in the BDO Zone. They were calculated with the Ecostrat sawmilling residue tool and based on the production capacities provided by Forisk[25] and confirmed by outreach. Note that sawmilling residue, like pulpwood quantities, were not rated in this study due to existing local demand for this by-product.

Table C-2: Sawmill residue production estimates in the BDO Zone

Supplier products	**Sawlog-to-product conversion factor** (% of sawlog volume)	**Total amount generated in BDO Zone** (odt/yr)
Wood chips	24%	660,884
Sawdust	8%	220,295
Shavings	4%	110,147
Bark	4%	110,147
Total	**40%**	**1,101,473**

[23] www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/timber-tenures/fibre-recovery/tr2018n7.pdf
[24] Personal communications with local forest industry representatives
[25] forisk.com

Map C-1 shows that only three sawmills are operational in the Quesnel BDO Zone. However, only two of them (West Fraser and Dunkley Lumber) generate sawmill residue in quantities relevant to this study while Kandola is a remanufacturing facility (not a sawmill).

Map C-1: Sawmills located in the BDO Zone (red) and Competition Zone (blue).

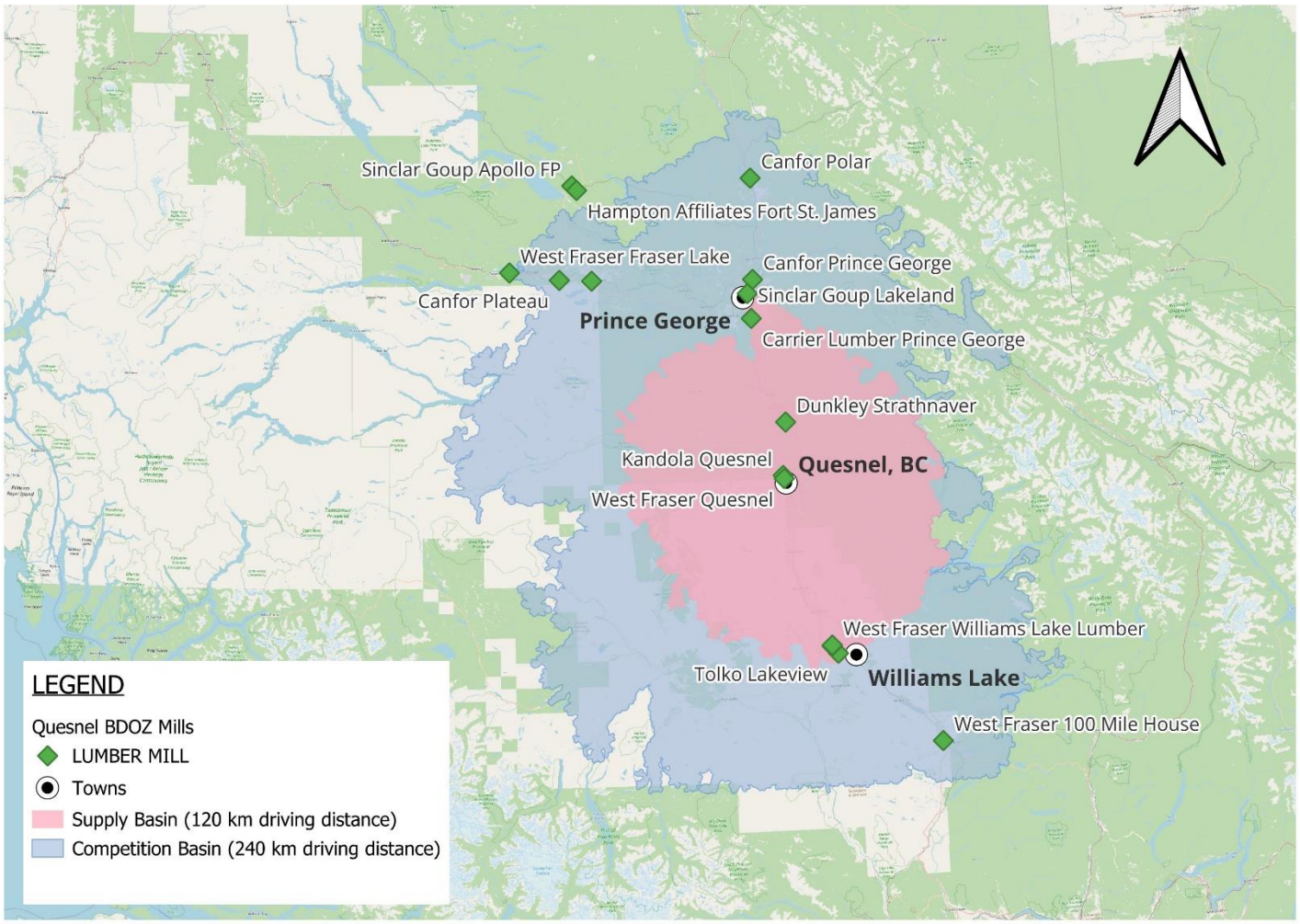


Table C-3 presents the estimated demand (adjusted by distance to the BDO Zone center) from all competitors in the Competition Zone. The total adjusted demand (1.8 million odt/yr) confirms that the sawmilling residue and pulpwood quantities estimated in Tables C-1 and C-2 would not be available for a potential project in the Quesnel BDO Zone.

Table C-3: Woody biomass demand by competitor category

Competitor category	Feedstock demand (odt/yr)	Feedstock demand from the BDO Zone* (odt/yr)	Feedstock types
Pulp and paper	2,646,173	1,303,586	Sawmill chips, pulpwood
Wood pellet	647,914	242,911	Sawdust, chips, shavings, pulpwood, forest residue
Power and cogeneration	848,500	289,577	Bark (hog fuel), forest residue, pulpwood
Total	**4,142,586**	**1,836,073**	

* Adjusted proportionally by the distance from Quesnel to each competitor

Table C-4 and Figures C-1 and C-2 show that in the past decade a significant number of sawmills, pulp mills, and pellet mills have closed operations due mainly to shortages of high value wood fibre (i.e., sawlogs) resulting from severe drops in AAC levels in the Williams Lake, Quesnel, and Prince George TSAs.

Table C-4. Mill closures in the Competition Zone since 2008

Year	Mill type	Company/Location
2008	Sawmill	West Fraser - NorthStar, Quesnel
2014	Sawmill	Canfor, Quesnel
2016	Pellet Mill	Pinnacle, Quesnel
2018	Sawmill	M & K Sawmills, Quesnel
2019	Sawmill	Tolko, Quesnel
2022	Pellet Mill	PacBio, Prince George
2023	Pulp mill	Canfor, Prince George

Figure C-1: Historical number of sawmills and total sawmilling capacity (MMBF) in the Quesnel BDO Zone

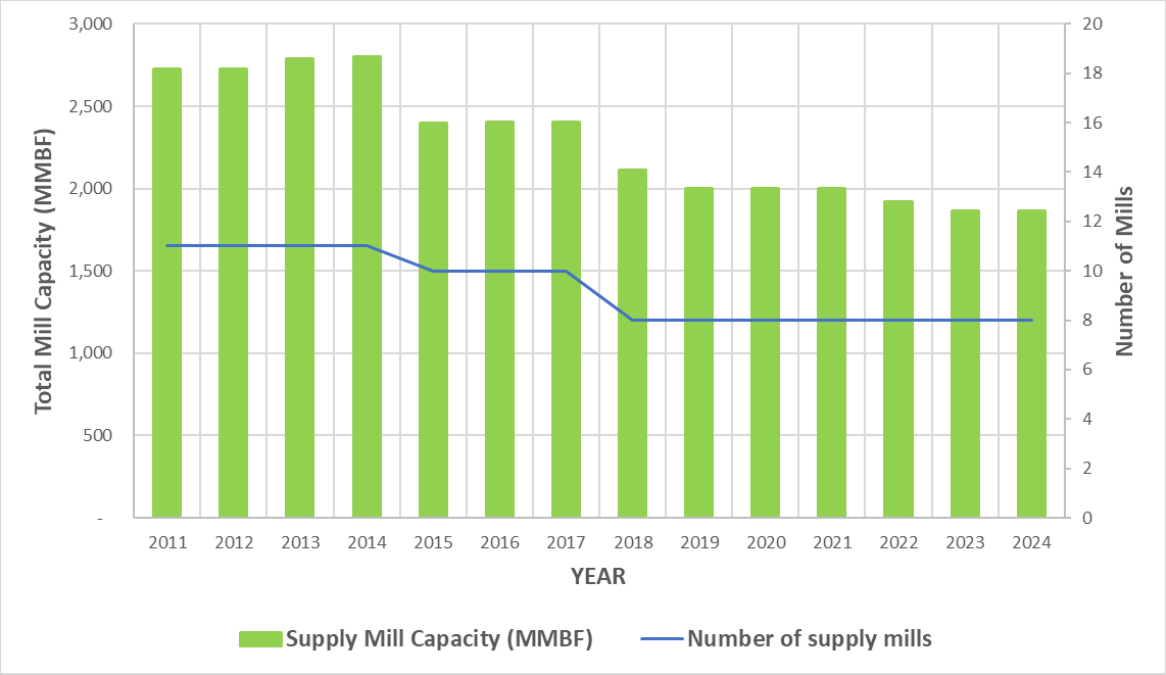
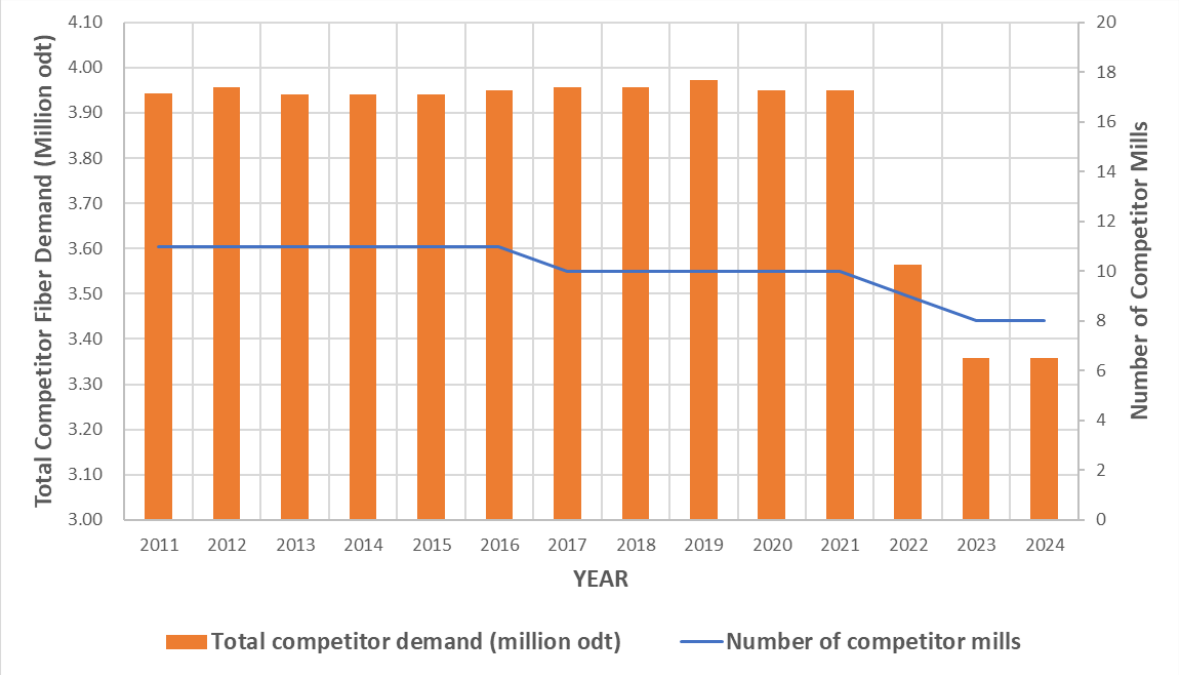


Figure C-2: Historical number of competitor mills (pulp & paper and pellet mills) and total fibre demand (million odt)



The forest residue supply curves presented in Figure C-3 were modelled after the supply curves developed by FPInnovations for the Quesnel TSA[26] for the price ranges and fuel price increases considered in this study. Please note that a fuel price increase is expected to generate a significant shift in forest residue availability, especially in the $60-90/odt price range.

Figure C-3: Forest residue rated quantity (odt/yr) for different prices ($60/odt - $110/odt) under two fuel price scenarios (current and 50% increase)

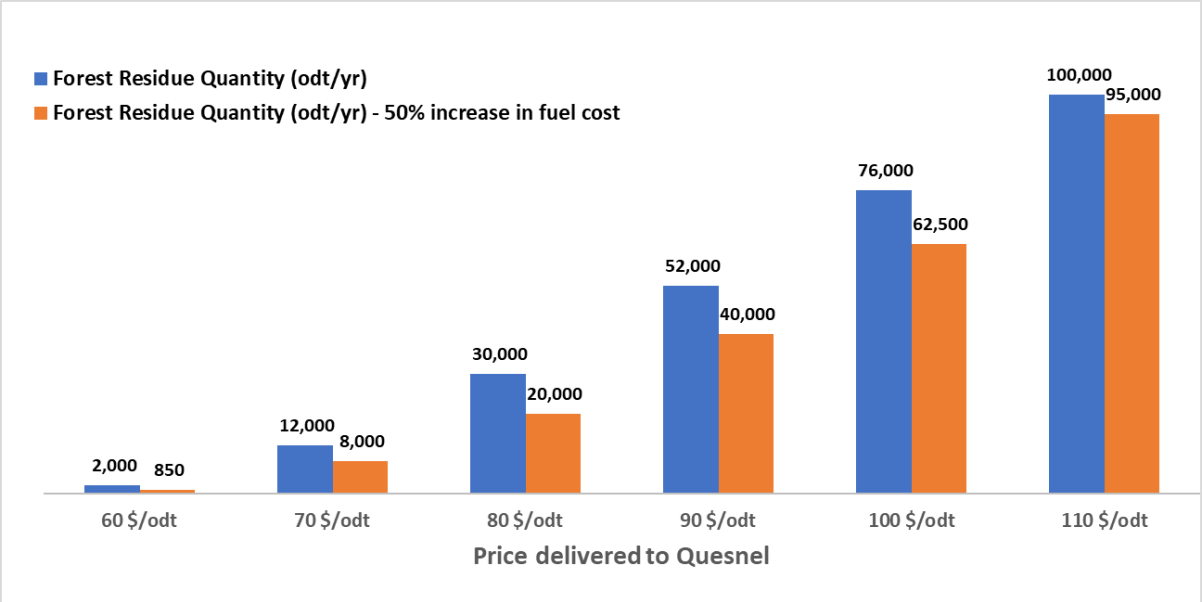
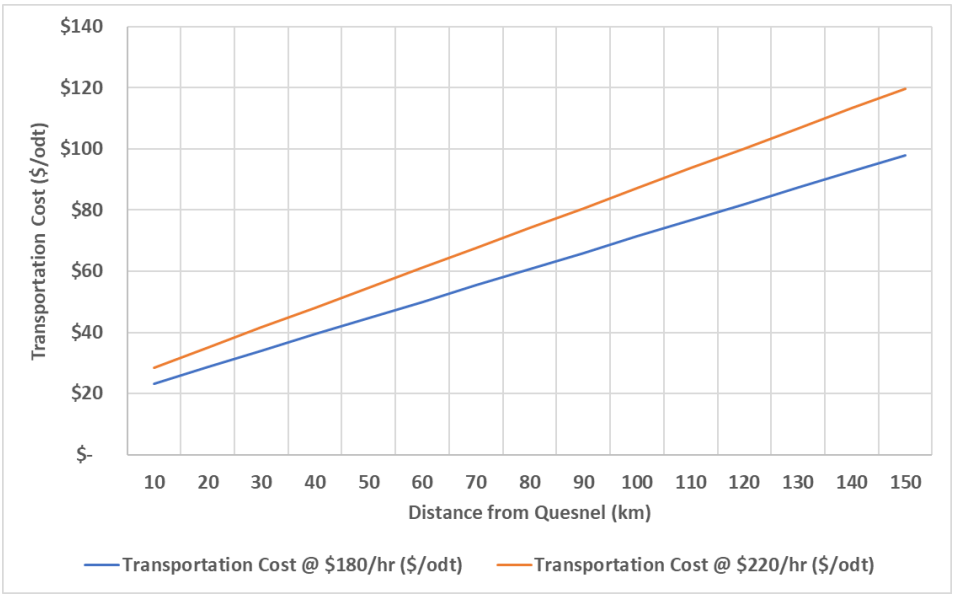


Figure C-4: Comminuted Forest Residue Transportation Costs ($/odt)



[26] www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/timber-tenures/fibre-recovery/tr2018n7.pdf

Figure C-5: Historical Diesel Prices in Prince George, BC (2016-2024)[27]

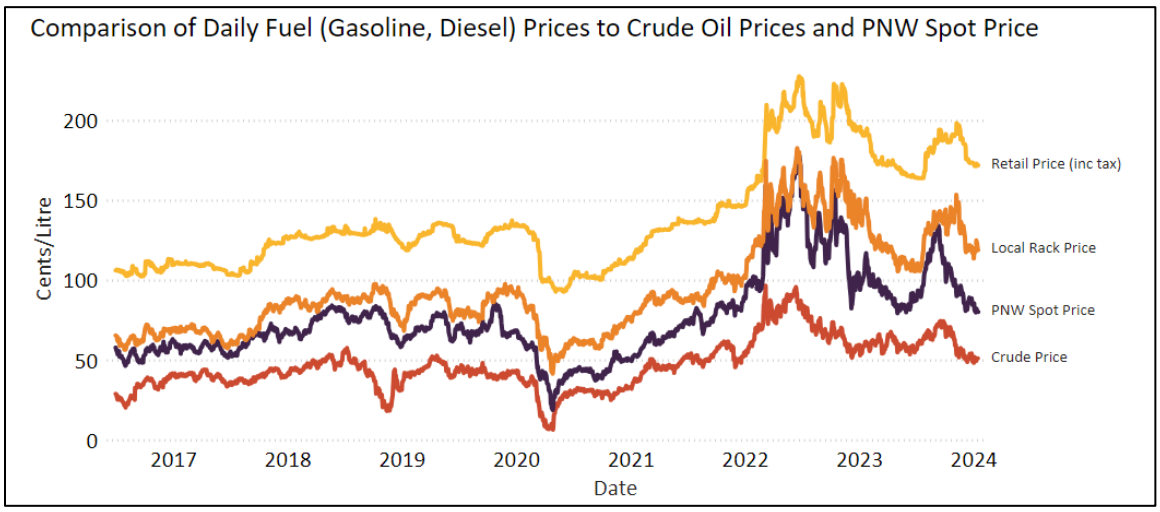
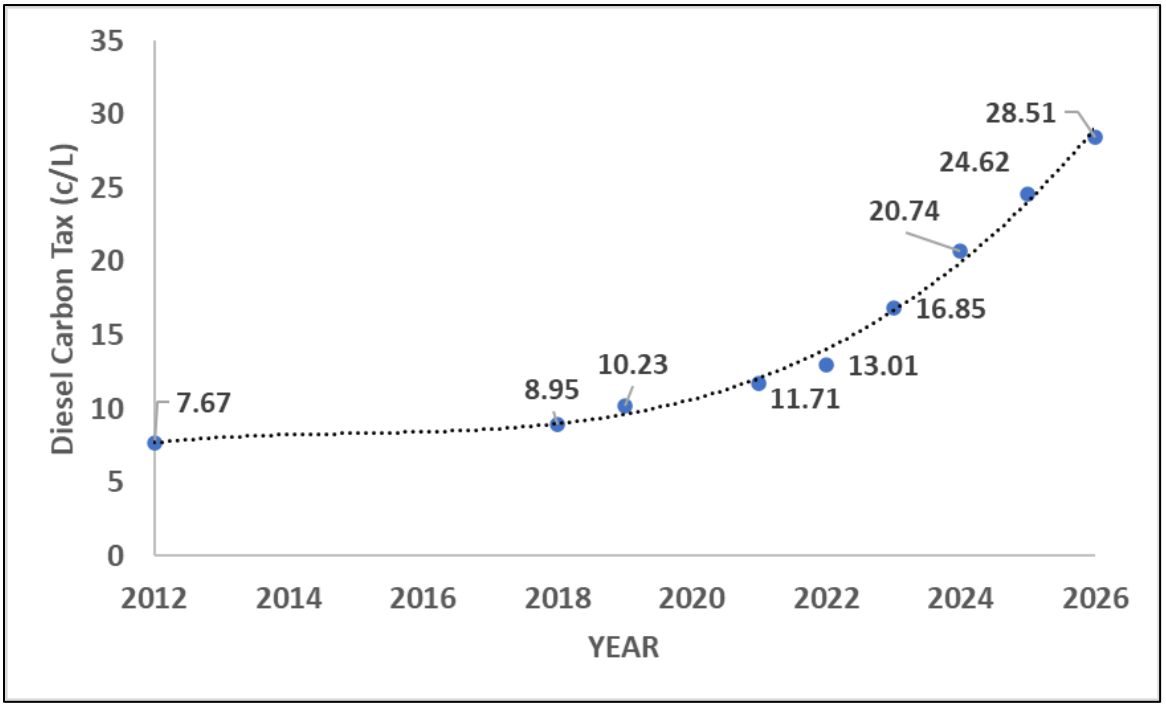


Figure C-6: Historical and Projected Diesel Carbon Tax in British Columbia (2012-2026)[28]

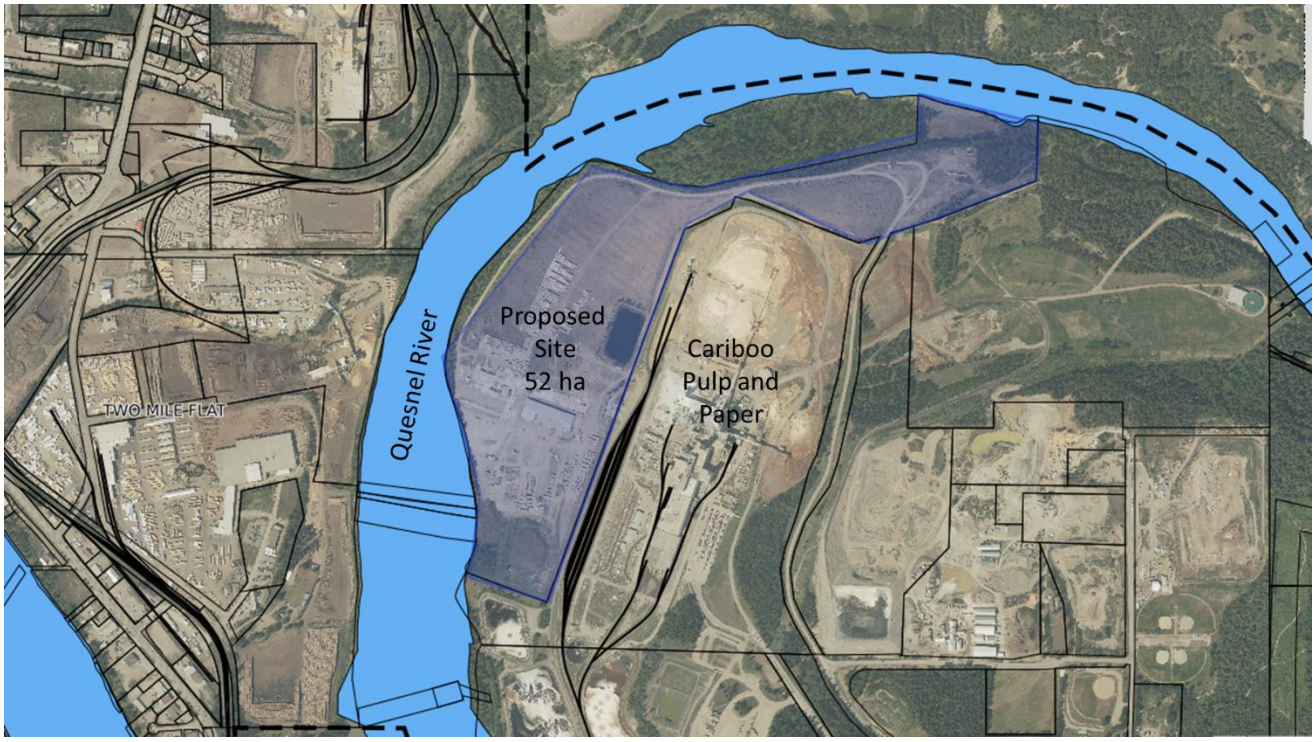


[27] www.gaspricesbc.ca/

[28] https://www2.gov.bc.ca/assets/gov/taxes/sales-taxes/publications/carbon-tax-rates-by-fuel-type-from-july-1-2012.pdf; https://www2.gov.bc.ca/gov/content/taxes/sales-taxes/motor-fuel-carbon-tax/publications/carbon-tax-rates-by-fuel-type

APPENDIX D: ADDITIONAL INFRASTRUCTURE INFORMATION

Map D-1: Proposed project site



APPENDIX E: LEGAL DISCLAIMER

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