BDO Zone Rating: **'A'**

Biofuel Development Opportunity Zone Risk Rating

'A'

The Coconino County, AZ BDO Zone is rated 'A'. A total of 100,000 bdt/yr of wood fiber is available at low-to-moderate risk from planned ecological restoration and fire management operations within the region's forests and woodlands.

Rating Parameters:

Category	Rated Quantity	Delivered Price	BDO Zone Size
Forest residue	50,000 bdt/yr	$50-$75/bdt	75-mile drive distance from Bellemont, AZ
Sawmill residuals	10,000 bdt/yr	$55-$70/bdt	
Woodland biomass	40,000 bdt/yr	$110-$120/bdt	

BDO Zone Assets

- **Quantities of woody biomass sufficient for medium-scale bio-projects are available at low risk**
- **Diverse network of organizations committed to biomass supply chain development**
- **Lack of local competitors for wood fiber**

BDO Zone Liabilities

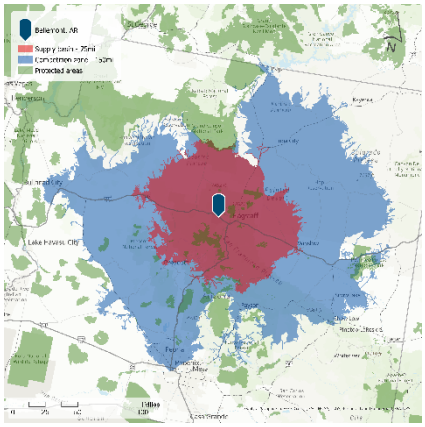
- **Regional forest industry is operating below historical capacity**
- **Unpredictability of timber and stewardship contract arrangements is being actively addressed but remains an issue**
- **Moderate risk of temporary wood supply disruptions from forest fires and post-fire flooding**
- **Biomass power plant located within competition zone**

BDO Zone Risk Rating

The Coconino County, AZ, Biofuel Development Opportunity Zone is rated 'A,' or investment grade quality.

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

Coconino County, AZ BDO Zone



Scoring & Rating Methodology

In assessing the biomass supply chain risk for the Biofuel Development Opportunity (BDO) Zone, 72 Risk Indicators from the US 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 bone dry tons per year (bdt/yr), while feedstock costs are expressed in United States (USD) dollars. Maximum transport distance is based on a 75-mile driving distance from the center point (Bellemont, AZ).

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 likelihood 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).

Next, each BDO Zone Risk Indicator is given a **Raw Risk Impact (RRI)** score which denotes the impact 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.

Then, the **Gross Risk Indicator (GRI)** score is calculated as the product of the RRL and the RRI

scores. For example, if the 'Competitor Price and Price Sensitivity' is scored at a RRL of 2 and a RRI of 9, then the GRI for this risk indicator is 2 × 9 = 18.

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.

Finally, 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 20 or less are deemed *very low risk*; scores between 21 and 40 are deemed *low risk*; scores between 41 and 60 are deemed *medium risk*; scores between 61 and 80 are deemed *high risk*; and scores of 81 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 Coconino County, AZ is ***20.93 out of 100, resulting in an 'A' designation***.

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

Analyst Notes

The Coconino County, AZ BDO Zone encompasses an 8,925 square mile area of mountain forest, shrubland, and desert in northern Arizona (delimited by a 75-mile drive distance from Bellemont, AZ). Forests are present at mid- to high-elevations (>7,000 feet) and are comprised mainly of Ponderosa pine with complements of oak, spruce, fir, and other pine species. Forests transition into woodlands, shrublands, savanna, and desert at lower elevations. Tree species present at lower elevations (<7,000 feet) are restricted mainly to pinyon pine and juniper (referred to as pinyon-juniper woodlands).

The vast majority of mid- and high-elevation forestland in the region is owned and managed under the USDA-USFS National Forest System. The BDO Zone encompasses Coconino National Forest (NF) and Kaibab NF; the adjacent Apache-Sitgreaves NF and Tonto NF are located outside the limits of the Zone. At lower elevations, pinyon-juniper woodlands are present on a patchwork of federal, state, private, and municipal lands.

Forest management within the NFs is guided by ecological restoration, wildfire mitigation, and water conservation objectives under the Four Forests Restoration Initiative (4FRI). Current forest structure in the region's ponderosa pine stands is widely regarded as unnatural, consisting of high stem densities and uneven vertical canopy structures, which can lead to above-normal wildfire frequency and intensity. At lower elevations, pinyon-juniper woodland encroachment has reduced rangeland size and increased wildfire risk. Wildfire mitigation and ecological restoration of forestlands and woodlands often requires active management in the form of commercial thinning and prescribed burning.

The 4FRI initiative aims to commercially thin 50,000 acres of ponderosa pine forest annually. Within the Coconino and Kaibab NFs (collectively referred to as the westside), the objective is to commercially thin approximately 25,000 acres/year. Since 2010, the largest acreage commercially thinned in any single year on the westside was approximately 7,000 acres.

The main challenge to realizing the objectives of the 4FRI initiative on the westside relates to the lack of local markets for low quality biomass. Piles of unmerchantable wood that accumulate during thinning operations (referred to as forest residue or slash) pose a risk of wildlife and insect infestation. Burning slash piles is not a preferred solution because of air quality concerns, carbon emission concerns, and insufficient USFS fire crew capacity. It is preferable to haul forest residue off site but without local markets, this is generally not economically possible.

Most of the merchantable roundwood that is produced during thinning operations on the westside is delivered ~150 miles to sawmills in the Phoenix area. Sawmills located within 75 miles of Bellemont, AZ currently have low annual timber demands (average of ~60,000 tons/year per mill).

Solid wood products produced from the region's timber resources include pallets, small dimensional lumber, engineered wood products, and specialty wood products. A portion of annual roundwood production is also used to supply the regional firewood market.

There are approximately 15 forestry contractors that regularly operate in the region, including 6 logging/thinning contractors and 9 trucking companies. Forest residue comminution operations are rare and involve the use of grinders owned and operated by two local contractors, a large sawmill under development in Bellemont, and by companies located outside the region. Forest operations are driven by a mixture of market and non-market incentives. To encourage commercial thinning operations, the USFS must often fund a portion of the operations using stumpage payments for merchantable timber or special funds.

We estimate that 50,000 bdt/yr of forest residue procured from ponderosa pine thinning operations on the westside is available for new bio-projects in the BDO Zone. Procuring this amount of forest residue would require thinning operations on ~5,000 acres/yr in the Coconino and Kaibab NFs. This approximates average 4FRI thinning activity over the 2010-2023 period, and is less than one-fifth of the total annual acreage that would be thinned if the 4FRI initiative target was realized (~25,000 acres/yr on the westside).

The availability of sawmill residuals (chips, bark, sawdust, and shavings) for new projects in the BDO Zone is more limited. This is mainly due to the relatively low annual throughput of roundwood in the five sawmills currently operating in the area. To avoid competition risks associated with existing buyers of sawmill residuals, including a 28 MW biopower plant located in Snowflake and a soil amendment and chip/mulch producer located in Phoenix, we assumed that a new project could secure 10,000 bdt/yr at the rated price range of $55-$70/bdt delivered 50-75 miles (<15% of total annual production).

An additional 40,000 bdt/yr of biomass from pinyon-juniper woodlands could also be made available at low-to-medium risk with investments in equipment and skilled operators. Achieving this level of woodland biomass production within a scale-up period of 3-5 years is regarded as a low-risk proposition pending the development of a bio-project located within a 75-mile transport distance.

BDO Zone Assets

A large network of private, governmental, and community organizations are actively involved in biomass supply chain research and development on the westside. This includes the USFS, the Arizona Department of Forestry and Fire Management (ADFFM), the Coconino County Flood Control District (CCFCD), the City of Flagstaff, The Nature Conservancy (TNC), Northern Arizona University (NAU) and its Ecological Restoration Institute (ERI), Campbell Global, and TSS Consultants, among others. Each of these organizations collaborates closely under formal peak associations and programs (e.g., the Greater Flagstaff Forests Partnership (GFFP) and 4FRI) and special projects.

Utilities (e.g., the Salt River Project) and larger companies involved in wood fiber sale and procurement are also closely involved in restoration and fire mitigation efforts. The Salt River Project (SRP) recently signed a 10-year power purchase agreement (PPA) with a large biopower plant that began in June 2023. Part of the agreement involves the provision of renewable energy credits to municipalities for forest thinning activities. This partnership will help support the SRP's goal of thinning 500,000 acres of forest by 2035. This improves the prospects for realizing the 4FRI objective of 50,000 acres/year (25,000 acres/year on the westside).

A large sawmill that is under construction in Bellemont (Restoration Forest Products, RFOR) would be a significant asset to bio-projects in the region, if developed to its planned capacity of 150 MMBF/yr. At this size, the mill would consume the majority of the merchantable roundwood available on the westside under

the 25,000 acres/yr target. Uncertainty over year-to-year commercial thinning activity would be eliminated, ensuring procurement of the rated quantity of forest residue at the rated price range.

On balance, the prevalence of federal timberland and woodland ownership is viewed as an asset. There is a relative shortage of standing merchantable timber in the region, precluding a conventional growth-and-yield forest management strategy. The unique overarching non-timber objectives of forest management in the region (namely ecological restoration and wildfire mitigation) would not likely be achieved under private ownership. The USFS and local partners are working to improve management and contracting arrangements to leverage private enterprise, while maximizing annually treated acreage.

Another significant asset of the BDO Zone relates to the lack of local buyers of residue, residuals, and woodland biomass. Larger potential competitors to new bio-projects in the Bellemont-Flagstaff area are located approx. 150 miles from the Coconino and Kaibab NFs. Prices paid for forest residue and woodland biomass in the region generally do not exceed $100/bdt, which limits viable transportation distances to less than 80-100 miles after the costs of harvesting and comminution are incurred. A new project is therefore likely to secure the rated quantities within the BDO Zone.

BDO Zone Liabilities

There are signs of growth in the regional forest industry, including pallet manufacturing growth in Phoenix and prospects for the full-scale operation of the RFOR mill in Bellemont. However, the industry is currently producing value-added products at well-below historic levels. Over the past twenty years major sawmills have closed permanently. Temporary and permanent sawmill closures in northern Arizona have continued in recent years. Mill closures have resulted in significant workforce losses: for example, between 2005 and 2009, the forestry workforce in Arizona declined by 50%.

The historic decline in milling and workforce capacity can be attributed largely to forest resource limitations. Merchantable roundwood is relatively scarce in northern Arizona after decades of harvesting in excess of sustainable growth and yield. Current growing stock in ponderosa pine forests is relatively low, with a typical sawlog production of less than 5,000 board feet/acre and an average diameter-at-breast height of less than 20 inches. Large swaths of the region are inhospitable to tree and shrub growth.

Commercial thinning under 4FRI is viewed as a means of procuring a sustainable supply of merchantable roundwood for industry, while realizing primary ecological restoration and wildfire mitigation objectives. The USFS has had consistent difficulties achieving the stated 4FRI goal of treating 50,000 acres annually (25,000 acres/yr on the westside). Since the program began in 2010, commercial thinning activity has never exceeded ~20,000 acres in any single year (~7,000 acres/yr on the westside). On the eastside (the Apache-Sitgreaves and Tonto NFs), a large biopower plant (Novo BioPower) capable of purchasing large quantities of forest residue and woodland biomass frequently experiences biomass supply shortages.

The unpredictability of contracting under the USFS 4FRI initiative is also regarded as a significant barrier to commercial thinning scale-up. While this is being addressed through revisions to the contracting system, we expect some level of continued unpredictability in the near term. Contracting for the rated quantity of woodland biomass is not a significant risk.

There is a high risk of temporary wood supply disruption from extreme weather events, particularly for the rated quantity of forest residue. Seasonal weather events, including forest fires, floods, and winter storms, lead to prolonged operational pauses in most years. It is expected that maintaining feedstock inventories and shifting operations to PJ woodlands will mitigate seasonal disruptions, but this remains a liability compared to other regions in North America.

A further liability relates to potential competition with existing consumers of low-quality wood fiber in the region. At full capacity, the 28 MW Novo BioPower plant has biomass consumption of 175,000 – 200,000 bdt/yr, equivalent to the total residue supply potential in the BDO Zone. Novo BioPower does not pay enough to cover the costs of comminution and transport from the westside. However, if the plant was to receive new subsidies that enabled procurement of greater quantities from the westside, a new project in the Bellemont-Flagstaff area would be in direct competition. This is regarded as unlikely but is noteworthy.

Long-term (>30 year) prospects for the forest biomass industry are uncertain. Successful forest restoration will result in an eventual scarcity of small-diameter trees that pose a fire risk. However, the objectives of ecological restoration and wildfire mitigation are not expected to be met within the lifespan of a new project (30-50 years). Further, a decline in residue availability from thinning operations in the NFs could be offset by production of woodland biomass if supply chain efficiencies improve.

Infrastructure Profile

The industrial site selected for risk assessment is a 159-acre undeveloped parcel in eastern Flagstaff. The site has direct access to electricity, natural gas, water, and modern telecommunications, and is located in close proximity to a rail line. The site is within a 50-mile drive distance of the majority of biomass resources available in the BDO Zone and has direct access to forestry research and workforce training institutions. The site's favorability for bio-project development is representative of other potential infrastructure sites in the Wiliams-Bellemont-Flagstaff area.

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Figure 1: Risk Indicators (Sorted by Risk Level)

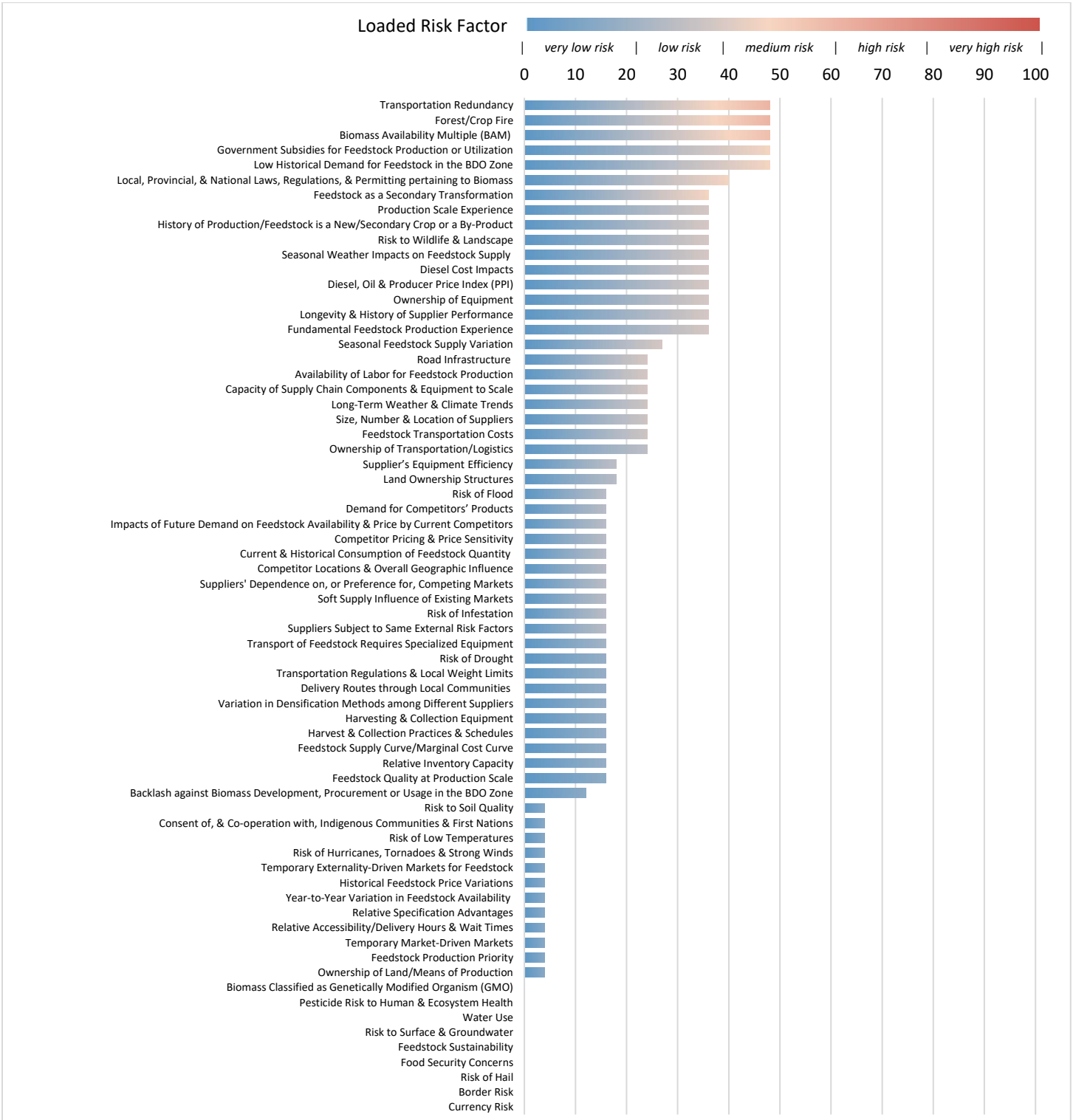


Table 1: Risk Indicators and Associated Scores

	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	8	6	48	25%	36
1.2.1	Supplier's Dependence on, or Preference for, Competing Markets	4	4	16	N/A	16
1.3.1	Ownership of Land / Means of Production	2	2	4	N/A	4
1.3.2	Ownership of Equipment	6	6	36	N/A	36
1.3.3	Ownership of Transportation/Logistics	4	6	24	N/A	24
1.3.4	Feedstock as a Secondary Transformation	6	6	36	N/A	36
1.4.1	Fundamental Feedstock Production Experience	6	6	36	N/A	36
1.4.2	Production Scale Experience	6	6	36	N/A	36
1.5.1	Supplier's Equipment Efficiency	6	4	24	25%	18
1.6.1	Feedstock Production Priority	2	2	4	N/A	4
	Category 2.0: Competitor Risk					
2.1.1	Competitor Locations and Overall Geographic Influence	4	4	16	N/A	16
2.1.2	Current and Historical Consumption of Feedstock Quantity	4	4	16	N/A	16
2.1.3	Competitor Pricing and Price Sensitivity	4	4	16	N/A	16
2.1.4	Impacts of Future Demand on Feedstock Availability and Price by Current Competitors	4	4	16	N/A	16
2.1.5	Soft Supply Influence of Existing Markets	4	4	16	N/A	16
2.1.6	Temporary Market-Driven Markets	2	2	4	N/A	4
2.2.1	Relative Inventory Capacity	4	4	16	N/A	16
2.2.2	Relative Accessibility / Delivery Hours and Wait Times	2	2	4	N/A	4
2.2.3	Relative Specification Advantages	2	2	4	N/A	4
2.2.4	Demand for Competitors' Products	4	4	16	N/A	16
	Category 3.0: Supply Chain Risk					
3.1.1	Biomass Availability Multiple (BAM)	6	8	48	N/A	48
3.1.2	Feedstock Supply Curve / Marginal Cost Curve	4	4	16	N/A	16
3.1.3	Seasonal Feedstock Supply Variation	6	6	36	25%	27
3.1.4	Year-to-Year Variation in Feedstock Availability	2	2	4	N/A	4
3.2.1	Historical Feedstock Price Variations	2	2	4	N/A	4
3.2.2	Low Historical Demand for Feedstock in the BDO Zone	6	8	48	N/A	48
3.2.3	History of Production/Feedstock is a New/Secondary Crop or a By-Product	6	6	36	N/A	36
3.3.1	Diesel, Oil and Producer Price Index (PPI)	6	6	36	N/A	36
3.3.2	Currency Risk	NR	NR	NR	NR	NR
3.3.3	Border Risk	NR	NR	NR	NR	NR
3.3.4	Temporary Externality-Driven Markets for Feedstock	2	2	4	N/A	4
3.4.1	Harvest and Collection Practices and Schedules	4	4	16	N/A	16
3.4.2	Harvesting and Collection Equipment	4	4	16	N/A	16
3.4.3	Variation in Densification Methods among Different Suppliers	4	4	16	N/A	16
3.4.4	Availability of Labor for Feedstock Production	4	6	24	N/A	24
3.5.1	Feedstock Transportation Costs	4	6	24	N/A	24
3.5.2	Diesel Cost Impacts	6	6	36	N/A	36
3.5.3	Transport of Feedstock Requires Specialized Equipment	4	4	16	N/A	16
3.5.4	Delivery Routes through Local Communities	4	4	16	N/A	16
3.5.5	Transportation Regulations and Local Weight Limits	4	4	16	N/A	16
3.5.6	Road Infrastructure	6	4	24	N/A	24
3.5.7	Transportation Redundancy	6	8	48	N/A	48
3.6.1	Size, Number and Location of Suppliers	6	4	24	N/A	24
3.6.2	Suppliers Subject to Same External Risk Factors	4	4	16	N/A	16
3.6.3	Land Ownership Structures	6	4	24	25%	18
3.7.1	Seasonal Weather Impacts on Feedstock Supply	6	6	36	N/A	36
3.7.2	Long-Term Weather and Climate Trends	6	4	24	N/A	24
3.7.3	Forest / Crop Fire	8	6	48	N/A	48
3.7.4	Risk of Infestation	4	4	16	N/A	16
3.7.5	Risk of Hail	NR	NR	NR	NR	NR
3.7.6	Risk of Flood	4	4	16	N/A	16
3.7.7	Risk of Drought	4	4	16	N/A	16
3.7.8	Risk of Hurricanes, Tornadoes and Strong Winds	2	2	4	N/A	4
3.7.9	Risk of Low Temperatures	2	2	4	N/A	4
3.8.1	Government Subsidies for Feedstock Production or Utilization	8	8	64	25%	48
3.8.2	Local, Provincial, and National Laws, Regulations, and Permitting pertaining to Biomass	4	10	40	N/A	40
3.8.3	Backlash against Biomass Development, Procurement or Usage in the BDO Zone	2	6	12	N/A	12
3.8.4	Consent of, and Co-operation with, Indigenous Communities and First Nations	2	2	4	N/A	4

3.8.5	Food Security Concerns	NR	NR	NR	NR	NR
3.9.1	Feedstock Sustainability	2	2	4	N/A	4
3.9.2	Risk to Soil Quality	2	2	4	N/A	4
3.9.3	Risk to Surface and Groundwater	NR	NR	NR	NR	NR
3.9.4	Water Use	NR	NR	NR	NR	NR
3.9.5	Pesticide Risk to Human and Ecosystem Health	NR	NR	NR	NR	NR
3.9.6	Risk to Wildlife and Landscape	6	6	36	N/A	36
3.9.7	Biomass Classified as Genetically Modified Organism (GMO)	NR	NR	NR	NR	NR
	Category 4.0: Feedstock Scale-up Risk					
4.1.1	Feedstock Quality at Production Scale	4	4	16	N/A	16
4.1.2	Capacity of Supply Chain Components and Equipment to Scale	4	6	24	N/A	24
	Category 5.0: Infrastructure					
5.1	Physical Infrastructure	3.8	3.8	15.6	N/A	15.6
5.2	Logistics	4.5	4.5	21	N/A	21
5.3	Social Infrastructure	4	4	21.71	N/A	21.71
5.4	Workforce and Permitting	5	5	26	N/A	26
					Average	**20.93**



Coconino County, AZ BDO Zone Independent Review Committee (IRC)

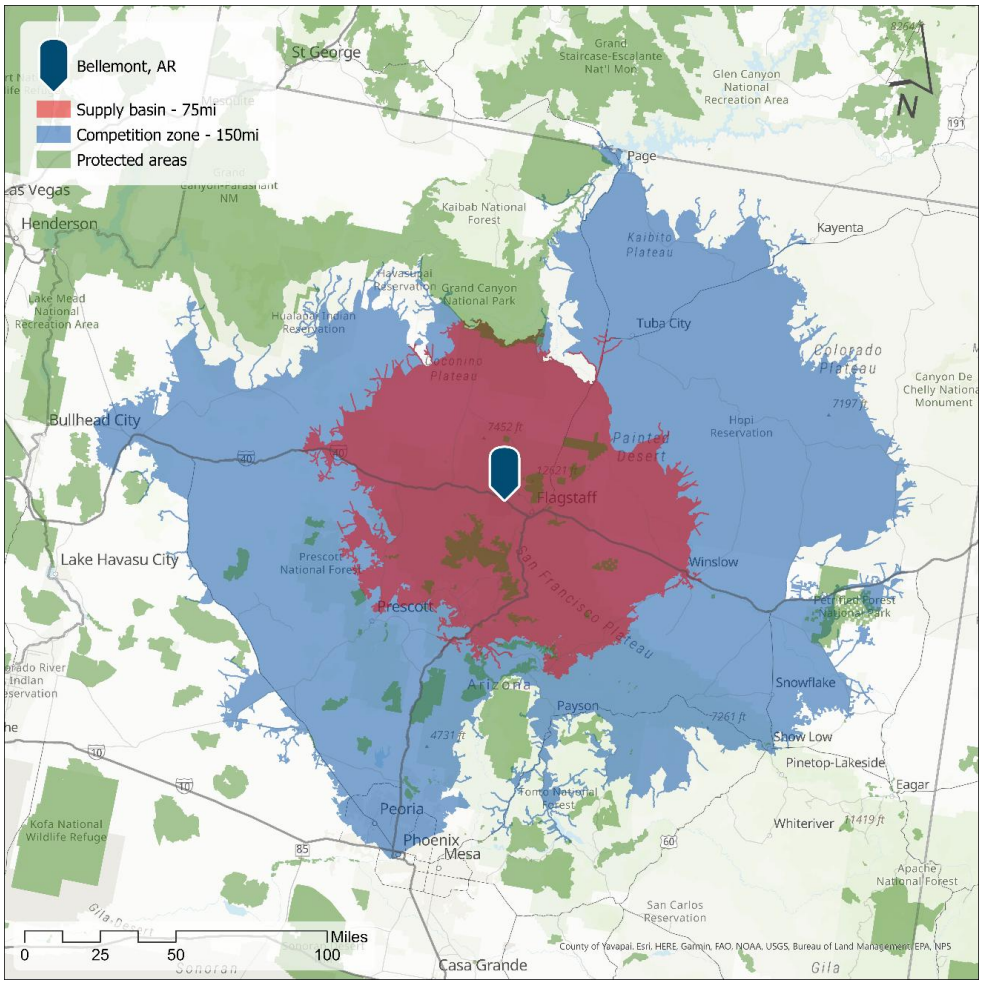
Jay Smith – Forest Restoration Director, Coconino County
Tabi Bolton – Area Supervisor, Campbell Global
Han-Sup Han – Professor and Director of Forest Operations and Biomass Utilization, Northern Arizona University – Ecological Restoration Institute
Joel Jurgens – Forest Program Director, The Nature Conservancy
Kevin Ordean – Forest Operations Manager, Restoration Forest Products
Diane Vosick – Chair, Forest Biomass Coalition
John Richardson – Assistant State Forester, Arizona Department of Forestry & Fire Management
Marshall Randol – Timber Sale Administrator, Coconino National Forest
Scot Rogers – 4FRI Program Manager, United States Forest Service
Ben Stewart – Deputy State Director, U.S. Senator Kyrsten Sinema
David Hayward – Partner, Restoration Soils

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 total potential amount of woody biomass that can be produced within the BDO Zone (75-mile drive distance from Bellemont). This estimate of total potential is then reduced based on expected demand for woody biomass and by applying the Biomass Availability Multiple (BAM), which reduces the amount available based on informed assumptions of supply chain constraints (e.g., operational, accessibility, and market constraints). The final 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 wider competition zone (150-mile drive distance from Bellemont) and reflects the anticipated price that a new bio-project would have to pay to secure the rated quantity of biomass. The BDO Zone/supply basin and competition zone are shown on Map A-1.

Map A-1. Coconino County BDO Zone and competition zone with Bellemont as center point



Note on units: all quantity units are standardized to bone dry tons per year (bdt/yr) and can be converted to green tons using a moisture content assumption of 40%-50%. All price units are standardized to 2023 USD per bdt ($/bdt) and can be expressed either as freight-on-board (FOB) at the location of feedstock production (not including the costs of transporting the feedstock to a new bio-project) or as delivered (including the costs of transporting the feedstock to a new bio-project).

Note on terminology: The BDO Zone is also referred to as the supply basin.

Woody Biomass Types in the Supply Basin

The Coconino County BDO Zone risk rating was evaluated with reference to the availability and pricing of three types of woody biomass that are available for new projects in the region: forest residues, sawmill residuals, and woodland biomass.

For the purposes of the analysis, forest residues are defined as unmerchantable components of trees and unmerchantable small-diameter trees that are recovered and piled for later processing during commercial thinning treatments in Ponderosa pine stands (Image A-1). Piles of forest residue (also referred to as "slash") are later comminuted for transport with grinders. Note that the potential for whole-tree chipping in stands with low sawlog potential is not evaluated here.

Image A-1: Ponderosa pine stand with piled forest residue



Image source: Jay Smith, 2023

Sawmill residuals are the byproducts of sawmill operations, produced from conversion of sawlogs into finished wood products such as lumber, pallets, and engineered wood. Sawmill residuals considered in the analysis include wood chips, bark, sawdust, and shavings.

Woodland biomass is defined as the above-ground mass of trees recovered during whole-tree harvesting operations in pinyon-juniper (PJ) woodlands, specifically in lower elevation juniper-dominant PJ woodlands which are of primary concern to the ranching/livestock industry (Image A-2). Note that this approach leads to a more conservative estimate of biomass availability: a new project could source a proportion of its feedstock from higher elevation pinyon-dominant woodlands, where tree density is much higher (Image A-3).

Image A-2: Juniper-dominant pinyon-juniper (PJ) woodlands



Image source: Bob Buckingham, 2023

Image A-3: Pinyon pine-dominant pinyon-juniper (PJ) woodlands



Image source: Jim Morefield, "Classic pinyon-juniper woodland vegetation, White Mountains, Inyo County, California," 2017. Accessed via https://www.flickr.com/photos/127605180@N04/27083444849 CC BY-NC 2.0

Note that merchantable roundwood produced during thinning operations in Ponderosa pine forests was not evaluated due to high demand relative to supply in the region. Over 90% of the roundwood produced annually from thinning treatments in the Coconino and Kaibab National Forests is delivered to pallet manufacturers in Phoenix and the RFOR – Bellemont sawmill. If realized, planned capacity expansions will utilize most of the roundwood available in the region. Therefore, we decided not to consider roundwood supply for new projects.

Woody Biomass Availability in the Supply Zone

Forest Residue

Nearly the entirety of the 1.3 million acres of forested land present within the BDO Zone is located within the federally owned and USDA-USFS managed Coconino and Kaibab National Forests (NFs).[1] Since 2010, forestry activities within the NFs have been managed under the Four Forests Restoration Initiative (4FRI). The 4FRI initiative aims to ecologically restore the Ponderosa pine forests in the region, which have unnaturally high stem densities. Physically removing small diameter understory trees (generally <14 inches diameter-at-breast height) through commercial thinning operations is regarded as a means of reducing stocking to more natural levels while also reducing wildfire risk.

The stated long-term objective of the USFS Four Forests Restoration Initiative (4FRI) is to implement ecological restoration/fire mitigation thinning treatments on 50,000 acres/yr across the Kaibab, Coconino, Apache-Sitgreaves, and Tonto NFs. For the Kaibab and Coconino NFs (the westside), the target is approximately 25,000 acres/yr. Of the total 25,000 acres/yr of potentially treated acreage, we assume that 5,000 acres could be treated on an annual basis over the next 20-30 years. We expect this assumption would hold if (1) a bio-project capable of paying for forest residue is developed in the Bellemont-Flagstaff area, (2) the efficiency of 4FRI contracting improves, and (3) regional lumber markets remain steady or improve.

Sawmill Residuals

There are only five sawmills located within the BDO Zone, with an estimated annual residuals production of **70,000 bdt/yr**. For the assumed sawlog-to-residual conversion factors, we estimate an annual production of 50,000 bdt/yr of chips, 10,000 bdt/yr of bark, 5,000 bdt/yr of sawdust, and 5,000 bdt/yr of shavings (Table A-1). Larger sawmills located in Phoenix generate significant amounts of sawmill residuals but are located too far from Bellemont to justify consideration in the analysis.

Table A-1: Estimates of sawmill residuals production in the BDO Zone

	Sawlog-to-product conversion efficiency	Total amount generated in BDO Zone (bdt/yr)
Lumber	47%	N/A
Wood chips	33%	50,000
Sawdust	5%	5,000
Shavings	5%	5,000
Bark	10%	10,000
Total	100%	70,000

Woodland Biomass

To determine the rated quantity of biomass that could be recovered from pinyon-juniper woodlands in the BDO Zone, we estimated the annual production capacity of two woodland biomass sides (crew) operating year-round. A typical woodland biomass side in the region consists of a dozer or loader felling trees, a log skidder or loader piling felled trees, and a grinder that comminutes piled trees directly into chip trucks for delivery. With this configuration, a single side would have an annual productivity of approx. 20,000 bdt/yr (Table A-2). Two sides would therefore produce 40,000 bdt/yr and would require ~10,000 acres/yr of woodland. For purposes of comparison, this represents ~0.5% of the total area in the BDO

[1] State trust lands and US Department of Defense lands (Camp Navajo) account for <4% (30,000 acres and 18,700 acres) of the total ponderosa pine forest coverage in the region.

Zone occupied by PJ woodlands (~2.1 million acres).[2] Note that the Kaibab NF Land Management Plan as of 2018 specified a PJ restoration treatment goal of 5,000 – 10,000 acres/year.[3]

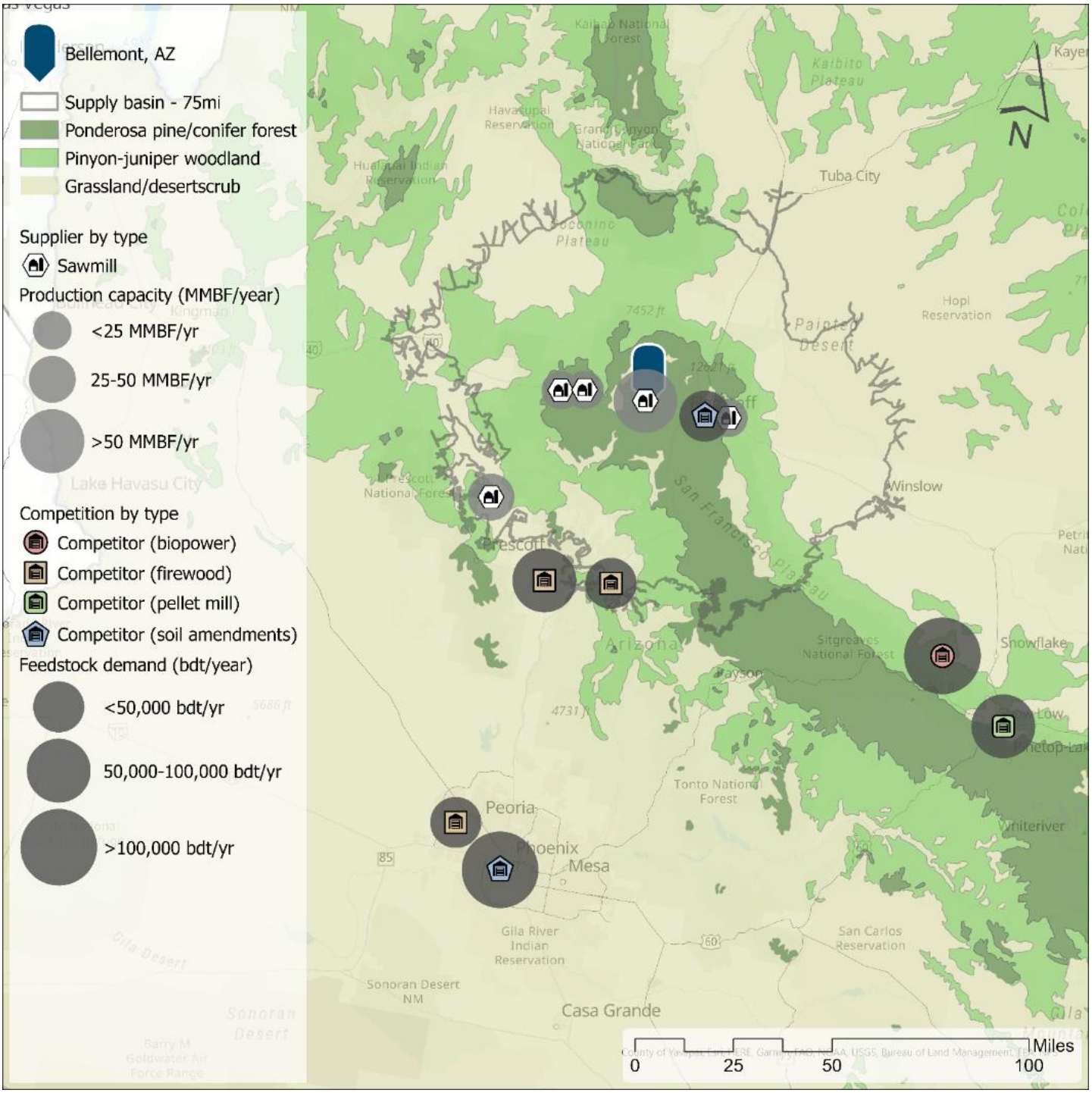
Table A-2: Annual productivity of a single side (crew) operating in pinyon-juniper woodlands

Parameter/Assumption/Estimate	Value
Productivity per day (acres/day)	20
Biomass per acre (bdt/acre)[4]	4
Productivity per day (bdt/day)	80
Operating days per year (@5 days/week and 50 weeks/yr)	250
Total biomass production per year (bdt/yr)	20,000

The location of sawmills and potential competitors to new bio-projects in the region are shown in Map A-2.

[2] Vegetation map: https://azgeo-open-data-agic.hub.arcgis.com/datasets/azgeo::natural-vegetation/about
[3] TSS Consultants. 2019. Biomass feasibility study for a wood to energy facility at Camp Navajo, AZ, https://tssconsultants.com/reports-papers/, (p.60)
[4] Biomass recovery factor estimates for PJ woodlands range from 4 to 10 bdt/acre (Rappold, P.M., & Han, H.-S. (July 2020). Feedstock supply assessment for HM3 Energy, Inc. – Drake, Arizona. 41 pp. (p.2); TSS Consultants (September, 2016). Biomass feedstock supply availability assessment for Yavapai County. Prepared for: Upper Verde River Watershed Protection Coalition.)

Map A-2: Potential suppliers and competitors in relation to ponderosa pine and pinyon-juniper resources



Woody Biomass Demand in the Competition Zone

Within the competition zone (150-mile drive distance from Bellemont), existing consumers of forest residue, sawmill residuals, and woodland biomass include a 28 MWe biopower plant in Snowflake, AZ (Novo BioPower), a ~50,000-ton capacity wood pellet mill, and two soil/mulch producers. Current demand within the BDO Zone for the three biomass types is estimated to be ~75,000 bdt/yr (Table A-3). Sawmill residuals comprise approx. 95% of this amount. Supply chains for forest residue derived from within the BDO Zone operate infrequently and amount to <4,000 bdt/yr (<400 acres @10 bdt/acre).[5] Supply chains for woodland biomass have never been established within the BDO Zone. Pricing for sawmill residuals was determined through outreach, whereas pricing for forest residues and woodland biomass was estimated based on expected delivered costs.

Table A-3: Woody biomass demand and feedstock type in the competition zone by competitor category

Competitor category	Total feedstock demand (bdt/yr)	Feedstock demand from BDO Zone (bdt/yr)	Feedstock type
Landscaping / soil amendment producer	230,000	30,000	Bark, chips, shavings, forest residue
Biopower plant	200,000	20,000	Bark, chips, shavings, forest residue, woodland biomass
Firewood producer	70,000	20,000	Forest residue
Pellet mill	55,000	5,000	Sawdust, chips, logs
Total	555,000	75,000	--

Final Rated Quantities and Prices

The risk assessment was carried out with reference to final rated quantities of **50,000 bdt/yr** for forest residue, **10,000 bdt/yr** for sawmill residuals, and **40,000 bdt/yr** for woodland biomass (Table A-4).

Table A-4: Potential and rated quantities for evaluated biomass types

	Potential quantity (bdt/yr)	Rated quantity (bdt/yr)
Forest residue	250,000[6]	50,000
Wood chips	50,000	5,000
Sawdust	5,000	0
Shavings	5,000	0
Bark	10,000	5,000
Woodland biomass	40,000 (with two sides) 60,000 (with three sides)	40,000

The rated quantity of forest residue (50,000 bdt/yr) was determined by applying the residue recovery factor (10 bdt/acre) to the annual thinning acreage from which a new project is likely to source residue (5,000 acres). This estimate takes into consideration competition and the impact of operational factors on cost-effective procurement (e.g., inadequate road coverage and quality, logging capacity shortages, extreme weather events). The residue recovery factor of 10 bdt/acre (16 – 20 green tons/acre @40-50% moisture content) is based on published sources and outreach. Residue recovery factors commonly used by forestry professionals in the region range from 15 to 28 green tons/acre (7.5 – 14 bdt/acre); in lower-

[5] Data provided by the Arizona Department of Forestry and Fire Management (AZDFFM) and through outreach to local experts.
[6] Given 4FRI westside target of 25,000 acres/yr and 10 bdt/acre

quality stands where sawlog content is low, residue availability could be as high as 80 green tons/acre (40 bdt/acre). Note that the rated quantity of forest residue would require annual commercial thinning operations on ~5,000 acres/yr of the Coconino and Kaibab NFs. In comparison, treated acreage on the westside over the 2010 – 2022 period has ranged from ~3,000 acres/yr – ~8,000 acres/yr.

The rated quantity of sawmill residuals (10,000 bdt/yr) represents less than 15% of total annual residuals production in the BDO Zone. This is equivalent to a Biomass Availability Multiple (BAM) of 7.0x. Sawdust and shavings were not rated due to low overall production in the BDO Zone.

Finally, the rated quantity of woodland biomass (40,000 bdt/yr) assumes that two sides consisting of felling, yarding, and grinding equipment could operate year-round in the BDO Zone. We expect that the presence of a new project willing to pay $110-$120/bdt for woodland biomass would provide sufficient incentive for the year-round operation of two sides. Note that there are already three grinders available within the BDO Zone.

The rated price ranges for forest residue ($70-$85/bdt delivered), sawmill residuals ($55-$70/bdt), and woodland biomass ($110-$120/bdt) were estimated on the basis of outreach to local experts and published studies (Table A-5).

Table A-5: Recent historic pricing and rated price range for evaluated biomass types

	Recent historic pricing ($/bdt)	Rated price range ($/bdt) *delivered @50-75 miles
Forest residue	$20-$35 (FOB) $38-$50 delivered	$50-$75[7]
Wood chips	$25-$45 (FOB)	$55-$70
Sawdust	$25-$45 (FOB)	$55-$70
Shavings	$25-$45 (FOB)	$55-$70
Bark	$25-$45 (FOB)	$55-$70
Woodland biomass	>$80 delivered[8] $38-$50 delivered	$110-$120[9]

[7] In a study of the costs of whole tree harvesting of small diameter trees in northern Arizona, Pan et al. (2008) estimated a delivered cost of $49/bdt - $72/bdt (nominal) for a transport distance of 30 to 36 miles. TSS Consultants (2016) reported a delivered price of $45/bdt – $50/bdt for ponderosa pine residue for a 40-mile transport distance. These estimates were inflated to 2023 dollars and adjusted for a transport distance of 50-75 miles.
[8] Assuming $160/acre harvesting and comminution cost (TSS, 2016), biomass recovery of 4 bdt/acre, and transportation cost of $40/bdt @75 miles.
[9] TSS (2016) reported a range of delivered costs for PJ biomass of $55 – $75/bdt for a transport distance of 40 miles.

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: The forest industry in northern Arizona has been in significant decline since the 1980s, when declining growing stock and federal regulatory developments were beginning to limit available timber supplies. The Southwest Forest Industries sawmill in Flagstaff – which had been in operation for over a century – was permanently closed in 1998. More recently, major declines in milling and workforce capacity were experienced during the recession of 2007-2009. Between 2005 and 2009, the forestry workforce in Arizona was reduced by 50%, the largest workforce loss rate of the thirteen western states.[10] Many sawmills in the BDO Zone and in northern Arizona more broadly have closed (e.g., Newpac Fiber, Williams) or permanently reduced capacity.

***Sawmill residuals*:** As of November 2023, only five wood processing facilities were operating within the supply basin, producing an estimated 70,000 bdt/yr of sawmill residuals. A large sawmill with engineered wood product manufacturing capabilities (Restoration Forest Products, RFOR) has been under development since 2012. Once construction of the facility is complete, it is expected to have an annual roundwood demand of 400,000 – 600,000 tons/yr, with a potential residuals production of ~100,000 bdt/yr. The facility has changed ownership at least three times since construction began in 2012. Total investment in the facility's milling and EWP manufacturing capacity likely exceeds $200 million. The facility's timber and milling operations increased over the summer of 2023 in anticipation of the opening of a second milling line. The four other sawmills in the BDO Zone have roundwood demands of 10,000 – 130,000 gt/yr.

Forest residue: Procuring the rated quantity of forest residue will require a reliable local logging contractor base.[11] There are at least five logging companies that operate regularly within the Coconino and Kaibab NFs, with an average business duration of less than 10 years.[12] Two of these companies employ multiple sides (crews), whereas the remainder employ a single side. Annual roundwood demand and thinning activity on the westside has not exceeded 8,000 acres/yr over the past decade (approx. 160,000 green tons/yr, or 20 million board feet, of roundwood).

Woodland biomass: Biomass recovery experience in pinyon-juniper woodlands in the BDO Zone is restricted to whole-tree mastication with on-site retention of masticated biomass and tree felling with firewood recovery.[13] Companies in the region with experience loading and hauling biomass from pinyon-juniper woodlands are located further east, in close proximity to the Apache-Sitgreaves NF (referred to as the eastside). PJ biomass supply chains on the eastside have been established in support of Novo BioPower in Snowflake, AZ. Knowledge and equipment could be readily transferred to the westside.

[10] https://www.nrs.fs.usda.gov/pubs/gtr/gtr-nrs-p-105papers/02keegan-p-105.pdf (Table 2, p.4)
[11] A logging contractor that operates 200-250 days per year and has a productivity of 10-15 acres treated per day would produce 20,000 – 37,500 bdt/yr, assuming a forest residue recovery factor of 10 bdt/acre.
[12] A recent survey of forestry contractors in the US Southwest (AZ, CO, NM) by the Northern Arizona University (NAU) Ecological Restoration institute (ERI) found that businesses had an average operating history of 22 years and that business owners had an average experience of over 25 years (Vaughan, D., C. Edgeley, and H.-S. Han. 2022. Workforce training needs of forestry contractors in the US Southwest: Results of an industry survey. ERI White Paper—Issues in Forest Restoration. Ecological Restoration Institute, Northern Arizona University. 16 p.)
[13] Mastication operations in PJ woodlands occur on USFS, state, and private lands. Operations on state lands tend to involve private ranching companies, which hold grazing leases with the Arizona State Lands Department (ASLD).

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 *RRL Mitigation (Notch)* Logging contractors in the supply basin have significant institutional leverage. The Nature Conservancy (TNC), which has been operating in the region for over two decades, frequently hires logging contractors for wood supply demonstration projects. Campbell Global also provides logistics and crew contracting support. Contractors have also been supported by long-term agreements with private companies (Restoration Forest Products) and the USFS. New investments by logging contractors in the region are **ongoing,** with over $3 million invested in new equipment over the past two years. New investments in sawmill capacity were made in the last quarter of 2023. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is 25%.	**Notch** **25%**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 36 out of 100	**Score** **36**

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 suppliers' dependence 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:

Forest residue: Most biomass recovered during forest restoration and fire management operations at the Coconino and Kaibab National Forests (NFs) is piled and burned on site due to lack of markets. In instances when residue must be removed from the site following thinning operations, the residue is comminuted and typically delivered to Novo BioPower (~150 miles from the Coconino and Kaibab NFs) at a cost to the forestry contractor. A new bio-project operating on the westside that is willing to pay $50-$75/bdt would have an advantage relative to existing customers.

Sawmill residuals: There is some risk that suppliers of sawmill residuals will prefer existing customers. This conclusion is reached on the basis of (1) the small size of the regional network of sellers and buyers of residuals (which is restricted to five sellers and five buyers) and (2) the fact that none of the owner-operators and employees of sawmills contacted during outreach were willing to share general pricing and customer information. The low rated quantity (10,000 bdt/yr) accounts for this risk. Note that suppliers' preferences for larger competitors (e.g., Novo Biopower) are unlikely at the rated price range of $55-$70/bdt.

Woodland biomass: There are no current suppliers of woodland biomass in the BDO Zone.

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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**Score** **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 two-thirds of the rated quantity of woody biomass is expected to be sourced from the Coconino and Kaibab National Forests (NFs), federally owned and managed by the USDA-USFS. Since 2010, the USFS Four Forests Restoration Initiative (4FRI) has pursued the stated objective of removing small diameter roundwood and forest residue from 50,000 acres of land annually via commercial thinning operations. Over the 2010 - 2022 period, actual acreage treated across the four forests has varied from ~12,000 to ~18,000 acres/year, with the largest annual acreage treated in 2021 (Figure C-1, Appendix C).[14] Within the Coconino and Kaibab NFs, approx. 25,000 acres of ponderosa pine forests are currently available for harvesting annually under the 4FRI initiative.

As long as markets for merchantable roundwood are sustained, we view the disproportionate federal ownership of land in the BDO Zone as an asset for new projects. The contracting system is shifting from inflexible long-term contracts that award large acreages to single companies,[15] to flexible short-term contracts that award smaller acreages that can be treated within a few months/years to a mix of companies/contractors. Contractor capacity is also increasing as a result of longer operating experience, new investments in equipment, and collaborative operations optimization studies led by TNC and Campbell Global.[16]

A small fraction of the rated forest residue and the majority of the rated pinyon-juniper woodland biomass would be sourced from the ~30,000 acres of state trust ponderosa pine forests, ~300,000 acres of state trust PJ woodland, ~300,000 acres of federal (NF) PJ woodland, and ~1.5 million acres of privately owned PJ woodland. Given the stated objective of Arizona State to restore ponderosa pine forests and to mitigate encroachment of juniper species onto

[14] Note that the system of reporting treated acreage was changed in 2022. While this has improved program monitoring and evaluation, it led to overestimation of treated acreage in FY22. Treated acreage values that were reported in the lates 4FRI monthly report (August 2023) at the time of writing (November 2023) were adjusted based on outreach to USFS-4FRI personnel.

[15] The 4FRI Phase I Master Stewardship Contract awarded 300,000 acres to a single company over the period 2012 to 2022. Only 16,000 acres were treated.

[16] Companies and contractors operating on the westside have invested over $3 million in forest operations equipment over the past couple years.

rangeland, we view state ownership as an asset for any future woodland biomass supply chains in the region. We also view the disproportionate private ownership of PJ woodlands as an asset because demand for pasturage is an important revenue driver on private lands. Ranchers in the region have many decades of experience masticating juniper for purposes of grassland renewal.

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 *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is N/A.	**Notch** **N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 4 out of 100.	**4**

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:

Forest residue: All of the logging contractors that regularly operate on the westside own and operate their own equipment. Despite the growing costs of equipment ownership, larger sawmills and logging contractors in the region continue to make investments in new equipment. Grinders required for comminution of forest residue and woodland biomass are owned by a larger sawmill in the BDO Zone. One large contractor is considering purchasing or renting comminution equipment for purposes of biomass recovery from Coconino NF and Kaibab NF. A distributor for Morbark (manufacturer of comminution equipment) is also present in the region. The decision to rent vs. buy equipment is not expected to present risks to biomass supply.

Woodland biomass: Equipment required for successful recovery of woodland biomass is conventional (e.g., dozers, skidders, loaders) but there currently are no companies in the area that have assembled sides for dedicated PJ woodland harvesting.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, 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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 36 out of 100.	**Score** **36**

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: There are an estimated 25 logging trucks and 10-15 chip trucks that can be made available to thinning operations on the westside. Trucks are owned by a combination of logging contractors, third-party companies or single-truck sole proprietorships, and manufacturing facilities. Chip trucks are typically brought in from outside the region owing to a lack of local capacity.

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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 24 out of 100.	**Score** **24**

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: The rated quantity of forest residue is partly dependent upon the strength of markets for wood products. Most roundwood purchases from the westside are driven by demand for pallets, which are produced by sawmills in the Phoenix area. Pallet markets in the region are relatively strong, as evidenced by the ability for sawmills in Phoenix to pay for the costs of transporting roundwood over 150 miles from the Coconino and Kaibab NFs. Sawmills within a 75-mile drive distance of Bellemont do not produce pallets, instead relying on markets for dimensional lumber. In recent years, lumber markets have been relatively steady but the future health of wood product markets in the northern Arizona is relatively uncertain due to the recent history of industry decline.

The annual supply of residue will depend on whether annual commercial thinning activity can be sustained at over 5,000 acres/yr on the westside. We determined through outreach that the main constraint to sustained commercial thinning activity at these levels relates in part to the requirement for logging contractors to remove forest residue off site, coupled with the lack of local demand for this feedstock type. Risk for this indicator is modest because achieving sustained thinning on >5,000 acres/yr is partly dependent on the stability and growth of regional lumber markets. Although lumber markets are currently stable, market declines have been significant over the past 20 years. Note that some proportion of future commercial thinning levels will occur independent of timber markets, driven instead by government subsidies for ecological restoration and fire mitigation.

There are no significant secondary transformation risks associated with sawmill residuals and woodland biomass. While dependent on the health of primary markets, the rated quantity of sawmill residuals represents <15% of total annual production. Woodland biomass is produced as a consequence of market demand for woodland biomass and for rangeland restoration/wildfire mitigation services and therefore does not represent a risk for 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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (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: Most of the sides that regularly operate in the area have over a decade of experience in integrated commercial thinning operations. Equipment operators are familiar with the required machinery (feller-bunchers, grapple skidders, and processors), the terrain, and best practices for efficiently recovering merchantable roundwood while simultaneously felling and piling unmerchantable branches, tops, and small diameter trees. Operational optimization services provided by intermediary organizations like TNC, Campbell Global, and others significantly reduce risks associated with any inexperience.

Woodland biomass: We expect that woodland biomass recovery operations will be restricted to areas with a high prevalence of juniper species and a low prevalence of pinyon pine.[17] Although there is no direct woodland biomass recovery experience within the BDO Zone, PJ biomass recovery operations have been occurring in areas east of the Zone (within a 150-mile drive distance of Bellemont) since the early 2010s. We expect that companies involved in juniper harvesting, mastication, and transport will expand into the BDO Zone if a market develops. Organizations are becoming increasingly interested and involved in PJ biomass recovery operations, including ranchers, the AZDFFM, and Coconino National Forest.

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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 36 out of 100.	**36**

[17] Juniper has been preferred over pinyon pine in demonstrated woodland biomass recovery operations in the region (Novo Biopower) and previous studies have focused on quantifying juniper recovery (e.g., TSS Consultants, 2016, https://tssconsultants.com/wp-content/uploads/2016/09/Upper-Verde-Report-Final-20160913.pdf; Rappold, P.M., & Han, H.-S. (July 2020). Feedstock supply assessment for HM3 Energy, Inc. – Drake, Arizona. 41 pp.). There are also concerns that treating older pinyon-juniper woodlands is counterproductive from the perspective of ecological restoration (Floyd & Romme, 2012, https://scholar.google.com/citations?view_op=view_citation&hl=en&user=Wh36Z0MAAAAJ&sortby=pubdate&citation_for_view=Wh36Z0MAAAAJ:QIV2ME_5wuYC).

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:

Forest residue: Procuring the rated quantity of forest residue would require that commercial thinning operations occur consistently over an area of at least 5,000 acres/year in the Coconino and Kaibab NFs. Since 4FRI was established in 2010, the maximum acreage thinned on the westside in any one year has not exceeded 8,000 acres/yr; average annual commercially thinned acreage over the period 2010 – 2022 has approximated 5,000 acre/yr.[18] There is therefore only low-to-moderate risk associated with production scale experience.

Woodland biomass: There is no previous experience in biomass recovery from PJ woodlands in the BDO Zone. Experience is restricted to felling and firewood recovery with chainsaws and mastication with in-situ residue dispersal or piling. The risk is moderated by the decade-long presence of woodland biomass recovery operations on the eastside, approximately 150 miles from Bellemont. Knowledge and experience could readily be transferred to the westside.

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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 36 out of 100.	**Score** **36**

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:

Forest residue: Forestry contractors in the region utilize feller-bunchers for felling, grapple skidders for yarding, and processors or pull-through delimbers for processing on landings. A typical efficiency for a crew operating 1 x feller-buncher, 2 x grapple skidders, 1 x processor, and 1 x loader is 5-15 acres per day. For a single side, annual residue production is expected to range from 20,000 bdt/yr to 37,500 bdt/yr.[19] Current grinding operations on the westside occur following thinning operations; this expected to be the case moving forward. In concert with chip trucks, tracked grinders will enter commercially thinned stands and comminute piled residue direct into chip trucks. In some cases, 6x6

[18] Inferred from reporting of annual commercial thinning under 4FRI from 2010 to 2022. See Table 1 in 4FRI monthly report for August, 2023. (https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd1140866.pdf)

[19] Assuming 180-250 working days er year and 10 bdt/acre.

wheeled trucks will be used to forward biomass to more accessible locations (e.g., landings) for comminution. In both in-stand and landing-based operations, the productivity of a single grinder could range from 10,000 bdt/yr to 30,000 bdt/yr.[20] Successful delivery of residue at an acceptable cost will require a degree of coordination between grinding sides and chip truck operators that has yet to be demonstrated.

Sawmill residuals: Not applicable.

Woodland biomass: There is limited regional experience with biomass recovery from pinyon-juniper woodlands.[21] However, any supply chains for woodland biomass that are developed in the BDO Zone will likely involve forwarding whole-trees for roadside comminution, as this is what has been demonstrated on the eastside. A typical woodland biomass operation in the region consists of a dozer or loader felling trees, a log skidder or loader piling felled trees, and a grinder that comminutes piled trees directly into chip trucks for delivery. With this configuration, a single side would have an annual productivity of approx. 20,000 bdt/yr.[22] Two sides would therefore produce 40,000 bdt/yr and would require ~10,000 acres/yr of woodland. An alternative configuration could involve direct mastication with in-stand chip truck loading.[23]

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 *RRL Mitigation (Notch)* Forestry contractors in the region have benefited from assistance relevant to production scale experience. Over the period 2021-2023, TNC provided high accuracy GPS antennas and computer systems to equipment operators with the aim of decreasing costs associated with tree identification and removal. The NAU-ERI has been consistently involved in optimization studies over the past two decades. TNC and Campbell Global have also offered supply chain efficiency advisory and logistical services. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is 25%.	**Notch** **25%**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 18 out of 100.	**18**

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

[20] Assuming 10 – 15 bdt/PMH, 6 – 8 PMH/day, and 180-250 working days per year.
[21] Ranchers, First Nations, and others in the region have a long history of treating pinyon-juniper woodland through burning and physical removal. Chainsaw felling and processing for firewood markets occurs frequently but at a small scale. Many ranchers in the area have been utilizing wheeled direct mastication equipment (grinders) but have not attempted to recover biomass to market.
[22] Assuming 20 acres/day, 4 bdt/acre, and 250 days/year
[23] Rappold, P.M., & Han, H.-S. (July 2020). Feedstock supply assessment for HM3 Energy, Inc. – Drake, Arizona. 41 pp. (p.19)

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: There are no risks associated with this risk indicator for any of the evaluated feedstocks. Thinning operations in ponderosa pine forests and biomass recovery operations in PJ woodlands are guided primarily by the objectives of ecological restoration and wildfire mitigation. Merchantable roundwood cannot be recovered without also processing, piling, and in many cases comminuting slash and unmerchantable small diameter trees. Sawmill residuals are produced as by-products of milling operations and therefore do not constitute a feedstock production priority risk.

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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (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: Larger competitors currently operating within a 150-mile drive distance of Bellemont, AZ are limited to a 28 MW biomass power facility in Snowflake, AZ (145 miles from Bellemont), a pellet mill in Show Low, AZ (150 miles from Bellemont), at least three firewood producers (>65 miles from Bellemont), and two soil amendment/mulch producers, the largest of which is located ~150 miles from Bellemont. The average distance of competitors to the Bellemont/Flagstaff area is >100 miles.

The relatively small quantities of forest residue that are brought to market from the westside are consumed by the biopower plant in Snowflake. Most of the sawmill residuals produced within the BDO Zone are consumed by the more distant competitors identified above; smaller local buyers include landscaping companies and horticultural nurseries. There are no buyers of biomass available from PJ woodlands in the BDO Zone. There is therefore low risk associated with

competitor locations and geographical influence. A new project located in the vicinity of Bellemont, AZ would have a significant chance of outcompeting existing buyers of biomass due to significant shorthauling advantages.

The Restoration Forest Products (RFOR) sawmill-in-development at Bellemont, AZ is not regarded as a competitor to a new bio-project. There would likely be synergies between RFOR and a new bio-project, as the new project could utilize roundwood <9-11 inches, forest residue, and the sawmill residuals generated as a by-product of RFOR 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 *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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (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:

Forest residue: Over the past decade, relatively small quantities of forest residue produced on the westside have been comminuted and sent to the biopower plant in Snowflake (~150 miles away). This only occurs for 4FRI contracts that require the removal of residue from operating areas. Since there are no alternative markets for residue, contractors have incurred the costs of transporting comminuted residue to the biopower plant. When bidding for contracts that require residue removal, contractors are careful to ensure that revenues generated from the sale of merchantable roundwood exceed total costs, including costs of residue comminution and transport. Without contracts requiring residue removal, the biopower plant would not procure residue from the westside.

Sawmill residuals: Detailed data on residuals consumption could not be obtained through outreach. Given the downward trend in lumber production capacity in the region, we suspect that demand for residuals has tended to outpace supply in recent years. The long distances over which residuals are transported is evidence of this. The biopower facility in Snowflake and a soil amendment producer in Phoenix frequently purchase bark and chips from the BDO Zone at estimated prices of $30-$45/bdt FOB and $55-$70/bdt delivered. Some portion of the residuals produced annually within the supply basin are known to be landfilled due to lack of consistent markets. The relatively low rated quantity of residuals (10,000 bdt/yr) hedges against uncertainty over historical consumption of feedstock quantity.

Woodland biomass: N/A.	
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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**Score** **16**

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:

Forest residue: The biopower plant in Snowflake is known to marginally increase prices paid at the plant gate to accommodate contractors operating in difficult conditions. However, prices offered have never been sufficient to cover the costs of comminuted residue transport from the Coconino and Kaibab NFs, which can amount to $120-$140/bdt for a transport distance of 150 miles.[24] Forestry contractors operating on the westside deliver residue to the plant when 4FRI contracts require residue removal from the operating area. When bidding on contracts of this kind, contractors ensure that there are sufficient volumes of merchantable roundwood so that revenue generated through roundwood sales offsets the costs of delivering biomass at this distance.[25] A new project located near the Bellemont-Flagstaff area would have significant procurement advantages over the biopower plant, as transportation distances would be reduced to <75 miles.

Sawmill residuals: Given that a portion of the residuals produced annually are known to be landfilled, a new project would likely secure a share of the annual production (~15%) for prices equivalent to, or slightly above, existing prices.

[24] Assuming a cost of comminution and truck loading of $40/bdt and a transport cost of $0.60/bdt/loaded mile.
[25] The plant would likely have to pay over $120/bdt for biomass delivered from the westside NFs to make grinding and transport of biomass profitable for contractors.

Any price competition with existing buyers of residuals would likely be seasonal, as market activity for wood chips and bark is known to increase during the spring and summer months (landscaping season).

Woodland biomass: There is no current demand for woodland biomass available in the BDO Zone. Future prices are therefore expected to correlate strongly with delivered costs. A new project located in the Bellemont-Flagstaff area would have significant advantages relative to existing competitors in the region, who have not demonstrated an ability or willingness to pay for woodland biomass.

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 N/A.	**Notch** **N/A**
Loaded RI Score	**Score**
The Loaded RI Score (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 supply basin 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: There are no indications that the two larger competitors located within the competition zone will expand feedstock demand to a level that would put a new bio-project located in the Bellemont-Flagstaff area at risk. A new 10-year power purchase agreement (PPA) between Novo Biopower and the Salt River Project was signed in June of 2023.[26] We expect the biopower plant to continue operating at or near capacity over the next 10-20 years. There are no indications that the new PPA will result in a situation where the plant will be capable of paying for the full cost of delivering comminuted residue from the westside (~150 miles away). The same can be concluded for the Lignetics pellet mill, which has not significantly increased production capacity since 2011 and is located ~150 miles from the Coconino and Kaibab NFs.

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**

[26] https://media.srpnet.com/srp-and-valley-municipalities-join-forces-to-invest-in-forest-restoration-to-help-prevent-devastating-wildfires/

The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**Score** **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: The regional forest industry is small, consisting of no more than 20 businesses involved in wood supply and milling. Supplier-competitor allegiances in the form of personal relationships and familiarity are expected to be more prevalent compared to regional industries that involve more businesses and transactions. Sawmills contacted during outreach were unwilling to share high-level quantity and pricing information, which is uncommon in our experience and indicative of close relations among existing businesses in the region. However, most local experts contacted during outreach believed that potential suppliers for new projects would be responsive to pricing above all else. There are currently no long-term offtake agreements between feedstock suppliers and buyers in the region.

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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**Score** **16**

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.[27]
Risk Information: No risks associated with temporary market-driven markets are foreseen.
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) **N/A**
No adjustment.
RRI Mitigation (Notch)
No adjustment.
The Total Notch (RRL Notch × RRI Notch) is N/A.
Loaded RI Score **Score**
The Loaded RI Score (Total Notch × GRI Score) is 4 out of 100. **4**

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: Larger competitors within a 150-mile drive distance of Bellemont have >30-day inventory capacities. Risk associated with the inventory capacity of competitors is moderated by regional biomass availability shortages (which negate inventory capacity advantages) and regional hot weather conditions (which impose limitations on storage due to combustion risks).
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**

[27] Bergtold 2018.

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

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: The forest industry and associated wood fiber supply chains are relatively depressed in northern Arizona. Larger competitors in the region have difficulty maintaining 5-day feedstock inventories. There is therefore no risk associated with competitors' accessibility.

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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 4 out of 100.	**4**

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: Forest residue and woodland biomass are low quality forms of wood fiber, consisting of a mixture of white wood, bark, and soil. Novo Biopower is the only competitor in the BDO Zone that buys this material. The pellet mill in Show Low procures forest residue from 4FRI thinning operations but is not known to procure woodland biomass, likely due to issues of quality. Being located ~150 miles from the Coconino and Kaibab NFs, the feedstock quality standards of existing competitors are not expected to have an impact on the rated quantities of feedstock for new projects located in the Bellemont-Flagstaff area.

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 *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is N/A.	**Notch** **N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 4 out of 100.	**4**

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: Novo BioPower is expected to continue operating at or near full capacity. The company renewed its power purchase agreement (PPA) in 2023, indicating that the plant will most likely remain operational over the next 10 years. Demand for electricity produced by the plant will be relatively constant over this period, as there are no plans for the plant to make the large capital investments required to increase its rated capacity. Informants noted that buyers of wood fiber in the region are having difficulty finding sufficient resources to meet daily/weekly feedstock demand, indicating that regional biomass resources and supply chains are inadequate for present demand levels. Prices paid for residue and woodland biomass in the region generally do not exceed $100/bdt, which limits viable transportation distances to less than 80-100 miles after the costs of harvesting and comminution are incurred. Demand for products produced by other existing competitors in the region, including mulch and wood pellets, could increase over time but not significantly enough to pose a risk to the rated quantities.

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 N/A.	**Notch** **N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**16**

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:

Forest residue: Thinning activity within the BDO Zone (the Coconino and Kaibab NFs) has never exceeded 8,000 acres/yr and has averaged approximately 5,000 acres/yr over the 2010-2023 period. If the Biomass Availability Multiple (BAM) is calculated on the basis of this information, a BAM of 1.6x results (8,000 acres/yr divided by 5,000 acres/yr). However, a much larger acreage has been awarded under contract. In Fiscal Year 2023, approximately 18,000 acres/yr was awarded for commercial thinning. Using this value results in a BAM of 3.6x. Risk is elevated slightly by the fact that a BAM value greater than 1.0x cannot be calculated with confidence: there are no assurances that future harvesting levels will be maintained at or above 5,000 acres/yr. However, risk is moderated by the limited scale-up requirements and by the fact that our estimate of the amount of residue that can be produced per acre (10 bdt/acre) is near the low end of the range of reported per acre values.[28]

Sawmill residuals: We assume that ~15% of annual residuals production can be captured by a new project in the Bellmont-Flagstaff area, resulting in a BAM of 7.0x.

Woodland biomass: The assumptions used to estimate the annual availability of woodland biomass for new projects were based on previous assessments of the PJ woodland resource. Parameters were chosen to minimize uncertainty. However, operations have yet to be demonstrated in the BDO Zone. Significant uncertainty remains regarding the actual quantity and cost of comminuted woodland biomass that can be brought to market. Once woodland biomass recovery operations commence, issues likely to be encountered include getting access to land (negotiation, contracting), maintaining productivity in heterogenous terrain/vegetation, and coordinating between harvesting, comminution, and transportation phases of the supply chain. There is considerable uncertainty as to the total amount of woodland biomass that could be sustainably harvested over time and therefore no BAM is calculated for this feedstock type.

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.	**N/A**
RRI Mitigation (Notch) No adjustment.	

[28] Residue recovery factors commonly used by forestry professionals in the region range from 15 to 28 green tons/acre (7.5 – 14 bdt/acre); in lower-quality stands where sawlog content is low, residue availability could be as high as 80 green tons/acre (40 bdt/acre).

The Total Notch (RRL Notch × RRI Notch) is N/A.	
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 48 out of 100.	**48**

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 Bellemont-Flagstaff area is located within a large contiguous tract of ponderosa pine forest. PJ woodlands are concentrated along the boundary of the ponderosa pine forest (Map C-1, Appendix C). Over half of the potential supply of sawmill residuals is available within a 20-mile drive distance of Bellemont. Given the distribution of biomass resources in the BDO Zone, we expect that over 75% of the rated quantity is available within a 40-mile drive distance of Bellemont-Flagstaff (Figure C-2, Appendix C).

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.	**N/A**
RRI Mitigation (Notch) No adjustment.	
The Total Notch (RRL Notch × RRI Notch) is N/A.	
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**16**

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[29] and can manifest in shortages and higher costs for Issuers.

[29] Golecha & Gan 2016.

Risk Information:

Forest residue: Logging operations typically occur for 9-10 months over a calendar year. Operations generally stop or slowdown during the spring and winter due to wet conditions caused by snowmelt and excessive rain. Wildlife-related regulations also restrict logging during the summer and spring in higher elevation forests. Operational pauses also occur during extreme fire conditions but are relatively infrequent and seldom involve full forest closure; instead, operations are allowed to continue at specific times. Between 2002 and 2022, there were four wildfires larger than 10,000 acres in the region.[30]

During operational pauses and slowdowns, a reduced level of wood supply is sustained by utilizing regional log and residuals inventories and, to a lesser extent, shifting operations to the Prescott NF. These measures are generally sufficient to ensure a steady flow of wood fiber comparable to times of the year when seasonal weather conditions are favorable to forest operations in the Coconino and Kaibab NFs. However, risk is heightened by the fact that it is plausible that fire conditions could cause prolonged operational pauses in the future.

Woodland biomass: Woodland biomass is less susceptible to seasonal feedstock supply variation. Fuel loads are naturally lower and fire return intervals longer.

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)* Woodland biomass operations of the scale considered in this analysis could offset supply losses when commercial thinning operations shutdown or slowdown.[31] *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is 25%.	**Notch** **25%**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 27 out of 100.	**Score** **27**

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: The stated objective of 4FRI is to treat 50,000 acres per year (~25,000 acres/year from westside) to achieve ecological restoration and wildfire mitigation objectives. Pinyon-juniper encroachment into grasslands does not occur at rates sufficient to affect wood supply for new projects over a decadal time horizon. We expect that the availability of acreage for forest residue and woodland biomass recovery will be stable over time.

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

[30] The 2002 Rodeo-Chediski fire (>450,000 acres), the 2010 Shultz fire (>15,000 acres), the 2011 Wallow fire (>500,000 acres), and the 2022 Tunnel-Pipeline fire (>25,000 acres).
[31] Rappold, P.M., & Han, H.-S. (July 2020). Feedstock supply assessment for HM3 Energy, Inc. – Drake, Arizona. 41 pp. (p.19)

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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 4 out of 100.	**Score** **4**

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 decade, prices for low quality wood fiber in the region have increased gradually with inflation. No major jumps in pricing in recent years were identified during outreach. This is expected, as the forest industry in northern Arizona has been a state of stasis and decline since the late 1990s. Despite significant increases in the costs of input prices over the past few years, including equipment (e.g., forestry machinery), accessories (e.g., tires), and fuel (e.g., diesel), feedstock price increases in recent years have been localized and temporary. This reflects, in part, the lack of supply chain activity 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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 4 out of 100.	**Score** **4**

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 pulpwood and manage log debarking and chipping internally. Rather than requiring inexperienced suppliers to deliver debarked wood chips.

Risk Information:

Forest residue: Forestry contractors that regularly operate within the BDO Zone are experienced in commercial thinning operations, including best practices of forest residue/slash pile management. However, experience with the comminution and hauling of forest residue is limited since the 4FRI initiative began in 2010.

Woodland biomass: In the case of woodland biomass, mastication and on-site retention of biomass is commonplace but there is no experience recovering the biomass to market through felling-yarding-comminution operations. Recovering masticated biomass to market presents unique logistical challenges: chip truck transportation usually requires a longer planning period, greater coordination during loading and unloading, and longer loading and unloading times.

Sawmill residuals: There are no risks associated with lack of experience in the production of sawmill residuals.

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 *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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 48 out of 100.	**Score** **48**

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:
Forest residue: As noted in Risk Indicator 1.3.4, the availability of the rated quantities of forest residue and sawmill residuals is contingent upon stable demand for value-added forest products (e.g., dimensional lumber, pallets, finished wood products). The relatively small number and capacity of sawmills, and the historical volatility of regional sawmill output, present unique risks to the Coconino County BDO Zone compared to other regional forest industries in North America. Risk is moderated by the fact that some portion of thinning activity is driven by subsidies rather than markets.

Woodland biomass: PJ biomass supply chains are undemonstrated within the BDO Zone. Treatment of PJ woodlands has involved mastication only, without felling-yarding-comminution supply chains. This does not represent a high risk to the rated quantity because PJ biomass supply chains have been operating on the eastside (just outside of the BDO Zone); experience and equipment could be transferred to the westside. While logistical optimization will likely take many years, the presence of regional knowledge and expertise reduces risks associated with production history.

Sawmill residuals: N/A

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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 36 out of 100.	**Score** **36**

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: Variation in the Consumer Price Index (CPI) for the West region (inclusive of Arizona) is comparable to those of the Mountain and South regions (Figure C-2, Appendix C). Risk associated with regional price levels is therefore deemed to be low. However, risks associated with diesel prices are considerable. In the western United States, diesel fuel costs are among the highest in the country and have trended upward over the past three decades (Figure C-3, Appendix C). Diesel price risks are lower, however, when compared to other western states, including California and Washington. Therefore, this indicator presents only a medium risk likelihood and risk impact: Arizona diesel prices are considerably higher compared to eastern and central regions of the US but have remained lower than other western states.

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) 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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 36 out of 100.	**Score** **36**

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: Irrelevant to this rating.

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 (Total Notch × GRI Score) is not rated.	**Score** **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: Irrelevant to this rating.

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 (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.[32]

Risk Information: There are no identifiable circumstances that might lead to competition with producers of non-traditional products.

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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (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.

[32] Bergtold 2018.

Risk Information: As reviewed in Risk Indicator 1.5.1, forest operations in the BDO Zone are fully mechanized and involve conventional practices. Crews operate feller-bunchers, grapple skidders, and processors to recover merchantable roundwood and pile residue. Prolonged exposure to the sun is the largest risk associated with harvest and collection practices and schedules but this is not expected to present significant problems to feedstock quality if most comminution involves the use of grinders.

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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (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 residue: Virtually all forest operational activity in the supply basin is fully mechanized, involving feller-bunchers and grapple skidders. This contrasts with the significant contribution of manual felling with chainsaws in the US Southwest (up to 40%).[33] The relatively advanced level of operational mechanization in the region considerably reduces risks associated with harvesting and collection equipment.

Sawmill residuals: N/A

Woodland biomass: Woodland biomass supply chains involving the use of conventional equipment (dozers, loaders, and skidders) have already been proven in northern Arizona. Alternative harvesting configurations, including cut-and-bale, chip-and-forward, and shear-and-forward, remain unproven after over a decade of research.[34]

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**

[33] Vaughan et al. (2022) reports the regional mix as: Felling: chainsaw = 43.4%, feller-buncher = 43.4%, harvester = 13.2%, Extraction: skidder = 85.7%, forwarder = 14.3%. Vaughan, D., C. Edgeley, and H.-S. Han. 2022. Workforce training needs of forestry contractors in the US Southwest: Results of an industry survey. ERI White Paper—Issues in Forest Restoration. Ecological Restoration Institute, Northern Arizona University. 16 p.
[34] https://www.srs.fs.usda.gov/pubs/ja/2013/ja_2013_rummer_002.pdf

The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100	**Score** **16**

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 fiber 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 (Huhnke 2018).

Risk Information:

Forest residue: Recovery of forest residue (slash) is typically achieved by comminuting slash piles using grinders, which comminute feedstock using a spinning cylinder equipped with blunt protrusions ("hammers"). Compared to chippers, which involve the use of spinning cylinders equipped with sharp cutting edges ("knives"), grinders have superior efficiency and cost-effectiveness when processing dry and soil/rock-contaminated feedstock. In most commercial thinning operations, residue and other unmerchantable material are piled for comminution at a later date. This leads to some level of contamination which is easily addressed through the use of grinders and screens.

There is, however, a chance that chippers will also be used in biomass recovery operations in the BDO Zone, particularly in lower quality stands amenable to whole tree harvesting. The relative performance of chippers and grinders in ponderosa pine biomass recovery operations is currently being investigated in a detailed time-motion trial conducted by TNC and OIB Consulting, in partnership with Novo Biopower. Depending on the results, future biomass supply chains in the BDO Zone could involve a mix of chipping and grinding operations. While this will lead to some level of feedstock heterogeneity, most biomass recovery operations in the region are expected to be integrated with merchantable roundwood recovery. In these cases, grinding is expected to remain the most efficient and cost-effective option.

Sawmill residuals: There is limited variation in the types of stationary equipment used to produce chips, bark, sawdust, and shavings at sawmills. Therefore, no significant variation in the cost and quality of sawmill residuals is foreseen.

Woodland biomass: Due to the properties of aboveground tree and shrub biomass in PJ woodlands (e.g., small diameters, high leaf percentages), PJ biomass recovery operations are most likely to involve grinders. Alternative densification options, including balers and mobile chippers, cannot be ruled out but are unlikely.

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)	**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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**Score** **16**

3.4.4 Availability of Labor for Feedstock Production

Rationale: Skilled labor shortages can be difficult to remedy in the short-term. Availability of suitable labor in an area can impact the ability to procure sufficient feedstock quantities on required schedules. Labor 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 labor force.

Risk Information:

Forest residue: Local forestry professionals contacted by Ecostrat generally agreed that the main bottleneck to wood supply on the westside is the lack of logging truck operators. The ~25 logging trucks that frequent the westside are owned by a mix of sawmills, logging contractors, and independent owner-operators. There are a number of companies in the region with large trucks fleets that are capable of investing in logging trucks and chip vans but finding skilled operators willing to work the long hours required is challenging. The availability of chip van drivers is also inadequate for a scale up in residue supply.

The availability of forestry equipment operators is not as much of a concern. Approximately ten mechanized sides regularly operate on the westside and are capable of commercially thinning between 10,000 – 35,000 acres/yr.[35] Although previous surveys of forestry contractors in the US Southwest have concluded that finding skilled workers is a principal concern of business owners involved in logging, comminution, and trucking,[36] this conclusion does not apply to the subset of contractors that operate in the Coconino and Kaibab NFs. Instead, we conclude that workforce shortages are only a significant problem for the transportation phase of the supply chain. There is sufficient thinning capacity and, depending on assumptions about the productivity of grinders, workforce availability for grinding operations may also be adequate for the rated quantity of residue. Over half of current employees of forestry contractors on the westside are under the age of 40.

Sawmill residuals: There are no significant risks of labor availability for the rated quantity of sawmill residuals (10,000 bdt/yr), which would require only two chip vans operating 200 days per year.[37]

Woodland biomass: There are currently no PJ biomass recovery operations in the BDO Zone. Procuring the rated quantity (40,000 bdt/yr) would require two sides and 8-10 operators. With the development of a market for PJ biomass, we expect that businesses that make the investments in required equipment will be able to find the required workers.

[35] Assuming 5-15 acres/day per crew and 180-250 operating days/year per crew.
[36] Vaughan, D., Edgeley, C., and Han, H.-S. 2022. Forest contracting businesses in the US Southwest: current profile and workforce training needs. Journal of Forestry 120(2): 186-197.
[37] Assuming 13 bdt/trip and two trips per day.

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 *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is N/A.	**Notch** **N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 24 out of 100.	**24**

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.

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: Relatively high capital, O&M, and fuel costs in northern Arizona result in elevated biomass transportation costs compared to central and eastern US states (e.g., $0.30/ton/mile vs. $0.25/ton/mile). However, the risk of feedstock transportation costs for new projects located in the Bellemont-Flagstaff area is mitigated by the comparatively short transportation distances over which feedstock would be supplied. Most of the rated quantities of feedstock are available within a less than 50-mile drive distance. This contrasts with feedstock transportation distances under current market conditions, which average ~150 miles. The proximity of biomass resources to potential project development sites (including the industrial site evaluated in section 5.0) significantly reduces transportation cost risks. The conservative transportation cost formula used to estimate the rated price ranges for forest residue and woodland biomass delivered to bio-projects further reduces risk for this indicator.

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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 24 out of 100.	**24**

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: Diesel prices on the west coast of the United States are consistently higher than prices in the central and eastern regions. Long-term diesel price volatility on the west coast tracks diesel price volatility nationally, but at a higher price point. In contrast to other regions in the United States, real diesel prices have been trending upwards over the past three decades (Figure C-3, Appendix C). As discussed in Risk Indicator 3.5.1, the costs of owning and operating transportation equipment have also increased significantly in recent years. The ongoing escalation of diesel prices may impose constraints on accessing the rated quantities. Note that diesel prices in AZ are much lower than in other western states, including CA and WA (often a $1/gallon difference).

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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 36 out of 100.	**36**

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: There are approximately 25 logging trucks and 10-15 chip trucks that regularly traffic the supply basin. Outreach has determined that there are occasional shortages of top-loading and walking floor trailer configurations in the BDO Zone. For current wood fiber demands, this does not cause significant delays in feedstock deliveries. However, without investment in additional chip trucks and trailers, a reliable year-to-year supply of the rated quantities of feedstock is unlikely. New investments in regional chip van capacity have recently been made.

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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**Score** **16**

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: Generally, the majority of residents and workers in the region are supportive of ecological restoration and of the forest industry which makes restoration economically possible. There are a large number of local organizations – including community groups – that support forest operations for purposes of forest restoration and wildfire mitigation. In 2012, voters approved a $10 million bond support ecological restoration and wildfire management around the City of Flagstaff. Transportation of feedstock to the evaluated industrial site will not require truck traffic through the center of Flagstaff, as the site is located on the eastern edge of the city. Truck traffic in the eastern edge of Flagstaff is already common due to the presence of a sawmill and soil amendment producer.

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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**Score** **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: Arizona has an 80,000 lbs weight limit but companies can buy permits to enable a GVW as high as 97,000 lbs. Trucks must navigate I series highways and are therefore subject to federal Dept. of Transportation regulations. Generally, risks related to transportation regulations and weight limits were assessed as low by local forestry professionals contacted by Ecostrat.

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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**Score** **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:

Forest residue: Existing road and bridge capacities in the Coconino and Kaibab NFs are adequate for forestry truck traffic (Map C-2, Appendix C). However, primary and secondary road extent in the region's forests is limited. Tertiary roads can be built relatively easily during most times of the year but the costs associated with road building are often not covered by revenues from merchantable roundwood sales. In many operating areas, USFS funding is insufficient to cover the required road investments.[38] However, in general, the drier weather conditions in the region are favorable to road access and maintenance.

Sawmill residuals: Primary and secondary roadways are in good condition in northern Arizona and do not pose a risk to feedstock deliveries to and from sawmills.

Woodland biomass: Road infrastructure is not expected to pose a risk to the transportation phase of PJ woodland biomass operations. Unpaved tertiary roadways and flatter portions of operating areas are trafficable for chip trucks (the exception being during parts of the rainy season in the summer/early fall).

[38] https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd969259.pdf#:~:text=The%20Four%20Forest%20Restoration%20Initiative,over%20the%20next%2020%20years (p.10)

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 *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is N/A.	**Notch** **N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 24 out of 100.	**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: There are an estimated 25 logging trucks and 10-15 chip vans that currently operate within the BDO Zone. While trucking capacity is adequate for current demand, any increase in commercial thinning activity and biomass recovery from PJ woodlands will require investments in additional chip trucks and operators. We estimate that reliable and cost-effective supply of the rated quantities would require of 5-15 additional chip trucks and an equivalent number of operators.[39]

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 *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is N/A.	**Notch** **N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 48 out of 100.	**48**

[39] Assuming 5,000 bdt/year per chip truck.

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: Most potential suppliers, including forestry contractors and sawmills, are best characterized as small. For example, the larger logging contractors that frequently operate on the westside have only two sides. Sawmills located within Williams-Bellemont-Flagstaff are relatively small, with lumber capacities ranging from 2-15 MMBF/yr. The RFOR sawmill in Bellemont currently has a capacity of ~10-15 MMBF/yr but has a planned capacity of 150 MMBF/yr. The Chino Valley sawmill is the largest operational sawmill in the supply basin, with a capacity of 30 MMBF/yr (located ~70 miles from Bellemont). Trucking companies involved in the logging business also tend to be relatively small (e.g., <5 trucks).

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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 24 out of 100	**24**

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: Suppliers of forest residue and woodland biomass are subject to external risks related to seasonal weather extremes (wildfires, flooding) and input price inflation. Risks associated with seasonal weather extremes can be managed by shifting operations to unaffected areas and accumulating feedstock inventories during favorable weather

periods. In most years, we expect that seasonal unavailability of forest residue (owing to wildfires/flooding) can be partially compensated for by woodland biomass operations.

This Risk Indicator is not relevant for sawmill residuals.

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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**16**

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 fiber (i.e., the cost that one pays to a landowner for the right to cut and purchase their wood fiber) 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: The prevalence of federal ownership within the BDO Zone is associated with positive and negative impacts on potential wood supply and pricing. Positive aspects of federal ownership include access to subsidies for biomass removal (e.g., IRSCs), federal responsibility for overhead costs associated with operational planning and inventory, relatively low stumpage costs, and a large government workforce committed to the objective of forest restoration and industry growth. Negative aspects mainly pertain to the unpredictability and variability of mechanisms for achieving objectives, namely contract arrangements and associated provisions. Since 2010, in an effort to encourage increased thinning activity, at least four different contract types have been offered by the USFS (standard timber sales, stewardship contracts, integrated resource timber contracts (IRTCs), integrated resource service contracts (IRSCs)). For each contract type, a number of provisions have been offered, including payments for biomass comminution and hauling, subsidies for road construction and maintenance, and long-term (>10 year) acreage allocations to individual companies, for example. The type of contracts and provisions offered in a given year can vary significantly from what was offered in the preceding year, and history has shown that contracts and associated provisions can be rescinded by the USFS.

The difficulties that have been encountered over the 12 years of 4FRI program development and implementation on the westside mainly reflect the lack of local buyers of forest residue. The recurring inefficiency and unpredictability of USFS contracting reflect the attempt on the part of the USFS to experiment with alternatives in the face of lack of local feedstock demand and funding constraints. The USFS is shifting increasingly to third party contracting arrangements, whereby responsibility for inventory, operational planning, and subcontracting is allocated to lower levels of government or private enterprise. This is exemplified by the USFS Good Neighbor Authority (GNA) program where a separate

organization (usually the Arizona Department of Forestry and Fire Management (AZDFFM)) administers the contract, subcontracts the loggers, and oversees operations on behalf of the USFS. Third party contracts of this kind are expected to result in improvements to contracting efficiency and predictability but success will ultimately require the development of local markets for lower quality biomass.

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 *RRL Mitigation (Notch)* The USFS is experimenting with different contracting arrangements, including out-sourcing to state, municipal, and tribal governments (e.g., GNA). *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is 25%.	**Notch** **25%**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 18 out of 100.	**18**

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 supply basin. Such estimates are important in assessing feedstock risk and enable accurate assessment of the efficacy of Issuer's mitigation methods.

Risk Information: Forest operations generally do not occur on the Coconino and Kaibab NFs for 2-3 months each year for regulatory and weather-related reasons. Strict rules prohibiting operations in conditions that could lead to rutting and runoff effectively rule-out harvesting during the wetter winter and spring seasons when temperatures are above freezing. During the spring and winter, logging generally occurs in the evening once temperatures reach below freezing. Operations can also slowdown or stop during the summer months due to major fire and flooding events. Inventory capacities at RFOR and shifting of operations to the Prescott NF (which is not subject to the same regulations) provide some assurances that wood supply remains constant throughout the year. However, during bad fire seasons or prohibitive winters (e.g., record-braking snowfall during the winter of 2022), wood supply could become affected from prolonged operational shutdowns.

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 N/A.	**Notch** **N/A**
Loaded RI Score	**Score**
The Loaded RI Score (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: The US Southwest is drought-prone and subject to large swings in year-to-year climate extremes. While many climate model projections forecast increasing drought conditions in Arizona and the surrounding Southwest, historical evidence is less clear. For example, the worst droughts in Arizona's recent history occurred in 1932-36, 1942-64, and 1974-77.[40] Historical records of rainfall in Arizona also indicate no trend in the incidence of extreme precipitation.[41] Considering the 2-degree Fahrenheit increase in Arizona temperatures over the past century and forecasts of continued warming under anthropogenic climate change,[42] climate risk is relatively high in northern Arizona over longer time periods. Over the lifespan of a typical bio-project, however, the risk of long-term weather and climate trends is considered to be low-to-moderate.

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 *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is N/A.	**Notch** **N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 24 out of 100.	**24**

[40] https://pubs.usgs.gov/fs/2005/3081/pdf/FS2005-3081WEB.pdf
[41] https://www.climate.gov/news-features/event-tracker/record-breaking-rain-arizona
[42] https://climatechange.chicago.gov/climate-impacts/climate-impacts-southwest

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: Forest fires are a common occurrence in northern Arizona. Between 2002 and 2022, there were at least five major wildfires in the region. Two of these fires affected over 450,000 acres. All of the fires were caused by human activities, including campfires, flares, and sparks caused by equipment operator error.[43] There is no evidence of a long-term trend towards increased fire activity in northern Arizona and the broader Southwest. A study of fire history in ponderosa pine forests and pinyon-juniper woodlands in Nevada (approx. 400 miles from the BDO Zone) concluded that fire frequency increased rapidly between ~1700 and the 1880s, peaking in the 1860s and 1880s, before declining to pre-1700 levels after the 1880s.[44] Given the recent history of forest fires in the region, the risk that wildfires will impede future biomass supply chains for the rated quantities is assessed as high.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**8**
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 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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 48 out of 100.	**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.

[43] 2002: Rodeo-Chediski fire (468,000 acres) caused by chemical fuels (matches and flares); 2010: Shultz fire (15,000 acres) caused by campfire; 2011: Wallow fire (538,049 acres) caused by campfire; 2019: Museum fire (1,961 acres) caused by excavator involved in forest restoration project striking a rock causing a spark; 2022: Tunnel-Pipeline fire (26,532 acres) caused by small fire started with matches.
[44] https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/ES10-00068.1

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: There are a variety of bark beetle species native to ponderosa pine forests and pinyon-juniper woodlands in the US Southwest. There is evidence that bark beetle infestations are made worse by environmental events that cause tree foliage loss and branch dieback.[45] Over the lifespan of a bio-project, this is not expected to present significant risks to feedstock supply and pricing.

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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**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: Irrelevant to this rating.

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**

[45] https://awcs.azgfd.com/habitats/montane-conifer-forests; https://www.fs.usda.gov/research/treesearch/31240

Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is not rated.	**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: Post-fire flooding is common in northern Arizona. Significant post-fire flooding events occurred in 2010 (Shultz Fire) and 2017 (Museum Fire). Dedicated organizations and programs are in place to mitigate the causes and effects of flooding. With federal support, the Coconino County Flood Control District spends tens of millions of dollars annually on project designed to mitigate flooding events, including those caused by post-fire flooding. While these efforts may lead to significant reductions in the impacts of flooding events in the region, flooding is a normal historical occurrence in the region. Future wood supply disruptions caused by flooding events are likely to be localized and temporary (weeks rather than months).

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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**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 fiber for an Issuer.

Risk Information: As discussed in Risk Indicator 3.7.2, Arizona is drought-prone and drought frequency and intensity could increase under anthropogenic climate change. However, over the lifespan of a bio-project, there is no evidence from recent history that droughts will significantly influence the availability of wood fiber procured from ponderosa pine or pinyon-juniper ecosystems.

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) 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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**Score** **16**

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: Although hurricanes do not occur in northern Arizona and tornados are exceedingly rare, high wind conditions sufficient to uproot trees are relatively common. The total area impacted by these wind events is typically localized and therefore wind events are not expected to impede wood supply.

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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 4 out of 100.	**Score** **4**

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 are typical during the winter months but do not negatively affect operations and forest/woodland resources.

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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 4 out of 100.	**4**

3.8 Risk Factor: Political and Social

3.8.1 Government Subsidies for Feedstock Production or Utilization

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

NOTE: This risk indicator refers to direct feedstock subsides only; it does not apply to government subsidies that pertain indirectly to the operations of the Issuer such as Loan Guarantees or to the markets for products produced by the Issuer.

Risk Information: To avoid the risks associated with retaining forest residue slash piles in the forest (e.g., beetle infestation, fire risk), it is preferable to remove the material off site. Without companies willing to pay for comminuted residue, removing residue from the forest typically requires subsidies in the form of payments per acreage treated or payments per ton of residue produced. Funding for this purpose is either provided through stumpage payments to the USFS for merchantable roundwood (integrated resource timber contracts, IRTCs) or through the USFS budget (integrated resource service contracts, IRSCs, stewardship contracts).

The increase in 4FRI treated acreage in 2021/2022 to over 15,000 acres/yr can be partly attributed to the Build Back Better and Inflation Reduction Act programs, which have increased available funds by a factor of four. Funding is expected to return to normal levels within the next couple years, which could lead to a return to thinning levels experienced in 2020 without improvements in contracting and markets (10,000 – 12,000 acres/yr). Another aspect of contracting that pertains to this indicator is the presence of contract provisions that subsidize contractors for removing residue. This is uncommon but has been offered in the past. This is another unpredictable aspect of contracting/subsidies under the 4FRI initiative, as there are recent examples of contracts with biomass recovery provisions being cancelled by the USFS. The unpredictability of funding and contracting for purposes of ecological restoration poses a substantial subsidy-related risk to new projects.

Raw Risk Likelihood (RRL)	**Score**

The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**8**
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 64 out of 100.	**Score** **64**
Mitigation/Notching *RRL Mitigation (Notch)* Efforts to improve contracting arrangements are on-going. Options being considered include increasing the frequency of contract offerings and increased delegation of responsibility for contract management to lower levels of government (AZDFFM) or private companies. Ultimately, the development of local markets for woody biomass is expected to improve contracting/subsidy challenges. The presence of another company willing to pay for the costs of comminuting and transporting residue would reduce subsidy dependence. It is unlikely, however, to eliminate subsidy dependence: On the eastside where markets for low quality biomass are present, subsidies for transportation have also been necessary to maintain/increase treated acreage. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is 25%.	**Notch** **25%**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 48 out of 100.	**Score** **48**

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: In combination with the contractual arrangements offered to subsidize commercial thinning operations (as reviewed in Risk Indicator 3.8.1), laws and regulations in the form of USFS objectives/mandates for ecological restoration and fire mitigation present another risk to wood supply in the BDO Zone. Government laws, regulations, and associated objectives are often subject to change, as are the measures that are authorized for achieving those objectives. For example, the decision to require the removal of slash piles on many forest sites could readily be overturned in favor of prescribed burning of slash piles. Likewise, the USFS-4FRI objective to ecologically restore ponderosa pine forests and pinyon-juniper woodlands could eventually be replaced by a market-oriented approach to management that emphasized timber sales only.

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 high*, therefore the RRI is 10 out of 10.	**Score** **10**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 40 out of 100.	**Score** **40**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 40 out of 100.	**40**

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: The public is generally supportive of forest operations for purposes of thinning, i.e., forest restoration, fuel reduction. In 2012, voters approved the City of Flagstaff's issuing of a $10 million bond for purposes of forest fuel reduction (the Flagstaff Watershed Protection Project). National and local organizations with ecological priorities are actively involved in supporting forest operations for these purposes (e.g., TNC, NAU-ERI, Coconino County, Greater Flagstaff Forests Partnership). Although there are some organizations in the region actively opposed to ecological restoration (e.g., most notably the Sierra Club), strict federal regulations and wildlife/archeological survey requirements significantly reduce the likelihood that public opposition to bio-projects will develop.

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 *medium*, therefore the RRI is 6 out of 10. RRI is assessed as medium because of the limited biomass quantity and low ownership diversity in the region: if public opposition was to develop, it could result in a curtailment of thinning operations throughout the NF system.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 12 out of 100.	**12**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 12 out of 100.	**12**

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: None of the rated quantities of feedstock are expected to come from the lands of the Navajo, Hopi, Hualapai, and Paiute Nations. Generally, the Nations are supportive of the regional forest industry and are party to a number of programs and partnerships. The Wood For Life program, funded by the National Forest Foundation, provides free firewood to households interested in substituting coal for heating and cooking purposes. The Coconino NF's Tribal Relations Program offers workshops on the forest industry that include career mentoring services.[46]
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) — **N/A** No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is N/A.
Loaded RI Score — **Score**
The Loaded RI Score (Total Notch × GRI Score) is 4 out of 100. — **4**

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: Irrelevant to this rating.
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 (Total Notch × GRI Score) is not rated. — **NR**

[46] https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd839803.pdf (p.26)

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:

Forest residue: Sustainability assurances are built into the USFS-4FRI initiative. Commercial thinning operations are governed principally by the objective of restoring forests to a more natural state with lower stem densities. Progress towards this objective is being assessed using the USFS network of permanent sample plots in the Coconino and Kaibab NFs as well as vegetation plots established by the USFS in cooperation with Northern Arizona University (NAU).[47]

Woodland biomass: PJ woodland management is directed by both rangeland preservation and restoration objectives. Pinyon pine and juniper species are not amenable to management for repeated harvesting due to their slow growth rates.[48] However, the sustainability of woodland biomass supply for new projects is assured by the negligible proportion of total woodland area that would have to be harvested annually to attain the rated quantity (10,000 acres/yr, of a total 2.1 million acres).

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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 4 out of 100.	**Score** **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.

[47] https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd839803.pdf (p.29)

[48] A pinyon pine seedling can take as long as 100 years to reach a diameter of 10 inches (https://www.srs.fs.usda.gov/pubs/misc/ag_654/volume_1/pinus/edulis.htmhttps://www.srs.fs.usda.gov/pubs/misc/ag_654/volume_1/pinus/edulis.htm)

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: Forest operations in the region are not expected to result in long-term deterioration of soil quality. Ponderosa pine commercial thinning operations remove a small fraction of total above-ground biomass. During the early spring season, forest operations often occur in the evening to reduce rutting damage and preserve soils. Operations in PJ woodlands will generally be undertaken for purposes of rangeland preservation, ecological restoration, or fire mitigation and therefore concerns relating to the capacity of soils to promote tree growth in the future do not apply.
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)* **N/A** No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is N/A.
Loaded RI Score **Score** The Loaded RI Score (Total Notch × GRI Score) is 4 out of 100. **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: Irrelevant to this rating.
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 (Total Notch × GRI Score) is not rated. **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: Irrelevant to this rating.

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 (Total Notch × GRI Score) is not rated.	**Score** **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: Irrelevant to this rating.

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 (Total Notch × GRI Score) is not rated.	**Score** **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: The National Forests are subject to strict regulations related to potential impacts on wildlife and ecosystems. Before forest operations begin, wildlife surveys must be carried out. Surveys can take up to two years because sampling must occur over the four seasons. Even after wildlife sampling is complete, operations can be temporarily shutdown to ensure the welfare of threatened species. For example, harvesting in the NFs was temporarily halted in 2019-2020 as a result of an injunction related to the Mexican spotted owl.[49] Given evidence that calls into

[49] Vaughan, D., C. Edgeley, and H.-S. Han. 2022. Workforce training needs of forestry contractors in the US Southwest: Results of an industry survey. ERI White Paper—Issues in Forest Restoration. Ecological Restoration Institute, Northern Arizona University. 16 p.

question the hypothesis that commercial thinning and wildfire mitigation presents a net benefit to threatened species like the Mexican spotted owl,[50] the risk of wildlife concerns to future biomass supply chains is heightened.
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)* **N/A** No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is N/A.
Loaded RI Score **Score** The Loaded RI Score (Total Notch × GRI Score) is 36 out of 100. **36**

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: Irrelevant to this rating.
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 (Total Notch × GRI Score) is not rated. **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.

[50] https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/ecs2.2354

Risk Information: We do not expect that the rated quantities of feedstock will be subject to significant risks related to feedstock quality. Operators in the region are familiar with best practices in wood fiber management and storage. The expected prevalence of grinding in the BDO Zone reduces feedstock quality concerns, as forest residue and woodland biomass piles can be left to dry for long periods of time without affecting the efficiency and cost-effectiveness of comminution. In this regard, the extended dry season in northern Arizona is favorable from a feedstock quality perspective, as moisture content is reduced. Risk is increased slightly by the fact that woodland biomass is known to have a higher ash content and is more prone to soil and rock contamination.

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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**16**

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: Previous studies have determined that logging, comminution, and trucking capacity in the US Southwest is insufficient for the required extent and intensity of forest restoration and fuel reduction operations.[51] The capacity of logging contractors on the westside is likely adequate for the rated quantities of forest residue.[52] Grinding capacity would likely only require a marginal increase to recover the 140,000 bdt/yr of forest residue and woodland biomass available for new projects.[53] However, chip truck capacity would likely have to double to ensure a steady supply of the rated quantities.[54] Recent investments in chip trailers by a large incumbent in the region reduce this scale-up risk. Logging truck capacity would not have to increase under an annual treatment scenario of 5,000acres/year.[55] With regards to woodland biomass, two sides capable of felling and forwarding biomass in PJ woodlands year round will need to be established.

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

[51] Vaughan, D., C. Edgeley, and H.-S. Han. 2022. Workforce training needs of forestry contractors in the US Southwest: Results of an industry survey. ERI White Paper—Issues in Forest Restoration. Ecological Restoration Institute, Northern Arizona University. 16 p.
[52] Assuming 10 sides @ 5 acres/day and 200 operating days/year.
[53] There are 3-5 tracked grinders currently available on the westside. Assuming an annual grinder productivity of 20,000 bdt/yr, no more than 7 grinders will be required to procure the rated quantities of forest residue and woodland biomass.
[54] Assuming current capacity of the 10 chip trucks operating on the westside is 50,000 bdt/yr (10 chip trucks x 26 bdt/day x 200 operating days/year).
[55] Assuming current capacity of the 15 logging trucks operating on the westside is ~150,000 green tons/yr or 7,800 acres/yr

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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 24 out of 100.	**Score** **24**

CATEGORY 5.0: INFRASTRUCTURE RISKS

5.1 Risk Factor: Physical Infrastructure

5.1.1 Land Parcel

Risk Information: For the purposes of this rating, we have selected an available 159-acre parcel within the BDO Zone to help highlight many of the infrastructure-related risk factors. This site is representative of the type of industrial land available in the region.

The chosen parcel is located 2 miles east of Flagstaff bordering Interstate 40 and Route 66 (See Appendix D for additional information). It is Arizona State Trust Land which means it is owned and managed by the State. State Trust Land is not public land. Trust Land is different from public land such as parks or National Forests, in that Trust Lands are managed by the Land Department to generate revenue for 13 specific beneficiaries. They are available for sale or lease to individuals or investors.

The parcel is currently undeveloped and was chosen due to its immediate proximity to rail lines, natural gas pipelines, highways, electric power, and a major Arizona city (Flagstaff Pop. 76,000). As an undeveloped parcel, the risk is higher than a parcel that is already operational, but its location and features mitigate that risk down to low for future bio-project 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 N/A.	**Notch** **N/A**

Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**16**

5.1.2 City Ownership

Risk Information: The Arizona State Land Department manages approximately 9.2 million acres of state trust land in Arizona. The lands were granted to the State under the provisions of the Federal Enabling Act that provided for Arizona's statehood in 1912. To request a long-term lease or purchase of a parcel, an application is filed with the Land Department with the proposed use, an Alta Survey, environmental review and an archeological statement. If accepted, the parcel goes up for public auction at its sale or lease market price. There is no existing activity on this parcel.

The management by the State of these trust lands provides revenue to 13 specified beneficiaries that include K-12 Public Schools, Universities, The Department of Corrections, and several specialty educational facilities. All the funds generated remain within the State. The approximate timeline for this ownership transaction is 3-6 months. This ownership risk for a development parcel is considered low due to the State's encouragement to new industries.

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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**16**

5.1.3 Industrial Land Use Zone

Risk Information: Zoning requests or changes on the trust land detailed above goes through normal local City and County processes. The parcel is currently "unzoned." Its location is ideal to be zoned as industrial or even heavy industrial if that is called for. There are several operating commercial and industrial facilities within a quarter mile of the site. A zoning request within Coconino County takes 4-5 months to get approved. This risk is considered low to get the site permitted for new development.

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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 4 out of 100.	**4**

5.1.4 Natural Gas Line

Risk Information: Arizona gets its natural gas from two main underground supply basins: the San Juan Basin in New Mexico and the Permian Basin in Texas. The gas is then injected into the interstate pipeline system for delivery into Arizona. The two northern pipelines are owned by El Paso Natural Gas and Transwestern travelling the full width of the state from east to west. Each is 30" and considered "highly reliable." Unisource Energy operates the gas service in the Flagstaff area charging an average of $6.97/mcf. This rate is on par with the national average and has seen a 17% reduction over the past year from $7.71/mcf, due to increased storage capabilities and production. See Map C-3, Appendix C for a map of the natural gas pipelines in Arizona. These lines run parallel to the chosen parcel in the BDO Zone. Overall, natural gas risk in the Flagstaff area for new industrial projects is low due to available volume and pricing.

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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**16**

5.1.5 Electrical

Risk Information: Coconino County consumes only 53.19% of the electricity generated in the county, meaning they can store or export the surplus 46.81%. The County produces its power from two sources: Glen Canyon Dam (hydro 1,340 MWs) which accounts for 93% of the County's electricity and wind farms generating 7%. Both sources are zero CO2 emissions.

The average industrial electric rate is $7.87 cents/kWh and supplied by Arizona Public Service. This is 18% higher than the national average of $6.67 cents/kWh.

The availability of power for new biofuel industries is low risk. However, the average price is higher than the national average. Risk is assessed as moderate.
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) **N/A**
No adjustment.
RRI Mitigation (Notch)
No adjustment.
The Total Notch (RRL Notch × RRI Notch) is N/A.
Loaded RI Score **Score**
The Loaded RI Score (Total Notch × GRI Score) is 36 out of 100. **36**

5.1.6 Fresh Water Supply

Risk Information: The Coconino aquifer (C aquifer) is a regionally extensive multiple-aquifer system supplying water for municipal, agricultural, and industrial use in northern Arizona, northwestern New Mexico, and southeastern Utah, including the Arizona State Trust Land industrial site. Wells in the Flagstaff area range in depth from 1500-2500 feet and are capable of 1000 gallons per minute. Additional surface water is also available from the San Francisco Peaks runoff. Flagstaff currently maintains its 100-year Adequate Water Supply Designation. The City of Flagstaff maintains the municipal water supply, including to the industrial site.

Water risk is low for the Flagstaff area and any pending new industrial industries locating in the area.

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) **N/A**
No adjustment.
RRI Mitigation (Notch)
No adjustment.
The Total Notch (RRL Notch × RRI Notch) is N/A.
Loaded RI Score **Score**
The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100. **16**

5.1.7 Sewage Disposal Trunk Line

Risk Information: Sewage disposal is handled by the City of Flagstaff public works. This system is targeted to support a population of 80,000-85,000. The facilities are approaching their capacity based on the current configuration and are estimated to be expanded within the next 10 years. The wastewater is typically treated at one of three city-owned treatment facilities and used for several things: irrigating non-food crops, watering city ballparks and replenishing the underground wells, or aquifers, that store drinking water. This is a well-established public utility and therefore the risk is considered low for new customers in the coming few years.

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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**Score** **16**

5.1.8 Drainage and Stormwater Management

Risk Information: Coconino County Public Works Department – Flagstaff is responsible for road maintenance, snow removal for county streets, solid waste transfer stations, and storm water management. Though technically most of this water flows away from Flagstaff and to the South, it ultimately drains into the Colorado River. This is considered a low risk for new industries.

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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**Score** **16**

5.1.9 Available ICT (Information & Communication Technology) Services

Risk Information: Residential and Commercial high-speed internet service is available at the industrial site Century Link, AT&T, Quantum Fiber and HughesNet up to 5G. All areas around Flagstaff are serviceable, therefore, it is very low risk.

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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 4 out of 100.	**4**

5.1.10 Infrastructure – Landfill/Alternative Markets for Waste Disposal

Risk Information: In Coconino County, solid waste is disposed in the Cinder Lake Landfill, a sanitary landfill owned and operated by the City of Flagstaff, located approximately five miles north of the City of Flagstaff in the Doney Park area. The current tipping fee is $43/ton for commercial and industrial waste. Waste Management and Northern Arizona Waste Systems provide solid waste disposal and recycling services. Business and industrial users are also reported to utilize Waste Management on an individual contract basis for solid waste disposal. The Cinder Lake Landfill also operates a Hazardous Products Center (HPC), which accepts hazardous waste such as automotive products, batteries, electronics, and gardening products for residential and industrial customers.

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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**16**

5.2 Risk Factor: Logistics

5.2.1 Road and Highway Access and Intersection

Risk Information: Flagstaff and the selected site are served by Interstate 40, the primary highway running east to west across the northern portion of the State. The site itself is accessed off semi-residential roads with no direct paved access onto the parcel. There would necessarily need to be surface roads added at the edge of the parcel, this would be at the developers' expense. Interstate 17 serving Phoenix and Tucson originates in Flagstaff and travels the length of the State going south. 144 miles to the south is Phoenix, AZ, 321 miles to the east is Albuquerque, NM, 253 miles to the West is Las Vegas and Los Angeles (455 miles). To the north is the Grand Canyon, along Arizona's border and impassable. The local road and highway system in Coconino County is well established and maintained. The road/highway system within the BDO Zone is very well-developed, however accessing this site increases the risk level to medium.

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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 36 out of 100.	**Score** **36**

5.2.2 Ocean/River Access

Risk Information: The Flagstaff region is at 7,100' altitude in the middle of Arizona, which is a high desert plateau. There is no Ocean access or navigable river access within the State. The Colorado River is 230 miles to the southwest and not considered commercially navigable, and the Pacific Ocean nearly 500 miles west. This would generally be a higher risk to new industry development but due to the extensive highway and rail access the area has, this risk is reduced to 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 N/A.	**Notch** **N/A**

Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**16**

5.2.3 Railway Service

Risk Information: Flagstaff is served by The Burlington Northern Santa FE (BNSF) railroad via primary east/west routes. BNSF has over 100 trains a day through northern Arizona including 3 daily arrivals/departures by Amtrak with a station in downtown Flagstaff. The area is unique having both freight and passenger train availability as a former "Transcon" hub for the Santa Fe Railway. Rail spurs are available with the approval of BNSF and local permitting to new and existing industries. These costs would be borne by the developer/owner of the new site. Risk is low for new biofuel facilities seeking rail access for inbound and outbound freight needs.

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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**16**

5.2.4 Accessibility to Airport

Risk Information: Flagstaff's Pulliam airport is less than 5 miles south of Flagstaff off Interstate 17. It provides commercial airline and cargo service to Phoenix and Dallas-Ft Worth via American Eagle, Alaska, and SkyWest. The closest international airport is in Phoenix, 159 miles to the south. Air access is considered low risk for the Flagstaff area for accessibility to new industries and workers.

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 N/A.	**N/A**

Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**16**

5.3 Risk Factor: Social Infrastructure

5.3.1 Healthcare Facilities

Risk Information: Flagstaff Medical Center is a standout regional hospital distinguished by its high-quality care and specialty services, including an award-winning spine surgery program, comprehensive inpatient and outpatient behavioral health services, and the only Level 1 Trauma Center north of Phoenix. Northern Arizona Healthcare serves more than 700,000 people with a team of 4,000 doctors, nurses and other experts, as well as millions of tourists visiting nearby sites such as Grand Canyon National Park, Sedona, Monument Valley and Lake Powell. The risk of not having adequate and readily available healthcare in the flagstaff area is 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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 4 out of 100.	**4**

5.3.2 Educational Facilities

Risk Information: The Flagstaff Unified School District contains 16 schools and has 8,950 students enrolled in public K-12 programs. Northern Arizona University is in downtown Flagstaff and is home to 28,194 students as of 2023. NAU has a very extensive program in their School of Forestry. This program offers undergrad and graduate curriculums in forestry management, sustainability, biology, and business. In addition, Coconino Community College, Indian Bible College, Embry-Riddle Aeronautical University and Arizona College provide specialty and technical training.

There are extensive educational services and facilities in the Flagstaff area, therefore, this risk is 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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 4 out of 100.	**4**

5.3.3 Transportation Facilities

Risk Information: In addition to an extensive rail and highway network, Flagstaff offers inter-city bus service by Mountain Line, interstate bus service provided by Greyhound, Amtrak rail passenger station, Navajo Transit System (to the Navajo Nation), and a well-developed bicycle and walking path system. This is considered a very low risk item for incoming industries and their workers.

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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 4 out of 100.	**4**

5.3.4 Recreational Facilities

Risk Information: Flagstaff is located right in the middle of the 1.86-million-acre Coconino National Forest, which is a part of the world's largest ponderosa pine forest. Recreational areas and facilities for fishing, camping, hunting, snow skiing, and hiking, are abundant and easily accessible. Within the City's limits there are numerous public parks and bike trails.

Flagstaff enjoys four different seasons including periods when there is a lot of snow. When the temperature in Phoenix soars above 100 degrees, Flagstaff's 7,000' altitude keeps summers warm but tolerable.

Recreational facilities infrastructure is a very low risk item due to Flagstaff's extensive recreational opportunities; however, the risk is elevated to medium because of the altitude. That could limit some people and their ability to live and work with the thinner air.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 36 out of 100.	**Score** **36**

5.3.5 Cultural Facilities

Risk Information: The landscape surrounding Flagstaff is mountainous and forested, creating a social setting that is very different from most of the other cities in Arizona. For a small city, Flagstaff has an impressive diversity of arts and entertainment. Cultural activities concentrate within the city's core, creating a very close, community-based environment.

Northern Arizona University is in southern Flagstaff, and because there are many students in the area, one can find all sorts of exciting events, from concerts and entertainment to athletic competitions, and educational opportunities. The local colleges host lectures, music and arts performances and dancing in the town square.

There is a significant Native American influence due to the surrounding Navajo, Hopi, Hualapai, and Paiute Nations contributing to the cultural diversity of the area.

This area is well-diversified culturally attracting a wide range of potential employees for new industry.

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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 4 out of 100.	**Score** **4**

5.3.6 Public Safety Facilities

Risk Information: The Flagstaff Police Department and the Coconino County Sheriffs Office provide the primary public safety services to the area. The violent crime rating for Flagstaff (5.56/1000) is one of the highest in Arizona (4.89) and ranks somewhat high among the nation's cities of similar size (4.0 average). No specific reasons are given for this. There is extensive public training and classes provided by law enforcement departments. The risk here is deemed as medium due to this higher-than-normal crime rate.

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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 36 out of 100.	**Score** **36**

5.3.7 Housing

Risk Information: The Flagstaff metro area is ranked 44 out of 273 cities across the US in terms of cost of living. The cost of living in Flagstaff is 113% higher than the national average. The average home price in 2023 was just over $700k.

The rental market is stressed with the University students competing for space. The average rent for apartments in Flagstaff is between $1,718 and $2,007 in 2023. There are new housing developments to the west (10 mile) in Bellemont and to the east of downtown.

Expensive housing markets increase the risk of new industries attracting staff; therefore, the risk is high.

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 *high*, therefore the RRI is 8 out of 10.	**Score** **8**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**Score** **64**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is N/A.	**Notch** **N/A**
Loaded RI Score	**Score**

The Loaded RI Score (Total Notch × GRI Score) is 64 out of 100.	**64**

5.4 Risk Factor: Workforce and Permitting

5.4.1 Labor Availability

Risk Information: According to a study by career site Zippia, Flagstaff came in second among cities with the worst job markets in the United States for 2021. The Flagstaff unemployment rate is at 4.80%, compared to 5.00% last month and 4.90% last year. This is lower than the long-term average of 6.83%. There is a population of students that account for much of the local, lower-wage jobs in the city. The University attracts higher-education disciplines, and a large Native American workforce population is within an hour's drive. Professional level and skilled labor are sometimes difficult to source within the county. These factors place a medium risk on the availability of labor for new industries.

With respect to labor availability in the forest industry, a survey of forestry contractors in the Southwest found that "finding skilled workers" was the largest barrier to the success of business operations.[56] Between 2005 and 2009, the forestry workforce in Arizona was reduced by 50%, the largest workforce loss rate of the thirteen western states.[57] Risks are moderated by plans to establish a forest operations training program and the presence of a local college that offers a CDL program.

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 N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 36 out of 100.	**36**

5.4.2 Labor Cost

Risk Information: The minimum wage in Northern Arizona is currently $16.80/hr. General labor income averages $33,400 with construction foremen averaging $84,334. These numbers are 8% higher than the national average for similar positions. This labor cost structure is a medium risk for new industries.

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**

[56] Vaughan, D., C. Edgeley, and H.-S. Han. 2022. Workforce training needs of forestry contractors in the US Southwest: Results of an industry survey. ERI White Paper—Issues in Forest Restoration. Ecological Restoration Institute, Northern Arizona University. 16 p.
[57] https://www.nrs.fs.usda.gov/pubs/gtr/gtr-nrs-p-105papers/02keegan-p-105.pdf (Table 2, p.4)

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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 36 out of 100.	**Score** **36**

5.4.3 Training Programs/Community College

Risk Information: Coconino County Community College offers a wide variety of technical, vocational and career training opportunities. University of Phoenix and Arizona State offer on-line, remote education and Flagstaff College has a focused curriculum of ecological and environmental studies. The area offers extensive opportunities for students and employees to further their education, therefore, this risk is low. Northern Arizona University is continually holding classes for training in various disciplines of Forestry, for part-time and night students.

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 N/A.	**Notch** **N/A**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**Score** **16**

5.4.4 Permit Process

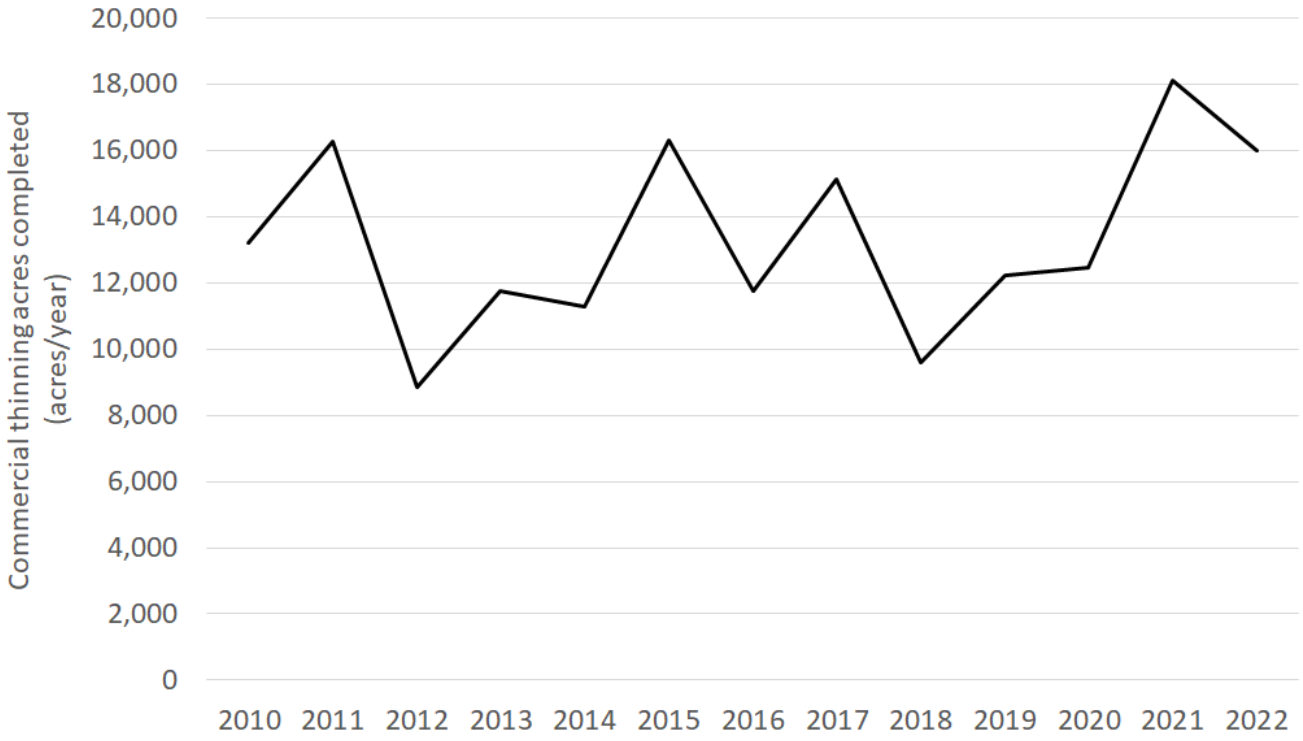
Risk Information: The permitting process in Northern Arizona and specifically Coconino County is considered easy to navigate and objectively open to new industries. The average permitting process is 30-60 days. There is such a presence of wood-based feedstock in the area that the local government is anxious to attract biofuel business to utilize this material for the latest technologies. This risk is considered low due to a permit-friendly atmosphere.

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	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is N/A.	**N/A**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is 16 out of 100.	**16**

APPENDIX C: TABLES, FIGURES AND MAPS

Figure C-1: Annual commerical thinning acreage under the USFS-4FRI initiative, 2010-2022 .



Source: 4FRI August 2023 Monthly Report (p.3), adjusted on the basis of outreach

Map C-1: Ponderosa pine forest and pinyon-juniper woodland within a 75-mile drive distance of Bellemont, AZ.

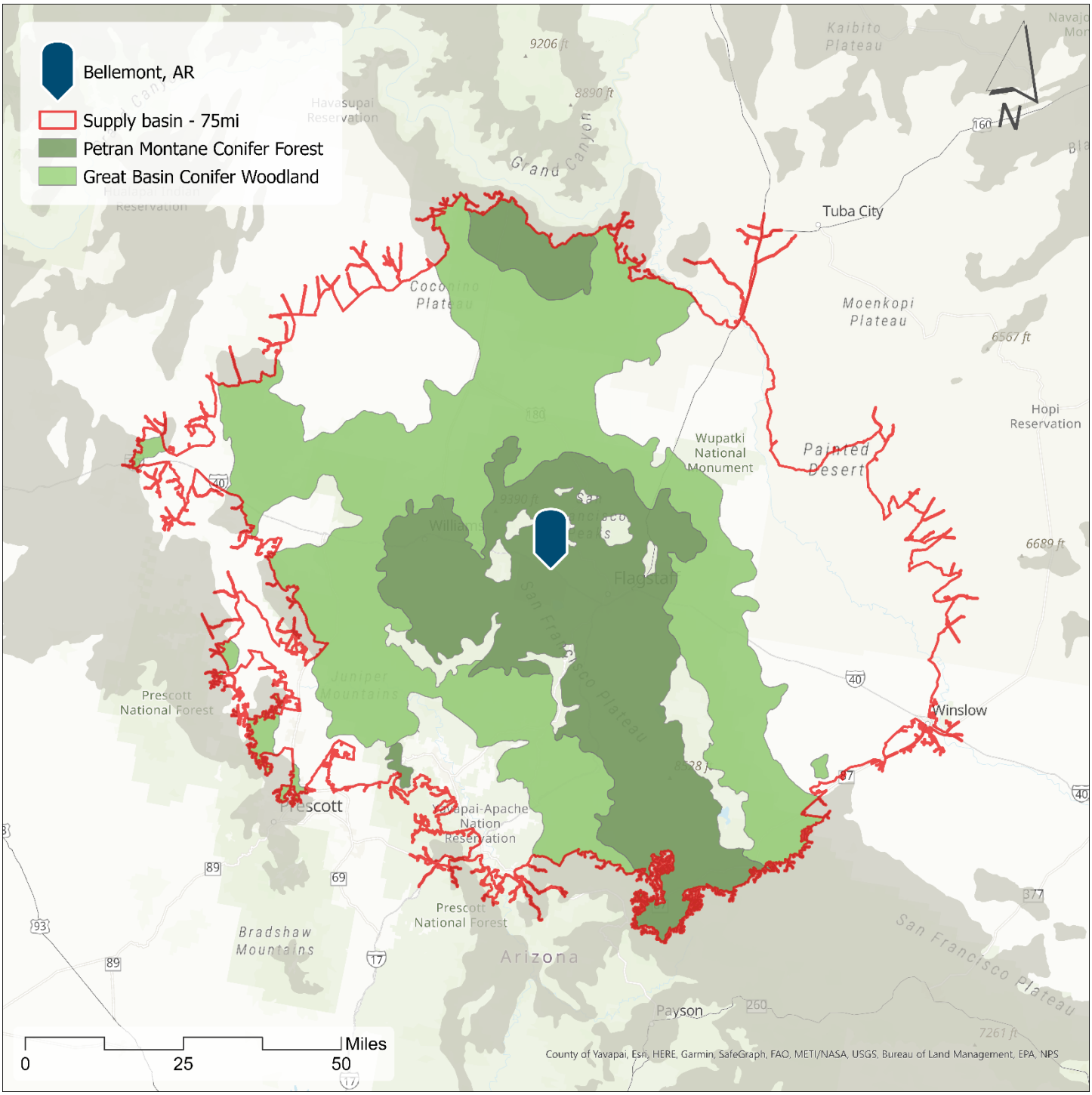
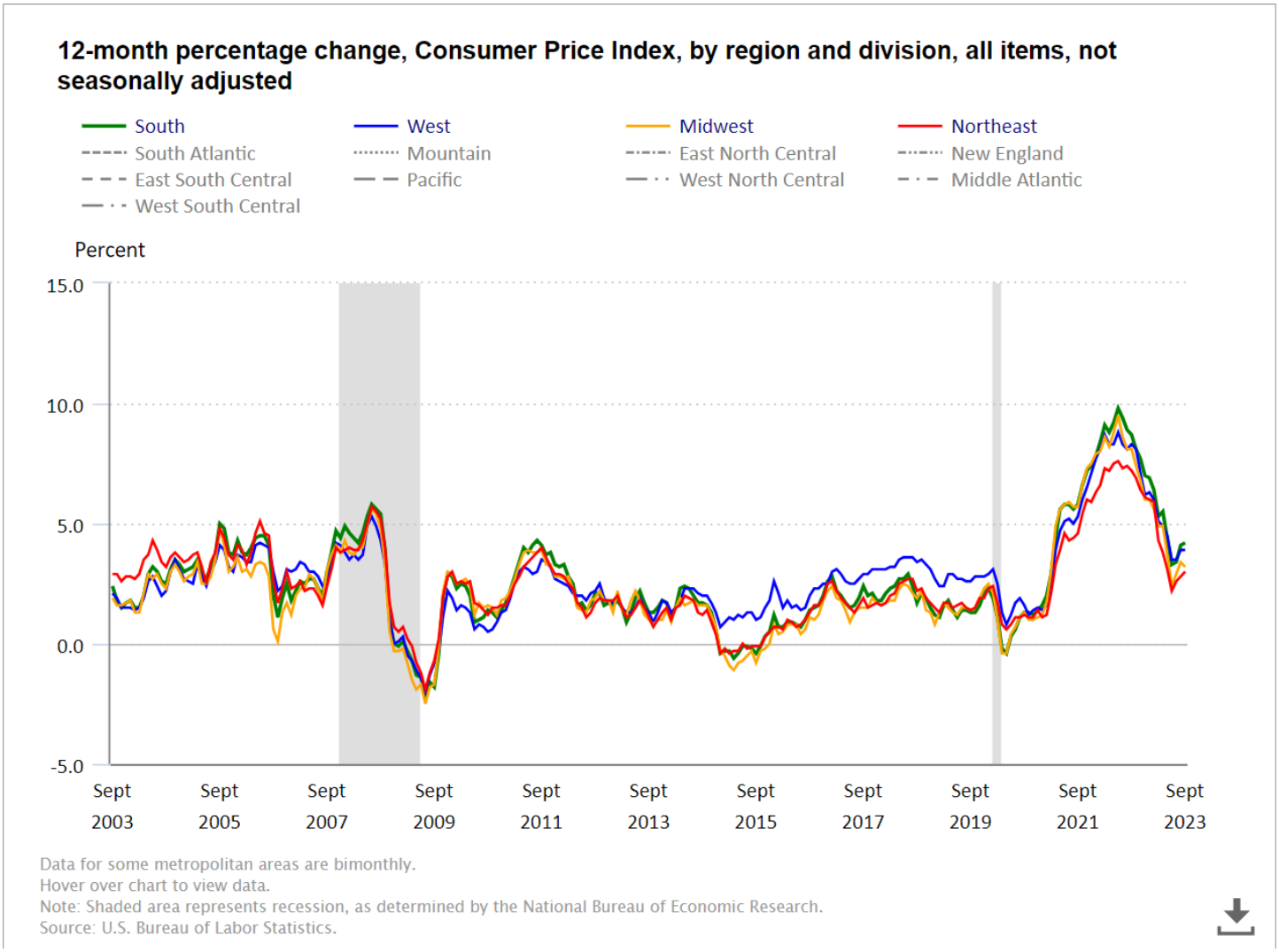
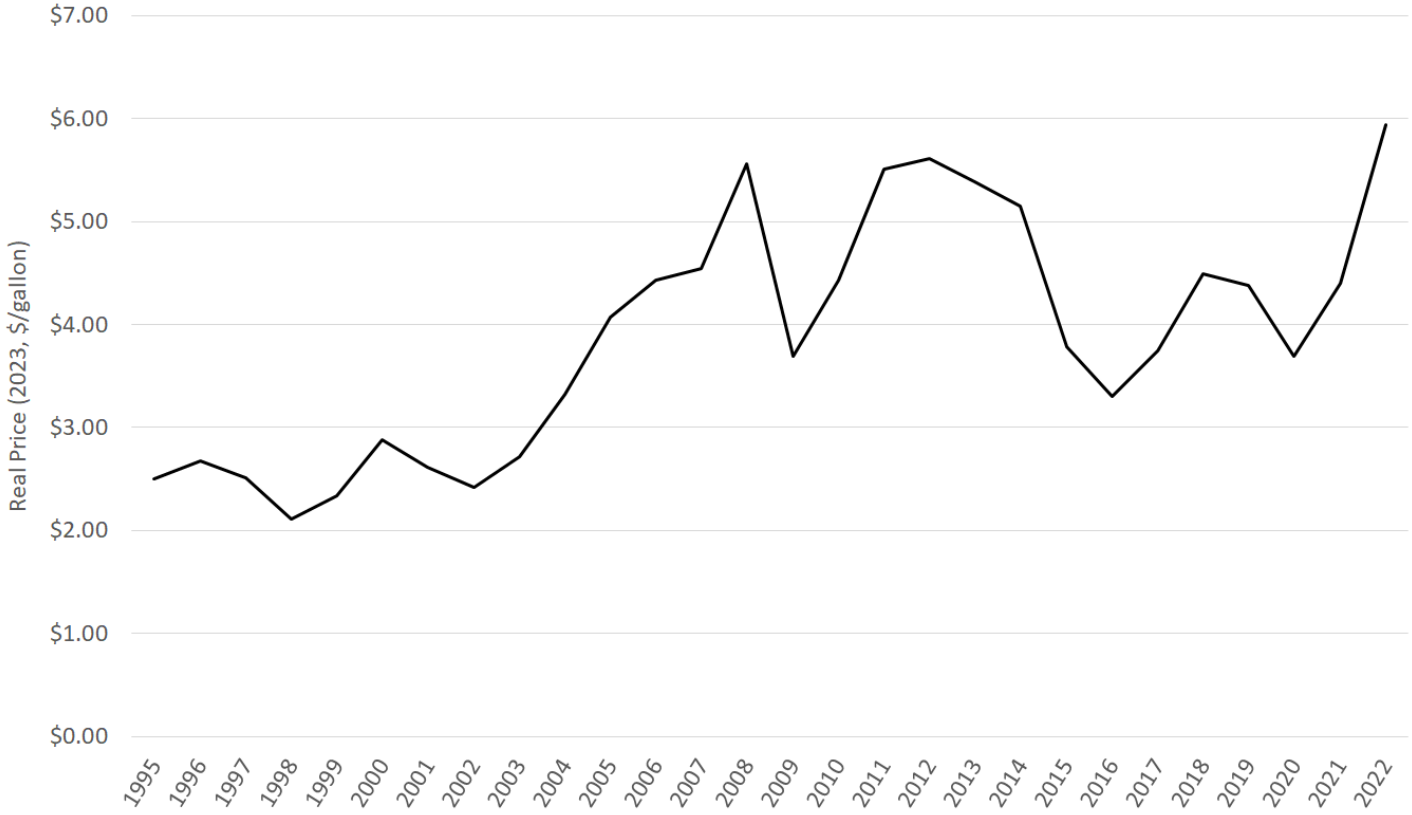


Figure C-2. CPI for the South, West (incl. Arizona), Midwest, and Northeast US regions, 2003-2023.



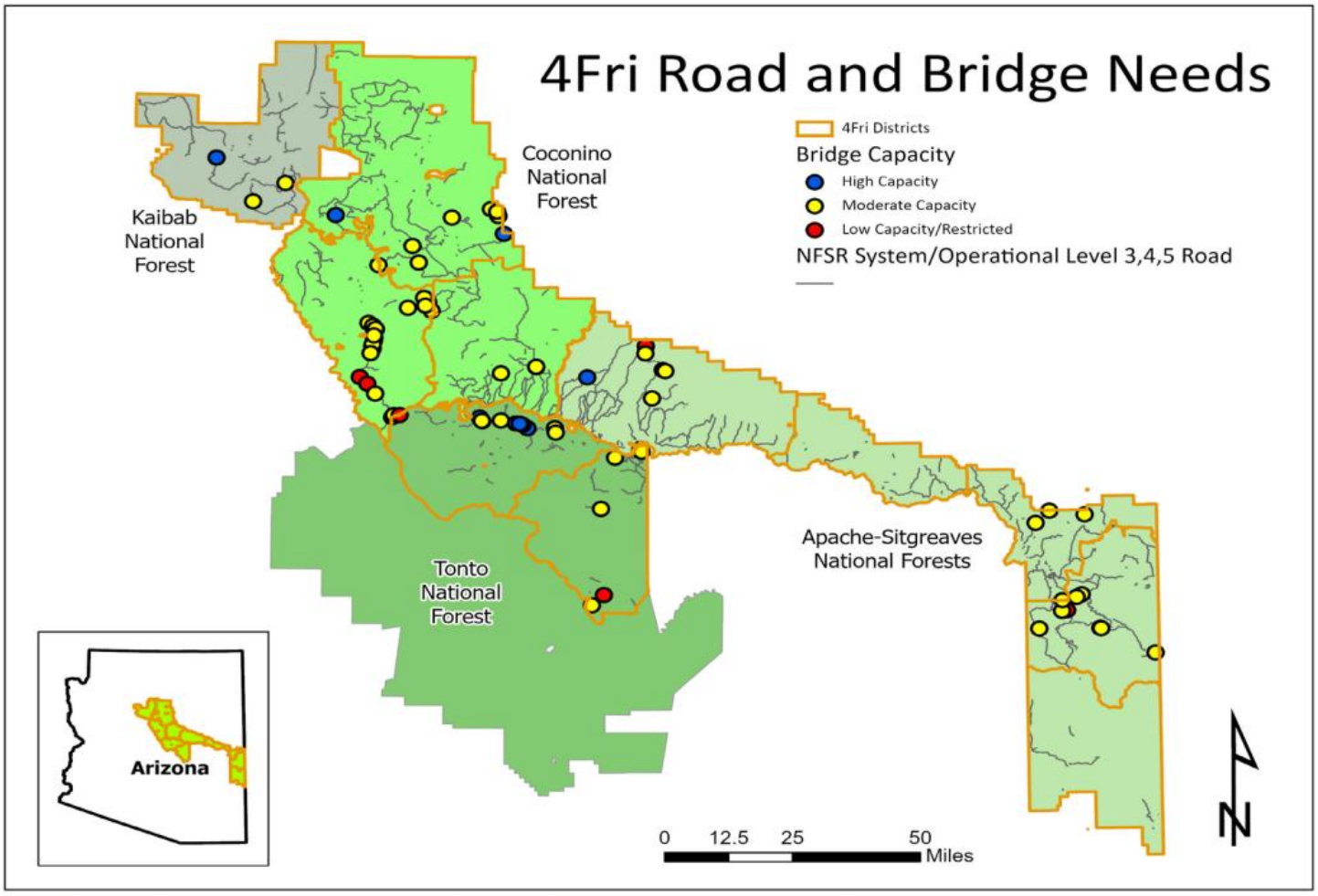
https://www.bls.gov/charts/consumer-price-index/consumer-price-index-by-region.htm

Figure C-3. PADD 5 West Coast diesel prices, 1995-2022.



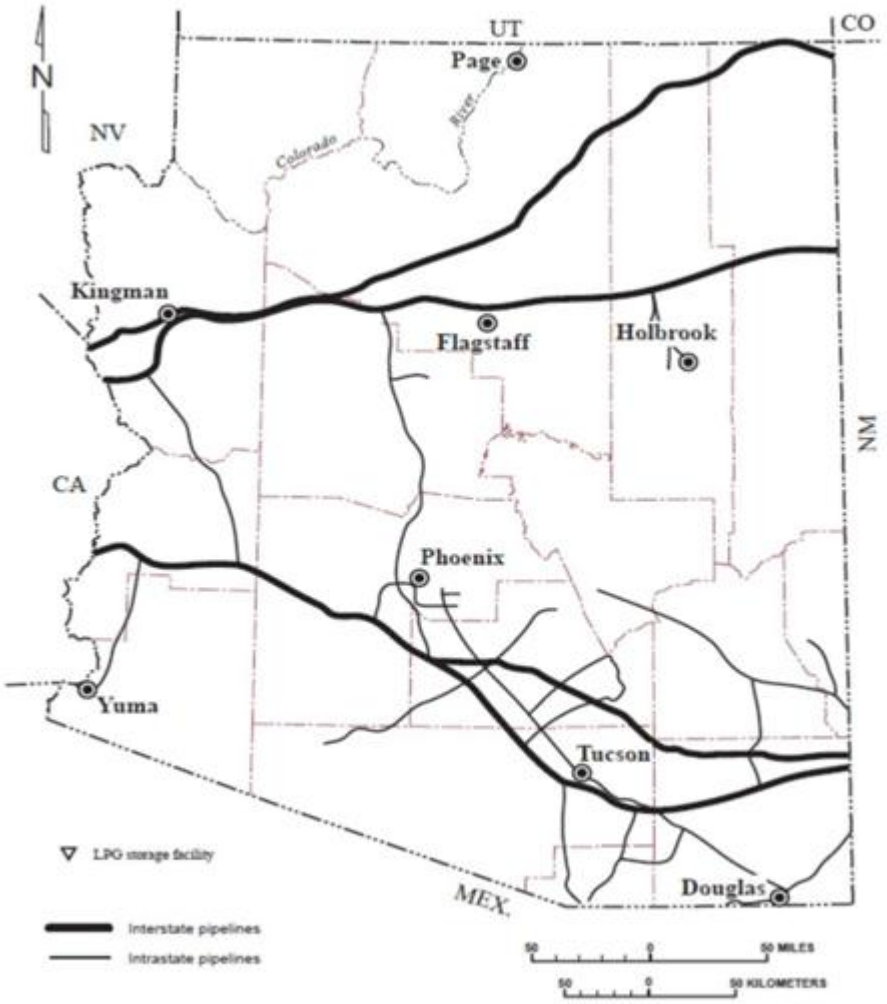
https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=EMD_EPD2D_PTE_R50_DPG&f=A

Map C-2. Road and bridge capacity in the USFS 4FRI National Forests



https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd969259.pdf#:

Map C-3. Natural gas pipelines in Arizona



APPENDIX D: ADDITIONAL INFRASTRUCTURE INFORMATION

The industrial site selected as a representative location that a new bio-economy industry might consider is described here.

The site is a 159-acre undeveloped parcel, 2 miles east of downtown Flagstaff. It is not currently zoned, but industrial or semi-industrial applications can be submitted to the local permitting office. The site is currently Arizona State Trust Land (see Risk Indicator 5.1.2). The site has electric, natural gas, water, and telecommunications right-of-way crossing at various points on the parcel. The BNSF railroad runs along the northern edge of the acreage. The location and images of the site are shown below.

Map D-1: Location of industrial site in relation to Flagstaff and major roadways.

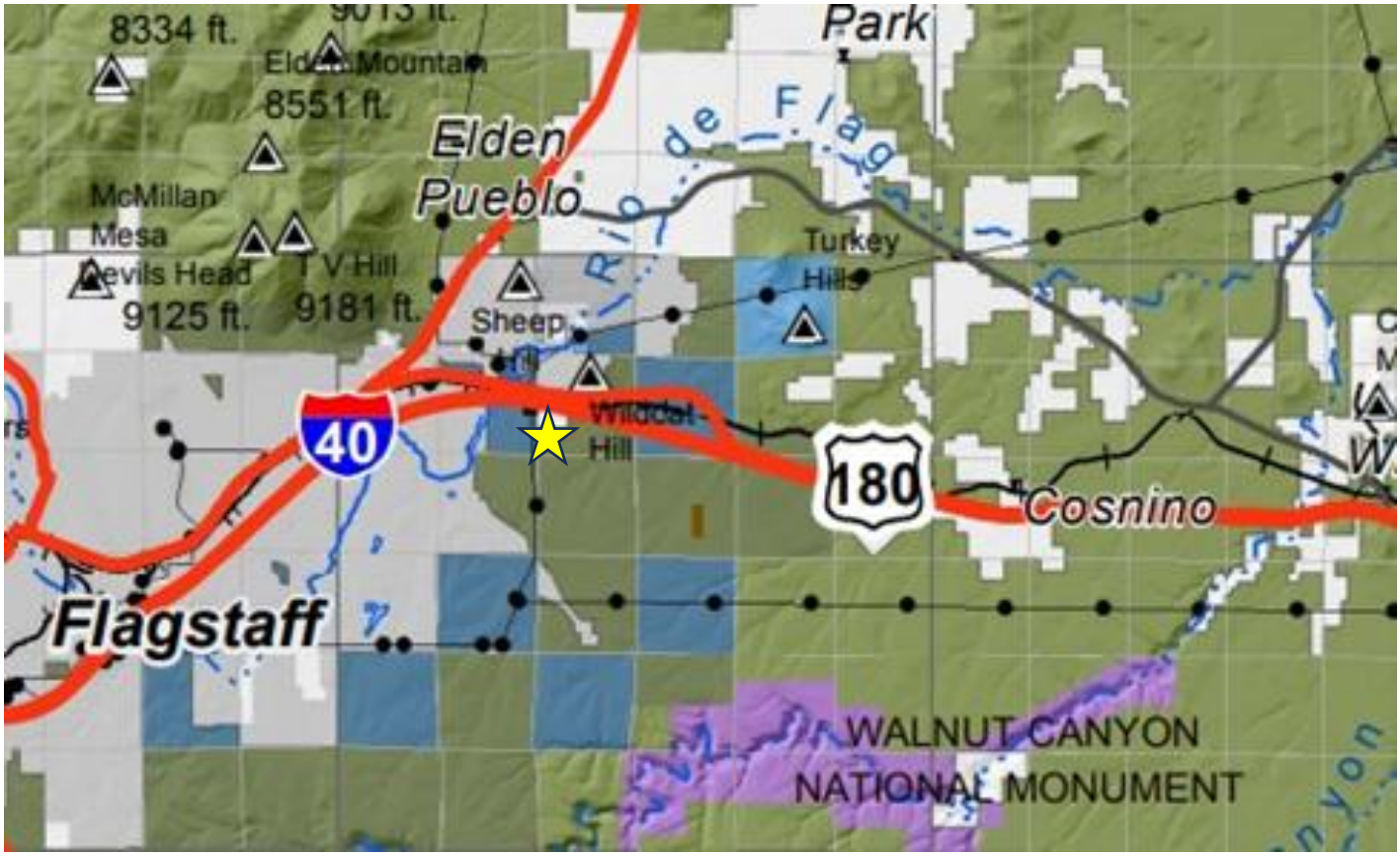


Image D-1: South-facing view of industrial site.



Map D-2: Arizona State Land Trust Parcel Identification.



APPENDIX E: LEGAL DISCLAIMER

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