Biofuel Development Opportunity Zone Risk Rating

A

The Siloam Springs Biofuel Development Opportunity Zone is rated "A." Long-term outlook on feedstock quantity is deemed stable. Limited exposure to price risk over time.

Rating Parameters

Quantity	Feedstock Type	Feedstock Price	Supply Basin Drive Distance
1,500,000 tons/year	Poultry Litter	$14-$26/ton delivered	75 miles

BDO Zone Assets

- **Stable long-term outlook on quantity, reliability and supply chain resiliance.**
- **10X Biomass Availability Multiple: 1,500,000 tons of PL within 40 miles of the Siloam Springs BDO Zone.**
- **Key supply chain components are well developed and mature.**
- **Supply chain redundancy is high. Risk of supply disruptions due to individual supplier failure is low.**
- **A new bio-based production facility in Siloam Springs would short-haul many existing markets.**
- **Local aggregators and producers indicate that new biomass development would be widely accepted and encouraged.**

BDO Zone Liabilities

- **PL cost fluctuates with cost of manufactured fertilizer. Limited exposure to price risk over time.**
- **PL is not wholly homogeneous in composition or nutritive value and different types of bioprocessing facilities may be more or less impacted by the variability.**

BDO Zone Risk Rating

The Siloam Springs BDO Zone is rated "A" or *low risk* for poultry litter ("PL") feedstock supply and supply chain infrastructure.

Risk Rating Grades are defined as follows: Aa (*very low risk*), A (*low risk)*, Baa (*low-moderate risk*), Ba (*moderate risk*), B (*moderate-high risk*) or C (*high risk*).

In assessing the biomass supply chain risk for Siloam Springs, 48 Risk Indicators from the *US Biomass Supply Chain Risk (BSCR) Standards* were applied. These BDO Zone Risk Indicators are the subset of BSCR Risk Indicators applicable to gauging feedstock risk within a BDO Zone.

Feedstock Quantity is expressed in tons. Feedstock cost is expressed in US dollars, delivered to the Siloam Springs area.

Scoring and Ratings Methodology

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 Risk Indicator is given a **Raw RI** score based on the research and analysis conducted on the feedstock supply chain in the region. Raw RI Scores are scaled between 1 (*low risk*) and 10 (*high risk*).

Next, each Risk Indicator is discounted, or "notched," based on the degree to which the uncertainty drivers are deemed to be addressable, and whether there is a reasonable expectation that mitigation measures could be put into place within the price parameters for this rating. The **Notched Salience score** represents this, and corresponds to the likelihood of each Risk Indicators' described risk materializing given the implementation of reasonable mitigation measures. To arrive at the Notched Salience score, Raw RI scores are reduced based on the efficacy of the proposed mitigation measures. If applicable, notching occurs at one of 3 levels: 25%, 50% or 75%.

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

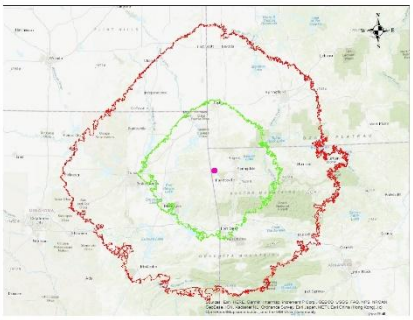
The **Loaded RI** score for each Risk Indicator is then calculated as the product of Notched Salience and Impact Level scores. For example, Risk Indicator '*Biomass Availability Multiple (BAM)'* is scored at 2 and Impact Level is deemed high (i.e., 9.99). The final Loaded RI score for this risk indicator is 2 x 9.99 = 19.98 (out of 100).

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

The total risk rating for the BDO Zone is the average of all Loaded RI scores. The BDO Zone score for Siloam Springs, AR is ***16.42 out of 100, resulting in an "A" designation.*** All scoring and rationale for each Risk Indicator is provided in Appendix A.

Analyst Notes

Siloam Springs BDO Zone



The Siloam Springs BDO Zone is indicated by the pink area in the map above. The 75-mile supply basin is outlined by the green line. The perimeter of the 115-mile competition zone is enclosed by the red line. Appendix B shows this map in greater detail.

PL includes manure from chicken or turkeys, and can include residual wood shavings or rice hulls that are used as bedding in poultry houses. Clearing of PL is variable among farmers, but once a year is typical.

Key BDO Zone Assets

The Siloam Springs BDO Zone presents several strong supply chain assets. We note, in particular, strong, steady and reliable generation of large volumes of poultry litter: an estimated 3.99 million tons of generated within the 75-mile supply basin, with over 1,500,000 tons within 40 miles of Siloam Springs.

At least 91 potential PL suppliers are identified within the supply basin. Supply chain redundancy is high. Risk of supply disruptions due to individual supplier failure is low.

Poultry production in the region is well-established and has steadily increased since 2009. Many PL producers in the region are in the process of expanding operations on the assumption that growth will continue.

Fundamental drivers of PL production are strong and expected to maintain: PL generation keys directly to poultry production, and therefore an increase in poultry production is expected to correlate with an increase PL generation. We find the fact that PL is a necessary by-product of poultry production to be an asset that speaks to the reliability and consistency of production.

Key supply chain components are well-developed and mature. The supply basin has a history of large-scale PL procurement, and producers have sufficient expertise in PL production to ensure reliable supply. PL production, storage, and removal are not drivers of material risk. Transportation infrastructure is mature with a robust network of third-party haulers and aggregators operating in the BDO Zone supply basin. New markets for PL will be able to leverage the available existing supply chain infrastructure.

Supply of PL is price driven: producers will generally sell to the highest bid and ground level support by producers is high for alternative markets that can match or exceed prices paid by traditional land application markets.

Nutrient loading in the local watershed is a major environmental and political issue in the area. We expect that alternate markets for PL that reduce nutrient loading will enjoy local support. Alternative disposal methods could become necessary as current legal cases pertaining to nutrient loading in the state develop; however, we note that a state restriction or ban on use of PL for land application would exert significant *downward pressure* on PL costs and be strongly favorable to alternative markets to land application.

In addition to creating new jobs, the development of a PL-processing bio-facility would help address one of the region's major political and environmental problems in a sustainable fashion.

Siloam Springs short-hauls many existing land application markets, which constitutes a significant competitive advantage for a new bio-based production facility sited in the Siloam Springs BDO Zone.

Price fluctuation for PL is a risk for producers and we find it reasonable to expect that some would enter into longer-term supply contracts that enable them to mitigate that risk.

Anecdotal on-the-ground feedback from PL aggregators and producers in the region suggests that a biomass development in the region would widely be accepted and encouraged. Risk associated with backlash against biomass plant development,

procurement or usage in the region is deemed low.

The Siloam Springs BDO Zone allows bio-based projects to benefit from tax and other financial incentives with investments that generate economic growth within the Opportunity Zone situated in the center of the supply basin. We note that only the area of the supply basin overlapping with the Siloam Springs Opportunity Zone constitutes the Siloam Springs BDO Zone for which this rating was completed.

Key Risk Indicators

PL is a substitute for manufactured fertilizer in the region and current markets for PL are almost exclusively land application for soil amendment or fertilizer.

The primary factor driving competitive use of PL is cost: litter is a low-cost substitute for manufactured fertilizer. As a result, the landed cost of PL follows the pricing curve for fertilizer – when fertilizer cost goes up, so does the cost of PL, and vice-versa. While the cost of manufactured fertilizer at any given time acts as an effective cap to the cost of PL, new markets for PL are exposed to material price volatility risk due to fluctuations in manufactured fertilizer cost. We note that fertilizer prices had been decreasing since 2014 before increasing significantly in the first half of 2021: if sustained, such a trend would put upward pressure on PL cost.

Over the long term, we see limited but material exposure to price (but not quantity) risk in the BDO Zone. We proxy historical standard deviations in manufactured fertilizer costs to estimate forward fluctuations in PL cost. The current market price for lower quality PL varies between $6 and $10 per ton FOB producer. Based on historical cost trends for manufactured fertilizer, we expect the ongoing cost of lower quality PL to vary between $4.74 and $12.10 FOB producer.

PL has clear but not significant exposure to diesel prices. We find sensitivity of delivered PL cost to reasonable forward expectations of gas/diesel prices to be *low to moderate*.

It is clear that, as a feedstock, PL is not wholly homogeneous in composition or nutritive value, and different types of bioprocessing facilities may be more or less impacted by the variability. A rigorous and statistically relevant sampling and testing procedure of PL to ensure viability with specific plant technology is recommended.

Datasets pertaining to PL purchase cost, local fertilizer costs, and land-application costs are rare and most are incomplete. The most recently available data on litter generation estimates were from the USDA (2017) and lack nuance and granularity. Much of the pricing data utilized in this rating is based on direct feedback from poultry producers, PL brokers and aggregators, and land-application markets in the region. While every effort was made to triangulate and confirm data points, front-end validation was not possible in many cases.

Infrastructure Asset Profile

Siloam Springs's infrastructure assets are scored on a scale of 0 - 10, with scores defined as follows: 0 (*insufficient*), 2 (*poor*), 4 (*fair*), 6 (*reasonable*), 8 (*good*), 10 (*very good*). 66% of all assets are scored as either *good* or *very good*, and 0 are scored as *poor* or *insufficient*. Among the top rated assets are proximity to major markets, crime rates, and cost of land. Overall, Siloam Springs presents a profile of positively rated infrastructure assets, with an average score of **7.83**. This score supplements Siloam Springs' BDO Zone rating, and reinforces its **A** (*low risk*) designation. The full infrastructure asset profile is detailed in *Table 2*. Documentation supporting infrastructure assessment is available upon request.

Analyst Contacts:

Marcin Lewandowski - *Director, Analytics & Risk*
marcin@ecostrat.com

Rafael Rosas – *Senior Analyst*
rafa@ecostrat.com

Figure 1 - Risk Indicators (sorted by risk level)

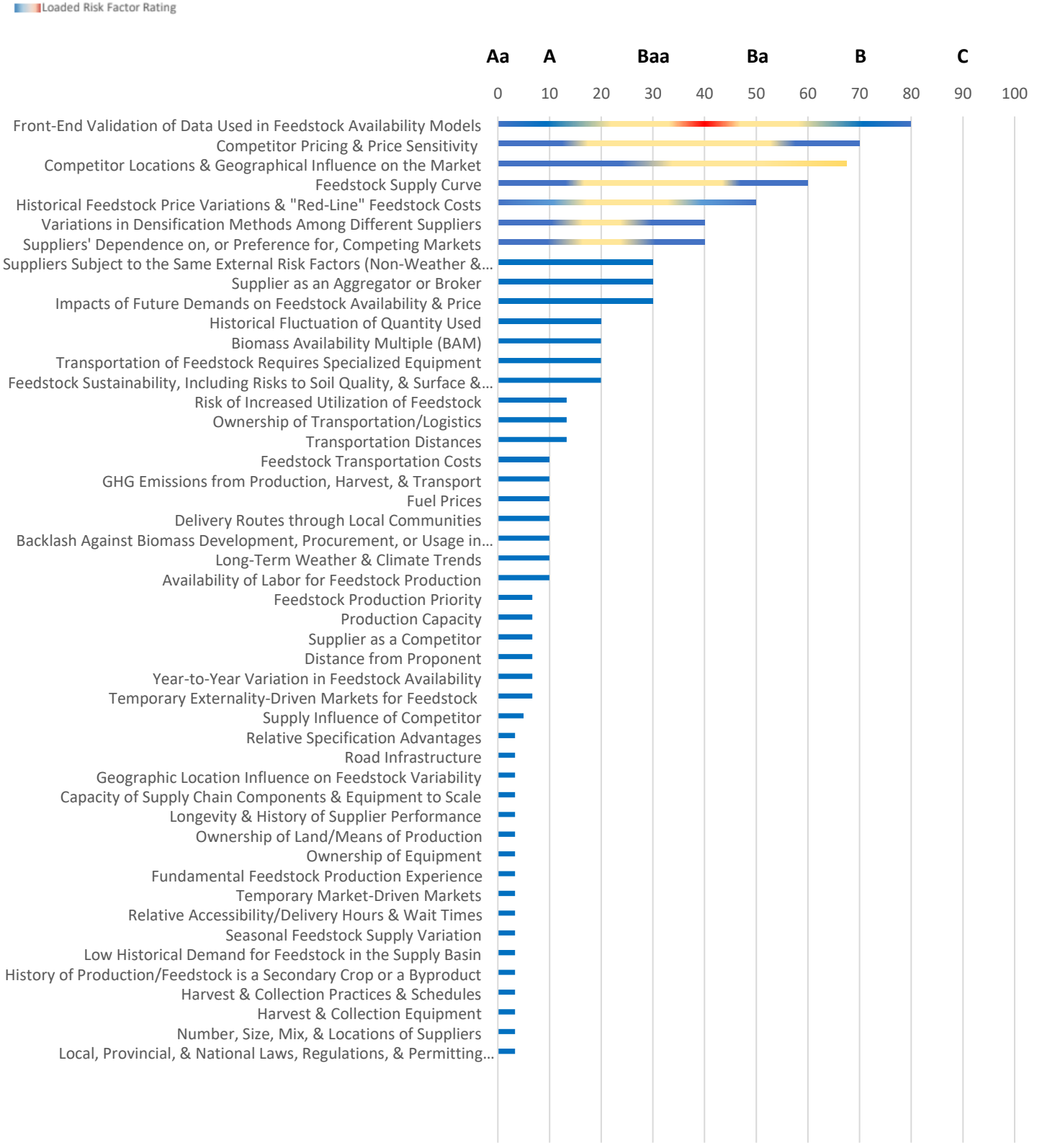


Table 1 - Risk Indicators

Feedstock Supply Chain Risk Indicators	Raw RI Score	Notched Salience	Impact Level	Loaded RI Score
Category 1: Supplier Risk				
Longevity & History of Supplier Performance	1	1	3.33	3.33
Production Capacity	1	1	6.66	6.66
Supplier's Dependence on, or Preference for, Competing Markets	4	4	9.99	39.96
Supplier as a Competitor	1	1	6.66	6.66
Ownership of Land/Means of Production	1	1	3.33	3.33
Ownership of Equipment	1	1	3.33	3.33
Ownership of Transportation/Logistics	4	4	6.66	26.64
Supplier as an Aggregator or Broker	3	.75	9.99	7.49
Distance from Proponent	2	2	3.33	6.66
Fundamental Feedstock Production Experience	1	1	3.33	3.33
Feedstock Production Priority	1	1	6.66	6.66
Category 2: Competitor Risk				
Competitor Locations & Geographical Influence on the Market	9	6.75	9.99	67.43
Historical Fluctuation of Quantity Used	6	6	6.66	39.96
Competitor Pricing & Price Sensitivity	7	7	9.99	69.93
Impacts of Future Demand on Feedstock Availability & Price	6	3	6.66	19.98
Supply Influence of Competitor	3	1.5	3.33	4.99
Temporary Market-Driven Markets	1	1	3.33	3.33
Relative Accessibility/Delivery Hours & Wait Times	1	1	3.33	3.33
Relative Specification Advantages	1	1	3.33	3.33
Category 3: Supply Chain Risk				
Biomass Availability Multiple (BAM)	2	2	9.99	19.98
Impact of Increased Utilization of Feedstock	2	2	6.66	13.32
Feedstock Supply Curve	6	6	9.99	59.94
Seasonal Feedstock Supply Variation	1	1	3.33	3.33
Year-to-Year Variation in Feedstock Availability	1	1	6.66	6.66
Front-End Validation of Data Used in Feedstock Availability Models	8	8	9.99	79.92
Historical Feedstock Price Variations & "Red-Line" Feedstock Cost	5	5	9.99	49.95
Low Historical Demand for Feedstock in the Supply Basin	1	1	3.33	3.33
History of Production/Feedstock is a Secondary Crop or a By-product	3	3	3.33	9.99
Fuel Prices	1	1	3.33	3.33
Harvest & Collection Practices & Schedules	1	1	3.33	3.33
Harvesting & Collection Equipment	2	2	3.33	6.66
Temporary Externality-Driven Markets for Feedstock	2	2	3.33	6.66
Variations in Densification Methods Among Different Suppliers	6	6	6.66	39.96
Availability of Labor for Feedstock Production	3	1	3.33	9.99
Feedstock Transportation Costs	3	3	3.33	9.99
Transportation Distances	2	2	6.66	13.32
Transportation of Feedstock Requires Specialized Equipment	3	3	6.66	19.98
Delivery Routes through Local Communities	3	3	3.33	9.99
Road Infrastructure	1	1	6.66	6.66
Number, Size, Mix & Locations of Suppliers	1	1	3.33	3.33
Suppliers Subject to Same External Risk Factors (Non-Weather & Equipment Based)	3	3	9.99	29.97
Seasonal Weather Impacts on Feedstock Supply	1	1	3.33	3.33
Long-Term Weather and Climate Trends	3	3	3.33	9.99
Local, Provincial, & National Laws, Regulations, & Permitting Pertaining to Biomass	1	1	3.33	3.33
Backlash Against Biomass Development, Procurement or Usage in the Region	1	1	9.99	9.99
Feedstock Sustainability, Including Risks to Soil Quality, & Surface & Groundwaters	2	2	9.99	19.98
GHG Emissions from Production, Harvest & Transport	3	3	3.33	9.99
Geographic Influence on Feedstock Variability	1	1	6.66	6.66
Capacity of Supply Chain Components & Equipment to Scale	1	1	3.33	3.33
		Risk Score		**16.42**

Table 2 - Asset Indicators

Infrastructure Assets	Overview	Score
Category 1: Physical Infrastructure		
1.1 Land Parcel	At least 51 undeveloped property areas remain for sale in the City of Siloam Springs. Properties range from 2 to 500 acres.	10
1.2 Industrial Land Use Zone	The city of Siloam Springs has large areas zoned for I-1 (Industrial) and I-2 (Light-Industrial) land use.	8
1.3 Natural Gas Line	Natural gas line is available.	6
1.4 Electrical	Electricity is available at various scales, consumption rates, and prices predicated on requirement and geographic location. The city also operates its own electrical company.	8
1.5 Fresh Water Supply Line	The Illinois River is the primary water source for the City of Siloam Springs. The City of Siloam Springs Department of Water/Wastewater maintains the city's water meter and water towers.	8
1.6 Sewage Disposal Trunk Line	The City of Siloam Springs Department of Water/Wastewater maintains the city's sewer lines, manholes, and sewer pumping. They are also available to assist with sewage issues if the issue is with city plumbing.	10
1.7 Drainage	Drainage is maintained by the City of Siloam Springs. If there is a clog in a city pipeline, the City offers a service where they will help address the issue, reducing plumbing costs that could otherwise be incurred.	8
1.8 Stormwater Management	The City of Siloam Springs, Arkansas Stormwater Management and Drainage Manual offers detailed provisions, requirements, policy, and regulations across a variety of pipe and detention ponds. Average annual rainfall in the region is 45.9 inches per year.	8
1.9 Available ICT Services	Good. Fiber optics cabling is available and additional conduit has been placed throughout the industrial park.	8
1.10 Available Land	Good. Land is available for sale at various scales and price points.	8
1.11 Cost of Land - Initial Cost	Land for sale of many sizes appears to be very competitive, with only 17 of 110 land listings priced at more than $1 million.	10
1.12 Cost of Land - Property Tax	Average effective property tax rate in Benton County, Arkansas is 0.75%.	6
1.13 Infrastructure - Landfill/waste disposal	At least 7 landfill/waste disposal options are identified in the vicinity of Siloam Springs.	10
Category 2: Logistics		
2.1 Highway Access and Intersection	GIS analysis reveals an effective network of roads and highways going in and out of Siloam Springs	8
2.2 Proximity to Major Markets	Good road transportation. The city is situated in the center of the markets generating poultry litter.	10
2.3 Accessibility to Airport	The City of Siloam Springs Regional Airport sits just outside of the city center. The NW Arkansas National Airport is situated 20 miles from the city center, and the Tulsa International Airport is 80 miles from the center of Siloam Springs.	6
Category 3: Social Infrastructure		
3.1 Quality of Life	Family-friendly. Good outdoor activities (water and land) with a few restaurants and a couple hotels.	8
3.2 Education - Elementary & High School	Reasonable. Public schools are available for pre-k, kinder, elementary, middle, and high school.	6
3.3 Education - Post Secondary	John Brown University, a private, Christian university is located in Siloam Springs. Additionally, the state's flagship public University of Arkansas is 30 miles from the city center. Northeast State University, a 4-year university in Tahlequah, Oklahoma, is 44 miles from the Center of Siloam Springs.	6
3.4 Local Retail	Reasonable. Retail in Downtown is vibrant and diverse.	6
3.5 Culture and Recreation	Variety of outdoor recreational activity. City website boasts of a vibrant and diverse café scene.	6
3.6 Hospital and Doctors	Reasonable. Siloam Springs Regional Hospital serves the local community.	6
3.7 Housing Availability	Fast real estate searches reveal that there is ample available across price ranges for apartments and houses to rent in Siloam Springs.	8
3.8 Crime Rate	The crime rate in the City of Siloam Springs is 30.88 per 1,000 residents, which is lower the US average of 41.29 per 1,000 residents.	10
	Total	***7.83***



Biofuel Development Opportunity Zone Program Advisory Committee:

Jordan Solomon, Ecostrat

Phillip Patterson, City of Siloam Springs

Chris Tindal, CAAFI

Delia Haak, Arkansas House of Representatives, District 91

Jeff Hawkins, Northwest Arkansas Regional Planning Commission

Tim Conklin, Northwest Arkansas Regional Planning Commission

Kristen Efurd Osgood, Cooks Venture

Michelle Perez, Winrock International

Nick Andrews, USA Bioenergy

Rob Smith, Northwest Arkansas Council

Scott Chabina, Chabina Energy Partners

Travis Chaney, Illinois River Watershed Partnership

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APPENDIX A: RISK INDICATOR SCORING METRICS

CATEGORY 1: SUPPLIER RISK

1.1. Longevity & History of Supplier Performance

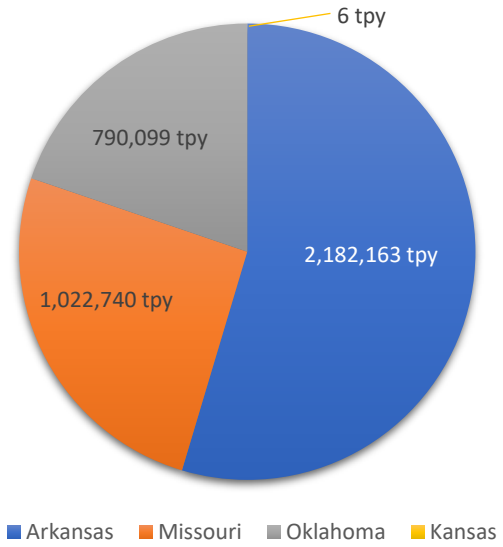
Rationale. Number of years in business is a positive indicator of future solvency. Historical performance is an indicator of future performance.	
Raw RI Score. Poultry litter (PL) is a direct by-product of the poultry industry. Poultry litter producers (PL producers) in the region have been operating on a large-scale for decades[1]. At present, the state of Arkansas is the largest poultry producer in the United States[2]. PL is a direct by-product of the primary commodity production (poultry products). The industry is strong in the region, so it follows that the historical PL supply is also stable and robust. Poultry production in Arkansas has been increasing, and the trend is expected to continue. Estimated average PL generation per farm in the 75-mile driving distance supply basin is 43,901 tons per year (tpy), though production varies greatly depending on farm size. The removal of PL from the houses where the birds reside is essential for both broiler and egg production. The scale of the poultry industry in the region, and its increasing size, are testaments to producers' abilities to effectively clear PL. The risk associated with the longevity and history of supplier performance is deemed low. Raw RI score is 1 out of 10.	**Score 1**
Notched Salience. No adjustment.	**Score Unnotched**
Impact Level. RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score. The Loaded RI Score (Raw RI Score x Impact Level) is 3.33 out of 100.	**Score 3.33**

1.2. Production Capacity

Rationale. Supplier production capacity can be a strong indicator of long-term credit worthiness and future solvency. Higher production capacities can denote strength of operational elements, including cash flows, that are important to future solvency.	
Raw RI Score. Internal modeling and conversations with local experts enable an estimated 3,995,008 tpy of PL generated in the supply basin[3], with 2.2-2.5 million tons of the total generated in Northwest Arkansas. There is no seasonal variation in the production of PL in the region. While sizes of poultry farms can vary greatly, estimated average monthly PL production per farm is 3,658 tons per month. Large farms can average up to 8,333 tons per month.	**Score 1**

[1] Encyclopedia of Arkansas: https://encyclopediaofarkansas.net/entries/poultry-industry-2102/.
[2] Arkansas Farm Bureau:https://www.arfb.com/pages/arkansas-agriculture/commodity-corner/poultry/.
[3] See Appendix C for a detailed discussion on PL generation modeling process and assumptions.

Estimated PL Generation in the Supply Basin by State



The fact that poultry production in Arkansas grew by more than 28% from 2009 to 2019[4] and that poultry farms are currently expanding operating capacity, suggest continued future growth of PL production. We find wholly reasonable the assumption that PL production linearly follows the poultry production trends in the region: as poultry production continues to increase, we assume that PL production in the region will also increase.

The risk associated with production capacity is deemed to be low. Raw RI Score is 1 out of 10.

Notched Salience. No adjustment.	**Score** **Unnotched**
Impact Level. RI Impact Level is deemed *moderate*.	**Score** **6.66**
Loaded RI Score. The Loaded RI Score (Notched Salience x Impact Level) is 6.66 out of 100.	**Score** **6.66**

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

Rationale. Supplier may have a vested interest or preference to supply to specific competitors for biomass feedstock. Preferences may be due to historical, long-term, or personal relationships, less stringent feedstock quality requirements, more flexible operating hours by competing markets, or supplier's dependences on competing markets to accept or purchase other products/by-products. During periods of feedstock shortage such suppliers may be more likely to allocate the scarce supply to a competitor resulting in supply disruptions for the Proponent.

[4] United States Department of Agriculture, Agricultural Statistics Service Delta Region Arkansas Field Office: https://www.nass.usda.gov/Statistics_by_State/Arkansas/Publications/Livestock_Releases/Production_and_Value/arbroilerPV.pdf

Raw RI Score. Use of PL as soil amendment or fertilizer through land-application represents the only major competition for feedstock in the region surrounding the BDO Zone—PL is seen as a lower-cost alternative to manufactured fertilizer and use is ubiquitous.

Score 4

Producers typically accumulate PL on-site until it is needed by farmers—which is on a seasonal basis, with highest demand just before new crops are planted. Producers sell PL either directly to end markets, or through one of several well-established intermediaries/ aggregators operating in the region.

We estimate that land-application markets intake at a minimum 3,569,549 tpy[5] of PL. Some producers also store PL and age it over several years on-site to increase nutritive value. Aged PL sold at a premium to PL markets both within and outside the Siloam Spring Competition Zone.

There are several key regional intermediaries/aggregators supplying PL to land-application markets, some of which handle upwards of 300,000 tons of PL annually.

However, despite long-term relationships with PL producers, it is not anticipated that existing markets or intermediaries would materially affect the ability of a new bio-based project to obtain feedstock for these reasons:

(i) The market tends to be spot-based and price-driven: at comparable prices, a new bioprocessing facility should capture significant quantities PL.
(ii) External environmental and political pressures in the region serve to make alternative markets attractive to producers and intermediaries alike. Direct application of PL as a soil amendment or fertilizer has led to significant nutrient runoff and water quality issues within Arkansas and in neighboring Oklahoma. A pending judicial order that is the product of a lawsuit between the states, once signed, could significantly reduce the amount of litter markets would be permitted to apply as a soil amendment. We speculate that at the same prices, non-land application markets would be attractive to producers.
(iii) Neither end-markets nor intermediaries/regional aggregators tend to have long-term contracts with PL producers.
(iv) Key intermediaries and PL producers in the Siloam Springs supply basin indicated a willingness to provide PL to new bioprocessing markets.

Insofar as existing land application markets constitute the only current viable option for PL producers, it is clear that there is a high degree of dependence. We note that current dependance, however, is largely a product of the absence of alternative viable PL markets. A bio-based market could act as an incentive to mitigate environmental risk associated with land application markets by contracting a portion of PL to new alternative markets.

While we see the market as primarily spot-based and price driven, we are unable to gauge the risk that qualitative factors (such as goodwill or longstanding personal relationships between producers and buyers) may play. Supply chains could take time to establish.
Raw RI Score is 4 out of 10.

[5]See Appendix C for a detailed discussion on PL land-use modeling process and assumptions.

Notched Salience. No adjustment.	**Score** Unnotched
Impact Level. RI Impact Level is deemed *high*.	**Score** 9.99
Loaded RI Score. The Loaded RI Score (Notched Salience x Impact Level) is 39.96 out of 100.	**Score** 39.96

1.4. Supplier as a Competitor

Rationale. The risks of feedstock costs going up and availability going down increase if a supplier is also a competitor to the Proponent. In times of feedstock shortage, the risk of supply commitments not being met increases.	
Raw RI Score. Poultry growers utilize insignificant amounts of feedstock internally. Some cattle farmers also grow poultry; however, outreach suggests that such markets predominately use generated PL internally. The risk of suppliers serving as competitor for feedstock is deemed low. Raw RI is 1 out of 10.	**Score** 1
Notched Salience. No adjustment.	**Score** Unnotched
Impact Level. RI Impact Level is deemed *moderate*.	**Score** 6.66
Loaded RI Score. The Loaded RI Score (Notched Salience x Impact Level) is 6.66 out of 100.	**Score** 6.66

1.5. Ownership of Land/Means of Production

Rationale. Suppliers that own land where feedstock is produced, or a production facility, tend to have better control of supply chains and present lower degrees of supply risk.	
Raw RI Score. Poultry growers in the region typically own the land where birds are grown, including the growing houses. Risk associated with the ownership of land and means of production is deemed low. Raw RI is 1 out of 10.	**Score** 1
Notched Salience. No adjustment.	**Score** Unnotched
Impact Level. RI Impact Level is deemed *low*.	**Score** 3.33
Loaded RI Score. The Loaded RI Score (Raw RI Score x Impact Level) is 3.33 out of 100.	**Score** 3.33

1.6. 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 do 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.	
Raw RI Score. Chicken litter production is not meaningfully dependent upon equipment ownership. Risk associated with ownership of equipment is deemed low. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience. No adjustment.	**Score Unnotched**
Impact Level. RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score. The Loaded RI Score (Raw RI Score x Impact Level) is 3.33 out of 100.	**Score 3.33**

1.7. Ownership of Transportation/Logistics

Rationale. In most cases, suppliers that own or lease transportation equipment necessary to transport biomass 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.	
Raw RI Score. Since current end-markets for PL are mostly land application, live-bottom trailers are often used to transport PL from producers to markets. Live-bottom trailers are semi-specialized equipment and relatively expensive to acquire (versus open top dry van-type equipment or dump trailers). Therefore, we do not find surprising, nor a significant pathway for risk, that transportation of PL in the region is currently predominantly performed by established third-party trucking services who own the equipment necessary for this particular supply chain. Risk associated with ownership of transportation/logistics is deemed moderate-low. Raw RI is 2 out of 10.	**Score 2**
Notched Salience. No adjustment.	**Score Unnotched**
Impact Level. RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score. The Loaded RI Score (Notched Salience x Impact Level) is 13.32 out of 100.	**Score 13.32**

1.8. Supplier as an Aggregator or Broker

Rationale. Aggregators may effectively provide supply chain redundancy and eliminate risk and complexity of dealing with multiple sources of supply by combining supplies into a single master contact. Aggregators can add much needed stability into biomass supply basins by increasing offtake stability for both suppliers and markets. An aggregator can be a more reliable long-term offtake for suppliers by virtue of having multiple markets; and can be a	

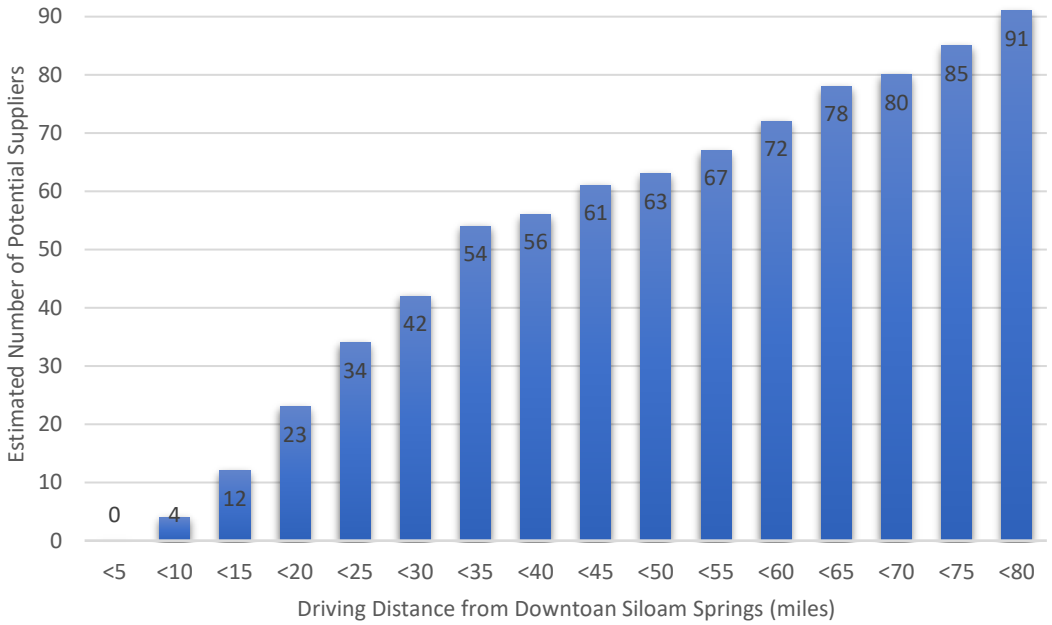
more reliable long-term supplier for markets by virtue of having multiple suppliers. Further, when a single supplier breaches, the aggregator can source from another.

Raw RI Score. Aggregators of PL are players of note in the BDO Zone's supply basin and handle a significant amount of generation. However, access to producers tends not to be contractually "locked" and direct feedback from multiple producers suggests willingness to provide feedstock to alternative markets under more favorable terms with the price being the key driver. Anecdotal feedback from one large broker of PL, indicated that local land application markets do not have the capacity to dispose of all the PL that is generated in the region in a sustainable or environmentally responsible manner and that, as a result, a new bioprocessing market would be welcomed. Risk associated with the supplier acting as an aggregator or broker is deemed low. However, the impact of lack of goodwill by aggregators in the regions (however unlikely) is deemed high. Raw RI is 3 out of 10.	**Score 3**
Notched Salience. No adjustment.	**Score Unnotched**
Impact Level. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score. The Loaded RI Score (Notched Salience x Impact Level) is 29.97 out of 100.	**Score 29.97**

1.9. Distance from Proponent

Rationale. The greater the distance from a supplier to a plant, the more exposure it has to weather and fuel cost risks, and the greater the competitive pressure (to breach) that a closer competitor can exert.	
Raw RI Score. PL is the necessary by-product of poultry production, which does not vary significantly with temporary weather events. Discussions with key aggregators in the region indicated that Siloam Springs, generally, is well-situated in the center of a high concentration of poultry producers. There are more than 60 producers within 50 miles of Siloam Springs. Transportation distance will be as close or closer than many alternative land-application markets. Distance is not anticipated to be a significant cost driver for a new bio-based plant in the BDO Zone.	**Score 2**

Potential Suppliers Estimated Spatial Distribution



Risk associated with supplier distance from the proponent is deemed low. Raw RI Score is 2 out of 10.

Notched Salience. No adjustment.	**Score** Unnotched
Impact Level. RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score. The Loaded RI Score (Notched Salience x Impact Level) is 6.66 out of 100.	**Score 6.66**

1.10. Fundamental Feedstock Production Experience

Rationale. Risk is higher when a supplier has limited experience with planting/ growing/ harvesting/ processing and/or collecting biomass. In cases where experience is lacking, Proponent should show that steps have been taken to ensure proper training, knowledge dissemination and monitoring.

Raw RI Score. Poultry producers in the region have extensive (and in some cases generations) of experience working with the PL production and management. The risk associated with fundamental feedstock production experience is deemed low. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience. No adjustment.	**Score** Unnotched
Impact Level. RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score. The Loaded RI Score (Raw RI Score x Impact Level) is 3.33 out of 100.	**Score**

	3.33

1.11. 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 sufficient effort to consistently produce it. Risk of breach increases when production and/or delivery of feedstock compromises supplier's ability to make a primary product. When biomass feedstock is a by-product of another main higher margin or main product, such as corn stover (e.g., corn) or forest residues (e.g., pulpwood), supply may not be a top priority for a supplier.	
Raw RI Score. Production of PL is a necessary by-product of poultry production and disposal of PL is a necessary activity for producers. While PL is produced consistently, it is accumulated on-site by producers in poultry house beds for periods of time that range from 6-12 months, and sometimes up to 10 years. PL that goes through a longer aging process is sold at a premium due to its low percent-volume-content of non-PL content (such as wood shavings and feathers) and extensive post-collection treatment routines. Beds can be cleaned out 1-2 times per year, though sometimes they are cleaned much less frequently. The staggered availability of feedstock from individual suppliers is not deemed to pose significant risk: consistency of supply would be achieved through a supply chain composed of multiple producers. Future demand for high quality / high value PL is unknown. Risk associated with RI 1.11 is deemed low. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience. No adjustment.	**Score** Unnotched
Impact Level. RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score. The Loaded RI Score (Notched Salience x Impact Level) is 6.66 out of 100.	**Score 6.66**

CATEGORY 2: COMPETITOR RISK

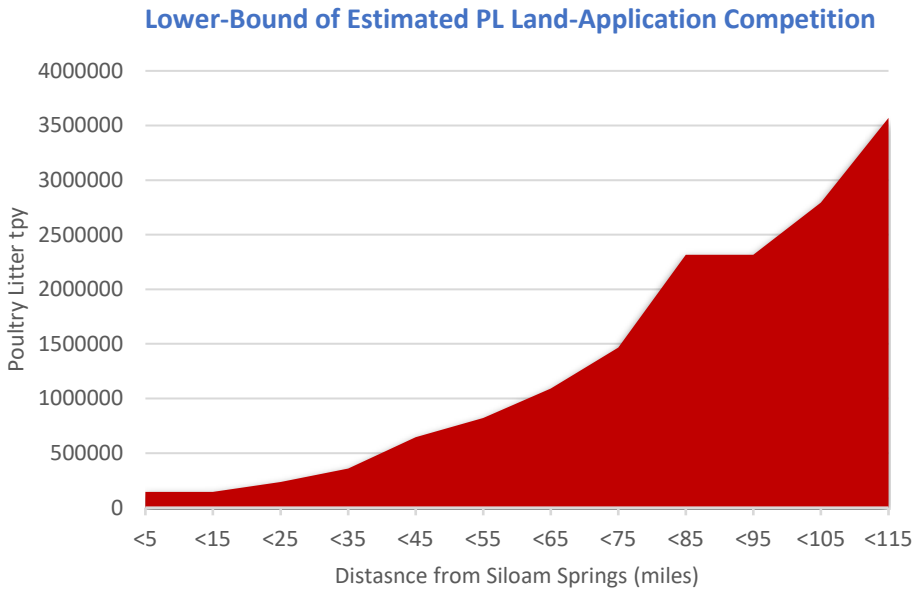
2.1. Competitor Locations & Geographical Influence on the Market

Rationale. Competitors' locations relative to a Proponent 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, including competitive advantages such as short-hauling.	
Raw RI Score. Use of PL by cattle farmers on pastureland or grazing land represents the primary competing market in the BDO Zone's competition zone. The primary factor driving	**Score 9**

competitive use of PL is cost: litter is a low-cost substitute for manufactured fertilizer. As a result, the landed cost of poultry litter follows the pricing curve for fertilizer – when fertilizer cost goes up, so does the cost of litter, and vice-versa. The cost of manufactured fertilizer acts as an effective cap to the cost of poultry litter. At the present time, landed prices paid for poultry litter vary from $6-$18 per ton, FOB generation site.

The 115-mile competition zone assessed for this BDO Zone rating encompasses counties in 4 states, (AR, AS, OK, MO) with different standards and regulations for land-application of PL as a soil amendment or fertilizer in each state. Within this region, there are more than 500 estimated operating cattle farms[6].

Transportation costs significantly reduce the effective size of the zone—and the number of land application markets that can compete for PL generated in the Siloam Springs supply basin before transportation cost drive the landed cost above the point where manufactured fertilizer is the less expensive option. **Geographic influence of competitors is in fact limited, always functioning under the price-limiting constraint of the cost of manufactured fertilizer.** Indeed, the majority of current PL markets are within 40 miles or less of the PL producers' site[7].



There is significant demand for PL from land application markets located proximate to Siloam Springs—with demand estimated as approximately 1,000,000 tpy within 60 miles. Potential demand for PL within the Competition Zone was estimated from 2017 USDA Census of Agriculture Data[8]. Potential usage was estimated by aggregating land acreage that was counted as either pasture/grazing land, or land that was registered as having been treated with manure. Due to the identified geographic dynamics, land-application competition was modeled within 115 miles of Siloam Springs: the 75-mile supply basin, plus

[6] D&B Hoovers Business Database
[7] Interviews with various PL producers and aggregators on 13/05/2021, and 19/05/2021.
[8] USDA National Agricultural Statistics Service:
https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_County_Level/

40 miles, the likely maximum distance from which suppliers can afford to source PL at today's market conditions.

Risk associated with competitor locations and geographical influence on the market is deemed high. Raw RI Score is 9 out of 10.

Notched Salience. Current competing markets incur costs relating to land application that add approximately $8 per ton to the delivered cost of PL. For a bio-based plant, the lack of land application costs potentially constitutes a significant competitive advantage which can be paid as a "premium" to producers. The lack of land application costs could give bio-based plant the ability to outbid competitors at the same distance. However, it is worth noting that bioprocessing facilities sometimes must pretreat feedstock, which can incur some amount of cost. Recent peer-reviewed studies have shown that the pretreatment PL must go through for optimal usage as feedstock can be done through fairly simple means[9,10,11]; and therefore, presumably at low cost. However, these studies did not quantify pretreatment costs, and data on PL pretreatment costs for bioprocessing are not publicly available. As a result, Raw RI is notched by 25%: Notched Salience is 6.75.	**Score 6.75**
Impact Level. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score. The Loaded RI Score (Notched Salience x Impact Level) is 67.43 out of 100.	**Score 67.43**

2.2. Historical Fluctuation of Quantity Used

Rationale. Clear understanding of key competitors' consumption of each type of feedstock utilized by the Proponent is essential to quantifying the risks associated with each competitor. Understanding historical trends of feedstock utilization can provide valuable information about feedstock price elasticity during shortages, and 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).	
Raw RI Score. Industry standards for usage of PL as fertilizer or soil amendment recommend application of 1-3 tons per acre of land. Application follows planting seasonal cycles. Feedstock can be land-applied for grasslands or prior to new crop planting. We found no public source that tracks historical PL quantity use over time. However, since PL producers must remove PL from the production premises, producers "ask" prices will continue to lower until the market price is low enough (versus manufactured fertilizer) for	**Score 3**

[9] Gaspareto et al. (2020) successfully treated PL for bioprocessing in a one-step process, followed by 3 further extractions.
[10] Rubežius et al. (2020) successfully treated PL for bioprocessing through sieving PL and then storing in airtight containers at 5˚C with tap water.
[11] Böjtl et al. (2017) successfully treated PL for bioprocessing by fermenting PL with maize silage and corn stover.

the market to clear most existing PL inventory. In short, while sell prices of PL will change, the quantity used by land application markets in the region is expected to remain consistent.

Legal issues relating to sustainability have been of concern in the region for years and could function to significantly attenuate demand by land application markets for PL.

The risk associated with RI 2.2 is deemed low. Raw RI Score is 3 out of 10.

Notched Salience. No adjustment.	**Score** Unnotched
Impact Level. RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score. The Loaded RI Score (Notched Salience x Impact Level) is 19.98 out of 100.	**Score 19.98**

2.3. Competitor Pricing & Price Sensitivity

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

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

Raw RI Score. Competing markets are predominantly local farms who land-apply PL as a soil amendment or fertilizer. Current prices paid by most competitors for PL FOB producers facility range from $6 to $20 per ton, depending on the quality of the PL. Aging increases the value of the fertilizer by reducing the non-PL organic content of materials such as wood shavings and feathers, and undergoing post-collection treatment. **Score 7**

Competitors' cost for PL are estimated as follows:

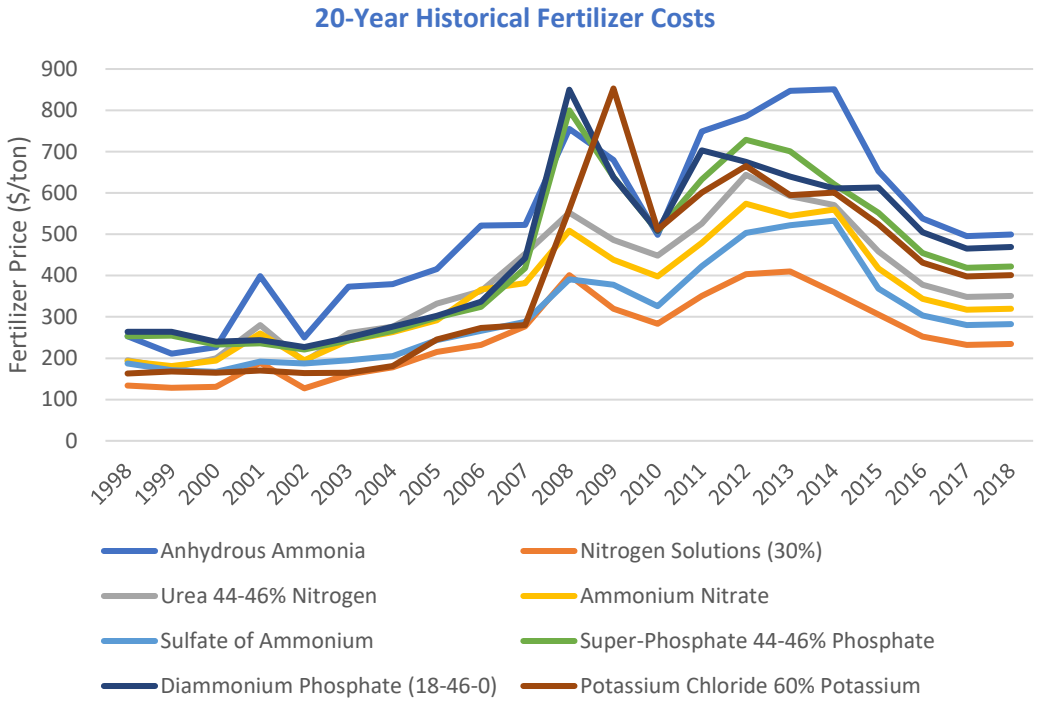
(i) Purchase cost: Lower quality PL typically sells for $6-$10 per ton FOB producer with higher quality selling at $20 per ton or more.
(ii) Transportation Cost: $8-$10 per ton for distances of 30 miles or less, plus an estimated $5.58 per loaded mile when distances are greater than 30 miles.
(iii) Land Application cost: ~$8 per ton.

Manufactured fertilizer cost is the key driver for PL cost. We understand that inflection points for land-application market demands for PL vary with the cost of manufactured fertilizer: "ask" prices for PL drop as the price for the alternative becomes lower, and vice-vera. Other factors such as contracts and buyer-supplier relationships are less powerful demand drivers[12].

[12] A regional study conducted for the Southern Agricultural Economics Association found that when purchase cost plus transport cost for PL approached the cost of manufactured fertilizer, market willingness to purchase feedstock dropped precipitously. The inflection point at the time of the study was $19 per ton FOB producer; when costs were $20-24 per ton, the number of competitors that were willing to purchase was 13% of

While FOB prices for PL will track manufactured fertilizer, we note that the price of manufactured fertilizer constitutes an effective "demand cap" for PL from competing markets. As the price of PL approaches manufactured fertilizer, land application will switch, and because producers must clear PL inventory, they will drop PL prices to ensure that this happens.

Because the price of PL depends on the cost of manufactured fertilizer, prices FOB producers fluctuate, and negotiated prices are market-based and often "spot." A public index for PL pricing does not exist, but anecdotal on-the-ground feedback from multiple sources indicate that over the last 10 years the price paid for PL FOB producers has varied between $2 and $18 per ton.



20-year historical prices for fertilizer from 1998-2018[13], 2018 being the most recent year for which data are available, show that the price of fertilizer has varied significantly over time. Other sources that track fertilizer prices on shorter time scales report fertilizer prices spiked throughout 2021[14].

In order to compete, bio-projects would have to meet or exceed the market pricing for PL which will continue to fluctuate over time with fertilizer costs.

the amount that were willing to purchase at prices $19 and below. When prices were $25 or above, the amount of litter farmers were willing to purchase was just 3% of the amount at $19.

[13] USDA Fertilizer Use and Price Data: https://www.ers.usda.gov/data-products/fertilizer-use-and-price/

[14] DTN Fertilizer Prices, 2019-2021 https://www.dtnpf.com/agriculture/web/ag/crops/article/2021/07/14/dap-potash-prices-post-significant

For these reasons, risk associated with RI 2.3 is deemed high. Raw RI Score is 7 out of 10.

Notched Salience. We estimate that total price for PL in the BDO Zone is approximately $24/ton delivered. Up to one third of the total price that Purchasers pay for PL are land application costs at approximately $8 per ton. This cost is factored into the total budget Purchasers are willing to allocate for PL, but a bioprocessing facility would not have to consider this land-application cost when purchasing litter. A facility could exploit this nuance in price advantageously to capture feedstock, by outbidding competition when necessary. We again note that bioprocessing facilities sometimes must pretreat feedstock, which can incur a level of cost. These at-present unknown feedstock pretreatment costs could moderately to significantly reduce this price advantage. As these pretreatment costs are not known, we do not notch RI 2.3.	**Score 7**
Impact Level. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score. The Loaded RI Score (Notched Salience x Impact Level) is 69.93 out of 100.	**Score 69.93**

2.4. Impacts of Future Demand on Feedstock Availability and Price

Rationale. Future competitors for feedstock, or expansion of feedstock demand by current competitors, can cause feedstock market disruption. Even before new competitors become operational, 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 Proponent. Once operational, new competitors increase demand on feedstock, potentially lowering availability and increasing cost. Existing competitors may seek to expand operations, increasing consumption of feedstock.	
Raw RI Score. We expect future demand will remain consistent since PL is a quality alternative to fertilizer and PL producers must (eventually) dispose of it. PL price however can be expected to fluctuate since producers will adjust sell prices to maintain market demand. We believe that the land application market for PL is mature and relatively saturated. As a result, we find the risk of increased future demand by existing markets to be low. We were able to identify no indications that demand from other agricultural sectors will increase. There are currently no projects announced or under construction that would utilize PL as feedstock in or near the BDO Zone. We therefore expect future demand to be flat. Legal issues associated with perceived negative environmental implications of land application of PL could put immediate and extreme downward pressure on demand and PL prices. A pending judicial order that is the product of a lawsuit between various states, once signed, could significantly reduce the amount of litter Purchasers would be permitted to	**Score 6**

land-apply. A legal restriction to land application would result in a surplus of feedstock looking for alternative markets. Many producers are aware of the legal issues, and such awareness could motivate some to seek alternative markets at similar prices to land application.

We find exposure to increased demand to be low; however, we find material price risk due to exposure to the price of manufactured fertilizer and difficulties in predicating future fertilizer prices in the region.

Raw RI Score is 6 out of 10.

Notched Salience. A bio-facility could somewhat mitigate risk related to cost fluctuations by locking into longer term contracts with a portion of producers at prices higher than current market price. As a result, Raw RI is notched by 25%: Notched Salience is 3.	**Score 4.5**
Impact Level. RI Impact Level is deemed *moderate.*	**Score 6.66**
Loaded RI Score. The Loaded RI Score (Notched Salience x Impact Level) is 29.97 out of 100.	**Score 29.97**

2.5. Supply Influence of Competitor

Rationale. In some cases, competitors may be able to exert high degrees of pressure over local suppliers, effectively enabling them to control feedstock, especially during times of shortage. This control can derive from long previous relationships between suppliers and competitors. It can also result from verbal or "understood" agreements, or a competitor being able to assist suppliers in times of surplus by maintaining large inventories which enable suppliers to continue supplying when other markets impose quotas. Understanding and planning around such soft risk factors is important. If such relationships exist in the Proponent's procurement area, they may indicate increased risk of feedstock shortage or pricing changes.

Raw RI Score. Supply influences of competing markets tend to derive from geographic advantage which lowers transport costs and gives one competing market a competitive advantage over another. Typically, lower transport cost gives a competing market the ability to pay a premium for the feedstock FOB the producer. Our data show that PL transportation distances are typically 40 miles or less[15]. A biobased plant in Siloam Springs would be as close, or closer than, many of the existing land application markets for PL. In fact, a plant located in Siloam Springs would have access to 42 PL producers and an estimated 1,084,876 tons per year of PL within 40 miles.	**Score 3**

[15] Interviews with various PL producers and aggregators on 13/05/2021, and 19/05/2021.

Contractual restrictions from existing markets are not seen as a source of supply influence: most agreements are either "spot" or short term. Our research for this designation suggests that long-term, fixed-price supply contracts are the exception, not the norm. The fact that PL prices fluctuate according to the cost of manufactured fertilizer is, of course, a disincentive to fixed price contracts. While we acknowledge that factors other than price can play a role in producers' decisions about the end market for PL[16], we believe that the role of qualitative factors is minor in the Siloam Springs BDO Zone supply basin. The risk associated with the supply influence of competitors is deemed to be low. Raw RI Score is 3 out of 10.	
Notched Salience. A bio-facility could mitigate supply influence of land application competing markets by enabling producers to avoid the environmental issues associated with land application (producers can mitigate the risk of a land-application legal ban by providing PL to a bio-plant). It could further mitigate supply influence of competing land application markets by providing better payment terms than existing markets, and by providing constant non-seasonal offtake for PL. As a result, Raw RI is notched by 50%: Notched Salience is 1.5.	**Score 1.5**
Impact Level. RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score. The Loaded RI Score (Notched Salience x Impact Level) is 4.99 out of 100.	**Score 4.99**

2.6. Temporary Market-Driven Markets

Rationale. Alternative, non-traditional, market-driven competitors for feedstock can drive feedstock demand in unusual circumstances.	
Raw RI Score. There currently are no non-traditional, market-driven markets for PL in the Siloam Springs competition zone and we find the likelihood of such markets emerging to be low. Raw RI Score is 1 out of 10.	Score 1
Notched Salience. No adjustment.	**Score Unnotched**
Impact Level. RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 3.33 out of 100.	**Score 3.33**

[16] Some producers contacted for this rating indicated that they would continue to supply a small amount of their generation to traditional markets – even at the cost of a better financial offer.

2.7. Relative Accessibility/Delivery Hours & Wait Times

Rationale. The value attributed by suppliers to local markets can be directly related to the degree of flexibility the market provides in terms of delivery hours, and the more efficiently discharge can occur.	
Raw RI Score. Transportation of PL in the region is typically handled by haulers subcontracted by purchasers, or by regional aggregators – not by suppliers. Suppliers typically clear out poultry houses and load trucks provided (directly or indirectly) by buyers. Our research for this rating did not show the need for unusual delivery hours or rapid discharge by transport providers. We assume that a new bio-based facility would provide industry-standard accessibility, delivery hours and wait times. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience. No adjustment.	**Score Unnotched**
Impact Level. RI Impact Leve is deemed *low.*	**Score 3.33**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 3.33 out of 100.	**Score 3.33**

2.8. Relative Specification Advantages

Rationale. When choosing a market, suppliers not only look at price, but also at relative quality requirements or specifications. It is important to understand a competitor's feedstock quality specifications in order to accurately quantify the risk that a competitor can exert on the Proponent's supply chain.	
Raw RI Score. There are markets for PL across a spectrum of qualities at prices ranging from $6-$18 FOB producer. Price premiums are based on the quality of the PL (based on how long PL is aged) non-nutritive content (such as percent volume of wood shavings and feathers), and treatments that improve the attributes for land application. Outreach indicated that while some PL purchasers do require lab testing to determine PL nutrient content to inform their purchase decisions, it is unknown what overall percentage of current purchasers operate on this practice. Agreements between buyers and producers tend to be "as is, where is" and title to PL (if it is defined at all) passes at the producers' facility at the point of loading, In order to compete effectively, specifications for a bio-based facility would have to align with existing "as is, where is" arrangements. We expect that producers have neither the willingness nor the capability to carry out any additional processing above and beyond that which currently takes place. We note that a new bio-based market with technology that could accept the biogenic debris concentration in the lower cost PL could source its supply from less expensive sources with less competition from existing PL markets. Conversely, a new market that could not handle	**Score 1**

expected variations in PL homogeneity, composition and other specifications could be at a significant disadvantage versus current markets.

Raw RI Score is 4 out of 10.

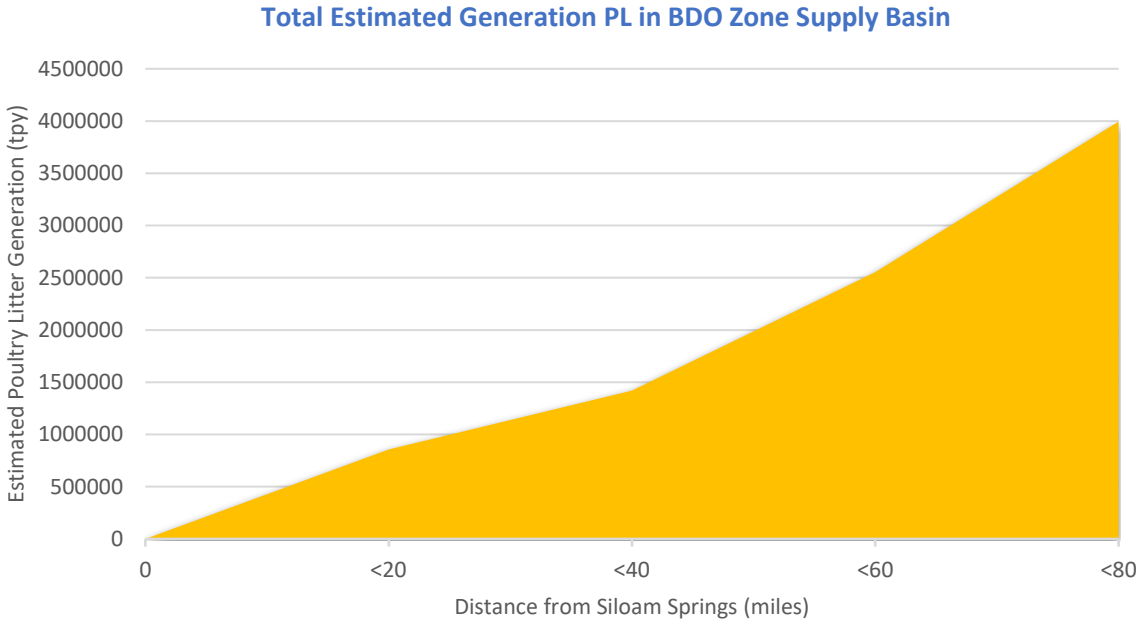
Notched Salience. No adjustment.	**Score** Unnotched
Impact Level. RI Impact Leve is deemed *low.*	**Score 3.33**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 3.33 out of 100.	**Score 3.33**

CATEGORY 3: SUPPLY CHAIN RISK

3.1. Biomass Availability Multiple (BAM)

Rationale. Biomass Availability Multiple (BAM) indicates the degree of redundancy in a Proponent's supply chain. BAM is the ratio of biomass feedstock generated, divided by the project's feedstock requirements. A high BAM is a strong indicator of supply chain resilience when stressed by supply shortage and/or supplier breach.

Raw RI Score. Within 40 miles, an estimated 1.5 million tpy of PL generated. Assuming intake for a bio-based facility of 150,000 tpy, coverage ratio or BAM is 10X the estimated facility intake requirement, which is very high. **Score 2**



Our internal calculations of BAM are based on the following assumptions:

(i) Economic transport distance is <40 miles.

(ii) Feedstock intake for a potential plant is estimated to be 150,000 tons per year[17].
(iii) A new bio-facility can pay a slight premium for feedstock versus the current land application markets.

Raw RI Score is 2 out of 10.

Notched Salience. No adjustment.	**Score Unnotched**
Impact Level. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 19.98 out of 100.	**Score 19.98**

3.2. Risk of Increased Utilization of Feedstock

Rationale. Feedstock utilization in a supply basin can change over time. Existing consumers of feedstock can expand operations or new facilities can enter the market. Increased utilization puts additional pressure on feedstock and can lead to higher prices, feedstock disruptions, shortages or supplier breach.

Raw RI Score. Poultry production in Arkansas grew by more than 28% from 2009 to 2019[18]. Expansion of litter production can be expected to exert downward pressure on PL costs over time. **Score 2**

As noted in RI 2.3, "ask" prices for PL drop as the price for manufactured fertilizer becomes lower, and vice-versa. As the price of PL approaches manufactured fertilizer, land application markets will switch; before that happens, however, PL producers will drop PL prices as necessary in order to clear inventory. For this reason, we believe that long-term risk of increased utilization of PL by existing land application markets is nominal with flat, consistent demand for PL the expected norm.

Risk associated with the impact of increased utilization of PL by existing or future competition is deemed low. Raw RI Score is 2 out of 10.

Notched Salience. No adjustment.	**Score Unnotched**
Impact Level. RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 13.32 out of 100.	**Score 13.32**

3.3. Feedstock Supply Curve

Rationale. The greater the feasible transport distance, the more feedstock is accessible to the Proponent, but at a higher delivered cost. The feedstock supply curve is a function of feedstock

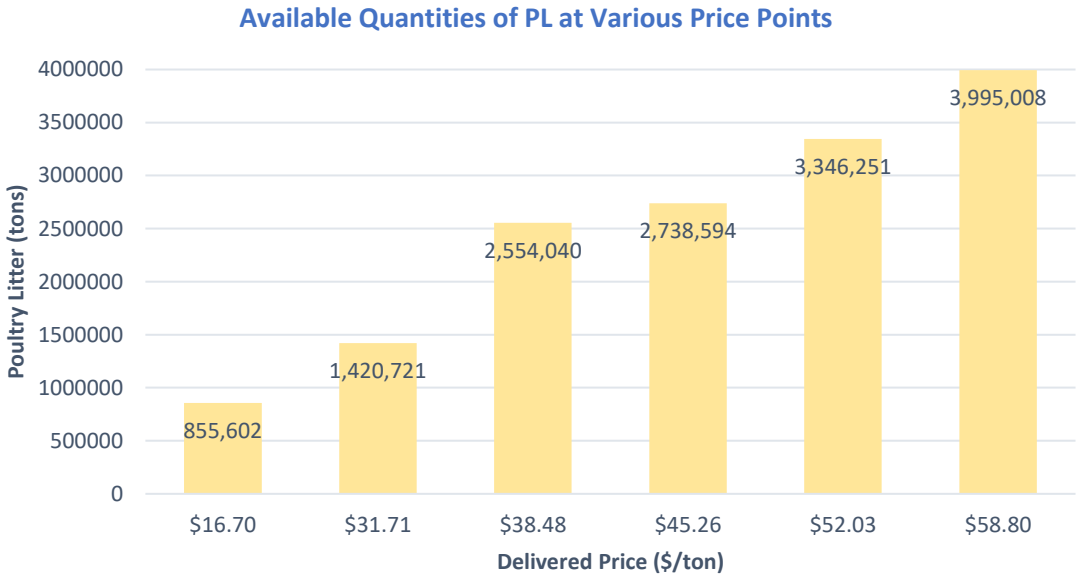
[17] Delaware Business Times: https://delawarebusinesstimes.com/news/new-partnership/
[18] USDA Arkansas Field Office: https://www.nass.usda.gov/Statistics_by_State/Arkansas/Publications/Livestock_Releases/Production_and_Value/arbroilerPV.pdf

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.

Raw RI Score. The feedstock supply curve below represents projected quantities of PL that are project-available at various price points for a plant situated in Siloam Springs.

Score 6

We note that point-in-time supply curves are not useful for gauging long-term feedstock availability and cost risks; over the long term, ***we see limited but material exposure to price (but not quantity) risk in the BDO Zone***. Exposure to price risk derives from the fact that the cost of PL is tied to the cost of manufactured fertilizer. With the exception of a significant increase in fertilizer costs in 2021[19], over 5 years manufactured fertilizer costs have evidenced a standard deviation of less than 22% of average prices. Extrapolating on that basis, we believe average future 10-year cost of PL can be expected to vary between $8.99 and $14 per ton FOB producers.



Finally, we note a significant cost-based competitive advantage for bio-based plants versus current land-application markets for PL: supply chain costs for land-application markets for PL include purchase cost, transport cost, ***plus land spreading costs***. Land spreading costs vary from $3-$8 per ton (though $8 per ton is more typical in the region), and can constitute over 30% of the costs of utilizing PL by land-application markets. Because bio-based markets do not incur land spreading costs, we expect such markets to be able to consistently outbid traditional land application markets for PL. This is in line with our finding of low long-term PL availability risk but moderate pricing risk.

The risk associated with availability and price are deemed to be low and moderate, respectively. Raw RI Score is 6 out of 10.

[19] The drivers of fertilizer costs are beyond the scope of this rating; however, we see the 2021 spike as an anomaly due to the economic impact of COVID-19.

Notched Salience. We speculate that bio-based markets for PL could mitigate the risk of fluctuation in PL cost over time by surcharging the existing market in return for longer-term supply contracts with certain PL producers. However, without a knowledge of the trigger price or the desired contract length, we do not notch RI 3.3.	**Score Unnotched**
Impact Level. RI Impact Level is deemed *high.*	**Score 9.99**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 59.94 out of 100.	**Score 59.94**

3.4. 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 regional biomass supply imbalances[20] and can manifest in shortages and higher costs for Proponents.	
Raw RI Score. There are no regularly-occurring, noteworthy seasonal variations in PL supply. The risk associated with seasonal feedstock supply variation is deemed low. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience. No adjustment.	**Score Unnotched**
Impact Level. RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score. The Loaded RI Score (Notched Salience x Impact Level) is 3.33 out of 100.	**Score 3.33**

3.5. 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.	
Raw RI Score. PL generation keys directly to poultry production, and is a necessary, unavoidable by-product of the poultry industry: seasonal or year-to-year variations in PL generation would show in similar variations in poultry production. However, ground-level feedback from potential suppliers, producers, and aggregators did not indicate any such major variations over the last 10 years. The risk associated with year-to-year variation in PL availability is deemed low. We note that poultry production in the region has been increasing since 2009, and the industry is expected to continue to grow. Raw RI Score is 1 out of 10.	**Score 1**

[20] Golecha & Gan, 2016

Notched Salience. No adjustment.	**Score** **Unnotched**
Impact Level. RI Impact Level is deemed *moderate.*	**Score** **6.66**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 6.66 out of 100.	**Score** **6.66**

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

Rationale. Feedstock supply models can be complex. Lack of clarity about model assumptions and baseline data can result in confusion on the part of the capital markets and drive financing costs for biomass projects. The adequacy and credibility of assumptions and baseline data is paramount to credible model outputs.	
Raw RI Score. Datasets pertaining to PL purchase cost, local fertilizer costs, and land-application costs are rare and most are incomplete. The most recently available data on litter generation estimates were from the USDA (2017) and lack nuance and granularity. Much of the pricing data utilized in this rating is based on direct feedback from poultry producers, PL brokers and aggregators, and land-application markets in the region. While every effort was made to triangulate and confirm data points, front-end validation was not possible in many cases. The risk associated with front-end validation of data used in feedstock availability models high. Raw RI Score is 6 out of 10.	**Score** **6**
Notched Salience. No adjustment.	**Score** **Unnotched**
Impact Level. RI Impact Level is deemed *high.*	**Score** **9.99**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 79.92 out of 100.	**Score** **79.92**

3.7. Historical Feedstock Price Variations and "Red-Line" Feedstock Cost

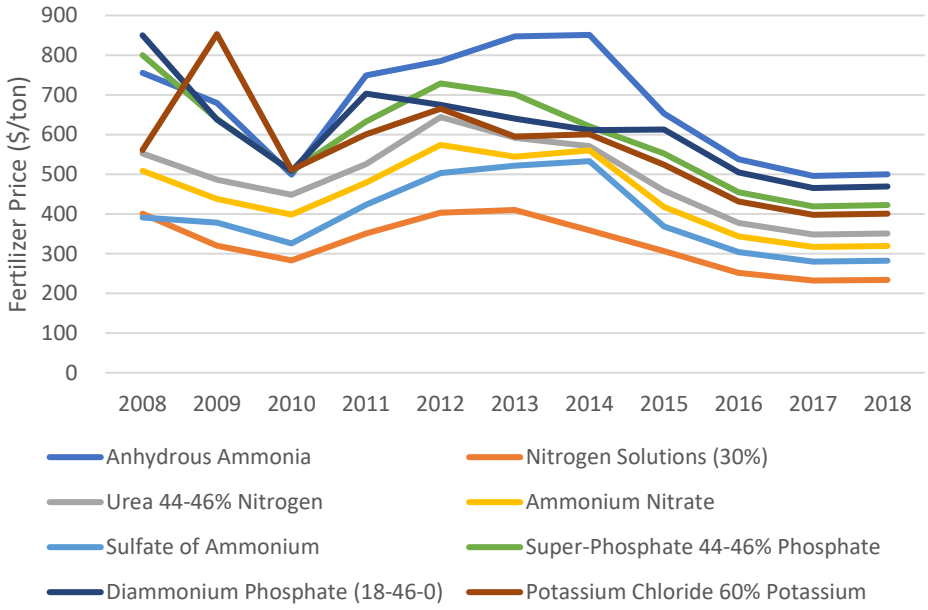
Rationale. If volatility is shown in the historical feedstock price, then the risk of future price fluctuation is elevated. If feedstock prices have historically exceeded the price at which the Proponent would have to cease operations or breach a financial covenant (i.e., the "red-line" feedstock cost), then mitigation measures should be put in place.	
Raw RI Score. The purchase cost of PL generally tends to track the cost of manufactured fertilizer with a degree of delay. The DTN graph shows fertilizer cost trends from 2019 to May 2021[21].	**Score** **5**

[21] Russ Quinn, DTN Staff Reporter: https://www.dtnpf.com/agriculture/web/ag/crops/article/2021/07/14/dap-potash-prices-post-significant

It is important to note that fertilizer price cannot be compared on a per-ton basis to PL per-ton prices directly. The specific soil chemistry on a plot of land and the nutrient content of soil amendment must be considered to effectively fertilize an area. A more accurate cost-comparison strategy would be to compare the overall cost of soil amending on a per-acre basis. Nonetheless, the charts below show general trends that can be proxied to PL cost trends.

In the past 10 years, average fertilizer costs of the lowest-cost fertilizer tracked by the USDA have varied between $232 and $410 per ton. The standard deviation from 2008-2018 was found to be ±$67.22 per ton, approximately 21% of the average cost. DTN and USDA data both suggest that fertilizer costs have been much more stable over the past 5 years, with average fertilizer price ranging from $265 to $296 per ton. Over 5 years, fertilizer cost standard deviation was found to be ±$11.87 per ton, or 4% of average costs over that period.

USDA Historical Fertilizer Costs, 2008–2018[22]

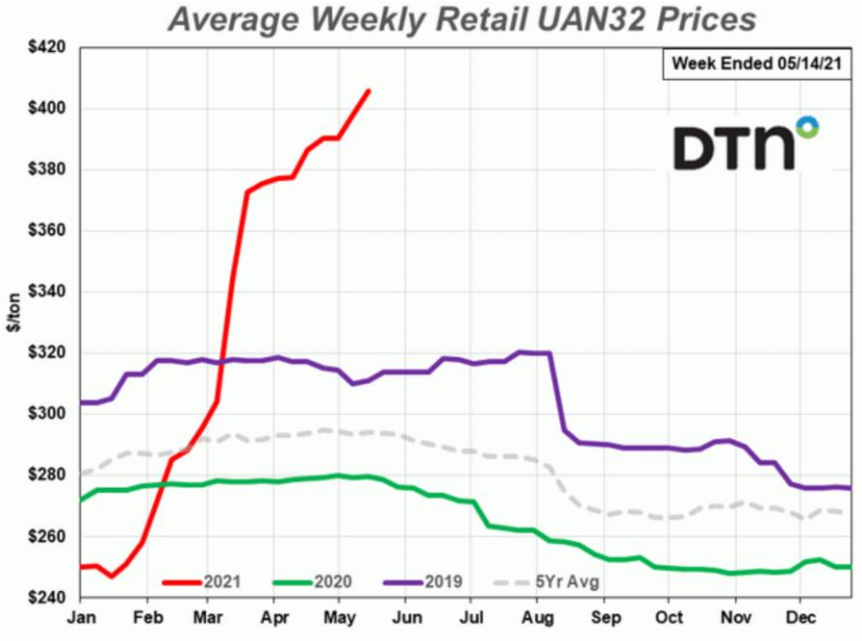


We proxy these standard deviations to PL prices over the same time periods. The current market price for lower quality PL varies between $6 and $10 per ton FOB producer, with high quality PL selling up to $18 per ton. Based on historical cost trends for manufactured fertilizer, we expect the ongoing cost of lower quality PL to vary between $4.74 and $12.10 FOB producer.

We note that costs skyrocketed in the first half of 2021, and although this may be an anomaly due to the pandemic, it underlines material price risk for PL users over the long term.

[22] USDA Fertilizer Use and Price Data: https://www.ers.usda.gov/data-products/fertilizer-use-and-price/

DTN Historical Fertilizer Costs, 2019–2021



The risk associated with historical feedstock price variations and "red-line" feedstock cost appears to be moderate. Raw RI Score is 5 out of 10.

Notched Salience. Price fluctuation for PL is a risk for producers in the region and we find it reasonable to expect that some would enter into longer-term supply contracts that enable them to mitigate that risk[23]. We speculate that RI 3.7 could potentially be mitigated by inducing producers to provide longer-term contracts at a fixed price (or a price which tracked with a fertilizer cost index with a price cap). However, we are uncertain of the number of producers that might enter into such contracts, and whether that number might be sufficient to substantially mitigate RI 3.7. As a result, we do not notch the Raw RI.	**Score** **Unnotched**
Impact Level. RI Impact Level is deemed *high.*	**Score** **9.99**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level is 49.95 out of 100.	**Score** **49.95**

3.8. Low Historical Demand for Feedstock in the Supply Basin

Rationale. If Proponent supply basin 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.	
Raw RI Score. Historical demand for PL in the region is strong: the estimated intake of PL by land-application markets within 115 miles of Siloam Springs is at least 3,569,549 tpy. The supply basin has history of developed, large-scale PL procurement, and suppliers have	**Score** **1**

[23] Some producers that provided qualitative data for this rating opined that the introduction of a new market for feedstock would help stabilize prices in the region, over the long-term.

sufficient expertise in PL production to ensure reliable supply. Collection practices are well-established and present low risk. Infrastructure required for collection and delivery is mature and robust. Raw RI Score is 1 out of 10.	
Notched Salience. No adjustment.	**Score** **Unnotched**
Impact Level. RI Impact Level is deemed *low.*	**Score** **3.33**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 6.66 out of 100.	**Score** **3.33**

3.9. History of Production/Feedstock is a Secondary Crop or a By-product

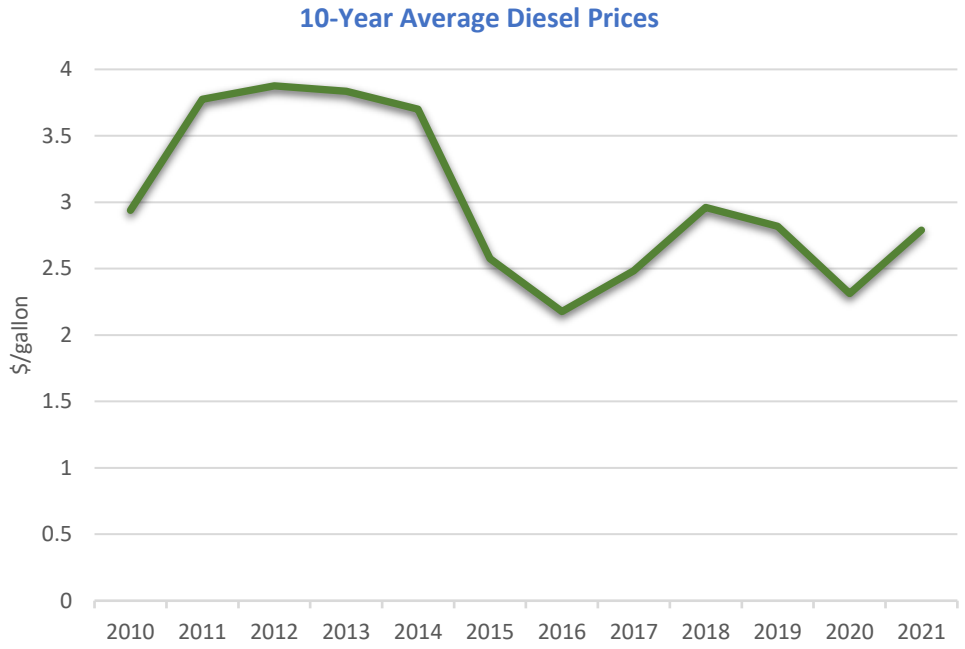
Rationale. If feedstock is a new/secondary crop or a by-product, suppliers may either lack sufficient experience to mitigate risk, or be unable to react to such risk. Secondary crop or by-product producers may be less likely to prioritize production. If feedstock is a secondary crop, then production can be subject to variables beyond suppliers' control (e.g., changing primary crop prices).	
Raw RI Score. Poultry production in the region is well-established and has steadily increased since 2009. Many PL producers in the region are in the process of expanding operations on the assumption that growth will continue. We find the fact that PL is produced as a necessary by-product of poultry production to be an asset, that speaks to the reliability and consistency of production, rather than a risk. The risk associated with the history of production of the primary product is deemed low. Raw RI Score is 1 out of 10.	**Score** **1**
Notched Salience. No adjustment.	**Score** **Unnotched**
Impact Level. RI Impact Level is deemed *low*.	**Score** **3.33**
Loaded RI Score. The Loaded RI Score (Raw RI Score x Impact Level) is 3.33 out of 100.	**Score** **3.33**

3.10. Fuel Prices

Rationale. Diesel, oil and PPI can impact feedstock cost of harvest and collection over time. Sensitivities to worst case scenarios should be run.	
Raw RI Score. PL cost has clear but not significant exposure to diesel prices. We find sensitivity of delivered PL cost to reasonable forward expectations of gas/diesel prices to be low to moderate. Diesel prices in the region from 2010 to 2020 fluctuated from $2.18 to $3.88 per gallon[24].	**Score** **3**

[24] U.S. Energy Information Administration Data: https://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_r30_a.htm

Assuming a maximum transport distance of 75 miles, a conservative average of 35 miles one-way, a milage rate of 8 miles per gallon, and an average weight per load of 23 tons of PL, an increase in diesel cost of $1.50 per gallon would impact delivered cost of PL by approximately $0.65 per ton – which is insignificant at 5% of total current delivered PL cost.



Raw RI Score is 3 out of 10.

Notched Salience. No adjustment.	**Score** Unnotched
Impact Level. RI Impact Level is deemed *moderate.*	**Score 3.33**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 9.99 out of 100.	**Score 9.99**

3.11. 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.	
Raw RI Score. PL collection practices and schedules, while variable from producer to producer, are typically well-established and regular. All poultry growers are required to have a litter management plan. PL collection typically occurs annually or bi-annually. Sometimes litter is aged for up to 5 and even 10 years to increase density, composition, and nutrient concentration and market value.	**Score 1**

The risk associated with the harvest and collection practices and schedules is deemed to be low. Raw RI is 1 out of 10.	
Notched Salience. No adjustment.	**Score** Unnotched
Impact Level. RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score. The Loaded RI Score (Raw RI Score x Impact Level) is 3.33 out of 100.	**Score 3.33**

3.12. Harvesting & Collection Equipment

Rationale. Different types of harvesting and collection equipment used by suppliers 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.	
Raw RI Score. PL collection equipment is low-tech, non-specialized and typically owned or co-owned and shared among producers. The risk associated with the harvesting and collection of equipment is deemed low. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience. No adjustment.	**Score** Unnotched
Impact Level. RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score. The Loaded RI Score (Raw RI Score x Impact Level) is 3.33 out of 100.	**Score 3.33**

3.13. Temporary Externality-Driven Markets for Feedstock

Rationale. Alternative, non-traditional, externality-driven competitors for feedstock can drive feedstock demand (and cost) in unusual circumstances.	
Raw RI Score. In order to address problems associated with nutrient overload of farmland in the Siloam Springs competition zone, some main regional poultry processors (such as Simmons) offer a transportation subsidy of $2 per ton to poultry producers as an incentive to move PL out of the region, in which nutrient-overload is a salient and politically fraught issue. In the past, states in the region have also offered similar subsidies of up to $4 per ton. Such external subsidies function to help PL producers cover higher transportation costs; however, they *do not* function to increase the net profit of PL producers themselves. As such, they do not constitute any price or variability risk to a new bio-based facility.	**Score 2**

Risk associated with temporary externality-driven markets for feedstock is deemed to be low. Raw RI is 2 out of 10.

Notched Salience. No adjustment.	**Score** Unnotched
Impact Level. RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 6.66 out of 100.	**Score 6.66**

3.14. Variations in Densification Methods Among Different Suppliers

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

Raw RI Score. PL producers in the BDO Zone's supply basin employ various densification methods depending on the intended final quality of the PL as a soil amendment. Less dense feedstock presents lower soil nutrient values and vice-versa. Less dense PL is typically generated by frequently cleared houses for egg-producing hens and has a higher content of non-PL organics with little or no post-collection treatment. Higher density PL is typically the result of less frequently cleared houses for larger birds, with low percent content of non-PL organics and extensive post-collection treatment routines. Variables that impact feedstock densification include periodicity of poultry-house cleaning, size and type of bird (e.g., broilers vs egg-producing hens), percent volume content of non-feedstock organics such as wood shavings and feathers, and post-collection treatment routines. It is difficult to speculate on the impact of these variations in composition and quality, since impact depends largely on the handling and processing technology of a specific bio-based plant. However, it is clear that, as a feedstock, PL is not wholly homogeneous in composition or nutritional value and different types of bioprocessing facilities may be more or less impacted by the variability. A rigorous and statistically relevant sampling and testing procedure of PL to ensure viability with specific technology is recommended. Risk associated with variation in densification methods among different suppliers is deemed to be moderate-high. Raw RI is 6 out of 10.	**Score 6**
Notched Salience. We speculate that long-term supply contracts could incentivize certain producers to deliver a desired feedstock density or composition. However, lack of data in this regard means that we do not notch RI 3.14.	**Score** Unnotched
Impact Level. RI Impact Level is deemed *moderate.*	**Score 6.66**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 39.96 out of 100.	**Score 39.96**

3.15. 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 for facilities where supply chains are not yet active; or for Proponent's for whom large feedstock requirements, or development of new (or expanded) supply chains, demand significant additions to the local labor force.	
Raw RI Score. At present, the state of Arkansas is the largest poultry producer in the United States[25]. Poultry producers in the region have been operating on a large-scale for decades[26] and the poultry production market is growing: poultry production in Arkansas grew by more than 28% from 2009 to 2019. Anecdotal feedback from PL producers in the BDO Zone supply basin indicated that many producers within 50 miles of Siloam Springs are expanding their poultry houses to accommodate increasing demand for poultry production. Local market dynamics are such that, though poultry production is increasing, the number of poultry farms is expected to decrease with time as children of some PL growers have shown disinterest in continuing family operations. While the overall number of farms is expected to lessen, individual farm sizes are increasing. PL production is dependent on poultry populations, not number of farms; thus, we find the assumption reasonable that PL generation will also continue to increase. Furthermore, the employment positions created by a bioprocessing facility could prove to be an appealing opportunity for the local workforce that is no longer interested in poultry production as the overall number of farms decreases. Given that PL is a direct by-product of steady and increasing regional poultry production, and that its removal from the producers' site is a necessity, we see minimal risk of a shortage of required labor for PL production. Raw RI is 3 out of 10.	**Score 3**
Notched Salience. No adjustment.	**Score** Unnotched
Impact Level. RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 9.99 out of 100.	**Score 9.99**

3.16. 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.

[25] Arkansas Farm Bureau. (2021). *Arkansas Agriculture: Poultry.* Poultry | Arkansas Farm Bureau. https://www.arfb.com/pages/arkansas-agriculture/commodity-corner/poultry/

[26] Central Arkansas Library System. (2019, March 19). *Poultry Industry.* Encyclopedia of Arkansas. https://encyclopediaofarkansas.net/entries/poultry-industry-2102/

Raw RI Score. Transport of PL in the Siloam Springs supply basin is generally done by third-party haulers using live-bottom trailers. Average payload weight for PL is 23-25 tons. In general, transport cost is a flat rate of $8-$10 per ton for deliveries less than 30 miles (or $184-$250 flat), plus approximately $5.58 per loaded mile beyond 30 miles. These costs are relatively in line with live-bottom transportation costs elsewhere. Within 30 miles of the BDO Zone, an estimated 1,252,799 tpy of PL are generated, with approximate delivered price estimated between $14.17 and $22.87 per ton. Ground level anecdotal feedback suggests that transport distances greater than 40 miles can drive landed PL cost to the point where manufactured fertilizer becomes the less expensive option, which could put downward pressure on PL costs (FOB producers) over time. At the present time, there is some upward pressure on transport costs by local third-party haulers which have pushed for increases in delivery prices per ton; however, the impact of successful across-the-region implementation of such an increase is deemed low, as it is less than 6% of transport cost and less than 3% of total cost of PL to land-application markets (including spreading). For these reasons, risk associated with feedstock transportation costs is deemed moderate low. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience. No adjustment.	**Score Unnotched**
Impact Level. RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 9.99 out of 100.	**Score 9.99**

3.17. Transportation Distances

Rationale. Average transport distances of 40-50 miles for biomass feedstocks are typical but larger distances can be common. Where average transport distance from suppliers to Proponent 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 feedstock from competitors closer to the source. Understanding average transport distance can help flag higher-risk suppliers where transport distance materially exceeds the average.	
Raw RI Score. As noted in RI 3.1, within 40 miles there is an estimated 1.5 million tpy of PL generated. Assuming intake for a bio-based facility of 150,000 tpy, coverage ratio or BAM is 10X, which is very high. Assuming the ability to pay at or slightly above market price for PL FOB producer, we do not see transport distance as a significant pathway of supply chain risk. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience. No adjustment.	**Score**

	Unnotched
Impact Level. RI Impact Level is deemed to be *moderate.*	**Score 6.66**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 13.32 out of 100.	**Score 13.32**

3.18. Transportation of Feedstock Requires Specialized Equipment

Rationale. Requirements for specialized transport equipment can increase supply chain risk. Where there is low availability in required transportation equipment, equipment owners have increased leverage over transportation prices and supply chain resiliency can be lower.	
Raw RI Score. Transportation of PL sometimes requires live-bottom trailers, which are semi-specialized equipment. However, there is a well-established sector of third-party haulers in the region that reliably moves PL at present. We see no barriers to contracting with existing transport infrastructure in the BDO Zone. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience. No adjustment.	**Score Unnotched**
Impact Level. RI Impact Level is deemed *moderate.*	**Score 6.66**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 19.98 out of 100.	**Score 19.98**

3.19. 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 a Proponent's ability to transport feedstock. This risk is greater in greenfield projects than operational ones.	
Raw RI Score. PL odor during transportation can be noticeable and unpleasant. However, major transportation routes around Siloam Springs generally lie on the periphery of major community centers. In any case, transportation of PL has a long track record in the region with no issues tied to RI 3.19-- we see little risk of future public or political pushback in the future. The risk associated with delivery routes through local communities is deemed low. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience. No adjustment.	**Score Unnotched**
Impact Level. RI Impact Level is deemed *low.*	**Score 3.33**

Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 9.99 out of 100.	**Score 9.99**

3.20. 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.	
Raw RI Score. Road infrastructure is well-developed and can be expected to support load weights and transport frequency. The risk associated with road infrastructure is deemed low. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience. No adjustment.	**Score Unnotched**
Impact Level. Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 6.66 out of 100.	**Score 3.33**

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

Rationale. In general, a supply portfolio involving multiple suppliers of various sizes is important for ensuring steady and uninterrupted feedstock supply with minimal price fluctuations. If a small number of large suppliers 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, a large number of 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.	
Raw RI Score. The BDO Zone's supply basin presents a healthy mix of small, medium, and large potential PL producers, with at least 91 producers within 75 miles. At an estimated average of 50,000 birds per house[27], and between 10 and 25 poultry houses per producer, total average production per producer is estimated to be 20,530 to 51,326 tpy, though a small number of the largest producers generate up to 100,000 tpy. Given a theoretical intake requirement of 150,000 tpy for a new bio-based facility, the required supply portfolio is estimated to be between 3 and 8 PL producers—although smaller contracts for a portion of producers output is likely possible to further mitigate risk of RI 3.21. The risk associated with the number, size mix and locations of suppliers is deemed low. Raw RI Score is 1 out of 10.	**Score 1**

[27] Poultry House Operations: An Overview: http://cbes.org/uploads/3/4/8/7/34875804/sfchick16__002_.pdf

Notched Salience. No adjustment.	**Score** Unnotched
Impact Level. RI Impact Level is deemed *low.*	**Score** 3.33
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 3.33 out of 100.	**Score** 3.33

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

Rationale. When a single risk event can impact the feedstock production ability of all (or most) suppliers, then feedstock risk is higher and supply chain resiliency is lower. Resilience is maximized when biomass supply chains exhibit diversity in spatial location (i.e., geography), production practices and other elements of supply chain structure such that the impact of single high-risk events have varying impacts on suppliers.	
Raw RI Score. PL producers are subject to the same external risk factors, which are endemic to poultry production. Many are under contract with the same poultry aggregators. However, we see no risk that could cause major disruptions to the poultry demand (and therefore to PL production) in the BDO Zone supply basin. Alternative disposal methods could become necessary as current legal cases pertaining to nutrient runoff in the state develop; however, we note that a state restriction or ban on use of PL for land application would exert significant downward pressure on PL costs and be strongly favorable to alternative markets to land application. Risk associated with the suppliers being subject to the same external risk factors is deemed low. Raw RI Score is 3 out of 10.	**Score** 3
Notched Salience. No adjustment.	**Score** Unnotched
Impact Level. Impact level is deemed *high.*	**Score** 9.99
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 29.97 out of 100.	**Score** 29.97

3.23. Long-Term Weather and Climate Trends

Rationale. In certain regions, climatic trends and significant potential changes to future weather patterns can create feedstock risk.	
Raw RI Score. Poultry demand (and therefore PL production) is uncorrelated to long-term weather and climate trends. However, long-term climate change trends could push favorable poultry conditions, and therefore perhaps poultry production, further north. Raw RI Score is 3 out of 10.	**Score** 3
Notched Salience. No adjustment.	**Score**

	Unnotched
Impact Level. RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 9.99 out of 100.	**Score 9.99**

3.24. Local, Provincial, and National Laws, Regulations, and 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.

Raw RI Score. Nutrient runoff and phosphorus loading of local watersheds due to the land-application of PL has been a major political issue in the region for several years. Feedstock supply could be disrupted by environmental regulations, in the event that new local or state laws and regulations are passed that reduce the amount of PL that can be land applied as a soil amendment. As noted above, this would put ***downward*** pressure on PL costs and support alternative market development. The poultry industry is vital to the regional economy; changes in land-use regulations that could seriously disrupt the feedstock supply chain and impact poultry production are deemed unlikely. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience. No adjustment.	**Score Unnotched**
Impact Level. RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 3.33 out of 100.	**Score 3.33**

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

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

Raw RI Score. Anecdotal on-the-ground feedback from PL brokers and producers in the region suggest that a biomass development in the region would widely be accepted and	**Score 1**

encouraged by poultry producers. Risk associated with backlash against biomass development, procurement or usage in the region is deemed low.

Raw RI Score is 1 out of 10.

Notched Salience. No adjustment.	**Score** Unnotched
Impact Level. RI Impact Level is deemed *high.*	**Score** 9.99
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 9.99 out of 100.	**Score** 9.99

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

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.

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 biomass harvesting and production. For different feedstock types, there are also different thresholds at which feedstock removal causes significant negative consequences on soil.

Excessive nutrient runoff from biomass feedstock production can accumulate in surface waters and result in algal blooms and hypoxia which can lead to habitat loss for aquatic species higher up the food chain and alter aquatic ecosystem food webs. Damage to aquatic ecosystems can cause social and regulatory backlash. Water intake issues can also increase risk.

Raw RI Score. There is significant concern in the region about the use of PL as a soil amendment for grass and crop growth, especially with nutrient overloading in soils, and rivers and groundwater contamination. There is significant political pressure from neighboring states on the state of Arkansas to find alternative markets for the PL that are more sustainable. By-products of new markets (such as digestate) are likely to be examined with alacrity, and evidence of sustainable disposal of by-products (if any) will be required. Most bioprocessing facilities that intake poultry litter as feedstock, however, produce biochar and renewable natural gas, with few by-products of concern. For these reasons, the risk associated with feedstock sustainability, including risks to soil quality and surface and groundwaters is deemed low. Raw RI Score is 2 out of 10.	**Score** 2
Notched Salience. No adjustment.	**Score** Unnotched

Impact Level. RI Impact Level is deemed *high.*	**Score 9.99**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 19.98 out of 100.	**Score 19.98**

3.27. GHG Emissions from Production, Harvest, & Transport

Rationale. Understanding a project's overall emissions and the carbon intensity throughout the feedstock supply chain is an essential part of reducing risks related to carbon pricing mechanisms and related regulations

GHG emissions from production, harvest and transportation can be a significant challenge to Proponent claims of carbon neutrality for biomass projects. Carbon emissions from harvested soils, as well as emissions from harvesting machinery or delivery trucks, can make the achievement of net-zero GHG emissions difficult. If a Proponent's financial model relies on carbon neutrality/GHG regulatory pricing frameworks, then an investigation into the feedstock's carbon emission status is essential.

Raw RI Score. We anticipate no new or additional GHG emissions from production, collection and transport of PL to a biomass facility as opposed to traditional soil amendment markets. Risk associated with GHG emissions from production, harvest and transport of feedstock is deemed low. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience. No adjustment.	**Score Unnotched**
Impact Level. RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 9.99 out of 100.	**Score 9.99**

3.28. Geographic Location Influence on Feedstock Variability

Rationale. Feedstock from different regions may differ in quality due to variations in soil quality, topography, harvest practices, weather, fertilizer applied, etc.

Raw RI Score. The geographic region from which feedstock is sourced does not impact feedstock quality. The risk associated with geographic location influence on feedstock variability is deemed low. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience. No adjustment.	**Score Unnotched**
Impact Level. RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 3.33 out of 100.	**Score 3.33**

3.29. Capacity of Supply Chain Components & Equipment to Scale

Rationale. Scale-up risk increases if supply chain components, or underlying feedstock infrastructure necessary for these components, cannot scale to handle Proponent feedstock requirements and throughput capacity. Capacity to scale should be demonstrated.	
Raw RI Score. The supply chain for PL is, at present, increasing in scale to be able to meet the increasing demand for poultry. Since PL supply for a new alternative market would divert existing supply from traditional land-application markets, and since PL production is effectively capped (as a direct by-product of poultry farming), no increase of supply chain capacity is seen as necessary to service a new bio-based market for PL. The risk associated with the capacity of the supply chain components and equipment to scale is irrelevant and therefore deemed low. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience. No adjustment.	**Score Unnotched**
Impact Level. RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score. Loaded RI Score (Notched Salience x Impact Level) is 3.33 out of 100.	**Score 3.33**

APPENDIX B: DISCUSSION OF THE POULTRY LITTER SUPPLY CHAIN

INTRODUCTION

This appendix serves as a biomass availability background discussion to augment the BDO Zone Risk Rating pertaining to poultry litter (PL) for the City of Siloam Springs, Arkansas.

Included Counties, Supply Basin and Competition Zone

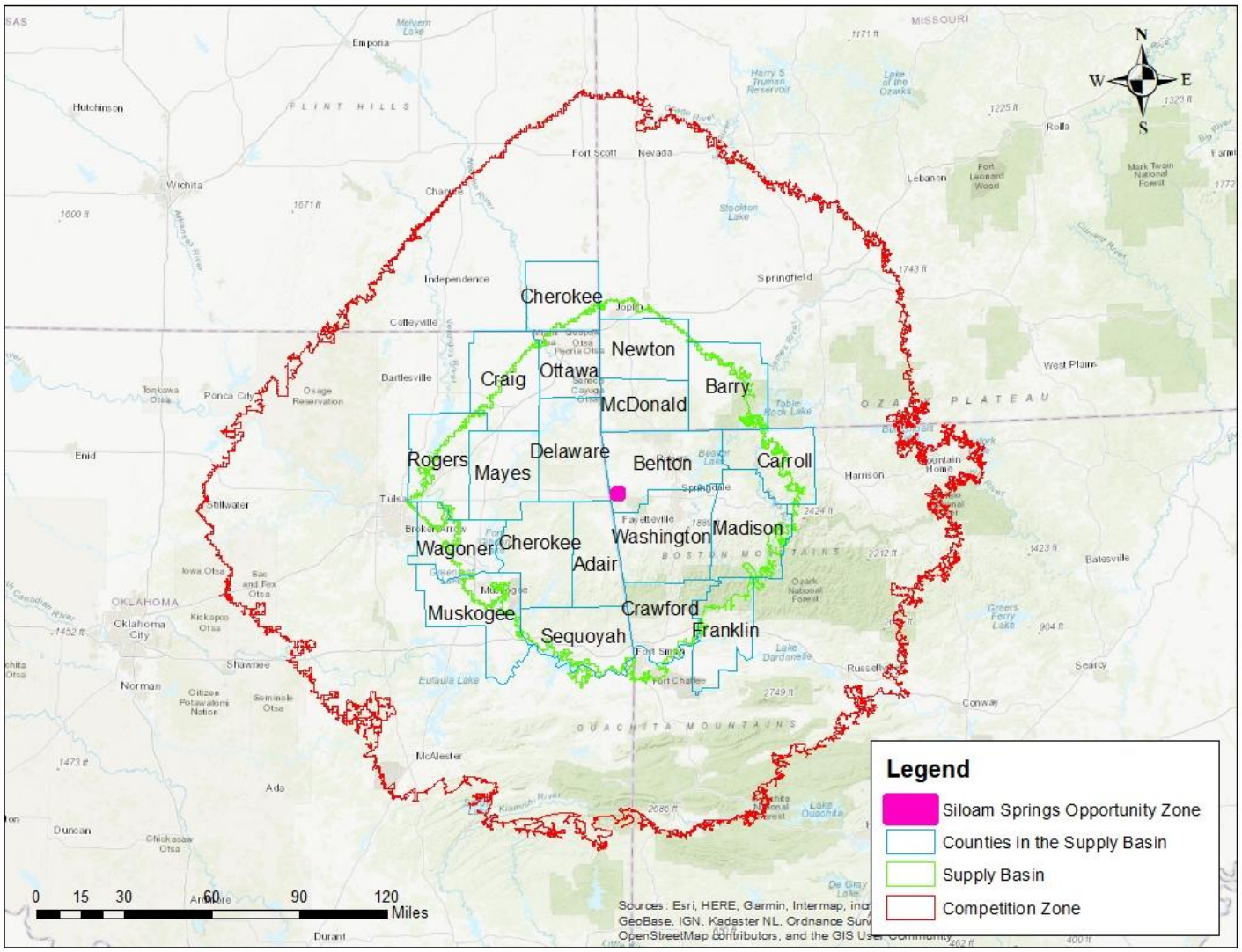
The Siloam Springs BDO Zone is a U.S. Opportunity Zone with low-risk potential for bio-based economic development, colored bright pink in Map 1. The supply basin – an area within a 75-mile drive distance of Siloam Springs – is the area from which PL can be economically sourced for a project sited within the Siloam Springs BDO Zone. The supply basin area is outlined by the green line in Map 1. The competition zone is defined by a 115-mile drive distance from Siloam Springs, AR, depicted in red in Map 1. The competition zone is defined as 115-miles based on our understanding that competitors are typically not willing to source feedstock from distances greater than 40 miles: therefore, competition should be accounted for within the 75-mile supply basin, plus 40 miles.

Supply analysis for this study was conducted on the state and county levels. The counties included in the supply basin are summarized in Table 1 and labeled in Map 1. The distance column in Table 1 lists the approximate distance from the center of Siloam Springs, Arkansas, to the center of each respective county. When a county center was greater than 75 miles from Siloam Springs, the distance was taken as 75 miles. When county borders extended beyond the BDO Zone supply basin, only the approximate percentage of the county within the supply basin was included in analysis. The approximate percentage of each county within the supply basin was estimated using GIS modeling.

Table 1: Counties in Supply Basin

County Name	State	Distance from Siloam Springs (miles)	Approximate Percentage of County in Supply Basin
Benton	Arkansas	0	100%
Washington	Arkansas	41	100%
Crawford	Arkansas	56	100%
Madison	Arkansas	65	80%
Carroll	Arkansas	75	50%
Franklin	Arkansas	75	20%
Sequoyah	Oklahoma	55	100%
Adair	Oklahoma	24	100%
Cherokee	Oklahoma	45	100%
Wagoner	Oklahoma	73	67%
Muskogee	Oklahoma	75	20%
Mayes	Oklahoma	53	100%
Rogers	Oklahoma	75	50%
Craig	Oklahoma	75	50%
Ottawa	Oklahoma	60	100%
Delaware	Oklahoma	32	100%
McDonald	Missouri	44	100%
Barry	Missouri	72	67%
Newton	Missouri	68	100%
Cherokee	Kansas	75	13%

Map 1: Siloam Springs BDO Zone, Supply Basin, Included Counties & Competition Zone



PL Generation Modeling Methodology

Poultry litter generation was modeled with data from the US Department of Agriculture's (USDA) 2017 Census of Agriculture[28], the most recent data available, and the American Society of Agricultural Engineer's Standards transfer functions for poultry litter generation[29]. For a detailed discussion on generation modeling, see Appendix C.

When an entire county did not fall within the supply basin, it was assumed that the approximate percentage of the county within the supply basin was the percentage of that county's PL generation produced within the supply basin, and therefore counted towards the supply basin total. For example, approximately 50% of Carroll County, Arkansas, lies within the supply basin, so 50% of the PL generation within Carroll County was counted towards the supply basin total. Where appropriate, outreach was performed to stakeholders, potential suppliers, local experts, and other relevant individuals to anecdotally contextualize the numeric modeling outputs.

[28] USDA 2017 Census of Agriculture Poultry Populations: Arkansas | Oklahoma | Missouri | Kansas
[29] American Society of Agricultural Engineers Manure Production & Characteristics Standard

Supply Chain Overview

The Siloam Springs PL supply chain can be broken into four components:

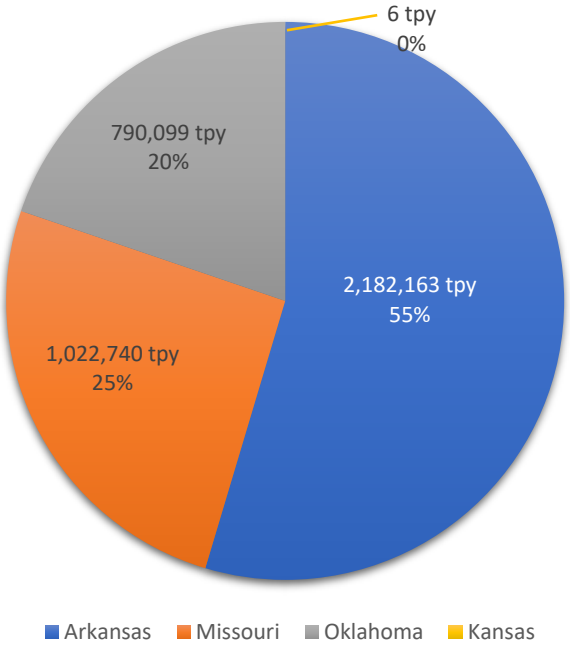
(i) poultry producers, who necessarily generate feedstock as a by-product of their poultry production;
(ii) in some instances, aggregators are incorporated into the supply chain, either as individual producers who aggregate waste from across their farms, or litter movers who collect feedstock from various poultry producers;
(iii) third-party transportation services that are typically hired by the purchasers of feedstock to move the supply; and
(iv) Other farmers who purchase PL as a soil amendment or fertilizer, understood to be predominantly cattle farmers.

SUPPLY

High-Level Supply (Feedstock Generation)

An estimated 3,995,008 tons per year (tpy) of feedstock are generated within the Siloam Springs BDO Zone supply basin. An estimated 2,182,163 tpy are generated in Arkansas (55% of the supply basin total total), followed by 1,022,740 tpy in Missouri (25%), and 790,099 tpy in Oklahoma (20%). As Kansas' estimated PL generation within the supply basin is a mere 6 tpy, the state was excluded from analysis.

Figure 1: Estimated Feedstock Generation in the Supply Basin by State



Total supply basin PL generation was modeled on a county level for the three states (AR, MO, OK) that generate significant amounts of feedstock within the supply basin. Counties are listed by generation in descending order in Table 2.

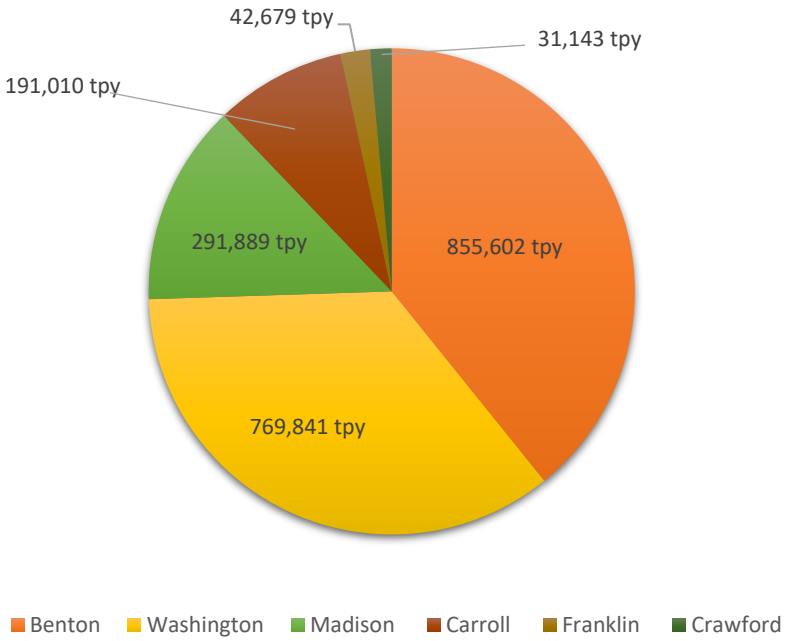
Benton County in Arkansas is the largest producer within the supply basin, generating an estimated 855,602 tpy of PL. Washington County, AR was the next largest overall PL producer, with generation estimated at 769,841 tpy. Barry County in Missouri was the supply basin's third largest producer, generating an estimated 370,644 tpy of PL.

Table 2: Estimated Feedstock Generation by County within the Supply Basin

County Name	State	Estimated Feedstock Generation (tpy)	Percentage of Supply Basin Total
Benton	Arkansas	855,602	21%
Washington	Arkansas	769,841	19%
Barry	Missouri	370,644	9%
McDonald	Missouri	336,328	8%
Delaware	Oklahoma	335,845	8%
Newton	Missouri	315,767	8%
Madison	Arkansas	291,889	7%
Adair	Oklahoma	229,274	6%
Carroll	Arkansas	191,010	5%
Ottawa	Oklahoma	82,312	2%
Mayes	Oklahoma	43,129	1%
Franklin	Arkansas	42,679	1%
Crawford	Arkansas	31,143	<1%
Sequoyah	Oklahoma	27,971	<1%
Cherokee	Oklahoma	27,150	<1%
Rogers	Oklahoma	22,610	<1%
Craig	Oklahoma	19,765	<1%
Muskogee	Oklahoma	1,874	<1%
Wagoner	Oklahoma	169	<1%
Cherokee	Kansas	6	0%

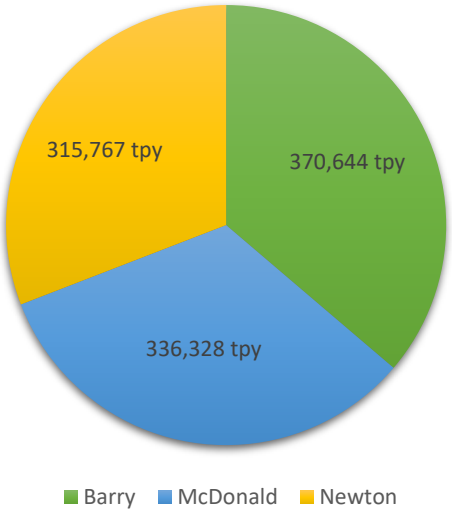
County generation estimates are presented in state-clusters due to states potentially having, or in the future developing, unique guidelines, regulations, or laws for the management of PL generated within each respective state.

Figure 2: Estimated Feedstock Generation by County within the Supply Basin, Arkansas



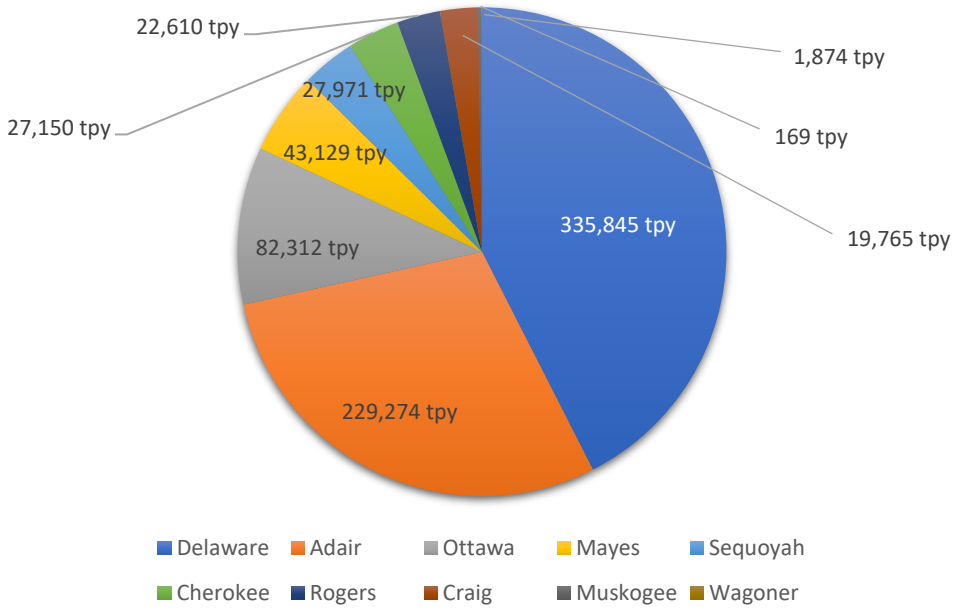
Of Arkansas counties within the supply basin, Benton and Washington Counties were found to be the top two feedstock generators, producing approximately 21% and 19% of the supply basin total, respectively. Madison County was the next largest producer, generating 291,889 tpy of feedstock (7%). Carroll County was the only other county in the state to generate significant amount of feedstock at 191,010 tpy (5%). Franklin (42,679 tpy) and Crawford (31,143) Counties each generated approximately 1% of the supply basin total.

Figure 3: Estimated Feedstock Generation by County within the Supply Basin, Missouri



Modeling indicates a fairly even split in generation within Missouri's counties included in the supply basin. Barry County was the largest producer in the state, generating 370,664 tpy of PL, approximately 9% of the estimated supply basin total. The next largest producer was McDonald County, where generation totaled an estimated 336,328 tpy (8% of total). Newton County generates an estimated 315,767 tpy of feedstock (8%).

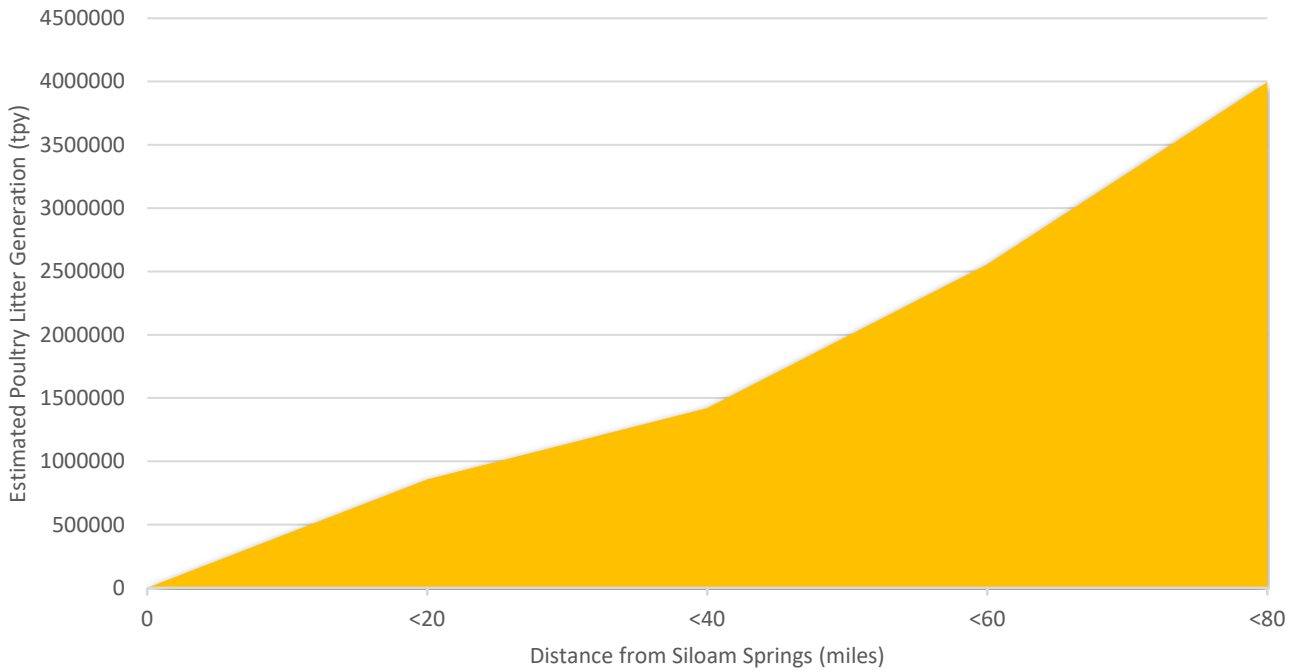
Figure 4: Estimated Feedstock Generation by County within the Supply Basin, Oklahoma



Delaware County was found to be the largest feedstock generator in Oklahoma, producing an estimated 335,845 tpy of feedstock (8% of supply basin total). Adair County generates an estimated 229,274 tpy of feedstock (6%). Ottawa County was the only other major feedstock generator in the state, with production totaling 82,312 tpy (2%). Mayes, Sequoyah, Cherokee, Rogers, Craig, Muskogee and Wagoner counties all individually generated 1% or less of the supply basin total, but collectively the 7 counties accounted for an estimated 142,668 tpy of feedstock generation, approximately 4% of the supply basin total.

Counties within a drive-distances of 20 miles from Siloam Springs generated 855,602 tpy of feedstock. Over the next 20 miles, estimated generation of feedstock increased by 565,119 tpy to an estimated 1,420,721 tpy. From 40 miles to the end of the 75-mile supply basin, generation growth was fairly linear and strong. In the last 35 miles of the supply basin, generation grew from 1,420,721 tpy to its aggregate total of 3,995,008 tpy at a rate of approximately 73,551 tpy per mile.

Figure 5: Estimated Feedstock Generation Distribution within Supply Basin



Seasonal & Annual Feedstock Supply Variation

There are no regularly-occurring, noteworthy seasonal variations in feedstock supply. Feedstock generation keys directly to poultry production, and is a necessary, unavoidable by-product of the poultry industry: seasonal or year-to-year variations in feedstock generation would show in similar variations in poultry production. However, ground-level feedback from potential suppliers, generators, and aggregators did not indicate any such major variations over the last 10 years.

Suppliers

A total of 91 potential suppliers were identified within the supply basin[30]. Potential suppliers include poultry farmers and producers, and does not include aggregators who operate in the region. While discussions and pursuit of supplier commitments are beyond the scope of a BDO Zone rating, anecdotal conversations with feedstock aggregators revealed

[30] D&B Hoovers Business Database

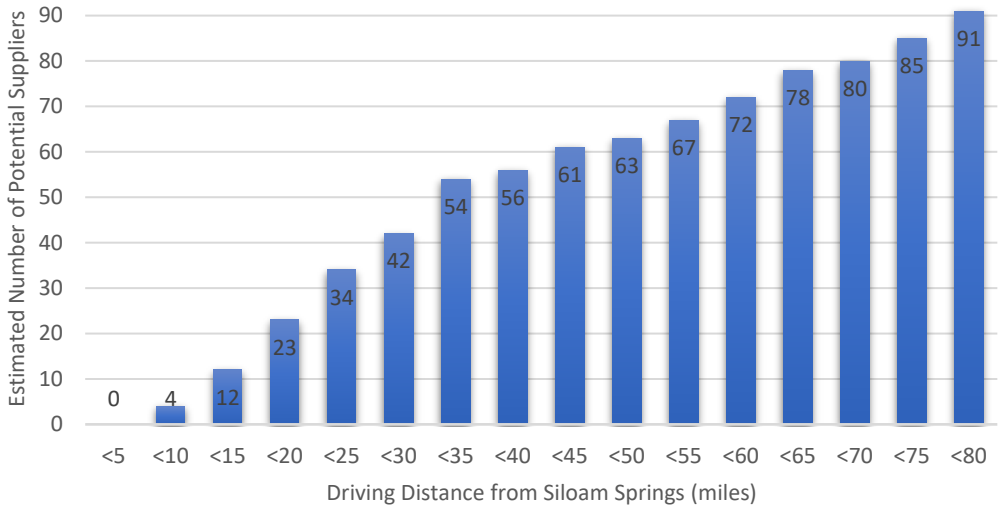
that there is a desire for new markets for feedstock, and it is highly likely generators and potential suppliers would be willing to supply to a potential project, should a new market's price be competitive.

Aggregators in the supply basin are typically:

(i) individuals who own several poultry farms, and aggregate feedstock generated across all their farms for centralized loading, or processing/treatment to make litter better suited for land application; or
(ii) individuals who aggregate litter from several individual farms in the basin to then sell to other purchasers.

Potential suppliers' spatial distribution is fairly constant. A total of 34 potential suppliers (37%) are within a 25-mile driving radius of Siloam Springs. Within 50 miles, the number of potential suppliers increases to 63, representing 69% of the total suppliers in the supply basin. When the driving radius is increased to the entire 75-mile supply basin, 28 more potential suppliers are added to reach the aggregate total of 91.

Figure 6: Potential Suppliers Estimated Spatial Distribution



Suppliers as Aggregators or Brokers

Aggregators handle a substantive portion of the supply basins' generated PL. However, Generators tend not to be contractually bound to aggregators, and in most cases could supply directly to a market.

Anecdotal feedback from a large broker of PL in the supply basin indicated that neither they nor farmers have the capacity to dispose of all the waste that is generated in the region in a sustainable or environmentally responsible manner and that, as a result, a new bioprocessing market would be welcome in the BDO Zone. A new bio-based facility looking to intake feedstock could likely choose to deal with either supplier's directly or with feedstock aggregators.

Suppliers as Competitors

From conversations with local industry leaders, we understand that poultry growers utilize insignificant amounts of feedstock themselves. Some cattle farmers grow poultry; however, outreach suggests that such markets predominantly use their own generated feedstock internally, and in many cases do not seek to supplement their internal generation with any external supply.

Suppliers' Dependence on, or Preference for, Competing Markets

Cattle and cropland farmers in the region that utilize PL as soil amendment or fertilizer through land-application represent the only major competition to potential bio-based projects—however, such use is widespread and poultry litter as a lower-cost alternative to 'manufactured' fertilizer is a key competing market. Modeling indicates that within the BDO Zone, land-application markets that potentially utilize PL as a fertilizer or soil amendment total 1,539,229 acres[31].

It is understood that selling feedstock either directly to end markets, or through one of several aggregators, is currently the only significant method of poultry litter disposal for producers. Producers typically accumulate poultry litter on-site until it is needed by farmers—which can be on a seasonal basis, with highest demand just before new crops are planted.

Insofar as existing land application markets being the only current PL market for generators, it is clear that there is a high degree of dependence. However, we anticipate that price is the key driver for producers, and as a result, previous dependency is unlikely to be binding.

Despite the large land-area that could potentially be treated with PL in the BDO Zone, there is no inherent preference that suppliers feel for competing markets. Their dependence on currently existing competitors can be credited to the absence of alternative markets.

Feedstock Production Priority

Production of PL is the necessary by-product of poultry production and disposal of PL is a necessary activity for producers. While PL is produced consistently, it is accumulated on-site by producers in poultry house beds for periods of time that typically range from 6-12 months, but can be as long as 10 years. PL that goes through a longer aging process is sold at a premium due to its low percent-volume-content of non-feedstock organics (such as wood shavings and feathers) and extensive post-collection treatment routines.

Production of feedstock is an unavoidable consequence of poultry farming. However, there is variable priority among suppliers for sustainably disposing of their feedstock. Anecdotal evidence suggests that for farmers who feel a natural concern for the environment, finding a more sustainable, but still cost-effective, method of feedstock disposal is a high priority.

For many producers however, finding alternative cost-effective methods of feedstock disposal is not a high priority. However, we find it highly likely that a new bio-based facility could acquire feedstock from poultry farmers who are predominantly motivated by economic – rather than environmental – factors by purchasing PL at the current market price, or a slight premium.

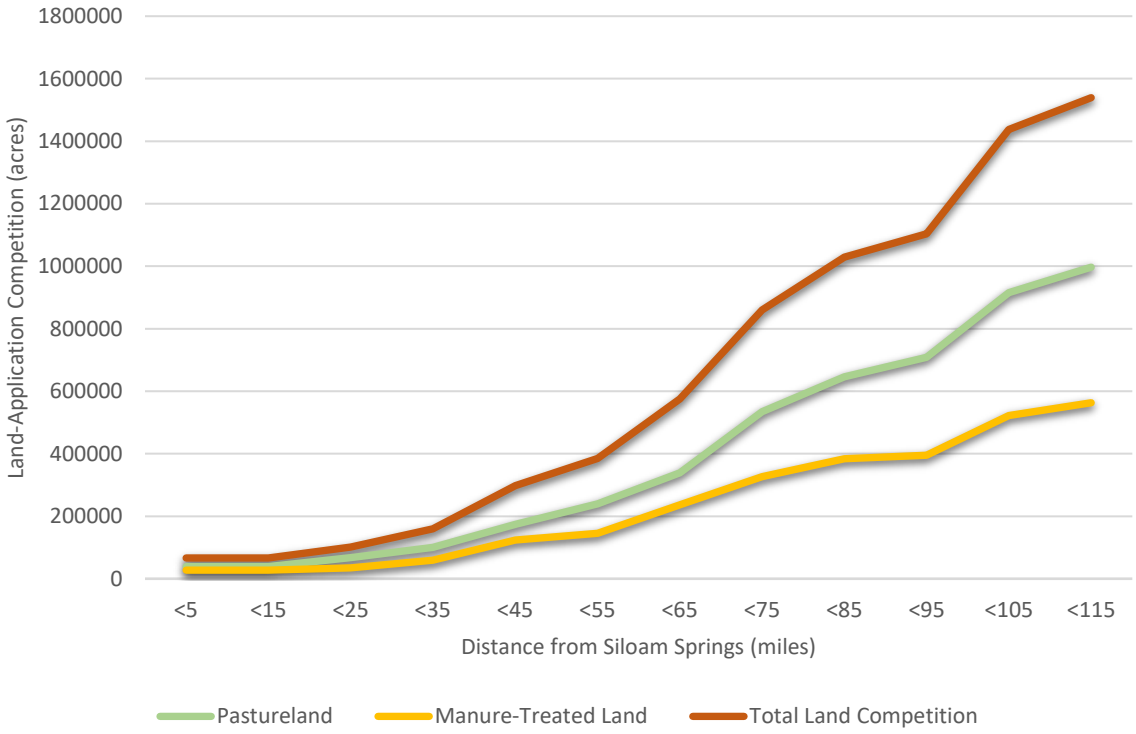
DEMAND

Competitors

Major competitors for feedstock in the Siloam Springs competition zone fall into one of two major categories: cattle farmers or cropland farmers. Between Pasture/Grazing Land (Pastureland) and Manure-Treated Land, a total of 1,539,229 acres of land could compete with a potential bio-facility for feedstock in the competition zone (shown in Figure 7). Modelling was conducted based on data collected from the 2017 USDA Census of Agriculture, the most recent data available.

[31] See Appendix C for a discussion on Sources, Methodology and Assumptions behind Land-Competition Modeling.

Figure 7: Total Estimated Potential Land-Area Competition for PL within Competition Zone



Exact competitor PL use was not modeled due to incomplete or non-existent datasets pertaining to (i) manure-type use (e.g., cow manure vs PL vs goat/sheep manure); and (ii) tracked volume of PL used as a soil amendment or fertilizer annually. Furthermore, the specific soil chemistry and nutrient content on a plot of land must be to known effectively determine how much PL must be applied to fertilize the area. For these reasons, estimated competition from land-application markets are not reported in this study.

It is critical to note that there are currently no other major uses for PL within the competition zone beyond land-application markets, and poultry producers are required to have a litter management plan. As a result, we find it reasonable to assume that essentially all of the PL generated within the BDO Zone's supply basin is at present utilized by land-application markets.

There are several key regional players in the land-application market. However, despite long-term relationships with poultry producers, it is not anticipated that any leverage such regional players may have with producers, would function to adversely affect the ability of a new bio-based project to obtain feedstock for these reasons:

(i) Average estimated delivered price for PL in the BDO Zone is approximately $24/ton delivered[32] . Up to one third of the total price that Purchasers pay for PL are land application costs at approximately $8 per ton. This cost is factored into the total budget Purchasers are willing to allocate for PL, but a bioprocessing facility would not have to consider this land-application cost when purchasing litter. A facility could exploit this nuance in price advantageously to capture feedstock, by outbidding competition when necessary.

(ii) External environmental and political pressures in the region serve to make alternative markets attractive to producers. Direct application of PL as a soil amendment or fertilizer has led to significant nutrient runoff and water quality issues within Arkansas and in neighboring Oklahoma. A pending judicial order that is the product

[32] See Appendix A.2.3 for an exact breakdown of delivered PL cost

of a lawsuit between the states, if signed, could significantly reduce the amount of litter current purchasers would be permitted to apply as a soil amendment. We speculate that at the same prices, non-land-application markets may be attractive to producers as this legal issue concludes.

(iii) Current Purchasers tend not to have long-term contracts with producers, meaning that at comparable prices, a new bioprocessing facility could capture PL without significant burdens from contractual restrictions.

(iv) The market tends to be price-driven, so a purchaser who offers a higher price would likely capture the feedstock.

(v) Aggregators in Siloam Springs have indicated a willingness to provide PL to new bio-based markets.

Pastureland

Pastureland represents the largest competition to a potential project for feedstock. Pasturelands are defined as areas that could be fertilized with feedstock to grow grass that farmers then utilize for cattle grazing. An estimated 996,898 acres of pastureland could be fertilized with feedstock are used for grazing within the competition zone. Pastureland markets represents 64% of the total land-area competition.

Manure-Treated Cropland

Manure-Treated Cropland encompasses all land area that the USDA tracked as having been fertilized or amended with some kind of animal-based manure. Manure types can include feces from cattle, poultry, and goats and sheep. The total Manure-Treated cropland area of 542,331 acres within the Siloam Springs competition zone represents approximately 36% of the total potential land-area competition.

Biomass Availability Multiple (BAM)

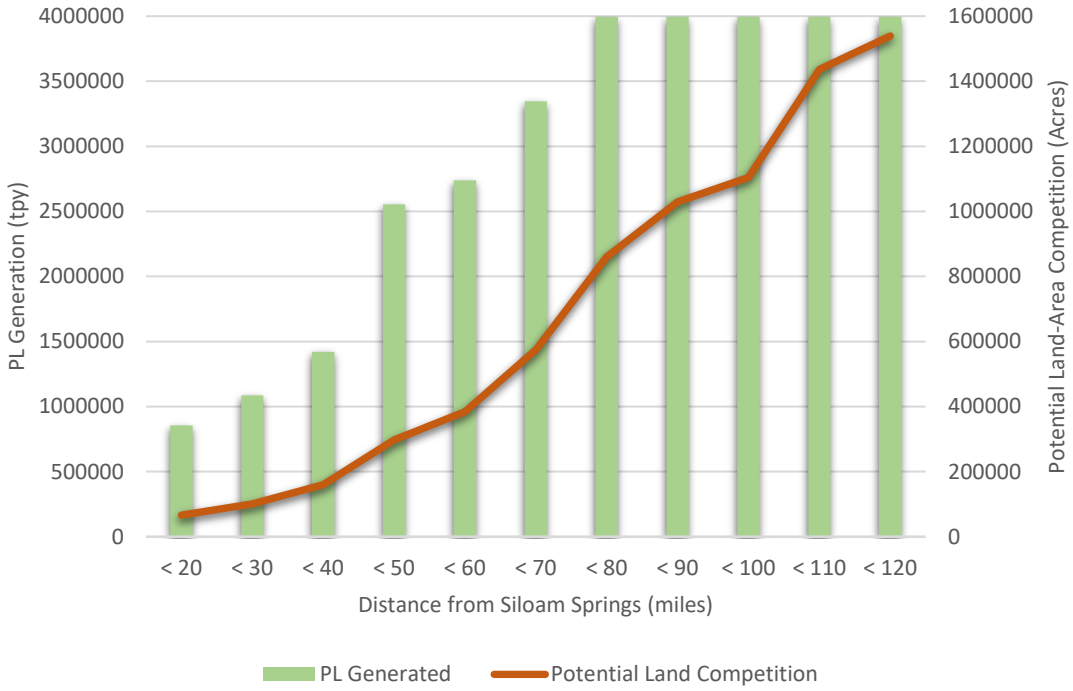
The Biomass Availability Multiple (BAM) indicates redundancy of available feedstock within the supply basin for a pre-defined project intake capacity. It was assumed that a potential Project would have a feedstock intake requirement of 150,000 tpy[33].

The supply basins' total PL generation of 3,995,008 tpy is nearly 27 times the assumed facility intake requirement of 150,00 tpy. As has been discussed previously, a small percentage – if any – of this generated PL is at-present unused by the more than 1.5 million acres of competitive land-application markets. However, we believe that the key driver for PL producers is price: if a bio-based market is willing to pay either market price or a slight premium for PL, it is likely a facility could acquire its desired PL quantity.

A noteworthy observation that could prove advantageous for a bio-based facility intaking PL in Siloam Springs is that within 20 miles, estimated PL generation totals 855,602 tpy. However, in this same area, there are only 66,324 total estimated acres that could utilize PL as a fertilizer or soil amendment (illustrated in Figure 8 below). At this drive distance, the ratio of supply-to -demand is potentially advantageous for a new bio-based market. The estimated 855,602 tpy of generation is equivalent 5.7 times the assumed facility intake requirement of 150,00 tpy, and we speculate is available with comparatively low competitive pressure.

[33] Estimated Feedstock intake requirement of 150,000 tpy: https://delawarebusinesstimes.com/news/new-partnership/

Figure 8: Total Estimated PL Generation in Supply Basin & Land-Application Markets in Competition Zone



Future Competitors

There are currently no projects announced or under construction that would intake PL as feedstock. No indications that demand from other agricultural sectors will increase in the long-term were identified.

Land-application markets' demands for PL is partially driven by manufactured fertilizer price: as fertilizer prices increase demand for PL increases, and vice-versa. Manufactured fertilizer costs have increased dramatically through the first half of 2021 (see Pricing Section below). We anticipate demand from land-application markets to increase in the short-term, but stabilize over the long-term as fertilizer prices decrease. In addition, given that existing land-application markets must consider land application costs in their budgets, it is likely that existing PL markets will not compete on price with a bio-based facility that can pay at or near the cost of manufactured fertilizer.

PRICING

Current Pricing

Current prices paid by competitors for feedstock are understood to be $6 to $20 per ton, plus spreading costs, which are estimated as $3-$8 per ton[34], and transportation costs. Transportation costs start at a flat rate of $8-$10 per ton for a standard transportation distance between 1 and 30 miles. Transportation cost then increase by approximately $5.58 per loaded mile of transport beyond the first 30 miles. Higher quality feedstocks are more expensive, with prices having reached up to $50 per ton FOB generator in extreme cases, however this extremely high cost is an outlier, even for high-quality PL.

[34] Per conversations with local purchasers and USDA data: Natural Resource Conservation Service Oklahoma, USDA, through the Environmental Quality Incentives Program (EQIP). "Poultry Litter Manure Transfer Incentives Information Sheet." Information Sheet. January 2006.

The feedstock supply curve, presented in Figure 9, shows the breakdown of how much estimated PL can be captured at various price points. A feedstock supply curve represents a single point in time: the curve represents current costs for PL FOB generator plus transport costs against PL at that price for a plant situated in Siloam Springs.

Figure 9: Estimated Available PL at Various Price Points



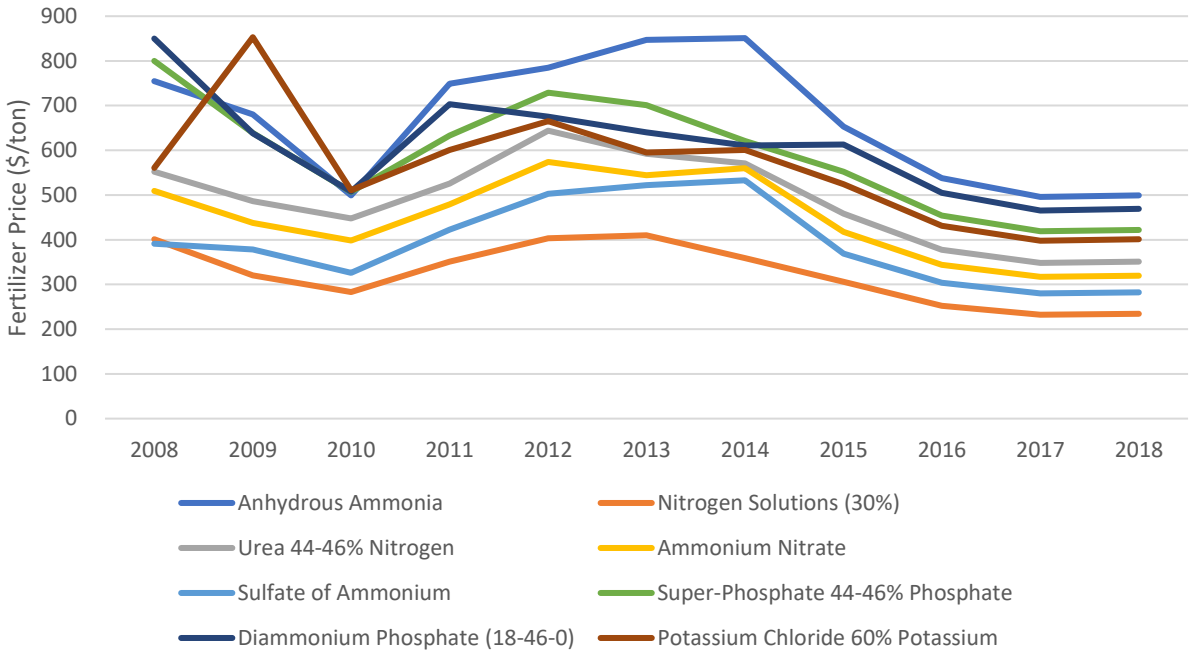
At a delivered price of $16.70 per ton, we believe a bio-facility could unlock more than 855,000 tons of PL, nearly 6 times the assumed facility intake requirement of 150,00 tpy. When delivered price is increased to $31.71 per ton, a facility would unlock an estimated 1.4 million tons of PL. A facility could unlock 64% of the supply basin's estimated PL generation at a delivered price of $38.48. A marginal increase in unlocked PL volume is observed when delivered cost is increased to $45.26 per ton. When delivered cost is increased to $52.03 per ton, access to an estimated 3,346,251 tpy of PL is unlocked. Finally, to unlock the supply basin's estimated aggregate total of 3,995,008 tpy of generated PL, delivered price increases to $58.80 per ton.

Historical Pricing

The purchase cost of PL generally tends to track the cost of manufactured fertilizer with a degree of delay. The graphs below show national fertilizer costs. Figure 10 is derived from USDA fertilizer price data from 2008-2018, and Figure 11 shows DTN-tracked fertilizer cost trends from 2019 to May 2021.

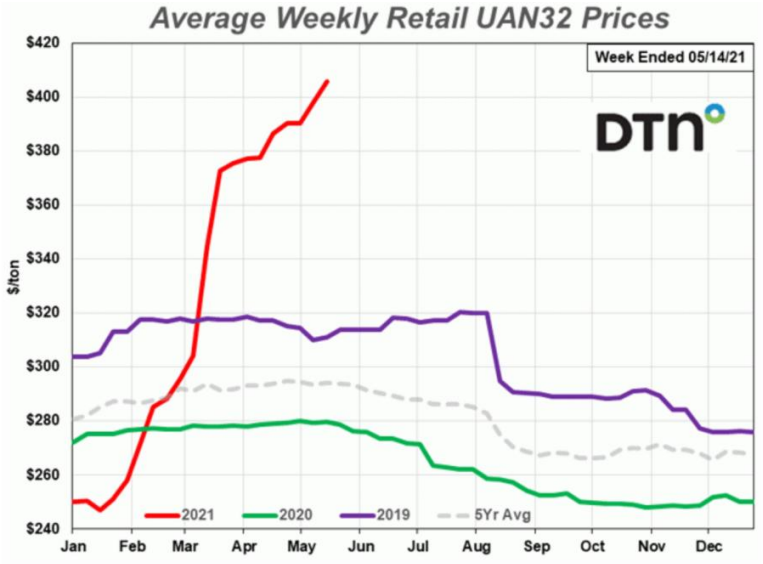
It is important to note that fertilizer price cannot be compared on a per-ton basis to PL per-ton prices directly. The specific soil chemistry on a plot of land and the nutrient content of soil amendment must be considered to effectively fertilize an area. A more accurate cost-comparison strategy would be to compare the overall cost of soil amending on a per-acre basis. Nonetheless, the charts below show general trends that can be proxied to PL cost trends.

Figure 10: USDA Historical Fertilizer Costs, 2008–2018



The data indicate that fertilizer prices had been decreasing since 2014. However, fertilizer costs skyrocketed in the first half of 2021, which suggests that PL cost will increase in the short-term. While 2021 fertilizer prices have escalated dramatically, they appear to be relatively stable in the long-term. The drivers of fertilizer costs are beyond the scope of this rating; however, we believe the 2021 spike is an anomaly potentially due to the economic impact of COVID-19.

Figure 11: DTN Historical Fertilizer Costs, 2019–2021



In the past 10 years, average fertilizer costs of the lowest-cost fertilizer tracked by the USDA, Nitrogen Solutions 30% (NS), have varied between $232 and $410 per ton, and PL costs between $2 and $18 per ton. NS fertilizer costs' standard deviation from 2008-2018 was found to be ±$67.22 per ton, approximately 21% of the average cost.

DTN and USDA data agree that fertilizer costs have been much more stable over the past 5 years, with average fertilizer prices ranging from $265 to $296 per ton. Over 5 years, fertilizer cost standard deviation was found to be ±$11.87 per ton, or 4% of average costs over that period. We believe it fair to proxy these standard deviations to litter prices.

The current market price for lower quality PL varies between $6 and $10 per ton FOB Generator, with high quality PL selling at up to $18-$20 per ton. As a secondary product whose value is dependent on the cost of manufactured fertilizer, the "red-line" cost for PL can be expected to vary in a similar manner. Based on historical cost trends for manufactured fertilizer, we expect the ongoing cost of lower quality PL to vary between $4.74 and $12.10 FOB generator. Extrapolating in the same manner, we believe future 10-year average costs of medium-quality PL can be expected to vary between $8.99 and $14 FOB generators, assuming an average price of $12/ton.

TRANSPORTATION

Transportation Regulations & Load Weight Limits

The state of Arkansas allows a gross vehicle and cargo weight of up to 80,000 pounds on 5 or more axles. Live-bottom trailers in the region typically transport 23-25 tons of cargo weight, or 46,000-50,000 pounds. Live-bottom trailers typically weigh 18,000 lbs., meaning the gross weight of transportation can be up to 12,000 lbs. below the state limit.

Ownership of Transportation

Since current end-markets for PL are land application, live-bottom trailers are often used to transport PL from producers to purchasers. Live-bottom trailers are semi-specialized equipment and relatively expensive to acquire (versus open top dry van-type equipment or dump trailers).

Transportation of PL in the region is currently predominantly performed by established third-party trucking services who own the equipment necessary for this particular supply chain. A facility would likely not have to acquire this capital-cost intensive equipment unless it desired to. The transportation services in the supply basin are well-established and experienced.

INFRASTRUCTURE

Road Infrastructure

Road infrastructure is well-developed and capable of transporting the substantial loads a potential project would require. Preliminary GIS analysis revealed that there are several roads and highways, both and in and out of Siloam Springs. GIS analysis was also performed to ensure that there were no bridges in or out of Siloam Springs from out-of-state supply routes. The absence of these bridges confirms that, should it be desired, large amounts of feedstock can be brought in from Missouri or Oklahoma without concern about interstate bridge weight limits.

It is prudent to note that the movement of massive amounts of poultry products around the region is an anecdotal testament to the well-developed nature of road infrastructure in the supply basin that a potential project could use to its advantage.

Availability of Labor

At present, the state of Arkansas is the largest poultry producer in the United States[35]. Poultry producers in the region have been operating on a large-scale for decades[36] and the poultry production market is growing: poultry production in Arkansas grew by more than 28% from 2009 to 2019[37]. Anecdotal feedback from PL producers in the BDO Zone indicated that many producers within 50 miles of Siloam Springs are expanding their poultry houses to accommodate increasing demand for poultry production.

Local market dynamics are such that, though poultry production is increasing, the number of poultry farms is expected to decrease with time as children of some PL growers have shown disinterest in continuing family operations. While the overall number of farms is expected to lessen, individual farm sizes are increasing. PL production is dependent on poultry populations, not number of farms; thus, we find the assumption reasonable that PL generation will also continue to increase.

Furthermore, the employment positions created by a bioprocessing facility could prove to be an appealing opportunity for the local workforce that is no longer interested in poultry production as the overall number of farms decreases.

Given that PL is a direct by-product of steady and increasing regional poultry production, and that its removal from the producers' site is a necessity, we see minimal risk of a shortage of required labor for PL production.

POLICY

Local, Federal, & National Laws, Regulations, & Permitting Pertaining to Biomass

Nutrient runoff and phosphorus loading of local watersheds due to the land-application of PL has been a major political issue in the region for several years. Feedstock supply could be promoted by environmental regulations, in the event that new local or state laws and regulations are passed that reduce the amount of PL that can be land applied as a soil amendment. As noted above, this would put downward pressure on PL costs for a new alternative bio-based market.

The poultry industry is vital to the regional economy; changes in land-use regulations that could seriously disrupt the feedstock supply chain and impact poultry production are deemed unlikely.

[35] Arkansas Farm Bureau. (2021). *Arkansas Agriculture: Poultry.* Poultry | Arkansas Farm Bureau. https://www.arfb.com/pages/arkansas-agriculture/commodity-corner/poultry/
[36] Central Arkansas Library System. (2019, March 19). *Poultry Industry.* Encyclopedia of Arkansas. https://encyclopediaofarkansas.net/entries/poultry-industry-2102/
[37] United States Department of Agriculture, Agricultural Statistics Service Delta Region Arkansas Field Office: https://www.nass.usda.gov/Statistics_by_State/Arkansas/Publications/Livestock_Releases/Production_and_Value/arbroilerPV.pdf

APPENDIX C: POULTRY LITTER MODELING

Poultry Litter Generation Procedure & Assumptions

1. County-level data on production of broiler, layer, and pullet chickens were acquired from the USDA's 2017 Census of Agriculture[38].
2. When an entire county did not land within the supply basin, it was assumed that the percentage of the county within the supply basin was the percentage of birds within the supply basin:

$$CPP_n = CC_n \times GP_n$$

Where:
- CPP_n = county poultry population, from the USDA's Census of Agriculture
- CC_n = Total number of broiler, layer, and pullet chickens in the County
- GP_n = Geographical percentage of county within the supply basin

3. Applied the appropriate American Society of Agricultural Engineers Standard Transfer Function[39], assuming a finishing time of 48 days for poultry:

$$CFG_n = 4.9\frac{kg\ litter}{chicken} * CPP_n * 2.204\frac{lbs}{kg} * \frac{1\ ton}{2000\ lbs} * \frac{365\ {}^{days}/_{year}}{48\ days}$$

Where:
- CFG_n = County PL Generation
- It was assumed that all chicken types produce the same litter mass per finishing time

4. Total Supply Basin Generation, *Total PL Generation*:

$$Total\ PL\ Generation = \sum_{n=1}^{20} CFG_n$$

Poultry Litter Land-Use Modeling Procedure & Assumptions

1. County-level data on agricultural land use was acquired from the USDA's 2017 Census of Agriculture for land use[40]. Lands that were identified by the USDA as either pastureland or manure-treated land for each county were tracked. To ensure the most conservative estimates within our modeling, it was assumed that all pastureland was treated exclusively with PL. As percentage of manure-treated land that was treated with PL could not be determined, it was assumed that one third of manure-treated land was treated with PL.
2. When an entire county did not land within the supply basin, it was assumed that the percentage of the county within the supply basin was the percentage of land competition for feedstock within the supply basin:
3.

$$LC_n = GP_n \times (PL_n + MT_n)$$

Where:
- LC_n = Total County Land Competition for feedstock, in acres
- GP_n = Geographical percentage of county within the supply basin
- PL_n = Pastureland within the county, in acres
- MT_n = Manure-treated land within the county, in acres

4. Total Land competition was aggregated within a 100-mile driving distance of Siloam Springs. It was then assumed that 3 tons of feedstock were applied per acres of land competition. Therefore, *Total PL Competition* was:

$$Total\ PL\ Competition = 3 \times \sum LC_n$$

[38] USDA 2017 Census of Agriculture Poultry Populations: Arkansas | Oklahoma | Missouri | Kansas
[39] American Society of Agricultural Engineers Manure Production & Characteristics Standard
[40] USDA 2017 Census of Agriculture Fertilizer & Chemicals Applied: Arkansas | Oklahoma | Missouri | Kansas