Kaw Valley Grazing & Agrivoltaics, LLC

Kansas Sky Energy Center
Grazing Management Plan

OCTOBER 10, 2023

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A. Project Overview

The Kansas Sky Energy Center (KSEC, Project) is a proposed 159-megawatt (MW) utility-scale photovoltaic (PV) solar generation energy facility. The proposed Project will co-locate agrivoltaics throughout the Project Area.

The Project may encompass approximately 1,100 acres north of Lawrence, Kansas, pending regulatory approval. The Project is under development by Free State Solar Project, LLC (Free State), a subsidiary of Savion, LLC, with a proposal for Evergy to build, own, and operate the energy facility, pending regulatory approval.

Free State has engaged the services of Kaw Valley Grazing & Agrivoltaic, LLC (KVGA), a Douglas County grazing and agrivoltaics consultant company, in preparing the Grazing Management Plan.

The Grazing Management Plan (GMP) provides a plan for managing the vegetation at the solar site using soil-regenerating grazing methods. The GMP is developed in collaboration with Central Grazing Company, Inc., a women-owned and operated regenerative lamb grazing company located in Douglas County, Kansas.

B. Vegetation Management

1. Service Area

Solar facilities must have regular vegetation management during the growing season to prevent the shading of PV panels. Vegetation that grows underneath panels reaching heights above the leading edge of panels will cause shading and must be managed several times yearly.

The KSEC Project proposed GMP recommends sheep grazing for vegetation management treatment on installed perennial pollinator-friendly vegetation. The proposed GMP outlines Grazing Management and Soil Health methods recommended by the United States Department of Agriculture Natural Resource Conservation Service (USDA-NRCS). The recommended grazing methods are proven to build soil, enhance ecosystems, and increase profits for the grazer. ("Grazing Management and Soil Health")

Grazing management areas within the Project Area will be determined through advanced engineering design, public approval processes, and a competitive bid process. The KSEC Vegetation Management Decision Tree provides additional detail on potential grazing management areas.

Using the USDA-NRCS grazing recommendations, KSEC may improve the biological attributes of the Project Area by responsibly incorporating managed grazing practices. These practices build soil fertility, help retain groundwater, nurture native prairie species, secure food systems, and provide opportunities to agricultural businesses.

Applying the USDA-NRCS Grazing Management and Soil Health practices will also:

- Conserve the natural resources within the Project Area.
- Support the symbiotic relationships with native prairie species and pollinators.
- Encourage wildlife habitat restoration.
- Promote good animal welfare farming practices.
- Create economic opportunities for local sheep grazers.
- Contribute to increased quality of life for the rural community by regeneration of soils.
- Preserve the agricultural economy at solar sites.

The agrivoltaic goals of the project are to:

- Provide vegetation management for the Project Area.
- Improve soil fertility using regenerative grazing methods.
- Create economic opportunities for new, beginning, and minority farmers.
- Strengthen rural public/private partnerships to contribute to a robust local food system.
- Keep the land in agricultural use.

2. Sheep Employed for Vegetation Management

Grazing is highly effective in managing vegetation around and under panel areas that can be hard to reach or expensive with conventional mowing equipment. Sheep are the recommended livestock for grazing underneath panels and racking equipment because they are small and agile. Their size and strength mean that any rubbing on equipment is unlikely to impact the PV panels negatively. Including sheep grazing for vegetation management will also have additional economic and ecological benefits.

"Grazing Management and Soil Health." *Natural Resources Conservation Service*, USDA - NRCS, http://www.nrcs.usda.gov/sites/default/files/2022-09/Grazing%20Management_SoilHealth_0.pdf. Accessed 14 September 2023.
Kaw Valley Grazing & Agrivoltaics, LLC: GMP 230914

3. Seed Mixes

Soil testing is recommended at the Project Area before the proposed seed mixes' finalization and construction commencement. The soil testing will inform the species selection and seeding rates suitable for grazing at KSEC.

The seed mixes will be customized based on existing conditions, the nutritional needs of the flock, and the expected construction timeline for installing the PV panels. The seeding plan for the Project Area includes seeding a cover crop preconstruction, terminating the cover crop, and then installing a species-rich mix of permanent perennial species with a cover crop to establish quick soil coverage. Alternately, the area may be seeded with a combined temporary seed and permanent perennial seed mix at preconstruction. The proposed seed mix will not include invasive or noxious species under State of Kansas Laws and Administration Rules.

a. Cover Crops

Cover crops containing annual grasses and legumes establish quickly, provide erosion control, build soil organic matter, reduce soil compaction, and assist with weed suppression before seeding perennial seed mixes. Seeding rates for cover crops are selected based on timing, seeding methods, and whether cover crops are seeded with or without permanent seed. Seed mix specifications for cover crops will be determined by soil test, timing, and season.

Cover crop seed mixes are designed to meet two primary objectives:

- Assist with establishing permanent vegetation.
- Soil stabilization occurs when agricultural land is left idle or overwintered before permanent seeding or Project construction.

b. Permanent Perennial Seed

The seed mixes will be customized to establish permanent and perennial ground cover compatible with the Project vegetation management goals.

i. Native / Non-Native Seed Mix

The seed mixes will be customized to blend native and non-native grasses, forbes, and wildflowers. The customized species will be adapted to compacted soils, moist soils, well-drained soils, wet and drought conditions, sun and shade, cool and warm seasons, and cold and hot weather.

Furthermore, the customized seed mix will provide good nutritional resources for sheep and encourage wildlife habitat restoration. Once established, this mix will enhance several ecosystem services compared to existing agricultural conditions or traditional turf grass mixes.

Immediate and long-term benefits include:

- Reduced soil erosion and runoff.
- Nutrient building.
- Water infiltration and purification,
- Biodiversity, increased pollinators, and other wildlife habitats.

ii. Native Pollinator Habitat Seed Mix

The customized seed mix will contain native grasses, sedges, rushes, forbes, and wildflowers. The blend provides a diversity of wildflowers, with flowering occurring over each of the three blooming periods (spring, summer, and fall), along with native species that provide benefits to pollinators and other wildlife. The seed mix is intended to be cost-effective, provide short to medium-stature plant cover, and improve soil health.

4. Seed Mix Vendors

The seed will be purchased from local vendors, when practical, that supply quality sourced seed. All seeds, including cover crops and permanent seed mixes, will be supplied with seed tags that indicate seed weight, pure live seed, region of origin, and noxious weed content. Seed mix vendors will develop permanent seed mixes that support the following objectives:

- Contracting with producers and seed companies to grow specialty seed mixes that meet the nutritional requirements of the flock measured by finishing rates.
- Low growth, quickly established, perennial, and native pollinator-friendly seed mix.
- A diverse mix of seeds targeted to soil type, drainage, sun and shade, and climate.
- Compatible with engineering objectives, including low-growth vegetation.
- Control of woody and invasive species.
- Conserving and regenerating soil health and biodiversity of the Project Area to preserve the rural agricultural land and economy for future generations.

C. Seeding Phases

A cover crop is recommended to stabilize the soils following harvest and pre-construction. Pre-seeding a cover crop will ensure ground cover through construction.

- Cover Crops
    - It is recommended that KSEC install cover crop seeds in the Project Area post-agricultural harvest.
        - The cover crop seed may also be combined with the permanent perennial seed mix.
- Permanent Perennial Seeds
    - The areas under the array area.
    - The perimeter areas inside the fence.
    - The perimeter areas outside the fence.

1. Anticipated Seeding Phases

Seeding of the permanent perennial seed and wildflower seed mix is anticipated to be completed in phases.

2. Seed Timing

Through time, native grasses will eventually establish naturally. To intentionally plant warm-season native grasses, the best time is between December 1 to May 15. After mid-May, cover crops should be used, followed by termination by mechanical mowing or grazing, then seeding of perennial mixes.

Winter seeding may be done between January and March when the ground temperatures cycle between freeze and thaw. Seeding should happen when there is light snow cover, preferably on dry days when the ground temperature is near but not above freezing. Seeding on windy days should be avoided.

Soil disturbance should be minimized throughout the construction process. Another suitable native seeding window is spring through July 15, but it should not occur if the seeding areas are experiencing a large flush of weedy species; soils should be prepped first and then seeded.

3. Seeding Methods

Seed installation methods depend on existing conditions and PV installation timing. Three standard methods are drill, broadcast, and culti-packer seeding (e.g., Brillion seeder).

a. Drill Seeding

Drilling is the preferred method for seed installation, where cover crop stubble and minor amounts of residue are present. Drill seeding typically requires less soil preparation and less seed. Drill double-disc openers should not exceed 6 inches between discs. For adequate coverage, the drill should pass over the soil two times from opposing directions. A drawback to drill seeding is difficulty maneuvering in tight spaces (e.g., near PV panels), and drill seeders are not viable for placing seed under PV panels. A native seed drill is recommended to install native species.

b. Broadcast Seeding

Broadcast seeding is required to install temporary and permanent seed mixes post-construction under PV

panels. Native species should be planted no deeper than ½ inch. Broadcasting seeds before moving sheep into the area is the best practice, and this will allow the weight of the flock to compact the soil and achieve seed/soil contact after spreading the seed. It is recommended that broadcast seeding be done up to 2 weeks before the installation of livestock. The high stocking density of the flock will help 'hoove' the seeds in creating more seed-to-soil contact.

4. Seeding Depth

Caution is recommended to minimize burying seeds too deep during broadcasting and subsequent packing/raking or drilling. Loose soils, such as in areas that are disced before seeding, are prone to deep seed burial. The recommended planting depth is between 1/16 - 1/4 inches deep, especially for tiny seeds that comprise much of the permanent mixes. Large seeds, such as cover crops, can be seeded slightly deeper, no more than ½ inch deep. Minimizing vehicle and equipment traffic in recently planted areas is recommended to minimize additional compaction and seed burial.

D. Site Preparation

Preparation for permanent seeding typically includes reducing cash crop residues, soil preparation on tilled soil such as discing, vertical tillage, or soil cultivator, and packing soils for firming before seed installation. Excessive field crop residue and associated soil compaction may hinder seed installation and establishment. Small grain stubble such as wheat, oats, and rye provide an excellent seedbed for cover crop seedling establishment.

Following cover crop termination, soil conditions provide a good seedbed for permanent perennial and native pollinator habitat seed mix.

1. Pre-construction

The construction timeline and soil tests will determine the seed mixes, termination strategy, and installation strategy of the cover crop and permanent perennial seed mix.

- The prior seeded cover crop should be terminated for the successful installation of permanent perennial seeds.
- Combining grazing and mowing will allow the best outcome to maintain the recommended cover crop height.
    - Depending on cover crop seed mix, construction timeline, soil temperatures, rainfall, and growing degree days, it is recommended that grazing and mowing start four weeks after cover crop seedlings emerge to maintain the appropriate height and to reduce weeds from flowering and seeding.
- Termination can include; grazing, rolling, chemical termination, mowing, or a combination of termination strategies.
    - Termination will be determined by construction timeline, soil temperature, rainfall, and growing degree days.

It is highly recommended that construction and seeding operations maintain good communication to anticipate which areas of the Project Area need to be terminated and seeded with permanent, perennial seed mixes, or alternatively will be seeded with a combination of cover crop and permanent perennial seed mixes.

Depending on the construction timeline, soil conditions, and rainfall, any mix utilized will be installed prior to construction. Grazing shall cease after termination of cover crop, and not begin again until 70% vegetation cover has been achieved after permanent seeding has occurred. Or alternately, grazing shall not begin until after 70% vegetation coverage after seeding of the temporary seed & permanent seed mix has been achieved by predominantly perennial species. This will assist in ensuring the successful establishment of vegetation coverage as required by the KDHE Construction Storm Water Permit.

2. Construction through Post-construction

Construction activity (e.g., pile driving, racking, and routine traffic) in areas where the permanent perennial seed mix is established is expected to result in moderate disturbance. These areas should be prepped and evaluated for reseeding using the permanent perennial seed mix or a combination of cover crop and permeate perennial seed mix.

3. Soil Amendments

Routine soil fertility and mineral testing are recommended to obtain any recommendations for soil amendments. Organic and non-organic fertilizers or other soil amendments should be used as indicated by

seed mix recommendations and in conformance with applicable local, state, and federal regulations. Native species establish best in low-nutrient environments. It is recommended that no synthetic and non-organic fertilizers or other soil amendments be applied after perennial species are established and when grazing commences. The exception is lime, which may be needed to increase the soil pH, making the soil less acidic and more alkaline. All soil amendments will be informed by soil testing and in accordance with applicable local and state regulations and recommendations.

a. Mulching

Mulch may need to be applied following permanent seeding to assist with seed germination in areas with limited vegetation establishment. Local sources of clean, seed-free hay or straw mulch are acceptable. Certified weed-free hay or straw is preferred. Wool can be a good substitute for hard-to-establish areas and is a natural byproduct of sheep management. Site-specific determination should be considered when addressing the mulching. All mulching management treatments are to be implemented in accordance with applicable local and state regulations and recommendations.

4. Invasive Weed Control Methods.

Appropriately timed seeding of cover crops and perennial species, along with adequately managed rotational grazing, can significantly reduce overall maintenance requirements for weed control. For the proposed Project Area, invasive and noxious weed species are defined under the following two categories:

- Includes species covered under State of Kansas Laws and Administration Rules.
- Species that are not legally defined as noxious or invasive but may interfere with the PV panels. Plant height may interfere with ecological goals and the establishment of native species or pose vegetation management concerns.

Invasive and noxious weeds can persist and thrive in abandoned agriculture fields. Excessive weed-seed germination often follows agriculture crop termination (aka, fallowing). This includes annual, biennial, and perennial weeds. The weed flush, left unchecked, will out-compete establishing permanent seed, and the site will become dominated by fast-growing, noxious, and incompatible weeds that compromise project goals.

Vegetation management facilitates plant establishment during the first two growing seasons. And proper management will ensure early problems do not become larger issues.

Invasive and noxious weed management should be conducted.

- Minimize the spread of noxious weeds from existing populations.
- Reduce competition and improve the establishment and success of the permanent seed mixes (as needed).
- Reduce vegetation impacts on PV panels and other solar facility infrastructure.

Besides grazing, noxious and weed species management may include cutting/mowing, hand-pulling, smothering, and spot application of herbicidal treatments.

a. Herbicides

Herbicides may be needed at various points of the site construction and operation process to control noxious species. Proper selection, use, and application of herbicides are important and outlined below.

In addition to natural controls like grazing or hand-pulling, mechanical controls such as mowing or

cutting, and in unique circumstances, biological controls are all tools to control invasive and noxious weeds. Herbicides are an effective tool for managing persistent invasive and noxious weeds, which may be needed during Project operation. However, respecting the vegetation and being ecologically sensitive to the Project Area is highly important. Using herbicides as the last "tool in the toolbox" to manage invasive and noxious weeds respects vegetation and ecologically sensitive areas and is highly recommended only after all other tools have been exhausted.

i. Herbicide Standard Industry Practices

Herbicides are vegetation management tools when used according to the manufacturer's instructions and following standard industry practices. The following practices are recommended when using herbicides to manage undesirable vegetation:

- Vegetation managers should apply principles of integrated vegetation management.
  Herbicide labels and Safety Data Sheets should be read before transport, mixing, loading, and application.
- The appropriate volume of herbicides and adjuvants necessary to complete a vegetation management task should be utilized.
- This includes targeted application techniques and properly calibrated equipment to minimize the environmental effects of sensitive areas.
- As product labels recommend, the appropriate concentrations of herbicides and adjuvants are used to achieve the intended outcomes.
- Use of selective herbicides to limit effects on non-target plants.
- Persistent noxious weeds typically require several treatments to control re-growth and spread adequately.
- Herbicide applications should be conducted during favorable weather conditions to maximize herbicide efficiency and minimize off-site drift and run-off.
- Avoid herbicide application during persistent heat, drought, freezing, or wet conditions.
- Herbicide should be applied to plants when plants are most physiologically prone to injury by active ingredients. Plants are most prone to herbicide injury when they are actively growing. Plant life cycles targetable for herbicide application include the flower bud stage and rosette stage. Plants that have senesced following flowering or are inactive due to high heat or drought should not be treated.
- Care should be taken to avoid injury to desirable grass species by waiting to apply herbicides after grass seedlings have matured for at least 90 days or have flowered at least once. Also, consult the herbicide label for application restrictions following seeding.

ii. Non-Selective Herbicides

Using non-selective herbicides for the KSEC Project Area is not recommended.

iii. Broadleaf-Selective Herbicides

It is recommended to use Broadleaf-selective herbicides cautiously for the KSEC Project Area.

iv. Grass-Selective Herbicides

It is recommended to use Grass-Selective herbicides with caution for the KSEC Project Area. Grass-selective herbicides are intended to injure or kill only grasses.

b. Herbicide Application Methods and Timing

Low-volume/spot applications are the only methods recommended for the KSEC Project Area. Timing should be based on a site-specific evaluation of target species, vegetation composition, and sensitivity of adjacent areas to herbicide applications.

i. Low Volume/Spot Applications

This method utilizes a hand-held sprayer mounted to small (3.5 to 25-gallon) tanks to selectively deliver herbicide to individual plants or small clumps of plants. Backpack sprayers are suitable for small areas, while pistol sprayers mounted to an all-terrain or utility terrain vehicle (UTV) are suitable for larger areas or large clumps of vegetation. Wicks may also be used for ultra-low volume delivery of herbicide to undesirable plants growing in sensitive ecological areas. These methods are appropriate for managing discrete populations of weedy and invasive species after construction.

ii. Broadcast Applications

This application method is not recommended for the KSEC Project Area.

iii. Herbicide Adjuvants

Adjuvants are typically added to herbicide mixes to improve herbicide performance. Herbicide labels should be consulted for recommendations on the types of adjuvants to add to a mix. Aquatic-approved adjuvants should be used to minimize potential impacts on wildlife, including pollinators. Aquatic-approved adjuvants should always be used in and near areas of standing water. Individuals should perform herbicide treatments in accordance with all applicable laws, regulations, and herbicide label instructions.

E. Grazing / Cutting / Mowing

Grazing or mechanical cutting/mowing should be appropriately timed once perennial vegetation is established to control noxious and weedy species (e.g., mow annual and biennial species during flowering and before seed production). Methods should be selected based on weed vegetation type, cover, and site accessibility.

Grazing or mechanical cutting/mowing is the primary management tool for establishing desirable vegetation. Grazing and mechanical cutting/mowing reduce the height of flowering or undesirable vegetation and maintain sunlight at the ground surface to encourage the germination and growth of desirable species.

Mowing using a deck mower is applicable in areas that are accessible with a small tractor and mower. Flail mowers are preferred, but rotary mowers are acceptable if significant clumping of grass clippings is minimized. A 3-point side-mounted trimmer mower attached to a small tractor may also cut vegetation around steel piles and under panels.

1. Mowing Height

Specific recommendations for mowing height vary by seed mix and location within the Project Area.

2. Frequency and Timing

The frequency and timing of grazing, mechanical cutting//mowing depend on the vegetation establishment timing. Mowing will be implemented throughout the establishment and maintenance phases with the goal of introducing the flock after predominate perennial vegetation has reached 70% coverage. The flock stocking rate will be increased to full capacity and stocked at a rate that is determined adequate by visual plant coverage, species biodiversity, and soil tests. At least one mowing per growth season (hot/cold/dormant) should occur during the first and second establishment year and grazing is expected to begin during the second establishment year.

It will take time for the established species to reach the required 70% coverage. Planning a grazing rotation before the grazing season starts is necessary, which is the guide for the flock manager's rotation plan. The flock manager would then use their experience and observations to decide daily if the rotation plan is reasonable and responsible and to make necessary adjustments in rotation days and stocking rates.

Examples of common adjustments to rotation plans include:

- First, in late spring, after rain events and warming weather, stocking rates may have to be increased to clear the vegetation growth.
- Secondly, in the summer, the flock may have to be moved from paddock to paddock faster than in spring or fall due to the slowed growth of cool-season vegetation.
- Predator and wildlife pressure.
- Weather.

a. Grazing: Establishment Phase

In the Project Area, frequent vegetation management is needed to manage vegetation height under the PV panels and to reduce fast-growing weeds.

The USDA - NRCS CONSERVATION PRACTICE STANDARD PRESCRIBED GRAZING Code 528 (Ac) applies to all agricultural lands where grazing animals are managed.

Following cover crop seeding, it is recommended that rotational grazing starts before the cover crops go to seed. If reseeding of the permanent perennial seeds is needed in disrupted areas, it is recommended that broadcast seeding be implemented up to 7 days before introducing the flock to the reseeded area.

Grazing will allow the flock to terminate the cover crops naturally. This technique will allow the management of the flock's health and productivity while nurturing the desired seeds and minimizing the use of synthetic fertilizers, leaving the soil covered to prevent soil erosion.

Utilizing grazing in the cover crop will also;

- Improve forage quantity and quality for grazing animals' health and productivity.
- Improve surface water quality and quantity.
- Improve or maintain riparian and watershed function.
- Reduce soil erosion, and improve soil health.
- Improve the quantity, quality, or connectivity of food and cover available for wildlife.
- Minimize soil compaction.
- Reduce fast-growing weeds.
- Maintain the land for agricultural use as necessary for agrivoltaics.

The GMP will minimize runoff and erosion and build soil organic matter through managed rotational grazing systems. The GMP will project the flock's stocking weight, frequency, timing, and duration to assist in establishing permanent perennial plants. The GMP will also;

- Minimize the flow of animal wastes into water bodies.
- Minimize animal impacts on streams or wetland areas.
- Provide adequate ground cover and plant density to maintain or improve infiltration capacity and reduce runoff.
- Maintain adequate riparian community structure and function to sustain associated riparian, wetland, floodplain, and stream species.

Additionally, mowing should be incorporated into the GMP until the permanent flock's stocking weight can increase to the Project Area's capacity. The stocking weight is determined by soil tests, the biodiversity of the permanent perennial plant communities, and the desired goals of the Project. The GMP will conform to all applicable Federal, State, and local laws.

b. Grazing: Transition Phase

By the third growing season, desirable vegetation should begin to be established. Years 3-5 represent a transition phase where desirable vegetation becomes increasingly diverse but remains susceptible to weed invasion. A minimum of one grazing or mowing should occur. Flock managers should target mowing for specific weed growth areas and reduce the incompatible vegetation height under the PV panels.

3. Long-Term Maintenance

Over the long term (years 6-30), grazing should continue at least once yearly. Mowing should occur once every 2-3 years as site conditions allow. Mowing is typically done during the dormant season (late fall to early spring) or, if necessary, in mid-to-late summer. The goal of routine mowing is to reduce weeds, encourage the growth of grasses, and minimize the establishment of woody vegetation. Actual mowing

frequency depends on soil moisture; wet areas and wet weather require more frequent mowing, while dry areas and dry weather reduce mowing frequency.

Haying, if feasible, offers better long-term management than mowing, as haying both mows and removes vegetation. The removal process reduces soil nitrogen. Reduction in soil nitrogen benefits desirable vegetation while discouraging noxious vegetation. Nitrogen reduction benefits native plants and pollinator habitats. Haying also benefits the producer with forage crops. The customized seed mixes will exclude non-edible, high bloat, and potentially toxic species to help make haying more feasible.

4. Grazing Hour

The amount of time the flock will spend in a paddock (grazing hour) will be considered for species regrowth, soil health, and flock nutrient needs. To allow for optimal plant regrowth, any flock's time in any grazing paddock should not exceed four days unless it is a dedicated sacrifice area or part of the grazing management to control weeds. The regrowth of plant species starts after four days of being grazed, and any grazing of this early regrowth can adversely affect plant health. Furthermore, a 4-day maximum rotation period reduces fecal matter contamination and improves pasture hygiene.

The pasture rest period (time between grazing periods) in the Great Plains should not be less than 40 days to minimize internal parasite pressure for sheep and to allow the plants to recover. As managed grazing is partially aimed at optimizing sheep's health and food sources, this health risk to sheep is minimized by following the GMP.

The Project Area also consists of access roads, inverter pads, and other site infrastructure that may consume a percent of the area within the Project Area and effectively reduce the overall vegetation area. The graziers should consider this acreage separately for each paddock. Furthermore, full vegetation coverage of the Project Area is expected to be low in the first 2-3 years. Increased reseeding rates should be considered during the first three years of grazing. However, once vegetation is established in and around the PV, and there should be no reduction in the flock's productivity compared to a traditional pasture once the pasture has recovered from construction. This GMP accounts for changes in growth using soil and forage testing to determine the grazing schedule and stocking rates.

NRCS. “Natural Resources Conservation Service CONSERVATION PRACTICE STANDARD PRESCRIBED GRAZING Code 528 (Ac).”

www.nrcs.usda.gov/sites/default/files/2022-09/Prescribed_Grazing_528_CPS.pdf.

F. Soil Fertility Improvements: Regenerative Grazing Method

Because KSEC is converting conventionally farmed agricultural land into a regenerative perennial grazing site, the Project Area soil, ecological, and biodiversity conditions will significantly improve. A carefully managed grazing system that utilizes skilled shepherds and recommendations from the United States Department of Agriculture- Natural Resources Conservation Services (USDA - NRCS) is critical for regenerating and conserving native ecosystems.

Carefully managed rotational grazing practices mimic how native ecosystems evolved. This practice is more advantageous to building soil fertility than managing vegetation through chemicals or mowing. Proper installation of a perennial species will maximize the forage nutrition while conserving and improving the soil for future agricultural use.

Sheep grazing has an essential role in maintaining soil health over the lifespan of a solar installation. A properly planned and managed rotational grazing system offers benefits.

- Direct soil fertilization via sheep grazing conserves and builds healthy soil ecology.
  Proper grazing and rest periods for the plants. These periods both encourage and protect plant root development.
- Living plant root structures in the soil year-round enhance soil microbial activity, nutrient flows, and a well-functioning water cycle.
- Prevents erosion, meaning soils are retained and enhanced.
- Soil structures improved over time.

1. High Stock Density Grazing using Adaptive Multi-paddock Grazing

It is recommended that KSEC utilizes High Stock Density Grazing (HSD) using Adaptive Multi-paddock (AMP) grazing to manage the vegetation. HSD using AMP grazing focuses on keeping animals in smaller areas at a time and then moving them regularly (often daily) so that vegetation can recover and regrow before being grazed again. The adaptive part of the system relies on direct observation of vegetation to determine the correct amount of time for animals to be in a single paddock and when the paddock is ready to be grazed again.

It is essential to distinguish between an HSD using AMP systems and a more traditional “selective grazed” (continuous grazing), where animals are put into a large pasture and left for extended periods. HSD using AMP is a practice of managing livestock grazing that mimics how native prairie ecosystems evolved - in relationship with herbivores. By focusing on quick, rapid grazing with long rest times, HSD using AMP allows species to grow long root systems that tap water deep in the soil bed, allowing a more extended grazing season in drought. Native species repopulate the pastures, allowing nutrient-building organisms to thrive.

HSD using AMP, calculates animal body weight and grazing area to determine paddock size. In this system, the goal is to move animals every 12-48 hours. Grass density is also a factor when determining the pasture's nutrient value. HSD using AMP causes more grasses and forbs to be utilized by animals eating or smashing the grasses down. Theoretically, the sheep eat 50% of the grasses, while 50% becomes ground cover. This system also concentrates animal waste into a more controlled and smaller area so that the soil organic matter increases from the wasted grass and the animal waste. This plan incorporates grazing to strengthen soil fertility and improve pastures. This rotational grazing system significantly improves soil health and forage yield over selective grazing or mechanical mowing and thus can support

greater animal stocking rates. Increased stocking rates and higher levels of animal performance with managed grazing will improve the economic returns to the producers.

An HSD using an AMP system in the GMP reduces synthetic pesticides and eliminates the need for non-organic fertilizers. This system does require more labor to manage vegetation. However, the overall parasitic management of the flock decreases due to the grazing rotation, thus decreasing parasitic exposures and management labor.

The GMP will outline a planned rotation for the flock. Each paddock's stocking rate is calculated based on the season, the flock's nutritional needs, and the biodiversity of the paddock. To allow for optimal soil regeneration, any flock's time in a grazing paddock should not exceed four days with optimal targets of 24-hour rotation.

A successfully managed sheep grazing system on large solar sites utilizes the following:

- Initial project grazing plan rotational map.
- Grazing experience in farm management.
- Ability to calculate stocking rates with pasture biodiversity density.
- Improve sheep genetics to promote stable flock health.
- A breeding plan allowing sheep yields to compete with the global market.
- Stringent treatment protocols for flock wellness that allow natural flocking behavior.
- Fulfilled nutritional requirements of the flock based on finishing rates.
- Access to mineral feed and clean and freshwater 24/7.
- Health checks every rotation day.
- Well-designed humane handling systems for animal wellness checks and treatment.

The pasture's biodiversity and soil health are expected to be low until perennial species and forbs are established. The GMP allows season and climatic events to shift the rotation. The producer would then use their experience and observations to decide daily if the rotation plan is reasonable and responsible and to make necessary adjustments in rotation days and stocking rates.

2. Soil and Forage Tests

Soil and forage tests should be performed before and after construction. A detailed organic matter (OM) soil test and nutritional forage test protocol are recommended for the GMP. These tests will help inform sheep stocking rates. Grazers may perform soil and forage testing at regular intervals to analyze the health of the soil and the nutrient quantity of the forage for the flock. Soil and forage tests will allow for adjustments to the planned grazing rotation.

3. Planning, Production, & Rotation

The agrivoltaics plan centers around a managed rotational grazing system outlined by a GMP. The GMP is a blueprint for managed grazing that determines:

- Sheep stocking rates.
- Potential paddock size.
- Timing of flock movements.
- Duration of pasture rest periods.
- Seeding protocols.
- Weed control protocols.

The GMP facilitates site management that achieves targets for vegetation control, flock production, soil

health, stormwater runoff reduction, pollinator supply, and water quality improvements.

4. Sheep Pasture Rotation & Grazing Plan

The Project Area will have ample fenced areas by its planned design. From the view of a grazier, the fencing at solar sites serves as grazing areas that, once subdivided into grazing paddocks, will assume ideal conditions for a pasture rotation with sheep.

The perimeter fencing and rotational grazing serve as predator deterrents, the solar panels provide shading and shelter for the animals, and the land used for PV panels provides nutritious pasture species for ruminant health. In turn, rotationally grazed sheep provide adequate and comparatively cheap and community-building vegetation management for solar, optimal ground coverage, and thus reduced erosion and run-off, and agricultural usage of lands that can add to the viability of farming communities.

Each permanently fenced array will be divided into smaller grazing units. The GMP requires dividing each array into fenced areas. Paddocks are created using permanent perimeter fencing and portable, battery-charged Electronet® fencing. The Electronet® is a portable fence used by grazers. It is a white, lightweight, temporary fence that is energized using a portable battery/solar combination or 110V power supply. This fencing is simple to power on/off and will only be inside the permanently fenced areas.

Typically, the grazer will mow perimeter paths where the grazing team will install the Electronet®. Using permanent and temporary fencing to form paddock walls, although some paddocks may be formed entirely by lengths of portable fencing. This system allows the grazers a high level of control over the vegetation. The portable, battery-charged Electronet® fencing allows for a simple, efficient rotation.

5. Wildlife

Properly managed perennial pastures can provide vast benefits to wildlife. Wildlife use of native grasses is well documented. Grassland nesting birds and other wildlife species utilize pastures. Grazers must avoid overgrazing to encourage wildlife diversity in the Project Area (unless overgrazing is strategically implemented as weed control). The GMP will include consideration for wildlife needs in the grazing rotation.

During operation and after initial ground vegetation establishment, management of array vegetation should minimize mowing impacts on wildlife, particularly grassland bird nesting, from late spring through summer of each year. Vegetation management activities should be scheduled outside this avoidance period to the extent feasible. Since mowing lanes is required during the avoidance period to install the grazing paddocks properly, personnel should be trained to look for sensitive wildlife to minimize impacts before engaging in such activities.

6. Pollinators

Planting a diverse permanent perennial species mix provides pollinators with blooms throughout the year. Establishing cover of native grasses, legumes, and forbs increases pasture biodiversity to ensure flowers bloom for as long as possible. This will attract pollinators throughout the growing season.

After establishment, well-managed grazing of the Project Area vegetation should minimize impacts on pollinators. Grazing will improve permanent perennial species composition and vigor of plant communities. It is recommended to include managing for pollinator forage or nest sites in the Project Area.

7. Predator Protection

Well-trained Livestock Guard Dogs (LGD) and herding dogs are valuable assistance to farmers. LGDs will permanently live with the flock at all times. LGDs are trained to protect the flock from coyote predation specifically. Herding dogs will be used to sort and control the flock's movement and aid in animal handling. Herding dogs do not live with the flock but are the manager's helpers. All dogs working around livestock must be properly trained and under control at all times. Working dog protocols will be incorporated into the GMP.

Based on the final facility design, if any culverts are determined to require predator barriers to protect grazing sheep and LGDs, appropriate features will be added. These barriers will only be required if a culvert of sufficient size is constructed that may allow predators such as coyotes to enter or allow LGDs to exit grazing areas.

8. Animal Welfare

Practical and common-sense Animal Welfare (AW) standards are recommended for the GMP. AW's main function is to provide commercial flocks at solar sites with good, peaceful, and humane lives. Flocks should be raised outdoors on pasture for their entire lives using AW standards. AW is important to healthier farming ecosystems, contributes to pasture hygiene, and supports community values.

The AW standards at KSEC should have a minimum of the following:

- Improved genetic protocols for effective and humane grazing under the PV. This will also allow for additional income for the producers.
- It is recommended to graze similar groups together
    - Dry (non-lactating) ewes, open (non-pregnant) ewes, ewes in their early stages of pregnancy, yearling ewes, or growing lambs. In the case of groups of growing lambs post-weaning, the lambs should be of the same sex or the males castrated by banding.
- Ad libitum clean and fresh water access.
    - Site-specific amenities like well water, connection to municipal water lines, or well water access are necessary for grazing. Before the commencement of grazing, suitable freshwater sources will be identified for the Project Area. Municipal water is not currently available at the Project Area; therefore, sources that will be considered include existing wells, new wells, existing ponds, or water tanks filled with freshwater transported to the site via truck. The wells or other water sources are anticipated to tie into a 1-inch plastic irrigation line on top of the ground and reach each paddock in the array. Freeze-proof watering troughs will tie into this, and the line can be drained in the fall and remain in place for the winter.
    - For sheep of the recommended production stages (non-lactating and > 60 lbs growing lambs), water requirements are very low in spring and fall and higher during summer. Typically, dry, non-gestating ewes consume between 5 and 10 % of their body weight in water daily, while lactating ewes can consume up to a gallon of water daily.
    - On average, each well/water source will serve the entire flock and should not need to draw more than 2,000 gallons a day in the hottest part of the summer. In early spring and late fall, the sheep have lower water needs from the wells/water source.
- Mineral feed must be available ad libitum and contain adequate concentrations.
    - Mineral feed is specially blended and commercially available for sheep producers. This is an important animal welfare and nutritional requirement often insufficient in the soil. It is recommended to set up standards for testing the minerals in the soil. Until and if the mineral content of the soil increases to sufficient levels, the mineral feed should be

offered in troughs that can be moved with the flock daily.

- The flock care team will visually inspect the sheep every day. Moving the flock(s) to the next paddock is a great time to seek out, monitor, and care for any sheep requiring it.
- A wellness inspection of individual sheep is recommended at regular intervals.
    - It is recommended that buffer areas at the Project Area consist of hay fields, animal handling pastures, compost, barn, and flock handling areas.
    - This inspection is only possible with a handling system. A well-thought-out handling system will be an essential tool for the flock manager. Handling systems for sheep can be portable or permanent.
    - The handling system and sacrifice areas will be semi-permanently located at a central location, and collapsible handling systems will be transported on a trailer for quick wellness checks as needed.
    - The system must allow gathering, leading in a single-file line through a treatment chute, stopping, and sorting sheep. Several commercial manufacturers of these systems are available in the US, including Sydell, Premier 1, and Te Pari. Handling sacrifice areas within the Project Area will be decided once the final civil layout is made.
- Before the flocks begin the grazing season each spring, certain protocols are recommended to ensure the flock is in optimal health before seasonal grazing begins.
    - Hooves must be checked and trimmed.
    - Ear tags replaced or added in compliance with The United States Department of Agriculture's Animal and Plant Health Inspection Service (APHIS), National Scrapie Eradication Program.
    - Wool sheep must be shorn.
    - Body condition scored before moving on site. This measurement provides information about the nutritional and health status of any animal on site and can be used to adjust the grazing rotation.

G. Creating Rural Economic Opportunities

As the KSEC development progresses in Douglas County, rural economic opportunities for a sheep grazing industry in Douglas County will emerge.

The agrivoltaic sheep grazing industry will:

- Promote opportunities for new, beginning, and minority farmers.
- Preserve agricultural land production.
- Create agricultural jobs for rural families.
- Build valuable and rare infrastructure for rural communities in multiple markets, including food, wool, and leather production.
- Scale secondary markets in rural communities' feedstuff commodities, farming equipment, vet services, and skilled contracted labor.
- Strengthen local services such as regional freight haulers and third-party fulfillment logistics.
- Attract investments for agricultural, market, and technological entrepreneurship.
- Increase the state and local tax base.
- Secure local and regional food systems from climate and economic disruptions.

A developed agrivoltaic industry catalyzes agricultural entrepreneurial opportunities to build robust local and regional food industries. In addition, KSEC's goal is to evaluate the feasibility of managed grazer(s) utilizing long-term contracts. Having contracts for long durations offers more security for producers and will allow them to invest in animals, agricultural infrastructure, and logistics they may need. Land access through agrivoltaics offers the following benefits for participating local food entrepreneurs:

- Producers can use long-term grazing contracts to build and scale commercial sheep enterprises. Access to securely fenced grazing areas can provide a resource base for a sheep flock that produces feeders, market lambs, and breeding stock.
    - The grazing area within the Project Area provides a feedstock resource that the farmer traditionally needs to purchase.
    - Producers can use their animals, time, and expertise to gain additional income from a vegetation maintenance contract with the Project owner.
    - The income from the grazing vegetation management contract provides meaningful revenue and can improve farm viability for farmers.
- KSEC will design an efficient grazing model.
- Permanent low interior fencing may be installed for easier grazing rotations.
- Also, semi-permanent above-ground water lines and freeze-proof water troughs fed by on-site wells or tanked water for easy delivery to the sheep flocks may be installed based on site development.
- The site plans might include a barn and animal handling areas to maintain year-round agrivoltaic management at the solar site.
- Additional buffer areas may be included as hay fields for winter feed for the flock.

Soil and forage tests, the biodiversity of the Project Area, the construction timeline, and the growing season will determine the total number of sheep for the Project Area. The initial estimated carrying capacity of the proposed site in the vegetation establishment phase is 1,430 mature ewes. As the soil, forage, and biodiversity of the Project Area improves, so will the carrying capacity of the soil. These animals may be contracted from one or more farms until a permanent flock is established in the Project Area.

H. Conclusion: Strengthening Rural Public/Private Partnerships

As the solar grazing industry emerges, research and policy are needed to facilitate best practices supporting grazers and solar developers. The American Solar Grazing Association (ASGA), a national organization, was founded to promote sheep in solar areas. It is recommended that the KSEC Project becomes certified through the ASGA Solar Grazing Training Certification Program. The ASGA-Certified training course covers key topics and best practices for using sheep to manage vegetation on solar energy sites.

Additional educational resources in this region make it advantageous for agrivoltaics to scale here. Agrarian Future Alliance offers services for new, beginning, and minority farmers interested in agrivoltaic careers. Johnson County Community College provides a sustainable agriculture certificate covering many critical food topics. The University of Kansas also offers a small business development center for business planning, financing, accounting, marketing, and taxes. In neighboring Manhattan, KS, the SAVE Farm trains veterans to become successful producers.

Furthermore, multiple regional organizations are already working to improve local food access and capacity. Based out of Kansas City, the Growing Growers program provides workshops and a connection for new producers to intern with existing producers and gain vital experience and knowledge. A sister organization, Cultivate KC, is working to improve local food access and support local producers inside the greater Kansas City urban area. The Kansas Rural Center and Sustainability Action Network are aligned nonprofits that support and do research in support of local food issues and access in this region.

In addition, Douglas County is home to CORE, a community initiative to energize Douglas County's entrepreneurial ecosystem. Douglas County Sustainability Department also focuses on agricultural lands and local food, including an FPC Food System Plan of Douglas County, Kansas.

Douglas County, Kansas, has a long history of support for local food production, agricultural heritage, farming values, and rural economics. Furthermore, the culture surrounding local and regional food production has created a path for agricultural innovations that solve many industry bottlenecks for new and beginning and minority farmers, including access to land and agricultural infrastructure. Plus, local agricultural entrepreneurs have resoundingly shown interest in recognizing the scale this unique opportunity provides for the sheep grazing industry.

The proposed Grazing Management Plan:

- Outlines a seeding plan, methods, establishments, and vegetation management through sheep grazing.
- Keeps agricultural land in production with a scheduled rotational grazing system.
- Conserves the rural economy by keeping the land in production.
- Builds soil fertility using proven regenerative grazing methods.
- Incorporates the highest animal welfare standards, allowing the flocks to live naturally.
- Eliminates land access barriers for new and beginning and minority farmers.
- Brings investment opportunities to build vital agricultural infrastructure.
- Creates agricultural entrepreneur opportunities for a secure local and regional food system.

The unique confluence of these factors - strong support for local food producers by city and county government, an existing strong culture of local food, small farms, and agricultural

entrepreneurs, and experienced and scalable local sheep brands and grazing experts - makes Douglas County, Kansas, the best place - and Kansas Sky Energy Center the best Project to scale agrivoltaics.