APPENDIX 15-E REVISED

Agrivoltaic Solutions Site Design

Agricultural Co-Location – Initial Analysis

Somerset Solar, LLC

Niagara County, New York

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February 2023

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Overview

The Somerset Solar project is projected to occupy approximately 1,765 acres on and adjacent to a former coal power station (1,090 acres) on the shore of Lake Ontario in the Town of Somerset, Niagara County, New York.

To meet NYSERDA incentives and project application compliance through the Office of Renewable Energy Siting 94-C process, the Somerset Solar project is being evaluated for possible agricultural co-utilization strategies. There are several considerations to guide decision making towards a robust and practical co-use strategy. Managed sheep grazing and potentially some small-scale hay production are strategies that make the most sense for the project.

Local agriculture and farming resources

Niagara County, NY hosts an active agricultural community consisting of close to 700 farms operating on over 140,000 acres according to the 2017 national agricultural census.[1] More than 80% of the farming is crop production, with Niagara County producing approximately 2% of NY agricultural sales. The majority is from sales of fruits, tree nuts and berries – the county is the 5th largest fruit and nut producer in NY, and Niagara County is ranked 91st nationally. Vegetable production, grain, dry beans, and dry peas follow in order of majority production for the county.

Regionally, New York is the largest sheep producing state in the Northeast with close to 90,000 head. Sheep production is a small part of animal agriculture in Niagara County, ranking behind cattle and poultry. The 2017 Census of Agriculture counted just 803 sheep and lambs and overall sales of livestock <40% of county agricultural sales. Data from the next census of agriculture will be key in identifying any changing dynamics in the county.

Niagara County ranks 26th out of the 62 counties in New York in dairy production. Due to challenges within the dairy industry (years of marginal profitability and increasing age of active farmers with lack of interest in farm succession) but with abundant agricultural infrastructure (farm supply vendors, feed mills, heifer barn facilities, etc.) in place, it is expected that the sheep sector may increase in size in NY State, with increased utilization of resources form the dairy sector. [2] Additionally, with regional hubs like New York City or Rochester

[1]United States Department of Agriculture, National Agricultural Statistics Service, 2017 Census of Agriculture, U.S. Summary and State Data, Niagara County, New York, https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/New_York/cp36063.pdf

[2] Kochendoerfer, N., and M. L. Thonney. 2021. Grazing Sheep on Solar Sites in New York State: Opportunities and Challenges. Scope and scaling-up of the NYS sheep industry to graze ground-mounted photovoltaic arrays for vegetation management., Cornell University Atkinson Center for a Sustainable Future, Ithaca, NY. https://bpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/c/9310/files/2021/03/Solar-Site-Sheep-Grazing-in-NY-v2.1.pdf

in proximity, ethnic markets are growing and a strong demand of small ruminant meat is already present; It is expected that demand will increase. [3]

Furthermore, considering the intensive land use practices in Niagara County, with 83% of the farmland in crop production and 31% of the farms utilizing intensive tillage strategies, conserving land in pasture to allow perennial growth with deeper root systems, will essentially lock soil organic carbon long term and contribute towards heathier soils. [4]

Site Characteristics

The Somerset Solar project layout was given a high-level review by AVS. The site layout is comprised of 8 separate buildable areas (A – H) of fenced solar ranging in scale from +/-35 acres to 1,090 acres. The land is owned by 2 companies, Terroir Development LLC (Areas A and D), and Somerset Operating Company LLC (Areas B, C, and E – H). Areas A and B are consecutive acres North of Rt 18 adjacent to Lake Ontario. Land parcels South of Rt. 18, between buildable areas is owned by various private landowners, giving the site a more fractured outline.

Location and previous land use

Two areas, making up more than 50% of the overall project acres, are located north of Lake Road. The balance of the project, comprised of six smaller fenced arrays, are located south of Lake Road between State Route 65/Hosmer Road, and State Route 108/Hartland Road. Much of the site appears to be located on small crop and hay fields, with numerous fruit and/or nut orchards observed. Given proximity to Lake Ontario, there are numerous small wetlands, marginal, and successional scrub land. A detailed description of previous usage as well as soil types[5] is given below and laid out in Figure 1:

- ***Section A*** will be built on an estimated 175 acres area that consists of mainly cropland and seems to have been intensively tilled in previous years. Soil types are mainly silt loam (> 75%), followed by very fine sandy loam and loamy fine sand. A small wetland (Wayland soils complex, frequently flooded, <0.5%) is in the center of the tilled cropland section.
- ***Section B***, is a formerly active coal plant comprised of approximately 1,090 acres. This area is more than 60% of the total project site. The soil profile of this section is similar to section A, with >80% consisting of silt loam. However, the usage of this section as coal plant warrants soil testing.

[3] Mount Morris Agrivoltaic Study, Lamb Demand In Northeastern US, 2021, Julie Stepanek Shiflett, Juniper Economic Consulting, https://solargrazing.org/wp-content/uploads/2022/01/MountMorris-AgrivoltaicReport-FINAL_PRINT_ready.pdf

[4] Amsili, J.P., H.M. van Es, R.R. Schindelbeck, K.S.M. Kurtz, and D.W. Wolfe, G. Barshad. 2020. Characterization of Soil Health in New York State: Summary. New York Soil Health Initiative. Cornell University, Ithaca, NY. https://bpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/6/7573/files/2018/04/Characterization-of-Soil-Health-in-New-York-State-Summary-Report.pdf

[5] United States Department of Agriculture, Natural Resource and Conservation Service, Web Soil Survey. https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

- ***Section C*** is located South of Rt 18 and is approximately 100 acres. The site is in agricultural use and consists of about half cropland, and half successional shrub land and fruit trees. Soil types are almost exclusively silt loam.
- ***Section D*** is 150 acres of mainly silt loam with a smaller portion (< 15%) of loamy fine sand. The section consists of mainly successional shrub land with a smaller portion of tilled crop land South of Haight Rd, surrounding West Somerset Cemetery.
- ***Section E*** are 35 acres, evenly divided into tilled cropland and successional shrub land. Soil types are silt loam and <5% loamy fine sand.
- ***Section F*** extends from Rt 18 to Height Rd. and is 110 acres. Mainly crop land, small areas of successional shrub land in Northwest and abandoned fruit trees in Southeast. In the Southeast a wetland (Wayland soils complex, frequently flooded) consists of approximately 11 acres (10%). The rest of this section is mainly silt loam, with >20% loamy fine sand.
- ***Section G***, a 35-acre area is intensively used (tilled) cropland. Dominant soils are silt loam.
- ***Section H*** is 70 acres and previously was used as tilled cropland in the West, with a majority of the eland being successional shrubland and trees in the East. The dominant soils are silt loam.

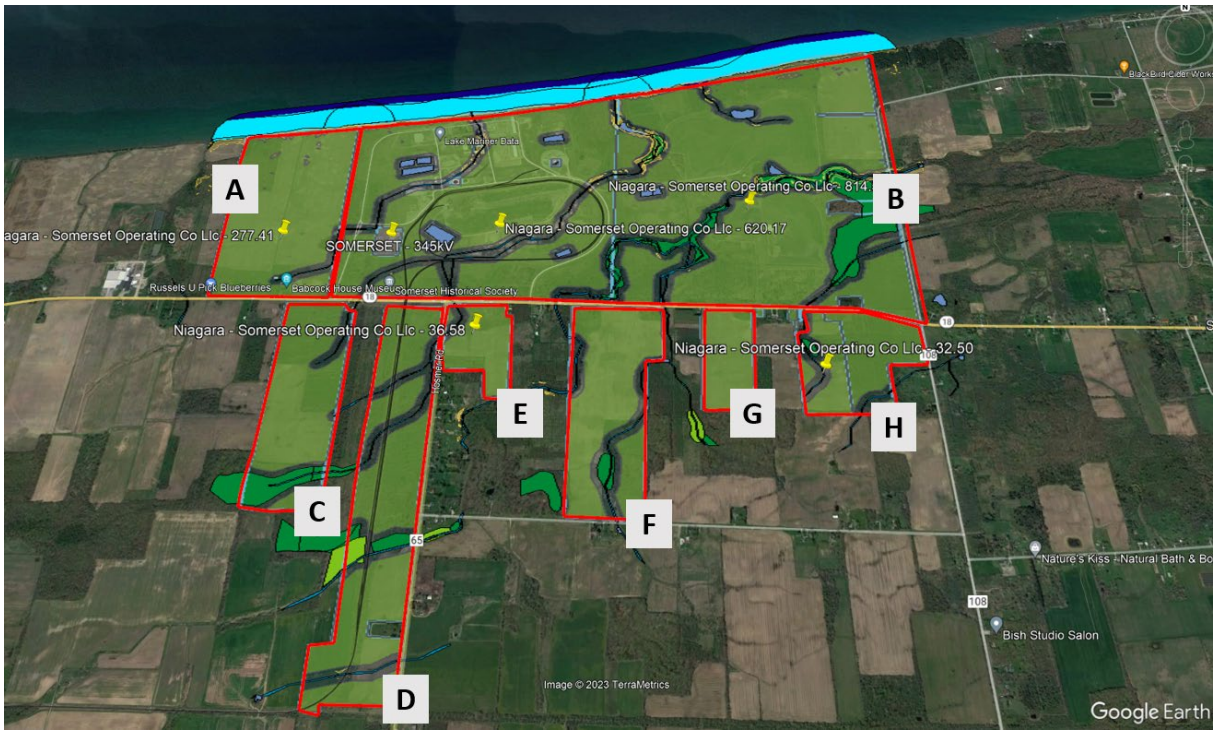

Figure 1. Site layout.

Soil characteristics

The dominant soil soils in the project, Collamer, Niagara, and Rhinebeck silt loam are all rated “medium” for their susceptibility of compaction during planting, management and harvest in crop rotations, a significant

potential for compaction with subsequent restricted growth for plantings. Due to the land use change towards perennial vegetation under solar panels, an increase in soil quality (mainly sequestered soil carbon) can be expected. Soil types present are suitable for both pasture and hay forages. To establish perennial vegetation cover, the entire area will have to be seeded to pasture and or hayfield seed mixes, containing species like Orchardgrass, Kentucky Bluegrass, White clover, Timothy, Quack grass, etc. It is expected that perennial species part of the resident vegetation and present in the seedbank will volunteer after intensive tilling is abandoned.

Weather and climate

Monthly precipitation is on average is between 2.69 inches (April) and 3.35 inches (September) in the forage growing season, with average temperature between 35 F (low, April) and 81 F (high, July). Conditions are ideal for forage growth. [6] Both, cool season grass species (Kentucky Bluegrass, Orchardgrass Ryegrass), requiring a temperature between 40 F and 75 and forage legumes and warm season species (Ladino Clover, Red Clover, Alfalfa, requiring temperatures between 70 F and 95 F will find optimal growths conditions [7].

Potential co-location opportunities

AVS looks at the Somerset project as a potentially grazeable site, with exception to the areas formerly occupied by active coal production. The silt and sandy loam soils of the project site are ideal for grazing operations and yield good forage quantities. With an average estimated 7 AUM (Animal Unit Month) [8], an expected stocking rate of 4 sheep per acre could be achieved. Appropriate pasture seed mixes will eventually yield good forage quantities on sections built on former crop fields or cleared, successional shrub land. The grazing pressure in freshly seeded areas (cleared successional shrub land and crop fields) will slowly be increased to avoid overgrazing and allow for an optimal forage stand as well as compliance with SWPPP.

There are currently few grazing contractors operating in Niagara County but there is growing interest and AVS anticipates this will change with more opportunities. Especially the smaller areas south of Lake Road are ideal for grazing operations and could be managed by smaller flocks ranging between 150 and 750 sheep. These are ideal opportunities for growing sheep farms and smaller flock owners. These flocks would be seasonally rotated through the individually fenced areas and could even be – given landowner support and preference – moved among these smaller sections. It is realistic to expect that landowners, owning parcels between the project areas South of Rt 18 are not interested in allowing sheep flocks to cross their land to rotate to another area (for example, from section E to section F, navigating fruit tree operations. This remains to be seen. However, depending on the requirements of a potentially larger flock, trucking could be utilized as well. Alternatively, the site could be grazed with smaller flocks separately in each area. This

[6] National Oceanic and Atmospheric Administration. National Centers for Environmental Information. https://www.ncei.noaa.gov/

[7] University of Vermont. Vermont Pasture Network. https://blog.uvm.edu/pasture-vtpasture/2014/05/19/162/

[8] United States Department of Agriculture, Natural Resource and Conservation Service, Web Soil Survey. https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

depends also on the sheep flock owner/ grazier. Additionally, section A could support another, larger, flock of sheep.

Grazing or haying areas formerly occupied by a coal plant is only advisable after extensive testing of soil, forages, ground, and above ground, standing, water. Coal ash as well as other environmental pollutants (including but not limited to lithium and arsenic) and potentially unsafe mineral levels of molybdenum, cobalt, or selenium due to coal production activity may render grazing lamb producing flocks for human meat consumption unsafe. Further, elevated mineral and toxin levels may cause metabolic or hormonal disturbances for grazing animals and should only be advised after excluding the possibility of uptake of unsafe chemicals into the forage resource.

Areas cleared from successional shrubland will benefit from grazing, however these areas would also be treated with more focused mowing in initial years. It will take some time for seed mixes to establish and form root systems and sod – during this time sheep grazing can slowly be scaled up, creating a more dense vegetation, and increase bulk density of the soil – all beneficial to prevent wind or water erosion. Sheep will be able to handle resident vegetation and early successional species like poison parsnip or poison Ivy.

Depending on local interest and capacity of contracted farmers, there are additional opportunities for hay production as well.

Next Steps

There are several next steps that should be taken soon if managed sheep grazing will be pursued for the Somerset Solar project.

AVS should begin a review of site civil layout and other infrastructure as it may pertain to grazing. In particular, tracker/racking type, CAB or similar systems, perimeter fencing, and gateways are most important.

AVS will provide feedback on any a necessary design changes needed to accommodate grazing. These will most likely be regarding site fencing.

AVS will also provide a list of recommended infrastructure for managed grazing, mainly around water supply/distribution and additional fencing and gates.

AVS recommends reaching out to potential farmer partners early in the process to gain input and assess interest.

Get soil and water and forage ssampling campaign started on coal plat to determne if sheep can be grazed.

Solar Facility Layout and Design Guidelines for Managed Grazing

Prepared for AES Clean Energy

Size of sheep: Size is breed dependent, but on average, adult sheep stand about 36-42" at the tip of their ears and 30-36" tall to the top of the shoulder. They duck under the leading edge of the panels at solar sites with panels as low as 24".

Fencing

Perimeter fences

- Specifications
  - Height is to be determined by FERC or other codes and does not need to be higher than 6' for sheep.
  - Tensioned woven wire ("ag fencing") 12.5 gauge or heavier is acceptable, chain link is always preferable.
  - Chain link requires a bottom tensioning wire above the ground, this is important for keeping sheep inside and predators outside.
  - Woven wire is designed for high- tension installation and will typically not require this additional tensioning wire.
  - Maximum post spacing for woven wire is 15' to ensure proper tension.The most important aspect for grazing sheep is the bottom gap tolerance to the grade. This should be as close to 0" as possible and should be tightly contoured to variations in grade with no openings or gaps. Maximum gap tolerance is 1.5".
  - If possible, bottom of fence should be buried slightly below the soil surface by post- installation grading. Another option for high predator areas is a "predator wrap" of fence material that lays out onto the ground for 6-8" away from the perimeter fence.

Figure 1. Perimeter fencing that follows grade well.

Gates

- Gates will be of the same fencing material as the rest of the fence, in the case of woven wire they will most likely be woven wire over a pipe framework.
- Ideally total gateway will be at least 20' wide, 24’ is preferable. This becomes more important for larger groups of animals. Gate width is highly important to be able to safely move larger groups of animals and avoid fence damage and injury to animals and personnel.
- Grade the roadbed under the gates for maximum tolerance of 3” between bottom edge of gate and ground. Avoid large gaps between the roadway shoulder and the gate.
- Gates should swing freely both ways.
- Alignment recommendations:
  - Whenever possible gates between project sections should be lined up, facing one another.
  - Gates do not need to face roads – some interior facing gates will be necessary.
  - Gates should be positioned to allow for the flow of animal traffic from one power block or fenced section to the next. The smooth transit and/or flow of animals is the goal.
- Other gaps in perimeter fence such as culverts or ditch crossings should be covered with steel mesh or “hog panel” material.

Interior fences

- Woven wire fencing will be sufficiently sturdy and cost effective.
  - 42-48” ideal height, but 36” will be acceptable.
  - Standard metal pipe gates are recommended for access road crossings, see below for more interior gate information.Power blocks & paddocks
  - For managed grazing programs on large scale solar sites, sheep will be rotated on a schedule through the site in paddocks, or site sub-sections that are broken down with portable or permanent fencing.
  - Paddock size is largely dependent on the site stocking rate described in the managed grazing plan. A rotationally grazed site, or area of site, will be divided into a minimum of 10 grazing paddocks. In many cases, some strategic placement of permanent interior fence greatly helps with creating paddocks and reducing the need for portable fencing installed by the grazing contractor. Permanent paddock fencing is both attractive to potential grazing providers and will reduce operating costs over the long term.
  - The grazing paddock layout will generally fit to the layout of power blocks and roadways, as it is easier to fit fencelines along roads and through gaps between powerblocks. It is difficult to install portable fencing across CAB lines and raised drivelines.
  - The paddocks / interior fencing could be constructed of woven wire mesh, as the perimeter fence.
  - Height: It can shorter: 36” or 42” will suffice.
  - Hot wire not necessary at the top
  - Fence should be connected to the perimeter fences.
  - Interior Paddock Gates: The gates should be planned in the site layout. There will be two types of gates: those for the sheep flock and those to allow general service person passage from one fenced area to the next.
- Sheep gates:
  - Where possible they should line up with interior laneways
  - They should be sized (in length) to allow for the passage of vehicles at roadways
  - Width should be 20-24’; double gateways are recommended.
  - Height is typically no more than 50”, should match interior fence type.
  - Gates will need to swing freely in both directions
  - Gate construction should be of wires that are spaced 4” on center or tighter
  - Gaps between gates and posts or gates and ground should
  - not exceed 3”.

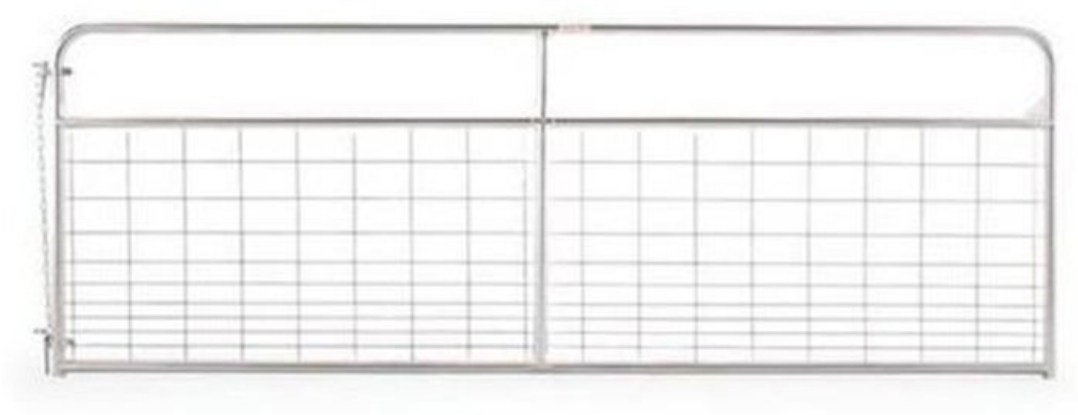

Figure 2. Sheep gates.

- Person gates
  - Should be placed to allow the easy flow of workers around the site.
  - Width likely 48”
  - Height is typically standard at 50”

Electrical access

- Providing the sheep farmers with access to 110v and/or 220 v power would be helpful.
- One box of outlets per powerblock or interior paddock is recommended.
- Shepherds will have limited use for this electricity: typically, it is to power a low voltage fence within a paddock or it would be to pump water. An example of the low voltage Electronet® fence is provided here, by Premier 1, the major manufacturer of this product line.

Wiring/Racking

- Good wire management is of paramount importance. Wiring should be neatly tucked and secured, with no large loops or dangles. Loose wiring not only can be caught by sheep, but also poses risks to mowing and trimming equipment.
- Conduit and sleeves are useful for wire control, as are zip ties.
- It is recommended that CAB cabling on grazed sites be installed 24-32” above the ground to allow sheep to easily pass underneath without excessive rubbing or swinging. CAB has been widely used successfully on grazed sites, even when installed lower than this, but considerable care should be taken to ensure good wire management, especially when wires are joined into the CAB system.
- It should be noted that sheep may swing or push on the CAB system as they pass through. It may be worth looking at options for heavier gauge CAB support cable and hanger brackets in the long term.

Figure 3. Sheep passing under CAB cabling.

Figure 4. Good wire management on module-module connectors.

Figure 5. Poor wire management on CAB system, has caused sheep entanglement.

Water

- The sheep will need fresh drinking water in every site paddock. Water requirements are highly weather dependent but at peak will be in the range of 1-2 gallons per sheep per day for mature sheep.
- Water can be delivered through the site using aboveground flexible ¾”-1” poly water line. These lines are best laid along site roadways or along fencelines and are easily drained to avoid freezing in winter. These will be fitted with spigots at regular intervals to allow water tanks to be moved from paddock to paddock as the sheep move through the site.
- Ideally, water should be sourced from on-site wells or municipal hookup if available. As a temporary measure, water can be trucked to holding tanks which feed into the delivery lines. Solar pressure pumps are a good solution for wells or tanks that offer flexibility in location and cost efficiency.
- Sheep are selective about water sources and will avoid dirty or brackish water. Pond sources of water may be an acceptable source to pump from in some instances but it is important to note that the dry periods of the summer are when sheep water needs are highest and are also often when pond levels are low and water muddy.
- Sheep should always be fenced out of ponds and other surface water to avoid manure contamination. This is best done with a permanent fence of the same type as recommended for permanent paddock fencing.

Sheep Exclusion

Equipment Pads

- Sheep are naturally curious, and while they do not pose a risk of damage to site equipment pads, they often find them attractive places to gather at and sleep on. This can lead to large amounts of manure collection and a nuisance to service personnel. Equipment pads should have simple exclusion fences places around them with gates for technician access. Height and material can be the same as the interior paddock fencing, or even simple metal gates can be set up around the exclusion area.

Figure 6. Simple exclusion fence around equipment pad.

Winter Housing

- The sheep will need winter housing off site or adjacent to the site. Sheep will not overwinter in Upstate NY otherwise. Generally, sheep will be off-site between November and May.

Handling Systems

- Periodically catching sheep and penning them into a small area is an essential part of good shepherding. This can be particularly challenging on solar sites where spaces are large and visibility is limited. Most shepherds will want their own handing system – typically a portable affair- installed from time to time at parts of a solar array. It is however possible to allow for more permanent structures to live at sites. They need not interfere with the racking or other site layout plans and can be placed off to the side in an area unusable for anything else.

Hay and Forage Production

General Requirements

- Forage production can be a useful tool for managing seasonal variation in vegetation growth on-site while producing a store-able agricultural product. This can be in the form of dry hay or semi-dry silage.
- Hay and forage can be made both inside the rows of panels and outside of the power blocks but inside of the perimeter fence.
- For hay making in between panel rows, equipment must be able to make single direction passes all the way down the rows and turn around at the end. This requires panel rows to be unobstructed by CAB cabling, cable trays, drivelines or other impediments. It also requires sufficient space (Roughly 50-70' minimum depending on equipment) for turning at the end rows.
- Hay and forage production outside of the rows in portions of the site inside the perimeter fence with larger open areas is less complex.
- Hay production is less advisable on steep sites for safety and liability reasons.
- Successfully producing hay on-site will largely be dependent on needs, equipment resources and abilities of the partner farmer.

Figure 7, 8, 9. Mowing and round baling hay on site.