

NORWAY PLAINS ASSOCIATES, INC.

LAND SURVEYORS • SEPTIC SYSTEM DESIGNERS • CIVIL ENGINEERS

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April 14, 2022

Shanna Saunders
Department of Planning Development
Rochester City Hall Annex
33 Wakefield Street
Rochester, NH 03867-1917



Re: Site Plan Review Application for GNH Solar 17, LLC; Shaw Drive, Rochester, NH - Tax Map 240, Lot 49;

Dear Ms. Saunders:

On behalf of GNH Solar 17, LLC, Norway Plains Associates Inc, hereby submit a Site Plan Review Application for their property located on Shaw Drive in Rochester. The parcel is located on the east side of Shaw Drive within the Agricultural (AG) Zoning District. The 27.6-acre parcel is shown on the City Accessing maps as 240, Lot 49.

The parcel is currently undeveloped and was recently logged with a wetland complex to the southern property line. The wetlands on the parcel is in the process of being delineated by Damon Burt, CWS #163. The proposed project is to construct 50 tracking solar units and plant blueberry bushes under the trackers. Please refer to the additional project narrative for a more in-depth description of the proposed use.

To access the site, the existing gravel road will be used. No parking will be necessary on the site as there will only be occasional maintenance requirements and there will be no employees located at the site. There will be no need for lights to be installed on the site as no access will be required during the night time hours. The site will not be connected to the city water or sewer.

The proposal will have a temporary earthwork of approximately 19,000 square feet. This disturbance is a result of the installation of the 10-foot by 10-foot concrete pillars for the tracking panels and the underground conduit. Once installed, the only impervious surfaces will be the 2-foot diameter pier and a small utility building. This build will be installed to house the meters and electrical switchgear for the tracking panels. The resulting changes to the site will not have any impacts to the existing topography of the site as the site will not be stumped or regraded.

Due to the limited impervious surfaces and earth disturbances on the site, a stormwater management system will not be required. During construction and site stabilization a wood chip berm will be utilized for erosion and sedimentation control to protect the wetlands and abutting property from any potential runoff.

Thank you for your consideration and please do not hesitate to contact me if you have any questions or if you require any additional information.

Sincerely,

NORWAY PLAINS ASSOCIATES, INC.

By: 

Scott A. Lawler, PE, Project Engineer

Cc: GNH Solar 17, LLC – Packy Campbell

PROJECT NARRATIVE

60 SHAW DRIVE
GNH SOLAR 17, LLC

GNM Solar 17, LLC seeks site plan approval for its combined agricultural and solar farm proposal on this 26+ acre parcel in the agricultural zone.

Our research on the benefits of the combination of an agricultural project combined with solar tracker arrays shows that the two uses have symbiotic benefits that greatly enhance the productivity of each use, while benefiting the environment in numerous ways as outlined below.

The proposal is to install up to 50 solar trackers that have a total inverter rating of up to One Megawatt Alternative Current (1 MW A/C). Underneath each of those trackers we will plant approximately twenty (20) high bush blueberry plants, for a total of approximately one thousand (1,000) plants that, when mature, will produce approximately 60,000 pounds of fruit per year.

This project follows the concept outlined by the French team of scientists in 2010 who were the first to use the term "agrovoltaics," which means when solar panels and food are combined on the same land to maximize land use. That project demonstrates how the two uses "feed" off of each other in a symbiotic and environmentally beneficial manner. A link to the study is here: <https://metsolar.eu.glob/what-is-agrovoltaics-how-can-solar-energy-and-agriculture-work-together/#!>

Specific benefits from agrovoltaics include:

Agricultural: The blueberry bushes growing under the solar trackers have the benefit of partially shaded diverse sunlight that reduces the amount of water required by the bushes. Further, the aspiration of the plants during photosynthesis results in a "micro climate" under the trackers where the ambient temperature is generally a few degrees cooler than in an unshaded area, resulting in less moisture evaporation from both the soils and plants, which result in greater growth of the fruit, hence greater production.

Solar (Photovoltaics): That same micro climate caused by the blueberry plants helps the tracker be approximately two to three percent (2-3%) more productive in the amount of power produced during the growing season as extreme heat conditions has a detrimental affect on the amount of power produced. agr

Additional environmental benefit: Another study documents other major benefits of a combined agricultural and solar tracker project with our target product - blueberries. Specifically, blueberry plants are "carbon sinks", in that they capture and store higher

amounts of carbon in the atmosphere during aspiration than most other plants. Further, since blueberry plants are perennials and have a long life cycle, the carbon they capture is stored in the soils for a long period of time (unlike annual crops like corn or soybeans or other annual crops where the carbon is released back to the atmosphere by tilling the soil and decomposition of resulting slash after harvesting), or even indefinitely if the roots are not disturbed by extraction from the soil. As a result, blueberry plants help reduce the amount of carbon in the atmosphere. The study link is here: <https://pubmed.ncbi.nlm.gov/27932219/>

The development of this combined agricultural (blueberry) and solar project on this particular parcel of land is further enhanced by its location in what was a heavy pine growth lot. The acidity of pine trees and pine needles that penetrated the soil of this parcel results in an layer of soil with a high acidity level that is greatly beneficial to blueberry plants which thrive in a high acidic soil.

Beyond the agricultural benefits of this project, we will produce non-carbon emitting renewable energy, being registered as a customer-generator under the PUC rules for renewable energy. The electricity produced by this project will be connected to a large existing electrical infrastructure situated near the Albany Composite factory on Airport Drive. The immediate benefit of tying this "green power" into the grid next to a large commercial consumer of electricity means that this production is consumed in the immediate area of our project, and not "transmitted" long distances. This helps the grid in balancing its grid load balancing by have production and consumption of electricity in such close proximity.

The project will also be registered as a Group Host under PUC net metering rules, whereby "net energy" delivered to the grid by this project (regardless of where the actual electricity is consumed) is credited to the accounts of the group members. Members of the group will include local municipalities, industrial uses and low income residential houses. All members of the group will benefit from savings by purchasing power at prices lower than their utility provider.

<https://metsolar.eu/blog/what-is-agrivoltaics-how-can-solar-energy-and-agriculture-work-together/#!>

What is agrivoltaics? How can solar energy and agriculture work together?

Published on 2021-05-29



Updated: 2021-09-29

Within past recent years PV technologies has sprouted dramatically. A lot of social actors – business, households, cities – acknowledged the environmental necessity and profit out of it and decided to implement it

in their own fashion. It happened in farming too. The famous notion of solar farms aroused followed by a controversy.

How solar changes traditional farming

Solar farm is a field filled with hundreds or maybe thousands of solar panels oriented into the sun. Instead of potatoes, beans or tomatoes planted in the soil, solar panels covers that land, while energy is being produced.

It's obvious that traditional farming is relatively risky business because one is very much dependent upon the weather conditions. If there is just the right amount of sun, rain and if there are no extreme storms, strong winds and etc. Thus, not to worry about all these environmental factors and still get income is really uplifting and a bit too good to be true. Therefore, next to power generation, solar farms found another niche – agrivoltaics (or in other words *APV*). It is an amazing idea for environmentally conscious world, both agribusiness and society.

However, it might haven't happened if traditional farming wouldn't be failing.

Since 2010, when the cost of installing solar systems has dropped more than a half, solar farming started to bloom. Karlee Weinmann, a researcher at the Institute For Local Self-Reliance (ILSR), explains to *Digital Journal* the situation on American farmers why they chose to replace crops with solar arrays: "The prevailing reasons farmers decide to replace crops with solar are because the farmers are getting older or because it's easier and more lucrative."



Now, we see its consequences: the more solar farming, the less food is grown. And that makes sociologists and economists worried. On one hand, we have renewable energy produced, on the other hand – if a field is given to PV technology, it basically means less food is grown which can have important impact for society and nature's ecosystems. So, is there a way out? Or is it better to stop solar farming altogether and increase regulations for this field?

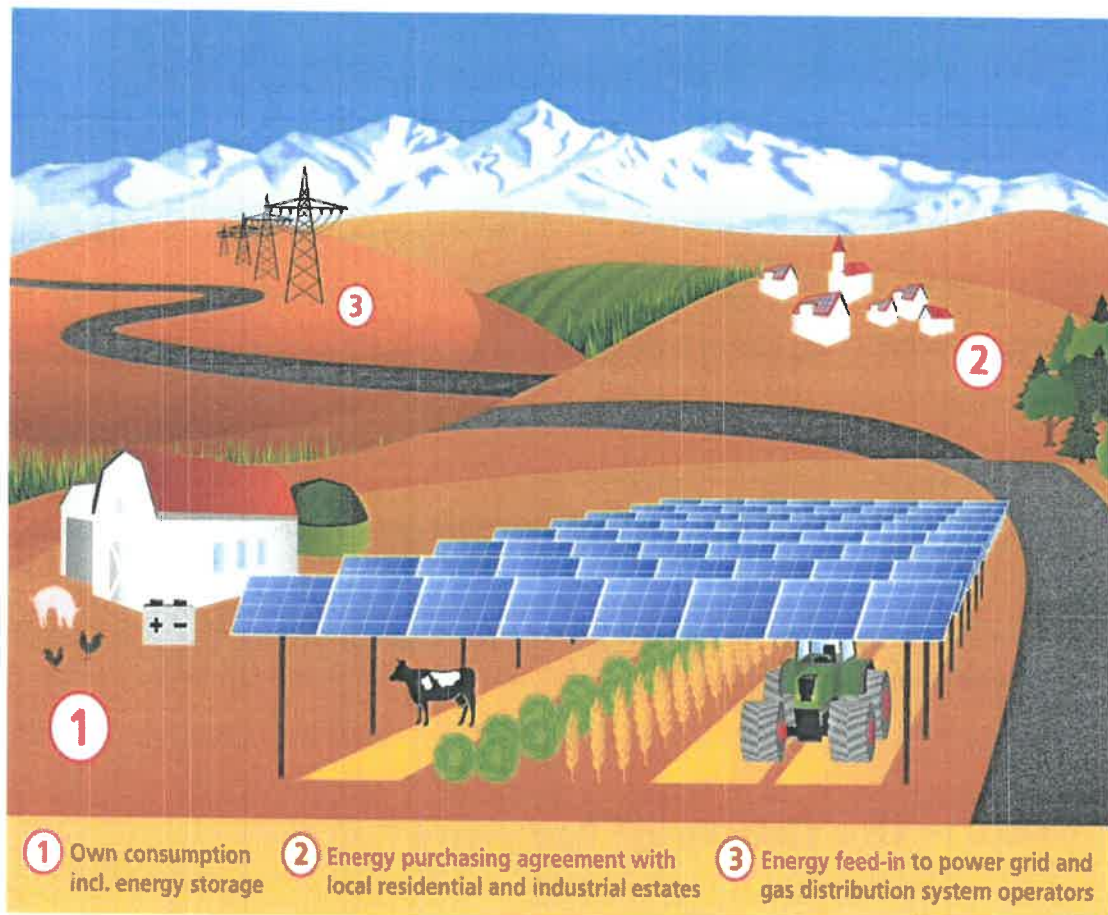
Neither of these options sound as good as the idea that solar technology and traditional farming can work hand in hand.

Agrivoltaic can increase global land productivity by 35-73%!

Agrivoltaic – the future of farming?

A team of French scientists lead by Christophe Dupraz were the first to use term agrivoltaic. It basically means when solar panels and food crops are combined on the same land to maximize the land use. It's an idea which could bring food producing to the next level. Their research field in Montpellier, France, indicated that agrivoltaic systems may be indeed very efficient: the increase of global land productivity can be from 35 to 73 percent!

Fraunhofer Institute's For Solar Energy Systems researchers carried out the [study about the same topic](#). Their goal was to find out how solar radiation and food crops can be used and ended up with synergic solution. The examination took place near Lake Constance which borders Switzerland, Germany and Austria. For one year the pilot project used 720 bi-facial solar modules which covered around 1/3 of a hectare. Researches decided to mount the panels high enough, so crops receive almost the same amount of sunlight as if they grow naturally. This also helps as proper farming technique could be used.

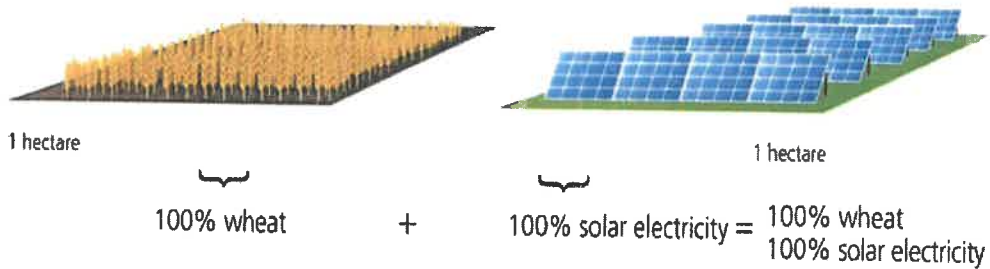


Results speaks for themselves

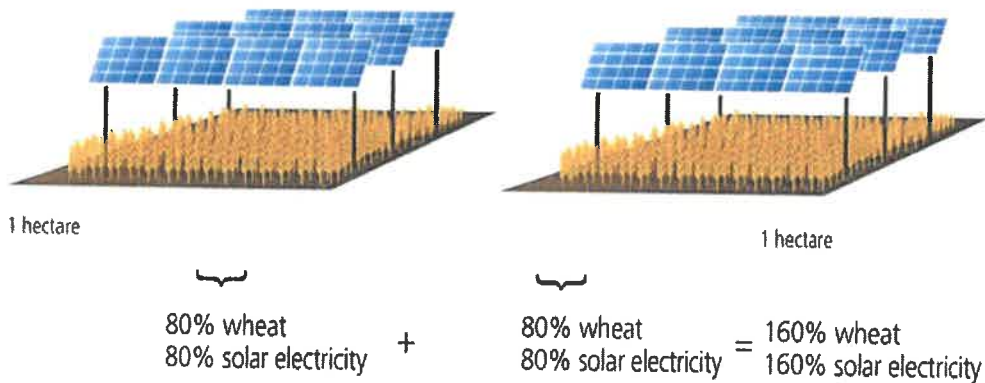
When all calculations were done, promising results appeared. Researchers discovered that [land's productivity could be raised by 60 percent](#). "The project results from the first year are a complete success: the agrophotovoltaic system proved suitable for the practice and costs as much as a small solar roof system. The

crop production is sufficiently high and can be profitably sold on the market,” explains Stephan Schindele, project manager of agrophotovoltaics at Fraunhofer ISE to *Digital Journal*.

Separate Land Use on 2 Hectare Cropland



Combined Land Use on 2 Hectare Cropland: Efficiency increases over 60%



The examination proved that farming and PV can be compatible. It reduces competition for land and works efficiently too, while providing additional income for farmers.

The last point is worth additional emphasis. As discussed above, one of the main reasons why farmers move to solar farming is a guaranteed financial gain and stress-free lifestyle. Fraunhofer Institute’s researches discovered that PV installation can work along with traditional farming and bring income even if nature’s conditions are incompatible grown culture’s needs.



UPDATE:

With booming solar industry and applications, it's being used – agrovoltaics is one of them. Let alone incredibly higher land efficiency with solar modules being placed on top of growing crops, the greenhouse farming industry has its way to go solution: **skylight solar glass**. With partial light transmittance achieved by differentiating solar cell arrangement and placement, not only shading can be achieved but energy demand can be reduced drastically of such agrivoltaics greenhouses.

So we believe agrophotovoltaic is a new way of using solar technology together with traditional farming. Of course, it still needs some discussions, testing and further development, but today it is obvious that such method – solar farming in its true sense – has big perspectives to benefit society and business more than it has ever been before.

Link: <https://metsolar.eu/blog/what-is-agrivoltaics-how-can-solar-energy-and-agriculture-work-together/#!>

Benefits of Agrivoltaics Across the Food-Energy-Water Nexus

Sept. 11, 2019

f t e + 89

Food and energy security need not be competing objectives. In fact, taking a holistic, integrated approach to food-energy-water decision making can increase resiliency of both food and energy systems.

In a recent article for [Nature Sustainability](#), the U.S. Department of Energy's National Renewable Energy Laboratory's (NREL) Lead Energy-Water-Land Analyst Jordan Macknick and co-authors from the universities of Arizona and Maryland investigated the potential benefits of co-located agriculture and solar photovoltaic (PV) infrastructure (dubbed "agrivoltaics") on food production, irrigation water requirements, and energy production.

Building Resilient Systems

Across the globe, reductions in precipitation and rising air temperatures are increasing vulnerabilities in both the agricultural and energy sectors. Water scarcity concerns are shaping conversations and driving action in the agricultural sector while extreme weather events are impacting energy systems worldwide, reducing the reliability of energy generation. As such, the resilience of the global energy system is of growing importance. Drought-proof technologies such as wind and solar photovoltaics can satisfy both resilience and sustainability concerns.

However, studies of ground-mounted PV installations with gravel groundcover have found increased temperatures surrounding solar arrays, creating a "heat island" effect. This is particularly problematic due to PV panel sensitivities to temperature increases and resulting consequences for performance.

The business-as-usual approach to PV installations is to employ gravel as ground cover. Swapping the gravel for vegetation via strategic planting can help counter the heat feedback loop.

Novel Ecosystems

Applying a model derived from low-impact urban design, researchers looked to the concept of "novel ecosystems," and how they might benefit renewable energy and food production systems in dryland ecosystems. Researchers considered the possibility of co-located agriculture and solar PV infrastructure to maximize crop yields, minimize water use, and produce resilient, renewable energy.

To test their concept, researchers planted three common plants (chiltepin pepper, jalapeño, and cherry tomato), representative of three different dryland environments, beneath PV panels.

During the three-month growing season, they monitored light levels, air temperature, and relative humidity using sensors mounted above the soil surface. They also measured soil temperature and moisture at a depth of 5 centimeters. Both the control and agrivoltaic systems received the same irrigation in two testing scenarios: daily irrigation and irrigation every two days.

Implications for the Food-Energy-Water Nexus

While impacts varied by plant type, the researchers found that the agrivoltaic systems held promising implications for food production, water savings, and renewable energy production. The reduction in direct sunlight exposure beneath the PV panels led to cooler air temperatures during the day and warmer temperatures at night, which allowed the plants under the solar arrays to retain more moisture than the control crops that grew in open-sky planting areas.

Results from the study include:



NREL researcher Jordan Macknick and Michael Lehan discuss solar panel orientation and spacing. The project is seeking to improve the environmental compatibility and mutual benefits of solar development with agriculture and native landscapes. *Photo by Dennis Schroeder, NREL*

Food production

- Total chiltepin fruit production was three times greater in the agrivoltaic system compared to the control
- Water-use efficiency for the jalapeño was 157% greater in the agrivoltaic system
- For the cherry tomato, water-use efficiency was 65% greater and total fruit production doubled in the agrivoltaic system

Water savings

- When irrigating every two days, soil moisture remained approximately 15% greater in the agrivoltaic system
- When irrigating daily, soil moisture in the agrivoltaic system remained 5% greater before the next watering

Improved renewable energy production

- Traditional ground-mounted PV panels were substantially warmer during the day than those with the plant-based understory
- The agrivoltaic PV panels were cooler during daytime hours compared to the traditional panel array by approximately 9°C, allowing for better performance.

The co-location of PV and agriculture could offer win-win outcomes across many sectors, increasing crop production, reducing water loss, and improving the efficiency of PV arrays. Adopting such synergistic paths forward can help build resilient food-production and energy-generation systems.

As Macknick notes, “The promising results of this work have broad implications for how solar development and farming across the globe could be integrated to provide mutual benefits.”

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Sci Total Environ. 2017 Feb 1;579:1084-1093. doi: 10.1016/j.scitotenv.2016.11.077. Epub 2016 Dec 5.

The effects of long-term management on patterns of carbon storage in a northern highbush blueberry production system

Denise Nemeth ¹, John G Lambrinos ², Bernadine C Strik ³

Affiliations

PMID: 27932219 DOI: [10.1016/j.scitotenv.2016.11.077](https://doi.org/10.1016/j.scitotenv.2016.11.077)

Abstract

Perennial crops potentially provide a sink for atmospheric carbon. However, there is a poor understanding of how perennial crops differ in their carbon allocation patterns, and few studies have tested how agronomic practices such as fertilization influence long-term patterns of carbon allocation in actual production systems. In this study, we report results of a long-term field experiment that tested the individual and combined effects of organic matter incorporation and nitrogen fertilization on carbon allocation. The mature (nine-year-old) blueberry plants in this study had an average standing carbon stock of 1147gCm⁻² and average annual Net Primary Production (NPP) of 523gCm⁻²yr⁻¹, values that are similar to those reported for other woody crops. Forty-four percent of blueberry annual NPP was sequestered in persistent biomass, 19% was exported as harvested fruit, and 37% entered the detrital pathway. Nitrogen applied at rates typical for blueberry production throughout the span of the study had no significant effect on total plant or soil C. However, pre-planting organic matter incorporation and periodic mulching with sawdust significantly increased both soil organic matter and soil C. Pre-planting organic matter incorporation also increased total standing plant C nine years later at maturity. At the field scale, we estimate that fields receiving pre-planting organic matter incorporation would have 4.8% (4.5Mgha⁻¹) more standing C relative to non-amended fields, although the difference is within the range of uncertainty of the estimated values. These results suggest that blueberry production can provide a valuable medium-term carbon store that is comparable in magnitude to that of temperate tree crops, but overall carbon budgets are influenced by management practices over the first decade after planting.

Keywords: Carbon sequestration; Long-term; Mulch; Nitrogen fertilization; Pre-planting soil amendment; *Vaccinium corymbosum*.

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LinkOut – more resources

Full Text Sources

[Elsevier Science](#)

Other Literature Sources

[scite Smart Citations](#)

Describe proposed activity/use: Proposed solar tracker field with blueberry bushes planted below.

Describe existing conditions/use (vacant land?): The parcel is currently vacant.

Utility information

City water? yes x no ; How far is City water from the site?

City sewer? yes no x; How far is City sewer from the site?

If City water, what are the estimated total daily needs? gallons per day

If City water, is it proposed for anything other than domestic purposes? yes no

If City sewer, do you plan to discharge anything other than domestic waste? yes no

Where will stormwater be discharged? under threshold for chapter 218 stormwater management requirements

Building information

Type of building(s): 10' x 10' Wood structure

Building height: 10' Finished floor elevation: match existing grade

Other information

parking spaces: existing: 0 total proposed: 0; Are there pertinent covenants? No

Number of cubic yards of earth being removed from the site N/A

Number of existing employees: 0; number of proposed employees total: 0

Check any that are proposed: variance ; special exception ; conditional use

Wetlands: Is any fill proposed? No; area to be filled: N/A; buffer impact? N/A

Proposed <i>post-development</i> disposition of site (should total 100%)		
	Square footage	% overall site
Building footprint(s) – give for each building	100	0.01
Parking and vehicle circulation		
Planted/landscaped areas (excluding drainage)	125,000	10.40
Natural/undisturbed areas (excluding wetlands)	937,258	77.96
Wetlands	121,774	10.13
Other – drainage structures, outside storage, etc.	18,124	1.50


Comments

Please feel free to add any comments, additional information, or requests for waivers here:

Submission of application

This application must be signed by the property owner, applicant/developer (if different from property owner), and/or the agent.

I (we) hereby submit this Site Plan application to the City of Rochester Planning Board pursuant to the City of Rochester Site Plan Regulations and attest that to the best of my knowledge all of the information on this application form and in the accompanying application materials and documentation is true and accurate. As applicant/developer (if different from property owner)/as agent, I attest that I am duly authorized to act in this capacity.

Signature of property owner: Packey Campbell 

Date: 4/13/2022

Signature of applicant/developer: 

Date: 4/13/2022

Signature of agent: _____

Date: _____

Authorization to enter subject property

I hereby authorize members of the Rochester Planning Board, Zoning Board of Adjustment, Conservation Commission, Planning Department, and other pertinent City departments, boards and agencies to enter my property for the purpose of evaluating this application including performing any appropriate inspections during the application phase, review phase, post-approval phase, construction phase, and occupancy phase. This authorization applies specifically to those particular individuals legitimately involved in evaluating, reviewing, or inspecting this specific application/project. It is understood that these individuals must use all reasonable care, courtesy, and diligence when entering the property.

Signature of property owner: 

Date: 4/13/2022

CIVIL ENGINEERS

TAX MAP 240, LOT 47
DENNIS L. & CAROL A. DAIGLE
5 DAIGLES WAY
ROCHESTER, NH 03868
SCRD 356-452

TAX MAP 240, LOT 47-1
KATIE M. DAIGLE
21 DAIGLES WAY
ROCHESTER, NH 03868
SCRD 4395-627
RBCF
11.5 5.38
(+5.7)

TAX MAP 240, LOT 47-2
CHARLES & ALICE PURPURA
23 DAIGLES WAY
ROCHESTER, NH 03868
SCRD 3531-330

TAX MAP 240, LOT 48
JOAN & STEVEN NOEL JOINT LIVING TRUST
108 EAGLE DRIVE
ROCHESTER, NH 03868
SCRD 3810-194
SEE PLAN REF. J

PSNH/31/163
PSNH/326
PSNH EASEMENT 100' WIDE
PSNH EASEMENT 35' WIDE
159A/5/RET&T/1A
NO CHW
NET/2
NO CHW
SHAW DRIVE
NET/212
3 NO CHW
NO NUMBER

PROPOSED 50' X 50' CULTIVATED BLUEBERRY PATCH LOCATED UNDER EACH TRACKER
PROPOSED INVERTERS (TYP) 8 UNITS
PROPOSED SOLAR TRACKER (TYP) 50 UNITS
PROPOSED WOOD CHIP EARTH BERM
50' WETLANDS BUFFER
APPROX. LIMIT OF WETLANDS
PROP. UNDERGROUND ELECTRIC WIRES
PROP. UTILITY BUILDING
100' (TYP.)
80' (TYP.)

N.H. NORTHCOAST RAILROAD
TO ROCHESTER
TO SOMERSWORTH

TAX MAP 239, LOT 26
NH NORTHCOAST CORP.
P.O. BOX 429
OSSISPEE, NH 03864
SCRD 1706-532
(SEE PLAN REF. 2)

TAX MAP 243, LOT 14
43 NORTH LLC
156 ROCHESTER HILL ROAD
ROCHESTER, NH 03867
SCRD 4438-413

TAX MAP 243, LOT 27
ALBANY ENGINEERED COMPOSITES, INC.
ATTN: ACCOUNTS PAYABLE
PO BOX 1807
ALBANY, NY 12201
SCRD 4289-427

159A/5/1041 VZ 10
159A/7 VZ 9
159A/8 VZ 8
159A/9
159A/10/43T
159A/11
VZ 1041.5

APRIL 1922
GRAPHIC SCALE
100 0 50 100 200 400
(IN FEET)
1 INCH = 100 FT.

2 Continental Blvd., Rochester, N.H. 603-335-3948