THIMBLE FARM CONCEPT PLAN

Prepared for the Island Grown Initiative (IGI)
by South Mountain Company

January 25, 2014

TABLE OF CONTENTS

Introduction 1
Plan Objectives 2
Programmatic Space Needs 3
Locus/Site Context 4
Climate Data Plan 5
Zoning Site Plan 6
Topography & Vegetation Plan 7
Existing Building Envelope Plan 8
Existing Utilities Plan 9
Farm Plan 10
Proposed Use Zones 11
Building Envelope Concept Plan 12
Existing Conditions Photographs 13
Energy, Water & Waste 14
Appendices
- Energy Model 15-18
- Wind Feasibility Study 19-23
- Ecological Assessment 24-27
- Martha's Vineyard Agricultural Map 28
- Participants 29

INTRODUCTION

Thimble Farm was gifted to the Island Grown Initiative (IGI) in 2012. This began a new era for the agricultural community of Martha's Vineyard.

The idea is to create an integrated "agricultural hub" that will service many aspects and needs of the Vineyard's food system. It is intended to provide services to farmers and the community that aid in the development of a robust and vibrant local food system.

Ultimately, the long-term vision for Thimble Farm consists of the following:

- Restoration and re-activation of the existing 32,000 SF greenhouse (already in progress);
- A new community meat processing plant, approved by the U.S.D.A;
- A new value-added food preparation area and community kitchen;
- Three units of farmer family housing;
- Congregate farm-worker housing;
- Restoration of the existing barn and re-purposing as office, meeting and educational space;
- A new distribution hub and grain mill;
- Restoration of existing steel buildings for equipment storage, maintenance shop, rest rooms, break room, etc;
- Restoration of the existing fields for crop production;
- Community garden space;
- An enclosed composting system;
- Solar and wind energy systems to generate electricity on-site;
- Updated infrastructure and landscape.

This Concept Plan is an early expression of that idea; both the plan and the farm will evolve over time.

Contents

The Concept Plan is comprised of many parts. The Plan Objectives are the concise statement of the goals and values of the project, and they lead directly to the Programmatic Space Needs, which is a list of the proposed buildings and their square footages.

Several plans of the site convey the context of the property, the topography and vegetation, the climate, and the existing conditions.

The area available for building consists of roughly 6 acres, nearly one acre of which is currently covered by the greenhouse. The Program led us to conclude that the Concept Plan can be distilled into four Use Zones. We relied on the Site Analysis, the Plan Objectives, and our observations of existing facilities to subdivide the building area by zone:

- **Residential**: closest to road and neighbors, contains farmer residences and farmworker housing;
- **Community**: closest to entrance, contains distribution, office, meeting spaces, and community garden space, and it provides a "face of the farm" to visitors;
- **Farming**: contains farmland, greenhouse, shop, and equipment storage;
- **Processing**: furthest from road and neighbors, screened by greenhouse, contains meat plant, processing area, kitchen, composting facility, and wind turbines.

There is clear rationale for each location, and the programmatic spaces fit well into each zone. Following the Use Zones is the Building Envelope Concept Plan, which is a diagram of the buildings, roads, parking, and energy generating equipment (two 50 kilowatt wind turbines and +/- 250 kilowatts of rooftop solar arrays) and the overall Farm Concept Plan.

Following these layouts, appendices provide some of our back-up material: the Energy Model from which we derived equipment needs for renewable energy generation, a Wind Site Feasibility Study, an Ecological Assessment, and the Vineyard Agricultural Map.

Community Input and Regulatory Process

Once this Concept Plan has been approved by IGI, six essential early elements of the permitting process can commence immediately:

- Begin Land Court process to remove internal lot line.
- Meet with Martha's Vineyard Land Bank to review the Concept Plan.
- Meet with neighbors to review the Concept Plan.
- Meet with community members at the Ag Hall.
- Meet with Tisbury Zoning Inspector, Planning Board, and Board of Health for preliminary review.
- Meet with Martha's Vineyard Commission Land Use Planning Commission for preliminary review.

These steps will inform us about community sentiments, potential obstacles, and alternate solutions.

When this process is complete, we will research specific permitting paths for the various elements (Meat Plant, Kitchen, Composting System) which may require permits from non-local agencies, and move from conceptual design to schematic design.

PLAN OBJECTIVES

Site

- Find the optimal mix of separations and connections between buildings;
- Zone the property for efficient use and a comfortable live/work environment;
- Prioritize protection of neighboring properties from noise, odors, and view disruptions;
- Efficiently manage parking and vehicle circulation for workers, housing, product drop-off and pick-up, product distribution, and visitors.

Design

- Make new structures which complement existing structures and combine with a sense of community;
- Achieve a "Vineyard Farm" feeling in scale and detail;
- Plan for 100+ year life for new structures and improve existing building durability;
- Use low-maintenance, locally-proven, low environmental impact products and systems;
- Design simple, understandable mechanical systems for easy operation and maintenance;
- Make spaces and systems that adapt easily to future use changes.

Food

- Make a state-of-the-art meat processing plant for the island;
- Make a state-of-the-art food-processing kitchen for value-added food products;
- Restore the existing greenhouse for food production that complements local farmers' production;
- Adhere to sustainable farming practices, using soil health as an objective metric of the success of the farming practices;
- Produce heritage grain crops as a way to diversify locally grown food.

Housing

- Create stable affordable housing for farm manager and workers;
- Create dormitory-style congregate housing for both year round (+/-six) and seasonal (+/-six) farm workers;
- Make housing high performance, high quality, low maintenance, and exceptionally well designed;
- Employ clean, comfortable, timeless aesthetics in the "Vineyard Farm" style;
- By accommodating farm workers and others, contribute to the solution of the Vineyard housing crisis.

Ecology

- Use waste treatment systems that minimize nitrogen discharge to local water resources;
- Manage storm water runoff for the benefit of the site and adjacent wetlands and water bodies;
- Mitigate existing invasive species encroachment and prevent future encroachment;
- Encourage native vegetation and wildlife to thrive;
- Operate the greenhouse as a closed-loop system;
- Use state-of-the-art covered composting to handle nutrient cycling.

Energy

- Implement state-of-the-art energy efficient design and food production practices;
- Maximize site-generated renewable energy (wind, solar, and biomass) and minimize the use of fossil fuels (through energy conservation);
- Strive for "net zero" energy use, thereby placing no additional demand on island energy resources.

Community

- Create a community asset that will benefit Islanders in diverse ways;
- Create an educational resource for training and raising agricultural awareness;
- Become a reliable resource/partner for local farmers;
- Make a community farm equipment leasing and repair co-operative;
- Create a sustainable economic business model to preserve the farm for generations to come;
- IGI, the non-profit umbrella organization, will oversee several professionally managed enterprises.

PROGRAMMATIC SPACE NEEDS

GREENHOUSE	GSF	Floor	Conditioned?	Notes
Greenhouse	28,048	1st	Yes	
Packaging Area	3,067	1st	Yes	
Walk-in Cooler/Freezer	233	1st	Yes	Re-use existing unit within Packaging Area.
Office	135	1st	Yes	
Bathrooms	0	1st	Yes	8-10 employees. Proposing use of adjacent Shop restroom.
Mechanical Space	650	1st	Yes	
Total first floor footprint	32,133			
TOTAL GREENHOUSE NSF	32,133			

PROCESSING	GSF	Floor	Conditioned?	Notes
Slaughtering Area	1,000	1st	Yes	Includes scalding & dehairing areas for swine.
Cut and Wrap	400	1st	Yes	
Chill Cooler	400	1st	Yes	
Holding Cooler	800	1st	Yes	
Freezer	800	Bsmt	Yes	
Smoker	120	1st	Yes	Min. clear area for smoker from Pioneer Slaughter is 10'-0" x 10'-6".
Office	80	1st	Yes	
Insp. Office	60	1st	Yes	Confirm with state.
Observation Area	260	1st	Yes	
Meat Plant Lockerrooms/Bathrooms	180	1st	Yes	Includes linen storage.
Public Bathroom	40	1st	Yes	One unisex handicapped accessible.
Break Room	120	1st	Yes	
Laundry	60	Bsmt	Yes	
Mechanical Space	140	Bsmt	Yes	
Supplies Storage	100	Bsmt	Yes	
Value-Added Kitchen	1,170	1st	Yes	
Kitchen Cooler/Freezer	600	1st	Yes	
Kitchen Office	80	1st	Yes	
Kitchen Bathroom	50	1st	Yes	One unisex handicapped accessible.
Kitchen Locker Room	120	1st	Yes	
Kitchen Mechanical Space	100	Bsmt	Yes	
Kitchen Storage	2,000	Bsmt	Yes	
Total first floor footprint	5,480			
TOTAL PROCESSING GSF	8,680			

HOLDING PEN	GSF	Floor	Conditioned?	Notes
Holding Pen	3,000	1st	No	See 3,000sf Grandin model. Fenced pasture to south of building if necessary.
Total first floor footprint	3,000			
TOTAL HOLDING PEN GSF	3,000			

WORKER HOUSING	GSF	Floor	Conditioned?	Notes
Entry	120	1st	Yes	Closet storage and open bench/shelves/hooks
Kitchen/Pantry	280	1st	Yes	Assumes 2 stoves, 2 ref's, 2 sinks, island and dedicated pantry
Gathering Area	750	1st	Yes	Multipurpose room
Dining Area	140	1st	Yes	
Living Area	380	1st	Yes	
Accessible Bedrooms	280	1st	Yes	2 bedrooms @ 140sf each.
Bedrooms	1,680	2nd	Yes	12 bedrooms @ 140sf each.
Accessible Bathrooms	300	1st	Yes	2 bathrooms @ 150 each.
Bathrooms	300	2nd	Yes	2 bathrooms @ 150 each.
Mechanical Space	100	Bsmt	Yes	
Laundry	100	1st	Yes	
Storage	100	Bsmt and 1st	Yes	Individual storage spaces in basement. Handicapped accessible on 1st.
Porch	360	1st	No	
Total first floor footprint	2,620			
TOTAL WORKER HOUSING GSF	4,890			

FARMER RESIDENCES	GSF	Floor	Conditioned?	Notes
Entry	70	1st	Yes	3 bedrooms
Kitchen/Pantry	120	1st	Yes	Assumes one full and one 1/2 bath
Dining Area	130	1st	Yes	
Living Area	250	1st	Yes	
Bedrooms	500	1st	Yes	
Bathrooms	80	1st	Yes	One full and one 1/2 bath
Mechanical	40	Bsmt	Yes	
Laundry	40	Bsmt	Yes	
Storage	500	Bsmt	Yes	
Porch	125	1st	No	
Subtotal: (1) Farmer Residence 1st floor footprint	1,275			
Subtotal: (1) FARMER RESIDENCE GSF	1,855			
Total: (3) Farmer Residences 1st floor footprint	3,825			
TOTAL: (3) FARMER RESIDENCES GSF	5,565			

EQUIPMENT CO-OP/SHOP	GSF	Floor	Conditioned?	Notes
Equipment Storage Space	1,860	1st	No	Reuse existing steel building #1
Office, Break Room, Restrooms	500	1st	Yes	Renovate existing apartment in steel building #2.
Mechanics Workshop	1,650	1st	Yes	Reuse existing steel building #2
Total first floor footprint	4,010			
TOTAL EQUIP. CO-OP/MECH. SHOP GSF	4,010			

COMPOSTING FACILITY	GSF	Floor	Conditioned?	Notes
Enclosed Composting Area	6,000	1st	No	Assuming heat extraction. Includes drum and hoppers.
Covered Work Area	2,000	1st	No	
Covered Storage	1,560	1st	No	Carbon source needs to be stored under cover. Reuse existing pole barn.
Total first floor footprint	9,560			
TOTAL COMPOSTING FACILITY GSF	9,560			

ADMINISTRATION	GSF	Floor	Conditioned?	Notes
Board Room/Meeting Space/Classroom	1600	1st	Yes	Renovate existing barn.
IGI Office	125	1st	Yes	
Storage	1035	2nd	Yes	
Total first floor footprint	1,725			
TOTAL ADMINISTRATION GSF	2,760			

DISTRIBUTION	GSF	Floor	Conditioned?	Notes
Distribution Hub	2,000	1st		
Storage	2,000	Bsmt		
Total first floor footprint	4,000			
TOTAL DISTRIBUTION GSF	4,000			

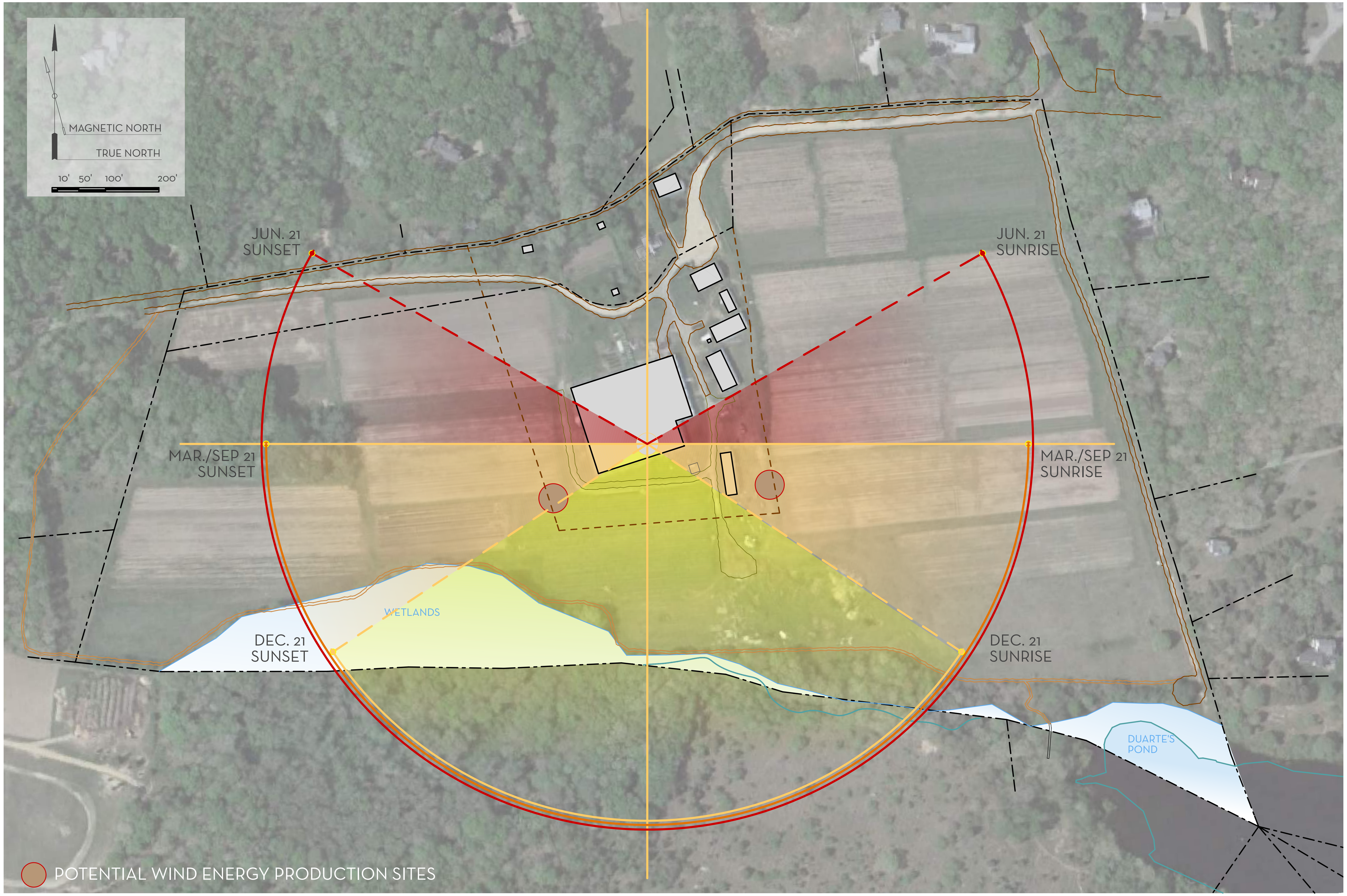
SPACE NEEDS SUMMARY	GSF	Footprint
GREENHOUSE	32,133	32,133
PROCESSING	8,680	5,480
HOLDING PEN	3,000	3,000
WORKER HOUSING	4,890	2,620
FARMER RESIDENCES	5,565	3,825
EQUIPMENT CO-OP/SHOP	4,010	4,010
COMPOSTING FACILITY	9,560	9,560
ADMINISTRATION	2,760	1,725
DISTRIBUTION	4,000	4,000
PROJECT TOTALS =	74,598	66,353

LOCUS/SITE CONTEXT

LOCUS DATA

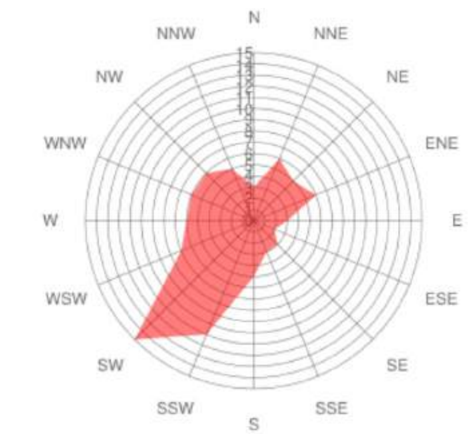
LATITUDE:	41.25 Degrees North
LONGITUDE:	70.37 Degrees West
STREET ADDRESS:	80+140 Stoney Hill Road, Tisbury

CLIMATE DATA PLAN



AVERAGE RAINFALL (SOURCE: WEATHER.COM)

AVERAGE WIND DISTRIBUTION
(MV AIRPORT ALL YEAR)



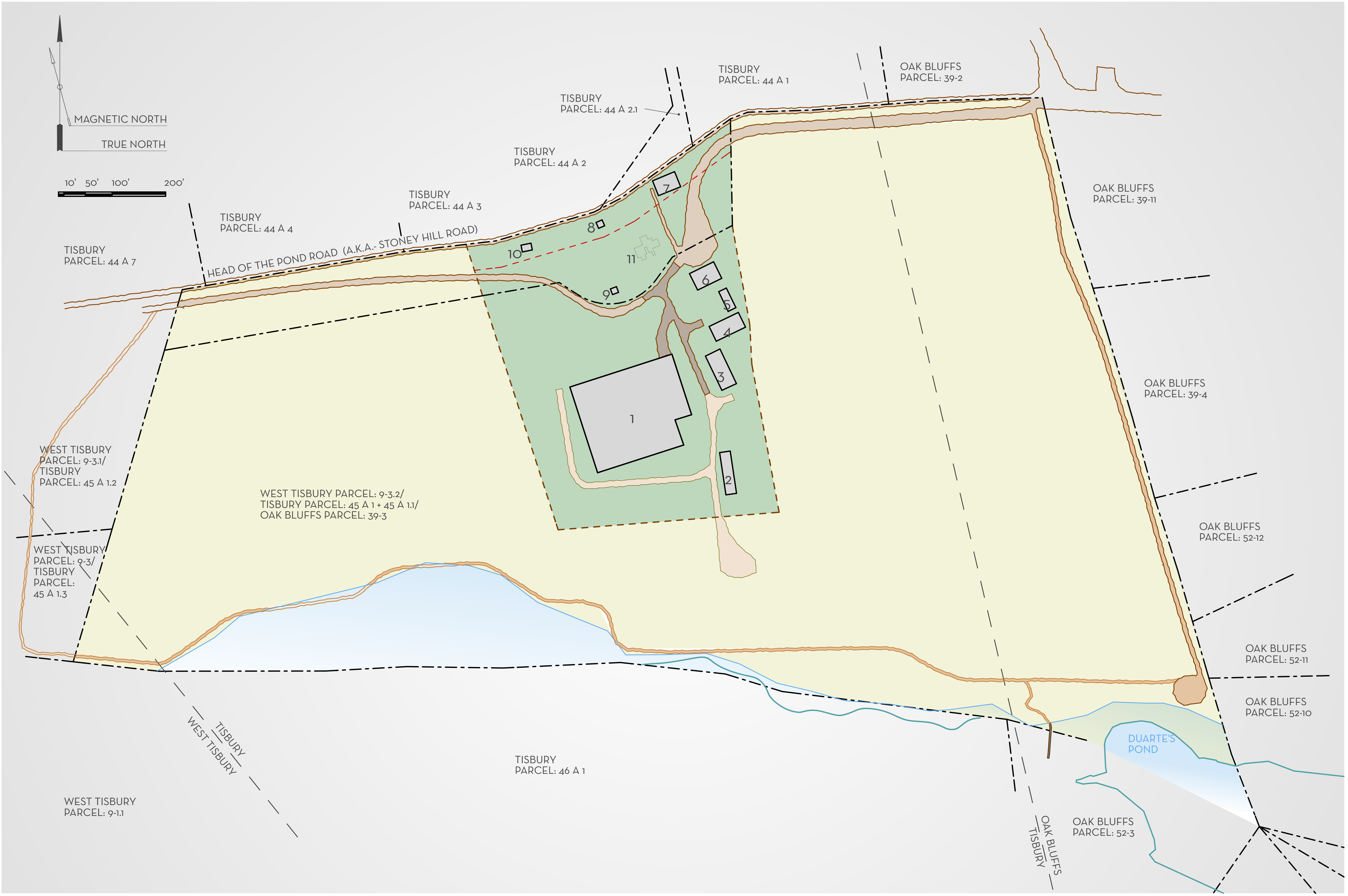
AVERAGE WIND DIRECTION & TEMPERATURE

MONTH	DIRECTION	SPEED (MPH)	TEMP (F)
JAN	NW	13	33
FEB	WNW	13	25
MAR	SW	14	42
APR	SW	14	51
MAY	SW	12	60
JUN	SW	12	68
JUL	SW	10	77
AUG	SW	10	75
SEP	SW	12	69
OCT	SW	13	60
NOV	NNE	13	50
DEC	WNW	13	41
SUM	*SW*	*12*	*55*

CLIMATE DATA
- HEATING DEGREE DAYS: 5,713
- (65 DEGREE HEATING BASE, TEMP DATA FROM EDGARTOWN)

MICROCLIMATE CONSIDERATIONS
- GRADES SLOPE UP 30'+/- FROM S.E. TO N.W. CORNER & ADDITIONAL 80' WITHIN 1 MILE NORTH OF SITE.
- WETLANDS TO SOUTH, OPEN FIELDS TO SOUTHWEST, OPEN WATER POND TO SOUTHEAST

ZONING SITE PLAN



KEY

- BUILDING ENVELOPE
- AGRICULTURAL PRESERVATION LAND
- ABUTTING PROPERTIES
- WETLANDS
- TRAIL EASEMENT
- DIRT ROAD
- 50' BUILDING SETBACK
- WOODEN PEDESTRIAN BRIDGE
- FENCE LINE

BUILDING KEY	AREA (SF)
1. GREENHOUSE #1	32,000
2. POLE BARN	1.600
3. STEEL BUILDING #2	2,150
4. STEEL BUILDING #1	1,860
5. FARM STAND	650
6. BARN	2,766
7. GREENHOUSE #2	1,345
8. SHED #1	148
9. WELL HOUSE (ABANDONED)	136
10. SHED #2	244
11. FORMER FARMHOUSE	1,067

THE ENTIRE PROPERTY IS SUBJECT TO THE FOLLOWING:

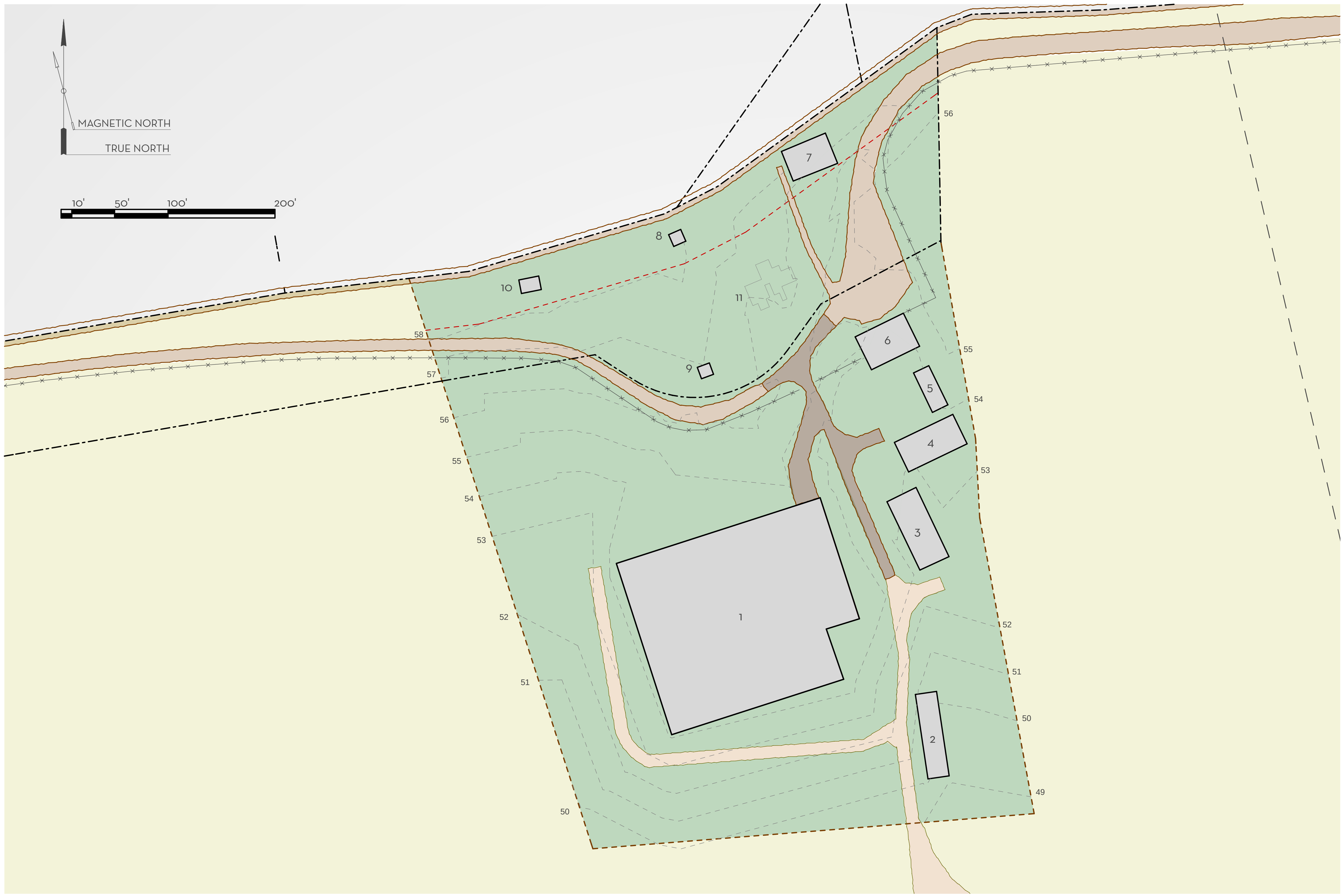
- AN AGRICULTURAL PRESERVATION RESTRICTION HELD BY THE MV LANDBANK
- A DEVELOPMENT OF REGIONAL IMPACT DECISION BY THE MV COMMISSION

PARCEL	ABUTTERS
WEST TISBURY	
9-1.1	VINEYARD MEADOW LLC
9-3	ASHLEY K. MACKEY
9-3.1	SARAH WYATT SMITH
TISBURY	
44-A-1	SONYA E SYLVA TRUSTEE
44-A-2	JAMES + VIRGINIA A LOBDELL
44-A-2.1	DARREN C. LOBDELL
44-A-3	CLEMENT LEVIN
44-A-4	MV LAND BANK COMMISSION
44-A-7	ROGER A. ARMSTRONG
46-A-1	VINEYARD MEADOW LLC
OAK BLUFFS	
39-02	DONNA TOMKINS
39-04	MARIANNE GALVEZ
39-11	DAVID M. BARNICLE
39-12	LEONARD P. REID
52-03	LAND BANK COMMISSION
52-10	IRON HILL HOMEOWNERS
52-11	MARC N. HANOVER
52-12	RAYMOND A MANDRA

PARCEL		ACREAGE (TOTAL:40.84+/-)	ZONING DISTRICT/ALLOWABLE USE	SETBACKS/MAX HEIGHT
WEST TISBURY PARCEL	9-3.2	.3	RU-AGRICULTURAL	N/A
TISBURY PARCEL	45 A 1	27.01	R-3A/AGRICULTURAL PRESERVATION & AGRICULTURAL BUILDING ENVELOPE	50'/35'
	45 A 1.1	3.1	R-3A/AGRICULTURAL PRESERVATION & AGRICULTURAL BUILDING ENVELOPE	50'/35'
OAK BLUFFS PARCEL	39-3	9.99	AGRICULTURAL PRESERVATION	N/A

TOPOGRAPHY & VEGETATION PLAN

EXISTING BUILDING ENVELOPE PLAN



KEY

- BUILDING ENVELOPE
- AGRICULTURAL PRESERVATION LAND
- ABUTTING PROPERTIES
- DIRT ROAD
- 50' BUILDING SETBACK
- FENCE LINE

BUILDING KEY	AREA (SF)
1. GREENHOUSE #1	32,000
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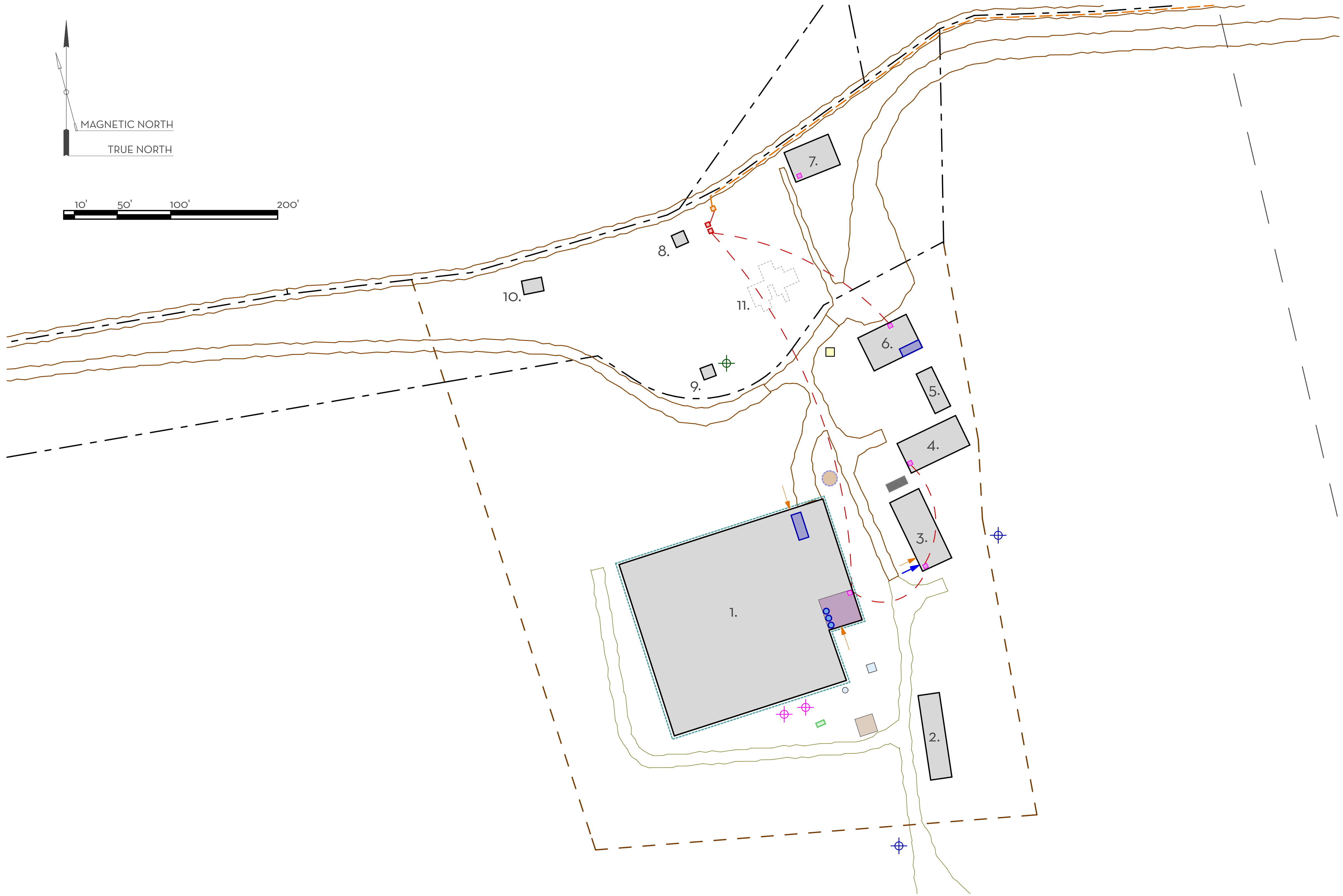
EXISTING UTILITIES PLAN



UTILITIES KEY

- CESSPOOL
- PRIMARY ELEC. SERVICE (APPROX.)
- SECONDARY ELEC. SERVICE (APPROX.)
- PERIMETER FRENCH DRAIN (ROOF RUNOFF)
- WELL- SERVING GREENHOUSE
- WELL- SERVING IRRIGATION
- WELL- FORMERLY SERVING HOUSE
- PRESSURE TANK
- HOSE BIB
- 1500 GAL. WATER TANK (FROM GREENHOUSE SINKS + WASHDOWN)
- TRANSFORMER
- PEDESTAL (200A + 400A)
- BREAKER PANEL
- CABLE BOX
- GENERATOR (APPROX.)
- SEPTIC TANK
- COOLERS
- PROPANE TANK ENCLOSURE (3) 1,000 GAL. TANKS
- MECHANICAL ROOM
- PROPANE LINE
- WATER LINE

BUILDING KEY		AREA (SF)
1.	GREENHOUSE #1	32,000
2.	POLE BARN	1,600
3.	STEEL BUILDING #2	2,150
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6.	BARN	2,766
7.	GREENHOUSE #2	1,345
8.	SHED #1	148
9.	WELL HOUSE (ABANDONED)	136
10.	SHED #2	244
11.	FORMER FARMHOUSE	1,067

EXISTING UTILITIES INFORMATION

- POWER FEED BURIED LINES
- SUBPANEL IN GREENHOUSE #2
- 200A SERVICE TO GREENHOUSE, BARN & STEEL BUILDINGS #1 & #2
- 3-PHASE POWER APPROX 1.2 MILES WEST ON STONEY HILL ROAD
- 1-PHASE POWER FEEDS FROM EAST +/- 30YR. OLD INFRASTRUCTURE
- ELECTRICAL PEDESTAL: 200A & 40A

FARM PLAN

KEY

1.	AG. LAND -WEST	8.18 ACRES +/-
2.	AG. LAND -SOUTH	1.58 ACRES +/-
3.	AG. LAND -EAST	12.60 ACRES +/-
4.	WOODED LAND	1.53 ACRES +/-
5.	BUILDING ENVELOPE	6.45 ACRES +/-
6.	COMMUNITY GARDEN	0.50 ACRES +/-
7.	ORCHARD	2.31 ACRES +/-

PROPOSED USE ZONES

BUILDING ENVELOPE CONCEPT PLAN

EXISTING CONDITIONS PHOTOGRAPHS


ENTRANCE VIEW - NORTHEAST


AGRICULTURAL BUILDINGS - NORTHEAST


AGRICULTURAL BUILDINGS - NORTHWEST


DUARTE'S POND - SOUTHWEST


BARN - SOUTHWEST


BARN - WEST


BARN - NORTHEAST


POLE BARN - NORTHWEST


GREENHOUSE - SOUTH


GREENHOUSE DETAIL - SOUTH


STEEL BUILDING #2 - SOUTHWEST


FARM STAND - NORTHEAST

ENERGY, WATER & WASTE

Electricity:

- Bring new 3 phase primary electric service from Edgartown Rd via Iron Hill Road
- 220 kW of solar electric array on roofs makes 250,000 kWh/year
- Two Endurance E3120 wind turbines make 85,000 kWh/year each (same as Allen and MG Farms)

Thermal Energy Possibilities:

- Waste heat from composting
- Waste heat from refrigeration
- Biomass boiler
- Air source heat pumps (powered by electricity)

Water:

- Potable supply from Oak Bluffs municipal system
- Irrigation from existing onsite wells

Waste Treatment:

- Two gravity-based systems, each below 2,000 gpd, with enhanced denitrification
- Enclosed composting for meat plant and farm waste

ENERGY MODEL

This work consists of a preliminary characterization of the energy loads of the various Thimble Farm program elements.

Methodology

The principal program elements at Thimble Farm are:

- Greenhouse
- Processing
- Farmer housing
- Worker housing
- Composting
- Septic/well/infrastructure

Loads are initially separated into thermal and electrical loads. Some thermal loads may be addressed by conversion technologies such as heat pumps, which alters the thermal load into an electrical load. The loads are characterized by month, as the intensity of use of various program elements varies across a full year. Even during weeks of full operation, the greenhouse, meat plant, and kitchen loads could vary significantly depending on how they operate and the end products they produce.

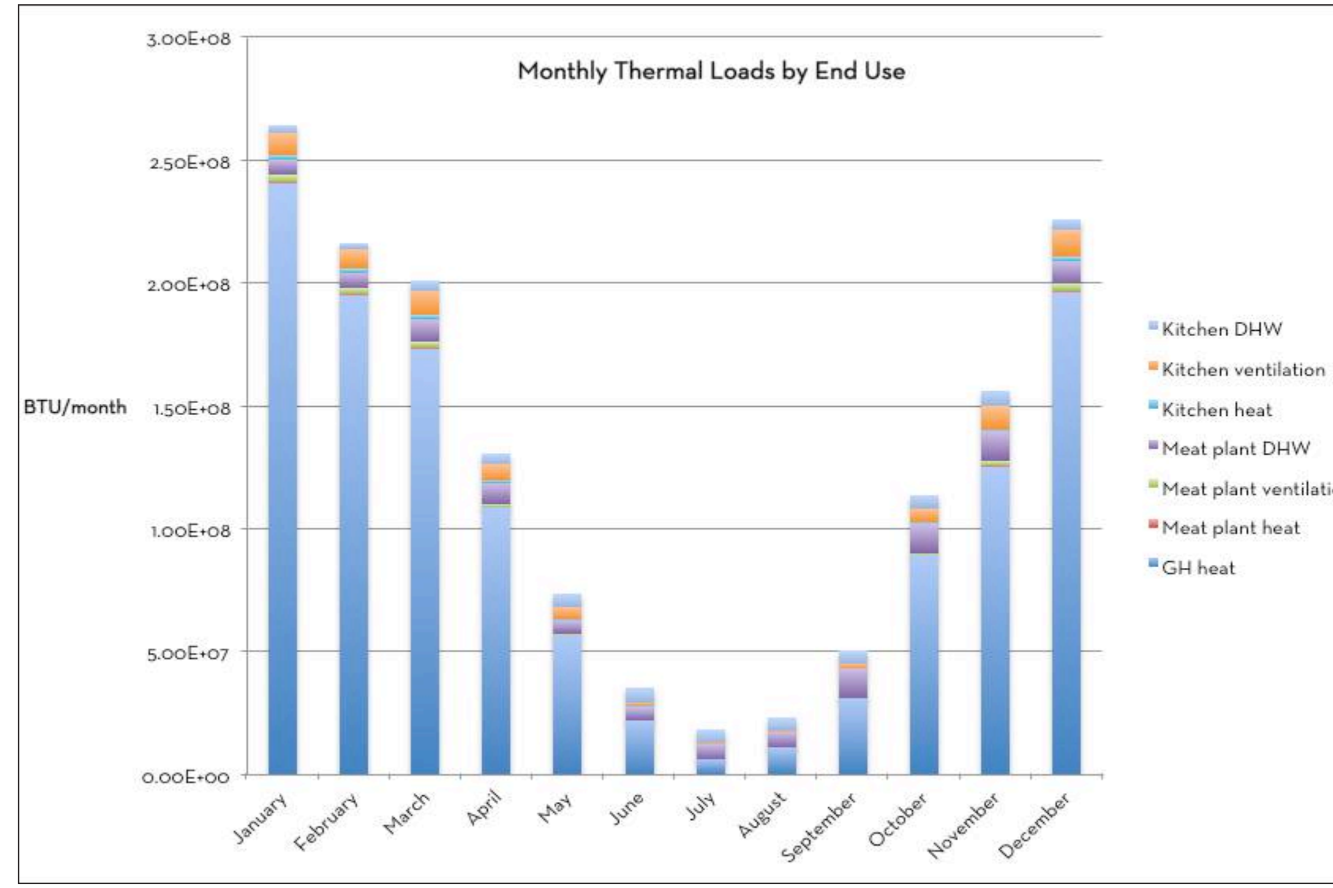
This model is based on scores of estimates and assumptions. Some are based on information that represents the best current guess of IGI. Some are based on data generously shared by people operating the Adams Farm Meat Plant and the Franklin County Food Processing Center. Some are based on past experience of Keith Wilda and Marc Rosenbaum, the rest are estimates. During schematic design of these program elements the assumptions will be refined.

Note that in the case of the greenhouse, meat plant, and kitchen the calculations are for loads rather than energy consumption. Energy consumption will depend on the type of equipment used to serve the loads, and its associated efficiency.

Thermal Loads

- **Greenhouse** – The greenhouse has a significant heating load and this calculation is based on 0.5 gallon of propane per square foot (sf) per year, and is allocated monthly based on heating degree days (which tally the amount of heating demand in every month). There is likely to be hot water usage in the greenhouse which would be addressed in schematic design; at this stage it is so much lower than heating that it is ignored.
- **Meat plant** – Although much of the plant will not be heated to comfort temperature, the meat plant does have a heating load. It may, in fact, need to be cooled for many more hours annually than typical spaces (e.g., cut-and-pack). The ventilation load may be larger than the heating load. Thus far we haven't characterized ventilation standards for small meat plants. The assumption is that it will be ventilated at 1 cubic foot of air (CFM)/sf and 70% heat recovery will be incorporated (70% of the heat in the exhaust air will be transferred to the incoming fresh air). The third, and likely largest, thermal load in the meat plant is domestic hot water (DHW).
- **Value-added kitchen** – The kitchen has similar loads to the meat plant, albeit in different proportions. Heat recovery is more difficult to implement on kitchen exhaust due to grease contamination, so ventilation is likely the largest thermal load. It is estimated here at 1 CFM/sf and that 50% of that load will need to be supplied to pre-condition the make-up air.
- **Housing** - These thermal loads will almost certainly be served most effectively by electrically-driven heat pumps, therefore they are covered under electrical loads.

Loads in the graph above are expressed in BTU/month. To help scale this, a gallon of propane has 91,600 BTU. The total load expressed above is about 1,500 million BTU (MMBTU), which if served by propane



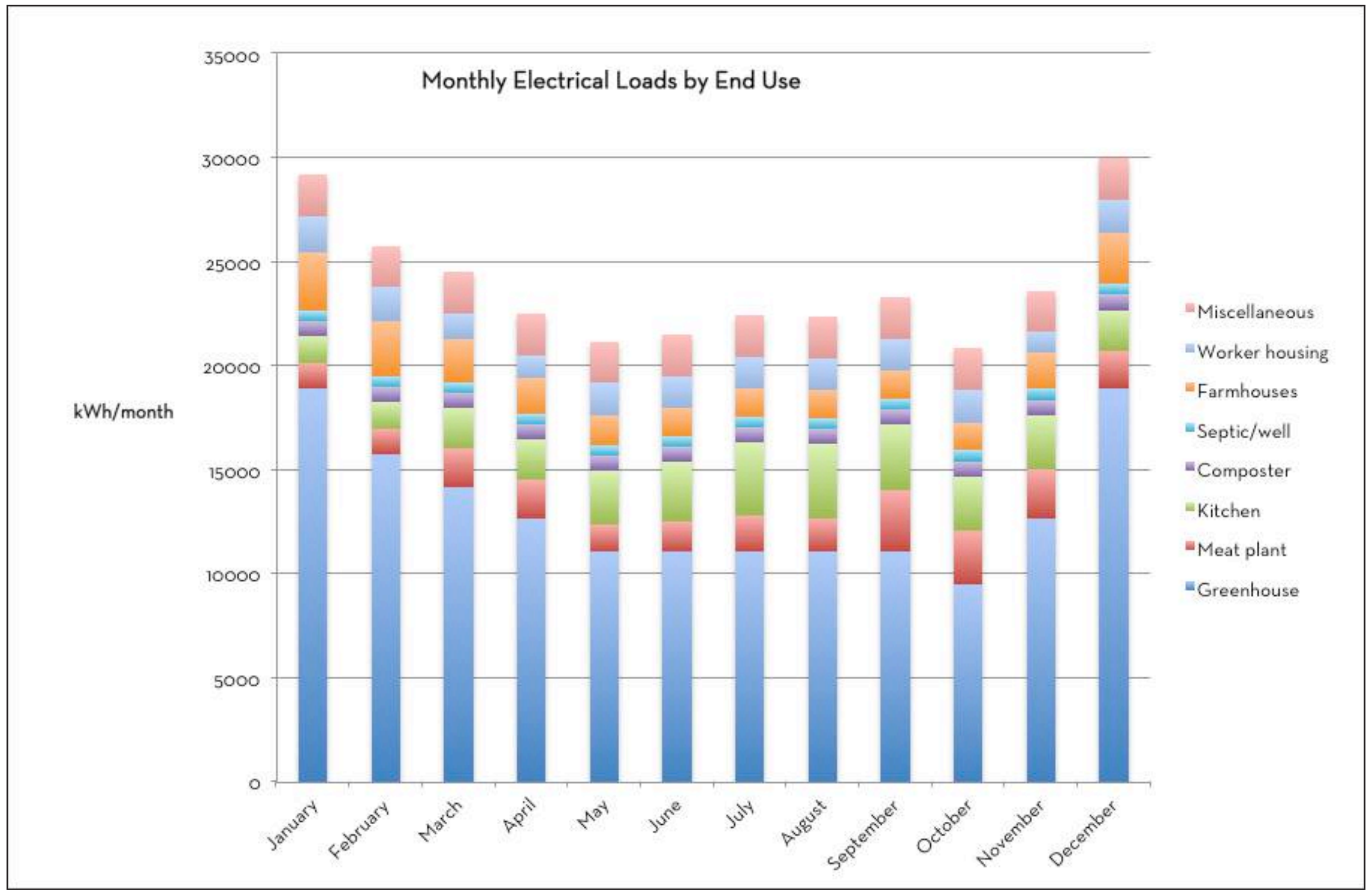
at 85% efficiency would require just under 20,000 gallons annually. The greenhouse heating load dominates all other thermal loads, as glass is a poor insulator.

Electrical Loads

- **Greenhouse** – The greenhouse uses electricity to operate lighting, fans and heaters, pumps for hydroponics and aquaculture, some cooler space, and actuators and controls. The model estimates an average power draw of 18 kilowatts (kW), leading to 157,500 kWh/year, which is apportioned seasonally.
- **Meat plant** – The electrical loads come from lighting, coolers and freezer, equipment, air conditioning, and fans and pumps. These were estimated individually. The result is substantially below data we have from Adams Farm per sf and per animal, so these numbers need further work in schematic design.

ENERGY MODEL Continued

- **Value-added kitchen** – The kitchen uses electricity for lighting, coolers and freezer, equipment, air conditioning, and fans and pumps, and perhaps some of the cooking equipment as well. The results are lower than the Greenfield facility we toured but not dramatically so.
- **Composting system** – Electricity is used for fans and pumps and motors for mixers. The model carries a 1 kW average load.
- Septic/well/infrastructure – The model assumes a 0.7 kW average load.
- **Farmhouses** – The model has three farmhouses heated by minisplit air source heat pumps (ASHP), with hot water provided by heat pump water heaters. The assumptions are robust based on significant experience with superinsulated net zero housing.
- **Worker housing** – The assumed heated area is equal to two farmhouses, and the hot water and lighting/appliance/plug loads are based on 1.25 times one farmhouse in the winter and 2.5 times one farmhouse in the summer.
- A miscellaneous load of 2 kW average is modeled.

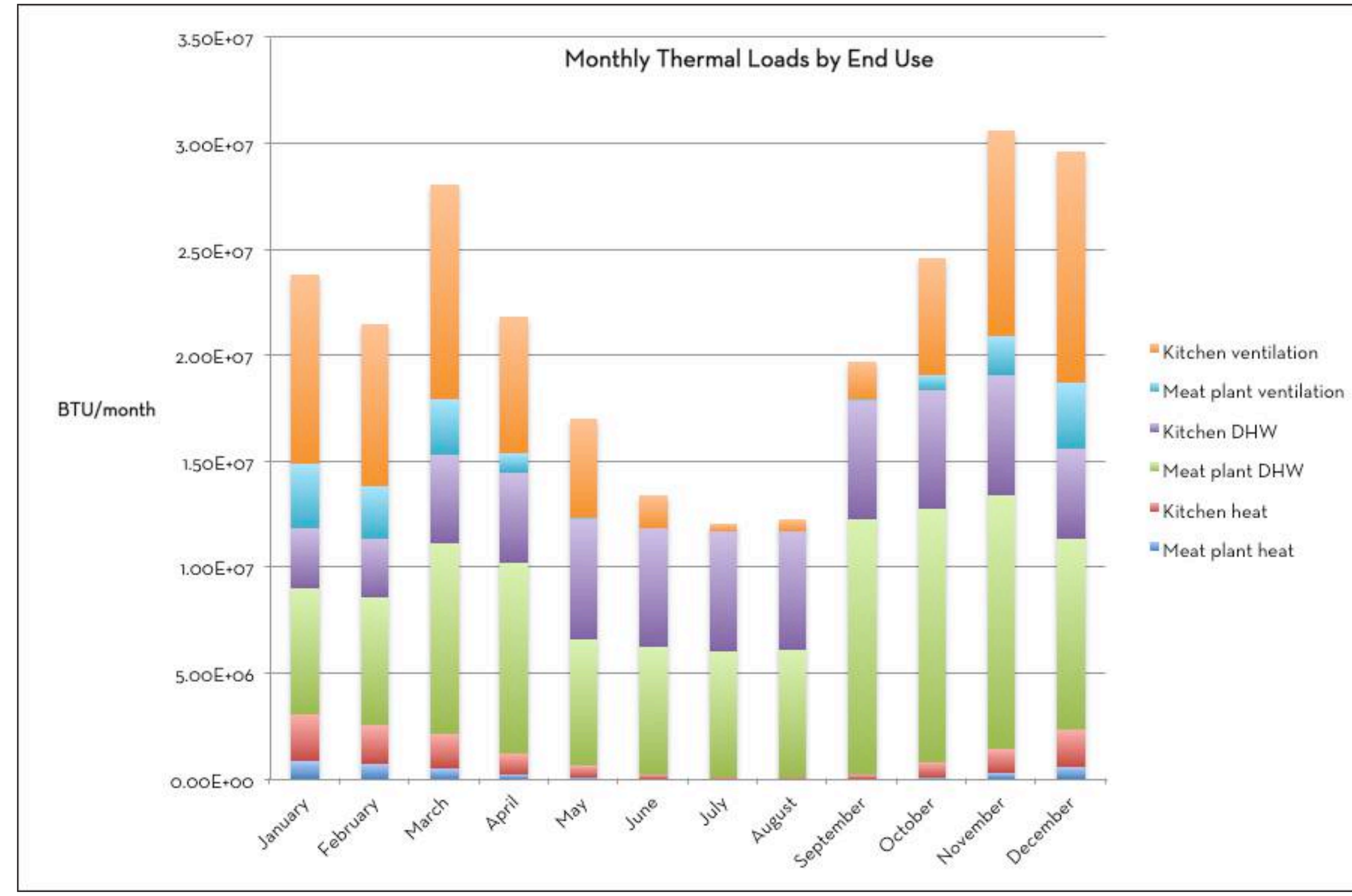


Loads in the graph above are expressed in kWh/month. Annual total is 287,000 kWh. Once again, the greenhouse is dominant, although not as dramatically as in the thermal load tally.

In very round numbers, if these loads were served conventionally by the electric grid and by propane, the cost of serving the thermal and electrical loads would be similar, each approximately $50,000 annually at current pricing (say, $2.50/gallon for propane, and $0.19/kWh for electricity).

Nature of Thermal Loads and Applicable Sources

The various thermal loads can be evaluated in terms of the flexibility of multiple sources to serve them. Easiest to serve are low temperature loads, such as heating the greenhouse. This might be done with water at 100°F, which could be generated by heat recovery from composting, various types of heat pumps, solar thermal, and heat recovery from coolers and freezers. Loads that require higher temperatures, such as service hot water as high as 180°F, are more restricted in the type of sources that can serve them, and usually the source is some type of combustion or occasionally electric resistance heating.



In the graph above, the greenhouse heating has been removed, in order to see the other thermal loads more clearly. Heating loads of the meat plant and kitchen are small relative to their DHW and ventilation loads. DHW is the largest, and that has a high temperature component. Some of the work heating DHW may be done by low temperature sources, which can preheat DHW, but final high temperatures will need to be provided by a fuel-burning device or by electrical resistance.

ENERGY MODEL Continued

Thermal Load Sources

The goal of IGI is that Thimble Farm be powered with renewable energy sources. This would include electricity produced by wind or solar, and thermal energy provided by burning biomass harvested on-Island. It is conceivable that small amounts of propane might be needed to avoid considerable over-sizing of renewable systems, yet this remains to be evaluated. The electricity strategy is almost certainly going to be based on net metering, exporting electricity to the grid when there is a surplus and importing from the grid in times of shortfall in onsite generation. There may be a place for advanced onsite electrical storage as these technologies evolve.

It is likely that the kitchen heating loads and the meat plant heating and ventilation loads will be served by electrically-driven Air Source Heat Pumps (ASHP). ASHPs extract heat from the outdoor air and deliver it to the space, and typically they operate at a Coefficient of Performance (COP) around 2.5, meaning they deliver 2-1/2 units of heat for every unit of electricity they consume. It is less certain, but possible, that the kitchen ventilation load will also be served by an ASHP. It is likely that 30-50% of the kitchen and meat plant DHW loads can be served by heat recovered from coolers and freezers in those buildings, where rejected heat from refrigeration equipment preheats the well water up to 90-100˚F, and/or by drainwater heat recovery from the waste water. The remaining load will be addressed by a fuel-burning device or by electrical resistance.

Heating the greenhouse is the biggest challenge and embodies the most opportunity for creativity. This can be a low temperature load. Distribution of heat is likely to be via warm water. Because some of the sources of warm water are intermittent and the greenhouse heating need can change rapidly, it is likely that considerable storage will need to be provided in the form of insulated water tanks. Once there are tanks, any number of sources can feed into them.

Possible sources of heat include:

- The composting system using a heat extraction technology such as that sold by Agrilab. This will need heat storage as it is a relatively constant output and the greenhouse need can change rapidly.
- Solar thermal, especially in locations in the greenhouse that are not requiring sunlight, such as aquaculture or composting areas. The glass is already there, and the collectors might be low cost plastic swimming pool collectors.
- Air-to-water heat pumps inside the greenhouse that take surplus heat during sunny periods and put that into heat storage for later use. We don't know if this has been done, possibly in Europe; we should check during schematic design.
- Air-to-water heat pumps with outdoor condensers that put heat into heat storage.
- Air-to-air heat pumps with outdoor condensers for direct heating as required without storage.
- Biomass boiler, burning wood chips, wood pellets, or firewood, depending on which is most available. Pellets would be most convenient but it is unlikely that they will be Island-sourced. Firewood boilers exist that have integral hot water storage that would be periodically fired; labor intensive to load but this is the lowest cost fuel. It will be worthwhile to evaluate labor needs by month; it may turn out that during the coldest months there is the least labor requirement for greenhouse operation so a person could spend some time operating a firewood boiler.

Shifting Thermal Loads to Heat Pumps

One possible scenario that would optimize the ability to power the farm with onsite renewable energy consists of the following:

- The heating and ventilation loads of the kitchen and meat plant will be served by heat pumps
- 40% of the DHW loads of the kitchen and meat plant will be served by heat recovery from coolers and freezers, and possibly from a drainwater heat recovery system that extracts heat from the waste water.
- The balance of these DHW loads is served by electric resistance.
- 50% of the greenhouse heating load will be served by the composter and solar or biomass
- 50% of the greenhouse heating load will be served by a heat pump operating at a COP of 2.5.

This scenario would reduce the annual thermal load from 1,500 MMBTU/year to 625 MMBTU/year, which is equivalent to approximately 8,000 gallons of propane, or 52 cords of firewood. The annual electrical load is projected to be 400,000 kWh/year.

Case	kWh/yr needed	Provided by wind	Provided by solar	kW solar needed	Area solar needed, sf
Base case	287,000	170,000	117,000	90	5,600
Case 2 (above)	399,000	170,000	229,000	175	11,000

Conclusion

With the goal of a renewably-powered complex, it is likely that we will push towards more electrically-driven loads and the extensive use of heat pumps. This load shifting reduces the thermal load to the equivalent of 8,000 gallons/year of propane. Heat extracted from composting is a likely thermal source and that might be complemented with a biomass boiler for high temperature loads such as hot water. As the greenhouse dominates the energy load profile, innovative ways to use less energy and generate more will be a central focus of the work moving forward. For electricity production, we recommend a combination of solar and wind. It is a robust approach that evens out the production of power throughout the year, and reduces the impact of any one system going down for a time.

The total predicted electrical load is approximately 400,000 Kilowatt hours per year.

The total area of south-facing roof is over 13,000 sf in the built-out plan. This area would support approximately 220 kW of solar electric generation, which would supply approximately 250,000 kWh/year. The wind contribution is based on the Endurance E3120 turbine, which is the same turbine currently operating at Morning Glory Farm and Allen Farm. At Thimble Farm the annual production of each Endurance E3120 is estimated at 85,000 kWh.

To serve the entire load, solar would contribute up to 250,000 kWh/year. Turbine #1 would add 85,000 kWh/year, and turbine #2 would add an additional 85,000 kWh/year, for a total of 420,000 kWh/year.

It will be a challenge to create an all or nearly-all renewable system of energy production to satisfy the complex matrix of project energy needs. If the commitment is strong, however, it can be done.

ENERGY MODEL Continued

Embedded Assumptions

Greenhouse

- Propane 0.5 gallon/sf/year for heating
- Electricity average of 18 kW
- No heated ventilation air
- Domestic hot water is a small fraction of the thermal load

Meat plant

- Operates 33 weeks/year
- Heating based on 50F as an average of varying indoor temperatures
- Ventilation 1 CFM/sf with 70% heat recovery
- Lighting 1.1 W/sf, equipment 2 W/sf, ventilation 1.75 W/CFM
- Cooling based on 50F as an average of varying indoor temperatures
- 396 sf coolers with 1,200 lbs/day product load, 120 sf freezer with 250 lbs/day product load
- 100 gallons of DHW/animal, 1074 animals/year, 85F delta T, 30% additional load due to storage and recirculation

Kitchen

- Operates 41 weeks/year
- Heating based on 1.5 BTU/sf/HDD
- Ventilation 1 CFM/sf with no heat recovery; heat required to preheat to 50% of indoor temperature
- Lighting 1.1 W/sf, equipment 2 W/sf, ventilation 1.75 W/CFM
- Cooling based on 50F as an average of varying indoor temperatures
- 396 sf coolers with 1,200 lbs/day product load, 120 sf freezer with 250 lbs/day product load
- 100 gallons of DHW/animal, 1074 animals/year, 85F delta T, 30% additional load due to storage and recirculation
- Small amount of cooling
- 300 sf coolers with 250 lbs/day product load, 300 sf freezer with 100 lbs/day product load
- 300 gallons/day of DHW, 90F delta T, 25% additional load due to storage and recirculation

Composter

- Electricity average of 1.0 kW

Septic/well

- Electricity average of 0.7 kW

Farmhouses (3)

- 1,800 kWh/year for heat, 1,400 kWh/year DHW, 4,000 kWh/year plug loads and lights – all based on minisplit heat pumps and heat pump water heaters

Worker housing

- 3,600 kWh/year for heat, 2625 kWh/year DHW, 11,250 kWh/year plug loads and lights – all based on minisplit heat pumps and heat pump water heaters
- Six workers year-round, twelve workers in warmer six months of the year

GREAT ROCK WINDPOWER
Wind Energy for Martha's Vineyard

THIMBLE FARM / ISLAND GROWN INITIATIVE (I.G.I.)
WIND FEASIBILITY REPORT

Prepared For:
South Mountain Company

December 2013

Site Assessment

Site Overview

The Thimble Farm is located off Stoney Hill Road primarily in the town of Tisbury. The majority of the property is open farm fields with a large greenhouse and small farm structures located in the center. Prospective sites should be located to the southeast and southwest of the large greenhouse to allow for clear wind fetch, maintain property setbacks, and maximize distance from neighboring dwellings. Small turbines such as the Endurance E3120 should be utilized due to the limited space and surrounding inhabited dwellings.

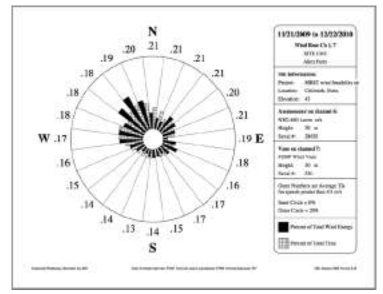
Micro Siting

While the AWS Truewind, Firstlook, and NASA modeled data all show a strong prevailing southwest wind on Martha's Vineyard annually, data collected data from the Allen Farm tall mast met tower indicates that the predominant wind power density comes from the west and northwest winds. Data from The Martha's Vineyard Airport also shows a more prominent west northwest component during the windiest winter months.

The open field area is roughly 1500 feet from east to west and is bordered by a tall tree line of roughly 50 feet in height. This east to west opening leaves substantial wind fetch area for two small to medium sized wind turbines. The property is also in a low lying area with hills to the north and the south roughly 30-40 feet above the elevation of the farm. The area to the west is relatively level. Due to the tall trees and surrounding farm buildings, a 140-foot tower is recommended. Two proposed sites are roughly 500 feet from Stoney Hill Road, 200 feet from the south tree line, and well clear of the east-west borders. Siting on the southerly side of the greenhouses allows for more fetch from the northwest keeping the turbines far from the hill to the North. If multiple turbines are required, the proposed sites, which are over 300 feet apart or roughly five rotor diameters, provide enough distance to minimize turbine-to-turbine wind shading.

Looking West from proposed site #1

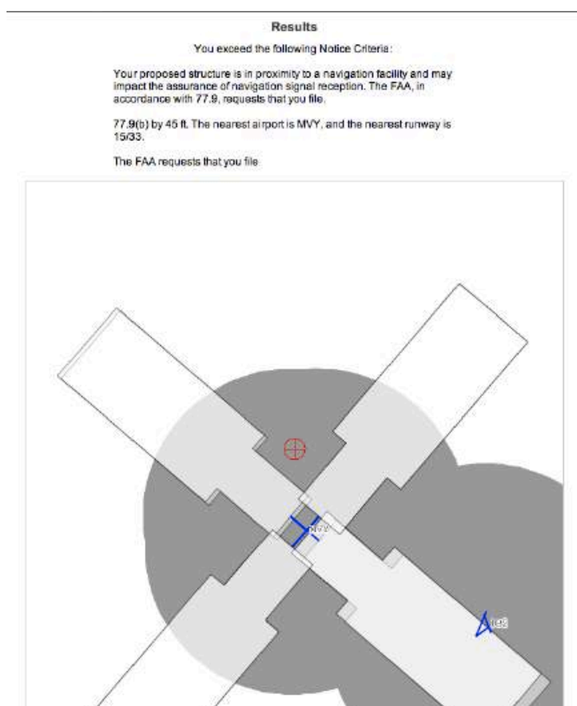
Looking West from proposed site #2

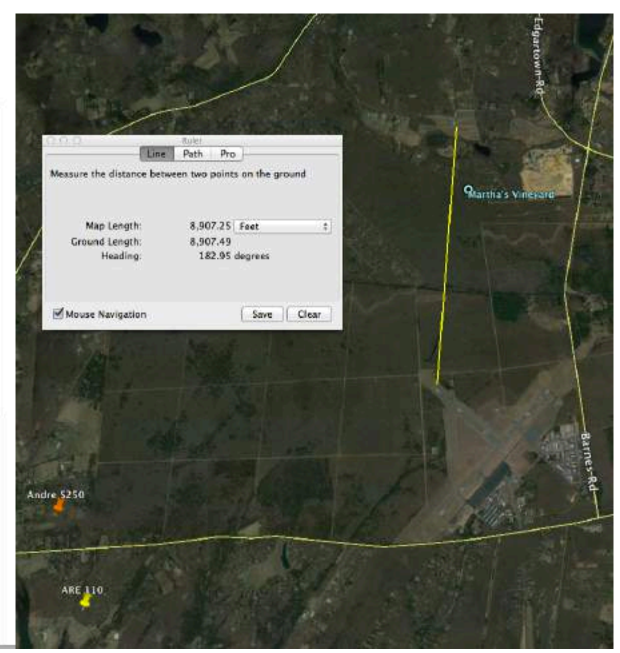


Actual recorded wind direction rose

Federal Aviation Administration (FAA)

A preliminary online assessment with the FAA indicates that the proposed sites are in proximity to a navigation facility, the nearest airport being MVY. The FAA requires notice of proposed construction to be filed. See the results from the online No Notice Tool attached below. Previous applications for projects located in a similar zone have resulted in approval. The proposed sites are not in the projected flight path and will not be emitting frequencies that could impede air navigation. Great Rock Windpower recommends an application be made as soon as possible to avoid delaying the project. This simple online application can be made on behalf of IGI by Great Rock Windpower upon request.





Setbacks

Tisbury setbacks are defined as to have its base not less distant than 110% of its height above mean natural grade. The suggested wind turbine locations are well within those limits, but due to their proposed height being above 80 feet, they may require a permit from the Board of Appeals. Since this proposal is for wind turbines on a working farm, Massachusetts General Law Chapter 40A Section 3 facilitates the permitting process.

Proximity to Adjacent Residences

The nearest off property residence is to the north and northwest approximately 600 feet from proposed wind turbine site #2. This is comparable to similar installations on Martha's Vineyard and is an acceptable distance. The nearest on property residence will be approximately 300 feet from the turbines

Sound

The turbine model Endurance E3120 on a 140-foot tower will not violate state noise regulations due to its quiet sound profile and the great distance from the property lines. Again, this is comparable to similar installations on Martha's Vineyard where no noise complaints have been filed regarding these turbines. On property residents at the Morning Glory Farm live within 250 feet of the turbine and multiple off property homes less than 600 feet from the turbine have not complained of sound emanating from the turbine.

Potential for Shadow on Adjacent Residences

On site residents will be affected briefly by the turbine shadow on sunny days when the turbine is operational but most of the shadowing will fall on the greenhouses and open fields. Nearby off property residences to the east will be minimally affected by shadow at the extremes of year when the sun is setting but are also protected by the tree line. The graphic below shows an estimated maximum shadow length at summer and winter solstice. The inset shows a plot created for a site in New England with all the worst case shadows from a 42 meter tower with a 20 meter rotor. It is our belief that these off property homes will not see any significant shadow flicker effect from the turbines at their proposed sites. Off property homes to the north, south and west will not be affected by shadow from the turbines.

Production Estimate

Site Overview

Great Rock Windpower used the Massachusetts Clean Energy Center's CWEST tool to estimate wind speed and output from the proposed turbine type at the Thimble Farm sites. The tool was updated to account for lower wind speeds and actual wind turbine power curves, and has proven of late to be fairly reliable in providing energy production estimates. The tool estimates annual energy output from an E3120 at 98,477 kWh/year on a 140-foot tower. See Wind Project System Summary Report. The tool places the adjusted wind speed at 4.7 m/s; however, Great Rock Windpower would estimate the annual average slightly lower. We feel it is safer to assume production ranges from 80,000 to 95,000 kWh /year depending on annual variation in wind speeds.

Grid Access

It is assumed that new three-phase underground 277/480V will be provided as part of the overall project. A detailed interconnection feasibility study will likely be required and performed by NSTAR.

Construction Access

Access to the site is facilitated via Stoney Hill Road from the east. The proposed wind turbine locations have excellent staging areas for cranes and other large construction equipment.

Choice of Equipment

The Endurance E3120 has been installed in over 500 locations worldwide and has a reliable performance record. The turbine is designed to produce in lower wind regimes and is known to be a very quiet turbine. It has seen success and is a known quantity on the Island and with the CEC and NSTAR as well. See attached literature for details.

Conclusion

The proposed sites at the Thimble Farm are characterized by good wind fetch to the west, appropriate distance to property lines and neighbors, excellent construction access, and grid availability. Given these conditions, Great Rock Windpower recommends that Thimble Farm/I.G.I. proceed further with detailed feasibility and planning for two Endurance E3120 wind turbines on 140 monopole towers. A single larger turbine may present unacceptable visual, sound, and shadow flicker issues for adjacent properties.

WIND FEASIBILITY STUDY Continued

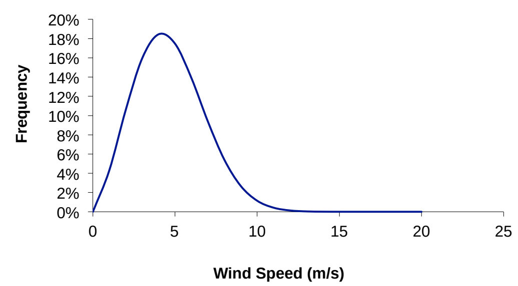
Wind Project System Summary Report

Customer Name:	IGI
System Designer:	Gary Harcourt
Report Date:	9/15/13

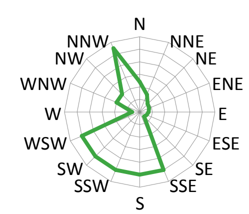
Site Information

Latitude (Tower Location):	41.4228
Longitude (Tower Location):	-70.6186
Annual Avg. Wind Spd:	5.8 m/s
Avg. Wind Shear Exp:	0.39 m
Avg. Obstacle Height:	8
Avg. Hub Height Wind Spd:	4.7 m/s
Conversion Losses	11%
Misc. Losses	0%
Wind Speed Derate Factor	10%
Weibull K Factor:	2.42

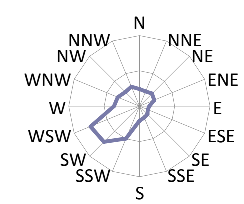
IGI Project Annual Wind Speed Distribution



Obstacle Height by Direction
10 ft/division



Site Wind Rose (5% per division)



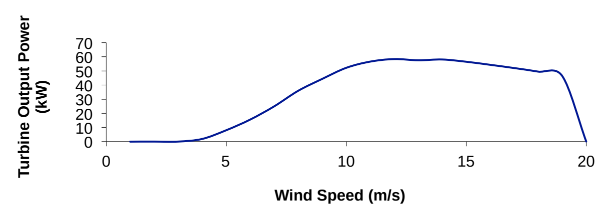
Wind Map Wind Speed Point

Latitude:	41.4222723
Longitude:	-70.6191203

System Information

Turbine Manufacturer:	Endurance
Turbine Model:	E-3120
Tower Height:	120 Feet
Rated Output Power:	56.74 kW
Rated Wind Speed:	11 m/s

Endurance E-3120 Power Curve



Energy Production Estimates

As Proposed	
Estimated Annual Energy Output:	80,187 kWh/yr
Estimated Annual Capacity Factor:	16.1%
Increase Hub Height by 20 Feet (6 meters)	
Estimated Annual Energy Output:	98,477 kWh/yr
Estimated Annual Capacity Factor:	19.8%
Production Increase vs. Proposed System	23%

Environmental Benefits of Small Wind System

Annual Pounds of CO2 Emissions Offset	98,309
Equivalent Acres of Trees Planted	12.19
Equivalent Cars Taken Off Road	8.6

MCEC Minimum Technical Requirements

Turbine Hub Height is 30+ Feet Above All Surrounding Obstacles? Yes

Report Generated Using CWEST

Developed by The Cadmus Group, Inc. www.cadmusgroup.com

For questions/comments, send email to: PTS@cadmusgroup.com

MASSACHUSETTS CLEAN ENERGY CENTER

Endurance wind power™
we power the future

Turbine

Configuration	3 blades, horizontal axis, downwind
Rated power @ 9.5 m/s	50kW
Applications	Direct grid-tie
Rotor speed	42 rpm
Cut-in wind speed	3.5 m/s (7.8 mph)
Cut-out wind speed	25 m/s (56 mph)
Survival wind speed	52 m/s (116 mph)
Overall weight	3 990 kg (8 800 lbs)

Rotor

Rotor diameter	19.2 m (63.0 ft)
Swept area	290 m² (3120 ft²)
Blade length	9.00 m (29.5 ft)
Blade material	Fiberglass/Polyester
Power regulation	Stall control (constant speed)

Generator

Type	Induction generator
Configurations	3ϕ, 480 VAC or 600 VAC @ 60 Hz 1ϕ, 240VAC @ 60Hz

Brake & Safety Systems

Main brake system	Rapid fail-safe dual mechanical brakes
Secondary safety	Pitch control system (for over-speed regulation) using passive, spring-loaded mechanism
Automatic shut down triggered by :	- High wind speed - Grid failure - Over-speed - All other fault conditions

Controls

Control System	Programmable logic controller (PLC)
User interface	Wireless or wired network software interface for remote monitoring and control

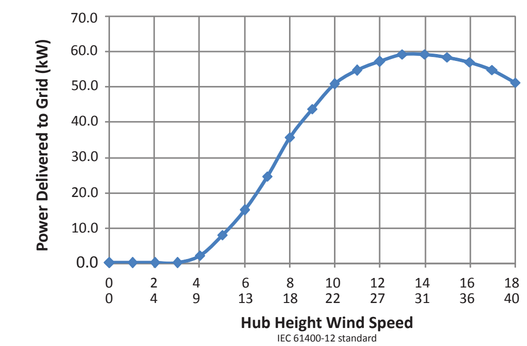
Warranty

Turbine & controls	5 years parts and labour

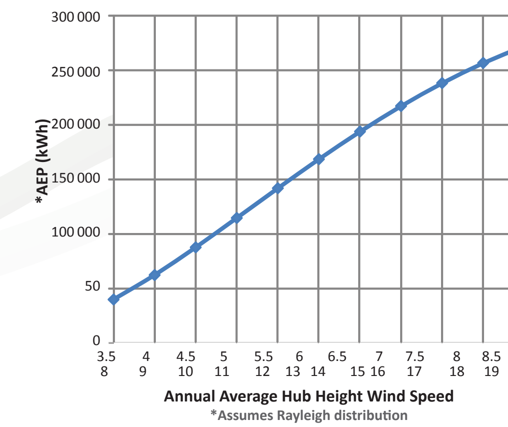
Towers

Free-standing monopole or lattice:	30.5m (100 ft), 36.5m (120 ft), 42.7m (140 ft)
Maintenance access	Safe climbing system Working space inside the nacelle Tower-top work platform

Power Curve



Annual Energy Production (AEP)



Annual Average Hub Height Wind Speed (m/s)	Annual Energy Production (kWh)
3.5	40 100
4.0	62 500
4.5	88 000
5.0	114 900
5.5	142 200
6.0	168 900
6.5	194 300
7.0	217 700
7.5	238 800
8.0	257 200
8.5	273 000

Wind Speed Conversion Table

m/s	4	5	6	7	8	9	10	11	12	14
km/h	14	18	22	25	29	32	36	40	43	50
mph	9	11	13	16	18	20	22	25	27	31

www.endurancewindpower.com
info@endurancewindpower.com

CE

bullfrogpower

Endurance Wind Power uses 100% renewable energy at its head office and manufacturing plant

WIND FEASIBILITY STUDY Continued

Preliminary Turnkey Installed Cost Estimates

	ONE E3120 140′ LATTICE	ONE E3120 140′ MONO-POLE	TWO E3120 140′ LATTICE	TWO E3120 140′ MONO-POLE
Installed Cost*	$375,000	$407,500	$745,000	$807,000
State Incentive**	-$100,000	-$100,000	-$200,000	-$200,000
Sub Total	$275,000	$307,500	$545,000	$607,000
Estimated Fed Tax Credit***	-$112,500	-$122,250	-$223,500	-$242,100
State Tax Credit	-$1,000	-$1,000	-$1,000	-$1,000
True Cost	$161,500	$184,250	$320,500	$363,900
AEP	90,000 kWh	90,000 kWh	180,000 kWh	180,000 kWh

* Includes 5 year maintenance contract

** Two turbines may be deemed one project by CEC and max award per project is 100K

*** CEC award may be taxable. Please consult a tax professional.

AEP = Annual Estimated Production expressed in kilowatt hours

Cost estimate assumes 3 phase 277/480 available at turbine sites

All estimates are based on current manufacturer pricing and may change

ECOLOGICAL ASSESSMENT (9.20.2013)

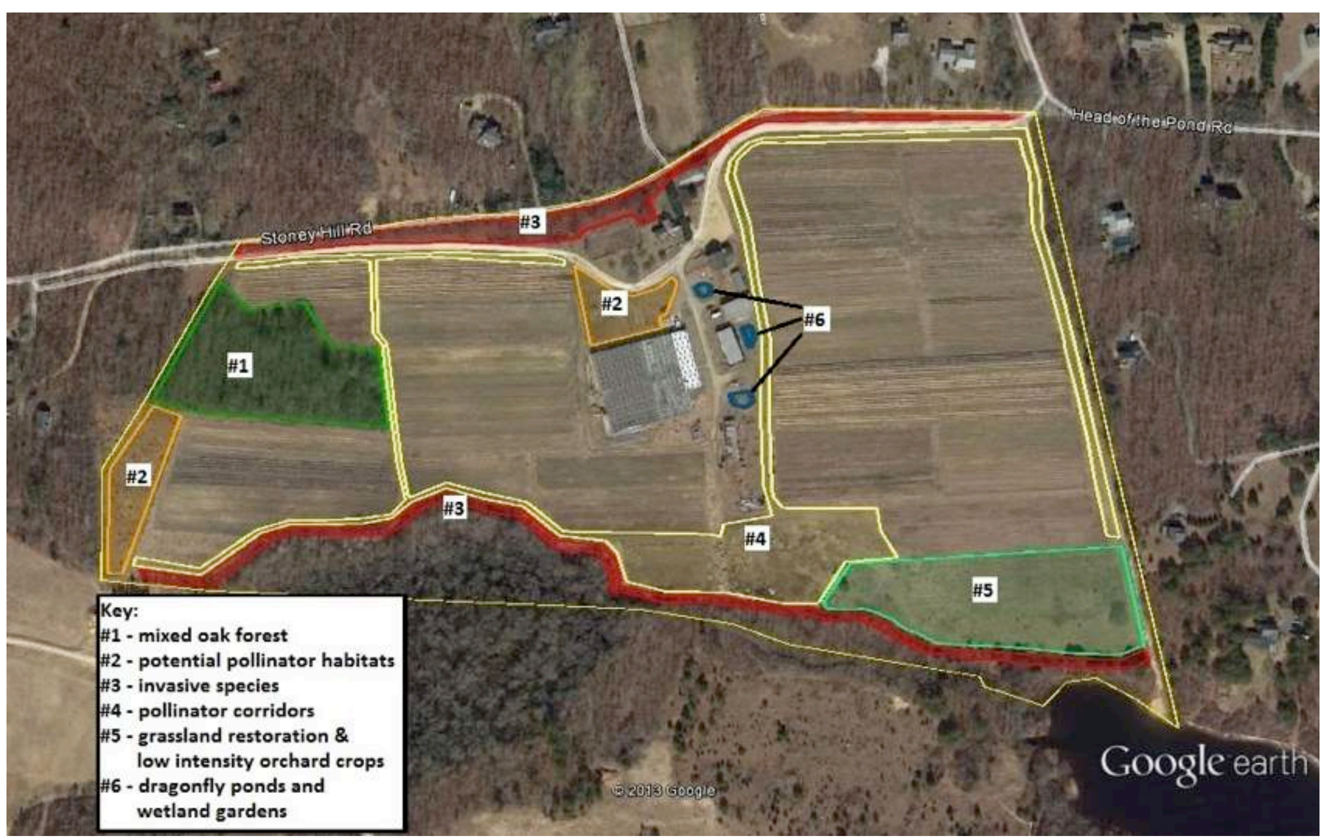
The Nature Conservancy
Protecting nature. Preserving life.™

Brian Lawlor
Program Manager, MV Habitat Network
Massachusetts Chapter, Island Office
18 Helen Ave, Vineyard Haven MA 02568
blawlor@tnc.org, 508-693-6287 x10

Ecological Context

The ecological neighborhood of Thimble Farm is dominated by mixed oak forest; however there is a remarkable diversity of habitat types that occur in small patches as a result of historic land use and development of the area. A red maple swamp occurs at the southern border of the property and drains into Duarte Pond to the southeast. Open areas in the neighborhood include agricultural grassland, cropland, native grassland, and residential development.

This diverse mosaic of habitat types is well suited to support a wide range of plants and animals, including species that perform valuable ecosystem services such as water filtration, pest control, and pollination. The remarkable diversity present is at some risk of homogenization by aggressive invasive plants, and any plan to improve the habitat quality of this parcel should incorporate a strategy to assess the distribution and abundance of these species in order to best plan for effective and meaningful management plans.



Priorities[1]

Mixed oak forest – (#1)

This section of the property is classified as Priority Habitat by the state Natural Heritage and Endangered Species Program (NHESP). Any management activities in this area should first be cleared by the appropriate regulatory bodies.

The western portion of this zone is in relatively good condition, dominated by a mixed age stand of oaks with an understory of native viburnum, blueberries and other common shrubs. Moving from west to east this area is increasingly impacted by invasive plants such as bittersweet, which has grown up into the canopy in some areas and threatens to outcompete even the most mature trees on the site. A large population of white poplar has also grown up along the eastern boundary of the forest and spread rapidly along the edge of the fields. This is listed as a potential invasive species in Massachusetts, with more data being required before a definitive classification can be made. Both the bittersweet and the white poplar are non-native plants which are capable of homogenizing this habitat and decreasing its value for a broad range of beneficial wildlife species. Given the scale of this invasion, a holistic strategy for control using both mechanical and chemical means is likely to provide the most effective results. The first phase of control could consist mainly of mechanical treatments such as cutting, pulling, and chipping. Afterwards, follow up with chemical methods would insure that sufficient levels of control are achieved.

1 Habitat management activities may be subject to the authority of state and local agencies including, but not limited to, town conservation commissions and the Massachusetts Natural Heritage and Endangered Species Program. Check with your local authorities before making modifications to wildlife habitat. The Nature Conservancy assumes no liability for work performed without required permits.

ECOLOGICAL ASSESSMENT Continued

Before undertaking any major invasive species control project it is important to set reasonable goals and define threshold levels for success. In many cases, total eradication is impossible or unfeasible and success must be defined in other terms.

White poplar

Pollinator habitat enhancement (#2)

These two portions of the property (mapped on page one) fall outside of the farmed areas of the landscape and offer excellent opportunities for pollinator habitat management. Both areas will receive some level of public visitation either through workshops at the farm or by hikers on adjacent trails. Given this scenario, signage to help visitors understand the importance of pollinator habitat would be an excellent addition to these zones.

Proper site-prep is essential for the establishment of quality pollinator habitat. There are both organic and chemical treatment options for weed control and the choice hinges on cost, scale of the project, and time-frame for installation. In some cases cover cropping followed by light tillage can be sufficient to achieve good weed control prior to habitat installation. Ernst seeds of Pennsylvania sells a pollinator habitat mix that was developed in collaboration with the Xerces Society for Invertebrate Conservation. More locally, Colonial Seed sells seed mixes of pollinator friendly species and North Creek nurseries has an excellent selection of native wildflower plugs with high conservation value.

Invasive species monitoring and control (#3)

Along the southern boundary of the crop fields and the northern boundary of the property are the highest densities of invasive shrubs and vines. The first step for any control project should include defining goals, and assessing current conditions. A number of magnificent oaks along the northern border of the property are threatened by vines that have already reached into the canopy. Areas like this might be good candidates for "triage" treatments to remove the most immediately pressing threats from invasive plants. Near the center of the southern fenceline, bittersweet is threatening the integrity of newly constructed fences. Again, this may merit immediate attention even before an overall strategy for invasives control has been completed.

We recommend that invasive species work should be carefully prioritized and done in a systematic way, and that regular follow up treatments are budgeted for as a part of any control strategy. It may be best to focus on small sections at a time, and rotating through the property on a long term schedule.

Among the invasive species that have been noted on this parcel are Asiatic bittersweet, autumn olive, garlic mustard, multiflora rose, Japanese honeysuckle, bush honeysuckle, and spotted knapweed. Each individual species may factor differently into the long term control strategy, depending on the goals and capacity of IGI staff.

Japanese honeysuckle and autumn olive are widespread invasive plants.

Pollinator corridors (#4)

In fragmented habitats, including crop fields, pollinators will benefit from linear corridors that provide linkages to various different habitats. Many of our native bees are superior to managed honeybees for the pollination of crop plants and are able to provide the bulk of pollination needs for many farmers. Pollinator corridors could be composed of woody hedgerows or herbaceous strips along fencelines or other marginal areas of the farm. Grants from NRCS and SARE can provide funding for the establishment of these habitats.

Grassland restoration (#5)

This portion of the property (mapped above) contains some of the most high-quality native grassland in the immediate neighborhood. Unfortunately, it is also heavily impacted by the invasive plant, spotted knapweed. This species is a major noxious weed in western rangelands and much of the literature on knapweed control comes from this part of the country. There are some insect species which have been approved by USDA for biological control of this plant, although it is unclear if this approach has been tried in our part of the country. Hand pulling and digging could be another approach to management of this species; however this would entail a great deal of labor over a long time period. Prescribed grazing has also been documented as a viable control method; reducing seed set of spotted knapweed in areas where it has been practiced.

The open nature of this area is further threatened by encroachment of both native and non-native shrubs such as eastern red cedar and autumn olive. Our recommendation is to maintain the open character of this zone by removing encroaching woody species.

If IGI chooses to proceed with a plan for managing this area as a low-intensity orchard, we recommend utilizing native crop species to whatever extent is possible. Widely spaced beach plums and highbush blueberries could provide a pick-your-own crop for the farm and still leave room for the warm season bunchgrasses and wildflowers that make this area such an attractive habitat. The grassland could be further enhanced by wildflower plantings that extend the season of floral resources in this area of the property, thus creating another haven for native pollinators on the farm.

ECOLOGICAL ASSESSMENT Continued

Dragonfly ponds and wetland gardens (#6)

Roof runoff from outbuildings and wastewater from the aquaculture operation could be fed through a series of constructed wetlands and bogs for filtration before being fed into a small pond. The pond design could be optimized for dragonfly habitat, and it could also be used as a backup source of irrigation water for the community garden plots. By creating a dragonfly nursery, the farm could benefit from the predatory insects as they go about devouring lepidopteran crop pests and mosquitos alike. Installation of the pond and wetland gardens could be done with the use of volunteer labor and materials may be eligible for funding through a grant from SARE or NRCS.

Breeding habitat for snakes

Snakes provide another valuable ecosystem service in the form of pest control. This is beneficial for farm crops as well as human health, as white footed mice are a dominant vector for Lyme disease in our area.

In many parts of the region, it is possible that snakes are limited by the abundance of overwintering structures (hibernacula) but given the preponderance or rubble and debris piles on the farm, that may not be the case in this instance. There are other strategies for snake conservation which may be more valuable in this situation.

Providing cover-boards for snakes to shelter under can be one way to attract and support their numbers. Cover boards are simply sheets of plywood or metal, that are left on the ground in sunny areas to provide both shelter and an attractive microclimate for reptiles and amphibians. This technique is used frequently by amateurs and scientists alike as a method for finding and studying these elusive animals. A minimum size of 4' x 4' is recommended to provide adequate protection from snake predators such as skunks or raccoons.

Another option is to create snake breeding grounds by allowing woodchip piles to slowly decompose in sunny locations. Rotting wood is widely known to attract egg laying snakes and the piles can even be fenced off with hardware cloth or chicken wire in order to protect eggs and young from rodents and other predators.

Nest-boxes for owls, bluebirds, and flycatchers

Great crested flycatchers, tree swallows, and eastern bluebirds are insectivorous species that are easily attracted by providing appropriately sized nest boxes. Larger boxes can also attract screech owls and barn owls that will help control rodent populations. Small ledges below the eaves of outbuildings can attract barn swallows to nest.

Nestboxes should be monitored and undesirable species such as house sparrows and starlings should be removed. Boxes should be protected from feral cats, squirrels, and other nest predators by the use of flashing or stove-pipe style predator baffles. Proper design and siting of boxes can help make sure that they are used by the appropriate species and are less likely to attract nuisance birds.

Beetle banks

These could be incorporated into many different portions of the farm, including hedgerows, pollinator corridors or other marginal areas. The general concept for a beetle bank is to create a raised area planted with bunchgrasses that will provide nesting and overwintering habitat for predatory ground-beetles. The beetles can then forage for insect pests in adjacent crop fields. Dead and decaying wood can be incorporated into the design, providing additional habitat for wood-nesting bees and other beneficial insects.

Additional resources:

Ecological Farming
http://farmscapeecology.org/

VHN resource page – including new species profiles and habitat management strategies www.nature.org/vineyardfactsheets

Pollinator conservation from the Xerces Society
http://www.xerces.org/pollinator-conservation/

Invasive species resources from the New England Wildflower Society
http://www.newfs.org/protect/invasive-plants/removal
http://www.newfs.org/protect/invasive-plants/removal/common-invasives-management.html

Invasive plant atlas of New England
http://www.eddmaps.org/ipane/management/management_links.htm

Articles on invasive plant management from the Ecological Landscaping Association
http://www.ecolandscaping.org/09/invasive-plants/controlling-small-scale-infestations-of-exotic-invasive-plant-species-ecological-and-ipm-information-for-landscapers-and-homeowners/

Plant identification and horticulture resources:
www.gobotany.org
www.wildflower.org
http://dendro.cnre.vt.edu/dendrology/idit.htm

Landscape design for wildlife
http://www.plantnative.com/how_intro.htm
http://wdfw.wa.gov/living/landscaping/

ECOLOGICAL ASSESSMENT Continued

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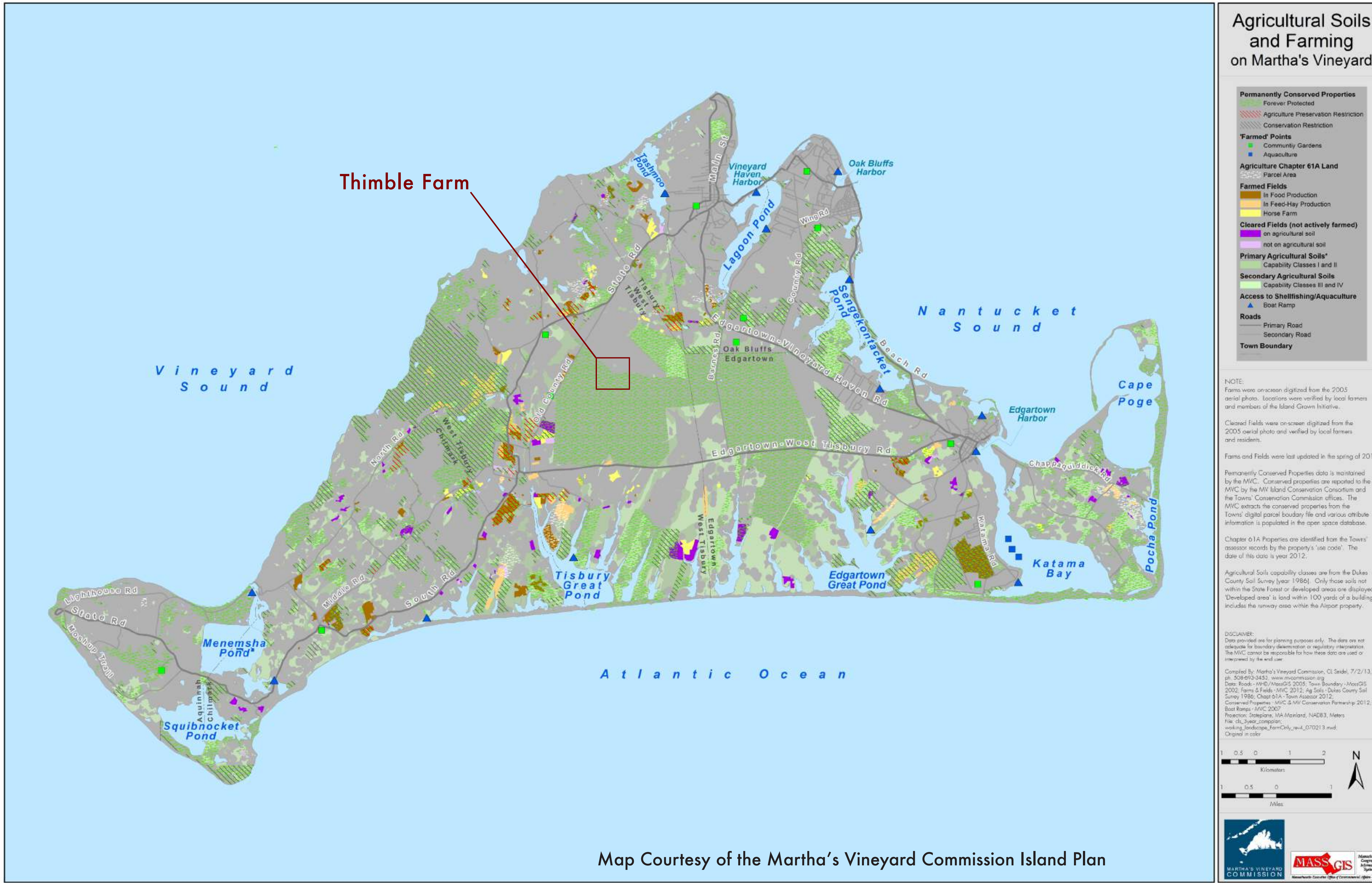
MARTHA'S VINEYARD AGRICULTURAL MAP



Map Courtesy of the Martha's Vineyard Commission Island Plan

PARTICIPANTS

The information assembled here comes from a major collaborative effort and many different sources. There are too many to name, but thanks is due to all and the following is a list of a few of the important participants:

- IGI Board of Directors (Sarah MacKay, President, Mary Kenworth, Treasurer, Randi Baird, Clerk
- IGI Project Manager Steve Bernier
- IGI Core Group (Noli Taylor, Jamie O'Gorman, Taz Armstrong, Melinda Defeo, Jefferson Munroe, Simon Athearn, Rebecca Miller, Emily Duncker, Kaylea Moore)
- Thimble Farm General Manager Keith Wilda
- Thimble Farm Slaughterhouse Committee (Jon Previant, Chair)
- Thimble Farm Kitchen Committee (Keith McGuire, Chair)
- Chris Alley, Civil Engineer, Schofield, Barbini, and Hoehn
- Philippe Jordi, Director, Island Housing Trust
- Ben Brungraber, Structural Engineer and Principal, Fire Tower Engineering
- Gary Harcourt, Great Rock Windpower
- Greg Watson, Commisioner, Massachusetts Department of Agriculture
- Sean Bowen, Aquaculture Coordinator, Massachusetts Department of Agriculture
- Brian Jerose, Agrilab Technologies, Inc.
- Ed Maltby, Manager, Adams Farm Slaughterhouse
- John Waite, Director, Franklin County CDC Food Processing Center
- Brian Lawlor Program Manager, Martha's Vineyard Habitat Network

The primary South Mountain Company staff who have contributed to this project to date are:

- John Abrams, Project Coordinator
- Ryan Bushey, Project Architect
- Marc Rosenbaum, Project Engineer
- Matt Coffey, Project Designer
- Greg Milne and Deirdre Bohan have provided artistic and graphic layout assistance.

Cover photo courtesy of Randi Baird.

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