PROJECT NARRATIVE: OYA RAMAN SOLAR PROJECT

0 Athol Rd, Town of Royalston, Worcester, MA 01368

Prepared By: OYA Solar MA, L.P.

July 6th, 2018

Cover Letter

Town of Royalston, Planning Board
Town Hall, 1st Floor
13 On the Common
Royalston, MA 01368

Re: Project Narrative:
OYA Raman Solar Project – 0 Athol Rd, Town of Royalston, MA 01368
(Tax Parcel ID No. 11-55-5)

To Whom It May Concern:

OYA Solar MA, L.P. ("OYA") would like to request Site Plan approval from the Town of Royalston Planning Board for the development of a 5 MWAC proposed Solar Photovoltaic ("PV") Facility Project located at 0 Athol Road ("Proposed Project") in the Town of Royalston, County of Worcester, Massachusetts.

At OYA, we pride ourselves on conducting a comprehensive investigation of every project site we are considering prior to submitting an application to a municipality. With the assistance of the best engineering consultants in the industry, we research a number of factors that could influence development of a solar facility, including but not limited to, field visits, land use, zoning requirements, wetlands analysis, storm water discharge impacts, cultural, biological, archeological studies and visual screening analysis. We also analyze the future impact on the land once the solar arrays are no longer in service by preparing a decommissioning plan. Furthermore, we work closely with the local utility company to determine the feasibility of the project in parallel with advancing the municipal permitting efforts.

Founded in 2009, OYA's principals have developed, permitted and financed over 500 MW of residential, commercial, industrial and utility scale rooftop and ground mounted solar photovoltaic ("PV") projects in North America. As a result, our in-house team along with our permitting consultants have gained an extensive amount of experience in engaging municipal agencies along with other stakeholders to ensure that our proposed solar project meets all required zoning ordinances and has been adequately presented to all stakeholders, including neighbouring property owners and any entity that could potentially be affected by the solar project.

We look forward to submitting our Site Plan application to the Planning Board. Our goal is to work closely and diligently with all stakeholders to make this Proposed Project a success while bringing positive economic, social, and environmental impacts to the Town of Royalston and the community.

Sincerely,

Manish Nayar,
President, OYA Solar MA, L.P.

OYA Solar MA, L.P.
144 Front Street West
Unit 310
Toronto, Ontario
M5J 2L7 CANADA

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www.oyasolar.com

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Executive Summary

OYA Solar MA, L.P. ("OYA") is proposing to develop a 5 MW_{AC} solar project located at 0 Athol Road ("Proposed Project") in the Town of Royalston, Massachusetts. The Proposed Project will operate over a 20-year term. OYA has contracted Stantec Inc. to assist in the submittal of the Site Plan Application and engage in further discussions regarding any additional permitting and engineering requirements.

OYA has, in place, an executed lease agreement with the landowner of the property. Preliminary desktop studies have been performed to ensure that the Proposed Project conforms to the Town of Royalston's Large-Scale Ground-Mounted Solar Photovoltaic ("PV") Installations By-Law.

OYA has identified potential municipal and federal permits required to move forward with the Proposed Project. Detailed site plan drawings have been created to highlight the overall project layout, including site access, setbacks from wetlands, concrete pad locations, PV module layout and interconnection points.

Additionally, the Proposed Project shall be designed to provide minimal visual effects on neighbouring parcels. The Proposed Project requires landscape screening and fence with a 100' front setback, 40' side setback and a 40' rear setback, from all adjacent non-owned properties as required in the RRA without sewers zone.

Site due diligence investigations have been conducted to ensure the suitability of the proposed site with respect to avoiding and/or minimizing impacts to sensitive resource areas. These include a Desktop Wetland and Floodplain Assessment, Environmental Analysis, Cultural and Archeological Analysis, and Biological Analysis. A site visit, performed by a wetland scientist, was also conducted to confirm wetland areas. The information collected were provided to the surveyor to compile a base plan using LiDAR data. Preparation of drawings and a Stormwater Management Report were also completed.

Construction activities are expected to take 6 to 8 months, including 2 months for commissioning.

Decommissioning will include the removal of all solar arrays, cables, electrical components, accessory structures, fencing and other ancillary facilities depending on the discussion between OYA and the Landlord. Security can be provided in the form of a surety bond or negotiated with other means to guarantee the availability of funds for system removal. The bond amount will adhere to any municipality by laws and or guidelines for decommissioning in Massachusetts.

1. Overview

We understand that changing government policies and rapid technological development can make even small renewable energy projects appear overwhelming. Our experienced team helps communities make sense of available renewable energy technologies, utility incentives, government programs and financing options. We will assist in developing and implementing a renewable energy plan that will both reduce the Town of Royalston's carbon footprint and provide the community with an alternative to purchasing electricity from a clean and more affordable source.

Solar projects offer numerous benefits to the community. These multi-million-dollar projects create construction, operation and maintenance jobs. At OYA, we work with local contractors for numerous components of the project.

Solar panels and renewable energy systems have been used in the United States for over forty years. Since then, it has increasingly gained popularity due to the environmental benefits that solar energy has over the use of traditional fossil fuels. In addition, the cost of solar technologies has become more competitive. Moreover, solar systems have been found to be a good-neighbor land use due to their passive nature, no negative impacts on neighboring property values and benefits to the environment and local economy. Lastly, a solar project will not change the underlying nature of the land.

The Proposed Project is proposed to have a capacity of 5 MW_{AC} and will be in operation over a 20-year term. The electricity produced will be distributed directly to the existing electrical grid and then allocated to potential subscribers who are interested in purchasing the clean electricity.

Frequently Asked Questions

Will the Proposed Project be harmful to the use and enjoyment of the land users in the area?

No, solar arrays are virtually silent and do not generate any traffic, other than scheduled maintenance (i.e. daytime, once a week or less) vehicles that would utilize public roads to access the solar project area. They are virtually invisible as the panels are situated low to the ground, comparable to half the height of a typical single-family home and lower than most farm buildings. In addition, the proposed project will be screened with dense landscaping, such as trees and shrubs. The site will also be surrounded by a security fence of 6-7 feet and produce no odors or fumes.

Will the Proposed Project impede the normal and orderly development and improvement of surrounding vacant property?

No. solar arrays will not prevent surrounding properties from being used for agricultural, residential, commercial and industrial and other typical permitted uses.

Does the Proposed Project have adequate utilities, access roads, drainage, and other necessary facilities?

Utilities	Typically not required, except for connection to nearby electrical power lines.
Access Road	Typically one gravel access road at site of existing driveway.
Drainage	Existing site drainage patterns will be maintained and there will be no increase to the storm water discharge rate from the site. The solar panels are attached to the ground via slender poles with little ground disturbance. Erosion and sediment control will be addressed in conformance with State and Federal regulations.
Accessory Structures	Small equipment buildings to house inverter and electrical components. Dimensions are approximately 8 ft x 20 ft x 9.5 ft

What measures will be taken to prevent offensive odor, fumes, dust, and noise so that none of these will constitute a nuisance?

Offensive Odor	None, the system does not release any offensive odor.
Fumes	None, the system does not release any fumes.
Dust	None, once proposed project is constructed. Measures will be put in place during construction to limit dust created by construction operations.
Noise	Minimal. Exhaust fans in electrical equipment cabinets that will be located over 1,000' from nearest residence. Noise from the exhaust fan is comparable to noise from a typical household air conditioning unit.
Hours of operation	Daytime maintenance visits, once a week or less.

Do solar panels have any effect on soil and ground water?

No, the solar panels will not have any effect on soil and ground water. While generating electricity, a solar plant produces no emissions or waste.

Are solar panels hazardous to the environment?

The most commonly utilized solar technologies use inert materials found at every building site including silicon (glass), aluminum (frame) and copper (wiring). Although thin film photovoltaics do contain some heavy metals, including cadmium, numerous studies (e.g. the "Sustainability of Photovoltaics[1]" and Life Cycle Impact Analysis of Cadmium in CdTe PV Production[2]") have found that these metals do not leach from the modules into the environment under normal conditions or anticipated accidents, such as storm damage or fires.[3]

Will there be any public costs incurred in the project?

There will be no cost to taxpayers for development of this project. On the contrary, the public will benefit from the proposed project as it will employ locals for construction, operations and the supply chain. There will be many indirect jobs created for support processes which complement the entire life cycle of the proposed projects, including, but not limited to; policy-making, sales and marketing, financial services, education, research and development, consulting, hotels, restaurants, etc.

Statistics show that for every job created in the solar industry, 1.8 to 2.8 jobs are created in other segments of the economy[4].

Will there be any burden on existing Public infrastructure and Services?

The Proposed Project will not produce a burden on existing public infrastructure and services. On the contrary, the passive nature of electric generation prevents the need for additional or increased services. The limited amount of vehicle traffic needed to access the site will prevent traffic hazards. A parking and laydown area may be designated on the proposed site during construction and decommissioning.

What are the main benefits from the project?

The Project is proposed and designed for the initial launch of the Massachusetts Department of Energy Resource's ("DOER") new Solar Massachusetts Renewable Target ("SMART")[5] incentive program as part of the Commonwealth of Massachusetts' commitment to 25% emissions reduction target by 2020 and 80% by 2050 through the

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[1] Fthenakis Vasilis, "Sustainability of photovoltaics: The case for thin-film solar cells." Vol 13, Issue 9, Dec 2009 Renewable and Sustainable Energy Review.
[2] Fthenakis Vasilis, "Life cycle impact analysis of cadmium in CdTe PV production." Vol 8, pp 303-334, 2004 Renewable and Sustainable Energy Review.
[3] https://solar.gwu.edu/do-solar-panels-contain-toxic-chemicals
[4] George Ban-Weiss et al., "Solar Energy Job Creation in California", University of California at Berkeley
[5] 225 CMR 20.00: Solar Massachusetts Renewable Target (SMART) Program https://www.mass.gov/files/documents/2017/10/16/225cmr20.pdf

use of renewable resources[6]. The SMART incentive program has also allocated 1,600 MW of solar power to be installed in the Commonwealth of Massachusetts. See *Appendix H: 255 CMR 20.00: SMART Program*

In addition, the siting authority for solar projects resides at the local level and not the state level as a means to encourage local efforts to expand clean energy generation in a sustainable way. As well, the proposed project will be generating clean energy which is fed into the local grid.

Will the Proposed Project conform to Town of Royalston zoning regulation?

Yes, the Proposed Project is in conformance with the Town of Royalston zoning regulations for solar developments.

This permitting narrative will address the requirements as set out in Section VII. B. [page 44] Large-Scale Ground-Mounted Solar Photovoltaic Installations of the Town of Royalston Zoning Bylaws, last amended and in effect as of April 10th, 2015.

According to Section VII. B.3, "Large-Scale Ground-Mounted Solar Photovoltaic Installations are allowed by Special Permit in the Residential (R) and the Residential/Agricultural (RA) Districts. Based on the Town's zoning map, the parcel is zoned Rural Residential and Agricultural District ("RR&A"), as such the proposed project shall be subject to such special permit approval from the planning board. [See *Appendix L: Zoning District Map with Proposed Project Location*]

[6] Chapter 298, Section 4, Global Warming Solutions Act, 2008
https://malegislature.gov/Laws/SessionLaws/Acts/2008/Chapter298

Important Contacts

Property Owner Information

Name:	Ramanjanappa Ravikumar
Parcel ID No.:	11-55-5
Address:	0 Athol Rd, Town of Royalston, Worcester, MA 01368

Proposed Project Consultant:

Name:	Stantec Consulting Services Inc.
Address:	226 Causeway Street 6th Floor, Boston MA 02114-2155
Phone Number:	(617) 654-6059
Contact Name:	Frank Holmes, Principal

Project Developer

Name:	OYA Solar MA, L.P.
Address:	144 Front St. W, Unit 310 Toronto, ON M5J 2L7
Phone Number:	416-840-3358 / 647-830-0579
Contact Name:	Taymaz Jahani, Chief Operating Officer

Municipality

Name:	Town of Royalston
Address:	Town Hall, 1st Floor 13 On the Common, Royalston, MA 01368
Contact Name:	Kate Collins, Planning Department Chair

2. Proposed Project Description

The Proposed Project is a 5 MW_{AC} fixed tilt or single axis solar generation facility located in the Town of Royalston (See "*Figure 1: Proposed Project Location*").

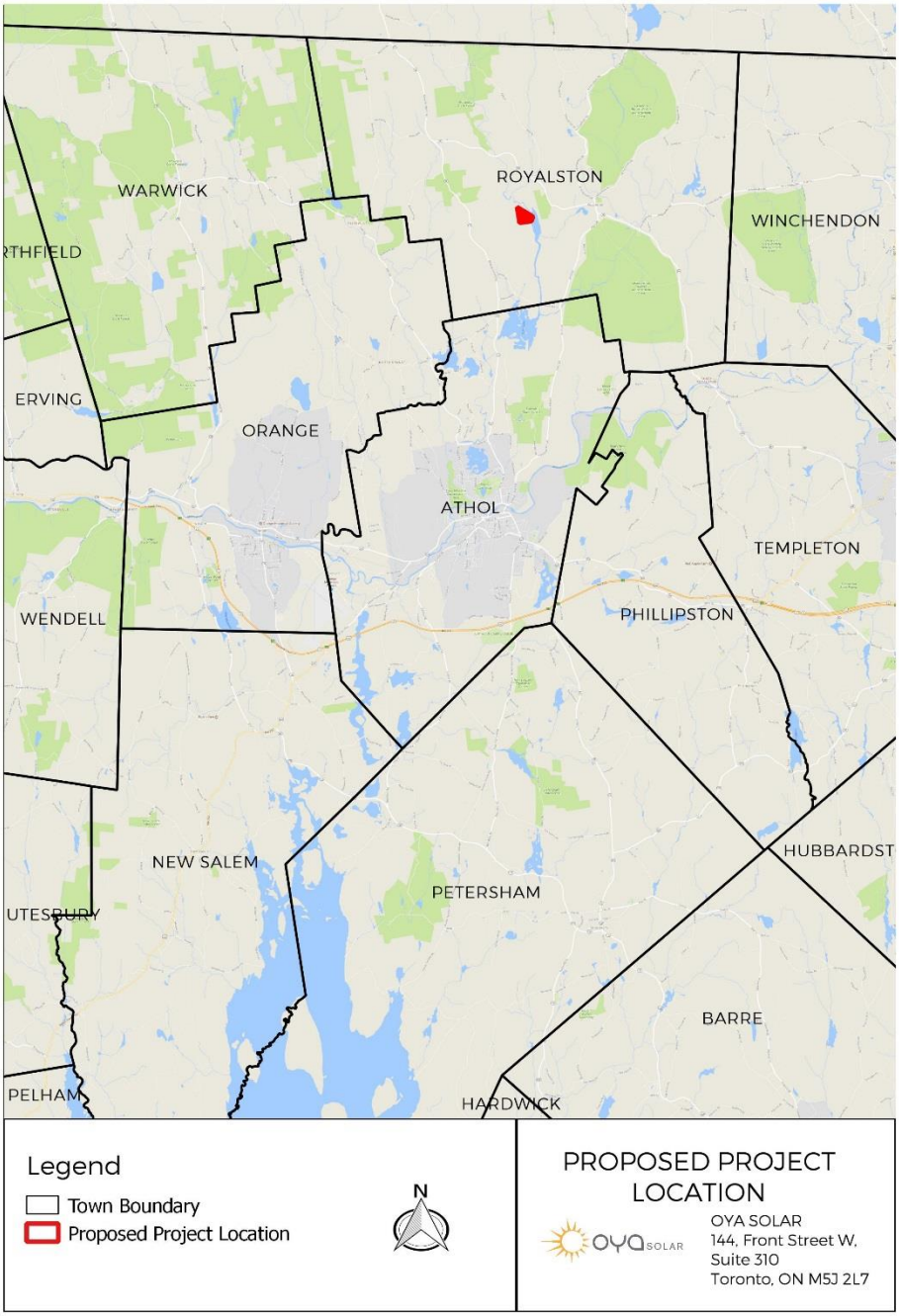


Figure 1: Proposed Project Location

Proposed Project Site Location

The Proposed Project site is located at 0 Athol Road, Town of Royalston, MA 01368 on approximately 36.0 acres of land that is currently zoned as Rural Residential and Agricultural District ("RR&A") in the Town of Royalston (See *"Figure 2: Proposed Project Site Location"*). The site access will be via a proposed gravel road off of Athol Road, entering at the northeast corner of the property.

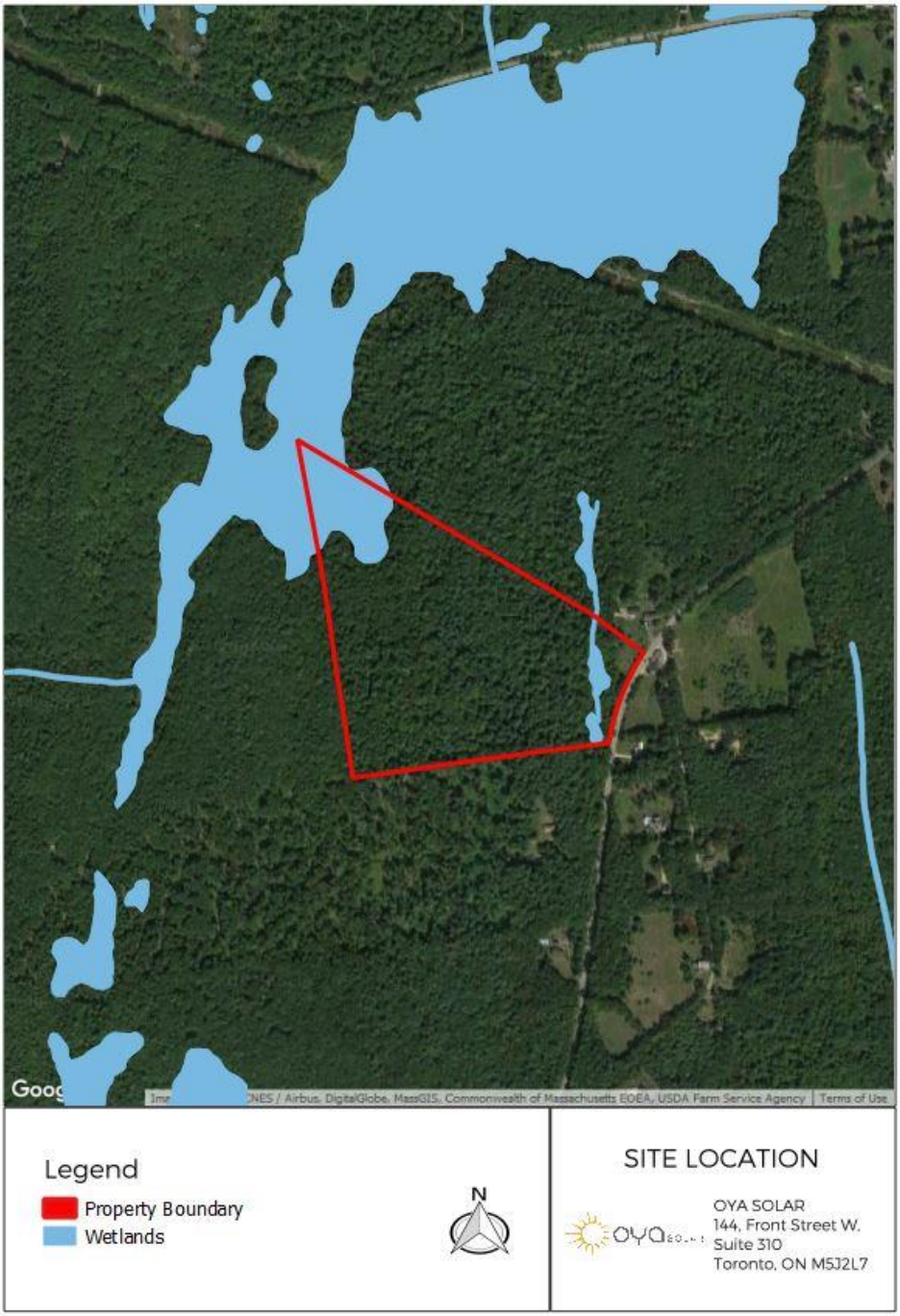


Figure 2: Proposed Project Site Location

3. Project Site Information

The Proposed Project site consist of one (1) parcel located in the Town of Royalston, Worcester County, Massachusetts. As of December 28th, 2017, OYA has executed a lease agreement with the landowner. The landowner fully supports the development of the solar facility.

The following table (see "*Table 1: Parcel Details*") and figure (see "*Figure 3: Parcels Boundaries*") illustrates specific parcel information of the Proposed Project and all abutting/ neighbouring parcels, all which are zoned as RR&A as defined in the Town of Royalston's Zoning Map[7].

Table 1: Parcel Details

#	Parcel Number	Parcel Location	Size (acres)	Land Use Zone
1	11-55-5	0 Athol Road	36.0	RR&A - Rural Residential and Agricultural District
Abutting Parcels				
1	10-55	0 Athol Road	81.0	RR&A - Rural Residential and Agricultural District
2	10-48	0 Warwick Road	82.0	RR&A - Rural Residential and Agricultural District
3	11-55-4	0 Athol Road	63.10	RR&A - Rural Residential and Agricultural District
4	11-5	20 Athol Road	3.0	RR&A - Rural Residential and Agricultural District
5	10-47	32 Athol Road	103.0	RR&A - Rural Residential and Agricultural District

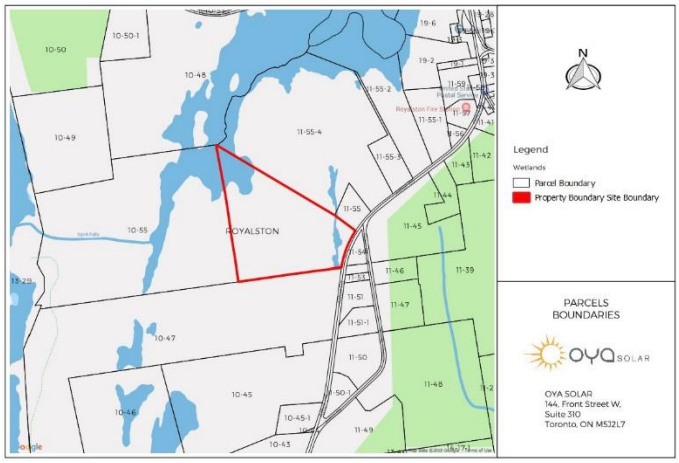


Figure 3: Parcels Boundaries

[7] Town of Royalston's Official Zoning Map 2015: http://www.royalston-ma.gov/Wordpress/wp-content/uploads/2016/12/Royalston_Zoning_MAP-OFFICIAL-2015_11x17L_051515.pdf

Section IV [page 14] of the Town of Royalston's Zoning Bylaw defines the setback requirements for zoned RRA districts.

Section V. [page 15] outlines the special permit review procedures, and summarized as follow:

1. Initial project review meeting (completed on June 20th, 2018)
2. Submit Special permit application and all required attachments
3. Attend planning board meeting to review Special Permit Application for completeness only
4. Once determined complete, Special Permit Application distributed to various town department for 35 days review period.
5. Public hearing held within 56 days of 'application completeness' determination
6. Decision made within 90 days of completeness

Section VIII. B. [page 41], Large-Scale Ground-Mounted Solar Photovoltaic Installations, establishes the criteria and standards for the placement, design, construction, operation, monitoring, modification and removal of such installation that address public safety, minimize impacts on scenic, natural and historic resources and to provide adequate financial assurance for the eventual decommissioning of such installation.

The following table provides a summary of the Town's requirements and OYA's current design and plan:

Table 2: Requirements for Large-Scale Ground-Mounted Solar Photovoltaic Installations

	Requirements	Developer Comment
Permits Required [Section VIII. B.]	Special Permit Approval from the Town Planning Board	
Min. Setback Requirements [Section IV. A.]	RRA without sewers: Front: 100' / Rear: 40' / Side: 40'	All the Height and Setbacks Requirements are met. See "Appendix *A*: Site Plan"
Wetland buffer [Section IV.]	Minimize work in wetlands and 100' wetland buffer.	All work will occur outside of state-regulated wetlands and their buffer zone.
Minimum lot Size [Section IV. A.]	Minimum lot size required is 3 acres	The proposed site area is more than 3 acres.

Screening / Buffer Requirements [Section VIII. B. 9c.]	If permitted by special permit in residential districts, the entire perimeter of the project shall have a vegetated buffer that will screen the view of the Large-Scale Ground-Mounted Solar Photovoltaic Installation. The buffer must be sufficiently dense to block the view of the Large Scale Ground-Mounted Solar Photovoltaic Installation and appurtenant structures from all dwellings abutting the property. In all other districts where site plan approval is given, the project shall have a vegetative buffer that will screen the view of the Large-Scale Ground-Mounted Solar Photovoltaic Installation from the boundary of any abutting residential premises and from the boundary of an abutting residential district and/or farm and forest district.	The majority of this site is heavily wooded and sufficient screening will be provided by the existing vegetated area within the buffers that are not disturbed. A mixture of native deciduous and evergreen trees and shrubs will be provided to supplement the existing vegetation as required to meet the screening requirements. See "Appendix *A*: Site Plan" See "*Figure 17: Visual Screening Example (Before and After*)"

As per Section VIII. B. 4. B. 2), "Large-Scale Ground-Mounted Solar Photovoltaic Installations", in the Town of Royalston's Zoning Bylaw, the following table summarizes the documents required for the submission of a Special Permit Application and OYA's comments with regards to the current design and plan against each requirement:

Table 3: Summary of Special Permit Application Submission Documents

Documents Required	Developer Comments
a) Site Plan Showing:	
i. Property lines and physical features, including roads, for the project site	See "*Appendix A: Site Plan*"
ii. Proposed changes to the landscape of the site, grading, vegetation clearing and planting, exterior lighting, screening vegetation or structures	See "*Section 6*" for Visual Screening explanations for typical vegetation screening. No lighting is proposed.
iii. Drawings of the solar photovoltaic installation signed by a Professional Engineer licensed to practice in the Commonwealth of Massachusetts showing the proposed layout of the system and any potential shading from nearby structures.	Blueprints will be provided prior to application for Building Permit. We request that this be a condition of approval.
iv. One or three line electrical diagram detailing the solar photovoltaic installation, associated components, and electrical interconnection methods, with all National Electrical Code compliant disconnects and overcurrent devices.	See "*Appendix C: Line Diagram*"
v. Documentation of the major system components to be used, including PV panels, mounting systems and inverter	See "*Appendix B: Major Equipment List*"
vi. – viii. Name, address, and contact information for proposed system installer/ Name, address, phone number and signature of the project proponent, as well as all co-proponents property owners, if any / Name, contact information and signature of any agents representing the project proponent, if any	The Proposed system installer is not known at this point. OYA Solar MA, L.P. is the proposed project developer and sole proponent of the generating facility. Stantec is representing OYA in filing for Special Permit Application
b) Documentation of actual or prospective access and control of the project	See "*Appendix J: Site Control*" for site control documents. OYA has an executed lease agreement in place with the landowner of the property,
c) Operation and Maintenance Plan	See "*Appendix F: Operations & Maintenance Plan*"
d) Zoning district designation for the parcel(s) of land comprising the project site (submission of a copy of a zoning map with the parcel(s) identified is suitable for this purpose.	See "*Appendix L: Zoning District Map with Proposed Project Location*"
e) Proof of liability insurance	Construction liability insurance is typically obtained prior to construction, however, please find OYA's general liability insurance in "*Appendix K: Proof of Liability Insurance*"
f) Payment of financial surety that satisfies Section 15	See "*Appendix G: Decommissioning Plan*" for estimate of cost for decommissioning. We request that payment of Financial Surety be a condition of approval.
g) Utility Notification: Evidence that the utility company has been informed.	See "*Appendix I: Utility Notifications*" for current utility screening status

Project Technology

The Project will either be a fixed tilt or single axis tracking solar PV system, utilizing tier one equipment suppliers. The solar panel modules have been sited to satisfy or exceed Town zoning ordinances, other than a single, non-critical area variance, with focus on minimizing visual impacts on surrounding landowners and the community. While 36.0 acres exist under site control, the total area of the solar PV system itself, not fenced area or basins, will occupy approximately 22.6 acres, which translates into a coverage percentage of 63%.

OYA will procure Tier-1 panels with a 25-year performance warranty. Panels will be installed on fixed or tracker-oriented racking to the south and will not exceed 10 feet in height. See *Appendix B: Major Equipment List* for list of major equipment and potential manufacturers.

Electricity generated from panels will be fed to the inverters which ultimately connect to the electrical grid at the point of interconnection, as determined by the utility company.

The solar panel will be supported on foundation/posts that will either be driven pile, helical pile, grouted piles, or screw piles. The posts will be installed into the ground at a depth adequate to handle engineered loads and mitigate frost heave. Posts can be pulled from the ground at the end of the system's useful life with minimal ground disturbance. Racking, panel and inverter manufacturers will be site-specific, depending on engineering, topography and array layout. The utility company will provide final approval of interconnection equipment including transformers, meters, disconnects, utility poles, and wires, as required by the utility company interconnection tariff. All equipment is engineered to meet industry, state and federal standards. See below "*Figure 4: Illustration of Types of Foundation Posts*" for illustrations of the various types of foundation/post mentioned above.

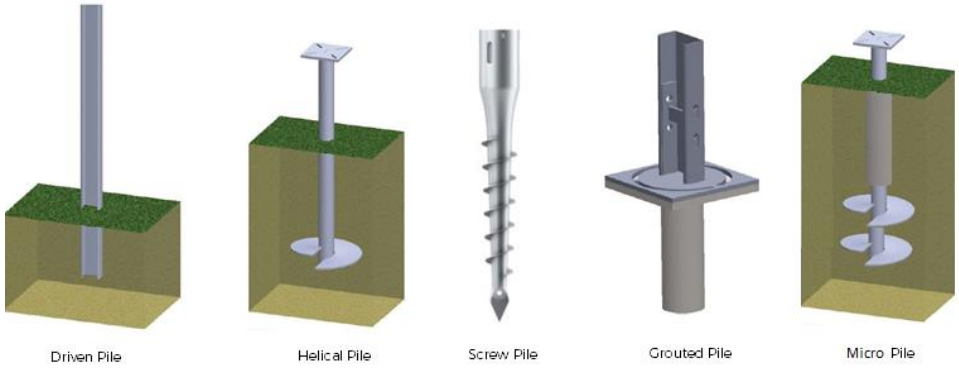


Figure 4: Illustration of Types of Foundation Posts

Transformers and related equipment will be placed on a concrete slab at grade level. The utility typically will require poles to be standard electric utility poles with overhead wires, unless otherwise authorized. Additional poles may be required depending on the method of interconnection. All non-utility equipment, materials, supplies, concrete etc. will be removed at the end of the useful life of the project.

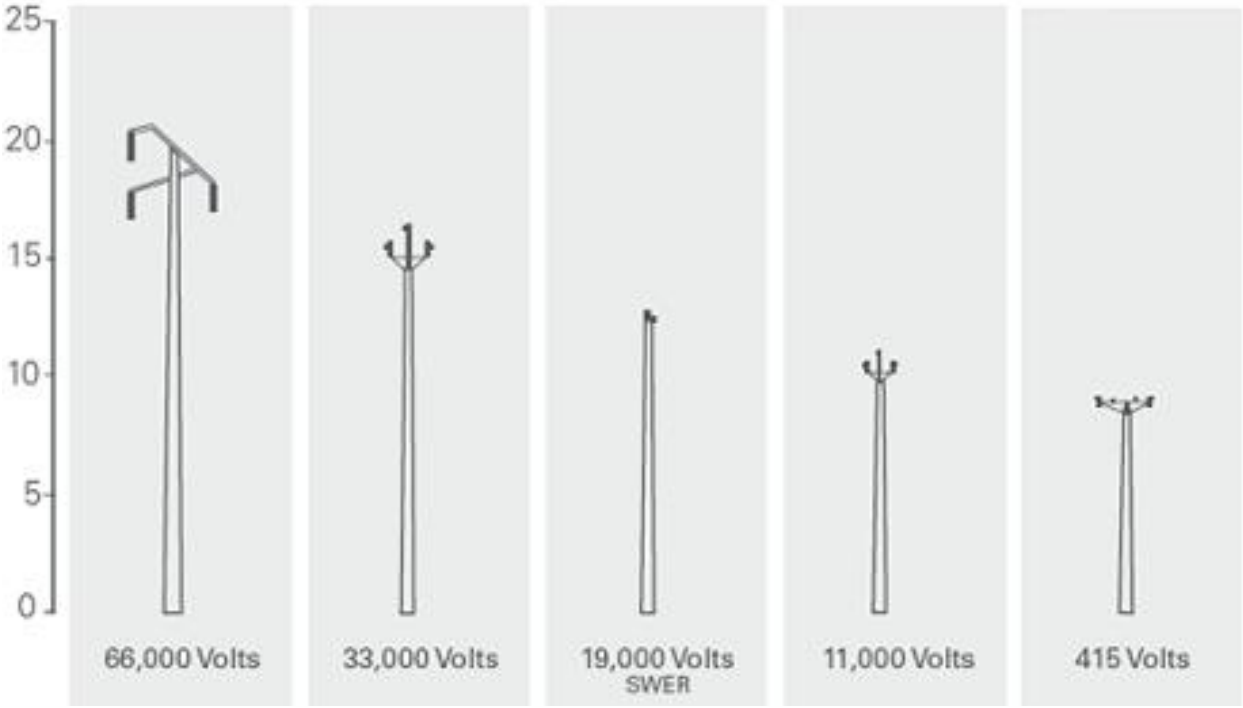


Figure 5: Types of Transmission Poles

All equipment will meet the utility company standards and national standards for interconnection and safety. In addition, adequate level of insurance coverage and a signed interconnection agreement will be required, along with continual production monitoring.

4. Studies/Report Completed

4.1 Site Due Diligence

A site due diligence investigation has been conducted to ensure the suitability of the proposed project site with respect to avoiding and/or minimizing impacts to sensitive resource areas. Please see Appendices for detailed Figures and Records. Our site due diligence investigation included the following studies:

- Wetland and Floodplain Assessment
- Desktop Environmental Analysis
- Desktop Cultural and Archeological Analysis
- Desktop Biological Analysis
- Other Environmental Information

See below for more details regarding the purpose of each study.

4.2 Wetland and Floodplain Assessment

Wetlands and other waters in the United States ("U.S.") are protected under Section 404 of the Clean Water Act ("CWA"). In Massachusetts, wetland resource areas are subject to the Massachusetts Wetland Protection Act, regulated by the Massachusetts Department of Environmental Protection ("MassDEP"), and administered by municipal conservation commissions. Any activity that involves any discharge of dredged or fill material into waterbodies in the U.S., including wetlands, is subject to regulation by the U.S. Army Corp of Engineers ("USACE").

Waters of the U.S. are defined to encompass navigable waters of the U.S.; interstate waters; all other waters where their use, degradation, or destruction could affect interstate or foreign commerce; tributaries of any of these waters; and wetlands that meet any of these criteria, or are adjacent to any of these waters or their tributaries.

A wetland assessment has been conducted based on the official MassDEP Wetlands maps as described in MGL Chapter 131, Section 40, Massachusetts Wetland Protection Act Law and provided in the data set from MassDEP and National Wetland inventory (See "*Figure 6: Wetland Assessment Map*").

An onsite delineation has not been performed. However, wetland scientists from Stantec conducted an evaluation of the site during a site visit on May 9, 2018. The purpose of this site visit was to confirm the location of wetlands identified on MassGIS and identify additional wetlands not found on MassGIS. Based on this information, the site plan was revised to avoid all wetland areas.

The Site is not in the FEMA's National Flood Zone (See "*Figure 7: FEMA Flood Map*").

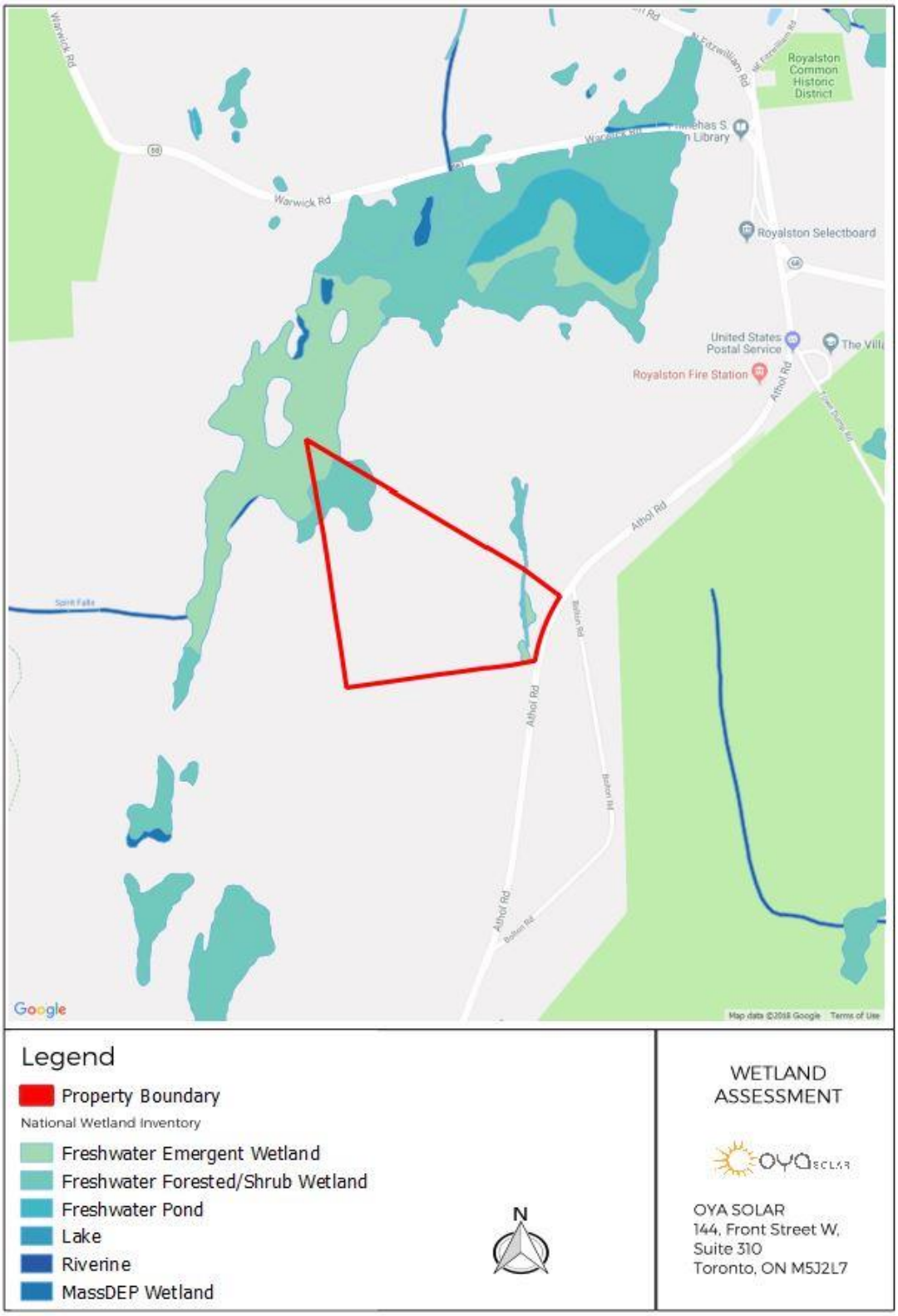


Figure 6: Wetland Assessment Map

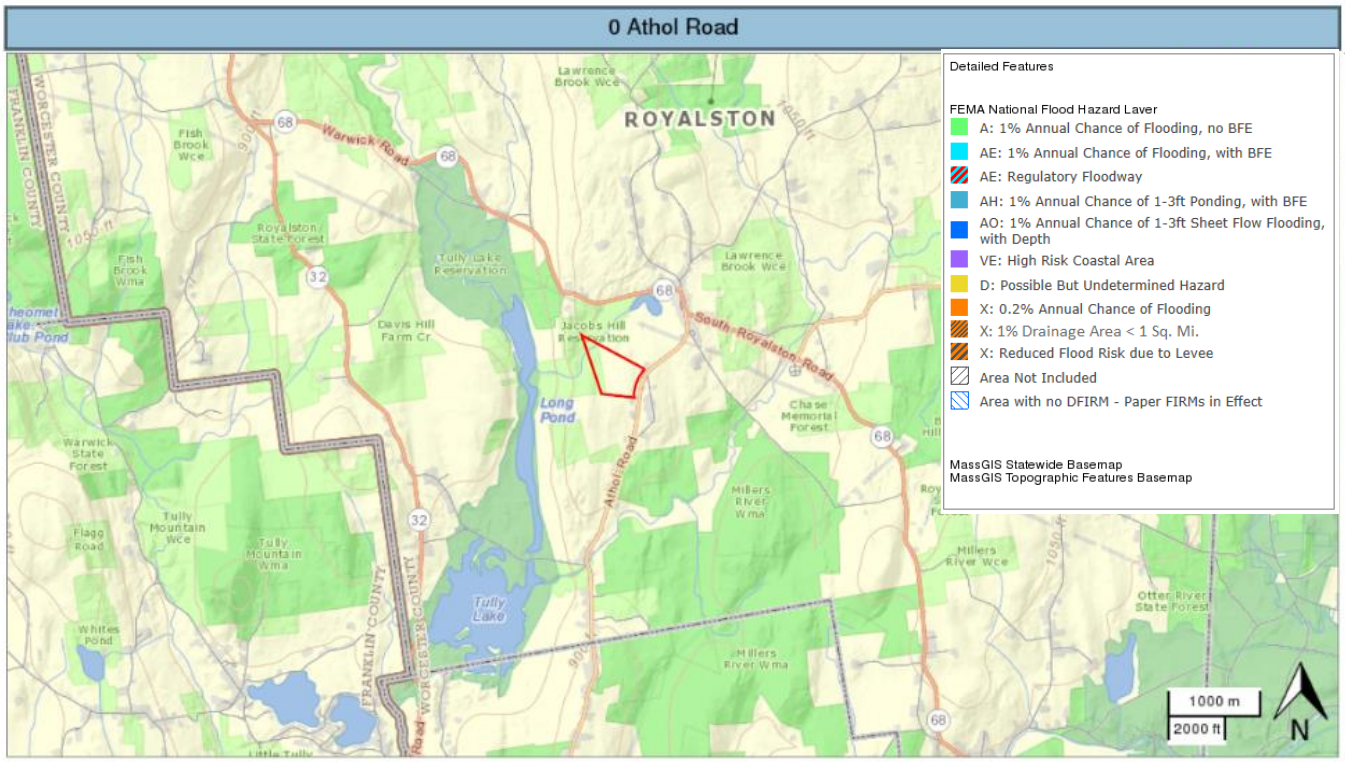


Figure 7: FEMA Flood Map

4.3 Desktop Environmental Analysis

A limited Phase 1 Environmental Site Assessment ("ESA") has been conducted in conformance with the requirements of American Society for Testing and Materials ("ASTM") Designation E 1527-13. The objective of the ESA was to appropriately inquire historical ownerships and uses of the Proposed Project site and whether if it was in consistent with good commercial or customary practices as outlined by ASTM's *"Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process, Designation E1527-13"*. The purpose of ESA was to identify, to the extent feasible, adverse environmental conditions, including recognized environmental conditions ("RECs") of the Proposed Project site based on desktop review from the following resources or records:

- Historical Resources
- Environmental Records
- Environmental Remediation Records

Historical Resources

Reviewing historical resources provided greater understanding of the type of activities on site as well as the prior land use. This information is helpful in assessing potential environmental contamination on or near the Proposed Project site. Review of the following resources were conducted:

- Aerial Photography

Historical aerial photographs have been obtained from the Environmental Data Resource ("EDR"), a third-party database search. Aerial photographs were also obtained from Google Earth. No indications of REC's were identified during the review of these photographs.

- Historical Fire Insurance Maps

Fire insurance maps were developed for use by insurance companies to depict facilities, properties, and their uses for many locations throughout the United States. These maps provide information on the history of prior land use and are useful in assessing whether there may be potential environmental contamination on or near the Site. These maps, which have been periodically updated since the late 19th century, often provide valuable insight into the historical uses of the site.

Historical USGS 7.5-Minute Topographic Maps and Current Topographic Map (see *Figure 8*) of the area were reviewed to help identify past and existing site usage and areas of potential environmental concern.

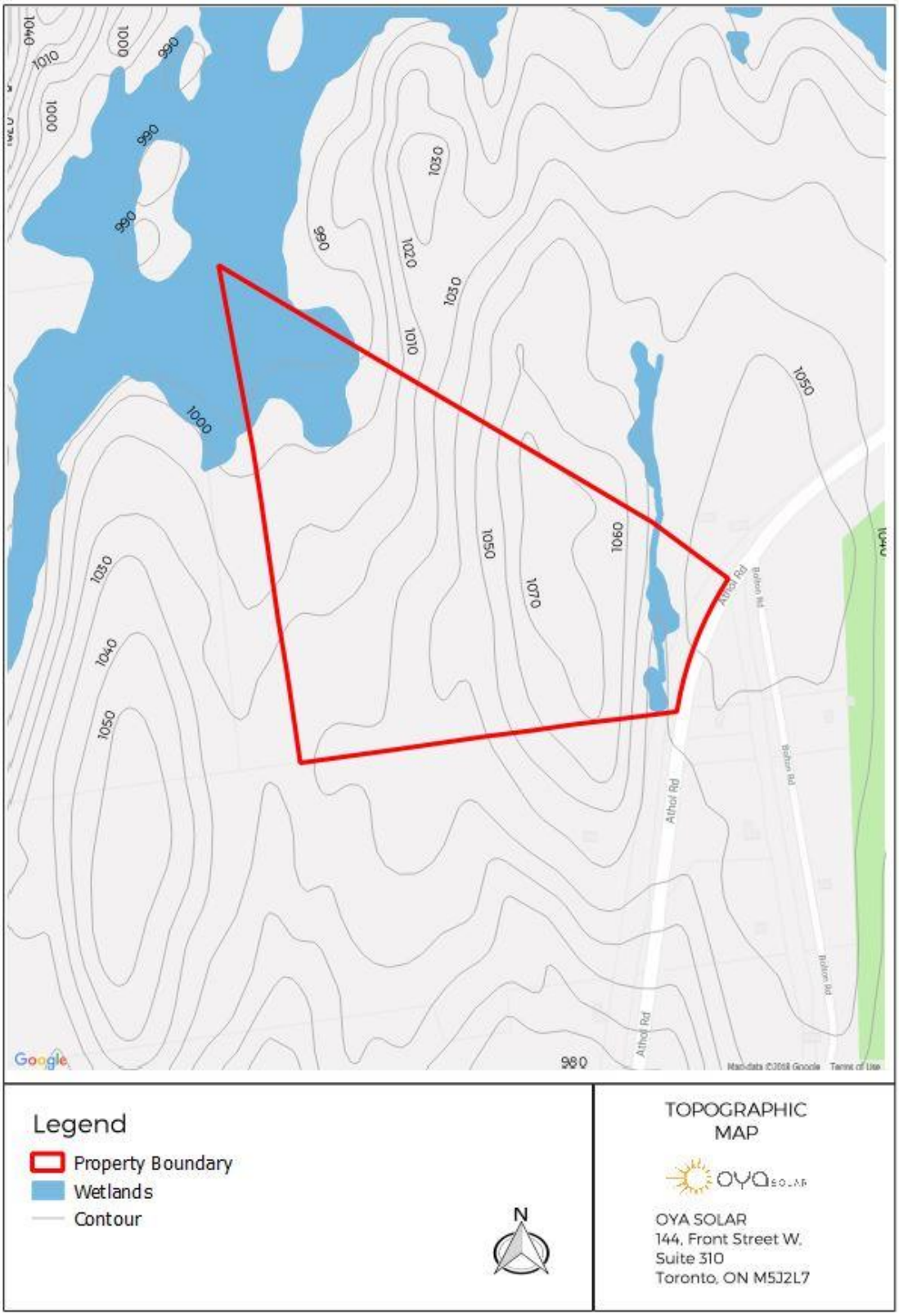


Figure 8: Topographic Map

4.4 Desktop Cultural, Historical and Archeological Analysis

Desktop Analysis of the Massachusetts Cultural Resource Information System ("MACRIS") mapping database identifies historic resource information maintained by the Massachusetts Historical Commission ("MHC"). The database was obtained from MassGIS website.

The database provided us with the following information:

- Historical sensitive areas and districts
- Inventory points containing the location of buildings, burial grounds, structures and objects (e.g. statues, monuments, walls)

4.5 Site Visit and LiDAR Survey

A site visit, performed by a wetland scientist, was conducted to confirm wetland areas using GPS equipment. The information collected was provided to a surveyor to produce a topographic survey using LiDAR data that incorporated the confirmed wetland locations. This survey was used to produce the design drawings and facilitate the stormwater management design and report.

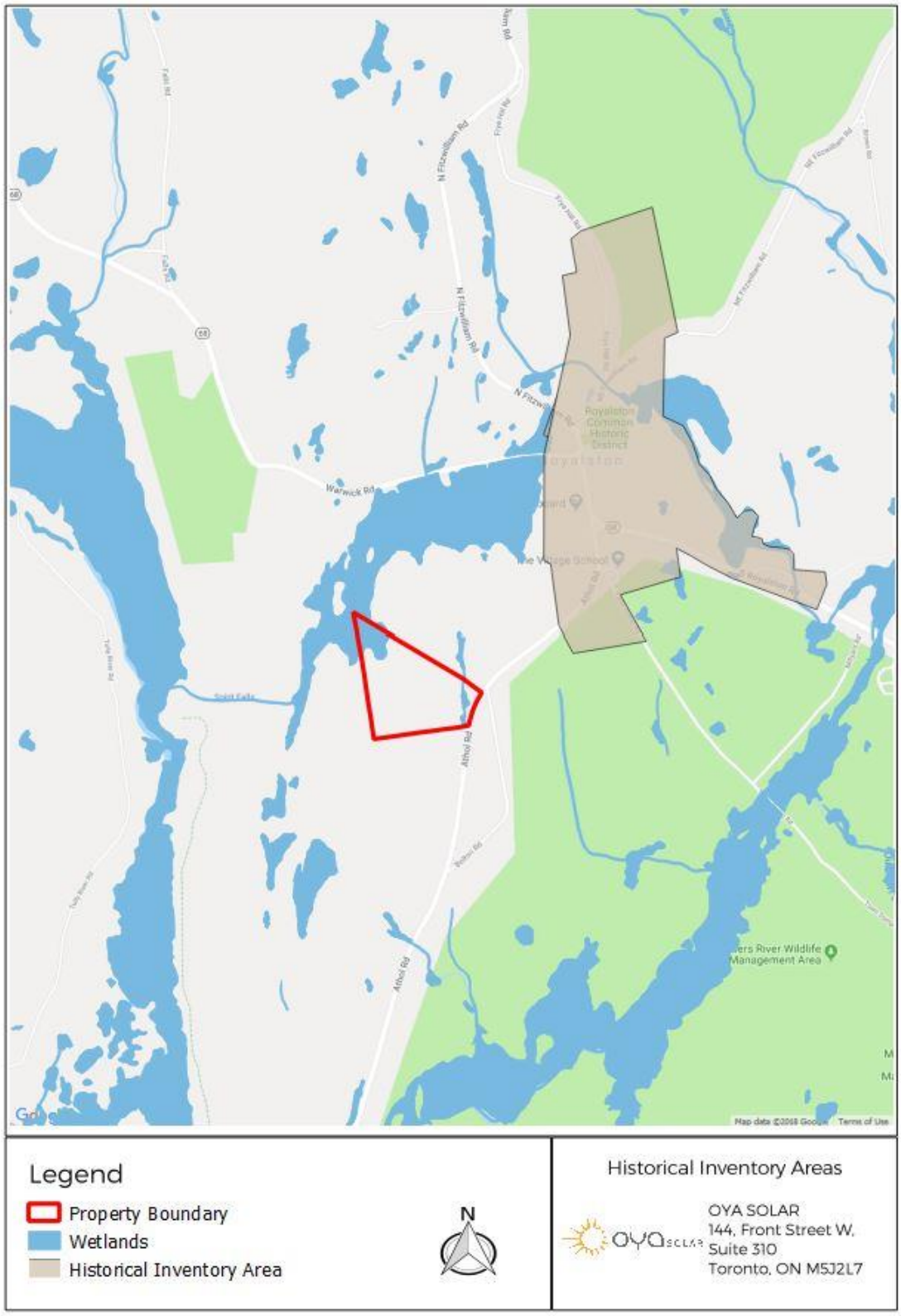


Figure 9: Historical Sensitive Area Map

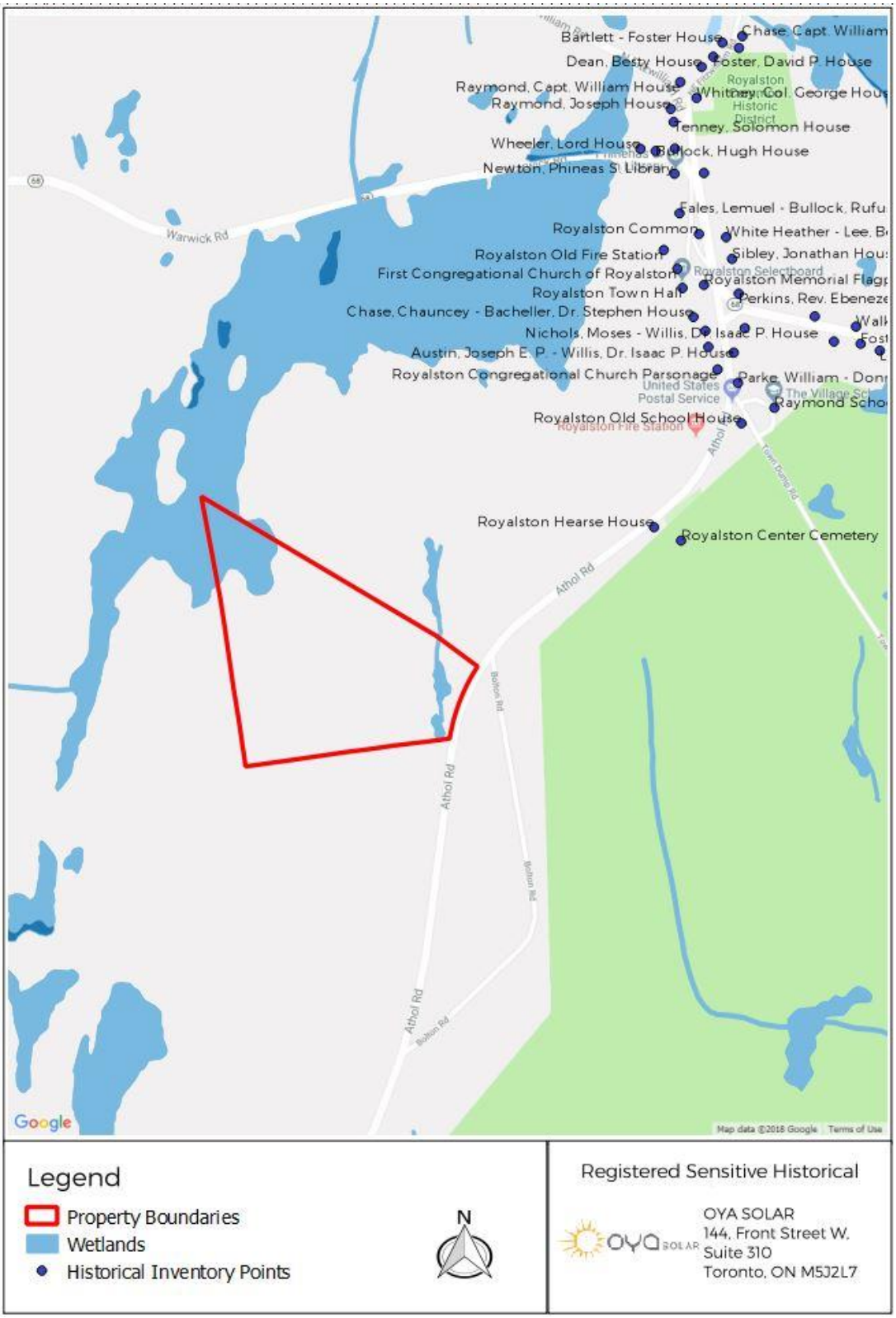


Figure 10: Registered Historical Site Map

4.6 Desktop Biological Analysis

Rare, threatened, and endangered species are those with specific regulatory protection under the federal and/or Massachusetts Endangered Species Act ("MESA") or other federal and state laws. A desktop review of the existing wildlife and plant species recorded in the vicinity of the project was conducted for the Proposed Project site.

Review of Habitat of rare animal and plant as defined by Massachusetts Natural Heritage and Endangered Species Program ("NEHSP") created under MESA. NEHSP is responsible for protecting rare animal and plant species and their habitats from being displaced or destroyed. NEHSP define the habitat into 2 groups according to the review process.

- *Priority Habitat*: These are areas known to be populated by state-listed rare species of animals or plants. Any project that could result in the alteration of more than two acres of Priority Habitat is subject to NHESP regulatory review.

- *Estimated Habitat*: These are a sub-set of Priority Habitats that are based on the geographical range of state-listed rare wildlife – particularly animals that live in and around wetlands. If the project is proposed for one of these areas and the local Conservation Commission requires filing a Notice of Intent ("NOI") under the Wetlands Protection Act

An online inquiry regarding federal T/E species has been made to the US Fish and Wildlife (USFWS) (See "*Appendix D: IPac Resource List*")

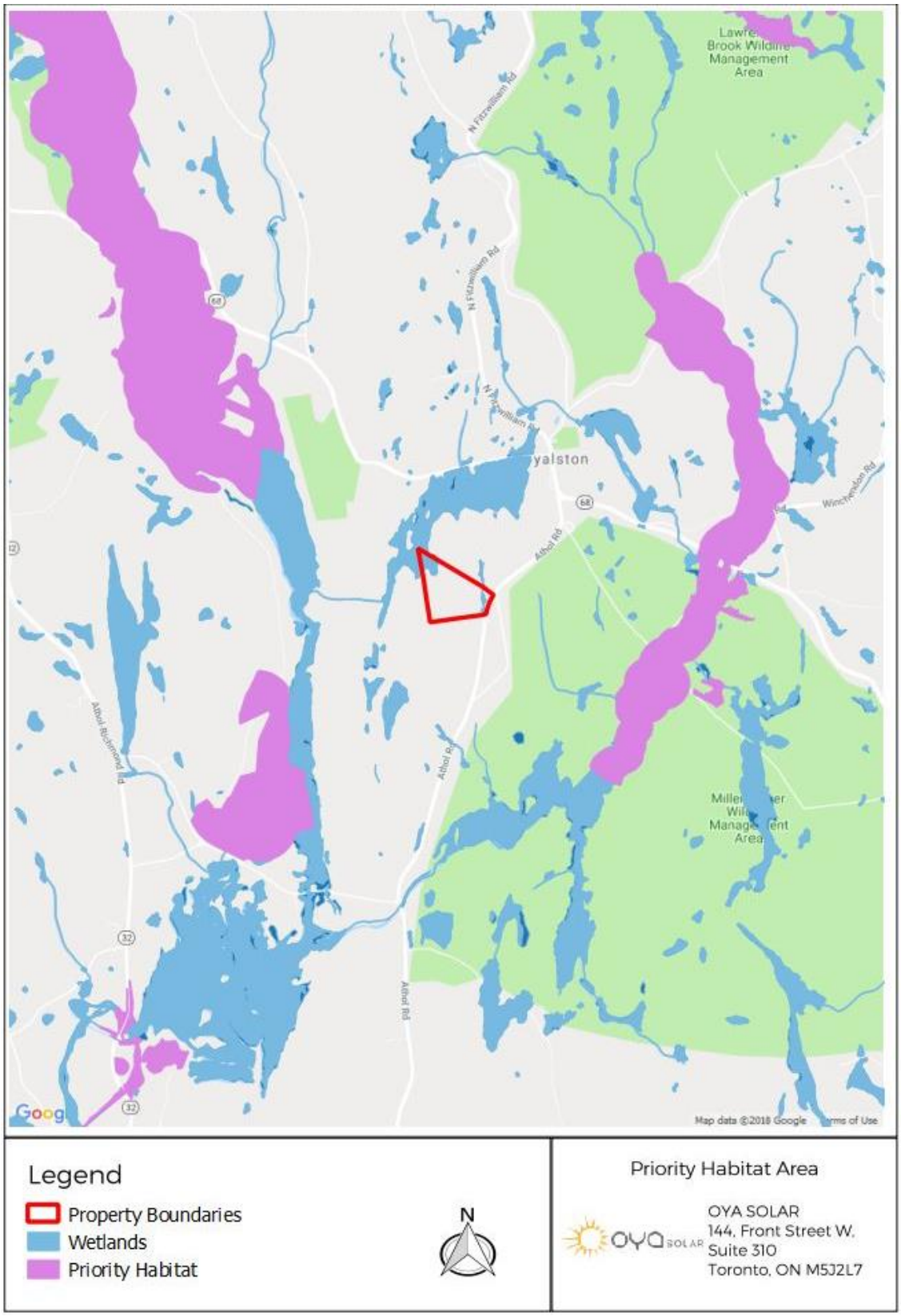


Figure 11: Priority Habitat Area

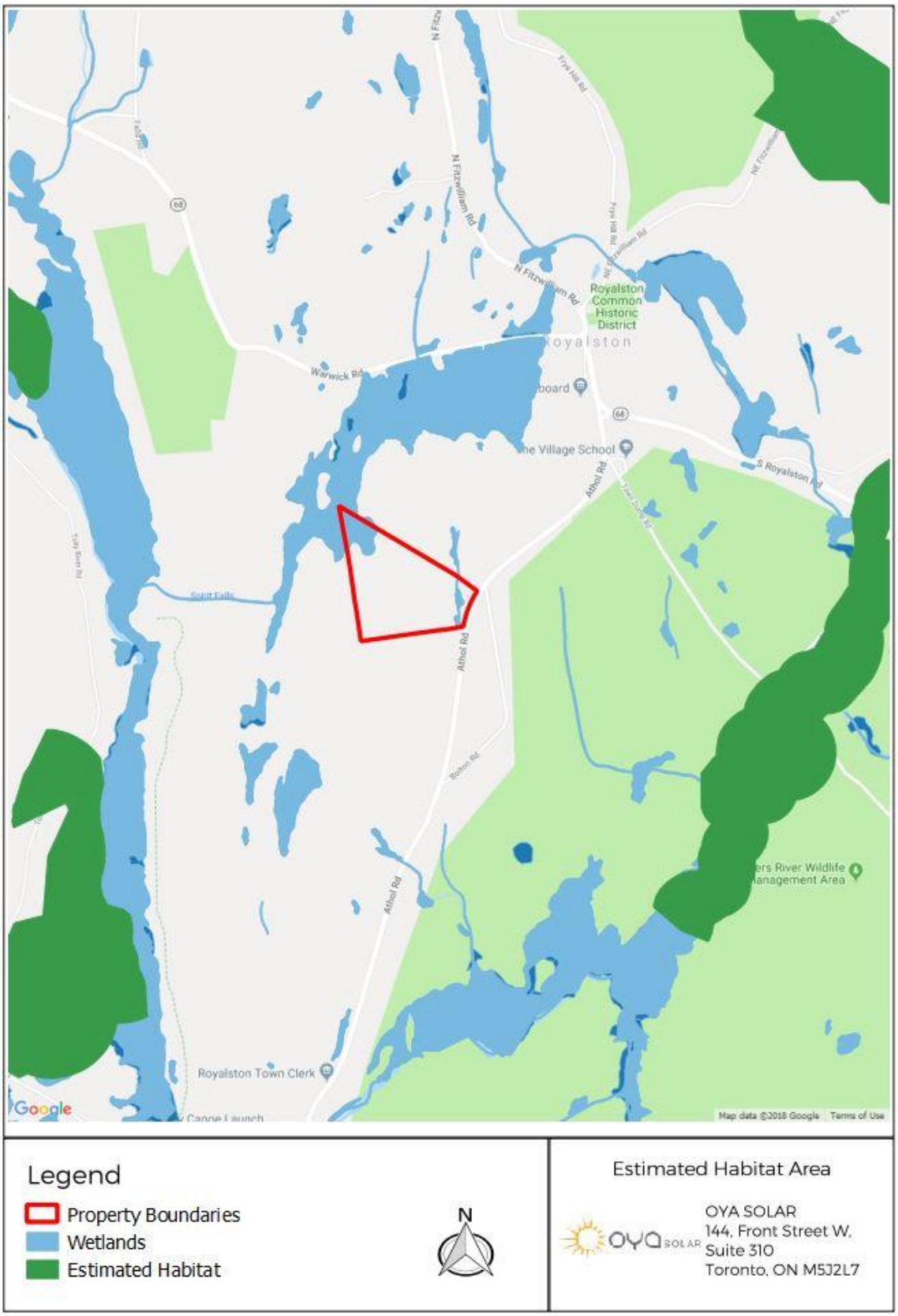
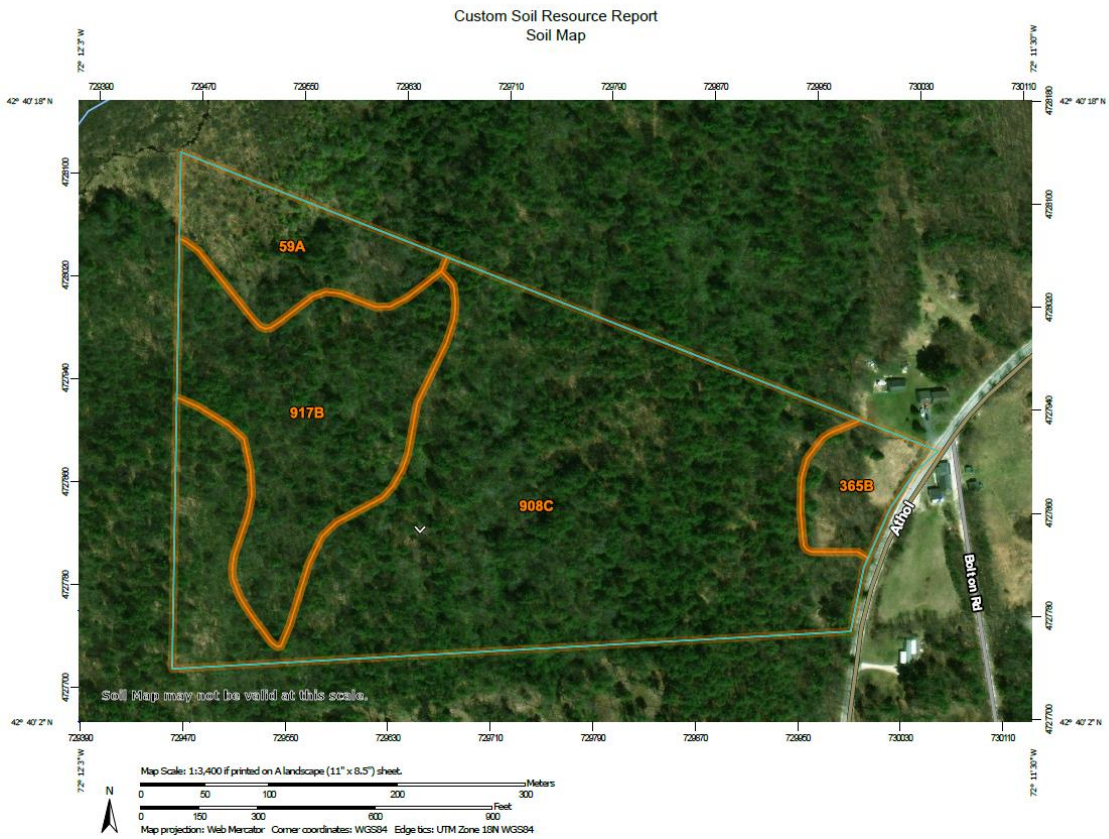


Figure 12: Estimated Habitat Area

4.7 Other Environmental Issues

Geology and Soils

Custom Soil Report (in "*Appendix E: Soil Report*") is prepared using United States Department of Agriculture's ("USDA)" Natural Resources Conservation Services ("NRCS"). Below Figure shows the Soil Classification of the Project Boundary.



Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
59A	Bucksport and Wonsqueak mucks, 0 to 2 percent slopes	3.6	9.4%
365B	Skerry fine sandy loam, 3 to 8 percent slopes	1.8	4.6%
908C	Becket-Skerry association, 0 to 15 percent slopes, extremely stony	24.6	64.4%
917B	Pillsbury-Peacham association, 0 to 8 percent slopes, extremely stony	8.2	21.6%
Totals for Area of Interest		**38.2**	**100.0%**

Figure 13: Soil Survey Map of the Proposed Project Site

The predominant surface feature at the Proposed Project site is identified as Thin Till with swamp and marsh deposits and wetlands as per the Surficial Geologic Map below.

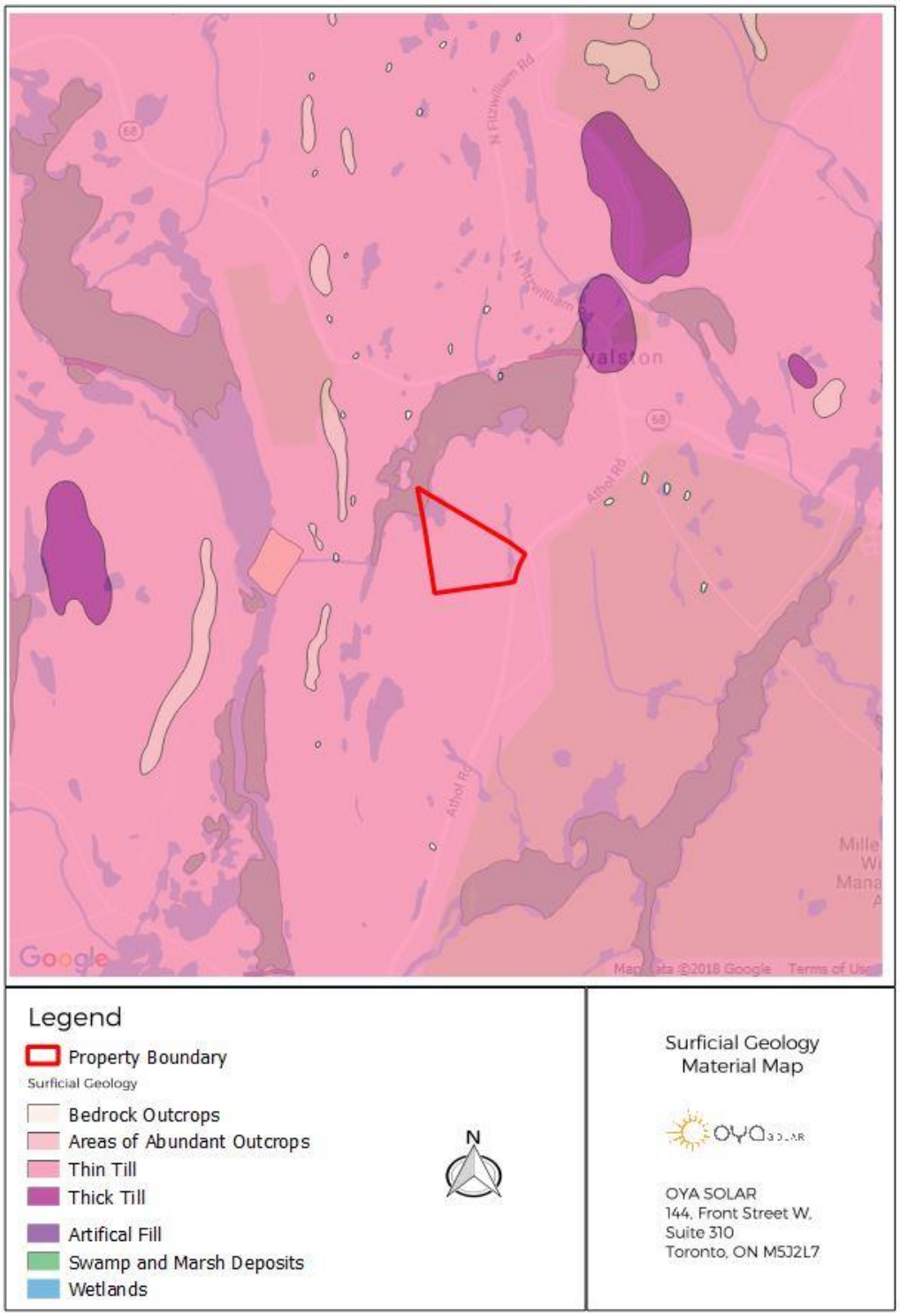


Figure 14: Surficial Geology Material Map

The protected and recreational open space maps contains the boundaries of conservation lands and outdoor recreational facilities in Massachusetts. The proposed project is surrounded by protected open space, illustrating that the proposed project will not be visible from the roads.

Figure 15: Public Open Space Areas Map

Table 4: Impact Summary

#	Type of Finding	Desktop Assessment	Required Actions
1	Known Historical Environmental Condition Onsite	None identified	None
2	Known Environmental Releases	None identified	No further action required
3	Biological Resource (Threatened/ Endangered Species)	Federal rare species may exist on site. According to IPaC documents these may include transient species such as Northern Long-eared Bat, and various bird species.	Migratory birds - Follow appropriate regulations and consider implementing appropriate conservation measures
4	Biological Resource (Wetlands and Waterways)	State-regulated wetland resources are located on site.	Site plan avoids all state-regulated wetland areas and their buffer zones.
5	Cultural Resource (Historic Structures)	None identified	No further action required

5. Existing Drainage

OYA understands that there will be some disturbance to the natural flow. As such, OYA has contracted Stantec to provide a Stormwater Management Report. The storm management design will be prepared by a Professional Engineer and will be compliance with the Massachusetts Stormwater Management Standards.

See *Appendix M: Stormwater Management Report*

6. Visual Screening

OYA will design, provide and maintain effective year-round screening to inhibit the view of the Proposed Project site, including photovoltaic installations, and all appurtenant structures from abutting neighbors and adjacent parcels and roadways. Visual Screening will be provided during the time from the Commercial Operation date through the end-of-life of the project.

Visual Screening may include vegetation consisting of a continuous fifteen-foot, required as per the Town of Royalston's bylaw, wide strip of trees and shrubs (hedges) planted in staggered pattern comprised of a selection of diverse plant material that is native, non-invasive and locally significant. The planting ration will be at a ratio of 60% coniferous vegetation and 40% multi-stem deciduous vegetation to provide year-round screening as well as visual interest.

Visual Screening will be provided that will address town requirements. Much of the site is heavily wooded, and area that falls within the buffer will remain mostly undisturbed. Supplemental planting will be provided as required to meet visual buffer requirements. For the purposes of clarification, "line of sight" is defined as any direct line drawn on a geo-referenced map that originates from any point within the Residence that intersects with any portion of the Facility, excluding the Connection line, or related security fencing. All such lines must be obstructed by the visual barrier.

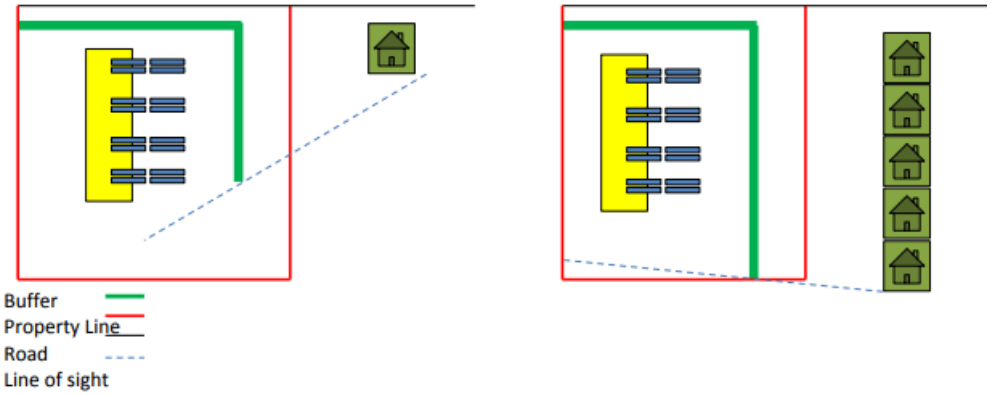


Figure 16: Line of Sight

6.1 Visual Screening Analysis

In a typically visual screening example, the vegetation around the Solar Project will cover the line of sight from neighbouring residences and the adjacent roadway. However, since the proposed site is already wooded, the installation should be able to take advantage of non-disturbance of the wooded area to address screening with minimal supplemental vegetation required. In other words, there will not be any significant difference between the existing site and site with solar facility.

Existing Site

Site with Solar Facility

Site after Visual Screening

.

Figure 17: Visual Screening Example (Before and After)

Figure 18: Typical Visual Screening of a Solar Project

Figure 19: Typical Vegetation Surround Solar Project Fence

Trees and Hedges: Many species of spruce trees (i.e. evergreens) are widely used for screening due to their resistance to drought, high tolerance to wet soil, pest resistance and the need for minimal care. Spruce trees generally grow approximately 8 to 16 inches per year, are non- invasive and compete against grass and weeds while also being deer-resistant.

Norway Spruce

Colorado Blue Spruce

Black Hill Spruce

Figure 20: Spruce Trees as Visual Screening Vegetation

7. Interconnection Process

The proposed project is located in the utility territory owned by Massachusetts Electric (d/b/a National Grid). Prior to construction, any new distributed generation facilities must apply to the utility for interconnection. In addition, as part of the SMART Program, an interconnection agreement must be signed with the utility before we are qualified for any incentives.

Typically, electricity generated from the solar facility are directed to the closest utility owned substations (i.e. the point of common coupling ("PCC")) via wires that are either on poles or located underground. The substation controls the voltage via three-phase electric power. The substations are connected to high-voltage transmission lines that carry the electricity over long distances to communities. Electricity from transmission lines are reduced to lower voltages at substations and distributed to homes and businesses.

The closest three-phase substation to the proposed project is approximately 5,940 feet.

The distributed generation application for interconnection has been submitted to the utility company. The utility has conducted preliminary studies of our application and is ready to proceed to Impact Study. See *Appendix I: Utility Notifications* of the current stage in which our project is being screened at.

8. Construction Timeline

Construction activities are expected to begin after satisfying all utility and regulatory requirements and is expected to take 6 to 8 months, including 2 months for commissioning. Installation posts at different depths and lengths will accommodate the minimal sloping on the site preventing the need for grading and fill activities. Grading and minor excavation may be needed for the inverter pads to ensure the slab is leveled. The inverter pad will be used to house all the electrical components of the generating facility. All necessary equipment supplies will be delivered within 2 to 4 weeks period at the start of construction, except the transformer which will be delivered 1 week before its installation. A temporary delivery direction sign may be installed at the start of construction upon approval from the Royalston Department of Public Works. Temporary staging will be off-road at the site entrance. Disposal of waste material will comply with all local, state and federal regulations and best practices.

Table 5: Construction Timeline

Milestone	Timeline
Mobilization	3 days
Road Construction	2 weeks
Fencing	2 weeks
Racking Delivery	3 days
Module Delivery	2 days
Other Electrical material delivery	1 week
Racking installation	3 weeks
Module installation	3 weeks
Transformer Delivery	2 days
Transformer Installation	2 weeks
High Voltage installation	1 month
Commissioning	2-3 month

OYA will follow any restrictions from the Planning Board on:

- Hours for construction work
- Hours for delivery of equipment

9. Decommissioning plan

Decommissioning will include the removal of all the solar array, cables, electrical components, accessory structures, fencing and other ancillary facilities depending upon the discussion between OYA and Landlord. Because this project includes maintains vegetation on site, the soil will be excellent for agricultural utilization upon decommissioning.

Detailed decommissioning plan includes:

- All cables and conduit will be removed.
- PV modules will be removed from racking and sold or transported to a recycling facility.
- Racking equipment will be dismantled and removed, and either re- used or sold for scrap.
- Inverters, transformers, switchgear etc. will be re-sold or scrapped per industry best practices and regulations.
- The security fence will be removed.
- The site will be returned to its preconstruction condition or similar state

See "*Appendix G: Decommissioning Plan*"

10. List of Appendices

Appendix A: Site Plan

Appendix B: Major Equipment List

Appendix C: Line Diagram

Appendix D: IPac Resource List

Appendix E: Soil Report

Appendix F: Operations & Maintenance Plan

Appendix G: Decommissioning Plan

Appendix H: 255 CMR 20.00: SMART Program

Appendix I: Utility Notifications

Appendix J: Site Control

Appendix K: Proof of Liability Insurance

Appendix L: Zoning District Map with Proposed Project Location

Appendix M: Stormwater Management Report

Appendix A: Site Plan

“See Separately Bound drawings Dated July 5, 2018 consisting of the following:

Cover Sheet

EX-1 - Existing Conditions

EX-2 - Existing Conditions

C-1 – Site Preparation and Erosion Control Plan

C-2 – Site Preparation and Erosion Control Plan

C-3 – Layout and Materials Plan

C-4 – Layout and Materials Plan

C-5 – Grading, Drainage and Utilities Plan

C-6 – Grading, Drainage and Utilities Plan

C-7 – Details

C-8 – Details”

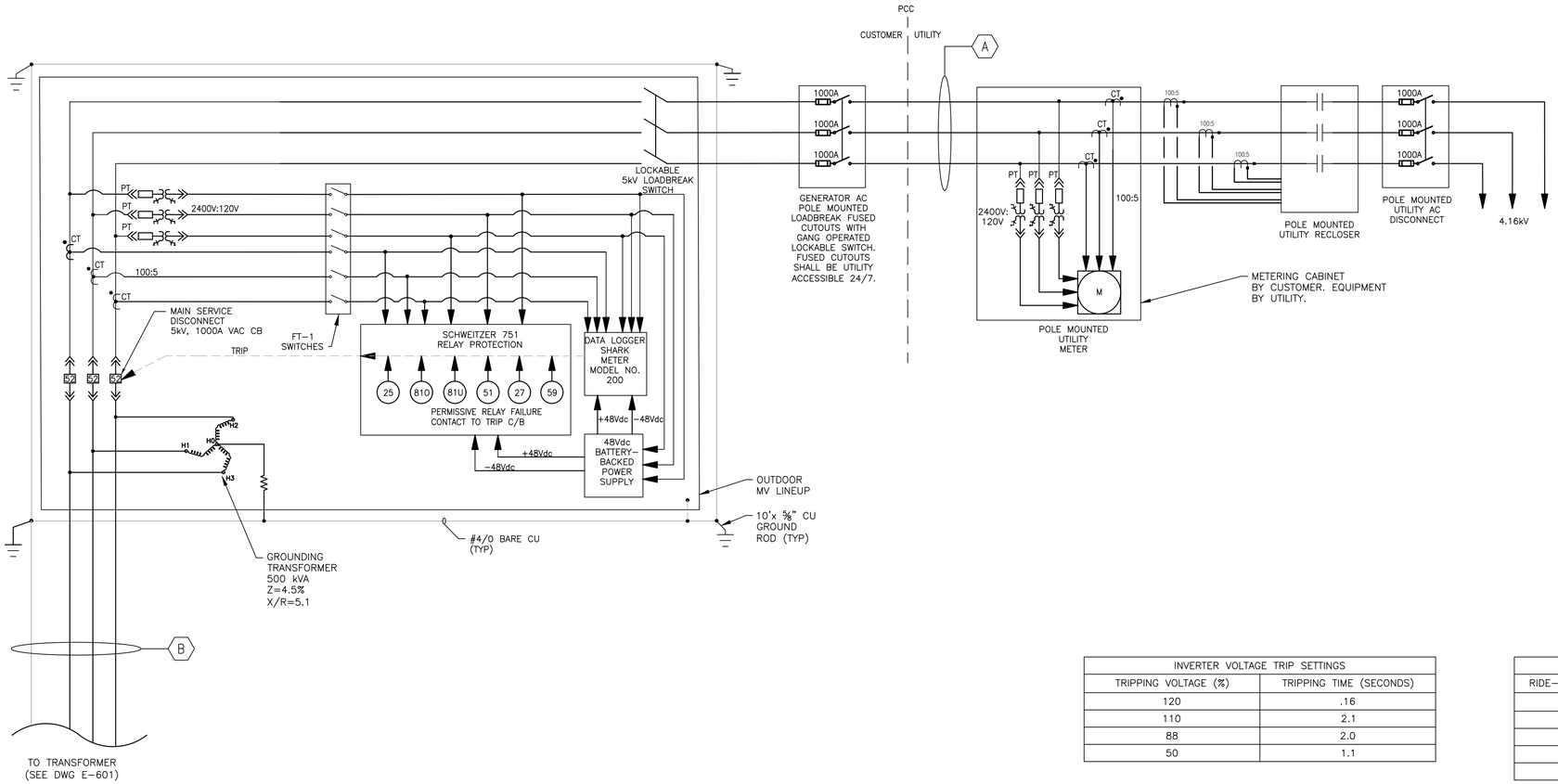
Appendix B: Major Equipment

Major Equipment List

Equipment	Manufacturer	Model
Modules	Heliene	340 Wp; 72-Cell Monocrystalline Modules
Inverter with Transformer	Sungrow	SG2500 U
Racking	TBD	Fixed Tilt or Single Axis

*See data sheets for detail specifications

Appendix C: Line Diagram



PROTECTIVE RELAY SETTINGS			
DEVICE	NAME	SETTINGS	DELAY
25	SYNCHRONIZING	0.2Hz, 3%V, 10°	N/A
27	UNDERVOLTAGE	< 88%	2.0 sec
51	OVERCURRENT (PHASE AND GROUND)	100%	0.5 sec
59	OVERVOLTAGE	> 110%	1.0 sec
810	OVER FREQUENCY	> 62.0Hz	.16 sec
81U	UNDER FREQUENCY	< 56.5Hz	.16 sec

A 2 SETS: 3-600kcmil AL ACSR

B 3 SETS: 3-500kcmil AL. (MV-90) & 1-#4/0 GND IN 4"C

NOTES:
1. 600V CABLE SHALL BE THHW - 75°C

INVERTER VOLTAGE TRIP SETTINGS	
TRIPPING VOLTAGE (%)	TRIPPING TIME (SECONDS)
120	.16
110	2.1
88	2.0
50	1.1

INVERTER VOLTAGE RIDE THROUGH SETTINGS		
RIDE-THROUGH VOLTAGE (%)	OPERATING MODE	RIDE-THROUGH TIME (SECONDS)
120≤V	N/A	NO RIDE THROUGH
110≤V<120	MANDATORY OPERATION	2
88<V<110	CONTINUOUS OPERATION	INFINITE
50≤V≤88	MANDATORY OPEATION	1.9
V<50	MOMENTARY CESSATION	1.0

INVERTER FREQUENCY TRIP SETTINGS	
FREQUENCY (Hz)	CLEARING TIME (SECONDS)
62	.16
60.6	300
58.5	300
56.5	.16

INVERTER FREQUENCY RIDE THROUGH CAPABILITY		
FREQUENCY RANGE (Hz)	OPERATING MODE	RIDE-THROUGH TIME (SECONDS)
f>62.0	N/A	N/A
60.6≤f<62.0	MANDATORY OPERATION a	299
58.5<f<60.6	CONTINUOUS OPERATION	INFINITE (c)
56.5<f≤58.5	MANDATORY OPEATION b	299
f≤56.5	N/A	N/A

PV SYSTEM DATA	
kWDC	7501.76
kWAC	4990

GRID SUPPORT UTILITY INTERACTIVE INVERTER FUNCTION STATUS	
FUNCTION	STATUS
SPF, SPECIFIED POWER FACTOR	ON
Q(V), VOLT-VAR FUNCTION WITH WATT OR VAR PRIORITY AS DEFINED BY SOURCE DOCUMENT	OFF
RR, NORMAL RAMP RATE	ON
FW, FREQ-WATT FUNCTION OFF	OFF

1 AC SCHEMATIC WIRING DIAGRAM - 4990 kW AC

N.T.S.

Revision	By	Appd.	YY.MM.DD

Issued	By	Appd.	YY.MM.DD
B REVISED UTILITY INTERCONNECTION	JD	MC	18.06.21
A UTILITY INTERCONNECTION	JD	MK	18.06.12

Permit-Seal

MICHAEL CLAYPOOLE
MASSACHUSETTS LICENSED PROFESSIONAL ENGINEER

COMMONWEALTH OF MASSACHUSETTS
MICHAEL L. CLAYPOOLE ELECTRICAL NO. 40255
REGISTERED PROFESSIONAL ENGINEER

MASSACHUSETTS LICENSE #40255

06/21/18
DATE

Consultants

Stantec

365 West Passaic Street, Suite 175
Rochelle Park NJ
www.stantec.com

Client/Project

Project Developer: OYA Solar MA, L.P.

Customer Utility #: 898346851

File Name: E-600 ELECTRICAL WIRING DIAGRAM.dwg	JD	MC	MK	18.03.02
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Title

ELECTRICAL WIRING DIAGRAM - 4.16KV
0 Athol Road Town of Royalston, MA 01368

Application No. : MA-25966627

Case No.: 00178669

Project No.

Scale: AS SHOWN

Drawing No.: E-600

Sheet: 1 of 2

Revision

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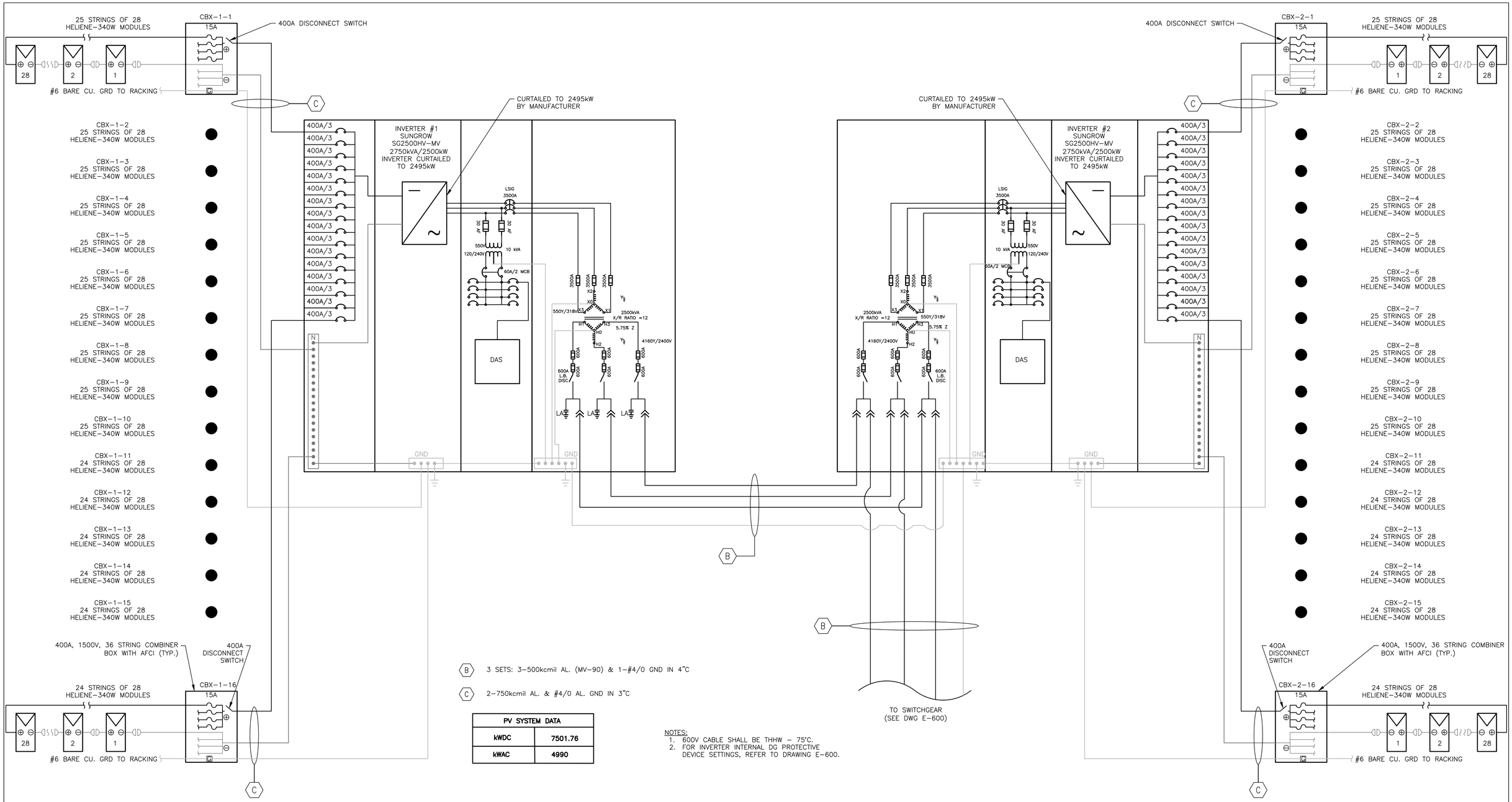
2018/06/25 2:30 PM By: Dancas, Jonathan



B 3 SETS: 3-500kcmil AL. (MV-90) & 1-#4/0 GND IN 4"C

C 2-750kcmil AL. & #4/0 AL. GND IN 3"C

PV SYSTEM DATA	
kWDC	7501.76
kWAC	4990

NOTES:
1. 600V CABLE SHALL BE THHW - 75°C.
2. FOR INVERTER INTERNAL DG PROTECTIVE DEVICE SETTINGS, REFER TO DRAWING E-600.

1 SCHEMATIC WIRING DIAGRAM - **4990 kW AC**
N.T.S.

Revision	By	Appd.	YY.MM.DD

Issued	By	Appd.	YY.MM.DD
B REVISED UTILITY INTERCONNECTION	JD	MC	18.06.21
A UTILITY INTERCONNECTION	JD	MK	18.06.12

Permit-Seal

MICHAEL CLAYPOOLE
MASSACHUSETTS LICENSED PROFESSIONAL ENGINEER

COMMONWEALTH OF MASSACHUSETTS
MICHAEL L. CLAYPOOLE
ELECTRICAL
NO. 40255
REGISTERED PROFESSIONAL ENGINEER

MASSACHUSETTS LICENSE #40255

06/21/18
DATE

Consultants

Stantec

365 West Passaic Street, Suite 175
Rochelle Park NJ
www.stantec.com

Client/Project

Project Developer: OYA Solar MA, L.P.
Customer Utility #: 898346851

File Name: E-601 ELECTRICAL WIRING DIAGRAM - 4.16KV.dwg

JD	MC	MK	18.03.02
Dwn.	Chkd.	Dsgn.	YY.MM.DD

Title

ELECTRICAL WIRING DIAGRAM - 4.16KV
0 Athol Road Town of Royalston, MA 01368

Application No. : MA-25966627

Case No.: 00178669

Project No.

Scale: AS SHOWN

Drawing No.: E-601

Sheet: 2 of 2

Revision

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2018/06/25 2:30 PM By: Dinces, Jonathan

Appendix D: IPac Resource List

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Project information

NAME

OYA Raman Solar

LOCATION

Worcester County, Massachusetts

Local office

New England Ecological Services Field Office

(603) 223-2541
(603) 223-0104

70 Commercial Street, Suite 300
Concord, NH 03301-5094

http://www.fws.gov/newengland

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population, even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Log in to IPaC.
2. Go to your My Projects list.
3. Click PROJECT HOME for this project.
4. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

---

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information.
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS

Northern Long-eared Bat *Myotis septentrionalis* Threatened

No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/9045

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

THERE ARE NO CRITICAL HABITATS AT THIS LOCATION.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON (IF A BREEDING SEASON IS INDICATED FOR A BIRD ON YOUR LIST, THE BIRD MAY BREED IN YOUR PROJECT AREA SOMETIME WITHIN THE TIMEFRAME SPECIFIED, WHICH IS A VERY LIBERAL ESTIMATE OF THE DATES INSIDE WHICH THE BIRD BREEDS ACROSS ITS ENTIRE RANGE. "BREEDS ELSEWHERE" INDICATES THAT THE BIRD DOES NOT LIKELY BREED IN YOUR PROJECT AREA.)
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Dec 1 to Aug 31
Black-billed Cuckoo *Coccyzus erythropthalmus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9399	Breeds May 15 to Oct 10
Bobolink *Dolichonyx oryzivorus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 20 to Jul 31
Canada Warbler *Cardellina canadensis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 20 to Aug 10
Evening Grosbeak *Coccothraustes vespertinus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 15 to Aug 10
Prairie Warbler *Dendroica discolor* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 1 to Jul 31

Rusty Blackbird *Euphagus carolinus* — Breeds May 10 to Jul 20

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Wood Thrush *Hylocichla mustelina* — Breeds May 10 to Aug 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

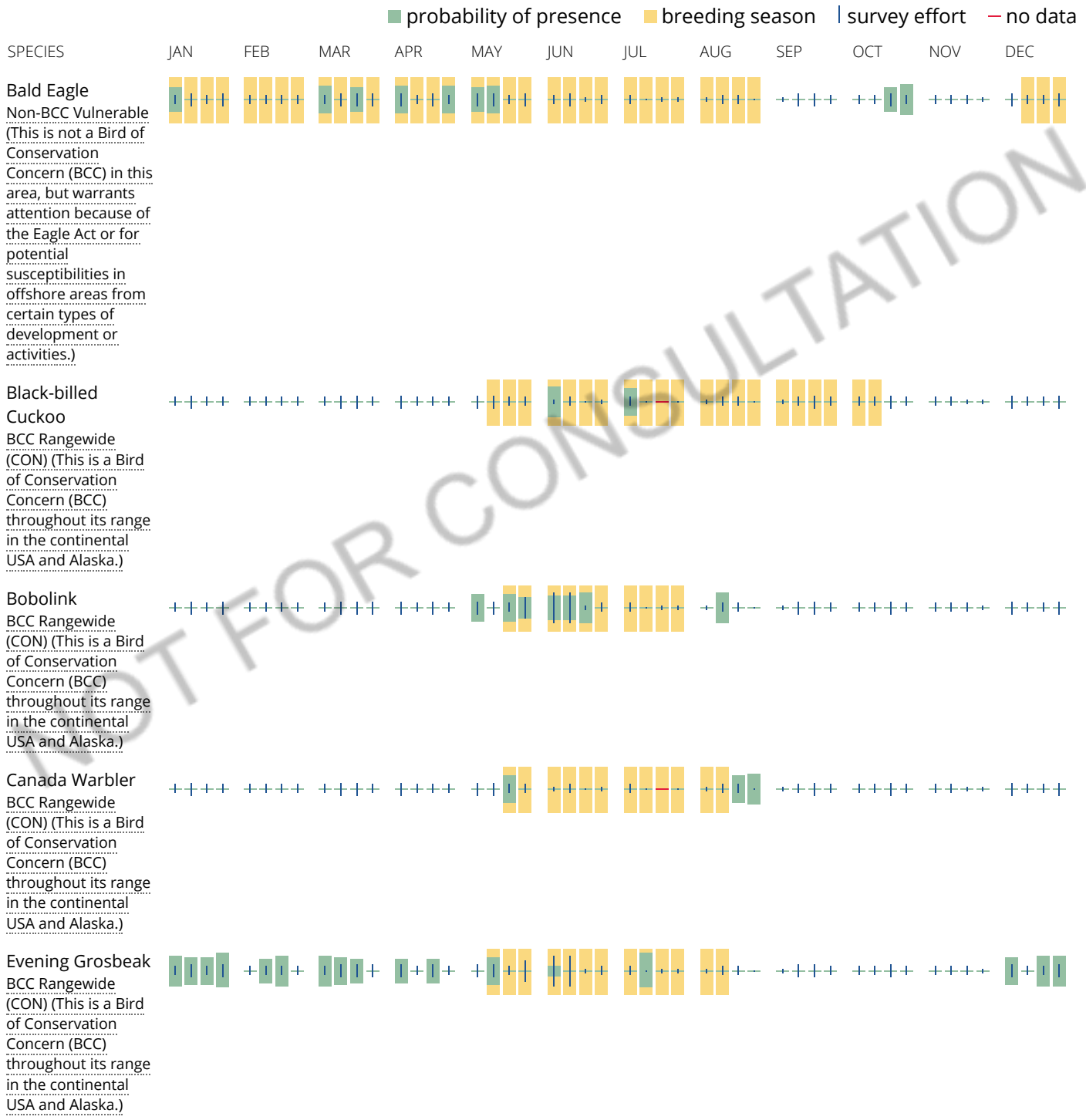
Breeding Season (■)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

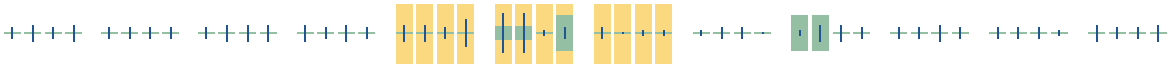
To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

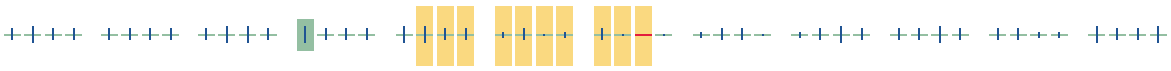
Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



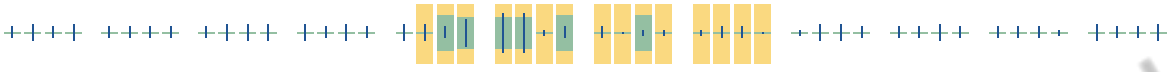
Prairie Warbler
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Rusty Blackbird
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Wood Thrush
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures and/or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the E-bird Explore Data Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ “What does IPaC use to generate the migratory birds potentially occurring in my specified location”. Please be aware this report provides the “probability of presence” of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look

carefully at the survey effort (indicated by the black vertical bar) and for the existence of the “no data” indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ “Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds” at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS AT THIS LOCATION.

Fish hatcheries

THERE ARE NO FISH HATCHERIES AT THIS LOCATION.

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

FRESHWATER EMERGENT WETLAND

- PEM1C
- PEM1E

FRESHWATER FORESTED/SHRUB WETLAND

- PFO1/4C
- PFO1E

A full description for each wetland code can be found at the National Wetlands Inventory website

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

Appendix E: Soil Report

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Worcester County, Massachusetts, Northwestern Part

0 Athol Rd, Town of Royalston, Worcester, MA 01368

June 5, 2018

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

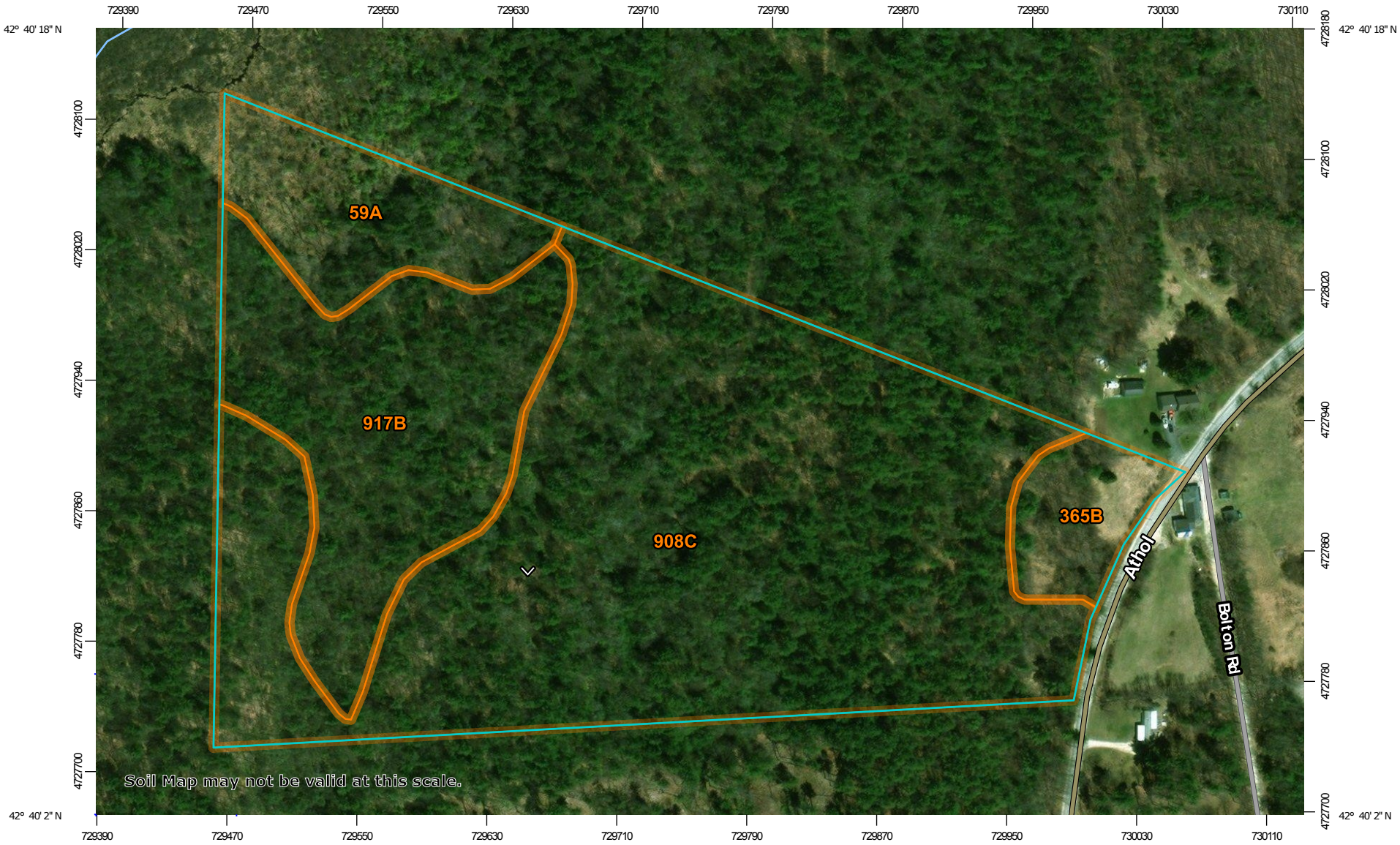
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:3,400 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Worcester County, Massachusetts, Northwestern Part
Survey Area Data: Version 11, Oct 6, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 11, 2014—Apr 19, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
59A	Bucksport and Wonsqueak mucks, 0 to 2 percent slopes	3.6	9.4%
365B	Skerry fine sandy loam, 3 to 8 percent slopes	1.8	4.6%
908C	Becket-Skerry association, 0 to 15 percent slopes, extremely stony	24.6	64.4%
917B	Pillsbury-Peacham association, 0 to 8 percent slopes, extremely stony	8.2	21.6%
Totals for Area of Interest		**38.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Worcester County, Massachusetts, Northwestern Part

59A—Bucksport and Wonsqueak mucks, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2ty70
Elevation: 0 to 1,770 feet
Mean annual precipitation: 31 to 95 inches
Mean annual air temperature: 27 to 52 degrees F
Frost-free period: 90 to 160 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Bucksport and similar soils: 48 percent
Wonsqueak and similar soils: 41 percent
Minor components: 11 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bucksport

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Mountainbase, interfluve, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Herbaceous organic material and/or woody organic material

Typical profile

Oa1 - 0 to 12 inches: muck
Oa2 - 12 to 25 inches: muck
Oa3 - 25 to 45 inches: muck
Oa4 - 45 to 65 inches: muck

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water storage in profile: Very high (about 21.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Description of Wonsqueak

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Toeslope, footslope

Landform position (three-dimensional): Mountainbase, interfluve, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Herbaceous organic material over loamy till

Typical profile

Oa1 - 0 to 8 inches: muck
Oa2 - 8 to 32 inches: muck
2Cg - 32 to 65 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Very high (about 18.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Peacham, very stony

Percent of map unit: 6 percent
Landform: Mountains, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Mountainbase, interfluve, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Brayton, very stony

Percent of map unit: 2 percent
Landform: Mountains, hills
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Mountainbase, interfluve, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Telos, very stony

Percent of map unit: 2 percent
Landform: Mountains, hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Mountainbase, interfluve, base slope
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Croghan

Percent of map unit: 1 percent
Landform: Outwash plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

365B—Skerry fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2w9p8
Elevation: 260 to 1,210 feet
Mean annual precipitation: 31 to 65 inches
Mean annual air temperature: 36 to 52 degrees F
Frost-free period: 90 to 160 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Skerry and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Skerry

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Mountainbase, interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loamy lodgment till derived from granite and gneiss and/or schist over sandy lodgment till derived from granite and gneiss and/or schist

Typical profile

Ap - 0 to 6 inches: fine sandy loam
Bs1 - 6 to 20 inches: gravelly fine sandy loam
Bs2 - 20 to 25 inches: gravelly fine sandy loam
Cd1 - 25 to 34 inches: gravelly loamy sand
Cd2 - 34 to 65 inches: gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 21 to 43 inches to densic material
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.01 to 1.42 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None

Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.9 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Colonel
Percent of map unit: 6 percent
Landform: Mountains, hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Mountainbase, interfluve
Microfeatures of landform position: Closed depressions, closed depressions
Down-slope shape: Linear, concave
Across-slope shape: Concave
Hydric soil rating: No

Becket
Percent of map unit: 4 percent
Landform: Mountains, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountainbase, interfluve
Microfeatures of landform position: Rises, rises
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Brayton
Percent of map unit: 3 percent
Landform: Mountains, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Mountainbase, interfluve
Microfeatures of landform position: Closed depressions, closed depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Hermon
Percent of map unit: 2 percent
Landform: Mountains, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountainbase, interfluve
Microfeatures of landform position: Rises, rises
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

908C—Becket-Skerry association, 0 to 15 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2x9ny
Elevation: 820 to 1,280 feet
Mean annual precipitation: 36 to 65 inches
Mean annual air temperature: 36 to 52 degrees F
Frost-free period: 90 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Becket, extremely stony, and similar soils: 45 percent
Skerry, extremely stony, and similar soils: 35 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Becket, Extremely Stony

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountainbase, mountainflank, side slope, nose slope, interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy lodgment till derived from granite and gneiss and/or schist over sandy lodgment till derived from granite and gneiss and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
E - 2 to 4 inches: fine sandy loam
Bhs - 4 to 5 inches: fine sandy loam
Bs1 - 5 to 7 inches: fine sandy loam
Bs2 - 7 to 14 inches: fine sandy loam
Bs3 - 14 to 24 inches: gravelly sandy loam
BC - 24 to 33 inches: gravelly sandy loam
Cd - 33 to 65 inches: gravelly loamy sand

Properties and qualities

Slope: 0 to 15 percent
Percent of area covered with surface fragments: 6.0 percent
Depth to restrictive feature: 21 to 43 inches to densic material
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.01 to 1.42 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 5.0 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Skerry, Extremely Stony

Setting
Landform: Mountains, hills
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Mountainflank, mountainbase, side slope, nose slope, interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loamy lodgment till derived from granite and gneiss and/or schist over sandy lodgment till derived from granite and gneiss and/or schist

Typical profile
Oa - 0 to 2 inches: highly decomposed plant material
E - 2 to 4 inches: fine sandy loam
Bhs - 4 to 6 inches: fine sandy loam
Bs1 - 6 to 20 inches: gravelly fine sandy loam
Bs2 - 20 to 25 inches: gravelly fine sandy loam
Cd1 - 25 to 34 inches: gravelly loamy sand
Cd2 - 34 to 65 inches: gravelly loamy sand

Properties and qualities
Slope: 0 to 15 percent
Percent of area covered with surface fragments: 6.0 percent
Depth to restrictive feature: 21 to 43 inches to densic material
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.01 to 1.42 in/hr)
Depth to water table: About 19 to 34 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 4.2 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Pillsbury, extremely stony
Percent of map unit: 6 percent
Landform: Mountains, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Mountainbase, mountainflank, side slope, nose slope, interfluve

Microfeatures of landform position: Open depressions, open depressions, closed depressions, closed depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Berkshire, extremely stony
Percent of map unit: 5 percent
Landform: Mountains, hills
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Mountainflank, mountainbase, side slope, nose slope, interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Monadnock, extremely stony
Percent of map unit: 5 percent
Landform: Mountains, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountainbase, mountainflank, side slope, nose slope, interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Tunbridge, extremely stony
Percent of map unit: 4 percent
Landform: Mountains, hills
Landform position (two-dimensional): Shoulder, backslope, summit
Landform position (three-dimensional): Mountainflank, mountainbase, interfluve, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

917B—Pillsbury-Peacham association, 0 to 8 percent slopes, extremely stony

Map Unit Setting
National map unit symbol: 9c0q
Elevation: 0 to 2,100 feet
Mean annual precipitation: 39 to 55 inches
Mean annual air temperature: 39 to 45 degrees F
Frost-free period: 120 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition
Pillsbury and similar soils: 45 percent

Peacham and similar soils: 35 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pillsbury

Setting

Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Friable coarse-loamy eolian deposits over dense coarse-loamy lodgment till derived from granite and gneiss

Typical profile

A - 0 to 4 inches: gravelly fine sandy loam
Bg - 4 to 14 inches: gravelly fine sandy loam
Bw - 14 to 24 inches: gravelly fine sandy loam
Cd - 24 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 0 to 8 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 15 to 35 inches to densic material
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C/D
Hydric soil rating: Yes

Description of Peacham

Setting

Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Highly-decomposed herbaceous organic material over dense coarse-loamy lodgment till derived from granite and gneiss

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oa - 2 to 11 inches: highly decomposed plant material
Bg - 11 to 14 inches: fine sandy loam
Cd - 14 to 18 inches: fine sandy loam
Cd - 18 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 0 to 3 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 6 to 18 inches to densic material
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: Yes

Minor Components

Peru

Percent of map unit: 10 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Wonsqueak

Percent of map unit: 6 percent
Landform: Bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Chocorua

Percent of map unit: 4 percent
Landform: Bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

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Appendix F: Operations & Maintenance Plan

OPERATION AND MAINTENANCE PLAN

1. Introduction

OYA Solar's maintenance and operations philosophy is to design an O&M program that meets the business requirements specific to an asset, and then deliver that program through a technically capable team using the best available practices and procedures in the current market. While this philosophy is relatively simple and straightforward, it has been a philosophy that has enabled OYA Solar to become one of the leading energy companies in today's market. OYA Solar develops an annual maintenance plans based on the OEM recommended maintenance for all equipment deployed to a project.

2. Information and Monitoring Systems

OYA Solar internally monitors energy delivery daily and we publish an in-depth project performance report on a monthly basis. We employ continuous modeling, which includes but is not limited to, pattern recognition and statistical outlier detection to identify temperature and performance outliers, vibration monitoring to assist in component failure or malfunction detection, and various performance models to detect sub-optimal energy production. This data is acquired from the project SCADA into our Enterprise PI System, and then pushed to our various analytical environments. A key component of OYA Solar's O&M solution is the use of our Renewables' Performance Monitoring Center ("RPMC") and Data Analytics. This centralized service monitors the performance of every single system within Renewables' portfolio utilizing the Enterprise OSI PI Software developed specifically for Solar Technologies. Data can be provided to facility owners via various means including but not limited to SFTP, PI to PI, and ICCP (if applicable).

Key functions provided by the RPMC include:

- Recording and reading alerts regarding data communication issues, availability of the system, sub-optimal performance, and other equipment problems
- Monitoring of performance to determine and schedule optimum times to carry out preventative and site maintenance tasks such as panel washings and vegetation abatement. Resolving issues which can be addressed from a remote location such as equipment resets
- Mobilizing personnel to the site promptly when needed, and ensuring personnel possess the appropriate training, tools, and spare parts to resolve the problem in minimal time

Identifying performance trends for projects through measurement tools at the individual equipment type by make and model in order to optimize performance and inform future procurement decisions.

Project Site Maintenance and Plans for Required Repairs:

- *Plant Performance Engineering*

As part of OYA Solar's Monitoring and Control Center Service, the performance of the Project will be monitored and analyzed to ensure that it is performing as expected. If any anomalies are identified, OYA Solar will organize a technical team to identify the root cause and remedy the performance deviation as quickly as possible. OYA Solar's approach to unscheduled maintenance is outlined below.

- *Approach to Unscheduled Maintenance*

Upon identification of an issue through Renewables M&D Center and Plant Performance Engineering:

- Advanced performance monitoring tools or technical experts alert Operations Team to a potential or an actual problem
- Operations Team will evaluate the problem and categorize it as a critical or noncritical repair
- In-house experts make an attempt to identify the cause of the problem and develop a detailed plan and timeline to rectify the issue
- For warranty repairs: Renewables contacts the warranty provider to place a claim.
- For non-warranty repairs, Renewables will develop a remedial plan including a timeline and budget based on the nature of the repair required (see below)
- Once notified of a warranty repair claim, the warranty provider has a defined timeline to produce a plan of action and remedy the problem based on the nature of the repair required (see below)

Critical repairs are those that entail the loss of power production or the loss of production recording, or situations that present a potential safety hazard. These usually fall under the system warranty and require resolution within 48 hours.

Non-critical repairs are all other repairs and usually entail intermittent loss of communications with the array. Many also fall under the system warranty and require resolution within two weeks.

Appendix G: Decommissioning Plan

DECOMMISSIONING PLAN

1. Introduction

This Decommissioning Plan describes how OYA plans to restore the Project Location into a clean and safe location for future uses, after the end of the life of the solar project ("**Project**"). The plan outlines all steps OYA will take in decommissioning the project and methods that will be taken to mitigate potential negative environmental impacts.

2. Decommissioning Plan Overview

Decommissioning involves the removal of solar equipment, the management of excess materials and waste, and the restoration of Project Location to allow for the future use of the land. Decommissioning takes 6 to 10 months.

Prior to construction, conditions of the Project Location will be documented, including photographs and Phase I Environmental Site Assessment report that will be stored for decommissioning.

Prior to decommissioning, OYA will reach out and meet with the landowner to discuss their preferences and OYA's commitment and obligation to restore the Project Location to its pre-construction condition or similar state. Decommissioning and restoration activities will adhere to industry best practices at the time of decommissioning. Similar to the construction phase, an on-site manager will be present while decommissioning activities are taking place.

This decommissioning plan is based on current procedures and OYA's experience. These procedures are subject to revision based on the engineering and environmental regulations and industry best practices at the time of decommissioning. Prior to decommissioning, various procedures will be assessed to ensure decommissioning is safe and minimizes the potential of impact on the environment. Soil erosion and sedimentation control measures, as well as other mitigation measures used during construction will be implemented during the decommissioning phase and will remain until the site is stabilized.

2.1 Decommissioning During Construction (Abandonment of Project)

In the unlikely event that construction ceases prior to the Project reaching Commercial Operational Date ("COD") and is not expected to restart, the project will be

decommissioned. All installed equipment will be removed and the land will be revegetated by seeding.

2.2 Decommissioning After Ceasing Operation

When the project ceases operation, typically thirty years or more after operation, the installed equipment will be removed and reused/recycled. Removal of equipment will be completed per the decommissioning plan expressed to the landowner, industry best practices, and manufacturers' recommendations.

3. Decommissioning of Solar Facility

3.1 Equipment Dismantling and Removal

After the Project has been disconnected from the electrical grid, all of the equipment will be dismantled and removed as outline below:

Table 1 - Equipment Dismantling and Removal

Equipment	Description
Above-ground	
PV Arrays	• Disconnect all above ground wiring, cables, and electrical interconnections • Remove photovoltaic ("PV") modules from racks and temporarily store on-site in delineated area before removal by truck to appropriate facilities • Dismantle and remove all racks and support structures, including extraction of in-ground support structures (see below). Temporarily store on-site before removal by truck to recycling facilities
Inverter Stations, Substation	• Disconnect and remove all electrical equipment • Remove inverters and associated components including combiners, medium voltage transformers, switch gear, overhead poles, and transport off-site to appropriate facility • Unbolt substation and remove from the foundation with a crane and dismantle all other substation components and transport off-site to an appropriate facility • Remove concrete foundations for inverter stations and substation components (see below)

Access road and other components	• Consult with landowners to determine if access roads should be left in place for their continued use • If one or more access road is removed after consultation with the landowners, the aggregate materials will be excavated by a backhoe/front-end loader, along with any underlying geotextile fabric • All compacted areas will be tilled in a manner adequate to restore the sub-grade material to the proper density and depth, consistent with the surrounding area. Clean and compatible sub-grade material, followed by topsoil will be applied as appropriate • Overhead lines and poles that are not owned by the utility will be removed along with associated equipment (isolation switches, fuses, metering) and holes will be filled in with clean fill or on-site fill, as appropriate • Removal of the perimeter fencing, followed by removal of fence pole foundations
Below Ground	
Underground cables	• Underground electrical lines running between inverters and the substation will either be removed or cut and left in place approximately 3 feet below ground
Equipment foundations	• The substation foundation will be removed to a depth of 3 feet below grade and covered with fill. Inverter stations and steel racking for the solar modules will have foundations that require removal. These foundations will likely consist of steel piles but may also include concrete. It is anticipated that structures will be fully removed from the ground and that the affected area shall be backfilled as necessary • In the event that a structure breaks during excavation, it is not anticipated that any waste materials will be left on-site with the possible exception of foundations or steel piles broken off below 3 feet in depth and/or disconnected underground electrical wires buried below 3 feet in depth. Waste concrete will be recycled off-site by a concrete recycler or crushed on-site and used as backfill material • All foundation materials will be removed from the site via truck and managed at appropriate facilities

3.2 Environmental Effects

Decommissioning has the potential to have environmental impacts, for example there is a potential for disturbance (erosion, silt and sediment runoff) to adjacent watercourses. OYA's mitigation strategies will be utilized during the decommissioning process, like those in the construction phase. These implementations will remain until the site is stabilized.

The use of construction machinery will result in escalated levels of noise. To avoid the impact, work will take place during daylight hours and adhere to local noise bylaws.

3.3 Site Restoration

After the decommissioning of the project, the site will be restored to a vegetated state status or the condition for the future intended land use.

Project equipment will be removed, and at the landowner's request will either be left or graded to restore terrain profile. The land may be seeded to help stabilize soil conditions, enhance soil structure, and increase soil fertility.

If there is a body of water, OYA will ensure that the operation of the solar facility will not produce sediments which could pollute the water, and the body of water will be restored so that the post-decommissioning off-site drainage pattern and quality and quantity of storm water will be similar to pre-construction levels.

Prior to the end of decommissioning, a site visit will be conducted to ensure post-decommissioning status satisfies agreements set in place by with the landowner.

3.4 Managing Excess Materials and Waste

Excess materials and wastes produced during the decommissioning phase will be removed from the site and reused, recycled, or disposed of. OYA will attempt to maximize recycling and reuse and will work with manufacturers, local subcontractors, and waste materials companies to separate and remove the materials off the property. OYA and its contractors will be responsible for the logistics of collecting and recycling the PV modules and will do so according to regulations and industry best practices at the time of decommissioning.

Table 2: - Managing Excess Materials and Waste

Material/Waste	Means of Managing Excess Materials and Waste
PV panels	If there is no possibility for reuse, the PV panels will either be returned to the manufacturer for appropriate recycling/disposal or will be transported to a facility where the glass, metal, and semiconductor materials will be separated and recycle. PV panels will be managed as per good management practices that are in effect at the time of decommissioning
Metal array mounting racks and steel supports	These materials will be recycled off-site at an approved facility or managed as per good management practices that are in effect at the time of decommissioning
Transformer and substation components	Oil from the transformers will be removed on-site to reduce the potential for spills and will be transported to an approved facility for disposal. The substation and step-up transformers at the inverter station will be transported off-site to be sent back to the manufacturer, recycled, reused, or safely disposed of off-site in accordance with standards and good practices of the day
Inverters, fans, fixtures	The metal components of the inverters, fans, and fixtures will be recycled, where possible. The remaining components will be disposed of according with standards and good practices of the day
Gravel (or other granular)	The materials will be removed from the project location by truck where the aggregate can be processed for salvage and then be reused as fill for construction
Geotextile fabric	During excavation of the aggregate, geotextile that is picked up will be sorted out and be disposed of off-site
Concrete inverter/transformer foundations	Concrete foundations will be broken down and transported for recycling
Cables and wiring	The electrical wiring that connects the substation to the Point of Common Coupling ("PCC") will be disconnected and recycled or disposed of at an appropriate facility. Support poles, if made of untreated wood will be chipped for reuse or disposed of off-site. Associated electronic equipment (isolation switches, fuses, metering) will be transported off-site to be sent back to the manufacturer, recycled, reused, or safety disposed of in accordance with prevailing standard practices
Fencing	Fencing will be removed and recycled at a metal recycling facility
Debris	Remaining debris from the site will be removed

Recyclable and residual waste materials will all be removed from the site by licenced contractors. It is not expected that any waste materials will be left on-site except for foundations or steel piles that may break below grade during removal and/or

disconnected underground electrical wires buried at 3 feet in depth. The final decision on waste disposal or recycling will be made by the on-site contractor, according to regulations and adhering to industry best practices at the time of decommissioning. Given that the methods for managing wastes and recyclables may change in the future, the information in this report will be updated approximately 6 months prior to the start of decommissioning to conform to future local and state regulations as well as industry best practices.

4. Future Land Use

While the decommissioning plan assumes that the Project Location is returned back to a vegetated state, the actual decommissioning will depend on the future use of the Project Location. Certain facilities may be utilized for future uses, such as the transmission facilities, roads, and drainage features. The extent that the actual decommissioning adheres to the decommissioning plan is subject to the future Project Location use that is to be negotiated with the landowner.

5. Decommissioning Financial Assurance

Table 3 is a sample list of decommissioning tasks and estimated costs that New York State Energy Research & Development Authority (NYSERDA) provided as guidance in their *Decommissioning Solar Panel Systems* fact sheet (See **Appendix A**). Although developed for projects in New York State, we feel that the estimated costs can be relied on as an estimate for projects in Massachusetts. The estimated costs listed are for a 2 MWac community solar system, which when scaled up for a 5 MWac solar project, is $247,250 ($150,500 at current costs) (See **Table 4**).

OYA proposes that an Escrow Account, Surety Bond, or Letter of Credit be established upon COD, according to the proposed funding schedule found in **Table 4**. 20% of total project decommissioning cost shall be established on a linear basis (2% per year for years 1-10) by year 10 with linear increases over time (8% per year for years 11-20) until the instrument reaches 100% by year 20 of operation. This would allow OYA to put income generated by the solar energy project towards the instrument and would minimize decommissioning and restoration from overly negatively impacting the Project's economic viability.

Table 3 - Sample List of Decommissioning Tasks and Estimated Costs (NYSERDA) – for 2 MWac System

Tasks	Estimated Cost ($)
Remove Rack Wiring	$2,459
Remove Panels	$2,450
Dismantle Racks	$12,350
Remove Electrical Equipment	$1,850
Breakup and Remove Concrete Pads or Ballasts	$1,500
Remove Racks	$7,800
Remove Cable	$6,500
Remove Ground Screws and Power Poles	$13,850
Remove Fence	$4,950
Grading	$4,000
Seed Disturbed Areas	$250
Truck to Recycling Center	$2,250
Current Total	$60,200
Total After 20 Years (2.5% inflation rate)	$98,900

Table 4 · NEW YORK STATE OF OPPORTUNITY. NYSERDA strument Funding Schedule

Estimated Cost			
- 2 MWac		$ 98,900.00	by year 20 (vs current estimated cost of $60,200)
- 5 MWac		$ 247,250.00	by year 20 (vs current estimated cost of $150,500)
Yr	**Funded %**	**$/2 MWac**	**$/5 MWac**
1	2%	$ 1,978.00	$ 4,945.00
2	4%	$ 3,956.00	$ 9,890.00
3	6%	$ 5,934.00	$ 14,835.00
4	8%	$ 7,912.00	$ 19,780.00
5	10%	$ 9,890.00	$ 24,725.00
6	12%	$ 11,868.00	$ 29,670.00
7	14%	$ 13,846.00	$ 34,615.00
8	16%	$ 15,824.00	$ 39,560.00
9	18%	$ 17,802.00	$ 44,505.00
10	20%	$ 19,780.00	$ 49,450.00
11	28%	$ 27,692.00	$ 69,230.00
12	36%	$ 35,604.00	$ 89,010.00
13	44%	$ 43,516.00	$ 108,790.00
14	52%	$ 51,428.00	$ 128,570.00
15	60%	$ 59,340.00	$ 148,350.00
16	68%	$ 67,252.00	$ 168,130.00
17	76%	$ 75,164.00	$ 187,910.00
18	84%	$ 83,076.00	$ 207,690.00
19	92%	$ 90,988.00	$ 227,470.00
20	100%	$ 98,900.00	$ 247,250.00

6. Conclusion

This report outlines the steps that will be taken to decommission a solar facility based on local and state (if applicable) decommissioning regulations, landowner participation, and industry standards at the time of decommissioning. Decommissioning will occur in a way that reduces environmental effects, ensures the site is restored back to its pre-construction status, and will be free of materials and waste.

Appendix A: NYPA Decommissioning Solar Panel Systems Fact Sheet

FACT SHEET

DECOMMISSIONING SOLAR PANEL SYSTEMS

This fact sheet provides information to local governments and landowners on decommissioning of large-scale solar panel systems.

As local governments develop solar regulations and landowners negotiate land leases, it is important to understand the options for decommissioning solar panel systems and restoring project sites to their original status.

From a land use perspective, solar panel systems are generally considered large-scale when they constitute the primary use of the land, and can range from less than one acre in urban areas to 10 or more acres in rural areas. Depending on where they are sited, large-scale solar projects can have habitat, farmland, and aesthetic impacts. As a result, large-scale systems must often adhere to specific development standards.

Abandonment and decommissioning defined

Abandonment occurs when a solar array is inactive for a certain period of time.

- Abandonment requires that solar panel systems be removed after a specified period of time if they are no longer in use. Local governments establish timeframes for the removal of abandoned systems based on aesthetics, system size and complexity, and location. For example, the Town of Geneva, NY, defines a solar panel system as abandoned if construction has not started within 18 months of site plan approval, or if the completed system has been nonoperational for more than one year.[1]
- Once a local government determines a solar panel system is abandoned, and has provided thirty (30) days prior written notice to the owner it can take enforcement actions, including imposing civil penalties/fines, and removing the system and imposing a lien on the property to recover associated costs.

Decommissioning is the process for removing an abandoned solar panel system and remediating the land.

- When describing requirements for decommissioning sites, it is possible to specifically require the removal of infrastructure, disposal of any components, and the stabilization and re-vegetation of the site.

What is a decommissioning plan?

Local governments may require to have a plan in place to remove solar panel systems at the end of their lifecycle, which is typically 20-40 years. A decommissioning plan outlines required steps to remove the system, dispose of or recycle its components, and restore the land to its original state. Plans may also include an estimated cost schedule and a form of decommissioning security (see Table 1).

What is the estimated cost of decommissioning?

Given the potential costs of decommissioning and land reclamation, it is reasonable for landowners and local governments to proactively consider system removal guarantees. A licensed professional engineer, preferably with solar development experience, can estimate decommissioning costs, which vary across the United States. Decommissioning costs will vary depending upon project size, location, and complexity. Table 1 provides an estimate of potential decommissioning costs for a ground-mounted 2-MW solar panel system. Figures are based on estimates from the Massachusetts solar market. Decommissioning costs for a New York solar installation may differ. Some materials from solar installations may be recycled, reused, or even sold resulting in no costs or compensation. Consider allowing a periodic reevaluation of decommissioning costs during the project's lifetime by a licensed professional engineer, as costs could decrease and the required payment should be reduced accordingly.

Table 1: Sample list of decommisioning tasks and estimated costs

Tasks	Estimated Cost ($)
Remove Rack Wiring	$2,459
Remove Panels	$2,450
Dismantle Racks	$12,350
Remove Electrical Equipment	$1,850
Breakup and Remove Concrete Pads or Ballasts	$1,500
Remove Racks	$7,800
Remove Cable	$6,500
Remove Ground Screws and Power Poles	$13,850
Remove Fence	$4,950
Grading	$4,000
Seed Disturbed Areas	$250
Truck to Recycling Center	$2,250
Current Total	$60,200
Total After 20 Years (2.5% inflation rate)	$98,900

[1] *Town of Geneva, N.Y. CODE § 130-4(D)(5) (2016):*

How can decommissioning be ensured?

Landowners and local governments can ensure appropriate decommissioning and reclamation by using financial and regulatory mechanisms. However, these mechanisms come with tradeoffs. Including decommissioning costs in the upfront price of solar projects increases overall project costs, which could discourage solar development. As a result, solar developers are sometimes hesitant to provide or require financial surety for decommissioning costs.

It is also important to note that many local governments choose to require a financial mechanism for decommissioning. Although similar to telecommunications installations, there is no specific authority to do so as part of a land use approval for solar projects (see Table 2). Therefore, a local government should consult their municipal attorney when evaluating financial mechanisms.

The various financial and regulatory mechanisms to decommission projects are detailed below.

Table 2: Relevant Provisions of General City, Town, and Village Laws Relating to Municipal Authority to Require Conditions, Waivers, and Financial Mechanisms

Site Plan Review	General City Law	Town Law	Village
Conditions	27-a (4)	274-a (4)	7-725-a (4)
Waivers	27-a (5)	274-a (5)	7-725-a (5)
Performance bond or other security	27-a (7)	274-a (7)	7-725-a (7)
Subdivision	**General City Law**	**Town Law**	**Village Law**
Waivers	33 (7)	277 (7)	7-730 (7)
Performance bond or other security	33 (8)	277 (9)	7-730 (9)
Special	**General City Law**	**Town Law**	**Village Law**
Conditions	27-b (4)	274-b (4)	7-725-b (4)
Waivers	27-b (5)	274-b (5)	7-725-b (5

Source: Referenced citations may be viewed using the NYS Laws of New York Online

Excerpts from these statutes are also contained within the "Guide to Planning and Zoning Laws of New York State," New York State Division of Local Governments Services, June 2011: **www.dos.ny.gov/lg/publications/Guide_to_planning_and_zoning_laws.pdf**

Financial mechanisms

Decommissioning Provisions in Land-Lease Agreements. If a decommission plan is required, public or private landowners should make sure a decommissioning clause is included in the land-lease agreement. This clause may depend on the decommissioning preferences of the landowner and the developer. The clause could require the solar project developer to remove all equipment and restore the land to its original condition after the end of the contract, or after generation drops below a certain level, or it could offer an option for the landowner to buy-out and continue to use the equipment to generate electricity. The decommissioning clause should also address abandonment and the possible failure of the developer to comply with the decommissioning plan. This clause could allow for the landowner to pay for removal of the system or pass the costs to the developer.

Decommissioning Trusts or Escrow Accounts. Solar developers can establish a cash account or trust fund for decommissioning purposes. The developer makes a series of payments during the project's lifecycle until the fund reaches the estimated cost of decommissioning. Landowners or third-party financial institutions can manage these accounts. Terms on individual payment amounts and frequency can be included in the land lease.

Removal or Surety Bonds. Solar developers can provide decommissioning security in the form of bonds to guarantee the availability of funds for system removal. The bond amount equals the decommissioning and reclamation costs for the entire system. The bond must remain valid until the decommissioning obligations have been met. Therefore, the bond must be renewed or replaced if necessary to account for any changes in the total decommissioning cost.

Letters of credit. A letter of credit is a document issued by a bank that assures landowners a payment up to a specified amount, given that certain conditions have been met. In the case that the project developer fails to remove the system, the landowner can claim the specified amount to cover decommissioning costs. A letter of credit should clearly state the conditions for payment, supporting documentation landowners must provide, and an expiration date. The document must be continuously renewed or replaced to remain effective until obligations under the decommissioning plan are met.[2]

Nonfinancial mechanisms

Local governments can establish nonfinancial decommissioning requirements as part of the law. Provisions for decommissioning large-scale solar panel systems are similar to those regulating telecommunications installations, such as cellular towers and antennas. The following options may be used separately or together.

- **Abandonment and Removal Clause.** Local governments can include in their zoning code an abandonment and removal clause for solar panel systems. These cases effectively become zoning enforcement matters where project owners can be mandated to remove the equipment via the imposition of civil penalties and fines, and/or by imposing a lien on the property to recover the associated costs. To be most effective, these regulations should be very specific about the length of time that constitutes abandonment. Establishing a timeframe for the removal of a solar panel system can be based on system aesthetics, size, location, and complexity. Local governments should include a high degree of specificity when defining "removal" to avoid ambiguity and potential conflicts.

[2] *See a letter of credit submitted to the Vermont Public Service Board by NextSun Energy, LLC.* ***http://psb.vermont.gov/sites/psb/files/docketsandprojects/Solar/Exhibit%20Petitioner%20JL-7%20(Revised%20326.14).pdf***

- **Special Permit Application.** A local government may also mandate through its zoning code that a decommissioning plan be submitted by the solar developer as part of a site plan or special permit application. Having such a plan in place allows the local government, in cases of noncompliance, to place a lien on the property to pay for the costs of removal and remediation.
- **Temporary Variance/Special Permit Process.** As an alternative to requiring a financial mechanism as part of a land use approval, local governments could employ a temporary variance/special permit process (effectively a re- licensing system). Under this system, the locality would issue a special permit or variance for the facility for a term of 20 or more years; once expired (and if not renewed), the site would no longer be in compliance with local zoning, and the locality could then use their regular zoning enforcement authority to require the removal of the facility.

What are some examples of abandonment and decommissioning provisions?

The New York State Model Solar Energy Law provides model language for abandonment and decommissioning provisions: **www.cuny.edu/about/resources/sustainability/reports/NYS_Model_Solar_Energy_LawToolkit_FINAL_final.pdf**

The following provide further examples that are intended to be illustrative and do not confer an endorsement of content:

- Town of Geneva, N.Y., § 130-4(D): **ecode360.com/28823382**
- Town of Olean, N.Y., § 10.25.5: **www.cityofolean.org/council/minutes/ccmin2015-04-14.pdf**

Is there a checklist for decommissioning plans?

The following items are often addressed in decommissioning plans requirements:[3]

- Defined conditions upon which decommissioning will be initiated (i.e., end of land lease, no operation for 12 months, prior written notice to facility owner, etc.).
- Removal of all nonutility owned equipment, conduit, structures, fencing, roads, and foundations.
- Restoration of property to condition prior to solar development.
- The timeframe for completion of decommissioning activities.
- Description of any agreement (e.g., lease) with landowner regarding decommissioning.
- The party responsible for decommissioning.
- Plans for updating the decommissioning plan.
- Before final electrical inspection, provide evidence that the decommissioning plan was recorded with the Register of Deeds.

Additional Resources

Template Solar Energy Development Ordinance for North Carolina (see Appendix G at pg. 21 for Sample Decommissioning Plan): **nccleantech.ncsu.edu/wp-content/uploads/Template-Solar-Ordinance_V1.0_12-18-13.pdf**

Land Use Planning for Solar: **training.ny-sun.ny.gov/images/PDFs/Land_Use_Planning_for_Solar_Energy.pdf**

Zoning Guide for Solar: **training.ny-sun.ny.gov/images/PDFs/Zoning_for_Solar_Energy_Resource_Guide.pdf**

Information on First Solar's recycling program for all of their modules: **www.firstsolar.com/en/Technologies-and-Capabilities/Recycling-Services**

PV Cycle: Europe's PV recycling program: **www.pvcycle.org/**

Solar Energy Industries Association (SEIA) information on solar panel recycling: **www.seia.org/policy/environment/pv-recycling**

Silicon Valley Toxics Coalition: **svtc.org/**

Silicon Valley Toxic Coalition Solar Scorecard: **www.solarscorecard.com/2015/2015-SVTC-Solar-Scorecard.pdf**

End-of-life PV: then what? - Recycling solar panels: **www.renewableenergyfocus.com/view/3005/end-of-life-pv-then-what-recycling-solar-pv-panels/**

NY-Sun, a dynamic public-private partnership, will drive growth in the solar industry and make solar technology more affordable for all New Yorkers. NY-Sun brings together and expands existing programs administered by the New York State Energy Research and Development Authority (NYSERDA), Long Island Power Authority (LIPA), PSEG Long Island, and the New York Power Authority (NYPA), to ensure a coordinated, well-supported solar energy expansion plan and a transition to a sustainable, self-sufficient solar industry.

[3] *North Carolina Solar Center, NC Sustainable Energy Center. December 2013. Template Solar Energy Development Ordinance for North Carolina.* ***https://nccleantech.ncsu.edu/wp-content/uploads/Template-Solar-Ordinance_V1.0_12-18-13.pdf***

Appendix H: 255 CMR 20.00: SMART Program

225 CMR 20.00: SOLAR MASSACHUSETTS RENEWABLE TARGET (SMART) PROGRAM

Section

20.01: Purpose and Application

The purpose of 225 CMR 20.00 is to establish a statewide solar incentive program to encourage the continued use and development of generating units that use solar photovoltaic technology by residential, commercial, governmental and industrial electricity customers throughout the Commonwealth. The continued use and development of these generating units has the potential to reduce peak demand, system losses, the need for investment in new infrastructure, and distribution congestion; increase grid reliability; improve public health and safety; and diversify the Commonwealth's energy supply. Further, it will also contribute to the Commonwealth's environmental protection goals concerning air emissions including, but not limited to, those required by the Global Warming Solutions Act, M.G.L. c. 21N, §§ 1 through 9, by displacing non-renewable generating resources. Owners of generating units that choose to participate in the statewide solar incentive program pursuant to 225 CMR 20.00 do so on a voluntary basis, but must comply with the terms and requirements of 225 CMR 20.00. Nothing in 225 CMR 20.00 should be read as requiring Owners of generating units to participate in this statewide solar incentive program.

20.02: Definitions

Agricultural Solar Tariff Generation Unit. A Solar Tariff Generation Unit located on Land in Agricultural Use or Prime Agricultural Farmland that allows the continued use of the land for agriculture.

Alternative On-bill Credit Generation Unit. A Standalone Solar Tariff Generation Unit that is enrolled under a tariff establishing a bill credit for generation from Solar Tariff Generation Units that is approved by the DPU and any other appropriate jurisdictional bodies, but is not a tariff approved pursuant to 220 CMR 8.00: *Sales of Electricity by Qualifying Facilities and On-site Generating Facilities to Distribution Companies, and Sales of Electricity by Distribution Companies to Qualifying Facilities and On-site Generating Facilities* or 220 CMR 18.00: *Net Metering*.

Authorized Agent. A person or entity that serves under an agreement entered into by each of the Owners of a Solar Tariff Generation Unit for all dealings with the Department.

Base Compensation Rate. The portion of a Solar Tariff Generation Unit's compensation rate related to the Generation Unit's rated alternating current capacity, prescribed in 225 CMR 20.07(3).

Behind-the-meter Solar Tariff Generation Unit. A Solar Tariff Generation Unit that serves On-site Load other than parasitic or station load utilized to operate the Generation Unit and that receives compensation under 220 CMR 8.00: *Sales of Electricity by Qualifying Facilities and On-site Generating Facilities to Distribution Companies, and Sales of Electricity by Distribution Companies to Qualifying Facilities and On-site Generating Facilities* or 220 CMR 18.00: *Net Metering*.

20.02: continued

Brownfield. A disposal site that has received a release tracking number from MassDEP pursuant to 310 CMR 40.0000: *Massachusetts Contingency Plan*, the redevelopment or reuse of which is hindered by the presence of oil or hazardous materials, as determined by the Department, in consultation with MassDEP. For the purposes of 225 CMR 20.02: Brownfield, the terms "disposal site", "release tracking number", "oil", and "hazardous materials" shall have the meanings giving to such terms in 310 CMR 40.0006: Terminology, Definitions and Acronyms. No disposal site that otherwise meets the requirements of 225 CMR 20.02: Brownfield shall be excluded from consideration as a Brownfield because its cleanup is also regulated by the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§ 9601-9675, the Resource Conservation and Recovery Act, 42 U.S.C. §§ 6921 - 6939g, or any other federal program.

Building Mounted Solar Tariff Generation Unit. A Solar Tariff Generation Unit with 100% of the nameplate capacity of the solar photovoltaic modules used for generating power installed on a building.

Business Day. Monday through Friday, exclusive of state and federal legal holidays.

Canopy Solar Tariff Generation Unit. A Solar Tariff Generation Unit with 100% of the nameplate capacity of the solar photovoltaic modules used for generating power installed on top of a parking surface, pedestrian walkway, or canal in a manner that maintains the function of the area beneath the canopy.

Capacity Block. A quantity of Solar Tariff Generation Unit capacity that is entitled to receive a particular set of Base Compensation Rates and Compensation Rate Adders within a Distribution Company's service territory.

Commercial Operation Date. The date on which a Distribution Company grants approval for a Solar Tariff Generation Unit to interconnect with the electric grid.

Community Shared Solar Tariff Generation Unit. A Solar Tariff Generation Unit that provides electricity or bill credits to three or more Customers of Record. No more than two participants may receive bill credits in excess of those produced annually by 25 kW of nameplate AC capacity, and the combined share of said participants' capacity shall not exceed 50% of the total capacity of the Generation Unit, except in the case of Generation Units smaller than 100 kW AC.

Compensation Rate Adder. An adder to a Solar Tariff Generation Unit's Base Compensation Rate established pursuant to 225 CMR 20.07(4).

Customer of Record. An eligible customer with the Distribution Company whose name appears on a Distribution Company billing account of a meter connected to or receiving bill credits from a Solar Tariff Generation Unit.

Department. The Massachusetts Department of Energy Resources, established by M.G.L. c. 25A.

Distribution Company. A company engaging in the distribution of electricity or owning, operating or controlling distribution facilities as defined in M.G.L. c. 164, § 1; provided, however, a Distribution Company shall not include a municipal utility established pursuant to the provisions of M.G.L. c. 164.

DPU. The Massachusetts Department of Public Utilities established by M.G.L. c. 25, § 1.

Eligible Landfill. A landfill that has received an approval from MassDEP for the use of a solar photovoltaic Generation Unit at the landfill as a post-closure use pursuant to 310 CMR 19.143: *Post-closure Use of Landfills*.

End-use Customer. A person or entity in Massachusetts that purchases electrical energy from a Distribution Company.

20.02: continued

Energy Storage System. A commercially available technology that is capable of absorbing energy, storing it for a period of time and thereafter dispatching the energy.

Environmental Attribute. All GIS Certificates and any other environmental benefits associated with the energy generation of a Solar Tariff Generation Unit.

Floating Solar Tariff Generating Unit. A Solar Tariff Generation Unit located on a body of water that are currently, or was formerly, used for water treatment, agricultural or industrial activities, and that allows for the continued use of the water body for its intended purpose.

Generation Attribute. A Generation Attribute, as defined in 225 CMR 14.02: *Definitions*.

Generation Unit. A Generation Unit, as defined in 225 CMR 14.02: *Definitions*.

GIS Certificate. An electronic record produced by the NEPOOL GIS that identifies Generation Attributes of each MWh accounted for in the NEPOOL GIS.

Greenfield Subtractor. A subtractor to a Solar Tariff Generation Unit's Base Compensation Rate, established pursuant to 225 CMR 20.07(4)(f).

Guideline. A set of clarifications, interpretations, and procedures, including forms, developed by the Department to assist in compliance with the requirements of 225 CMR 20.00. The Department may issue new or revised Guidelines. Each Guideline shall be effective on its date of issuance or on such date as is specified therein, except as otherwise provided in 225 CMR 20.00.

Independent Verifier. An entity approved by the Department to perform the function of a third party meter reader as defined in Rule 2.5(j) of the *NEPOOL GIS Operating Rules*, or any successor rule.

Interconnection Service Agreement. The agreement for interconnection service entered into between the interconnecting customer and a Distribution Company, as defined and provided in each Distribution Company's standards for interconnection of distributed generation.

ISO-NE. ISO New England Inc., the independent system operator for New England, the regional transmission organization for most of New England, which is authorized by the Federal Energy Regulatory Commission to exercise for the New England Control Area the functions required pursuant to the Federal Energy Regulatory Commission's Order No. 2000 and corresponding regulations.

Kilowatt (kW). A unit of power equal to one thousand watts, as measured in alternating current (AC).

Kilowatt-hour (kWh). A unit of electrical energy or work equivalent to one thousand watts of power operating for one hour.

Land in Agricultural Use. All land as defined under M.G.L. c. 61A, §§ 1 and 2, enrolled in a program established pursuant to M.G.L. c. 61A, and land that had been enrolled in a program established pursuant to M.G.L. c. 61A within the past five years.

Low Income Community Shared Solar Tariff Generation Unit. A Community Shared Solar Tariff Generation Unit with at least 50% of its energy output allocated to Low Income Customers in the form of electricity or bill credits.

Low Income Customer. An End-use Customer that is on a low-income discounted rate of a Distribution Company.

Low Income Property Solar Tariff Generation Unit. A Solar Tariff Generation Unit with a rated capacity greater than 25 kW that provides all of its generation output in the form of electricity or bill credits to low or moderate income housing, as defined under M.G.L. c. 40B.

20.02: continued

Low Income Solar Tariff Generation Unit. A Solar Tariff Generation Unit with an AC rated capacity of less than or equal to 25 kW that serves Low Income Customers.

MassDEP. The Massachusetts Department of Environmental Protection established by M.G.L. c. 21A, § 7.

MDAR. The Massachusetts Department of Agricultural Resources established by M.G.L. c. 20, § 1.

Megawatt (MW). A unit of power equal to one million watts, as measured in alternating current (AC).

Megawatt-hour (MWh). A unit of electrical energy or work equivalent to one million watts of power operating for one hour.

Municipality. A city or town in the Commonwealth of Massachusetts that has been issued a public identification number by the DPU pursuant to 220 CMR 18.00: *Net Metering*.

NEPOOL GIS. The New England Power Pool Generation Information System, which includes a generation information database and certificate system, operated by the New England Power Pool, its designee or successor entity, that accounts for Generation Attributes of electrical energy consumed and generated within, imported into, or exported from the ISO-NE Control Area.

Net Metered Generation Unit. A Standalone Solar Tariff Generation Unit that is also enrolled and compensated as Class I Net Metering Facility, Class II Net Metering Facility, or Class III Net Metering Facility, as defined under 220 CMR 18.02: *Definitions*.

Non-net Metered Generation Unit. A Standalone Solar Tariff Generation Unit that is also enrolled and compensated as a State Qualifying Facility under 220 CMR 8.00: *Sales of Electricity by Qualifying Facilities and On-site Generating Facilities to Distribution Companies, and Sales of Electricity by Distribution Companies to Qualifying Facilities and On-site Generating Facilities*.

On-site Load. Any new or existing electric load located at the site of a Solar Tariff Generation Unit including any parasitic load that may result from the installation of the Solar Tariff Generation Unit, and that is wired to receive a portion of the electrical energy output from the Solar Tariff Generation Unit before the balance of such output passes through the Solar Tariff Generation Unit's metered interconnection onto the electric grid.

Other Governmental Entity. A Department or agency of the Commonwealth, and any other state or local entity that has been issued a public identification number by the DPU pursuant to 220 CMR 18.00: *Net Metering*.

Owner. Any person or entity that, alone or in conjunction with others, has legal ownership of a Solar Tariff Generation Unit.

Primary Installer. The primary entity responsible for a Solar Tariff Generation Unit's installation. The Primary Installer must be a professional contractor licensed to conduct business in Massachusetts. Any electrical work performed on the installation must be conducted by an electrician holding a valid and current license in Massachusetts. The Primary Installer is directly responsible for turnkey project management and installation work, although the installation work may be sub-contracted. Homeowners or other individuals are not eligible to be a Primary Installer unless they are a Massachusetts licensed electrician completing an installation on their own property.

Prime Agricultural Farmland. Means those soils identified by the United States Department of Agriculture Natural Resources Conservation Service to be prime farmlands pursuant to 7 CFR § 657.5(a).

20.02: continued

Public Entity Solar Tariff Generation Unit. A Solar Tariff Generation Unit sited on property owned by a Municipality or Other Governmental Entity that is either:

(a) owned or operated by a Municipality or Other Governmental Entity; or

(b) the owner has assigned 100% of its output to Municipalities or Other Governmental Entities.

Renewable Generation. Means Renewable Generation, as defined in 225 CMR 14.02: *Definitions*.

Renewable Generation Attribute. Means a Renewable Generation Attribute, as defined in 225 CMR 14.02: *Definitions*.

Reservation Period. The period of time during which a Solar Tariff Generation Unit is entitled to a Statement of Qualification and Capacity Block reservation prior to the Solar Tariff Generation Unit's receipt of notice of authorization to interconnect from the Distribution Company.

RPS Class I Renewable Generation. Means RPS Class I Renewable Generation, as defined in 225 CMR 14.02: *Definitions*.

RPS Class I Renewable Generation Attribute. Means a RPS Class I Renewable Generation Attribute, as defined in 225 CMR 14.02: *Definitions*.

RPS Class I Renewable Generation Unit. Means a RPS Class I Renewable Generation Unit, as defined in 225 CMR 14.02: *Definitions*.

SMART Tariff. A tariff to implement the incentive program contemplated herein to be filed by each individual Distribution Company for review and approval by the DPU and any other appropriate jurisdictional regulatory bodies.

Solar Massachusetts Renewable Target (SMART) Program. The solar incentive program established pursuant to 225 CMR 20.00.

Solar Program Administrator. The program administrator for 225 CMR 20.00 that is selected pursuant to the process set forth in 225 CMR 20.09.

Solar Tariff Generation Unit. A Generation Unit that generates electricity using solar photovoltaic technology and meets all of the eligibility criteria set forth in 225 CMR 20.05 and 20.06.

Standalone Solar Tariff Generation Unit. A Solar Tariff Generation Unit that serves no associated On-site Load other than parasitic or station load utilized to operate the Generation Unit.

State Qualifying Facility. Means a Qualifying Facility, as defined by the DPU in 220 CMR 8.02: *Definitions*.

Statement of Qualification. A document issued by the Department that qualifies a Solar Tariff Generation Unit under 225 CMR 20.00.

Third-party Owner. An entity that has a turnkey contract involving a power purchase agreement, lease, or other arrangements with a Customer of Record, but is the Owner of the Solar Tariff Generation Unit. The Third-party Owner may have a separate contract with another entity for the actual installation work.

20.03: Administration

225 CMR 20.00 shall be administered by the Department.

20.04: Applicability

225 CMR 20.00 applies to Distribution Companies and to the Owners of Solar Tariff Generation Units.

20.05: Tariff Based Incentive Program for Solar Photovoltaic Generation Units

(1) Size of Program. The SMART Program shall support 1,600 MW of new solar generating capacity.

(2) SMART Program Effective Date. Solar Tariff Generation Units that receive a Statement of Qualification under the SMART Program will be eligible to begin receiving incentive payments upon the effective date of the SMART Tariffs, as approved by the DPU and any other appropriate jurisdictional regulatory bodies.

(3) Block Allocation. The amount of capacity available in each Distribution Company's service territory will be proportional to the total electric load served to Massachusetts End-use Customers by the Distribution Company in calendar year 2016. Each Distribution Company shall divide the capacity available in its service territory into eight equally sized Capacity Blocks, provided, however, that if a Distribution Company served less than 5% of the total electric load collectively served to all Massachusetts End-use Customers by the Distribution Companies in calendar year 2016, it may elect to have less than eight equally sized Capacity Blocks.

(a) Set-aside for Solar Tariff Generation Units Less than or Equal to 25 kW. Each Capacity Block shall have a minimum of 20% and a maximum of 35% of its total available capacity reserved for Solar Tariff Generation Units with nameplate capacities less than or equal to 25 kW.

(b) Special Provisions for Block 1. Other than Solar Tariff Generation Units selected under the one-time competitive procurement described in 225 CMR 20.07(3), no Solar Tariff Generation Unit shall be eligible to qualify in a Distribution Company's first Capacity Block unless it has a capacity equal to or less than 1,000 kW or is eligible to receive a Compensation Rate Adder.

(4) Transition between Capacity Blocks. If there is not enough capacity remaining in a Capacity Block for a Solar Tariff Generation Unit to fit entirely within the Capacity Block, that Solar Tariff Generation Unit shall receive a blended total compensation rate, which shall be prorated according to the amount of the Solar Tariff Generation Unit's capacity that is assigned to each Capacity Block.

(5) General Eligibility Criteria for Solar Tariff Generation Units.

(a) General Eligibility Requirements. The Solar Tariff Generation Unit must use solar photovoltaic technology and be interconnected with the electric grid in the Commonwealth of Massachusetts. The aggregate maximum capacity of Solar Tariff Generation Units located on a single parcel of land shall be five MW and shall not be inclusive of any solar photovoltaic generating capacity that is not qualified under 225 CMR 20.00. For any parcel of land for which a Solar Tariff Generation Unit has submitted a Statement of Qualification Application, if its current boundaries are the result of a subdivision recorded after January 1, 2010, the Owner shall demonstrate to the Department that the subdivision was not for the purpose of obtaining eligibility as a Solar Tariff Generation Unit. If the Owner fails to make such a showing to the Department, the five MW limit shall apply to the metes and bounds of the parcel as recorded prior to the subdivision.

(b) Commercial Operation Date Requirements. A Solar Tariff Generation Unit must have a Commercial Operation Date on or after January 1, 2018 and shall not have been previously qualified and commercially operational as a Solar Carve-out Renewable Generation Unit or Solar Carve-out II Renewable Generation Unit, as defined in 225 CMR 14.02: *Definitions*.

(c) Public Utility Regulatory Policies Act of 1978 Requirements. A Solar Tariff Generation Unit with a maximum net power production capacity of greater than one MW shall obtain federal qualifying facility status from the Federal Energy Regulatory Commission pursuant to 18 CFR § 292.207(a) and (b). A Solar Tariff Generation Unit with a maximum net power production capacity of less than or equal to one MW shall attest to its status as a federal qualifying facility in the Statement of Qualification application.

20.05: continued

(d) RPS Class I Eligibility. For each MWh of electricity generation produced by a Solar Tariff Generation Unit, it will be eligible to generate GIS Certificates encoded as RPS Class I Renewable Generation Attributes. These GIS Certificates and any other GIS Certificates associated with Environmental Attributes other than RPS Class I Renewable Generation Attributes, shall be transferred directly to an account owned by the Distribution Company in whose service territory the Solar Tariff Generation Unit is located upon issuance by NEPOOL GIS.

(e) Land Use and Siting Criteria. A Solar Tariff Generation Unit must meet the following performance standards, and will be placed into one of three categories with respect to the land or property on which it is sited. For the purposes of 225 CMR 20.05(5)(e), previously developed shall mean having pre-existing paving, construction, or altered landscapes, and does not include altered landscapes resulting from current agricultural use, forestry, or use as preserved natural area.

1. Category 1 Land Use. Solar Tariff Generation Units that meet one or more of the following criteria will be designated as either Category 1 Agricultural or Category 1 Non-agricultural:

a. Category 1 Agricultural. Solar Tariff Generation Units located on Land in Agricultural Use or Prime Agricultural Farmland that meet one or more of the following criteria will be designated as Category 1:

i. Agricultural Solar Tariff Generation Units;

ii. Building Mounted Solar Tariff Generation Units;

iii. Solar Tariff Generation Units sized to meet no greater than 200% of annual operation load of an agricultural facility.

b. Category 1 Non-agricultural. Solar Tariff Generation Units not located on Land in Agricultural Use or Prime Agricultural Farmland that meet one or more of the following criteria will be designated as Category 1:

i. Ground-mounted Solar Tariff Generation Units with a capacity less than or equal to 500 kW;

ii. Building Mounted Generation Units;

iii. Solar Tariff Generation Units sited on Brownfields;

iv. Solar Tariff Generation Units sited on Eligible Landfills;

v. Solar Tariff Generation Units that are ground-mounted with a capacity greater than 500 kW and less than or equal to 5,000 kW that are on land that has been previously developed; and

vi. Solar Tariff Generation Units that are ground-mounted with a capacity greater than 500 kW and less than or equal to 5,000 kW that are sited within a solar overlay district or that comply with established local zoning that explicitly addresses solar or power generation.

2. Category 2 Land Use. Solar Tariff Generation Units not otherwise designated Category 1 that are ground-mounted with a capacity greater than 500 kW and less than or equal to 5,000 kW and that are sited on land that:

a. has not been previously developed; and

b. is zoned for commercial or industrial use, shall be designated as Category 2 Land Use.

3. Category 3 Land Use. Solar Tariff Generation Units not otherwise designated Category 1 or Category 2 that are ground-mounted with a capacity greater than 500 kW and less than or equal to 5,000 kW shall be designated as Category 3 Land Use.

4. Solar photovoltaic Generation Units that meet one or more of following criteria shall not be eligible to qualify as Solar Tariff Generation Units under 225 CMR 20.00:

a. Solar photovoltaic Generation Units on protected open space, as established under Article XCVII of the Amendments to the Constitution, that do not meet the criteria of Category 1 Land Use;

b. Solar photovoltaic Generation Units sited in a wetland Resource Area, as defined in 310 CMR 10.04: *Definitions*, not including Buffer Zones, as defined in 310 CMR 10.04: *Definitions*, except as authorized by all necessary regulatory bodies; and

c. Solar photovoltaic Generation Units sited on properties included in the *State Register*, as defined in 950 CMR 71.03: *Definitions*, except as authorized by regulatory bodies.

20.05: continued

5. Performance Standards. All ground-mounted Solar Tariff Generation Units with a capacity greater than 500 kW must provide a certification from a professional engineer that the construction of the Solar Tariff Generation Unit complied with the following standards when installed on Land in Agricultural Use, Prime Agricultural Farmland, or other pervious open space:

a. no removal of all field soils;

b. existing leveled field areas left as is without disturbance;

c. where soils need to be leveled and smoothed, such as filling potholes or leveling, this shall be done with minimal overall impact with all displaced soils returned to the areas affected;

d. ballasts, screw-type, or post driven pilings and other acceptable minimal soil impact methods that do not require footings or other permanent penetration of soils for mounting are required, unless the need for such can be demonstrated;

e. any soil penetrations that may be required for providing system foundations necessary for additional structural loading or for providing system trenching necessary for electrical routing shall be done with minimal soils disturbance, with any displaced soils to be temporary and recovered and returned after penetration and trenching work is completed;

f. no concrete or asphalt in the mounting area other than ballasts or other code required surfaces, such as transformer or electric gear pads;

g. address existing soil and water resource concerns that may be impacted to ensure the installation does not disturb an existing soil and water conservation plan or to avoid creating a negative impact to soil and water conservation best management practices, such as stimulating erosion or water run-off conditions;

h. limited use of geotextile fabrics; and

i. maintain vegetative cover to prevent soil erosion.

(f) Project Segmentation. No more than one Building Mounted Generation Unit on a single building, or one ground-mounted Solar Tariff Generation Unit on a single parcel or contiguous parcels of land, shall be eligible to receive a Statement of Qualification as a Solar Tariff Generation Unit. The Solar Program Administrator or the Department may require Solar Tariff Generation Unit Owner or Authorized Agent to include a deed in the case of recorded land, or a numbered certificate in the case of registered land, from the registry of deeds with their Statement of Qualification Application in order to verify that the Solar Tariff Generation Unit meets this requirement.

(g) Exceptions to Project Segmentation. Notwithstanding 225 CMR 20.05(5)(f), the following types of Solar Tariff Generation Units shall be eligible to receive a Statement of Qualification:

1. a Solar Tariff Generation Unit with an AC rated capacity of 25 kW or less that is located on a parcel of land contiguous with another parcel or parcels of land containing a Solar Tariff Generation Unit, provided the parcels of land were not the result of a subdivision performed for the purpose of qualifying under 225 CMR 20.05(5)(g)1.;

2. a Solar Tariff Generation Unit with an AC rated capacity of 25 kW or less, a Canopy Solar Tariff Generation Unit, or a Building Mounted Solar Tariff Generation Unit, which is located on the same parcel of land as another Solar Tariff Generation Unit, provided that the Solar Tariff Generation Unit is separately metered from the original Solar Tariff Generation Unit and, in the case of a Solar Tariff Generation Unit with an AC rated capacity of 25 kW or less or a Building Mounted Solar Tariff Generation Unit, is located on a separate building from the original Solar Tariff Generation Unit;

3. a Solar Tariff Generation Unit with an AC rated capacity of 25 kW or less, or a Building Mounted Solar Tariff Generation Unit, which is located on the same building as another Solar Tariff Generation Unit, provided that the Solar Tariff Generation Unit is separately metered from the original Solar Tariff Generation Unit and is connected to a meter of a separate End-use Customer as the original Solar Tariff Generation Unit;

4. a Solar Tariff Generation Unit located on the same parcel or contiguous parcel of land to another Solar Tariff Generation Unit that submits a Statement of Qualification Application at least twelve months after the Commercial Operation Date of the original Solar Tariff Generation Unit and is separately metered or that can demonstrate to the Department's satisfaction that the Owners of the Solar Tariff Generation Units are unaffiliated parties;

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5. a Solar Tariff Generation Unit that is physically located across multiple parcels of land, provided that it is located behind a single interconnection point and single production meter, and that its AC rated capacity is 5 MW or less;

6. a Solar Tariff Generation Unit that can demonstrate to the Department's satisfaction that documentation required to meet the criteria set forth in 225 CMR 20.06(1)(c) was obtained prior to June 5, 2017; and

7. a Solar Tariff Generation Unit that can demonstrate to the Department's satisfaction that it should be granted an exception to the provisions of 225 CMR 20.05(5)(f) for good cause.

(h) Capacity Expansions. Both direct current (DC) and alternating current (AC) capacity expansions to the capacity listed in a Solar Tariff Generation Unit's Statement of Qualification are not permitted except under the following circumstances:

1. a direct current capacity expansion to a Solar Tariff Generation Unit's rated capacity is permitted if the expansion occurs within a Solar Tariff Generation Unit's Reservation Period; and

2. direct current and alternating current capacity expansions following a Solar Tariff Generation's Commercial Operation Date may be allowed if the Solar Tariff Generation Unit can demonstrate to the Department's satisfaction that the expansion is *de minimis* and is required for equipment replacement or reconfiguration necessary to ensure the continued operation of the Solar Tariff Generation Unit.

(i) Special Provisions for Relocated and Replacement Generation Units. The Department may provide a Statement of Qualification to a solar photovoltaic Generation Unit that meets one of the following categories and criteria, as well as all other relevant provisions of 225 CMR 20.00:

1. Relocated Solar Tariff Generation Unit. A solar photovoltaic Generation Unit whose equipment was used before January 1, 2018, to generate electrical energy outside of the Commonwealth of Massachusetts, and that is interconnected with the electric grid in the service territory of a Distribution Company on or after January 1, 2018, provided that no components of the Power Conversion Technology were used in a Generation Unit located in the Commonwealth prior to January 1, 2018. No components from a Generation Unit previously qualified as an RPS Class I Renewable Generation Unit, Solar Carve-out Renewable Generation Unit, or Solar Carve-out II Renewable Generation Unit shall be eligible to qualify as part of a Solar Tariff Generation Unit.

2. Replacement Solar Tariff Generation Unit. A solar photovoltaic Generation Unit that replaces an inactive or decommissioned solar photovoltaic Generation Unit that had operated on the same site before January 1, 2018, subject to the following limitations:

a. No component of the existing Generation Unit was part of a Generation Unit qualified as a Solar Tariff Generation Unit;

b. No component of the existing Generation Unit was part of a Generation Unit qualified as an RPS Class I Renewable Generation Unit, an RPS Solar Carve-out Renewable Generation Unit, or a Solar Carve-out II Renewable Generation Unit.

c. The existing Generation Unit has been inactive for at least one year prior to the submission of the Statement of Qualification Application.

(j) Special Provisions for Distribution Company Owned Solar Photovoltaic Generation Units. Any solar photovoltaic Generation Unit that is owned by a Distribution Company and was approved to be constructed by the DPU, pursuant to M.G.L. c. 164, § 1A, shall not be eligible to qualify as a Solar Tariff Generation Unit under 225 CMR 20.00.

(6) Reporting Requirements.

(a) Generator Account Registration. An asset must be established for individual Solar Tariff Generation Units within a generator account at NEPOOL GIS. For Non-NEPOOL Generators, as that term is defined under Rule 2.1(a)(vi) of the *NEPOOL GIS Operating Rules*, multiple Solar Tariff Generation Units may be registered under a single asset.

(b) Settlement Market System Assets. The electrical energy output from a Solar Tariff Generation Unit registered as a NEPOOL Generator, as that term is defined under Rule 2.1(a)(i) of the *NEPOOL GIS Operating Rules*, shall be verified by the ISO-NE.

20.05: continued

(c) Non-NEPOOL Market Assets. The electrical energy output from a Solar Tariff Generation Unit registered as a Non-NEPOOL Generator, as that term is defined under Rule 2.1(a)(ii) of the *NEPOOL GIS Operating Rules*, shall be reported to the Independent Verifier, as approved by the Department, for all such assets.

(d) Duration of Distribution Company Asset Ownership. A Distribution Company shall retain the asset ownership and rights to all RPS Class I Renewable Generation Attributes associated with a Solar Tariff Generation Unit registered in a Distribution Company's NEPOOL GIS generator account for as long as the Solar Tariff Generation Unit is eligible to receive payment for such RPS Class I Renewable Generation Attributes and any Environmental Attributes as prescribed in 225 CMR 20.07(1). Following this period, ownership rights to assets and the RPS Class I Renewable Generation Attributes, and any other Environmental Attributes that a Solar Tariff Generation Unit generates, will be owned by the Solar Tariff Generation Unit Owner.

20.06: Qualification and Block Reservation Process for Solar Tariff Generation Units

(1) Statement of Qualification Application. A Statement of Qualification Application shall be submitted to the Solar Program Administrator by the Owner of the prospective Solar Tariff Generation Unit or by the Authorized Agent of the Owner. The applicant must use the most current forms and associated instructions provided by the Department, and must include all information, documentation, and assurances required by such forms and instructions.

(a) Authorization to Interconnect. In order to retain a Statement of Qualification issued prior to a project's Commercial Operation Date, all Solar Tariff Generation Units must provide the Solar Program Administrator with a copy of the authorization to interconnect issued by the applicable Distribution Company.

(b) Required Documentation for Solar Tariff Generation Units with Rated Capacities of 25 kW or Less. A prospective Solar Tariff Generation Unit with a capacity of 25 kW or less must submit the following documentation as part of its Statement of Qualification Application in order to obtain a Statement of Qualification:

1. Executed Contract. The Owner or their Authorized Agent must submit a copy of an executed contract between the Primary Installer and the Customer of Record. For a Solar Tariff Generation Unit for which the Owner is a Third-party Owner and the Primary Installer is a subcontractor to the Owner, an executed contract between the Owner and the Primary Installer will satisfy this requirement. The contract must identify a project manager, and must include Statement of Qualification Application preparation, equipment procurement and installation, site preparation, permitting and interconnection support, Statement of Qualification Application completion paperwork, training, operations and maintenance, and compliance with all applicable state and local laws. The contract shall include a budget that identifies key project components and a timeline and corresponding payment schedule for installation of the project. Contract service must include responsibility for the Statement of Qualification Application process including submittal of authorization to interconnect, securing required permits and engineering approvals, installation of the project, scheduling and participation in all required inspections, and providing warranty services, as required.

2. Special Provisions for Third-party Ownership. If the Owner of a Solar Tariff Generation Unit is a Third-party Owner, the Owner or his or her Authorized Agent must also submit a copy of an executed contract power purchase agreement or lease with the Customer of Record.

3. Special Provisions for Low Income Generation Units. Prospective Solar Tariff Generation Units with capacities less than or equal to 25 kW that are seeking Statements of Qualification as Low Income Generation Units must provide evidence that the Customer of Record is classified as a Low Income Customer by the Distribution Company.

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4. Customer Disclosure Form. Prospective Solar Tariff Generation Units with a capacity of 25 kW or less must submit a copy of a customer disclosure form signed by the Owner as part of its Statement of Qualification Application. The customer disclosure form will be developed by the Department to provide consumer information including, but not limited to, contract pricing for the length of the agreement, complete system cost information, operation and maintenance responsibilities, disposition of associated RECs and tariff terms, and anticipated production. If the Solar Tariff Generation Unit Owner is a Third-party Owner, the form must be signed by the Customer of Record.

(c) Required Documentation for Solar Tariff Generation Units with Rated Capacities Larger than 25 kW. All Generation Units with a capacity larger than 25 kW must provide evidence of the following in order to obtain a Statement of Qualification:

1. an executed Interconnection Service Agreement, as tendered by the Distribution Company;
2. demonstrate a sufficient interest in real estate or other contractual right to construct the Solar Tariff Generation Unit at the location specified in the Interconnection Service Agreement; and
3. all necessary governmental permits and approvals to construct the Solar Tariff Generation Unit with the exception of ministerial permits, such as a building permit, and notwithstanding any pending legal challenge(s) to one or more permits or approvals.

(d) Special Provisions for Agricultural Solar Tariff Generation Units. In order to qualify as an Agricultural Solar Tariff Generation Unit, a Solar Tariff Generation Unit must submit documentation itemized in 225 CMR 20.06(1)(d). All final determinations regarding the eligibility of such facilities will be made by the Department, in consultation with MDAR. An Agricultural Solar Tariff Generation Unit must also submit satisfactory documentation to the Department as detailed in the Department's *Guideline Regarding the Definition of Agricultural Solar Tariff Generation Units*.

1. the Solar Tariff Generation Unit will not interfere with the continued use of the land beneath the canopy for agricultural purposes;
2. the Solar Tariff Generation Unit is designed to optimize a balance between the generation of electricity and the agricultural productive capacity of the soils beneath;
3. the Solar Tariff Generation Unit is a raised structure allowing for continuous growth of crops underneath the solar photovoltaic modules, with height enough for labor and/or machinery as it relates to tilling, cultivating, soil amendments, harvesting, *etc*. and grazing animals;
4. crop(s) to be grown to be provided by the farmer or farm agronomist in conjunction with UMass Amherst agricultural extension services, including compatibility with the design of the agricultural solar system for such factors as crop selection, sunlight percentage, *etc*.;
5. annual reporting to the Department and MDAR of the productivity of the crop(s) and herd, including pounds harvested and/or grazed, herd size growth, success of the crop, potential changes, *etc*., shall be provided after project implementation and throughout the SMART incentive period; and
6. other system design information, which shall include, but not be limited to:
   a. dual-use type, *e.g*., ground mount racking, pole towers, tracking, *etc*.;
   b. total gross acres of open farmland to be integrated with the project;
   c. type of crop(s) to be grown, including grazing crops;
   d. pounds of crop(s) projected to be grown and harvested, or grazed;
   e. animals to be grazed with herd size(s); and
   f. design drawing including mounting system type (fixed, tracking), panel tilt, panel row spacing, individual panel spacing, for pole tower spacing and mounting height, *etc*.

(e) Special Provisions for Energy Storage Systems. Solar Tariff Generation Units co-located with an Energy Storage System will be eligible to receive an energy storage adder under 225 CMR 20.07(4)(c), provided it meets the following eligibility criteria:

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1. Minimum and Maximum Nominal Rated Power. The nominal rated power capacity of the Energy Storage System paired with the Solar Tariff Generation Unit must be at least 25%. The nominal rated power capacity of the Energy Storage System paired with the Solar Tariff Generation Unit may be more than 100% of the rated capacity, as measured in direct current, of the Solar Tariff Generation Unit, but the Solar Tariff Generation Unit will receive credit for no nominal rated power capacity greater than 100% in the calculation of its Energy Storage Adder, pursuant to 225 CMR 20.07(4)(c).

2. Minimum and Maximum Nominal Useful Energy. The nominal useful energy capacity of the Energy Storage System paired with the Solar Tariff Generation Unit must be at least two hours. The nominal useful energy capacity of the Energy Storage System paired with the Solar Tariff Generation Unit may be more than six hours, but the Solar Tariff Generation Unit will receive credit for no nominal useful energy capacity greater than six hours in the calculation of its Energy Storage Adder, pursuant to 225 CMR 20.07(4)(c).

3. Minimum Efficiency Requirement. The Energy Storage System paired with the Solar Tariff Generation Unit must have at least a 65% round trip efficiency in normal operation.

4. Data Provision Requirements. The Owner of the Energy Storage System must provide historical 15-minute interval performance data to the Solar Program Administrator for the first year of operation and upon request for the first five years of operation.

5. Operational Requirements. The Energy Storage System must discharge at least 52 complete cycle equivalents per year and must remain functional and operational in order for the Solar Tariff Generation Unit to continue to be eligible for the energy storage adder. If the Energy Storage System is decommissioned or non-functional for more than 15% of any 12-month period, the Department may disqualify the Solar Tariff Generation Unit from continuing to receive the energy storage adder.

(f) Special Provisions for Low Income Community Shared Solar Tariff Generation Units. In order to qualify as a Low Income Community Shared Solar Tariff Generation Unit, a Solar Tariff Generation Unit must submit satisfactory documentation to the Department as detailed in the Department's *Guideline Regarding Low Income Generation Units*. Additionally, the Owner or Authorized Agent of a prospective Low Income Community Shared Solar Tariff Generation Unit must submit a copy of a customer disclosure form signed by each Customer of Record receiving electricity or bill credits generated by the Low Income Community Shared Solar Tariff Generation Unit as part of its Statement of Qualification Application. The customer disclosure form will be developed by the Department to provide consumer information including, but not limited to, contract pricing for the length of the agreement, complete system cost information, operation and maintenance responsibilities, disposition of associated RECs and tariff terms, and anticipated production. The Low Income Community Shared Solar Tariff Generation Unit Owner or Authorized Agent must provide updated customer disclosure forms for any new Customers of Record that receive electricity or bill credits generated by the Low Income Community Shared Solar Tariff Generation Unit after it is granted its Statement of Qualification. These updates must be provided annually by no later than December 31st.

(g) Special Provisions for Low Income Property Generation Units. In order to qualify as a Low Income Property Generation Unit, a Solar Tariff Generation Unit must submit satisfactory documentation to the Department as detailed in the Department's *Guideline Regarding Low Income Generation Units*.

(h) Special Provisions for Community Shared Solar Tariff Generation Units. The Owner or Authorized Agent of a prospective Community Shared Solar Tariff Generation Unit must submit a copy of a customer disclosure form signed by each Customer of Record receiving electricity or bill credits generated by the Community Shared Solar Tariff Generation Unit as part of its Statement of Qualification Application. The customer disclosure form will be developed by the Department to provide consumer information including, but not limited to, contract pricing for the length of the agreement, complete system cost information, operation and maintenance responsibilities, disposition of associated RECs and tariff terms, and anticipated production. The Community Shared Solar Tariff Generation Unit Owner or Authorized Agent must provide updated customer disclosure forms for any new Customers of Record that receive electricity or bill credits generated by the Community Shared Solar Tariff Generation Unit after it is granted its Statement of Qualification. These updates must be provided at least annually by no later than December 31st.

20.06: continued

(i) Special Provisions for Floating Solar Tariff Generation Units. In order to qualify as a Floating Solar Tariff Generation Unit, a Solar Tariff Generation Unit must submit documentation itemized in 225 CMR 20.06(1)(i). All final determinations regarding the eligibility of such facilities will be made by the Department, in consultation with MassDEP and the Massachusetts Department of Fish and Game, or other state agencies as necessary.

1. the Solar Tariff Generation Unit will not interfere with the continued use of the water body for its designed purposes;
2. the racking system shall be made of materials that have been tested for water quality impact;
3. the Solar Tariff Generation Unit will not be permitted in wetland resource areas and natural waterbodies such as salt ponds, or freshwater lakes and great ponds, as defined in M.G.L. c. 91;
4. the ratio of the total surface area covered by the Floating Solar Tariff Generating Unit divided by the total surface area of the water body under standard conditions shall not exceed 50%;
5. the Solar Tariff Generation Unit shall be designed to minimize potential interaction with native species;
6. the Solar Tariff Generation Unit is a floating structure allowing for continued use and maintenance of the water body while generating electricity; and
7. other system design information, which shall include, but not be limited to:
   a. total gross acres of open water to be integrated with the project;
   b. designated function of water body;
   c. anchoring system design and materials; and
   d. design drawing including mounting system type, panel tilt, panel row spacing, individual panel spacing, *etc.*

(2) Application Review Procedures.

(a) The Solar Program Administrator will notify the applicant when the Statement of Qualification Application is administratively complete or if additional information is required pursuant to 225 CMR 20.06(2).

(b) The Department may, at its sole discretion, provide an opportunity for public comment on any Statement of Qualification Application.

(3) Issuance or Non-issuance of a Statement of Qualification.

(a) If the Department finds that a Generation Unit meets the requirements for eligibility as a Solar Tariff Generation Unit pursuant to 225 CMR 20.00, the Solar Program Administrator will provide the Owner of such Unit or the Authorized Agent of the Owner with a Statement of Qualification.

(b) The Statement of Qualification shall include any applicable restrictions and conditions that the Department deems necessary to ensure compliance by a particular Solar Tariff Generation Unit with the provisions of 225 CMR 20.00.

(c) If a Generation Unit does not meet the requirements for eligibility as a Solar Tariff Generation Unit under 225 CMR 20.00, the Solar Program Administrator shall provide written notice to the Owner or to the Authorized Agent of the Owner, including the reasons for such finding.

(4) RPS Effective Date. The RPS Effective Date shall be the earliest date on or after the Commercial Operation Date on which electrical energy output of a Solar Tariff Generation Unit can result in the creation of RPS Class I Renewable Generation Attributes.

(5) Notification Requirements for Change in Eligibility Status. The Owner or Authorized Agent of a Solar Tariff Generation Unit shall notify the Solar Program Administrator of any changes that may affect the continued eligibility of the Generation Unit as a Solar Tariff Generation Unit. The Owner or Authorized Agent shall submit the notification to the Solar Program Administrator no later than five days following the end of the month during which such changes were implemented. The notice shall state the date the changes were made to the Solar Tariff Generation Unit and describe the changes in sufficient detail to enable the Solar Program Administrator and the Department to determine if a change in eligibility is warranted.

20.06: continued

(6) Notification Requirements for Change in Ownership, Generation Capacity, or Contact Information. The Owner or Authorized Agent of a Solar Tariff Generation Unit shall notify the Solar Program Administrator of any changes in the ownership, capacity, or contact information for the Solar Tariff Generation Unit. The Owner or Authorized Agent shall submit the notification to the Solar Program Administrator no later than five days following the end of the month during which such changes were implemented.

(7) Statement of Qualification Reservation Period. A Solar Tariff Generation Unit may retain its Statement of Qualification pursuant to the procedures set forth in the *Statement of Qualification Reservation Period Guideline*.

20.07: Compensation Rates

(1) Length of Compensation Rate Terms. All Solar Tariff Generation Units with capacities larger than 25 kW AC will be eligible to receive compensation under 225 CMR 20.00 for 20 years from the Solar Tariff Generation Unit's RPS Effective Date. All Solar Tariff Generation Units with capacities less than or equal to 25 kW AC will be eligible to receive compensation under 225 CMR 20.00 for ten years from the Solar Tariff Generation Unit's RPS Effective Date.

(2) Schedule of Base Compensation Rates and Compensation Rate Adders. Following the first Capacity Block, all Base Compensation Rates will decline by 4% per Capacity Block, with Base Compensation Rates in each Capacity Block being established at exactly 4% less than the Base Compensation Rate in the previous Capacity Block. Each Compensation Rate Adder will decline by 4% for every tranche of capacity established by the Department. The first tranche of capacity available to each adder shall be 80 MW, with the Department establishing the sizes of additional tranches as they are filled. Compensation Rate Adders in each additional tranche will be exactly 4% less than the Compensation Rate Adder available in the previous tranche. A schedule of such rates and the progress towards filling Capacity Blocks and reductions in Compensation Rate Adders shall be published on the Department's and Solar Program Administrator's websites. If a Distribution Company is eligible to have fewer Capacity Blocks and elects to do so, it may also establish a steeper rate of decline for Base Compensation Rates, which must be approved by the Department and shall yield a similar overall rate of decline as if the Distribution Company had elected to have eight Capacity Blocks.

(3) Base Compensation Rates. Initial Base Compensation Rates shall be established as follows:

(a) One-time Competitive Procurement for Proposed Solar Tariff Generation Units sized between 1 MW AC and 5 MW AC. Each Distribution Company shall concurrently issue competitive solicitations of Solar Tariff Generation Units sized 1 MW to 5 MW, collectively seeking approximately 100 MW statewide. The Distribution Companies will individually procure energy, RPS Class I Renewable Generation Attributes, and any Environmental Attributes associated with the solar photovoltaic generation produced by the Solar Tariff Generation Units, provided, however, that compensation for energy will be established and paid pursuant to tariffs approved by the DPU under 220 CMR 8.00: *Sales of Electricity by Qualifying Facilities and On-site Generating Facilities to Distribution Companies, and Sales of Electricity by Distribution Companies to Qualifying Facilities and On-site Generating Facilities*.

1. Schedule for Procurement. A request for proposals to conduct the competitive procurement must be developed by the Distribution Companies, in consultation with the Department, subject to DPU approval, if necessary, no later than October 24, 2017. Once issued by the Distribution Companies, the request for proposals shall remain open for 15 Business Days and proposals submitted by Owners or their Authorized Agents shall be reviewed in consultation with the Department. A bidder conference to address any questions surrounding the request for proposals shall be held by the Distribution Companies no later than 10 Business Days before the deadline to submit proposals. Final decisions on proposal selection shall be made within 25 Business Days of the close of the request for proposals.

2. Eligibility Criteria. Solar Tariff Generation Units that participate in the procurement shall:

20.07: continued

a. seek a Base Compensation Rate not to exceed the Ceiling Prices established in 225 CMR 20.07(3)(a)4.;
b. not be eligible to receive Compensation Rate Adders under 225 CMR 20.07(4);
c. be a Non-net Metered Generation Unit;
d. provide an executed Interconnection Service Agreement, as tendered by the Distribution Company;
e. demonstrate a sufficient interest in real estate or other contractual right to construct the Generation Unit at the location specified in the Interconnection Service Agreement;
f. provide all necessary governmental permits and approvals to construct the Solar Tariff Generation Unit with the exception of ministerial permits, such as a building permit, and notwithstanding any pending legal challenge(s) to one or more permits or approvals;
g. meet all other applicable eligibility criteria in 225 CMR 20.00;
h. certify that if selected, they will not be eligible to withdraw their proposal and reapply under a Capacity Block until 800 MW of Solar Tariff Generation Units have received a Statement of Qualification under 225 CMR 20.00;
i. provide a performance guarantee deposit at the time of bid submittal to the Distribution Company or the Solar Program Administrator, the amount and parameters of which shall be established in consultation with the Department, but which shall not exceed $25 per kW of capacity. Any Generation Unit that is not selected or declines an award shall have its deposit refunded. Additionally, any Solar Tariff Generation Unit that is selected and chooses to move forward shall have its deposit refunded provided it is constructed within 12 months of the SMART Program Effective Date;
j. certify that the Solar Tariff Generation Unit is bidding independently and has no knowledge of non-public information associated with a proposal being submitted by another party in response to the request for proposals other than a response submitted by an affiliate of that bidder or for a project in which that bidder is also a project proponent or participant; and
k. comply with other price and non-price eligibility threshold criteria as required by the Distribution Companies in their request for proposals, developed in consultation with the Department.

3. Review Criteria. All proposals must demonstrate that the Solar Tariff Generation Unit(s) will meet all eligibility criteria to receive a Statement of Qualification under 225 CMR 20.05(5)(a) and (e) and meet the eligibility criteria set forth in 225 CMR 20.07(3)(a)2.

4. Ceiling Prices. Proposals submitted by Owners or their Authorized Agents under the request for proposals shall not be considered eligible for consideration if they request a Base Compensation Rate higher than the Ceiling Price for their applicable size category. For Solar Tariff Generation Units with a capacity between 1 MW and 5 MW, the Ceiling Price shall be $0.17 per kWh.

5. Selection Process. Proposals that meet the eligibility criteria in 225 CMR 20.07(3)(a)2. shall be ranked by requested Base Compensation Rate, with proposals requesting lower Base Compensation Rates being given preference over those requesting higher Base Compensation Rates. After proposals have been ranked by price, each Distribution Company shall select any eligible proposals up to the amount of MW being solicited by the Distribution Company, which will be eligible to receive a Base Compensation Rate equal to the Clearing Price.

6. Greenfield Subtractors. A Solar Tariff Generation Unit selected under the procurement will have a Greenfield Subtractor, as established in 225 CMR 20.07(4)(f), applied to its Base Compensation Rate, if applicable.

7. Post Selection Requirements. In order to be eligible to receive compensation following the procurement, Solar Tariff Generation Units with selected proposals that were previously qualified as Solar Carve-out II Renewable Generation Units must notify the Department of the Solar Carve-out II Renewable Generation Unit's forfeiture of its RPS Class I Statement of Qualification within 15 days of selection.

20.07: continued

8. Clearing Price. The Clearing Price for Solar Tariff Generation Units with capacities between 1 MW and 5 MW shall be equal to the highest requested Base Compensation Rate among the selected proposals and shall be established separately for each Distribution Company. A Clearing Price may not exceed the Ceiling Prices established in 225 CMR 20.07(3)(a)4.

9. Proportional Allotment. Each Distribution Company shall solicit for an amount of capacity up to or equal to one half of its first Capacity Block, as established pursuant to 225 CMR 20.05(3).

10. Confidentiality. The Distribution Company and the Department, to the extent authorized by law, will treat all proposals received from prospective Solar Tariff Generation Units in a confidential manner and will use reasonable efforts, except as required by law, not to disclose such information to any third party or use such information for any purpose other than in connection with the evaluation of a Solar Tariff Generation Unit's participation in the procurement process described in 225 CMR 20.07(3).

11. Payment and Cost Recovery. All Solar Tariff Generation Units selected *via* the procurement process shall only be eligible to receive compensation from the Distribution Companies subject to DPU and any other appropriate jurisdictional regulatory bodies' approval of a tariff.

12. Termination of Solicitation. If the Department, in consultation with the Distribution Companies, determines that reasonable proposals were not received or that the solicitation was not competitive, the Department may terminate the solicitation, and may require additional solicitations or administratively set a clearing price and initial Base Compensation Rate to fulfill the requirements of 225 CMR 20.07(3)(a).

13. Additional Solicitation Parameters. If the Department terminates the solicitation and chooses to issue a new solicitation, pursuant to 225 CMR 20.07(3)(a)12., any subsequent solicitation may rank proposals using a different methodology and establish a clearing price and weighted average clearing price differently than the processes outlined in 225 CMR 20.07(3)(a)8. and 20.07(3)(b). Such methodologies shall be included in any subsequent request for proposals issued by the Distribution Companies, in consultation with the Department.

14. Unallocated Capacity. Should a Distribution Company not procure the full amount of capacity it must solicit, as described in 225 CMR 20.07(3)(a)9., the Department may allocate any remaining capacity to a future Capacity Block.

15. Miscellaneous. Other requirements, procedures, and eligibility criteria may be specified by the Distribution Companies in their requests for proposals, as developed in consultation with the Department.

(b) Block 1 Base Compensation Rates. For the purposes of establishing Base Compensation Rates for each Distribution Company under the Capacity Blocks established in 225 CMR 20.05(3), the Department shall calculate the mean price of all proposals selected in a Distribution Company's service territory under the competitive procurement process in 225 CMR 20.07(3)(a). This average price shall be the Base Compensation Rate for all projects that receive a Statement of Qualification under the first Capacity Block in a Distribution Company's service territory. If a Distribution Company receives insufficient bids for the Department to calculate a mean price for its service territory, the Department may require additional solicitations or administratively set the Base Compensation Rate for its first Capacity Block.

(c) Indices for Solar Tariff Generation Units equal to or less than one MW AC. Initial Base Compensation Rates for Solar Tariff Generation Units with capacities equal to or less than one MW AC will be established by multiplying the Block 1 Base Compensation Rate established under 225 CMR 20.07(3)(b) by the percentages in the following table:

20.07: continued

Generation Unit Capacity	Base Compensation Rate Factor (% of Block 1 Base Compensation Rate)
Low Income Solar Tariff Generation Units less than or equal to 25 kW AC	230%
Less than or equal to 25 kW AC	200%
Greater than 25 kW AC to 250 kW AC	150%
Greater than 250 kW AC to 500 kW AC	125%
Greater than 500 kW AC to 1,000 kW AC	110%

(4) Compensation Rate Adders.

(a) Location Based Adders. Initial Location Based Adder Rates shall be established as follows:

Generation Unit Type	Adder Value ($/kWh)
Building Mounted Solar Tariff Generation Unit	$0.02
Floating Solar Tariff Generation Unit	$0.03
Solar Tariff Generation Unit on a Brownfield	$0.03
Solar Tariff Generation Unit on an Eligible Landfill	$0.04
Canopy Solar Tariff Generation Unit	$0.06
Agricultural Solar Tariff Generation Unit	$0.06

(b) Off-taker Based Adders. Initial Off-taker Based Adder Rates shall be established as follows:

Generation Unit Type	Adder Value ($/kWh)
Community Shared Solar Tariff Generation Unit	$0.05
Low Income Property Solar Tariff Generation Unit	$0.03
Low Income Community Shared Solar Tariff Generation Unit	$0.06
Public Entity Solar Tariff Generation Unit	$0.02

(c) Energy Storage Adder. A Solar Tariff Generation Unit that co-locates with an Energy Storage System shall be eligible to receive a variable adder to its Base Compensation Rate.

1. Energy Storage Adder Multiplier. The energy storage adder multiplier shall be $0.045/kWh and shall decline pursuant to 225 CMR 20.07(2).

2. Energy Storage Adder Formula. The variable energy storage adder for Solar Tariff Generation Units paired with Energy Storage Systems that meet the requirements of 225 CMR 20.06(1)(e) will be calculated using the following formula:

$$\text{Energy Storage Adder} = \left[\frac{\left(\frac{\text{Nominal Rated Power Capacity of Energy Storage System}}{\text{DC Rated Capacity of the Solar Photovoltaic System}}\right)}{\left(\left(\frac{\text{Nominal Rated Power Capacity of Energy Storage System}}{\text{DC Rated Capacity of the Solar Photovoltaic System}}\right) + \exp\left(0.7 - \left(8 * \left(\frac{\text{Nominal Rated Power Capacity of Energy Storage System}}{\text{DC Rated Capacity of the Solar Photovoltaic System}}\right)\right)\right)\right)}\right] * \left[0.8 + \left(0.5 * \ln\left(\frac{\text{Nominal Rated Useful Energy of the Energy Storage System}}{\text{Nominal Rated Power Capacity of Energy Storage System}}\right)\right)\right] * \text{Energy Storage Adder Multiplier}$$

20.07: continued

The Department shall publish a Guideline on Energy Storage that provides an Energy Storage Adder calculator and explains the parameters of 225 CMR 20.07(4)(c) and the formula in 225 CMR 20.07(4)(c)2.

(d) Solar Tracking Adder. A Solar Tariff Generation Unit that follows the path of the sun to maximize the solar radiation incident on the PV surface with a two-axis array that points the system directly at the sun at all times and is designed to maximize possible daily energy shall be eligible to receive an additional $0.01/kWh Compensation Rate Adder.

(e) Combining Base Compensation Rates and Compensation Rate Adders.

1. A Solar Tariff Generation Unit with a capacity of 25 kW AC or less may only combine its Base Compensation Rate with the Energy Storage Adder, provided it meets the eligibility criteria in 225 CMR 20.06(1)(e). A Solar Tariff Generation Unit with a capacity larger than 25 kW AC can combine its Base Compensation Rate with no more than one Compensation Rate Adder from each of the four categories listed in 225 CMR 20.07(4)(a) through (d), provided it meets the eligibility criteria to qualify for each of the Compensation Rate Adders.

2. For Solar Tariff Generation Units with a capacity of greater than 25 kW AC, no combination of a Base Compensation Rate and Compensation Rate Adders can exceed the Base Compensation Rate for Low Income Solar Tariff Generation Units less than or equal to 25 kW AC established under 225 CMR 20.07(3)(b).

(f) Greenfield Subtractors. A Solar Tariff Generation Unit that is classified as Category 2 Land Use or Category 3 Land Use, as prescribed in 225 CMR 20.05(5)(e)2. or 3., shall have value subtracted from its all-in Compensation Rate as follows:

1. Category 2 Land Use Solar Tariff Generation Units. A Solar Tariff Generation Unit that is classified as a Category 2 Land Use, as prescribed in 225 CMR 20.05(5)(e)2., shall have its Base Compensation Rate reduced by a Greenfield Subtractor of $0.0005/kWh per acre of land that the Solar Tariff Generation Unit occupies.

2. Category 3 Land Use Solar Tariff Generation Units. A Solar Tariff Generation Unit that is classified as a Category 3 Land Use, as prescribed in 225 CMR 20.05(5)(e)3., shall have its Base Compensation Rate reduced by a Greenfield Subtractor of $0.001/kWh per acre of land that the Solar Tariff Generation Unit occupies.

3. Exceptions to Greenfield Subtractors. A Solar Tariff Generation Unit that is classified as Category 2 Land Use or Category 3 Land Use, as prescribed in 225 CMR 20.05(5)(e)2. or 3., shall not have its Base Compensation Rate reduced by a Greenfield Subtractor, as prescribed in 225 CMR 20.07(4)(f), if it can be demonstrated to the Department's satisfaction that:

a. documentation required to meet the criteria set forth in 225 CMR 20.06(1)(c) was obtained prior to June 5, 2017; or

b. it should be granted an exception to the provisions of 225 CMR 20.07(4)(f) for good cause.

4. Determination of Acreage of Land Occupied. For the purposes of 225 CMR 20.07(4)(f)1. and 2., the acreage of land that a Solar Tariff Generation Unit occupies shall be determined by calculating the square footage occupied by the solar photovoltaic modules that are part of the Solar Tariff Generation Unit.

(5) Review of Compensation Rates. Upon issuing Statements of Qualification for 400 MW of Solar Tariff Generation Units, the Department will conduct a review of the Base Compensation Rates, Compensation Rate Adders, and overall cost impact to ratepayers to determine if any revisions to the SMART Program are necessary.

20.08: Calculation of Incentive Payments for Solar Tariff Generation Units

(1) Calculation of Incentive Payments for Standalone Solar Tariff Generation Units. Any payments provided to the Owner of a Standalone Solar Tariff Generation Unit, which meets the criteria of 225 CMR 20.08(1)(a) or (b), will be equal to total of the Solar Tariff Generation Unit's Base Compensation Rate plus any Compensation Rate Adders minus any Greenfield Subtractor, multiplied by the total kWh generated by the Solar Tariff Generation Unit in the Distribution Company billing period, minus the value of the energy generated by the Solar Tariff Generation Unit in a Distribution Company billing period.

20.08: continued

Solar Incentive Payment
= (Base Compensation Rat e+ Compensation Rate Adders
– Greenfield Subtractor) *t otal kWh generated
– value of energy generated

(a) Value of Energy Generated for Standalone Solar Tariff Generation Units Receiving Bill Credits. The methodology for calculating the value of the energy generated by a Standalone Solar Tariff Generation Unit that receives a bill credit is dependent on whether it is qualified as a Net Metered Generation Unit or as an Alternative On-bill Credit Generation Unit and will be determined as follows:

1. Net Metered Generation Unit. The value of energy for a Net Metered Generation Unit shall be equal to the total kWh generated during a utility billing period multiplied by the Solar Tariff Generation Unit's applicable net metering credit, as established in M.G.L. c. 164, § 138.

Net Metered Generation Unit Energy Value
= total kWh Generated * net metering credit rate

2. Alternative On-bill Credit Generation Unit. The value of energy for an Alternative On-bill Credit Generation Unit shall be equal to the total kWh generated during a utility billing period multiplied by the Solar Tariff Generation Unit's applicable credit value under its applicable tariff structure.

Alternative On-bill Credit Generation Unit energy value
= total kWh generated * energy compensation rate

(b) Value of Energy Generated for Non-net Metered Generation Units. The value of energy for a Non-net Metered Generation Unit shall be equal to its total compensation received from a Distribution Company as a State Qualifying Facility under 220 CMR 8.00: *Sales of Electricity by Qualifying Facilities and On-site Generating Facilities to Distribution Companies, and Sales of Electricity by Distribution Companies to Qualifying Facilities and On-site Generating Facilities*.

Non-net Metered Generation Unit energy value
= total kWh generated * State Qualifying Facility value

(2) Calculation of Incentive Payments for Behind-the-meter Solar Tariff Generation Unit. Payments provided to the Owner of a Behind-the-Meter Solar Tariff Generation Unit by a Distribution Company for RPS Class I Renewable Generation Attributes and Environmental Attributes will be fixed at the point in time that a Solar Tariff Generation Unit receives its Statement of Qualification for the duration that the Solar Tariff Generation Unit is eligible under 225 CMR 20.00 and shall be equal to the total Solar Tariff Generation Unit's Base Compensation Rate plus any Compensation Rate Adders minus any Greenfield Subtractor, multiplied by the total kWh generated by the Solar Tariff Generation Unit in the utility billing period, minus the sum of the Owner's current distribution kWh charge, current transmission kWh charge, current transition kWh charge, and the average of the basic service kWh charge in the prior three calendar years, as of the Generation Unit's Commercial Operation Date.

Behind-the-meter Solar Tariff Generation Unit Compensation Rate
= (Capacity Based Rate + Compensation Rate Adders
– Greenfield Subtractor)
– (distribution kWh charge
+ transmission kWh charge
+ transition kWh charge
+ three year average of basic service kWh charge)

20.09: Solar Program Administrator

The Department shall determine if it is necessary for the Distribution Companies to issue a request for proposals to procure an independent Solar Program Administrator that will be responsible for providing some or all of the following services by no later than July 5, 2017:

20.09: continued

(1) receiving Statement of Qualification Applications;

(2) coordinating with the Department and the Distribution Companies to issue Statements of Qualification to Solar Tariff Generation Units;

(3) coordinating, receiving, and reviewing the requests for proposals under 225 CMR 20.07(3)(a);

(4) acting as the Independent Verifier for all Non-NEPOOL Market Assets, pursuant to 225 CMR 20.05(6)(c); and

(5) any other duties prescribed in a request for proposals.

20.10: Inspection

(1) Document Inspection. The Department may audit the accuracy of all information submitted pursuant to 225 CMR 20.00. The Department may request and obtain from any Owner or Authorized Agent of a Solar Tariff Generation Unit, and from any Distribution Company information that the Department determines necessary to monitor compliance with and enforcement of 225 CMR 20.00.

(2) Audit and Site Inspection. Upon reasonable notice to a Solar Tariff Generation Unit Owner, or Authorized Agent, the Department may conduct audits, which may include inspection and copying of records and/or site visits to a Solar Tariff Generation Unit's facilities, including, but not limited to, all files and documents that the Department determines are related to compliance with 225 CMR 20.00.

20.11: Non-compliance

Any Distribution Company, Owner, or Authorized Agent of a Solar Tariff Generation Unit that fails to comply with the requirements of 225 CMR 20.00 and accompanying Guidelines shall be subject to the provisions in 225 CMR 20.11(1) through (3).

(1) Notice of Non-compliance. A failure to substantially comply with the requirements of 225 CMR 20.00 and accompanying Guidelines shall be determined by the Department on a case by case basis. A written Notice of Non-compliance shall be prepared and delivered by the Department to any Distribution Company, Owner, or Authorized Agent of an Solar Tariff Generation Unit that fails to comply with the requirements of 225 CMR 20.00, and to the DPU, as applicable. The Notice of Non-compliance shall describe the requirement(s) with which the Distribution Company, Owner, or Authorized Agent failed to comply and the time period of such non-compliance.

(2) Publication of Notice of Non-compliance. A Notice of Non-compliance may be published on the Department's website and in any other media deemed appropriate by the Department. Such publication may remain posted until the Distribution Company, Owner, or Authorized Agent returns to compliance as determined by the Department.

(3) Suspension or Revocation of Statement of Qualification. The Department may suspend or revoke a Statement of Qualification if the Owner of a Solar Tariff Generation Unit or Authorized Agent of the Owner fails to comply with any provisions in 225 CMR 20.00.

20.12: Severability

If any provision of 225 CMR 20.00 is declared invalid, such invalidity shall not affect other provisions or applications that can be given effect without the invalid provision or application.

REGULATORY AUTHORITY

225 CMR 20.00: St. 2016, c. 75, § 11 and M.G.L. c. 25A, § 6.

Appendix I: Utility Notifications

Utility Notification (Status)

0 Athol Rd – OYA Raman Solar Project

Case
5000 kw / new svce wr 25847661

+ Follow

Case Number	Status	Step
00178669	Study	Draft

✓ ✓ ✓ ✓ **Study** Conditional ... Completion ... Meter Instal... Connected

KEY FIELDS THIS STAGE

Status	Study
Step	Draft

GUIDANCE FOR THIS STAGE

FORMS ACTIVE MILESTONES ALL MILESTONES

MILESTONE ID	STATUS	TYPE OF DAY	START DATE	DUE DATE	END DATE
Application-Hold-Application Review Hold	Complete	Business Day	2018-03-20	2018-04-25	2018-04-02
Application-Draft	Complete	Calendar Day	2018-03-16	2018-06-14	2018-03-19
Application-Submitted	Complete	Business Day	2018-03-19	2018-04-13	2018-04-02
Screening-In Progress-Initial Review	Complete	Business Day	2018-05-24	2018-07-10	2018-05-31
Screening-Complete-Pending Customer Decision	Active	Business Day	2018-06-01	2018-07-06	

Appendix J: Site Control

SOLAR GROUND LEASE
SUMMARY OF KEY PROVISIONS

Lessor:	**RAVIKUMAR RAMANJANAPPA**
Lessee:	**OYA SOLAR NY, L.P.**
Address of the Land:	The land known as Property ID: 2550110005500050 located at 0 Athol Road, in the Town of Royalston, County of Worcester, MA 01368, consisting of approximately 35.96 Acres.
Construction Rent:	The Construction Rent is $92.71 per month per acre.
Base Rent:	[redacted]
Term:	The Term of this Agreement is 20 years from the Rent Commencement Date.
Initial Due Diligence Period and Fee:	[redacted]
First Extended Due Diligence Period and Fee:	[redacted]
Second Extended Due Diligence Period and Fee:	[redacted]
Extension Term:	Lessee is granted the option to extend the term of this Lease for four (4) successive additional terms of five (5) years each.
Improvements and Permitted Use:	Lessee may develop, construct, maintain, operate, and remove a ground-mounted, grid-connected solar photovoltaic power plant.
Preliminary Site Plan:	The Preliminary Site Plan, attached as Exhibit A to the Commencement Date Agreement, will show the preliminary location(s) of the ground-mounted solar photovoltaic power plant including the ingress, egress, and regress to the power plant from one or more public access points.
End of Term or Extension Term:	At the end of the Term or any Extension Term, Lessee will surrender the Premises and either (i) negotiate an additional extension with Lessor, (ii) grant Lessor the option to purchase its personal property, or (iii) remove all personal property from the Land.

This Summary of Key Provisions is for informational purposes only and is not a part of the Solar Ground Lease. The information provided herein should not be construed as legal advice. Please review the Solar Ground Lease in full and consult with your legal counsel.

Solar Ground Lease

This SOLAR GROUND LEASE, dated as of December, 28, 2017, between RAVIKUMAR RAMANJANAPPA, having an address at 878 Salem St, Apt 3, Malden, MA 02148, as lessor ("Lessor") and OYA Solar NY, L.P., a Delaware limited partnership, having offices at 144 Front Street West, Unit 310, Toronto, ON M5J 2L7, Canada as lessee (**"Lessee"**).

WITNESSETH:

WHEREAS, Lessor is the fee-simple owner of those certain parcels or tracts of ground located at 0 Athol Road, known as Property ID: 2550110005500050, in the Town of Royalston, County of Worcester, Massachusetts, 01368, with approximately 35.96 acres (all of which parcels or tracts of ground are referred to herein as the "**Land**").

WHEREAS, Lessee is a developer of solar photovoltaic electric generation systems in the State of Massachusetts;

WHEREAS, Lessee desires to develop, design, construct, install, operate and maintain a ground-mounted, grid-connected solar photovoltaic electricity generation system (the "**Improvements**" and the "**Generating Facility**") on a portion of the Land (the **"Premises"**);

WHEREAS, Lessor desires to lease the Premises to Lessee, and Lessee desires to lease the Premises from Lessor, to enable Lessee to develop the Improvements and Generating Facility on the Premises.

Article I: Basic Terms and Definitions

Section 1.01 Definitions. The following terms, as used in this Lease and in all amendments to the Lease (unless otherwise specified or unless the context otherwise requires), shall have the meanings set forth below:

(a) **Access Easement:** Has the meaning set forth in Section 2.09(b) and is further described in Exhibit 1-A attached hereto.

(b) **Affiliate:** Any Person that directly or indirectly controls, is controlled by, or is under common control with the designated Person or any officer, director, managing or general partner, or member of such designated Person.

(c) **Alterations:** Has the meaning set forth in Section 5.02.

(d) **Base Rent:** The base rent set forth in Exhibit 2 annexed hereto.

(e) **Business Days:** Monday through Friday, excluding holidays observed by the Commonwealth of Massachusetts, the federal government of the United States, and/or the labor unions servicing the Improvements and Generating Facility.

(f) **Commence Construction:** Physical work on the Premises of a significant nature.

(g) **Commencement Date:** The date Lessee Commences Construction on the Improvements and Generating Facility.

(h) **Comparison Area:** Has the meaning set forth in Section 8.01.

(i) **Construction Rent:** The construction rent set forth in Exhibit 2 annexed hereto.

(j) **Contested Obligation:** Has the meaning set forth in Section 6.03.

(k) **Crop Destruct Payment:** Has the meaning set forth in Section 2.07.

(l) **Customary:** With respect to a form of policy or amount of coverage or endorsement or other aspect of insurance, has the meaning set forth in Section 8.01.

(m) Due Diligence Period: Collectively, the Initial Due Diligence Period, the First Extended Due Diligence Period, and the Second Extended Due Diligence Period.

(n) Environmental Laws: Has the meaning set forth in Section 6.02.

(o) Event of Default: Has the meaning set forth in Section 14.01.

(p) Expiration Date: The last day of the month in which occurs the twentieth (20th) anniversary of the Rent Commencement Date, as same may be extended pursuant to Article XXIII.

(q) Extension Conditions: Has the meaning set forth in Section 23.01.

(r) Extension Notice: Has the meaning set forth in Section 23.01.

(s) Extension Option: Has the meaning set forth in Section 23.01.

(t) Extension Term: Has the meaning set forth in Section 23.01.

(u) Fee Lender: The holder of any Fee Mortgage.

(v) Fee Mortgage: Any mortgage, deed of trust, assignment of leases and rents, financing statement or other agreement or instrument, and all modifications, extensions, supplements, consolidations and replacements thereof that secures repayment of any indebtedness by the grant of a lien, security interest or other encumbrance on the fee estate of Lessor in the Land, and/or Lessor's interest in this Lease, whether executed before or after this Lease.

(w) Final Governmental Approval: Has the meaning set forth in Section 6.02.

(x) First Extended Due Diligence Period: The twelve (12) month period of time commencing from the expiration of the Initial Due Diligence Period.

(y) First Extended Due Diligence Period Fee: Has the meaning set forth in Exhibit 2.

(z) Full Replacement Cost: Has the meaning set forth in Section 8.02.

(aa) Generating Facility: Has the meaning set forth in Section 5.01.

(bb) Governmental Authority. Any federal, state, county, local, municipal or other governmental or regulatory authority, agency, board, department, bureau, body, commission, or instrumentality, or quasi-governmental authority, and any court, arbitrator, or other administrative, judicial or quasi-judicial tribunal, or any other public or quasi-public authority, having jurisdiction over the Land or the matter at issue.

(cc) Hazardous Substances: Has the meaning set forth in Section 6.02.

(dd) Impositions: Has the meaning set forth in Section 4.01.

(ee) Improvements: All solar and/or photovoltaic electric generating equipment including the Generating Facility (as defined below), and other improvements now located, or hereafter erected, on the Premises and the Land (where applicable), together with all fixtures now or in the future installed or erected in or upon the Premises and the Land or such improvements and owned or leased by Lessor or Lessee (including but not limited to lighting, fencing, solar panels, substations, mounting substrates or supports, wiring and connections, power inverters, service equipment, metering equipment and utility interconnections).

(ff) Including: "Including" means "including but not limited to." **"Includes"** means "includes without limitation."

(gg) Indemnified Parties: Lessee and Lessee's officers, directors, employees, partners, members, managers, representatives, contractors, invitees, Sublessees, and agents.

(hh) Initial Due Diligence Period: The twelve (12) month period of time commencing from the date this Lease is executed.

(ii) Initial Due Diligence Period Fee: Has the meaning set forth in Exhibit 2.

(jj) Institutional Lender: A savings and loan association, savings bank, commercial bank or trust company, insurance company, educational institution, welfare, pension or retirement fund or system, any other entity subject to supervision and regulation by the insurance or banking departments of the Commonwealth of Massachusetts or by a department or agency of the United States exercising similar functions (or any successor department or departments hereafter exercising the same functions as said departments), any governmental agency or entity insured by a governmental agency, a finance company, a private mortgage company, a conduit or pooled mortgage investment fund, a real estate investment trust, an investment bank, or any other lender generally considered an "institutional" real estate lender and which makes loans secured by real estate as an ordinary part of its business. Notwithstanding the foregoing, no Affiliate of Lessee shall be deemed an Institutional Lender.

(kk) Insurance Requirements: Any code, order, directive, recommendation, or requirement of any fire insurance rating body applicable to the Land.

(ll) Land: All that certain plot, piece or parcel of land located in the City/Village/Town of Royalston, County of Worcester, Commonwealth of Massachusetts.

(mm) Law: Any present or future law, statute, ordinance, regulation, code, judgment, injunction, arbitral award, order, rule, directive, proclamation, decree, common law or other requirement, ordinary or extraordinary, foreseen or unforeseen, of the Federal or any state or local government, or any political subdivision, arbitrator, department, commission, board, bureau, agency or instrumentality thereof, or of any court or other administrative, judicial or quasi-judicial tribunal or agency of competent jurisdiction, or of any other public or quasi-public authority or group, having jurisdiction over the Land; and any reciprocal easement, covenant, restriction, or other agreement, restriction or easement of record affecting the Land and the Premises as of the date of this Lease or subsequent thereto.

(nn) Leasehold Lender: Has the meaning set forth in Section 12.02.

(oo) Leasehold Security Interest: Has the meaning set forth in Section 12.02.

(pp) Legal Requirements: All requirements of Law.

(qq) Lenders: All Leasehold Lenders and all Fee Lenders.

(rr) Lessee Notice Address: 144 Front Street West, Unit 310, Toronto, ON M5J 2L7, Canada, or at such other address(es) as Lessee may, from time to time, designate by notice to Lessee given in the manner prescribed in this Lease.

(ss) Lessor Improvement: Has the meaning set forth in Section 2.09(a).

(tt) Lessor Notice Address: 878 Salem St, Apt 3, Malden, MA 02148, or at such other address(es) as Lessor may, from time to time, designate by notice to Lessee given in the manner prescribed in this Lease.

(uu) Lessor Parties: Lessor, Lessor's managing agent, and all of their Affiliates, officers, directors, shareholders, members, managers, partners, and employees.

(vv) Liabilities: All losses, claims, suits, demands, costs, liabilities, and expenses, including reasonable attorneys' fees, penalties, interest, fines, judgment amounts, fees, and damages, of whatever kind or nature.

(ww) Liability Policy: Has the meaning set forth in Section 8.02.

(xx) Material: With respect to Article VI, "Material" has the meaning set forth in Section 6.02.

(yy) Party Responsible for Transfer Taxes: Lessee.

(zz) Permitted Use: (i) The unobstructed and exclusive right to erect, construct, reconstruct, install, maintain and operate the Improvements and Generating Facility, and sell the electrical energy and ancillary services generated therefrom to a Person(s) of Lessee's choosing; (ii) the right to construct and maintain an electrical connection line from the solar photovoltaic electric generating equipment to a specified utility connection point or points; and (iii) without limitation, undertake any other activities that Lessee determines are necessary, helpful, appropriate, convenient, or incidental to accomplishing any of the foregoing Permitted Uses or for the benefit of the solar photovoltaic generating equipment, including but not limited to conducting surveys and environmental, engineering, mechanical, structural, biological, cultural, geotechnical and other tests and studies.

(aaa) Person: Any individual, corporation, partnership, firm or other legal entity.

(bbb) Personal Property: All furniture and other personal property owned or leased by Lessor or Lessee or any Affiliate of Lessor or Lessee, located upon the Land and the Premises and used in the operation of the Generating Facility and Improvements, excluding trucks and cars.

(ccc) Placed in Service: The first date where all of the following events have occurred with respect to the Improvements and Generating Facility: (a) the Improvements and Generating Facility have been installed, tested and shown capable of operating in a reliable and continuous manner for their intended purpose; (b) legal title to and control over the Improvements and the Generating Facility and all components thereof have been conveyed to Lessee; and (c) all licenses and permits needed to operate the Improvements and Generating Facility (including authority from the local utility to commence parallel operation) and to put the Improvements and Generating Facility to its intended use of using it to generate electricity have been obtained.

(ddd) Premises: That portion of the Land leased by Lessee from Lessor as further described in Exhibit 1 attached hereto, and all rights, privileges, easements, and appurtenances to the Premises and the Land (where applicable). References in this Lease to the "Premises" shall be construed as if followed by the phrase "or any part thereof" unless the context otherwise requires.

(eee) Property Damage Policy: Has the meaning set forth in Section 8.02.

(fff) Release: Has the meaning set forth in Section 6.02.

(ggg) Remedial Action: Has the meaning set forth in Section 6.02.

(hhh) Removal Period: The period of not less than the number of days between the Commencement Date and the Rent Commencement Date.

(iii) Renewable Energy Attributes: Has the meaning set forth in Section 5.06.

(jjj) Rent: The Construction Rent and/or the Base Rent.

(kkk) Rent Commencement Date: The date, after the Commencement Date that the Improvements and Generating Facility are Placed in Service.

(lll) Requirements: All applicable Legal Requirements and Insurance Requirements.

(mmm) Second Extended Due Diligence Period: The twelve (12) month period of time commencing from the expiration of the First Extended Due Diligence Period.

(nnn) Second Extended Due Diligence Period Fee: Has the meaning set forth in Exhibit 2.

(ooo) Site: Has the meaning set forth in Section 2.09(a).

(ppp) Solar Easement: Has the meaning set forth in Section 2.09(a).

(qqq) Sublease: Any lease, sublease, license or other agreement for the use or occupancy of space on the Premises (other than this Lease).

(rrr) "**Sublessee**" means any lessee, licensee or other occupant of the Premises (other than Lessee).

(sss) Tax Equity Investor: A Person(s) that either enters into a tax equity financing transaction with Lessee or makes an equity investment in Lessee to obtain ownership of, monetize, and/or benefit from the Renewable Energy Attributes.

(ttt) Term: Has the meaning set forth in Section 2.01.

(uuu) Transmission Easement: Has the meaning set forth in Section 2.09(c) and is further described in Exhibit 1-B attached hereto.

(vvv) Transmission Facilities: Has the meaning set forth in Section 5.01.

Article II. Lease of Property

Section 2.01 Grant of Lease. Subject to the terms and conditions of this Lease, Lessor leases to Lessee, and Lessee leases from Lessor, and Lessor grants and conveys unto Lessee, its successors and assigns, an exclusive and unobstructed license across, over, under, and above the Premises for a term that shall commence on the Commencement Date and end on the Expiration Date (as such term may be extended from time to time pursuant to Article XXIII) (the **"Term"**), subject to earlier termination pursuant to any of the terms, covenants, or conditions of this Lease or pursuant to Law.

Section 2.02 Due Diligence Period.

(a) Initial Due Diligence Period. The Initial Due Diligence Period shall commence on the date this Lease is executed. Within thirty (30) days after the effective date of this lease, Lessee shall pay to Lessor the Initial Due Diligence Period Fee as set forth in Exhibit 2. Lessor and Lessee acknowledge and agree that the Initial Due Diligence Period Fee has been bargained for and agreed to as consideration for the Initial Due Diligence Period, Lessee's right to terminate this Lease pursuant to Section 21.04, and for Lessor's execution and delivery of this Lease. Such consideration is in addition to and independent of all other consideration provided in this Lease, and is nonrefundable.

(b) First Extended Due Diligence Period. Lessee may extend the Initial Due Diligence Period by the First Extended Due Diligence Period by providing written notice to the Lessor at any time prior to the expiration of the Initial Due Diligence Period and by paying to the Lessor the First Extended Due Diligence Period Fee as set forth in Exhibit 2 within thirty (30) days after the expiration of the Initial Due Diligence Period. If Lessee does not elect to exercise the First Extended Due Diligence Period, the First Extended Due Diligence Period Fee shall not be payable to Lessor. If Lessee has exercised the First Extended Due Diligence Period and the Rent Commencement Date occurs prior to the end of the Extended Due Diligence Period, any unamortized portion of the First Extended Due Diligence Period Fee shall be applied against the Construction Rent payment or Base Rent payment, as the case may be.

(c) Second Extended Due Diligence Period. Lessee may extend the First Extended Due Diligence Period by the Second Extended Due Diligence Period by providing written notice to the Lessor at any time prior to the expiration of the First Extended Due Diligence Period and by paying to the Lessor the Second Extended Due Diligence Period Fee as set forth in Exhibit 2 within thirty (30) days after the expiration of the First Extended Due Diligence Period. If Lessee does not elect to exercise the Second Extended Due Diligence Period, the Second Extended Due Diligence Period Fee shall not be payable to Lessor. If Lessee has exercised the Second Extended Due Diligence Period and the Rent Commencement Date occurs prior to the end of the Second Extended Due Diligence Period, any unamortized portion of the Second Extended Due Diligence Period Fee shall be applied against the Construction Rent payment or Base Rent payment, as the case may be. If Lessee has exercised the Second Extended Due Diligence Period and the Rent Commencement Date occurs after to the end of the Second Extended Due Diligence Period,

provided a Commencement Date Agreement has been executed, Lessee shall pay to Lessor the Second Extended Due Diligence Period Fee per month until the occurrence of the Rent Commencement Date unless the Lease is terminated.

(d) Access During the Due Diligence Period. During the Due Diligence Period, Lessee (and its agents, representatives, consultants, and affiliates) shall be permitted access to the Premises at reasonable times and upon reasonable notice to Lessor, for purposes of conducting (at Lessee's expense) any and all investigations or testing of the Land and the Premises at Lessee may deem necessary, appropriate, or convenient. Lessee is hereby authorized to undertake direct discussions and/or negotiations with any Governmental Authority regarding the Land, the Premises, and the Permitted Use.

Section 2.03 Condition of the Land. Lessee has examined the Premises and accepts possession of the Premises in its "AS IS" condition on the Commencement Date. Except as otherwise expressly provided in this Lease, (a) Lessee has full responsibility for the condition, alteration, maintenance, management, repair, and replacement of the Premises, and (b) except as otherwise expressly provided in this Lease, Lessor has no obligation whatsoever to perform any work or make any repairs with respect to the Premises, to furnish any services with respect to the Premises, or to incur any expenses with respect to the Premises, and (c) except as otherwise expressly provided in this Lease, Lessor has no responsibility with respect to the condition of the Premises (including any latent defects). Lessee expressly acknowledges and agrees that Lessor has not made and is not making, and Lessee, in executing and delivering this Lease, is not relying upon, any warranties, representations, promises, or statements, except to the extent that the same are expressly set forth in this Lease. Without limiting the generality of the preceding provisions, Lessee, by taking possession of the Premises or any portion thereof, shall conclusively be deemed to have agreed that the Premises were in satisfactory condition as of the Commencement Date.

Section 2.04 Commencement Date Agreement. Prior to the Commencement Date, Lessor and Lessee shall enter into an agreement, in the form annexed hereto as Exhibit 3, confirming the Commencement Date, the approximate Rent Commencement Date, the initial Expiration Date, the legal description of the Premises, and a Preliminary Site Plan for the development, construction, and installation of the Improvements and the Generating Facility. The failure of either or both parties to execute such agreement shall not affect the occurrence of the Commencement Date, the approximate Rent Commencement Date, or the initial Expiration Date.

Section 2.05 Permitted Use. Subject to all of the other terms, covenants and conditions of this Lease, Lessee shall use the Land (where applicable) and the Premises only for the Permitted Uses. Notwithstanding the foregoing, Lessee shall not at any time use or occupy the Land (where applicable) or the Premises, or suffer or permit anyone else to use or occupy the Land (where applicable) or the Premises, (a) in any manner that violates the provisions of this Lease, (b) so as to cause waste, (c) so as to violate any insurance policy then issued with respect to the Land and the Premises, or (d) so as to create a nuisance.

Section 2.06 Proceeds of Timber. In the event the development, construction, and installation of the Improvements and Generating Facility require the removal of timber on the Land (where applicable) and the Premises, Lessor may remove such timber prior to the Commencement Date and retain one hundred percent (100%) of the proceeds received therefrom. In the event Lessor does not remove the required amount of timber from the Land (where applicable) and the Premises prior to the Commencement Date, Lessee may remove such timber not already removed and retain one hundred percent (100%) of the proceeds received therefrom.

Section 2.07 Proceeds of Un-Harvested Crops. Notwithstanding anything contained in this Lease to the contrary, Lessor may continue to lease the Premises for agricultural purposes until the Commencement Date. In the event un-harvested crops occupy the Land (where applicable) and the Premises on the Commencement Date, Lessee shall pay to Lessor, Lessor Affiliate, or Lessor designee a "**Crop Destruct Payment**" for the destruction of such un-harvested crops occupying the Land (where applicable) and the Premises. The Crop Destruct Payment shall be determined according to the county data available from the

United States Department of Agriculture's National Agricultural Statistics Service for the applicable year in which the crop destruction occurs. The estimated weight of the crops for the purposes of calculating the Crop Destruct Payment shall be determined by Parties according to industry standard.

Section 2.08 Mineral Rights/Surface Use. This Lease does not demise or lease to Lessee any oil, gas or minerals in place underneath the surface of the Land or the right to extract and remove the same, and Lessor's rights, if any, in such oil, gas, and minerals are reserved to, and retained by, Lessor. During the Term or any Extension Term, Lessor may not use, or permit the use of the Land from the surface to a depth of five hundred (500) feet below the surface, for the purpose of exploring for, extracting, producing or mining such oil, gas or minerals. Lessor may explore for, extract or produce oil, gas and minerals from the Land in a manner which does not interfere with Lessee's use of the Land or the Premises or affect the Improvements and the Generating Facility and utilizes a method, such as "directional drilling" which does not require the use of the Premises to a depth of five hundred (500) feet below the surface.

Section 2.09 Easements.

(a) Solar Easement.

(i) Solar Easement. Lessor hereby grants and conveys to Lessee, for the Term, and any Extension Term, an exclusive easement on, over, and across the Premises for the following: the open and unobstructed access to the sun to any Improvements and the Generating Facility and to ensure adequate exposure of the Improvements and Generating Facility to the sun. In addition, Lessor hereby grants and conveys to Lessee an exclusive easement prohibiting any obstruction to the open and unobstructed access to the sun (together with the preceding sentence, the "**Solar Easement**") throughout the entire Land (where applicable) and the Premises to and for the benefit of the area existing horizontally three hundred and sixty degrees (360°) from any point where any Improvement or Generating Facility is or may be located at any time from time to time (each such point referred to as a "**Site**") and for a distance from each Site to the boundaries of the Land (where applicable) and the Premises, together vertically through all space located above the surface of the Land (where applicable) and the Premises, that is, one hundred eighty degrees (180°) or such greater number or numbers of degrees as may be necessary to extend from each point on and along a line drawn along the surface from each point along the exterior boundary of the Land (where applicable) and the Premises through each Site to each point and on and along such line to the opposite exterior boundary of the Land (where applicable) and the Premises.

(ii) Lessor Interference. Lessor may not, and shall cause all other tenants and invitees to not, place or plant any trees, buildings or improvements (a "**Lessor Improvement**") on the Land and the Premises after the effective date hereof which may, in Lessee's sole judgment, impede or materially interfere with the open and unobstructed access to the sun to any Site, Improvement, or Generating Facility, unless Lessor has received written approval from Lessee for any such trees, structure or improvement.

(iii) Unobstructed Access to the Sun. Lessor shall not materially interfere with, and shall not allow any other party to materially interfere with, the free, unobstructed and open and unobstructed access to the sun, solar speed or solar direction over and across the Premises. Notwithstanding the above, Lessor shall not be responsible for the acts or omissions of adjacent property owners.

(b) Access Easement. Lessor hereby grants to Lessee, for the Term, and any Extension Term, an easement (the "**Access Easement**") over, across and on the Land (where applicable) and the Premises for ingress to and egress from the Improvements and Generating Facility (whether located on the Land (where applicable) and the Premises, on adjacent property or elsewhere) by means of any existing roads and lanes, or by such route or routes as Lessee may construct from time to time. The Access Easement shall include the right to improve existing roads and lanes, or to build new roads, and shall run with and bind the Land (where applicable) and the Premises, and shall inure to the benefit of and be binding upon Lessor and Lessee, as applicable, and their respective heirs, personal representatives, transferees, successors, and assigns, and all persons claiming under them. The location and dimensions of such access roads shall be

made by Lessee in its sole discretion, except that Lessee agrees to use commercially reasonable efforts to (i) minimize the interruption of Lessor's operations on the Land by such access roads, and (ii) install such access roads perpendicular to county roads.

(c) Transmission Easement. Lessor hereby grants Lessee one or more easements for Transmission Facilities (defined below) (the "**Transmission Easements**") on, over and across the Land (where applicable) and the Premises, on such portions of the Land (where applicable) and the Premises as will be notified to Lessor by Lessee. Any such Transmission Easement shall contain all of the rights and privileges for Transmission Facilities as are set forth in this Lease. Any Transmission Easement shall also include the right of ingress to and egress from the Improvements and Generating Facility (whether located on the Premises, on adjacent property or elsewhere) over and along the Land (where applicable) and the Premises by means of roads and lanes thereon if existing, or otherwise by such route or routes as Lessee or Lessor may construct from time to time. The term of the Transmission Easements shall be the same as the term of this Lease unless terminated by Lessee by written notice to Lessor as set forth herein, and shall not expire or be terminable by Lessor under any circumstances. Lessee shall have the right to assign or convey all or any portion of any Transmission Easement to any person on an exclusive or nonexclusive basis. Any Transmission Easement shall run with the Land and the Premises and inure to the benefit of and be binding upon Lessor and Lessee and their respective transferees, successors, and assigns, and all persons claiming under them. Lessee shall have the right to assign its rights hereunder relating to the construction, operation, repair, and/or maintenance of the electric transmission or distribution systems to a third party that owns, operates, and/or maintains electric transmission or distribution systems. Transmission Facilities shall be deemed to be Improvements and part of the Generating Facility.

(d) Easements in Gross. The Solar Easement, the Access Easement, the Transmission Easement(s), and all other easements and related rights granted by Lessor in this Lease to Lessee are easements "in gross", which means, among other things, that they are interests personal to and for the benefit of Lessee, and its successors and assigns, as owner of the rights created by such easements. The Solar Easement, the Access Easement, the Transmission Easement(s), and other rights granted to Lessee by Lessor in this Lease are independent of any lands or estates or interest in lands, and there is no other real property benefiting from such easements. The burdens of the Solar Easement, the Access Easement, the Transmission Easement, and all other rights granted to Lessee in this Lease shall run with and against the Land (where applicable) and the Premises and will be a charge and burden on the Land (where applicable) and the Premises, and will be binding upon and against Lessor and its successors, assigns, permittees, licensees, lessees, employees, and agents. The Lease, the Solar Easement, the Access Easement, and the Transmission Easement(s) shall inure to the benefit of Lessee and its successors, assigns, permittees, licensees, and sublessees. Notwithstanding anything contained in this Section 2.09, the Solar Easement, the Access Easement, the Transmission Easement(s), and all other, easements and related rights granted by Lessor in this Lease to Lessee shall extinguish upon and with the termination or expiration of this Lease; provided, however, such easements shall survive any termination or expiration of the Lease for the Removal Period.

Article III. Rent

Section 3.01 Construction Rent. During the period between the Commencement Date and Rent Commencement, Lessee shall pay Lessor the Construction Rent, in equal monthly installments, on the first day of each calendar month during said period, without notice, bill, or demand. If the Commencement Date is not the first day of a new month, the Construction Rent for the month in which the Commencement Date occurs shall be apportioned according to the number of days in that month. On the Rent Commencement Date, Lessee obligation to pay to Lessor the Construction Rent shall end and its obligation to pay the Base Rent shall begin.

Section 3.02 Base Rent Payable Each Quarter. During the Term and commencing on the Rent Commencement Date, Lessee shall pay Lessor the Base Rent, in equal quarterly installments, in advance,

on the first day of each calendar quarter during the Term, without notice, bill, or demand. If the Rent Commencement Date is not the first day of a new quarter, the Base Rent for the quarter in which the Rent Commencement Date occurs shall be apportioned according to the number of days in that quarter. Upon the occurrence of the Rent Commencement Date, Lessee shall provide to Lessor a final site plan for the construction and installation of the Improvements and the Generating Facility.

Section 3.03 Where Rent is to be Paid. Rent payable to Lessor shall be paid to Lessor at Lessor's Address in lawful money of the United States of America by good check or, at Lessor's request, by wire transfer. All Rent shall be paid without notice, demand, deduction, abatement, or setoff, except as otherwise expressly provided in this Lease. A bill for Rent payable to Lessor sent by first class mail to the address to which Notices are to be given under this Lease shall be deemed a proper demand for the payment of the amounts set forth therein, but nothing contained herein shall be deemed to require Lessor to send a Rent bill or otherwise make any demand for the payment of Rent except where such notice or demand is expressly required by the terms of this Lease.

Section 3.04 Rent Not Collectible. If at any time during the Term the Rent is not fully collectible by reason of any Law, Lessee shall enter into such agreements and take such other action as Lessor reasonably requests and which is not prohibited by any Law, to permit Lessor to collect the maximum permissible Rent (but not in excess of the Rent). If such Law terminates prior to the Expiration Date (a) the Rent shall be paid in accordance with this Lease, and (b) Lessee shall pay to Lessor, if not prohibited by any Law, the Rent which would have been paid but for such Law, less the actual amount of Rent paid by Lessee to Lessor during the period of such Law.

Article IV. Payment of Impositions and Utilities

Section 4.01 Impositions Defined. "**Impositions**" shall mean, collectively, (a) all real estate taxes, all special assessments and all other property assessments, including all assessments for public improvements or betterments, whether or not commenced or completed within the Term of this Lease, and whether foreseen or unforeseen, (b) any tax imposed on Lessor's income or receipts (whether net or gross), (c) any mortgage recording tax imposed with respect to any Fee Mortgage, all rent and occupancy taxes and all similar taxes, (d) subject to Article XXII, any tax imposed with respect to the sale, exchange, or other disposition by Lessor of the Land , including any lease by Lessor of all or part of the Land, (e) franchise taxes, excess profits taxes, capital gains taxes, and taxes on doing business that are imposed on Lessor; (f) all fines, fees, charges, penalties, and interest imposed by any Governmental Authority or utility, and (g) all other governmental charges and taxes, in each case of any kind or nature whatsoever, general or special, foreseen or unforeseen, ordinary or extraordinary, which are at any time during or with respect to the Term assessed, levied, charged, confirmed or imposed with respect to the Land. If at any time during the Term the present method of real estate taxation or assessment is changed so that a new method is substituted for the type of Impositions presently being assessed or imposed on real estate, or in lieu of any increase in such Impositions, a tax described in clauses (a) or (g) that is imposed solely on owners of real estate, such substitute taxes shall be deemed to be included within the term "Impositions."

Section 4.02 Lessor to Pay Impositions. Except as provided in Section 4.03, throughout the Term, Lessor shall pay, or cause to be paid, all Impositions as and when the same shall become due and payable; provided that if any Imposition may by Law be paid in installments, Lessor may pay such Imposition in installments as permitted by Law. If Lessor fails to pay Impositions when due, Lessee may, in its sole discretion, pay those Impositions and any accrued interest and penalties in any manner Lessee chooses including, seeking reimbursement from Lessor or deducting the amount of its payment from Base Rent or other amount otherwise due to Lessor from Lessee.

Section 4.03 Lessee Impositions, Tax Payments, and Utilities.

(a) Lessee Impositions. Lessee shall pay, or cause to be paid, during the Term or any Extension Term, its proportional share of real estate taxes, special assessments, and other property assessments.

Lessee's proportional share of real estate taxes, special assessments, and other property assessments shall be calculated each year by finding the product of (1) the total real estate taxes, special assessments, and other property assessments levied for such year divided by the number of acres comprising the Land and (2) the number of acres comprising the Premises. Acreage shall be calculated to a decimal point equal to one/one-hundredth of an acre. To effectuate this payment, Lessor shall provide Lessee with a copy of Lessor's property tax statement within ten (10) days of its receipt thereof.

(b) Solar RPT Exemption. To the extent reasonably necessary, and without violating applicable Law, Lessor shall, at no out-of-pocket expense to Lessor, cooperate with Lessee in Lessee's efforts to obtain an exemption or partial exemption from an increase(s) in Lessor's real property taxes pursuant to M.G.L. c. 59, § 5, clause 45; M.G.L. c. 23A, § 3E; M.G.L. c. 40, § 59; M.G.L. c. 59, § 5, Clause 51; M.G.L. c. 59, § 38H(b); or any subsequent or similar legislation.

(c) Lessee Payments. Lessee shall pay, or shall cause to be paid (x) all ad valorem, sales, and use taxes on Personal Property; (y) all Personal Property and other taxes on Personal Property, the Generating Facility, and the Improvements; and (z) all water, sewer, and other utility charges imposed by any Governmental Authority directly to the Governmental Authority charged with the collection thereof, provided, that such charges imposed by such Governmental Authority relate to the usage or operation of the Generating Facility, the Improvements, and Lessee's Personal Property.

Section 4.04 Contest Validity and Amount of Charges. Either party may contest the validity or amount of any levied taxes, assessments, or other charges for which each is responsible under this Lease as long as such contest is pursued in good faith and with due diligence and the party contesting the tax, assessment, or charge has paid the obligation in question or established adequate reserves to pay the obligation in the event of an adverse determination. Should a party contest the validity or amount of any levied taxes, assessments, or other charges for which each is responsible under this Lease, the other party shall cooperate and support the contesting party in such contest.

Section 4.05 Lessee's Payments to Vendors and Utilities. Lessee shall obtain and pay for all utilities relating directly to the usage or operation of the Generating Facility, the Improvements, and Lessee's Personal Property directly from and to the utilities and vendors serving the Premises, including fuel, gas, electric, water, sewer service, trash collection, and telephone and internet service.

Article V. Initial Construction and Alterations

Section 5.01 Lessee Construction of Improvements and Generating Facility. Lessee may construct, install, alter, protect, repair, maintain, replace, operate, decommission, dismantle, and remove the Improvements, a ground-mounted electricity grid-connected photovoltaic solar power plant, and all related equipment, apparatus, accessories, works, and appurtenances thereto, including (a) meters, switchgear, relays, monitoring instrumentation, and equipment to protect and otherwise facilitate Lessee's solar monitoring activities, and (b) such dedicated electrical transmission, and/or distribution and communications lines and related cables, support structures, substations, relays, switchgear, radio towers, wires, conduit, circuit breakers, and transformers, and any and all necessary and proper facilities, fixtures, and additional equipment any way related to or associated with any of the foregoing for the transmission and delivery of electrical energy ("**Transmission Facilities**") as the Lessee, in its sole discretion, deems to be necessary or appropriate to generate or transmit power to the applicable connection point (collectively, the "**Generating Facility**"). Notwithstanding any rule of Law or equity, or the degree of affixation or attachment of the Improvements and Generating Facility to the Premises or the Land (where applicable), or any part thereof, Lessor acknowledges and agrees that title to the Generating Facility, all Improvements, and all Lessee Personal Property are and shall remain in the Lessee during the Term and thereafter except as the Lessor and Lessee agree to otherwise. Lessor hereby waives, releases, and relinquishes any and all rights to any lien, interest, or other claim to the Improvements, the Generating Facility, and Lessee's Personal Property or to assert any lien or other claim howsoever arising in respect of such property.

Section 5.02 Lessee Alterations. Lessee may, at its sole option and at its sole cost and expense, make any additions, replacements, changes, alterations, installations, repairs, or improvements to the Premises, the Improvements, and the Generating Facility (the "**Alterations**") that Lessee, in its sole discretion, deems necessary or appropriate.

Section 5.03 Manner of Work. All Improvements, the Generating Facility, and Alterations shall be made and constructed in a good and workmanlike manner, in compliance with all applicable Laws, and in compliance with the requirements of any Leasehold Mortgage and/or Fee Mortgage, and shall conform in all material respects with the plans and specifications approved by the applicable building department and, if applicable, the Lessor. Lessee shall complete all Improvements, the Generating Facility, and Alterations with reasonable diligence and shall promptly obtain all certificates, sign-offs, licenses, permits, and approvals required by Law to be obtained with respect to the Improvements, the Generating Facility, and Alterations and with respect to all equipment, machinery, and other items installed in connection with the Improvements, the Generating Facility, and Alterations.

Section 5.04 Standard of Care. Lessee shall design and plan the staging of all work at the Land (where applicable) and the Premises, and perform all construction at the Land (where applicable) and the Premises, with the highest degree of care so as to ensure the safety of persons and property at and around the Land and the Premises. Lessee shall take appropriate action to ensure that all improvements owned by adjacent property owners shall not be damaged or disturbed.

Section 5.05 Lessor Cooperation in Obtaining Approvals. To the extent Lessee requires, and without violating applicable Law, Lessor shall, at no out-of-pocket expense to Lessor, cooperate with Lessee in Lessee's efforts to obtain the required permits, approvals, and authorizations for the development and construction of the Improvements, the Generating Facility, and any Alterations, and the operation of the Improvements and the Generating Facility in accordance with the provisions of this Lease, including by joining in applications for building permits, subdivision plat approvals, certificates of dedication, public works, or other agreements, utility easements, permits for sewer, water, and other utility services, and the dedication to the applicable Governmental Authorities of such title to or easements for utility, roadway and slope or storm drainage areas or facilities as are reasonably necessary or desirable.

Section 5.06 Tax and Environmental Attributes.

(a) Ownership. At all times commencing from the date this Lease is executed until the Rent Commencement Date, and thereafter, during the Term or any Extension Term, the Generating Facility, all Improvements, all Alterations, and all Personal Property acquired (or leased) by Lessee or Lessee's Affiliates shall be the sole and exclusive property of Lessee.

(b) Renewable Energy Attributes. At all times commencing from the date this Lease is executed until the Rent Commencement Date, and thereafter, during the Term or any Extension Term, Lessee alone shall be entitled to all right, title, and interest in all of the tax and renewable energy credits (or solar renewable energy credits as the case may be), carbon credits, ancillary services, green tags, green tag reporting rights, environmental incentives, tax attributes of ownership (individually a "**Renewable Energy Attribute**" and collectively the "**Renewable Energy Attributes**") of the Generating Facility, all Improvements, all Alterations and all Personal Property acquired (or leased) by Lessee or Lessee's Affiliates, including, without limitation, the right to claim tax credits, depreciation, or cost recovery deductions, and other items of whatever nature relating to the environmental and energy attributes and incentives of the Improvements and Generating Facility.

(c) Lessor Cooperation. In addition, to the extent reasonably necessary, and without violating applicable Law, Lessor shall, at no out-of-pocket expense to Lessor, cooperate with Lessee in Lessee's efforts to meet the requirements of any certification, registration, or reporting program relating to the Renewable Energy Attributes, or otherwise cooperate with Lessee to obtain ownership of, monetize, and benefit from the Renewable Energy Attributes. If any Renewable Energy Attributes are initially credited or

paid to Lessor, Lessor shall immediately cause such Renewable Energy Attributes to be assigned or transferred to the Lessee, or as Lessee may otherwise direct. Lessor agrees to indemnify, defend, and hold Lessee harmless from and compensate Lessee for any losses, claims, liabilities, or expenses, arising out of or resulting from Lessor's delay or failure to claim any right or otherwise comply with a Lessee request with respect to the Renewable Energy Attributes.

(d) Lessor Actions with Respect to the Renewable Energy Attributes. Lessor agrees to: (i) not make any public claim or otherwise publicly suggest that Lessor or the Land is solar-powered or otherwise powered by renewable energy, unless Lessor or the Land is in fact solar-powered or otherwise powered by renewable energy by virtue of arrangements unrelated to this Lease; and (ii) not participate in any voluntary programs with respect to the Renewable Energy Attributes. Without diminishing Lessor's obligations set forth above, Lessor hereby irrevocably appoints Lessee as its attorney-in-fact and agent for and on behalf of Lessor to: (y) execute and deliver in the name of Lessor all documents and instruments that may be necessary to transfer, assign, or otherwise convey any Renewable Energy Attribute to Lessee or its nominee; and (z) register, certify, verify, quantify, inventory, record, validate, or otherwise substantiate and authenticate the Renewable Energy Attributes. This appointment and power of attorney, being coupled with an interest, shall not be revoked by the insolvency, bankruptcy, or incapacity of Lessor, and Lessor hereby ratifies and confirms and agrees to ratify and confirm all that Lessee may lawfully do or cause to be done by virtue of the provisions of this Section.

Section 5.07 Lessor Inspection. Lessor, its architects, engineers, and representatives shall have the right to reasonably inspect the Premises, and the Improvements (to the extent then constructed) from time to time during the construction of the Improvements, the Generating Facility, and any Alterations.

Section 5.08 No Liens or Encumbrances. Lessee shall keep the Land (where applicable), the Premises, and this Lease free from any lien or other encumbrance filed or recorded in favor of any mechanic, materialman, architect, or engineer and free from any similar lien or encumbrance with respect to work, material or services alleged to have been performed for Lessee. If any such lien or encumbrance is filed or recorded, Lessee shall discharge any such lien or encumbrance by bond or otherwise within thirty (30) days after Lessee receives notice of such lien or encumbrance. If Lessee fails to discharge such lien or encumbrance within such thirty (30) day period, Lessor may pay the amount reflected on such lien or encumbrance (or any portion thereof) and any costs, interest, and/or penalties imposed in connection therewith or take such other action as Lessor deems necessary or desirable to remove such lien or encumbrance, without being responsible for investigating the validity thereof and without regard to any objection by Lessee.

Section 5.09 Subordination and Non-Disturbance. Pursuant to this Section and Section 12.01, Lessor shall cooperate with Lessee to obtain non-disturbance and subordination agreements, or such other necessary agreements, from any person or entity with a lien, encumbrance, mortgage, deed of trust, lease or other exception to Lessor's fee title to the Land (whether recorded or unrecorded) to the extent necessary to eliminate any actual or potential interference by any such lienholder with any rights granted to Lessee under this Lease.

Article VI. Compliance with Law and Environmental Laws

Section 6.01 Lessee Compliance with Law. Lessee, at Lessee's expense, shall comply, and shall cause the Sublessees, if any, to comply, in all material respects at all times, with all Laws applicable to the Land, the occupancy of the Land, any Alterations, and/or any property on or activities at the Land (where applicable) and the Premises. Without limiting the foregoing, Lessee shall promptly cure all violations of Law as to which a notice of violation has been issued or as to which a directive or order has been issued by any public officer or other person having authority, promptly discharge of record any such notice of violation, promptly comply with any such order or directive, and pay all fines, penalties, interest and other costs imposed by any Governmental Authority in connection with any violation or requirement of Law.

Section 6.02 Environmental Laws. Without limiting the foregoing:

(a) Definitions. The following terms, as used in this Lease and in all amendments to the Lease (unless otherwise specified or unless the context otherwise requires), shall have the meanings and/or be construed, as the case may be, as set forth below:

(i) **Environmental Laws** shall mean all Laws (a) relating to the environment, human health or natural resources; (b) regulating, controlling or imposing liability or standards of conduct concerning Hazardous Substances; (c) relating to the remediation of the Premises for Hazardous Substances, including investigation, response, clean-up, remediation, prevention, mitigation, or removal of any Hazardous Substance; or (d) requiring notification or disclosure of releases of Hazardous Substances or of the existence of any environmental conditions on or at the Premises, as any of the foregoing may be amended, supplemented, or supplanted from time to time.

(ii) **Hazardous Substances** shall mean any and all substances, materials, chemicals, and/or wastes which now or hereafter are classified or considered to be hazardous or toxic, or that are or become regulated by any Governmental Authority because of toxicity, infectiousness, radioactivity, explosiveness, ignitability, corrosiveness, or reactivity under any Environmental Law applicable to the Premises, and shall also include (1) gasoline, diesel fuel, and other petroleum hydrocarbons; (2) asbestos and asbestos containing materials, in any form, whether friable or non-friable; (3) polychlorinated biphenyls; (4) radon gas; and (5) flammable liquids and explosives.

(iii) **Remedial Action** shall mean the investigation, response, clean up, remediation, prevention, mitigation, or removal of contamination, environmental degradation, or damage caused by, related to or arising from the existence, generation, use, handling, treatment, storage, transportation, disposal, discharge, Release (including a continuous Release), or emission of any Hazardous Substance, including the investigation, removal, or closure of any underground storage tanks and any soil or groundwater investigation, remediation, or other action required under or necessary to comply with any Environmental Laws.

(iv) **Release** shall mean the release or threatened release of any Hazardous Substances into or upon or under any land, water, or air, or otherwise into the environment, including by means of burial, disposal, discharge, emission, injection, spillage, leakage, seepage, leaching, dumping, pumping, powering, escaping, emptying, placement, and the like.

(v) **"Material,"** as used to describe Lessee's compliance obligations in this Article, shall mean that the failure to so comply may reasonably be expected to result in material risk of (1) physical injury or illness to any individual, (2) criminal liability, or (3) fines or Remedial Action or compliance costs.

(b) Compliance with Environmental Laws. Subject to subparagraph (c) below, Lessee, at Lessee's expense, shall comply, and shall cause its Sublessees, if any, to comply, in all material respects at all times, with all Environmental Laws. Such compliance includes Lessee's obligation, at its expense, to take Remedial Action when required by Law (in accordance with applicable Law and this Lease) and to pay all fines, penalties, interest, and other costs imposed by any Governmental Authority in connection with any violation or requirement of Law.

(c) Notification of Environmental Issue. Lessee shall notify Lessor promptly if (i) Lessee becomes aware of the presence or Release of any Hazardous Substance at, on, under, within, emanating from, or migrating to the Land in any quantity or manner, which could reasonably be expected to violate in any material respect any Environmental Law or give rise to any Material liability or the obligation to take Remedial Action or other material obligations under any Environmental Law, or (ii) Lessee receives any written notice, claim, demand, request for information, or other communication from a Governmental Authority, or a third party, regarding the presence or Release of any Hazardous Substance at, on, under, within, emanating from or migrating to the Land or related to the Land which could reasonably be expected

to violate in any material respect any Environmental Law or give rise to any Material liability or obligation to take Remedial Action or other material obligations under any Environmental Law.

(d) Remedial Action. Lessee shall take and complete any Remedial Action with respect to the Premises in full compliance with all Laws and shall, when such Remedial Action is completed, submit to Lessor written confirmation from the applicable Governmental Authorities that no further Remedial Action is required to be taken (**"Final Governmental Approval"**).

Section 6.03 Lessee's Right to Contest. Lessee shall have the right to contest, at its sole cost, by appropriate legal proceedings, the amount or validity of any fine, charge, or penalty imposed in connection with an alleged violation of Law, the validity of any Law to the Land (where applicable) and the Premises, the validity of any application of any Law to the Land (where applicable) and the Premises, the existence of any violation of Law, and/or the validity of any issued notice of violation of Law (the **"Contested Obligation"**). Lessee may defer payment and/or performance of the Contested Obligation to the extent that and so long as Lessee is diligently contesting, at its expense, by appropriate legal proceedings the existence, amount or validity of the Contested Obligation. Lessee shall indemnify and save Lessor harmless against any and all Liabilities incurred by Lessor in connection with any such contest or the Contested Obligation. Lessee shall, promptly after the final determination of such contest, comply with the requirements of such determination and pay all amounts levied, assessed, charged or imposed on any of the Lessor Parties, Lessee, the Land and the Premises or any part thereof, in connection therewith, together with all fines, penalties, interest, costs and Liabilities.

Section 6.04 Modification of Lease if Specific Legal Requirements Change. If under any applicable Legal Requirements the holder of a leasehold interest in the nature of that held by Lessee under this Lease becomes ineligible for any Renewable Energy Attribute established by any local, state, or federal Governmental Authority, then, in Lessee's sole discretion, Lessor and Lessee shall amend this Lease or replace it with a different instrument so as to convert Lessee's interest in the Land (where applicable) and the Premises to a substantially similar interest that makes Lessee eligible for such Renewable Energy Attribute.

Article VII. Repairs and Maintenance

Section 7.01 Operation and Maintenance. Lessee, at its own expense, shall at all times (a) maintain the Premises, the Improvements, and the Generating Facility in an orderly and safe condition, in a good state of repair, and in a manner consistent with the standards of operation and maintenance of first class properties and solar photovoltaic electric generation facilities similar to the Premises, the Improvements, and the Generating Facility and (b) make such repairs, replacements and Alterations to the Premises as are necessary to keep them in the condition required by the preceding clause (a).

Section 7.02 Visual Effects. Lessor acknowledges and understands that the Improvements and Generating Facility to be located on the Land (where applicable) and the Premises may impact the view on the Land or on adjacent land or otherwise cause visual effects. Lessor covenants and agrees that the Lessor will not assert that the Improvements and the Generating Facility constitute a nuisance.

Section 7.03 Lessor Obstructions. Notwithstanding any provision in this Lease, Lessor covenants that it will not build or place, or allow to be built or placed, any structure or obstruction of any kind within such portions of the Land (where applicable) and the Premises, or on any adjacent land owned by Lessor, (a) on which is located any portion of the Improvements and the Generating Facility, including any related interconnection equipment and/or (b) which may obstruct Lessee's exclusive access to the sun; and if such a structure or obstruction is built or placed within any portion of the Land (where applicable) and the Premises on which is located any portion of the Improvements and the Generating Facility, including any related interconnection equipment, or which obstructs Lessee's exclusive access to the sun, Lessor will remove the same at the request of the Lessee at no cost to the Lessee.

Article VIII. Insurance

Section 8.01 Insurance Terminology. The following basic terms, as used in this Lease and in all amendments to the Lease (unless otherwise specified or unless the context otherwise requires), shall have the following meanings: A **"Customary"** form of policy or amount of coverage or endorsement or other aspect of insurance is that form of policy, amount of coverage, endorsement or other aspect that is then customarily required by prudent Institutional Lenders for similar solar photovoltaic electric generating facilities in the vicinity of the Land (the **"Comparison Area"**).

Section 8.02 Lessee Insurance. Except as otherwise specifically provided below, Lessee, at Lessee's sole expense, shall maintain at all times during the Term, any Extension Term, and after the Term for so long as Lessee, or any Person holding through or under Lessee, remains in possession of the Premises, the following insurance:

(a) Liability Insurance. Lessee shall maintain a policy of commercial general liability insurance in Customary form (the "**Liability Policy**") protecting Lessee against claims of third parties for bodily injury, death, personal injury, and property damage (including personal injury liability covering libel, slander, false arrest and malicious prosecution, and fire and water damage legal liability) occurring in, upon, or about the Land (where applicable) and the Premises and any appurtenances thereto. Such policy shall include contractual liability coverage covering Lessee's indemnification obligations under this Lease with respect to covered claims. Subject to Lessor's right (as set forth below) to require Lessee to increase coverage limits, such policy shall have a per occurrence combined single limit of at least One Million Dollars ($1,000,000.00) annually and per location.

(b) Property Insurance. Effective on and after the date the Improvements and Generating Facility are Placed in Service, Lessee shall maintain property insurance covering the Improvements, the Generating Facility, and Personal Property insuring against (a) all risks, including fire, other risks, and losses and shall cover increases in costs incurred by reason of changes in ordinances or Laws, and (b) loss of revenue in an amount at least equal to gross receipts from all sources of income from the Premises, as reasonably estimated, for a period of at least twelve (12) months; and (c) losses due to disruption of utility services originating away from the Improvements and the Generating Facility (the **"Property Damage Policy"**). With respect to losses to property, such policy shall be in an amount equal to one hundred percent (100%) of the Full Replacement Cost (hereinafter defined) of the Improvements, the Generating Facility, and Personal Property, but such coverage shall be, in any event, at least sufficient to avoid the effect of the co-insurance provisions of the applicable policy or policies. The term **"Full Replacement Cost"** shall mean the actual replacement cost of the Improvements, the Generating Facility, and Personal Property, and without deduction for depreciation.

(c) Workers Compensation. Lessee shall maintain workers' compensation insurance as required by Law and which shall include employer's liability insurance for all employees of Lessee, in accordance with the statutory limits required by Law.

(d) Automobile Insurance. Lessee shall maintain a policy of Automobile Liability insurance on owned, non-owned, and hired motor vehicles used in connection with the operation of the Improvements and Generating Facility with a combined single limit for bodily injury and property damage of not less than One Million Dollars ($1,000,000.00).

(e) Insurance Required by Lenders. To the extent any Leasehold Lender may require Lessee to obtain any insurance coverage not required by this Lease, or require additional insurance coverage, or require a different or more highly rated insurance company to issue the insurance, or impose any requirement relating to Lessee's insurance that is more stringent than the requirements of this Lease, Lessee shall comply with such Leasehold Lender's insurance requirements.

Section 8.03 Insurer Requirements. All policies required by this Article shall be issued by insurance companies licensed to do business in the Commonwealth of Massachusetts. All such insurers shall have a claims paying ability rating of no less than "A-8" and a financial class category rating of at least "VIII" by

A.M. Best Company (or any successor rating agency or entity reasonably selected by Lessor if A.M. Best Company discontinues publishing ratings of insurance companies or if the rating system is changed). If it is commercially impracticable to obtain insurance from an insurer with an "A-8" rating and a financial size category of at least "VIII" because of changes in the insurance industry or conditions in the Comparison Area, Lessee's insurers shall have a policy holder's rating that is at least equal to the Customarily required rating.

Section 8.04 Blanket Policy. Such policies may be carried under a blanket policy covering the Premises and other locations of Lessee and Lessee's Affiliates, if such blanket policy contains an endorsement that guarantees a minimum limit available for the Premises equal to the minimum limits required by this Article and that the minimum limits shall not be reduced for claims made with respect to other properties, and otherwise complies with this Article.

Section 8.05 Lessor as Additional Insured. The Liability Policy shall name Lessor as an additional insured and shall include as additional insureds the Lessor Parties and all Lenders, if any. Notwithstanding the foregoing, to the extent this Section or any other Section of this Lease requires the Lessor Parties and/or Lenders to be (a) included as additional insured in any policy of insurance or (b) benefited by a waiver of subrogation endorsement, such requirement shall be triggered as to any Fee Lender or as to Lessor's managing agent only when Lessor has advised Lessee of the names and addresses of such entities and requested such inclusion.

Section 8.06 Insurance Endorsements. All insurance policies required by this Article shall (i) contain endorsements that such insurance may not be canceled or amended, except upon not less than thirty (30) days prior written notice to Lessor, any Leasehold Lender, or any Tax Equity Investor, and (ii) be written as primary policies not contributing to or in excess of any policies carried by Lessor, and (iii) each contain a waiver of subrogation endorsement, in form and substance reasonably satisfactory to the other party.

Section 8.07 Sublessee Insurance. Lessee also shall require the Persons described below to carry the following insurance.

(a) Sublessees. Lessee shall require all of its Sublessees to:

(i) maintain Customary insurance required of lessees in similar properties, and

(ii) include the Lessor Parties as additional insured on their commercial general liability policies (or equivalent policies); and

(iii) obtain a waiver of subrogation endorsement in all policies in favor of the Lessor Parties.

(b) Contractors, Subcontractors, Etc. Lessee shall require all of its contractors, subcontractors, design-builders, construction managers, consultants, and other entities providing services, materials, or labor to all or any portion of the Premises, and all of its Sublessees' contractors, subcontractors, design-builders, construction managers, consultants, and other entities providing services, materials, or labor to all or any portion of the Premises to:

(i) include as additional insured in their commercial general liability policies the Lessor Parties; and

(ii) obtain a waiver of subrogation endorsement in all policies in favor of the Lessor Parties, in each case to the same extent Lessee requires such contractors, subcontractors, construction managers, design-builders, consultants, and other entities to include Lessee as additional insured and/or to obtain a waiver of subrogation endorsement in favor of Lessee.

Each of the required coverages, excluding the professional liability insurance, fidelity insurance, and automobile liability insurance, shall contain a waiver of subrogation endorsement, in form and substance reasonably satisfactory to Lessor, in favor of the Lessor Parties.

Section 8.08 Compliance with Insurance Requirements. Lessee, at Lessee's expense, shall comply, and shall cause its Sublessees to comply, in all material respects at all times, with all Insurance Requirements.

Section 8.09 Lessor Insurance. Lessee recommends that Lessor, at Lessor's sole expense, maintain at all times during the Term, any Extension Term, and after the Term (i) commercial general liability insurance in Customary form covering any activities of Lessor on the Land with bodily injury and property damages coverage, (ii) property insurance, (iii) workers' compensation insurance covering its employees as required by Law, and (iv) adequate insurance in support of the indemnity obligation(s) set forth in Section 9.02. Notwithstanding the above and except as required by Law, Lessor shall have no affirmative obligation to obtain or maintain any form of insurance during the Term, any extension Term, or after the Term.

Article IX. Indemnity

Section 9.01 Lessee Indemnification. Lessee shall indemnify and hold harmless the Lessor Parties from and against any and all Liabilities arising from or in connection with all of the following: (a) the Premises and/or any operations or activities thereon during the Term and after the Term for so long as Lessee, or any Person holding through or under Lessee, remains in possession of the Premises, except to the extent such Liabilities arise out of Lessor's negligence or misconduct; (b) any act, omission, negligence, or misconduct of Lessee and/or any of Lessee's officers, directors, employees, partners, members, agents, contractors, invitees, or Sublessees; (c) any accident, injury, or damage (including death) occurring in, at or about the Premises during the Term and after the Term for so long as Lessee, or any Person holding through or under Lessee, remains in possession of the Premises, except to the extent such Liabilities arise out of the Lessor's negligence or misconduct; (d) any breach or default by Lessee under this Lease; (e) any claims made by Sublessees during or after the Term, except to the extent such claims arise out of Lessor's negligence or misconduct; and (f) any holdover by Lessee, or by any Person(s) holding through Lessee, after the Expiration Date. If any action or proceeding is brought against Lessor and/or any Lessor Party by reason of any such claim(s), Lessee, upon notice from Lessor or such Lessor Party, shall resist and defend such action or proceeding by counsel reasonably satisfactory to Lessor or such Lessor Party.

Section 9.02 Lessor Indemnification.

(a) Lessor General Indemnification. Lessor agrees to defend, indemnify, and hold harmless Lessee the "**Indemnified Parties**") against any and all Liabilities, to the extent resulting from or arising out of (i) any operations or activities of Lessor on the Land before, after, or during the Term or (ii) any negligent or intentional act or omission on the part of Lessor with respect to this Lease or the Land.

(b) Lessor Environmental Indemnification. Lessor agrees to defend, indemnify, and hold Lessee and the Indemnified Parties forever harmless against and from all Liabilities, including, without limitation, those asserted by any Governmental Authority or any third party, including reasonable attorneys' fees (losses), sustained or incurred by the Lessee and its successors and assigns as a result of or arising out of or by virtue of (i) any Release of any Hazardous Substance which originated on or before the Commencement Date and any Remedial Action required therefrom, (ii) any violation of any Environmental Law as a result of any Lessor, Lessor Party, or third party activities on the Land and any Remedial Action required therefrom, and/or (iii) any condition existing on the Land before the Commencement Date and after any expiration or termination of this Lease.

Article X. Casualty Damage and Condemnation

Section 10.01 Damage to the Improvements and Generating Facility. If the Land (where applicable), the Premises, Improvements, and/or the Generating Facility are damaged or destroyed by fire or other cause (ordinary or extraordinary) including access thereto, and to any degree of severity, Lessee shall give Lessor prompt notice of such event and inform Lessor within ninety (90) days of such event whether it will (i) repair the damage or remedy the event which has occurred or, (ii) terminate the Lease with no penalty thereon.

Section 10.02 Damage During Term. If the Land (where applicable), the Premises, Improvements, and/or the Generating Facility are damaged or destroyed by fire or other cause (ordinary or extraordinary) including access thereto, and to any degree of severity, by Lessor or Lessor Parties, Lessor shall repair the damage or remedy the event which has occurred within thirty (30) days of such damage or event, and shall pay to Lessee all direct, indirect, consequential, special, incidental, exemplary, or punitive damages of any kind or nature whatsoever that arise out of, result from, or are caused by Lessor or Lessor Parties. Should Lessor fail to make such repairs or remedy the event within thirty (30) days and pay to Lessee all direct, indirect, consequential, special, incidental, exemplary, or punitive damages of any kind or nature whatsoever that arise out of, result from, or are caused by Lessor or Lessor Parties, or should Lessor fail to advise Lessee that it shall make such repairs or remedy such event within thirty (30) days of the date of such damage or event, then Lessee may terminate this Lease by notice to Lessor with no penalty thereon, and Lessee may proceed pursuant to Section 15.04 to recover from Lessor all direct, indirect, consequential, special, incidental, exemplary, or punitive damages of any kind or nature whatsoever that arise out of, result from, or are caused by Lessor or Lessor Parties, including but not limited the cost of removing the Improvements and Generating Facility from the Land (where applicable) and the Premises. Lessor acknowledges that in the event of termination of the Lease by Lessee, Lessee does not waive any rights, claims, remedies or other damages under contract, tort or other common Law actions against Lessor.

Section 10.03 Termination of Lease Upon Taking. If any portion of the Land is taken by expropriation, or is purchased by any government agency or governmental body exercising the power of expropriation or eminent domain, and should such taking render the Land substantially unusable for the Lessee's Permitted Uses, then this Lease shall terminate upon the vesting of title or taking of possession. If any portion of the Land is taken by expropriation, or is purchased by any government agency or governmental body exercising the power of expropriation or eminent domain, and should such taking render the Land in substantially the same utility for the Lessee's permitted uses, then this Lease shall be unaffected by such act of expropriation.

Section 10.04 Payment After Taking. All payments made on account of any taking by expropriation or eminent domain shall be made to the Lessor, except that the Lessee shall be entitled to any award made for the reasonable removal and relocation costs of the Improvements and the Generating Facility that the Lessee has the right to remove, and for the loss and damage to any such Improvements and the Generating Facility (including lost profits or revenue) that the Lessee elects or is required to remove, and for the loss of use of the Land (where applicable) and the Premises by the Lessee, including but not limited to payment for business dislocation expenses, loss of Renewable Energy Attributes, tax recapture and similar losses, moving expenses, leasehold damages and diminution in the value of Lessee's leasehold estate and value of the Improvements and the Generating Facility. It is agreed that the Lessee shall have the right to participate in any settlement or court proceedings. If the parties do not agree upon a division of such award or purchase price, it shall be set by arbitration pursuant to the provisions of this Lease.

Article XI. Estoppel Certificates

Section 11.01 Estoppel Certificate Upon Request. Lessor and Lessee shall, at any time and from time to time, within ten (10) Business Days following receipt of written request from the other party, execute, acknowledge, and deliver a written statement certifying: that this Lease is in full force and effect and unmodified (or, if modified, stating the nature and date of such modification); the Commencement Date; the then Expiration Date; whether any Extension Options have been exercised and describing the Extension Term(s) to which such option(s) relate; the dates to which the Rent reserved hereunder has been paid and the amount of such Rent; whether or not, to the best knowledge of the signer, the other party is in default in performance of any of its obligations under this Lease (and, if so, specifying each such default of which the signer shall have knowledge); if the signer is the Lessee, that Lessee is not in default of any of its obligations under this Lease; and as to such other matters regarding this Lease as may reasonably be requested. Failure to deliver such statement within said ten (10) Business Days' period shall be conclusive as to the facts stated in the requested certification and binding upon the party who failed to deliver such certification.

Article XII. Mortgages and Financings

Section 12.01 Fee Mortgages. Lessor may mortgage its fee interest in the Land (a **"Fee Mortgage"**); provided that any such mortgage meets the requirements of this Lease, and provided further that should Lessor mortgage or encumber its fee interest in the Land, or should Lessor permit the Land to suffer any other lien, hypothecation, or encumbrance, whether recorded or unrecorded, it shall require, as a condition precedent to entering into any Fee Mortgage, or within ten (10) days following a request therefor, any Fee Mortgage Lender or other third party to enter into a non-disturbance, attornment, and subordination agreement, or such other necessary agreement (in form and substance acceptable to Lessee) to protect and secure Lessee's leasehold interest in the Land, and the Improvements and Generating Facility thereon; and whereby the holder of such mortgage, lien, or encumbrance acknowledges and agrees that in the event of enforcement of the mortgage, encumbrance, or lien, such Fee Mortgage Lender or other third party shall not attempt to (i) terminate this Lease, (ii) disturb Lessee's possession of the Land (where applicable and the Premises, (iii) make Lessee a party defendant to any such proceeding, (iv) or in any other way foreclose or otherwise extinguish or interfere with the rights of Lessee under this Lease, and that the validity and effectiveness of this Lease shall be maintained as an encumbrance on the Land according to its terms. Notwithstanding anything contained in this Lease to the contrary, Lessee may defer payment of Rent until Lessee has received each of the non-disturbance, attornment, and subordination agreements required to be delivered pursuant to this Section 12.01.

Section 12.02 Lessee Financing.

(a) Leasehold Mortgages and Security Interests. Lessee may, from time to time, and without the prior written consent of Lessor, grant to any Institutional Lender or other Lender providing financing or refinancing to Lessee with respect to the Improvements and the Generating Facility, a mortgage lien encumbering Lessee's interest in the Premises, and its interest in, to and under this Lease, together with an assignment of revenue and a security interest in the Improvements, the Generating Facility, and the Personal Property owned by Lessee, in order to secure the repayment of such financing, including interest thereon, and the performance of all of the terms, covenants, and agreements on the Lessee's part to be performed or observed under all agreements executed in connection with such financing or refinancing (collectively, a "**Leasehold Security Interest**"; and each holder of a Leasehold Security Interest, a **"Leasehold Lender"**). No such Leasehold Security Interest shall attach to Lessor's interest in this Lease or the Premises or to any Personal Property owned by Lessor, nor shall any such assignment affect Lessor's interest in this Lease. Lessee may have one or more Leasehold Security Interests at any time.

(b) Protection of Leasehold Security Interest and the Tax Equity Investment. Any Leasehold Lender and Tax Equity Investor shall, for so long as (1) its Leasehold Security Interest is in existence and until the lien or mortgage thereof has been extinguished, or (2) its tax equity investment is outstanding and for so long as a tax equity transaction is in existence, be entitled to the following protections:

(i) No Amendment. Lessor shall not agree to any amendment, mutual termination, or modification or accept any surrender of this Lease, nor shall any such amendment, termination or modification, or surrender be effective, without the written consent of the Leasehold Lender and/or the Tax Equity Investor.

(ii) Notice of Default. Lessor shall give any Leasehold Lender and any Tax Equity Investor all notices of default by Lessee. Notwithstanding any default by Lessee under this Lease, Lessor shall have no right to terminate this Lease unless and until Lessor shall have first given Leasehold Lender(s) and Tax Equity Investor(s) a written notice of Lessee's default and failure to cure same within the period(s) specified in Article XIV hereof and thereafter afforded the Leasehold Lender(s) and the Tax Equity Investor(s) an opportunity to cure such default within a period of sixty (60) days after receipt of such notice and the Leasehold Lender(s) and Tax Equity Investor(s) shall have failed to effect the cure of such default within the period(s) specified in Article XIV. The foregoing sixty (60) day period shall be extended for the time reasonably required to complete such cure, including the time required for the Leasehold Lender(s)

and the Tax Equity Investor(s) to perfect their rights to cure such default by obtaining possession of the Premises (including possession by a receiver) or by instituting foreclosure proceedings, provided the Leasehold Lender and the Tax Equity Investor shall be entitled to remedy any default under this Lease in the manner and on the same terms as granted to Lessee in Article XIV of this Lease.

(iii) Right to Perform. Any Leasehold Lender and any Tax Equity Investor shall have the right at any time to pay any rent due hereunder and to perform or cause to be performed any other obligation of Lessee at or within the time such payment or performance is required under this Lease. Nothing contained in this Lease shall be construed to obligate any Leasehold Lender or any Tax Equity Investor to cure any default of the Lease.

(iv) Foreclosure. If the Leasehold Lender becomes the assignee of this Lease by means of foreclosure or transfer in lieu thereof, such Leasehold Lender shall be liable under this Lease only for the period the Leasehold Lender remains a Lessee hereunder, provided that any subsequent assignee or Lessee shall assume all the terms and conditions of this Lease. A Leasehold Lender shall have the absolute right (1) to assign its leasehold mortgage or security interest; (2) to enforce its lien and acquire title to the leasehold estate and/or easement estate by any lawful means; (3) to take possession of and operate the Improvements and Generating Facility or any portion thereof and to perform all obligations to be performed by Lessee hereunder, or to cause a receiver to be appointed to do so; and (4) to acquire the leasehold estate and/or easement estate by foreclosure or by an assignment in lieu of foreclosure and thereafter to assign or transfer the leasehold estate and/or easement estate to a third party. Lessor's consent shall not be required for the acquisition of the encumbered leasehold, easement, or sub-easement estate by a third party who acquires same by foreclosure or assignment in lieu of foreclosure. Lessor shall recognize such Leasehold Lender or such third parties as the successor to Lessee under this Lease.

(v) New Agreement. Following (1) any re-entry and repossession of the Premises by Lessor or (2) any termination of this Lease (whether by rejection of the Lease in any bankruptcy or similar proceeding or otherwise), (A) Lessor shall deliver written notice to Leasehold Lender indicating the completion of Lessor's re-entry and repossession of the Premises or termination of this Lease and (B) Lessor shall enter into a new lease agreement with the Leasehold Lender or its designee within ten (10) days' following the written request from Leasehold Lender, provided the Leasehold Lender or its designee agrees to cure any previously uncured breaches and defaults of Lessee under this Lease which are reasonably susceptible to cure by the Leasehold Lender or its designee. The new lease agreement shall be for a term equal to the balance of the Term, and shall be at the same rental and upon the same terms, covenants, and conditions as contained in this Lease.

(vi) Right to Remove Improvements and Generating Facility. Notwithstanding anything contained in this Lease to the contrary: (1) any Leasehold Lender or Tax Equity Investor shall be permitted to remove some or all of the Improvements and Generating Facility or other Personal Property of Lessee from the Land (where applicable) and Premises; provided that the Leasehold Lender or the Tax Equity Investor agrees to repair any damage to the Land (where applicable) and the Premises caused by such removal in a commercially reasonable manner and in accordance with Law (including removal of debris); (2) if this Lease is terminated, Lessor shall provide Leasehold Lender and/or Tax Equity Investor with notice of such termination and the Removal Period following the Leasehold Lender's and/or Tax Equity Investor's receipt of such notice to remove some or all of the Improvements and Generating Facility and other Personal Property of Lessee from the Land (where applicable) and Premises in a commercially reasonable manner and in accordance with Law (including the removal of debris) (and, in such event only, if the Leasehold Lender or the Tax Equity Investor fails to remove some or all of the Improvements and Generating Facility and other Personal Property of Lessee from the Land (where applicable) and Premises prior to the end of the Removal Period or to pay Rent for the period thereafter, such Improvements and Generating Facility and other Personal Property of Lessee shall be considered abandoned and Lessor may dispose of or retain such Improvements, Generating Facility, and other Personal Property in its discretion); and (iii) any Leasehold Lender or any Tax Equity Investor shall be permitted access to the Land (where

applicable) and the Premises for the purposes of inspecting, assembling, decommissioning, dismantling, repossessing, removing, organizing, or selling, some or all of the Improvements, the Generating Facility, or other Personal Property of Lessee from the Land (where applicable) and Premises.

(vii) Consent and Recognition Agreement. At the request of Lessee, any Leasehold Lender, or any Tax Equity Investor, Lessor, at the requestor's cost and expense, shall procure from any mortgagee and/or ground lessor, any agreement as may be reasonably requested by Lessee, any Leasehold Lender, or any Tax Equity Investor recognizing the rights of the Leasehold Lender and/or Tax Equity Investor hereunder.

Article XIII. Assignment and Sublease

Section 13.01 Lessee Assignment. Lessee may assign this Lease or sublease all or substantially all of the Premises in a single transaction or related transactions without the prior consent of Lessor; provided, however, that Lessee shall, promptly after such assignment or sublease (i) provide notice to Lessor specifying the name, address, and employer identification number of the assignee or sublessee, if any; and (ii) deliver to Lessor a true and complete copy of the assignment or sublease, as the case may be, and all related agreements. No such assignment or sublease, nor any amendment thereto, shall be effective unless and until Lessee delivers to Lessor, within thirty (30) days of execution thereof, a duplicate original of the fully-executed instrument of assignment or sublease or amendment.

Section 13.02 Lessee Sublet. In accordance with Section 13.01, Lessee may sublet all or any part of the Premises without the consent of Lessor.

Section 13.03 Lessor Assignment. Lessor may assign any of its rights, duties, or obligations under this Lease without the prior written consent of Lessee, to any purchaser or transferee of the Land, provided that such assignee (i) enters into an Estoppel Certificate pursuant to Section 11.01 hereof and (ii) agrees in writing to be bound by all of the terms and conditions of this Lease.

Section 13.04 Lessor Transfer of the Land. If at any time during the Term or any Extension Term, Lessor receives a written offer or enters into a letter of intent, contract, or other similar agreement for the transfer of the Land (or any portion thereof) to a prospective transferee, then Lessor shall notify Lessee thereof within three (3) business days after receipt of such offer. For the purposes of this Section 13.04, a "transfer" means (i) a sale, transfer, or conveyance (other than a mortgage and other than a foreclosure or a deed in lieu of foreclosure action taken by the holder of any mortgage) of fee title, (ii) a lease, (iii) a contribution to an entity of which Lessor will be an owner, (iv) any other transfer, including by operation of law, or (v) any change of control (which for the purposes hereof shall mean the right and power, direct or indirect, to vote fifty-one percent (51%) or more of the outstanding capital, partnership, membership interests, or assets of the entity) with respect to Lessor, including, without limitation, a merger, acquisition, consolidation, or other reorganization; regardless of whether any of the foregoing transfers are voluntarily or involuntarily made. Lessor covenants and agrees that it shall not transfer the Land (or any portion thereof) if such transfer, in Lessee's discretion, (i) causes Lessee's current use of the Premises or operation of the Improvements and Generating to be in violation of any Law or (ii) disrupts, interferes with, or obstructs Lessee's current use of the Premises or operation of the Improvements and Generating. Prior to the execution or consummation of such transfer, Lessor shall assign all of its rights, duties, and obligations under this Lease pursuant to Section 13.03 to the transferee and shall cause the transferee to (i) enter into an Estoppel Certificate pursuant to Section 11.01 hereof and (ii) agree is writing to be bound by all of the terms and conditions of this Lease. In the event, Lessor fails to comply with the provisions of this Section 13.04, Lessor covenants and agrees that such transfer shall be void ab initio and Lessee shall be permitted to take such reasonable actions as are necessary and appropriate to protect its interests in the Land and the Premises.

Article XIV. Default and Conditions of Limitation

Section 14.01 Event of Default. Subject to Section 12.02(b) this Lease and the Term and estate thereof is subject to the conditional limitation that if any of the following events occur (each, an **"Event of Default"**):

(a) If Lessee fails to pay Rent to Lessor when the same is due and payable under the terms of this Lease and such failure continues for a period of thirty (30) days after written notice thereof is given to Lessee; or

(b) Lessee fails to discharge any mechanic's or other lien that is its obligation to discharge under the terms of this Lease within the applicable time period provided in this Lease; or

(c) Lessee, whether by action or inaction, fails to timely perform or observe any of the other terms, covenants or conditions of this Lease and such default is not remedied within twenty (20) days after written notice thereof is given to Lessee, provided that if such default cannot, with reasonable diligence, be fully remedied within such twenty (20) day period, Lessee shall have as long as is reasonably necessary to cure such default, but in no event longer than three (3) months after the date such default notice is given to Lessee, provided further Lessee commences compliance within such twenty (20) day period (or as promptly as reasonably possible in an emergency) and thereafter pursues compliance to completion with reasonable diligence; or

(d) Lessee deserts or abandons the Premises for sixty (60) or more consecutive days; or

(e) A receiver is appointed for Lessee or any property of Lessee in any action, suit, or proceeding by or against Lessee and such appointment is not vacated or annulled within one hundred twenty (120) days; or

(f) The interest of Lessee in this Lease or the revenue from the Premises is sold under execution or other legal process;

then Lessor may, at any time during the continuance of such Event of Default, give Lessee notice of termination of this Lease and, upon the date thirty (30) days after service of such notice, this Lease and the Term and estate thereof (whether or not the Commencement Date shall have occurred) shall terminate and end with the same force and effect as if that day were the day herein definitely fixed for the end and expiration of this Lease, but Lessee shall remain liable for damages as provided in this Lease and Lessor may resort to and enforce any of the remedies provided in Article XV below.

Section 14.02 Insolvency Event. Subject to Section 12.02(b), this Lease and the Term and estate thereof is subject to the further conditional limitation that if any of the following events occur ("**Insolvency Events**"):

(a) Lessee makes an assignment for the benefit of its creditors; or

(b) If an involuntary petition is filed against Lessee under any bankruptcy or insolvency Law or under the reorganization provisions of any Law of like import, and such petition is not dismissed within one hundred twenty (120) days after the date filed; or

(c) Lessee shall file a voluntary petition under any bankruptcy or insolvency Law, or whenever any court of competent jurisdiction shall approve a petition filed by Lessee under the reorganization provisions of the United States Bankruptcy Act or under the provisions of any Law of like import, or whenever a petition shall be filed by Lessee under the arrangement provisions of the United States Bankruptcy Act or under the provisions of any Law of like import;

then Lessor may, at any time during the continuance of such Insolvency Event, give Lessee notice of termination of this Lease and, upon the date thirty (30) days after service of such notice, this Lease and the term and estate thereof (whether or not the Commencement Date shall have occurred) shall terminate and end with the same force and effect as if that day were the day herein definitely fixed for the end and expiration of this Lease, but Lessee shall remain liable for damages as provided in this Lease and Lessor may resort to and enforce any of the remedies provided in Article XV below.

Article XV. Remedies

Section 15.01 Remedies After Termination for Cause. Subject to Section 12.02(b), if (a) this Lease is terminated pursuant to Article XIV, (b) Lessor reenters or obtains possession of the Premises by summary proceedings or any other action or proceeding, or (c) Lessor reenters or obtains possession by any other legal act (which Lessor may do without further notice and without liability or obligation to Lessee or any occupant of the Premises if this Lease is terminated pursuant to Article XIV), all of the provisions of this Section shall apply (in addition to any other applicable provisions of this Lease):

(a) Lessee shall immediately vacate the Premises and surrender the Premises to Lessor; provided, however, Lessee, any Leasehold Lender, any Lessee Affiliate, any Tax Equity Investor, or any of their successors or assigns shall have the Removal Period to remove, decommission, and dismantle the Improvements and the Generating Facility.

(b) After Lessee, any Leasehold Lender, any Lessee Affiliate, any Tax Equity Investor, or any of their successors or assigns removes, decommissions, and dismantles the Improvements and the Generating Facility for a period of time no greater than the Removal Period, Lessor, at Lessor's option, may (i) relet the Premises, or any portion of the Premises, from time to time, in the name of Lessor as determined by Lessor, to any person and on any terms, but Lessor shall have no obligation to relet the Land, or any portion of the Land, or to collect any rent (and the failure to relet the Premises, or any portion of the Premises, or to collect any rent shall not impose any liability or obligation on Lessor or relieve Lessee of any obligation or liability under this Lease, including the payment of Rent for the remainder of the Term or Extension Term, if applicable), and (ii) make any changes to the Premises as Lessor, in Lessor's judgment, considers advisable or necessary in connection with a reletting, without imposing any liability or obligation on Lessor or relieving Lessee of any obligation or liability under this Lease.

(c) Lessee shall pay Lessor the following amounts:

(i) All Rent payable to the date on which this Lease is terminated or Lessor reenters or obtains possession of the Premises; and

(ii) Any costs and expenses incurred by Lessor in connection with the termination, reentry or obtaining of possession, and the reletting of the Premises, including all repossession costs, brokerage commissions, reasonable attorneys' fees and disbursements, alteration costs and other expenses of preparing the Premises for reletting, provided that, except to the extent coverage is provided under any applicable insurance policy obtained by Lessee hereunder, Lessee shall not be liable for any indirect, incidental, special, punitive, exemplary, or consequential damages whether in an action in contract or tort (including negligence or strict liability) or otherwise resulting from its performance or any failure to perform hereunder, including, but not limited to, loss of anticipated profits or benefits.

Section 15.02 Equitable Remedies. Either party may seek to enjoin any breach or threatened breach of any provision of this Lease. The right of any party to exercise any particular remedy available under this Lease, at Law or in equity, shall not preclude such party from exercising any other remedy it might have pursuant to this Lease, in Law or in equity. Each right and remedy specified in this Lease and each other right or remedy that may exist at Law, in equity or otherwise upon breach of any provision in this Lease, shall be deemed distinct, separate, and cumulative; and no right or remedy, whether exercised or not, shall be deemed to be in exclusion of any other unless otherwise expressly provided in this Lease.

Section 15.03 Lessor Cure of Lessee Default. If (a) there is then an Event of Default, or (b) if Lessee fails to comply with any obligation under this Lease which in Lessor's reasonable opinion creates an emergency, Lessor may, but is not obligated to, cure the default. Lessee shall reimburse Lessor, for all Liabilities incurred by Lessor in connection therewith, within ten (10) days after Lessee is billed for such Liabilities.

Section 15.04 Binding Arbitration. Any dispute, controversy or claim arising out of or relating in any way to Lease including without limitation any dispute concerning the construction, validity, interpretation, enforceability, or breach of the Lease, shall be exclusively resolved by binding arbitration upon either party's submission of the dispute to arbitration. In the event of a dispute, controversy, or claim arising out

of or relating in any way to the Lease, the complaining party shall notify the other party in writing thereof. Within thirty (30) days of such notice, management level representatives of both parties shall meet at an agreed location to attempt to resolve the dispute in good faith. Should the dispute not be resolved within thirty (30) days after such notice, the complaining party shall seek remedies exclusively through arbitration administered by the American Arbitration Association. The demand for arbitration shall be made within a reasonable time after the claim, dispute, or other matter in question has arisen, and in no event shall it be made after one (1) year from when the aggrieved party knew or should have known of the controversy, claim, dispute or breach. The number of arbitrators shall be one. The place of arbitration shall be the county in Massachusetts the Land is located and Massachusetts Law shall apply. Judgment on the award rendered by the arbitrator may be entered in any court having jurisdiction thereof.

Section 15.05 Re-Entry Usage. The words "re-enter," "re-entry" and "re-entered" as used in this Lease shall not be considered to be restricted to their technical legal meanings.

Article XVI. No Impairment of Lessor's Title

Section 16.01 No Impairment of Lessor Title Generally. Nothing contained in this Lease, or any action or inaction by Lessor, shall be deemed or construed to mean that Lessor has granted to Lessee any right, power, or permission to do any act or to make any agreement which may create, give rise to, or be the foundation for, any right, title, interest, lien, charge, or other encumbrance upon the estate of Lessor in the Land.

Section 16.02 No Adverse Use. Lessee shall not permit the Premises to be used by any person or persons or by the public, as such, at any time or times during the term of this Lease, in such manner as might reasonably tend to impair Lessor's title to or interest in the Land or in such manner as might reasonably make possible a claim or claims of adverse use, adverse possession, prescription, dedication, or other similar claims of, in, to or with respect to the Land.

Section 16.03 No Liens. Lessee shall not cause, or permit any Sublessee to cause, Lessor's fee estate in the Land to be encumbered by any lien or other encumbrance, including any lien or other encumbrance filed or recorded in favor of any mechanic, materialman, architect, or engineer with respect to work, material, or services alleged to have been performed at or with respect to the Land. If any such lien or encumbrance is filed or recorded, Lessee shall discharge any such lien or encumbrance by bond or otherwise within thirty (30) days after Lessee receives notice of such lien or encumbrance. If Lessee fails to discharge such lien or encumbrance within such thirty (30) day period, Lessor may pay the amount reflected on such lien or encumbrance (or any portion thereof) and any costs, interest, and/or penalties imposed in connection therewith or take such other action as Lessor deems necessary or desirable to remove such lien or encumbrance, without being responsible for investigating the validity thereof and without regard to any objection by Lessee. Nothing in this Lease shall be deemed in any way to: (a) constitute Lessor's consent or request, express or implied, that any contractor, subcontractor, laborer, or materialman provide any labor or materials for any alteration, addition, improvement, or repair of the Premises; or (b) evidence Lessor's agreement to subject its fee estate to any such lien.

Article XVII. Representations; Quiet Enjoyment

Section 17.01 Lessor Representations. Lessor represents and warrants to Lessee that (a) Lessor holds fee simple title to the Land, free and clear of all liens and any other encumbrances, and (b) no lien or other encumbrance to which the Land is subject would reasonably be expected to adversely impact Lessee's rights hereunder. Lessor further represents and warrants to Lessee that Lessor has the right to execute and deliver this Lease and to grant to Lessee the Lease, licenses, and other rights hereunder, and that such grant does not, and will not, violate or breach Lessor's organizational documents, any Law, rule, or regulation, or any contract, agreement, or arrangement to which Lessor is a party or by or to which any of Lessor's assets or properties, including the Land, is bound or subject.

Section 17.02 Lessor Environmental Representations.

(a) Lessor represents and warrants that the Land (including the groundwater thereunder), any adjacent land owned by the Lessor, any Lessor improvements thereon, and the use and operation thereof, are currently in compliance with all Environmental Laws and all Legal Requirements (including, without limitation, consent decrees and administrative orders) relating to health, safety, and protection of the environment, and possesses and is in compliance with all permits required thereby.

(b) Lessor represents and warrants that there are no Hazardous Substances on, in, or under the Land (including the groundwater thereunder) and any adjacent land owned by the Lessor, and the Land, and any adjacent land owned by the Lessor, has never been used for Hazardous Substance generation (or manufacture, formulation, or production in any manner), transportation, treatment, storage, disposal, or handling in any manner.

(c) Lessor represents and warrants that with respect to the Land, and any adjacent land owned by the Lessor, there have not been and there are not any past or present events, conditions, circumstances, activities, practices, incidents, or actions that (1) could reasonably be expected to interfere with or prevent continued compliance with, or (2) may give rise to any legal liability or otherwise form the basis of any claim, action, suit, proceeding, hearing, or investigation pursuant to any Environmental Law or other Legal Requirement relating to health and safety, and protection of the environment.

Section 17.03 Quiet Enjoyment. Lessor covenants that if and so long as Lessee observes and performs each and every covenant, agreement, term, provision, and condition of this Lease on the part of Lessee to be observed and performed, Lessee shall quietly enjoy the Land (where applicable) and Premises without hindrance or molestation of Lessor or any Person acting through Lessor, subject to the covenants, agreements, terms, provisions, and conditions of this Lease, and Lessor, to the extent reasonably requested by Lessee, and at no out-of-pocket expense to Lessor, grant to and cooperate with Lessee in Lessee's efforts to obtain any additional easements as Lessee may require in the future.

Article XVIII. Limitation of Lessor Liability

Section 18.01 Transferee's Assumption of Lessor's Obligations. If Lessor sells, assigns, or otherwise transfers (whether by operation of Law or otherwise) all or part of its or their interest in the Land or this Lease, (a) the transferor shall be relieved of all obligations and liabilities of Lessor under this Lease accruing after the effective date of the transfer, and (b) the transferee shall be deemed to have assumed, and Lessor shall ensure such transferee has assumed, all of Lessor's obligations and liabilities under this Lease effective from and after the effective date of the transfer.

Section 18.02 Lessor No Personal Liability. Except as provided in Sections 9.02 and 10.02, Lessor and Lessor Parties shall have no personal liability under or in connection with this Lease; provided, that the acts or omissions of Lessor or Lessor Parties do not constitute fraud, gross negligence, or willful misconduct. Except as provided in Sections 9.02 and 10.02, Lessee shall look only to Lessor's interest in the Land and this Lease for the satisfaction of Lessee's remedies or to collect any judgment requiring the payment of money by Lessor or such persons under or in connection with this Lease. Except as provided in Sections 9.02 and 10.02, no other assets of Lessor or such persons shall be subject to lien, levy, execution, or other enforcement procedure for the satisfaction of Lessee's remedies or the collection of any judgment under or in connection with this Lease.

Article XIX. [Intentionally Omitted]

Article XX. Notices

Section 20.01 Notices. Except as may be provided in this Lease, any notice or other communication under this Lease, other than any Rent bill, shall be in writing and shall be sent by United States express mail or by a nationally recognized overnight delivery service that provides receipts or by hand delivery addressed to the party for whom intended at its Notice Address. Any such notice or other communication shall be

deemed given and received when delivered or refused or when delivery is attempted on a Business Day during normal business hours. Rent bills to Lessee may be sent in the manner set forth above or may be sent by first class mail; provided that nothing contained in this Section shall be deemed to require Lessor to bill or otherwise make demand on Lessee for the payment of Rent, except where this Lease expressly requires billing.

Section 20.02 Change of Address. Either party may, by notice to the other party, designate a different address (or addresses) for notices and other communications intended for it, which designation shall become effective on the date such notice is received.

Article XXI. End of Term

Section 21.01 End of Term. Subject to Article XXIII, on the Expiration Date or such earlier date that this Lease terminates or expires, Lessee shall peaceably and quietly surrender the Land (where applicable) and the Premises to Lessor free and clear of all Subleases, liens, and other encumbrances (except for liens and encumbrances caused or expressly consented to by Lessor), and perform or grant Lessor with the option to perform one of the following after providing Lessor with at least thirty (30) days written notice of its preference thereof (the "**Notice of Preference**"):

(a) Lessee may request in the Notice of Preference to renegotiate the terms of this Lease to extend the term hereof, and Lessor may, in its sole discretion, agree to renegotiate such term or terms; or

(b) In Lessee's sole discretion, Lessee may (i) remove, decommission, and dismantle all of Lessee's Personal Property (including the Improvements and Generating Facility) acquired (or leased) by Lessee or Lessee's Affiliates and all Personal Property of Sublessees and (ii) materially restore the Land (where applicable) and the Premises, and such removal and restoration shall occur over a period not less than the Removal Period commencing from Lessor's receipt of the Notice of Preference; or

(c) Lessee may sell to Lessor and Lessor may purchase from Lessee all of Lessee's Personal Property (including the Improvements and Generating Facility) acquired by Lessee or Lessee's Affiliates by providing Lessee with written notice of its election to purchase within thirty (30) days of Lessor's receipt of the Notice of Preference, and for a purchase price to be determined by good faith negotiations between the parties, provided the parties agree to consummate such transaction within sixty (60) days of Lessor's election to purchase; or

(d) If neither party elects to exercise all or a portion of its rights pursuant to subsections (a), (b), or (c) above, Lessee shall (i) remove, decommission, and dismantle all (or the remaining portion thereof) of Lessee's Personal Property (including the Improvements and Generating Facility) acquired (or leased) by Lessee or Lessee's Affiliates and all Personal Property of Sublessees and (ii) materially restore the Land (where applicable) and the Premises, and such removal and restoration shall occur over a period not less than the Removal Period.

Section 21.02 Delivery of Records and Documents Upon Expiration or Termination. Lessee shall deliver to Lessor, on or before the Expiration Date or such earlier date that this Lease terminates or expires, upon Lessor's request, all licenses, permits, warranties, and guaranties then in effect for the Premises (and shall assign same to Lessor upon Lessor's request) and all books and records reasonably requested by Lessor. Lessee shall cooperate with Lessor to achieve an orderly transition of the Premises to Lessor's control. Lessor and Lessee shall, prior to the Expiration Date, (a) adjust for Impositions and all other appropriate expenses and income of the Land, and (b) if a Memorandum of Lease has been recorded, execute a document in recordable form evidencing the termination of this Lease and all amendments thereto.

Section 21.03 Change in Law. If, prior to the expiration of the Term, any Law repeals, amends, alters, terminates, or materially changes Lessee's authority to construct, operate, and/or monetize the Improvements and the Generating Facility; or any applicable public electric utility or its assigns repeals, amends, alters, terminates or materially changes Lessee's authority to construct, operate, and/or monetize

the Improvements and the Generating Facility; Lessee may, in its sole discretion, by written notice to Lessor, terminate this Lease and, upon the giving of such notice, this Lease shall terminate effective as of the date provided for in such notice. All Rent shall be paid to the date of termination and, other than with respect to the Lessee's and/or Lessor's obligations pursuant to Section 21.01 above, neither party shall have any further obligations to the other or any claim against the other in connection with this Lease.

Section 21.04 Early Termination.

At any time between the effective date of this Lease and the Commencement Date, Lessee may terminate this Lease for any reason and for no penalty by providing Lessor with no less than thirty (30) days' written notice thereof. Thereafter, neither party shall have any further obligations to the other or any claim against the other in connection with this Lease.

Section 21.05 Liability After Expiration or Termination. If the Land (where applicable) and the Premises are not vacated and surrendered in accordance with this Lease, Lessee shall be liable to Lessor for (a) all Liabilities incurred by Lessor in connection with such holdover, including Liabilities incurred in connection with any summary proceedings, action, or proceeding to recover possession of the Land (where applicable) and the Premises from Lessee and any Sublessees, and (b) per diem use and occupancy in respect of the Premises equal to the fair rental value of the Land and the Premises, and (c) all damages incurred by Lessor in connection with such holdover, including any lost opportunity damages incurred by Lessor. Lessee shall indemnify, defend, and hold harmless Lessor against all claims made by any succeeding lessees to the extent such claims arise by reason of the failure of Lessee (and all other occupants) timely to vacate and surrender the Premises in accordance with this Lease. Lessor may recover amounts due it under this Section in any summary proceeding and/or any separate action or proceeding.

Article XXII. Memorandum of Lease; Transfer Taxes

Section 22.01 Memorandum of Lease. Concurrently with or within a reasonable time after the execution of this Lease, Lessor and Lessee shall execute and deliver to the other, a memorandum of this Lease, in the form attached hereto as Exhibit 4, together with such transfer tax returns and other documents as are required to record such memorandum in the appropriate county office. Lessee, at Lessee's expense, may record such memorandum of Lease. The parties shall modify such memorandum to reflect any requirements of the recording office. If this Lease is amended, Lessor and Lessee shall, promptly upon the request of either party, execute and deliver an amendment of such memorandum giving notice of such amendment. The party requesting such amendment shall pay the recording fees imposed in connection therewith. At the expiration or sooner termination of this Lease, each party shall, at the request of the other party, execute and deliver an instrument evidencing the termination of this Lease and Lessor may, at its sole cost and expense, record such instrument; but the failure of either party to execute and deliver such instrument shall not prevent or affect the termination of this Lease or serve to reinstate this Lease.

Section 22.02 Transfer Taxes. The Party Responsible for Transfer Taxes shall pay all transfer taxes imposed in connection with this Lease. Subject to Article XXIII, if this Lease is amended, the party requesting such amendment shall pay all transfer taxes imposed in connection with such amendment.

Article XXIII. Extension Option(s)

Section 23.01 Extension Option. Lessee is granted the option to extend the term of this Lease for four (4) successive additional terms of five (5) years each (each such additional term being referred to as an "**Extension Term**," and each such option being referred to as an "**Extension Option**"), provided all of the following conditions (the "**Extension Conditions**") are met with respect to each Extension Term: (a) Lessee gives Lessor notice (the "**Extension Notice**") at least thirty (30) days prior to commencement of the Extension Term to which such notice relates, that it is exercising the Extension Option, and (b) at the date the Extension Option is exercised, and at the commencement of the Extension Term to which such option relates, Lessee is not in default of its obligations under the Lease, unless such default is cured within the applicable cure period. Each such Extension Term shall commence at the expiration of the prior term.

Notwithstanding the above, in the event Lessee fails to give Lessor an Extension Notice at least thirty (30) days prior to the commencement of the Extension Term to which such notice relates, the Extension Options for such Extension Term shall automatically be deemed exercised by Lessee.

Section 23.02 Cancellation of Extension Option after Termination. If this Lease is terminated or expires for any reason, the Extension Options granted in this Article with respect to periods subsequent to such termination or expiration shall be deemed null and void.

Section 23.03 Amendments to Lease during Extension Term. Each such Extension Term shall be upon all of the terms and conditions of this Lease, except as follows and as otherwise hereinafter provided:

(a) Any rent concession granted in this Lease shall not apply to any Extension Term.

(b) At the end of the second Extension Term the provisions of this Article shall be deemed null and void and there shall be no further extension of the term of this Lease pursuant to this Article.

(c) The Base Rent payable during each Extension Term shall be determined in accordance with the provisions of Exhibit 2.

Section 23.04 Reset Rent Dispute. If Lessee validly exercises an Extension Option and, as of the commencement of the applicable Extension Term, there is a dispute as to the amount of the Base Rent payable by Lessee as of the commencement of the Extension Term and such dispute has not been resolved in accordance with the terms of this Lease, Lessee shall pay the Base Rent for the prior term from the commencement of such Extension Term until such dispute is resolved. Such payment and acceptance shall be without prejudice to Lessee's position. The parties shall adjust any overpayment or underpayment by Lessee promptly after resolution of such dispute. If Lessee fails to comply with its obligations under this Section, Lessee shall be deemed to have waived its right to contest Lessor's determination of the Base Rent for such Extension Term.

Section 23.05 Extension Costs. Lessee shall pay all transfer taxes imposed in connection with each extension of the Term of this Lease, including any extension effected through the exercise of any Extension Option.

Article XXIV. Miscellaneous

Section 24.01 Amendment. This Lease may not be changed orally, but only by an agreement in writing signed by the party against whom enforcement of any waiver, change, modification or discharge is sought.

Section 24.02 Receipt of Rent Not Waiver. Receipt or acceptance of Rent by Lessor and payment of any Rent by Lessee shall not be deemed to be a waiver of any default under the covenants, agreements, terms, provisions and conditions of this Lease, or of any right which Lessor or Lessee, as the case may be, may be entitled to exercise under this Lease. Failure to insist upon the strict performance of any of the provisions of this Lease or to exercise any right, remedy, or election herein contained or permitted by Law shall not constitute or be construed as a waiver or relinquishment for the future of such provision, right, remedy, or election, but the same shall continue and remain in full force and effect. The waiver by either party of any breach of this Lease shall not be deemed a waiver of any future breach.

Section 24.03 Consent of Lessor in Writing. Consent of Lessor to any act or matter must be in writing and shall apply only with respect to the particular act or matter to which such consent is given and shall not relieve Lessee from the obligation wherever required under this Lease to obtain the consent of Lessor to any other act or matter.

Section 24.04 Relationship of Parties. Lessor and Lessee acknowledge that they are not partners or joint venturers and that, except with respect to casualty insurance proceeds and condemnation awards (as set out in Articles VIII and X), they do not stand in a fiduciary relationship to one another.

Section 24.05 Severability. If any term or provision of this Lease or the application thereof to any person or circumstance shall, to any extent, be invalid or unenforceable, the remainder of this Lease, or the

application of such term or provision to persons or circumstances other than those as to which it is held invalid or unenforceable, shall not be affected thereby, and each term and provision of this Lease shall be valid and be enforced to the fullest extent permitted by Law.

Section 24.06 Governing Law. This Lease is governed by and shall be construed and enforced in accordance with the Laws of the Commonwealth of Massachusetts, without regard to principles of conflicts of Law.

Section 24.07 Binding on Successors and Assigns. The covenants, agreements, terms, provisions, and conditions of this Lease shall be binding upon and inure to the benefit of the successors and assigns of Lessor and the successors and assigns of Lessee.

Section 24.08 Obligations after Termination or Expiration. Upon the expiration of the Term of this Lease, neither party shall have any further obligation or liability to the other except as otherwise provided in this Lease and except for (a) such obligations as by their nature or under the circumstances can only be, or by the provisions of this Lease may be, performed after such expiration, and (b) any liability for Rent, and (c) any liability for acts or omissions occurring during the Term, all of which obligations shall survive such expiration.

Section 24.09 Mutual Representations. Each party represents and warrants (a) that this Lease has been duly authorized, executed and delivered by such party and constitutes the legal, valid and binding obligation of such party, (b) that there are no actions, suits or proceedings pending or, to the knowledge of such party, threatened against or affecting such party, at Law or in equity or before any Governmental Authority which would impair such party's ability to perform its obligations under this Lease, and (c) that the consummation of the transactions hereby contemplated and the performance of this Lease will not result in any breach or violation of, or constitute a default under any lease, bank loan or credit agreement. If Lessee is not an individual, Lessee shall provide to Lessor, upon Lessor's request, evidence that the execution and delivery of this Lease have been duly authorized by Lessee and that the person or persons executing and delivering this Lease on behalf of Lessee have been duly authorized to do so, together with a certified copy of Lessee's articles of incorporation, partnership agreement or operating agreement, as applicable, and all amendments thereto.

Section 24.10 No Merger. There shall be no merger of this Lease or the leasehold estate created by this Lease with a fee interest in the Land by reason of the fact that the same Person may acquire, own or hold, directly or indirectly, this Lease or the leasehold estate created by this Lease and the fee estate in the Land, unless and until such Person and every Leasehold Lender and Fee Lender shall join in a written instrument expressly providing for such merger and such instrument is recorded.

Section 24.11 Force Majeure. In any case where Lessor or Lessee is required to do any act (other than make a payment of money), delays caused by or resulting from an Act of God, severe weather conditions, war, insurrection, riot, civil commotion, fire or other casualty, strikes, lockouts, inability to obtain labor or materials, government regulations, or other causes beyond the party's control shall not be counted in determining the time when the performance of the act must be completed, whether that time is designated by a fixed time, a fixed period of time, or "a reasonable time." In any case where construction or replacement work is to be paid for out of insurance proceeds or condemnation awards, due allowance shall be made to both to the party required to perform the work and to the party required to make the payment for reasonable delays in the collection of such proceeds and awards.

Section 24.12 Entire Agreement. This Lease represents the entire agreement of the parties with respect to the Land and the Premises, and, accordingly, all prior understandings and agreements between the parties with respect to the Land and the Premises are merged into this Lease, which alone fully and completely expresses the agreement of the parties.

Section 24.13 Headings. The captions, headings and titles in this Lease are solely for convenience of reference and shall not affect its interpretation.

Section 24.14 Construction and Presumption. This Lease shall be construed without regard to any presumption or other rule requiring construction against the party causing this Lease to be drafted.

Section 24.15 Independent Covenants of Lessee. Each covenant, agreement, obligation or other provision of this Lease on Lessee's part to be performed, shall be deemed and construed as a separate and independent covenant of Lessee, not dependent on any other provision of this Lease.

Section 24.16 Number and Gender. All terms and words used in this Lease shall be deemed to include any other number and any other gender as the context may require.

Section 24.17 Drafts and Comments of Lease Not Binding. The submission of drafts of and comments to this Lease, the negotiation of this Lease, and the exchange of correspondence concerning the negotiation and execution of this Lease shall have no binding force or effect and shall confer no rights nor impose any obligations, including brokerage obligations, on either party. This Lease shall become a binding agreement only after both Lessor and Lessee have executed this Lease and duplicate originals thereof (including any counterparts) shall have been delivered to the respective parties.

Section 24.18 Counterparts. This Lease may be executed in counterparts, each of which shall be deemed an original and all of which together shall constitute one and the same instrument. The parties hereby agree signatures transmitted by facsimile or email shall be legal and binding and shall have the same full force and effect as if an original of this Lease had been delivered and hereby waive any defenses to the enforcement of the terms of this Lease based on the foregoing forms of signature.

[*Signature Page Follows*]

IN WITNESS WHEREOF, the parties hereto have duly executed this instrument as of the day and year first above written.

RAVIKUMAR RAMANJANAPPA

By R. Ravi Kumar,

OYA Solar NY, L.P., by its general partner OYA Solar NY, GP. Inc.

By _____,
Name: Manish Nayar
Title: President

EXHIBIT 1

Description of the Premises

Street Name:	0 Athol Road
Town:	Royalston
County:	Worcester
State:	Massachusetts
Zip Code:	01368
Property ID:	2550110005500050
Acres:	35.96*

*It is understood that only a portion of the parcel's acreage will be used to determine the rent per acres.

Proposed Premises Area:
The actual acreage of the Premises is yet to be determined. Below illustrates the parcel boundaries.

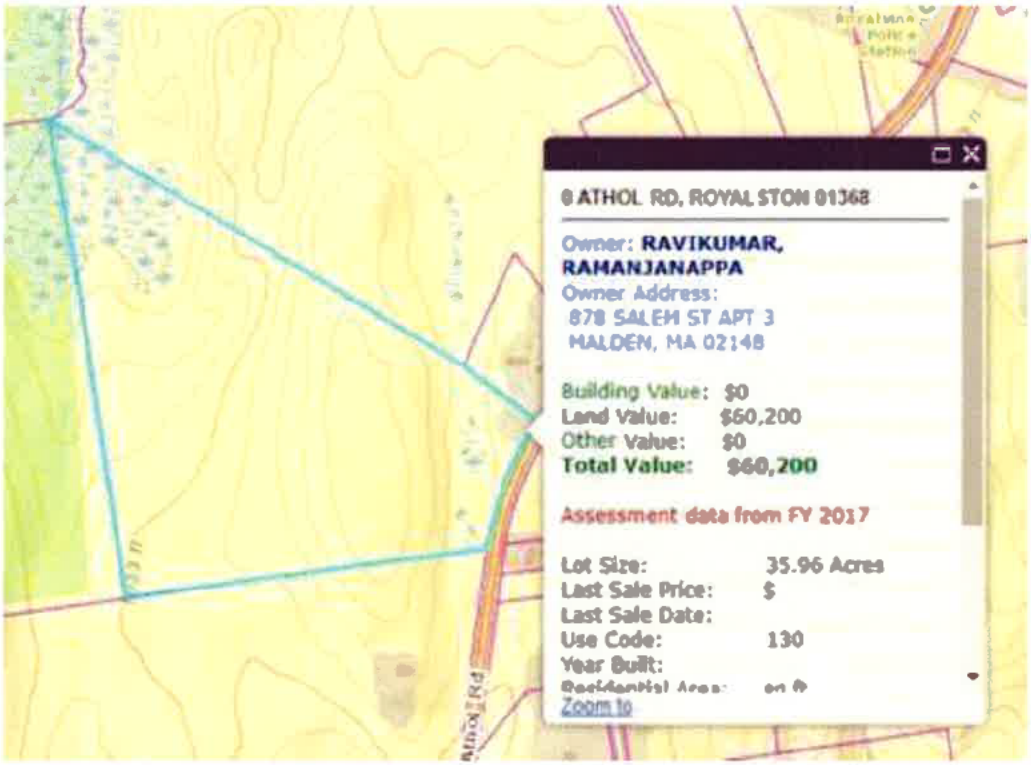


EXHIBIT 1-A

Description of the Access Easement

EXHIBIT 1-B

Description of the Transmission Easement

EXHIBIT 2

Due Diligence Period Fees, Construction Rent, and Base Rent

[redacted]

If Lessee exercises an Extension Option in accordance with the terms of this Lease and the Lease term is extended, the Base Rent payable with respect to the applicable Extension Term shall be an amount equal to the greater of (a) the annual Base Rent payable immediately before the commencement of the applicable Extension Period, and (b) the Reset Rent.

Determination of Reset Rent. The Reset Rent for each Extension Term shall be negotiated in good faith by Lessor and Lessee and mutually agreed upon Lessor and Lessee no later than thirty (30) days prior to the commencement of the applicable Extension Term. If Lessor and Lessee cannot agree on the Reset Rent for an Extension Term, the parties shall mutually engage a "**Qualified Appraiser**" to determine the Reset Rent, which determination shall be conclusive and binding on the parties. The parties agree to share the costs and expenses of the Qualified Appraiser equally. A "Qualified Appraiser" is an appraiser having an MAI

designation from the Appraisal Institute or any successor entity (or such other equivalent designation or certification as may be used by the Appraisal Institute or any successor entity in lieu of an MAI designation) and who has at least ten (10) years' experience in valuing photovoltaic solar ground leases within the Commonwealth of Massachusetts.

EXHIBIT 3

COMMENCEMENT DATE AGREEMENT

THIS COMMENCEMENT DATE AGREEMENT made as of the _____ day of _____, 201_, between **RAVIKUMAR RAMANJANAPPA** ("Lessor") and OYA Solar NY, L.P. ("Lessee").

RECITALS

A. Lessor and Lessee are Lessor and Lessee under that certain ground lease dated as of _____, 201_, (the "Ground Lease") pursuant to which Lessor has leased certain premises more particularly described therein to Lessee (the "Premises"). Capitalized terms not described herein are described in the Lease.

B. The Commencement Date has occurred, the Rent Commencement Date and the initial Expiration Date have been approximated and Lessor and Lessee wish to memorialize those approximate dates, which may be reasonably changed in accordance with the actual date the Improvements and Generating Facility are Placed in Service.

NOW, THEREFORE, Lessor and Lessee hereby agree as follows:

1. The Commencement Date is _____.

2. The approximate Rent Commencement Date is _____.

3. The Construction Rent is [redacted]

4. A Preliminary Site Plan for the construction and installation of the Improvements and Generating Facility is attached hereto as Exhibit A.

5. This Commencement Date Agreement is the document that Lessor and Lessee intended to execute pursuant to Section 2.04 of the Ground Lease.

6. Lessor and Lessee hereby ratify and confirm the terms and provisions of the Ground Lease.

IN WITNESS WHEREOF, Lessor and Lessee have executed this instrument as of the date above written.

RAVIKUMAR RAMANJANAPPA, Lessor

By: _____

OYA Solar NY, L.P., by its general partner, OYA Solar NY, GP Inc., Lessee

By: _____

Exhibit A

Preliminary Site Plan

The preliminary layout is yet to be determined, however it is understood that the entire parcel property will be made available for the proposed Solar Generating Facility with the final layout to be approved by the Lessor within 10 days of Lessee providing a detailed layout.
The solar system size is to be maximized pending wetland, environmental and topology limitations.

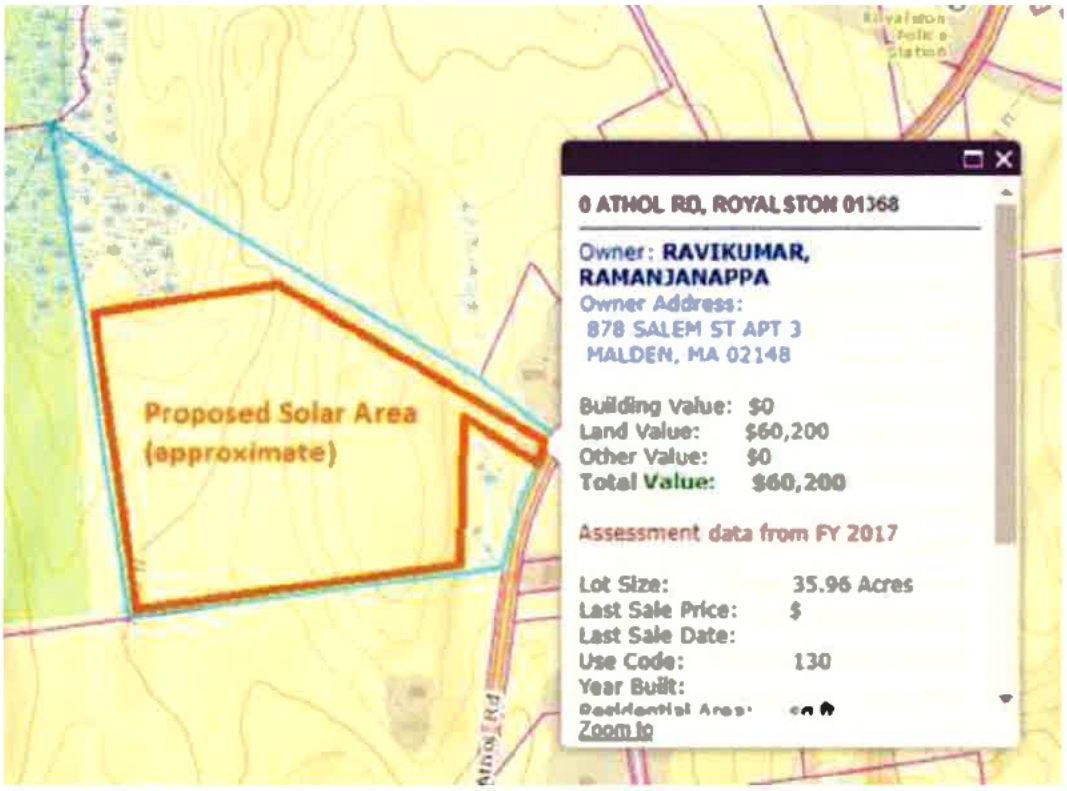


EXHIBIT 4

Memorandum of Lease

MEMORANDUM OF LEASE

RAVIKUMAR RAMANJANAPPA, as Lessor

and

OYA Solar NY, L.P., as Lessee,

Location of Premises

Street Name:	0 Athol Road
Town:	Royalston
County:	Worcester
State:	Massachusetts
Zip Code:	01368
Property ID:	2550110005500050
Acres:	35.96

Record and Return To:

Alexander S. Leff
SIVE, PAGET & RIESEL P.C.
560 Lexington Avenue, 15th Floor
New York, NY 10022

MEMORANDUM OF LEASE

THIS MEMORANDUM OF LEASE, made as of _____, 201_, between RAVIKUMAR RAMANJANAPPA, located at 878 Salem St, Apt 3, Malden, MA, 02148, as lessor (**"Lessor"**) and OYA Solar NY, L.P., a Delaware limited partnership, having offices at 144 Front Street West, Unit 310, Toronto, ON M5J 2L7, Canada as lessee (**"Lessee"**).

RAVIKUMAR RAMANJANAPPA, as Lessor, and OYA Solar NY, L.P., as Lessee, are parties to that certain lease dated as of _____ (the "Lease"), covering a defined portion of that certain parcel of land described in Schedule A annexed hereto, and identified on the current Property ID of the Town of Royalston, County of Worcester, Commonwealth of Massachusetts as 2550110005500050 (the "Premises").

1. Lessor's address, as set forth in the Lease, is 878 Salem St, Apt 3, Malden, MA, 02148.

2. Lessee's address, as set forth in the Lease, is 144 Front Street West, Unit 310, Toronto, ON M5J 2L7.

3. All members of the general public are hereby placed on notice of inquiry as to the specific provisions of the Lease, all of which are incorporated herein by reference with the same force and effect as if herein set forth in full.

4. The term of the Lease (the "Term") commences on the Commencement Date and extends for 20 years from the Rent Commencement Date, as such terms are defined in the Lease.

5. Lessee has the right to extend the term of the Lease (the "Extension Terms") for four additional five (5) year terms.

6. During the Term and any Extension Term of the Lease, Lessee has the sole and exclusive right to use the Premises for the Permitted Uses and Lessor shall not grant any rights in the Premises purporting to permit others to occupy or use the Premises in derogation of Lessee's sole and exclusive rights and privileges under the Lease.

7. The Improvements and the Generating Facility (as such terms are defined in the Lease) shall not be deemed to be fixtures (even if affixed to the Premises) and shall be and remain the sole property of the Lessee, free and clear of any liens or other interests in favor of Lessor,

8. At all times, Lessee shall have one hundred percent (100%) of all right, title, and interest in an to all renewable energy credits (or solar renewable energy credits as the case may be), ancillary services, green tags, green tag reporting rights, environmental incentives, tax attributes of ownership of the Generating Facility, all other Improvements, all Alterations and all Personal Property acquired (or leased) by Lessee or Lessee's Affiliates, including, without limitation, the right to claim tax credits, depreciation, or cost recovery deductions, and other items of whatever nature relating to the environmental and energy attributes and incentives of the Improvements and Generating Facility.

9. Lessor has granted Lessee a Solar Easement, an Access Easement (as further described in Schedule A-1 attached hereto), and a Transmission Easement (as further described in Schedule A-2 attached hereto) in the Lease, and the Solar Easement, the Access Easement, the Transmission Easement, and all other easements and related rights granted by Lessor in this Lease to Lessee shall constitute easements "in gross."

10. Lessee may, without the consent of Lessor, assign or sublease any of its rights, duties, or obligations under the Lease; provided that Lessee shall (i) provide notice to Lessor specifying the name, address, and employer identification number of the assignee or sublessee, if any; and (ii) deliver to Lessor a true and complete copy of the assignment or sublease, as the case may be, and all related agreements. No such assignment or sublease, nor any amendment thereto, shall be effective unless and until Lessee delivers to Lessor, within thirty (30) days of execution thereof, a duplicate original of the fully-executed instrument of assignment or sublease or amendment.

11. Lessor, its successors and assigns shall, upon the expiration or sooner termination of the Lease, obtain Lessee's written consent to execute and record an instrument evidencing the expiration or sooner termination of the Lease.

12. The purpose of this Memorandum is to give notice of the existence of the tenancy created by the Lease; and shall not be construed to vary or otherwise affect the rights or obligations of the parties under the Lease as it may be amended.

13. To facilitate execution, this Memorandum may be executed in as many counterparts as may be convenient or required. It shall not be necessary that the signature of, or on behalf of, each party, or that the signature of all persons required to bind any party appear on each counterpart. All counterparts shall collectively constitute a single instrument. It shall not be necessary in making proof of this Memorandum to produce or account for more than a single counterpart containing the respective signatures of, or on behalf of, each of the parties hereto. Any signature page to any counterpart may be detached thereon and thereafter, attached to another counterpart identical thereto except having attached to it additional signature pages.

14. Upon recording of this Memorandum in the real estate records of Worcester County, Massachusetts, this Memorandum will serve as notice of the Lease for all purposes.

[*Signature Pages Follow*]

IN WITNESS WHEREOF, the parties have duly executed this Agreement as of the date first above written.

LESSOR:

RAVIKUMAR RAMANJANAPPA

By: R. Ravikumar

COMMONWEALTH OF MASSACHUSETTS)
) ss.:
COUNTY OF Middlesex

On this 28 day of December, 2017 before me, the undersigned notary public, personally appeared Ramanjanappa Ravi Kumar (name of document signer), proved to me through satisfactory evidence of identification, which were Mass MA DL S71750377, to be the person who signed the preceding or attached document in my presence, and who swore or affirmed to me that the contents of the document are truthful and accurate to the best of (his) (her) knowledge and belief.

(as partner for _____, a partnership)
(as _____ for _____, a corporation)
(as attorney in fact for _____, the principal)
(as _____ for _____, (a) (the)_____)

Notary Public

AZIZA IZEM
Notary Public
COMMONWEALTH OF MASSACHUSETTS
My Commission Expires
August 13, 2021

IN WITNESS WHEREOF, the parties have duly executed this Agreement as of the date first above written.

LESSEE:

OYA Solar NY, L.P., by its general partner OYA Solar NY GP, Inc.

By: _____
Name: Manish Nayar
Title: President

STATE OF NEW YORK)

COUNTY OF)

On the 28 day of December in the year 2017 before me, the undersigned, before me, the undersigned, personally appeared Manish Nayar, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name(s) is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s), or the person upon behalf of which the individual(s) acted, executed the instrument.

_____
Notary Public

[NOTE: OYA ACKNOWLEDGEMENT CANNOT BE TAKEN OUTSIDE OF THE UNITED STATES]

ALEXANDER S. LEFF
NOTARY PUBLIC-STATE OF NEW YORK
No. 02LE6298487
Qualified in New York County
My Commission Expires March 17, 2018

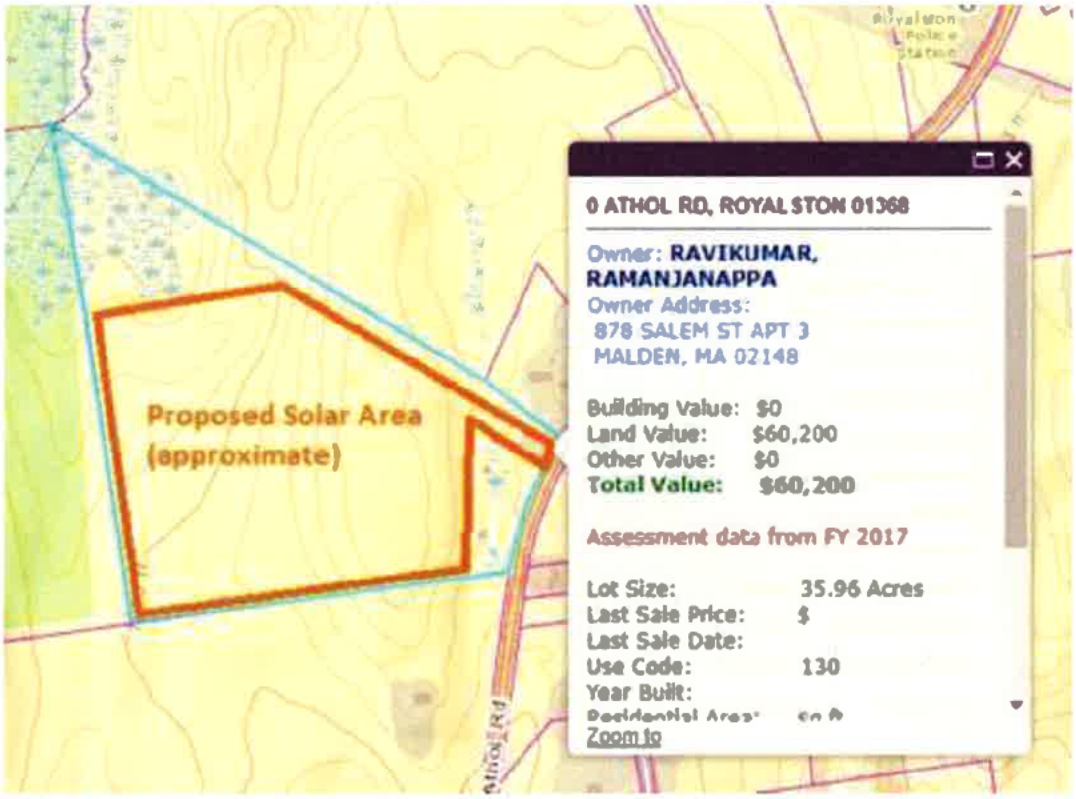
SCHEDULE A
TO MEMORANDUM OF LEASE

Description of the Premises

Street Name:	0 Athol Road
Town:	Royalston
County:	Worcester
State:	Massachusetts
Zip Code:	01368
Property ID:	2550110005500050
Acres:	35.96*

*It is understood that only a portion of the parcel's acreage will be used to determine the rent per acres.

Proposed Premises Area/Preliminary Site Plan:
The actual acreage of the Premises is yet to be determined. Below illustrates the parcel boundaries.



SCHEDULE A-1
TO MEMORANDUM OF LEASE
Description of the Access Easement

SCHEDULE A-2
TO MEMORANDUM OF LEASE
Description of the Transmission Easement

EXHIBIT 5

[Intentionally Omitted]

Appendix K: Proof of Liability Insurance

CERTIFICATE OF INSURANCE

ISSUE DATE (MM/DD/YY)
05/29/2018

BROKER

HUB International Ontario Limited
3063 Walker Road
Windsor, ON N8W 3R4

This certificate is issued as a matter of information only and confers no rights upon the certificate holder. This certificate does not amend,extend or alter the coverage afforded by the policies below.

Company A	CNA Canada
Company B	
Company C	
Company D	
Company E	

INSURED'S FULL NAME AND MAILING ADDRESS
Oya Solar U.S. G.P. Inc.
144 Front Street Suit 310
Toronto, ON M5J2L7
Canada

COVERAGES

This is to certify that the policies of insurance listed below have been issued to the insured named above for the policy period indicated, not withstanding any requirement, term or condition of any contract or other document with respect to which this certificate may be issued or may pertain. The insurance afforded by the policies described herein is subject to all the terms, exclusions and conditions of such policies. Limits shown may have been reduced by paid claims.

TYPE OF INSURANCE	CO LTR	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS OF LIABILITY (Canadian dollars unless indicated otherwise)	
COMMERCIAL GENERAL LIABILITY ☐ CLAIMS MADE ☒ OCCURRENCE ☒ PRODUCTS AND/OR COMPLETED OPERATIONS ☒ PERSONAL INJURY ☐ EMPLOYER'S LIABILITY ☒ TENANT'S LEGAL LIABILITY ☒ NON-OWNED AUTOMOBILE ☐ HIRED AUTOMOBILE	A	BINDER	05/29/2018	05/29/2019	EACH OCCURRENCE	$ 2,000,000
					GENERAL AGGREGATE	$
					PRODUCTS - COMP/OP AGGREGATE	$ 2,000,000
					PERSONAL INJURY	$ 2,000,000
					EMPLOYER'S LIABILITY	$
					TENANT'S LEGAL LIABILITY	$ 500,000
					NON-OWNED AUTOMOBILE	$ 2,000,000
					HIRED AUTOMOBILE	$
AUTOMOBILE LIABILITY ☐ DESCRIBED AUTOMOBILES ☐ ALL OWNED AUTOMOBILES ☐ LEASED AUTOMOBILES ** ☐ GARAGE LIABILITY ☐ **ALL AUTOMOBILES LEASED IN EXCESS OF 30 DAYS WHERE THE INSURED IS REQUIRED TO PROVIDE INSURANCE					BODILY INJURY PROPERTY DAMAGE COMBINED	$
					BODILY INJURY (Per person)	$
					BODILY INJURY (Per accident)	$
					PROPERTY DAMAGE	$
EXCESS LIABILITY ☐ UMBRELLA FORM ☐ OTHER THAN UMBRELLA FORM					EACH OCCURRENCE	$
					AGGREGATE	$
OTHER (SPECIFY)						$
						$
						$
						$
						$

DESCRIPTION OF OPERATIONS/LOCATIONS/AUTOMOBILES/SPECIAL ITEMS/ ADDITIONAL INSURED

For Information Purposes Only

Limits are in Canadian Funds.

CERTIFICATE HOLDER

Oya Solar U.S. G.P. Inc.
144 Front Street Suit 310
Toronto, ON M5J 2L7
Canada

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING COMPANY WILL ENDEAVOUR TO MAIL 0 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT, BUT FAILURE TO MAIL SUCH NOTICE SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE COMPANY, ITS AGENTS OR REPRESENTATIVES.

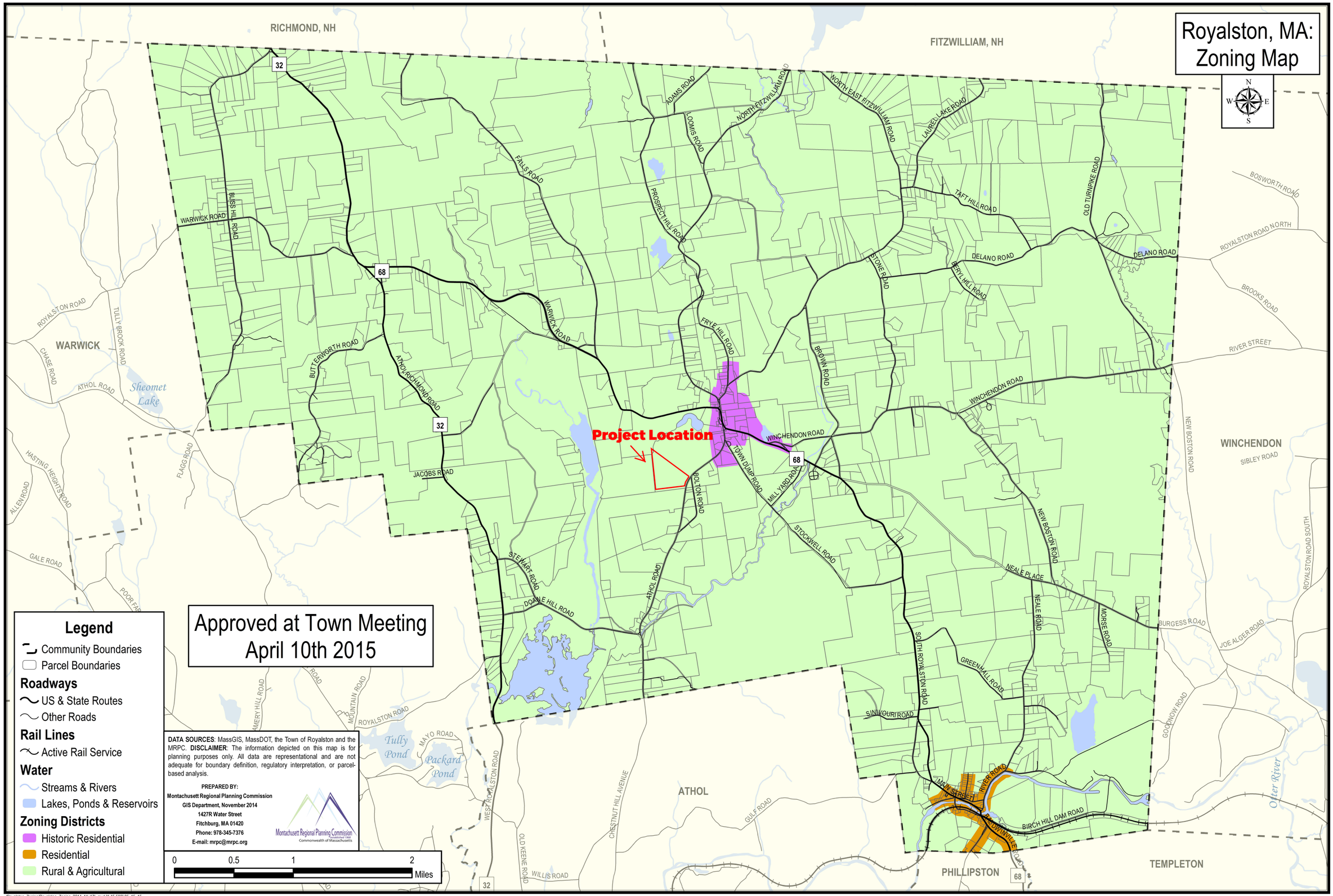
AUTHORIZED REPRESENTATIVE

Per: M. Zuke

NYZGZK4L

Appendix L: Zoning District Map with Proposed Project Location

Royalston, MA: Zoning Map



/Royalston_Zoning/Royalston_Zoning_2014_11x17L.mxd [1:45,500] 05_15_15

Appendix M: Stormwater Management Report

Stormwater Report

OYA Solar MA, L.P.

OYA Raman Solar

0 Athol Road

Royalston, MA 01368

July 5, 2018

Prepared for:

Town of Roylaston Planning Board
P.O. Box 127
Royalston, MA 01368

Prepared by:

Stantec Consulting Services Inc.
226 Causeway St., 6th Floor
Boston, MA 02114

Table of Contents

LIST OF TABLES

LIST OF APPENDICES

Project Summary

OYA Solar MA, L.P. (OYA) is proposing to construct a solar field on an existing vacant parcel of land at 0 Athol Road in the Town of Royalston, MA. The 4.99 MW AC field will be constructed on the 36-acre parcel, with a buildable area of approximately 30 acres.

In addition to the solar field and associated infrastructure, a 15-foot-wide access driveway, perimeter fence and stormwater management improvements will be constructed as part of the Project.

The proposed stormwater management system has been designed in accordance with the Massachusetts Department of Environmental Protection's *Stormwater Management Standards.* This report documents the Project's compliance with the Massachusetts standards for stormwater management.

Supporting figures can be found within Appendix A. Supporting calculations can be found in Appendix D. The Operation and Maintenance Plan and Log for the proposed system can be found in Appendix E. All elevations noted within this report reference the North American Vertical Datum of 1988 (NAVD 88) unless otherwise noted.

1.0 EXISTING CONDITIONS

1.1 SITE LOCATION

The 36-acre Project Site is located at 0 Athol Road, Royalston, MA in Worcester County. The Site is located directly to the west and north of the northern intersection of Athol Road and Bolton Road *(Appendix A – Figure 3 – Locus Map)*.

1.2 SITE TOPOGRAPHY

The topography of the Site slopes towards two bordering vegetated wetlands to the east and one to the northwest with the high point spanning south to north across the center of the site. Elevations range from 1073'± in the center to 1040'± near the east wetlands along Athol Road and 989'± at the northwest wetland (*Appendix A – Figure 1 – USGS Map*).

1.3 SITE WATERSHED

The Site is located within the Millers River Watershed. The Site does not discharge to a Public Water Supply or a Surface Water Protection Zone and does not discharge to Outstanding Resource Waters. The northwest bordering vegetated wetland is within a Zone B, 500-year floodplain *(Appendix A – Figure 4 – FEMA Map)*.

1.4 SITE PEDOLOGY

The Natural Resources Conservation Service (NRCS) Soil Survey of Middlesex County, Massachusetts indicates that the soil on Site is composed predominately of Becket-Skerry association (0-15 percent slopes, eastern and southwestern portions of the Site, Map Unit 908C). Another large portion of the Site is comprised of Pillsbury-Peacham association (0-8 percent slopes, centrally located on Site, Map Unit 917B). the remaining portion is comprised of Bucksport and Wonsqueak mucks (0-2 percent slopes, northwest portion of Site, Map Unit 59A) and Skerry fine sandy loam (3 to 8 percent slopes, northeastern corner of Site, Map Unit 365B).

The Becket-Skerry association is assigned a Hydrologic Soil Group (HSG) rating of "B/D". The Pillsbury-Peacham association is assigned a Hydrologic Soil Group (HSG) rating of "C/D". Bucksport and Wonsqueak muck is assigned a Hydrologic Soil Group (HSG) rating of "C/D". Based on the NRCS Soil Report, the Site has been assigned the appropriate Hydrologic Soil Group (HSG) rating for each portion of the site. (*Appendix C – NRCS – Custom Soil Resource Report*).

1.5 SITE GROUNDWATER

Based on the NRCS Soil Survey, depth to groundwater varies according to the soil types. For the Becket-Skerry association, water table is expected to be approximately 19" to more than 80" below grade. For the Pillsbury-Peacham association, water table is expected to be near the surface to approximately 18" below grade. Water table for the Bucksport and Wonsqueak mucks is expected to be at grade. Water table for the Skerry fine sandy loam is expected to be between 18-30" below grade.

2.0 MASSACHUSETTS STORMWATER MANAGEMENT STANDARDS

The following documents the Project's compliance with all ten standards for stormwater management as defined by the Massachusetts Department of Environmental Protection's (MassDEP) *Stormwater Management Standards*. The requirements for documenting compliance can be found within MassDEP's *Massachusetts Stormwater Handbook*.

2.1 STANDARD 1 – UNTREATED DISCHARGE

Standard 1 states that "no new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth."

No proposed impervious surface will generate runoff requiring treatment. The Stormwater runoff generated by or draining onto the Site will be captured and directed to detention basins prior to discharge to each design point. One outfall is proposed for each of the four basins, each discharging to separate design points. A riprap apron has been designed to dissipate energy from the outfalls to prevent erosion to the adjacent upland or wetland areas. Calculations for the sizing of the rip rap aprons are included in *Appendix D – Rip-rap Apron Sizing*.

Therefore, the Project complies with Standard 1.

2.2 STANDARD 2 – PEAK RATE ATTENUATION

Standard 2 states that "stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates."

The proposed stormwater management system is designed to reduce peak rate for all storms up to and including the 100-year, 24-hour event. In doing so, the post-development peak discharge rates do not exceed the pre-development peak discharges rates. The following sections outline the methodology and design criteria used in the development of a hydrologic model that best represents the Site in the pre- and post-conditions. Summary model output data serves as documentation of peak rate attenuation for the Project.

2.2.1 Methodology and Design Criteria

Site drainage analysis was performed using the Soil Conservation Service (SCS) TR-55 and TR-20 methodologies as facilitated by the computer program HydroCAD 10.00 (HydroCAD) by HydroCAD Software Solutions, LLC. Utilizing the HydroCAD software, a hydrologic model was developed to generate peak runoff rates for both the existing and proposed conditions of the Site. Design criteria for the hydrologic model included subcatchment areas, design points, soil conditions, curve numbers, time of concentration, and design storms.

<u>Subcatchment Areas</u>

For both the existing and proposed hydrologic conditions, the Site was divided into subcatchment areas based on the general flow direction of stormwater runoff. Each subcatchment, either directly or indirectly, discharges to one of the five design points as identified below.

Design Points

Design points, which serve as comparison points for the peak discharge rates of the pre- and post-development hydrologic conditions, were established at either the Site's property line or at a hydrologic point of interest. In total, five design point were established for the Site.

- **DP1**: Located on the eastern portion of the site, Design Point 1 is a bordering vegetated wetland that is located generally parallel to Athol Road.
- **DP2**: Also located on the eastern portion of the site, near the northern property line, Design Point 2 is a bordering vegetated wetland located approximately 100 feet to the north of DP1.
- **DP3**: Design Point 3, bordering the site to the East, is Athol Road.
- **DP4**: Located at the northwest corner of the site, Design Point 4 is a bordering vegetated which captures most of the site runoff.
- **DP5**: Located in the southwest corner of the site, Design Point 5 is adjacent, offsite forested land.

Soil Conditions

The soil conditions are as described in Section 1.4 of this report.

Curve Numbers

Curve numbers were developed for each subcatchment drainage area based on the different use categories and hydrologic soil group types. Based on the soil conditions outlined above, a hydrologic soil group classification of HSG C, D or C/D was utilized for hydrologic models and calculations depending on the portion of the site. The curve numbers were based on the SCS TR-55 methodology and can be found in the attached HydroCAD report.

Time of Concentration

The Time of Concentration (Tc) for each subcatchment was determined by finding the time necessary for runoff to travel from the most hydrologically distant point in the subcatchment to the point of concentration. The travel path was drawn based on the topography of the Site and the time was calculated using the TR-55 Method and HydroCAD. Time of concentration varies for each subcatchement, calculations can be found in the attached HydroCAD reports in Appendix D.

Design Storms

For both the existing and proposed hydrologic conditions, the hydrologic model analyzed the Site's performance during the 1 inch, 2-, 10-, 25-, and 100-year frequency rainfall events. The events were based on the Type-III, 24-hour duration storm. Rainfall depths corresponding to the selected storm events can be found in *Table 1 – Design Storm Events* and were acquired from the TP-40 lookup table in HydroCAD for Worcester County.

Table 1 – Design Storm Events

Storm Event	Rainfall Depth (inches)
2-year	3.00
10-year	4.50
25-year	5.30
100-year	6.50

2.2.2 Existing Hydrologic Conditions

The following assumptions were made for the existing hydrologic conditions analysis:

- Whenever possible, the property line, and/or a line outside the limit of proposed work, was delineated as the watershed boundary.
- The total watershed area for the proposed conditions corresponds to the total watershed area for the existing conditions.

For the existing conditions analysis, the Site was divided into five subcatchment areas *(Appendix D – Existing Watershed Plan*). The peak discharge rates for the pre-development conditions were analyzed at all five design points. The following provides a general description of each subcatchment:

Subcatchment EX1

Subcatchment EX1 is located in the southeast corner of the site and is composed of forested area and wetlands. Stormwater runoff from this subcatchment is directed towards the bordering vegetated wetland, DP1, described in section 2.2.1. Runoff flows towards the wetlands at the center of the subcatchment.

Subcatchment EX2

Subcatchment EX2 is located in the northeast corner of the site and is composed of existing forested area and a small wetland pocket, DP2, described in section 2.2.1. Runoff flows towards the wetland near the northern property line.

Subcatchment EX3

Subcatchment EX3 is located in the farm northeast corner of the site between EX1, EX2 and Athol Road. EX3 is composed of existing forested area. Runoff flows overland onto Athol Road.

Subcatchment EX4

Subcatchment EX4 spans across the central, west and northern portions of the site. EX4 is comprised of forested area. Runoff flows northwest towards the bordering vegetated wetland, DP4.

Subcatchment EX5

Subcatchment EX5 is located in the southwest corner of the site and is composed of existing forested area. Runoff flows offsite to the southwest to existing forested area, DP5.

A summary of the existing subcatchments can be found in *Table 2 – Existing Subcatchment Summary.*

Table 2 – Existing Subcatchment Summary

Subcatchment Area I.D.	Area (sf)	Time of Concentration, Tc (min.)	Curve Number, CN
EX1	274,559	18.6	70
EX2	130,654	29.2	70
EX3	6,419	6.0	74
EX4	921,536	76.1	74
EX5	53,515	13.9	70
TOTAL	**1,386,683**		

2.2.3 Proposed Hydrologic Conditions

The following assumptions were made for the proposed hydrologic conditions analysis:

- Whenever possible, the property line, and/or a line outside the limit of proposed work, was delineated as the watershed boundary.
- The total watershed area for the proposed conditions corresponds to the total watershed area for the existing conditions.

For the proposed hydrologic conditions analysis, the Site was divided into five subcatchment areas *(Appendix D - Proposed Watershed Plan).* The peak discharge rates for the post-development conditions were analyzed at each of the five design points. The following provides a general description of each subcatchment:

Subcatchment PR1

Subcatchment PR1 is in the southeast corner of the site and consists of densely vegetated tree and grass cover with a bordering vegetated wetland near the center. PR1 is divided into two catchment areas PR1A and PR1B. PR1A captures the western portion of runoff in a detention basin prior to discharge to the bordering vegetated wetland, DP1. PR1B is an undisturbed portion of land where runoff flows overland towards the bordering vegetated wetland, DP1, similar to existing conditions.

Subcatchment PR2

Subcatchment PR2 is in the northeast corner of the site and consists of densely vegetated tree and grass cover with a bordering vegetated wetland near the center. PR2 is divided into two catchment areas PR2A and PR2B. PR2A captures the western portion of runoff in a detention basin prior to discharge to the bordering vegetated wetland, DP2.

PR2B is a mostly undisturbed portion of land where runoff flows overland towards the bordering vegetated wetland, DP2, similar to existing conditions.

Subcatchment PR3

Subcatchment PR3 is an undisturbed portion of land located in the far eastern corner of the site. PR3 consists of grassed area that flows overland onto Athol Road.

Subcatchment PR4

Subcatchment PR4 spans across the central and northwestern portions of the site and consists of densely vegetated tree and grass cover. PR4 is divided into two catchment areas PR4A and PR4B. PR4A captures the eastern, southern and central portions of runoff in a detention basin prior to discharge to the bordering vegetated wetland, DP4. PR4B is the portion of the site adjected to the northwest bordering vegetated wetland. Runoff flows overland towards the bordering vegetated wetland, DP4, similar to existing conditions.

Subcatchment PR5

Subcatchment PR5 is in the far southwest corner of the site. PR5 consists of densely vegetated tree and grass cover. Runoff from PR5 is captured in a detention basin via overland flow and drainage swales prior to discharge offsite to DP5.

A summary of the existing subcatchments can be found in *Table 3 – Proposed Subcatchment Summary.*

Table 3 – Proposed Subcatchment Summary

Subcatchment Area I.D.	Area (sf)	Time of Concentration, Tc (min.)	Curve Number, CN
PR1A	80,503	7.1	74
PR1A	186,314	8.6	70
PR2A	76,739	11.7	74
PR2B	61,562	9.3	70
PR3	6,419	6.0	74
PR4A	682,806	27.6	77
PR4B	238,825	9.5	74
PR5	53,515	8.0	74
Total	**1,386,683**		

The peak discharge runoff rates were calculated for the 1-inch, 2-, 10-, 25-, and 100-year storm events for both proposed and existing conditions to demonstrate that proposed peak runoff rates do not exceed existing at all design points. The results of this comparison can be found in *Table 4 – Peak Discharge Runoff Rates.*

Table 4 – Peak Discharge Runoff Rates

Design Point		2-Year Storm (3.00")	10-Year Storm (4.50")	25-Year Storm (5.30")	100-Year Storm (6.50")
DP1	Existing Rate (cfs)	3.15	8.27	11.38	16.35
	Proposed Rate (cfs)	2.79	7.53	10.49	15.05
DP2	Existing Rate (cfs)	1.25	3.25	4.47	6.41
	Proposed Rate (cfs)	1.23	3.24	4.40	6.10
DP3	Existing Rate (cfs)	0.14	0.33	0.44	0.61
	Proposed Rate (cfs)	0.14	0.33	0.44	0.61
DP4	Existing Rate (cfs)	7.03	16.25	21.70	30.26
	Proposed Rate (cfs)	6.04	14.79	20.25	27.89
DP5	Existing Rate (cfs)	0.69	1.80	2.48	3.56
	Proposed Rate (cfs)	0.63	1.61	2.32	3.27

The proposed peak discharge runoff rates do not exceed the existing peak discharge runoff rates for the 1-inch, 2-, 10-, 25-, and 100-year storm events.

Therefore, the Project complies with Standard 2.

2.3 STANDARD 3 – STORMWATER RECHARGE

Standard 3 states that the "loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

The proposed conditions will not add any impervious area, nor will the natural ability of the site to infiltrate be altered. Stormwater runoff will continue to flow to the same design points as the existing condition, however with a reduced peak rate as required by standard 2. Overall, stormwater will continue to infiltrate the same in the proposed condition as it does in present day.

2.4 STANDARD 4 – WATER QUALITY

Standard 4 states that "Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids."

Standard 4 is met when a project complies with all the following criteria:

1. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;
2. Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and
3. Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook

The proposed project will not generate any potential sources of pollution or possible groundwater contaminates. Therefore, no structural stormwater best management practices or pretreatment are proposed.

2.4.1 Long-Term Pollution Prevention Plan

A long-term pollution prevention plan was not prepared as the project is not proposing any sources of pollution.

2.4.2 Required Water Quality Volume

The Massachusetts Stormwater Handbook requires a water quality treatment volume equal to the product of 1-inch and the total impervious area if the Site discharges to/from any of the following areas:

- From a Land Use with Higher Potential Pollutant Load
- From an area with an infiltration rate greater than 2.4 in/hr
- To a Zone II or Interim Wellhead Protection area
- To/near a Critical Area

For all other discharge conditions, the required water quality treatment volume is equal to the product of one-half inch and the total impervious area.

The project is not proposing any impervious area. Therefore, no water quality volume is required.

2.4.3 TSS Removal

The Massachusetts Stormwater Handbook requires that stormwater management systems remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). The Handbook also requires that at least 44% of the TSS must be removed prior to discharge to the infiltration structure if the discharge is within an area with a rapid infiltration rate (greater than 2.4 inches per hour).

No total suspended solids will be generated with this project, therefore no TSS removal is proposed.

2.5 STANDARD 5 – LAND USES WITH HIGHER POTENTIAL POLLUTANT LOADS (LUHPPL)

Standard 5 states that “for land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable.”

The Site is not considered a LUHPPL, as defined by the Massachusetts Department of Environmental Protection. Therefore, Standard 5 is not applicable to the Project.

2.6 STANDARD 6 – CRITICAL AREAS

Standard 6 states that "Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook."

Critical areas include any one of the following, as defined by the Massachusetts Department of Environmental Protection:

- Outstanding Resource Waters
- Special Resource Waters
- Zone I Recharge Areas
- Zone II Recharge Areas
- Interim Wellhead Protection Areas
- Zone A Recharge Areas
- Bathing Beaches
- Cold-water Fisheries
- Shellfish Growing Areas

The proposed stormwater management system does not discharge near or to any of the above listed critical areas. Therefore, the Project complies with Standard 6.

2.7 STANDARD 7 – REDEVELOPMENT PROJECTS

Standard 7 states that "a redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions."

A project may be classified as a redevelopment if it meets any one of the following criteria:

1. Maintenance and improvement of existing roadways, including widening less than a single lane, adding shoulders, correcting substandard intersections, improving existing drainage systems, and repaving.
2. Development, rehabilitation, expansion and phased projects on previously developed sites, provided the redevelopment results in no net increase in impervious area.
3. Remedial projects specifically designed to provide improved stormwater management, such as projects to separate storm drains and sanitary sewers and stormwater retrofit projects.

The proposed project is not a redevelopment project. Therefore, Standard 7 is not applicable to the Project.

2.8 STANDARD 8 – EROSION AND SEDIMENTATION CONTROL PLAN

Standard 8 states that "a plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented."

Erosion and sediment controls will be implemented during construction of the project. The Site Preparation Plans for the project include perimeter erosion controls, consisting of compost filter socks with siltation fence. During construction, the Contractor will prepare a Stormwater Pollution Prevention Plan that will include appropriate supplemental erosion controls that will contain additional information regarding the Construction Sequencing Plan, the Sequencing of Erosion and Sedimentation Controls, Inspection and Maintenance Schedules, and Inspection and Maintenance Logs. The Contractor will be responsible to control erosion and sedimentation controls throughout construction.

The project has been designed to control erosion and sedimentation through the appropriate design or rip rap aprons at detention basin outlets, rip rap spillways, and drainage channels lined with rip rap. Refer to the Rip-Rap Apron Sizing calculations in Appendix D.

2.9 STANDARD 9 – OPERATION AND MAINTENANCE PLAN

Standard 9 states that "a long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed."

An operation and maintenance plan can be found in Appendix E. This plan outlines long-term operation and maintenance procedures for non-structural BMPs, structural BMPs, and the overall Site that will allow the proposed stormwater management system to function as designed.

Therefore, the Project complies with Standard 9.

2.10 STANDARD 10 – ILLICIT DISCHARGES

Standard 10 states that "all illicit discharges to the stormwater management system are prohibited." As stated in the Massachusetts Stormwater Handbook, "The stormwater management system is the system for conveying, treating, and infiltrating stormwater on-site, including stormwater best management practices and any pipes intended to transport stormwater to the groundwater, a surface water, or municipal separate storm sewer system. Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater.

Proponents of projects within Wetlands jurisdiction must demonstrate compliance with this requirement by submitting to the issuing authority an Illicit Discharge Compliance Statement verifying that no illicit discharges exist on the project area and by including in the pollution prevention plan measures to prevent illicit discharges to the stormwater management system."

No potential sources of illicit discharges are proposed for this project.

APPENDIX

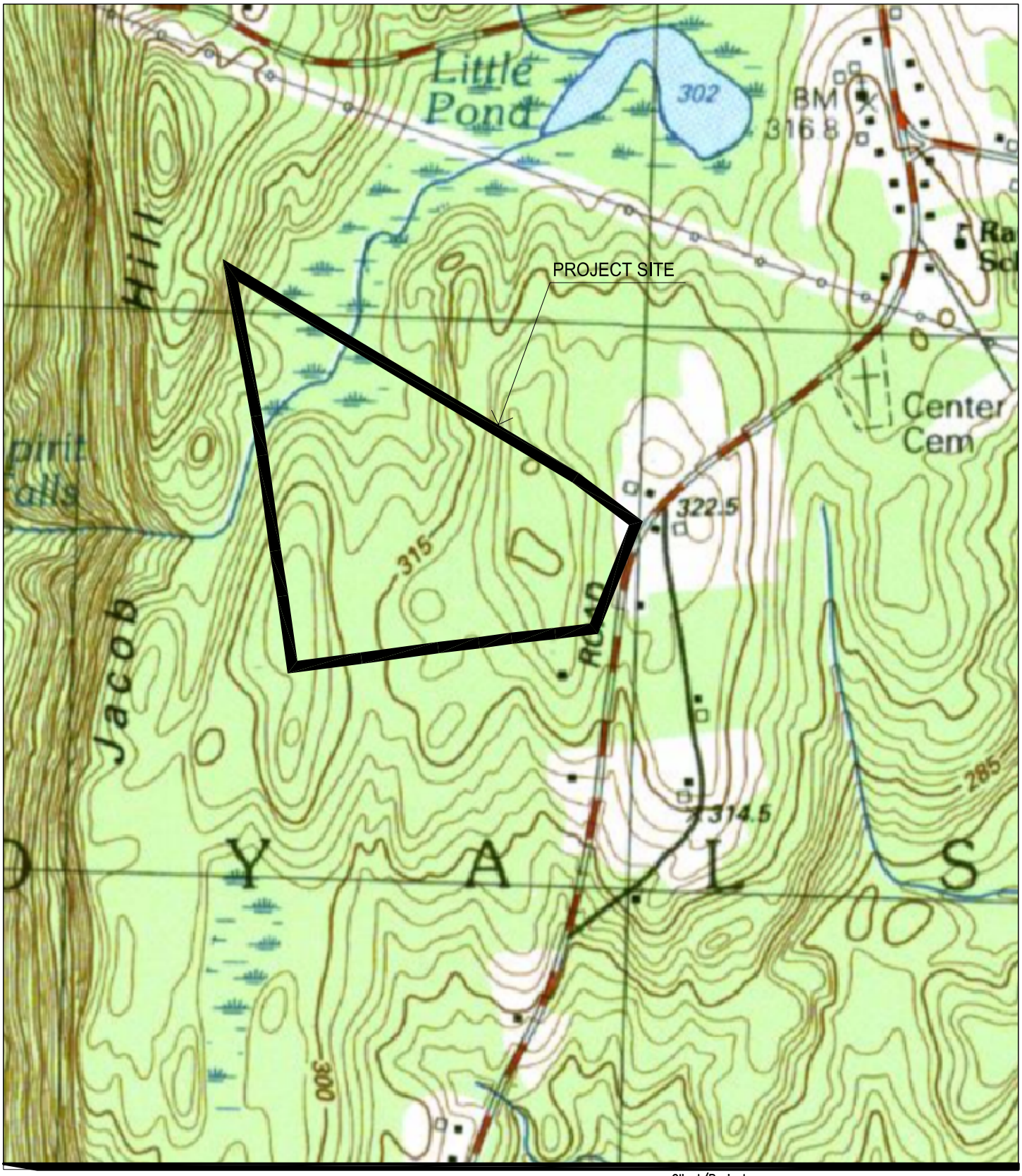
Appendix A FIGURES

A.1 FIGURE 1 – USGS MAP

A.2 FIGURE 2 – ORTHO MAP

A.3 FIGURE 3 – LOCUS MAP

A.4 FIGURE 4 – FEMA FLOOD MAP



Stantec Consulting Services, Inc.
226 Causeway St.
Boston MA 02114 U.S.A.
Tel. 617.523.8103
Fax. 617.523.4333
www.stantec.com

Client/Project
OYA Solar
OYA Raman Solar

Figure No.
1

Title
USGS TOPOGRAPHY MAP

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OYA Solar
OYA Raman Solar

Figure No.
2

Title
ORTHO MAP

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OYA Solar
OYA Raman Solar

Figure No.
3

Title
LOCUS MAP

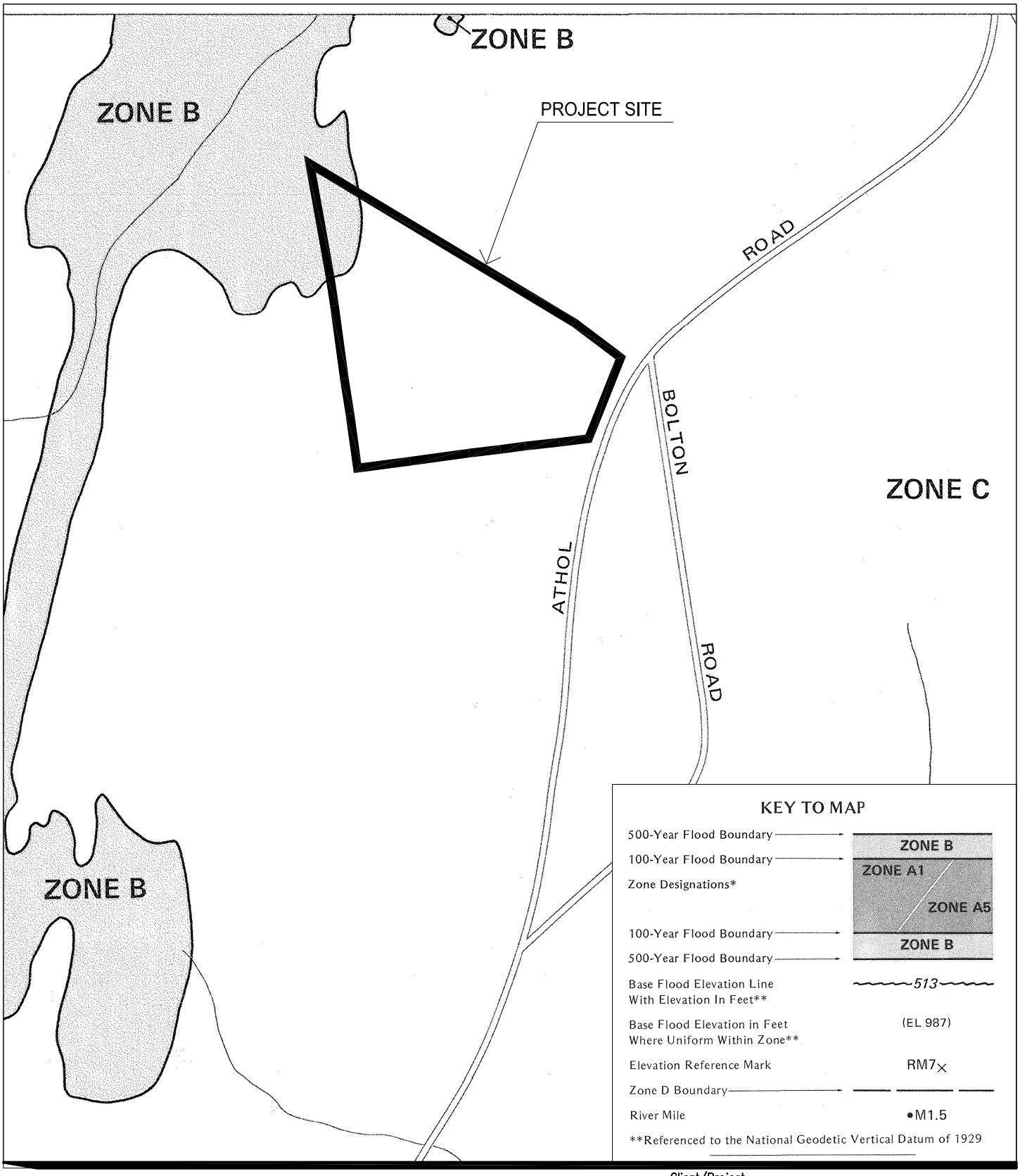

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Figure No.
4

Title
FEMA Flood Map
PANEL 250330 0020 B, JUNE 15, 1983

Appendix B STORMWATER CHECKLIST

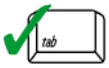
B.1 STORMWATER CHECKLIST

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature

COMMONWEALTH OF MASSACHUSETTS
FRANK
HOLMES
CIVIL
No. 40203
REGISTERED
PROFESSIONAL ENGINEER

Frank Holmes

Frank Holmes 7-5-18
Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☒ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☐ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☐ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☐ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): _____

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☒ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☒ Soil Analysis provided.

☐ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☐ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☐ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☐ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☐ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☐ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☐ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

- ☐ The BMP is sized (and calculations provided) based on:
  - ☐ The ½" or 1" Water Quality Volume or
  - ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.
- ☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.
- ☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

- ☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- ☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.
- ☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.
- ☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.
- ☐ All exposure has been eliminated.
- ☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.
- ☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

- ☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.
- ☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☒ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☐ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☐ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☐ An Illicit Discharge Compliance Statement is attached;

☒ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

Appendix C SOILS INFORMATION

C.1 NATURAL RESOURCES CONSERVATION SERVICE (NRCS) SOIL RESOURCE REPORT

United States Department of Agriculture

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Worcester County, Massachusetts, Northwestern Part

June 5, 2018

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

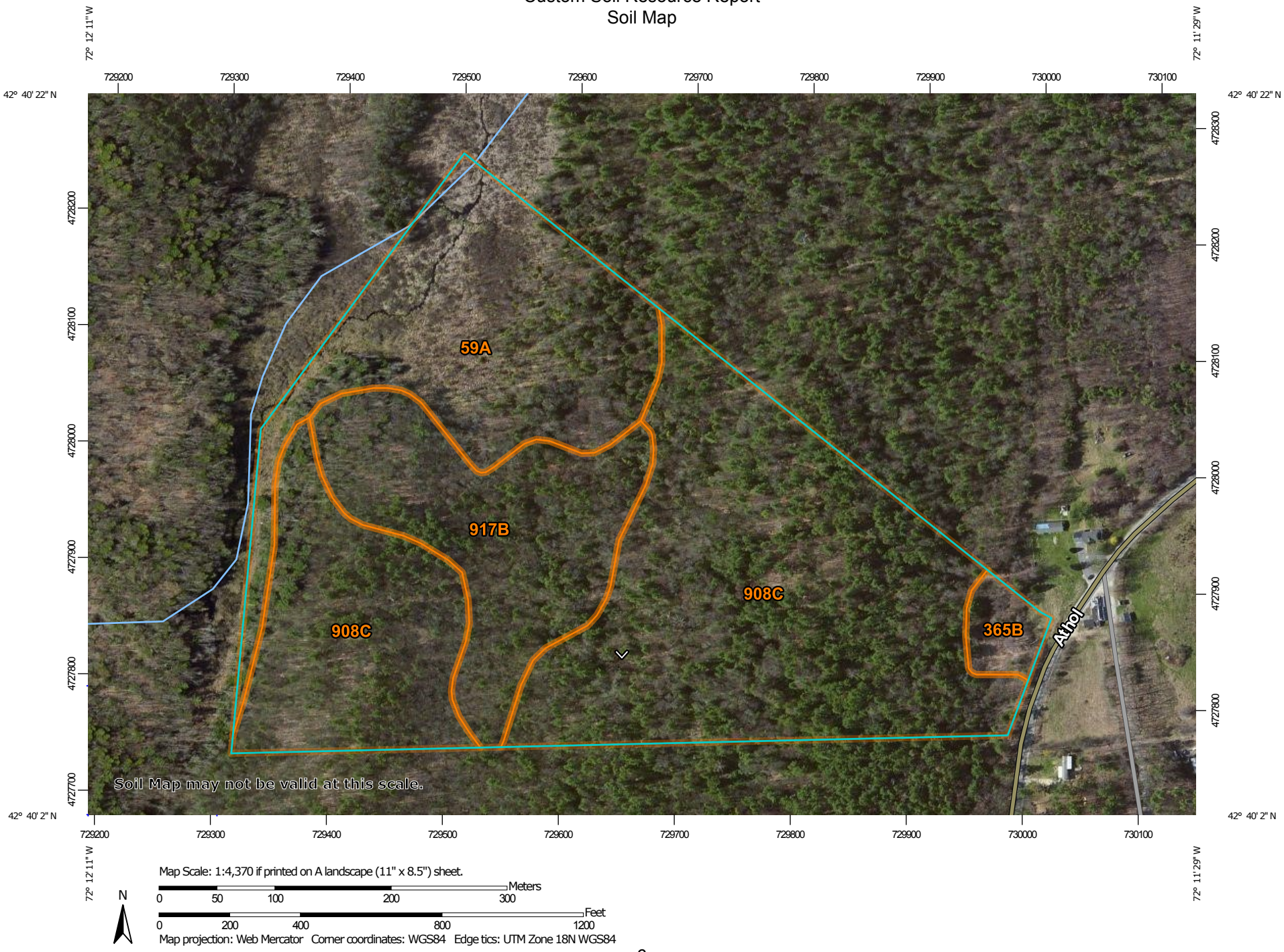
The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

Contents

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:4,370 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Worcester County, Massachusetts, Northwestern Part
Survey Area Data: Version 11, Oct 6, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 9, 2011—May 12, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
59A	Bucksport and Wonsqueak mucks, 0 to 2 percent slopes	13.1	23.5%
365B	Skerry fine sandy loam, 3 to 8 percent slopes	1.2	2.1%
908C	Becket-Skerry association, 0 to 15 percent slopes, extremely stony	31.3	56.1%
917B	Pillsbury-Peacham association, 0 to 8 percent slopes, extremely stony	10.2	18.2%
Totals for Area of Interest		**55.8**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Worcester County, Massachusetts, Northwestern Part

59A—Bucksport and Wonsqueak mucks, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2ty70
Elevation: 0 to 1,770 feet
Mean annual precipitation: 31 to 95 inches
Mean annual air temperature: 27 to 52 degrees F
Frost-free period: 90 to 160 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Bucksport and similar soils: 48 percent
Wonsqueak and similar soils: 41 percent
Minor components: 11 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bucksport

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Mountainbase, interfluve, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Herbaceous organic material and/or woody organic material

Typical profile

Oa1 - 0 to 12 inches: muck
Oa2 - 12 to 25 inches: muck
Oa3 - 25 to 45 inches: muck
Oa4 - 45 to 65 inches: muck

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water storage in profile: Very high (about 21.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Description of Wonsqueak

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Toeslope, footslope

Landform position (three-dimensional): Mountainbase, interfluve, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Herbaceous organic material over loamy till

Typical profile

Oa1 - 0 to 8 inches: muck
Oa2 - 8 to 32 inches: muck
2Cg - 32 to 65 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Very high (about 18.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Peacham, very stony

Percent of map unit: 6 percent
Landform: Mountains, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Mountainbase, interfluve, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Brayton, very stony

Percent of map unit: 2 percent
Landform: Mountains, hills
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Mountainbase, interfluve, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Telos, very stony

Percent of map unit: 2 percent
Landform: Mountains, hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Mountainbase, interfluve, base slope
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Croghan

Percent of map unit: 1 percent
Landform: Outwash plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

365B—Skerry fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2w9p8
Elevation: 260 to 1,210 feet
Mean annual precipitation: 31 to 65 inches
Mean annual air temperature: 36 to 52 degrees F
Frost-free period: 90 to 160 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Skerry and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Skerry

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Mountainbase, interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loamy lodgment till derived from granite and gneiss and/or schist over sandy lodgment till derived from granite and gneiss and/or schist

Typical profile

Ap - 0 to 6 inches: fine sandy loam
Bs1 - 6 to 20 inches: gravelly fine sandy loam
Bs2 - 20 to 25 inches: gravelly fine sandy loam
Cd1 - 25 to 34 inches: gravelly loamy sand
Cd2 - 34 to 65 inches: gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 21 to 43 inches to densic material
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.01 to 1.42 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None

Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.9 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Colonel
Percent of map unit: 6 percent
Landform: Mountains, hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Mountainbase, interfluve
Microfeatures of landform position: Closed depressions, closed depressions
Down-slope shape: Linear, concave
Across-slope shape: Concave
Hydric soil rating: No

Becket
Percent of map unit: 4 percent
Landform: Mountains, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountainbase, interfluve
Microfeatures of landform position: Rises, rises
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Brayton
Percent of map unit: 3 percent
Landform: Mountains, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Mountainbase, interfluve
Microfeatures of landform position: Closed depressions, closed depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Hermon
Percent of map unit: 2 percent
Landform: Mountains, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountainbase, interfluve
Microfeatures of landform position: Rises, rises
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

908C—Becket-Skerry association, 0 to 15 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2x9ny
Elevation: 820 to 1,280 feet
Mean annual precipitation: 36 to 65 inches
Mean annual air temperature: 36 to 52 degrees F
Frost-free period: 90 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Becket, extremely stony, and similar soils: 45 percent
Skerry, extremely stony, and similar soils: 35 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Becket, Extremely Stony

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountainbase, mountainflank, side slope, nose slope, interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy lodgment till derived from granite and gneiss and/or schist over sandy lodgment till derived from granite and gneiss and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
E - 2 to 4 inches: fine sandy loam
Bhs - 4 to 5 inches: fine sandy loam
Bs1 - 5 to 7 inches: fine sandy loam
Bs2 - 7 to 14 inches: fine sandy loam
Bs3 - 14 to 24 inches: gravelly sandy loam
BC - 24 to 33 inches: gravelly sandy loam
Cd - 33 to 65 inches: gravelly loamy sand

Properties and qualities

Slope: 0 to 15 percent
Percent of area covered with surface fragments: 6.0 percent
Depth to restrictive feature: 21 to 43 inches to densic material
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.01 to 1.42 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 5.0 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Skerry, Extremely Stony

Setting
Landform: Mountains, hills
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Mountainflank, mountainbase, side slope, nose slope, interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loamy lodgment till derived from granite and gneiss and/or schist over sandy lodgment till derived from granite and gneiss and/or schist

Typical profile
Oa - 0 to 2 inches: highly decomposed plant material
E - 2 to 4 inches: fine sandy loam
Bhs - 4 to 6 inches: fine sandy loam
Bs1 - 6 to 20 inches: gravelly fine sandy loam
Bs2 - 20 to 25 inches: gravelly fine sandy loam
Cd1 - 25 to 34 inches: gravelly loamy sand
Cd2 - 34 to 65 inches: gravelly loamy sand

Properties and qualities
Slope: 0 to 15 percent
Percent of area covered with surface fragments: 6.0 percent
Depth to restrictive feature: 21 to 43 inches to densic material
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.01 to 1.42 in/hr)
Depth to water table: About 19 to 34 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 4.2 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Pillsbury, extremely stony
Percent of map unit: 6 percent
Landform: Mountains, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Mountainbase, mountainflank, side slope, nose slope, interfluve

Microfeatures of landform position: Open depressions, open depressions, closed depressions, closed depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Berkshire, extremely stony
Percent of map unit: 5 percent
Landform: Mountains, hills
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Mountainflank, mountainbase, side slope, nose slope, interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Monadnock, extremely stony
Percent of map unit: 5 percent
Landform: Mountains, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountainbase, mountainflank, side slope, nose slope, interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Tunbridge, extremely stony
Percent of map unit: 4 percent
Landform: Mountains, hills
Landform position (two-dimensional): Shoulder, backslope, summit
Landform position (three-dimensional): Mountainflank, mountainbase, interfluve, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

917B—Pillsbury-Peacham association, 0 to 8 percent slopes, extremely stony

Map Unit Setting
National map unit symbol: 9c0q
Elevation: 0 to 2,100 feet
Mean annual precipitation: 39 to 55 inches
Mean annual air temperature: 39 to 45 degrees F
Frost-free period: 120 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition
Pillsbury and similar soils: 45 percent

Peacham and similar soils: 35 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pillsbury

Setting

Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Friable coarse-loamy eolian deposits over dense coarse-loamy lodgment till derived from granite and gneiss

Typical profile

A - 0 to 4 inches: gravelly fine sandy loam
Bg - 4 to 14 inches: gravelly fine sandy loam
Bw - 14 to 24 inches: gravelly fine sandy loam
Cd - 24 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 0 to 8 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 15 to 35 inches to densic material
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C/D
Hydric soil rating: Yes

Description of Peacham

Setting

Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Highly-decomposed herbaceous organic material over dense coarse-loamy lodgment till derived from granite and gneiss

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oa - 2 to 11 inches: highly decomposed plant material
Bg - 11 to 14 inches: fine sandy loam
Cd - 14 to 18 inches: fine sandy loam
Cd - 18 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 0 to 3 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 6 to 18 inches to densic material
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: Yes

Minor Components

Peru

Percent of map unit: 10 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Wonsqueak

Percent of map unit: 6 percent
Landform: Bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Chocorua

Percent of map unit: 4 percent
Landform: Bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Appendix D DRAINAGE CALCULATIONS

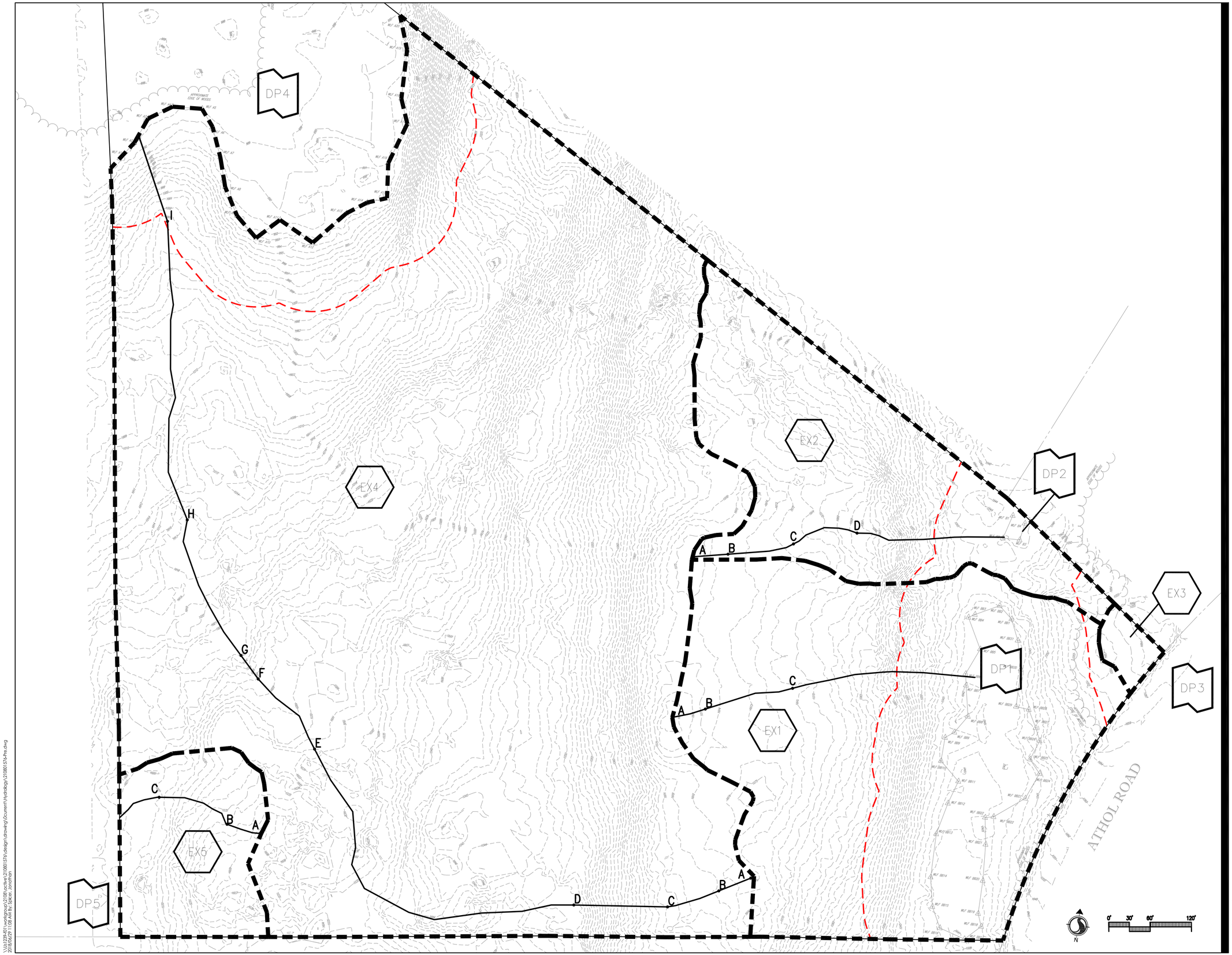
D.1 EXISTING WATERSHED PLAN

D.2 EXISTING CONDITIONS HHYDROCAD

D.3 PROPOSED WATERSHED PLAN

D.4 PROPOSED CONDITIONS HYDOCAD

D.5 RIPRAP APRON SIZING CALCULATIONS



Stantec

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Consultants

Legend

- WATERSHED AREAS
- TIME OF CONCENTRATION PATH
- EX/PR — WATERSHED AREA LABEL
- DP — DESIGN POINT
- A — TIME OF CONCENTRATION
- P1 — POND/BASIN

Issued	By	Appd.	MM.DD.YY

File Name: 210801576–Pre.dwg	Dwn.	Chkd.	Dsgn.	MM.DD.YY

Permit-Seal

Client/Project
OYA Solar MA, L.P.

Title
EXISTING WATERSHED PLAN

Project No. 210801576
Scale AS SHOWN
Sheet
Drawing No. WS-1

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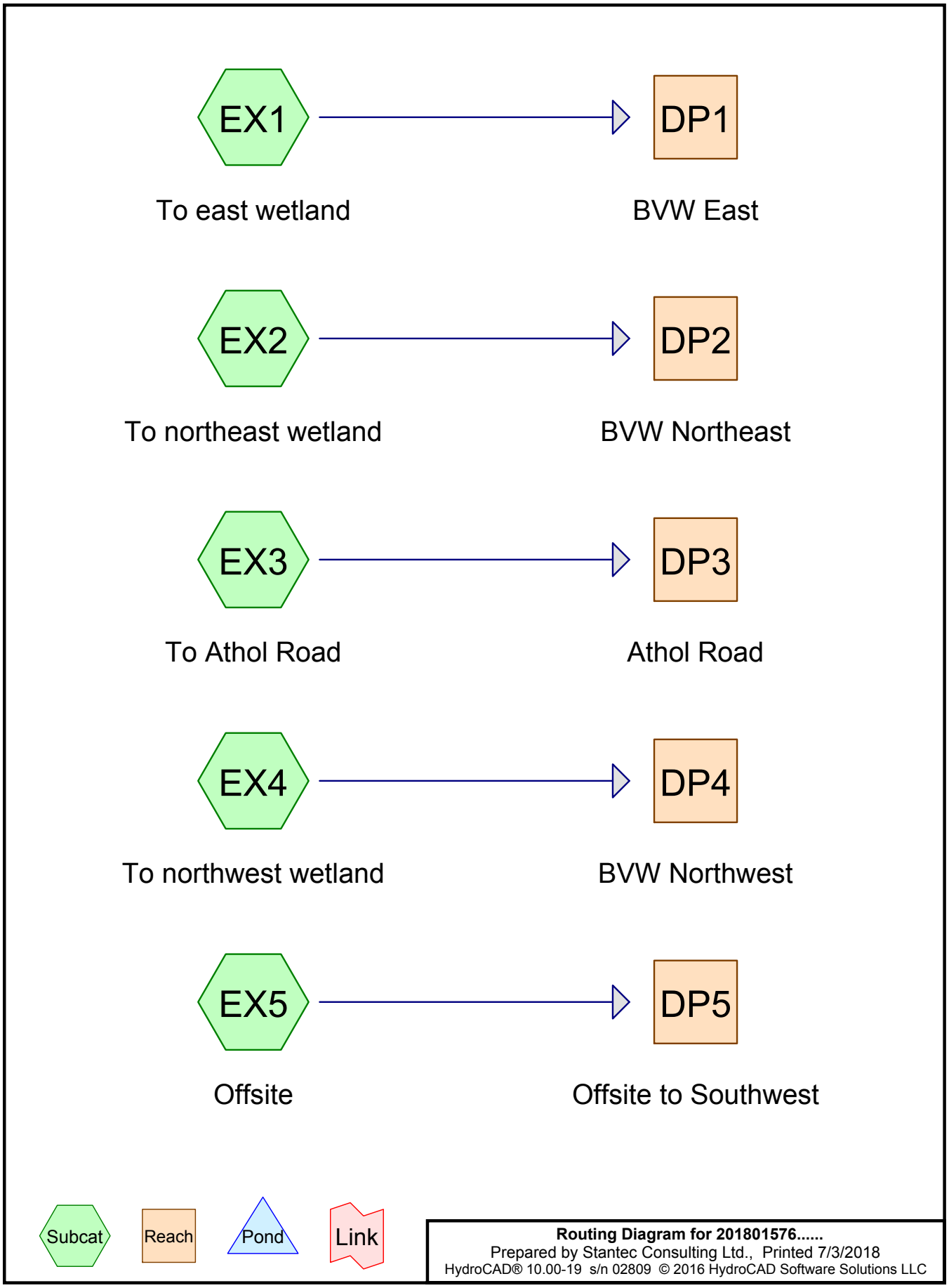
ORIGINAL SHEET - ARCH D



Routing Diagram for 201801576.....
Prepared by Stantec Consulting Ltd., Printed 7/3/2018
HydroCAD® 10.00-19 s/n 02809 © 2016 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
458,728	70	Woods, Good, HSG C (EX1, EX2, EX5)
927,955	74	Woods, Good, HSG C/D (EX3, EX4)
1,386,683	**73**	**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
0	0	1,386,683	0	0	1,386,683	Woods, Good	EX 1, EX 2, EX 3, EX 4, EX 5
0	**0**	**1,386,683**	**0**	**0**	**1,386,683**	**TOTAL AREA**	

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX1: To east wetland Runoff Area=274,559 sf 0.00% Impervious Runoff Depth=0.71"
Flow Length=395' Tc=18.6 min CN=70 Runoff=3.15 cfs 16,343 cf

Subcatchment EX2: To northeast wetland Runoff Area=130,654 sf 0.00% Impervious Runoff Depth=0.71"
Flow Length=462' Tc=29.2 min CN=70 Runoff=1.25 cfs 7,777 cf

Subcatchment EX3: To Athol Road Runoff Area=6,419 sf 0.00% Impervious Runoff Depth=0.91"
Tc=6.0 min CN=74 Runoff=0.14 cfs 486 cf

Subcatchment EX4: To northwest wetland Runoff Area=921,536 sf 0.00% Impervious Runoff Depth=0.91"
Flow Length=1,770' Tc=76.1 min CN=74 Runoff=7.03 cfs 69,748 cf

Subcatchment EX5: Offsite Runoff Area=53,515 sf 0.00% Impervious Runoff Depth=0.71"
Flow Length=240' Tc=13.9 min CN=70 Runoff=0.69 cfs 3,185 cf

Reach DP1: BVW East Inflow=3.15 cfs 16,343 cf
Outflow=3.15 cfs 16,343 cf

Reach DP2: BVW Northeast Inflow=1.25 cfs 7,777 cf
Outflow=1.25 cfs 7,777 cf

Reach DP3: Athol Road Inflow=0.14 cfs 486 cf
Outflow=0.14 cfs 486 cf

Reach DP4: BVW Northwest Inflow=7.03 cfs 69,748 cf
Outflow=7.03 cfs 69,748 cf

Reach DP5: Offsite to Southwest Inflow=0.69 cfs 3,185 cf
Outflow=0.69 cfs 3,185 cf

Total Runoff Area = 1,386,683 sf Runoff Volume = 97,539 cf Average Runoff Depth = 0.84"
100.00% Pervious = 1,386,683 sf 0.00% Impervious = 0 sf

Summary for Subcatchment EX1: To east wetland

Runoff = 3.15 cfs @ 12.30 hrs, Volume= 16,343 cf, Depth= 0.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
274,559	70	Woods, Good, HSG C
274,559		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	50	0.0600	0.06		**Sheet Flow, Sheet** Woods: Dense underbrush n= 0.800 P2= 3.00"
2.2	129	0.0390	0.99		**Shallow Concentrated Flow, Shallow Concentrated** Woodland Kv= 5.0 fps
2.1	216	0.1200	1.73		**Shallow Concentrated Flow, Shallow Concentrated** Woodland Kv= 5.0 fps
18.6	395	Total			

Summary for Subcatchment EX2: To northeast wetland

Runoff = 1.25 cfs @ 12.47 hrs, Volume= 7,777 cf, Depth= 0.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
130,654	70	Woods, Good, HSG C
130,654		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	50	0.0400	0.05		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.00"
4.6	97	0.0200	0.35		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
3.3	100	0.0400	0.50		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
4.5	215	0.1020	0.80		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
29.2	462	Total			

Summary for Subcatchment EX3: To Athol Road

Runoff = 0.14 cfs @ 12.10 hrs, Volume= 486 cf, Depth= 0.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

	Area (sf)	CN	Description
*	6,419	74	Woods, Good, HSG C/D
	6,419		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment EX4: To northwest wetland

Runoff = 7.03 cfs @ 13.10 hrs, Volume= 69,748 cf, Depth= 0.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

	Area (sf)	CN	Description
*	921,536	74	Woods, Good, HSG C/D
	921,536		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	50	0.0400	0.05		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.00"
2.7	78	0.0380	0.49		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
2.2	136	0.1700	1.03		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
21.1	540	0.0290	0.43		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
4.6	133	0.0370	0.48		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
0.9	42	0.0950	0.77		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
8.7	218	0.0280	0.42		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
16.4	441	0.0320	0.45		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
2.7	132	0.1060	0.81		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
76.1	1,770	Total			

Summary for Subcatchment EX5: Offsite

Runoff = 0.69 cfs @ 12.22 hrs, Volume= 3,185 cf, Depth= 0.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
53,515	70	Woods, Good, HSG C
53,515		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.4	50	0.0600	0.10		**Sheet Flow, Sheeet Flow** Grass: Bermuda n= 0.410 P2= 3.00"
2.6	115	0.0850	0.73		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
2.9	75	0.0300	0.43		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
13.9	240	Total			

Summary for Reach DP1: BVW East

Inflow Area = 274,559 sf, 0.00% Impervious, Inflow Depth = 0.71" for 2-Year event
Inflow = 3.15 cfs @ 12.30 hrs, Volume= 16,343 cf
Outflow = 3.15 cfs @ 12.30 hrs, Volume= 16,343 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP2: BVW Northeast

Inflow Area = 130,654 sf, 0.00% Impervious, Inflow Depth = 0.71" for 2-Year event
Inflow = 1.25 cfs @ 12.47 hrs, Volume= 7,777 cf
Outflow = 1.25 cfs @ 12.47 hrs, Volume= 7,777 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP3: Athol Road

Inflow Area = 6,419 sf, 0.00% Impervious, Inflow Depth = 0.91" for 2-Year event
Inflow = 0.14 cfs @ 12.10 hrs, Volume= 486 cf
Outflow = 0.14 cfs @ 12.10 hrs, Volume= 486 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP4: BVW Northwest

Inflow Area = 921,536 sf, 0.00% Impervious, Inflow Depth = 0.91" for 2-Year event
Inflow = 7.03 cfs @ 13.10 hrs, Volume= 69,748 cf
Outflow = 7.03 cfs @ 13.10 hrs, Volume= 69,748 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP5: Offsite to Southwest

Inflow Area = 53,515 sf, 0.00% Impervious, Inflow Depth = 0.71" for 2-Year event
Inflow = 0.69 cfs @ 12.22 hrs, Volume= 3,185 cf
Outflow = 0.69 cfs @ 12.22 hrs, Volume= 3,185 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX1: To east wetland Runoff Area=274,559 sf 0.00% Impervious Runoff Depth=1.67"
Flow Length=395' Tc=18.6 min CN=70 Runoff=8.27 cfs 38,295 cf

Subcatchment EX2: To northeast wetland Runoff Area=130,654 sf 0.00% Impervious Runoff Depth=1.67"
Flow Length=462' Tc=29.2 min CN=70 Runoff=3.25 cfs 18,223 cf

Subcatchment EX3: To Athol Road Runoff Area=6,419 sf 0.00% Impervious Runoff Depth=1.97"
Tc=6.0 min CN=74 Runoff=0.33 cfs 1,055 cf

Subcatchment EX4: To northwest wetland Runoff Area=921,536 sf 0.00% Impervious Runoff Depth=1.97"
Flow Length=1,770' Tc=76.1 min CN=74 Runoff=16.25 cfs 151,466 cf

Subcatchment EX5: Offsite Runoff Area=53,515 sf 0.00% Impervious Runoff Depth=1.67"
Flow Length=240' Tc=13.9 min CN=70 Runoff=1.80 cfs 7,464 cf

Reach DP1: BVW East Inflow=8.27 cfs 38,295 cf
Outflow=8.27 cfs 38,295 cf

Reach DP2: BVW Northeast Inflow=3.25 cfs 18,223 cf
Outflow=3.25 cfs 18,223 cf

Reach DP3: Athol Road Inflow=0.33 cfs 1,055 cf
Outflow=0.33 cfs 1,055 cf

Reach DP4: BVW Northwest Inflow=16.25 cfs 151,466 cf
Outflow=16.25 cfs 151,466 cf

Reach DP5: Offsite to Southwest Inflow=1.80 cfs 7,464 cf
Outflow=1.80 cfs 7,464 cf

Total Runoff Area = 1,386,683 sf Runoff Volume = 216,504 cf Average Runoff Depth = 1.87"
100.00% Pervious = 1,386,683 sf 0.00% Impervious = 0 sf

Summary for Subcatchment EX1: To east wetland

Runoff = 8.27 cfs @ 12.27 hrs, Volume= 38,295 cf, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
274,559	70	Woods, Good, HSG C
274,559		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	50	0.0600	0.06		**Sheet Flow, Sheet** Woods: Dense underbrush n= 0.800 P2= 3.00"
2.2	129	0.0390	0.99		**Shallow Concentrated Flow, Shallow Concentrated** Woodland Kv= 5.0 fps
2.1	216	0.1200	1.73		**Shallow Concentrated Flow, Shallow Concentrated** Woodland Kv= 5.0 fps
18.6	395	Total			

Summary for Subcatchment EX2: To northeast wetland

Runoff = 3.25 cfs @ 12.43 hrs, Volume= 18,223 cf, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
130,654	70	Woods, Good, HSG C
130,654		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	50	0.0400	0.05		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.00"
4.6	97	0.0200	0.35		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
3.3	100	0.0400	0.50		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
4.5	215	0.1020	0.80		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
29.2	462	Total			

Summary for Subcatchment EX3: To Athol Road

Runoff = 0.33 cfs @ 12.10 hrs, Volume= 1,055 cf, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	6,419	74	Woods, Good, HSG C/D
	6,419		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment EX4: To northwest wetland

Runoff = 16.25 cfs @ 13.07 hrs, Volume= 151,466 cf, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	921,536	74	Woods, Good, HSG C/D
	921,536		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	50	0.0400	0.05		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.00"
2.7	78	0.0380	0.49		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
2.2	136	0.1700	1.03		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
21.1	540	0.0290	0.43		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
4.6	133	0.0370	0.48		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
0.9	42	0.0950	0.77		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
8.7	218	0.0280	0.42		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
16.4	441	0.0320	0.45		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
2.7	132	0.1060	0.81		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
76.1	1,770	Total			

Summary for Subcatchment EX5: Offsite

Runoff = 1.80 cfs @ 12.21 hrs, Volume= 7,464 cf, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
53,515	70	Woods, Good, HSG C
53,515		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.4	50	0.0600	0.10		**Sheet Flow, Sheeet Flow** Grass: Bermuda n= 0.410 P2= 3.00"
2.6	115	0.0850	0.73		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
2.9	75	0.0300	0.43		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
13.9	240	Total			

Summary for Reach DP1: BVW East

Inflow Area = 274,559 sf, 0.00% Impervious, Inflow Depth = 1.67" for 10-Year event
Inflow = 8.27 cfs @ 12.27 hrs, Volume= 38,295 cf
Outflow = 8.27 cfs @ 12.27 hrs, Volume= 38,295 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP2: BVW Northeast

Inflow Area = 130,654 sf, 0.00% Impervious, Inflow Depth = 1.67" for 10-Year event
Inflow = 3.25 cfs @ 12.43 hrs, Volume= 18,223 cf
Outflow = 3.25 cfs @ 12.43 hrs, Volume= 18,223 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP3: Athol Road

Inflow Area = 6,419 sf, 0.00% Impervious, Inflow Depth = 1.97" for 10-Year event
Inflow = 0.33 cfs @ 12.10 hrs, Volume= 1,055 cf
Outflow = 0.33 cfs @ 12.10 hrs, Volume= 1,055 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP4: BVW Northwest

Inflow Area = 921,536 sf, 0.00% Impervious, Inflow Depth = 1.97" for 10-Year event
Inflow = 16.25 cfs @ 13.07 hrs, Volume= 151,466 cf
Outflow = 16.25 cfs @ 13.07 hrs, Volume= 151,466 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP5: Offsite to Southwest

Inflow Area = 53,515 sf, 0.00% Impervious, Inflow Depth = 1.67" for 10-Year event
Inflow = 1.80 cfs @ 12.21 hrs, Volume= 7,464 cf
Outflow = 1.80 cfs @ 12.21 hrs, Volume= 7,464 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX1: To east wetland Runoff Area=274,559 sf 0.00% Impervious Runoff Depth=2.26"
Flow Length=395' Tc=18.6 min CN=70 Runoff=11.38 cfs 51,741 cf

Subcatchment EX2: To northeast wetland Runoff Area=130,654 sf 0.00% Impervious Runoff Depth=2.26"
Flow Length=462' Tc=29.2 min CN=70 Runoff=4.47 cfs 24,622 cf

Subcatchment EX3: To Athol Road Runoff Area=6,419 sf 0.00% Impervious Runoff Depth=2.61"
Tc=6.0 min CN=74 Runoff=0.44 cfs 1,394 cf

Subcatchment EX4: To northwest wetland Runoff Area=921,536 sf 0.00% Impervious Runoff Depth=2.61"
Flow Length=1,770' Tc=76.1 min CN=74 Runoff=21.70 cfs 200,111 cf

Subcatchment EX5: Offsite Runoff Area=53,515 sf 0.00% Impervious Runoff Depth=2.26"
Flow Length=240' Tc=13.9 min CN=70 Runoff=2.48 cfs 10,085 cf

Reach DP1: BVW East Inflow=11.38 cfs 51,741 cf
Outflow=11.38 cfs 51,741 cf

Reach DP2: BVW Northeast Inflow=4.47 cfs 24,622 cf
Outflow=4.47 cfs 24,622 cf

Reach DP3: Athol Road Inflow=0.44 cfs 1,394 cf
Outflow=0.44 cfs 1,394 cf

Reach DP4: BVW Northwest Inflow=21.70 cfs 200,111 cf
Outflow=21.70 cfs 200,111 cf

Reach DP5: Offsite to Southwest Inflow=2.48 cfs 10,085 cf
Outflow=2.48 cfs 10,085 cf

Total Runoff Area = 1,386,683 sf Runoff Volume = 287,953 cf Average Runoff Depth = 2.49"
100.00% Pervious = 1,386,683 sf 0.00% Impervious = 0 sf

Summary for Subcatchment EX1: To east wetland

Runoff = 11.38 cfs @ 12.27 hrs, Volume= 51,741 cf, Depth= 2.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
274,559	70	Woods, Good, HSG C
274,559		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	50	0.0600	0.06		**Sheet Flow, Sheet** Woods: Dense underbrush n= 0.800 P2= 3.00"
2.2	129	0.0390	0.99		**Shallow Concentrated Flow, Shallow Concentrated** Woodland Kv= 5.0 fps
2.1	216	0.1200	1.73		**Shallow Concentrated Flow, Shallow Concentrated** Woodland Kv= 5.0 fps
18.6	395	Total			

Summary for Subcatchment EX2: To northeast wetland

Runoff = 4.47 cfs @ 12.42 hrs, Volume= 24,622 cf, Depth= 2.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
130,654	70	Woods, Good, HSG C
130,654		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	50	0.0400	0.05		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.00"
4.6	97	0.0200	0.35		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
3.3	100	0.0400	0.50		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
4.5	215	0.1020	0.80		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
29.2	462	Total			

Summary for Subcatchment EX3: To Athol Road

Runoff = 0.44 cfs @ 12.09 hrs, Volume= 1,394 cf, Depth= 2.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

	Area (sf)	CN	Description
*	6,419	74	Woods, Good, HSG C/D
	6,419		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment EX4: To northwest wetland

Runoff = 21.70 cfs @ 13.05 hrs, Volume= 200,111 cf, Depth= 2.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

	Area (sf)	CN	Description
*	921,536	74	Woods, Good, HSG C/D
	921,536		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	50	0.0400	0.05		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.00"
2.7	78	0.0380	0.49		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
2.2	136	0.1700	1.03		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
21.1	540	0.0290	0.43		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
4.6	133	0.0370	0.48		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
0.9	42	0.0950	0.77		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
8.7	218	0.0280	0.42		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
16.4	441	0.0320	0.45		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
2.7	132	0.1060	0.81		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
76.1	1,770	Total			

Summary for Subcatchment EX5: Offsite

Runoff = 2.48 cfs @ 12.20 hrs, Volume= 10,085 cf, Depth= 2.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
53,515	70	Woods, Good, HSG C
53,515		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.4	50	0.0600	0.10		**Sheet Flow, Sheeet Flow** Grass: Bermuda n= 0.410 P2= 3.00"
2.6	115	0.0850	0.73		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
2.9	75	0.0300	0.43		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
13.9	240	Total			

Summary for Reach DP1: BVW East

Inflow Area = 274,559 sf, 0.00% Impervious, Inflow Depth = 2.26" for 25-Year event
Inflow = 11.38 cfs @ 12.27 hrs, Volume= 51,741 cf
Outflow = 11.38 cfs @ 12.27 hrs, Volume= 51,741 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP2: BVW Northeast

Inflow Area = 130,654 sf, 0.00% Impervious, Inflow Depth = 2.26" for 25-Year event
Inflow = 4.47 cfs @ 12.42 hrs, Volume= 24,622 cf
Outflow = 4.47 cfs @ 12.42 hrs, Volume= 24,622 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP3: Athol Road

Inflow Area = 6,419 sf, 0.00% Impervious, Inflow Depth = 2.61" for 25-Year event
Inflow = 0.44 cfs @ 12.09 hrs, Volume= 1,394 cf
Outflow = 0.44 cfs @ 12.09 hrs, Volume= 1,394 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP4: BVW Northwest

Inflow Area = 921,536 sf, 0.00% Impervious, Inflow Depth = 2.61" for 25-Year event
Inflow = 21.70 cfs @ 13.05 hrs, Volume= 200,111 cf
Outflow = 21.70 cfs @ 13.05 hrs, Volume= 200,111 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP5: Offsite to Southwest

Inflow Area = 53,515 sf, 0.00% Impervious, Inflow Depth = 2.26" for 25-Year event
Inflow = 2.48 cfs @ 12.20 hrs, Volume= 10,085 cf
Outflow = 2.48 cfs @ 12.20 hrs, Volume= 10,085 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX1: To east wetland Runoff Area=274,559 sf 0.00% Impervious Runoff Depth=3.21"
Flow Length=395' Tc=18.6 min CN=70 Runoff=16.35 cfs 73,378 cf

Subcatchment EX2: To northeast wetland Runoff Area=130,654 sf 0.00% Impervious Runoff Depth=3.21"
Flow Length=462' Tc=29.2 min CN=70 Runoff=6.41 cfs 34,918 cf

Subcatchment EX3: To Athol Road Runoff Area=6,419 sf 0.00% Impervious Runoff Depth=3.61"
Tc=6.0 min CN=74 Runoff=0.61 cfs 1,931 cf

Subcatchment EX4: To northwest wetland Runoff Area=921,536 sf 0.00% Impervious Runoff Depth=3.61"
Flow Length=1,770' Tc=76.1 min CN=74 Runoff=30.26 cfs 277,201 cf

Subcatchment EX5: Offsite Runoff Area=53,515 sf 0.00% Impervious Runoff Depth=3.21"
Flow Length=240' Tc=13.9 min CN=70 Runoff=3.56 cfs 14,302 cf

Reach DP1: BVW East Inflow=16.35 cfs 73,378 cf
Outflow=16.35 cfs 73,378 cf

Reach DP2: BVW Northeast Inflow=6.41 cfs 34,918 cf
Outflow=6.41 cfs 34,918 cf

Reach DP3: Athol Road Inflow=0.61 cfs 1,931 cf
Outflow=0.61 cfs 1,931 cf

Reach DP4: BVW Northwest Inflow=30.26 cfs 277,201 cf
Outflow=30.26 cfs 277,201 cf

Reach DP5: Offsite to Southwest Inflow=3.56 cfs 14,302 cf
Outflow=3.56 cfs 14,302 cf

Total Runoff Area = 1,386,683 sf Runoff Volume = 401,730 cf Average Runoff Depth = 3.48"
100.00% Pervious = 1,386,683 sf 0.00% Impervious = 0 sf

Summary for Subcatchment EX1: To east wetland

Runoff = 16.35 cfs @ 12.26 hrs, Volume= 73,378 cf, Depth= 3.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
274,559	70	Woods, Good, HSG C
274,559		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	50	0.0600	0.06		**Sheet Flow, Sheet** Woods: Dense underbrush n= 0.800 P2= 3.00"
2.2	129	0.0390	0.99		**Shallow Concentrated Flow, Shallow Concentrated** Woodland Kv= 5.0 fps
2.1	216	0.1200	1.73		**Shallow Concentrated Flow, Shallow Concentrated** Woodland Kv= 5.0 fps
18.6	395	Total			

Summary for Subcatchment EX2: To northeast wetland

Runoff = 6.41 cfs @ 12.42 hrs, Volume= 34,918 cf, Depth= 3.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
130,654	70	Woods, Good, HSG C
130,654		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	50	0.0400	0.05		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.00"
4.6	97	0.0200	0.35		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
3.3	100	0.0400	0.50		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
4.5	215	0.1020	0.80		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
29.2	462	Total			

Summary for Subcatchment EX3: To Athol Road

Runoff = 0.61 cfs @ 12.09 hrs, Volume= 1,931 cf, Depth= 3.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	6,419	74	Woods, Good, HSG C/D
	6,419		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment EX4: To northwest wetland

Runoff = 30.26 cfs @ 13.02 hrs, Volume= 277,201 cf, Depth= 3.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	921,536	74	Woods, Good, HSG C/D
	921,536		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	50	0.0400	0.05		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.00"
2.7	78	0.0380	0.49		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
2.2	136	0.1700	1.03		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
21.1	540	0.0290	0.43		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
4.6	133	0.0370	0.48		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
0.9	42	0.0950	0.77		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
8.7	218	0.0280	0.42		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
16.4	441	0.0320	0.45		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
2.7	132	0.1060	0.81		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
76.1	1,770	Total			

Summary for Subcatchment EX5: Offsite

Runoff = 3.56 cfs @ 12.20 hrs, Volume= 14,302 cf, Depth= 3.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
53,515	70	Woods, Good, HSG C
53,515		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.4	50	0.0600	0.10		**Sheet Flow, Sheeet Flow** Grass: Bermuda n= 0.410 P2= 3.00"
2.6	115	0.0850	0.73		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
2.9	75	0.0300	0.43		**Shallow Concentrated Flow, Shallow Concentrated** Forest w/Heavy Litter Kv= 2.5 fps
13.9	240	Total			

Summary for Reach DP1: BVW East

Inflow Area = 274,559 sf, 0.00% Impervious, Inflow Depth = 3.21" for 100-Year event
Inflow = 16.35 cfs @ 12.26 hrs, Volume= 73,378 cf
Outflow = 16.35 cfs @ 12.26 hrs, Volume= 73,378 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP2: BVW Northeast

Inflow Area = 130,654 sf, 0.00% Impervious, Inflow Depth = 3.21" for 100-Year event
Inflow = 6.41 cfs @ 12.42 hrs, Volume= 34,918 cf
Outflow = 6.41 cfs @ 12.42 hrs, Volume= 34,918 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP3: Athol Road

Inflow Area = 6,419 sf, 0.00% Impervious, Inflow Depth = 3.61" for 100-Year event
Inflow = 0.61 cfs @ 12.09 hrs, Volume= 1,931 cf
Outflow = 0.61 cfs @ 12.09 hrs, Volume= 1,931 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP4: BVW Northwest

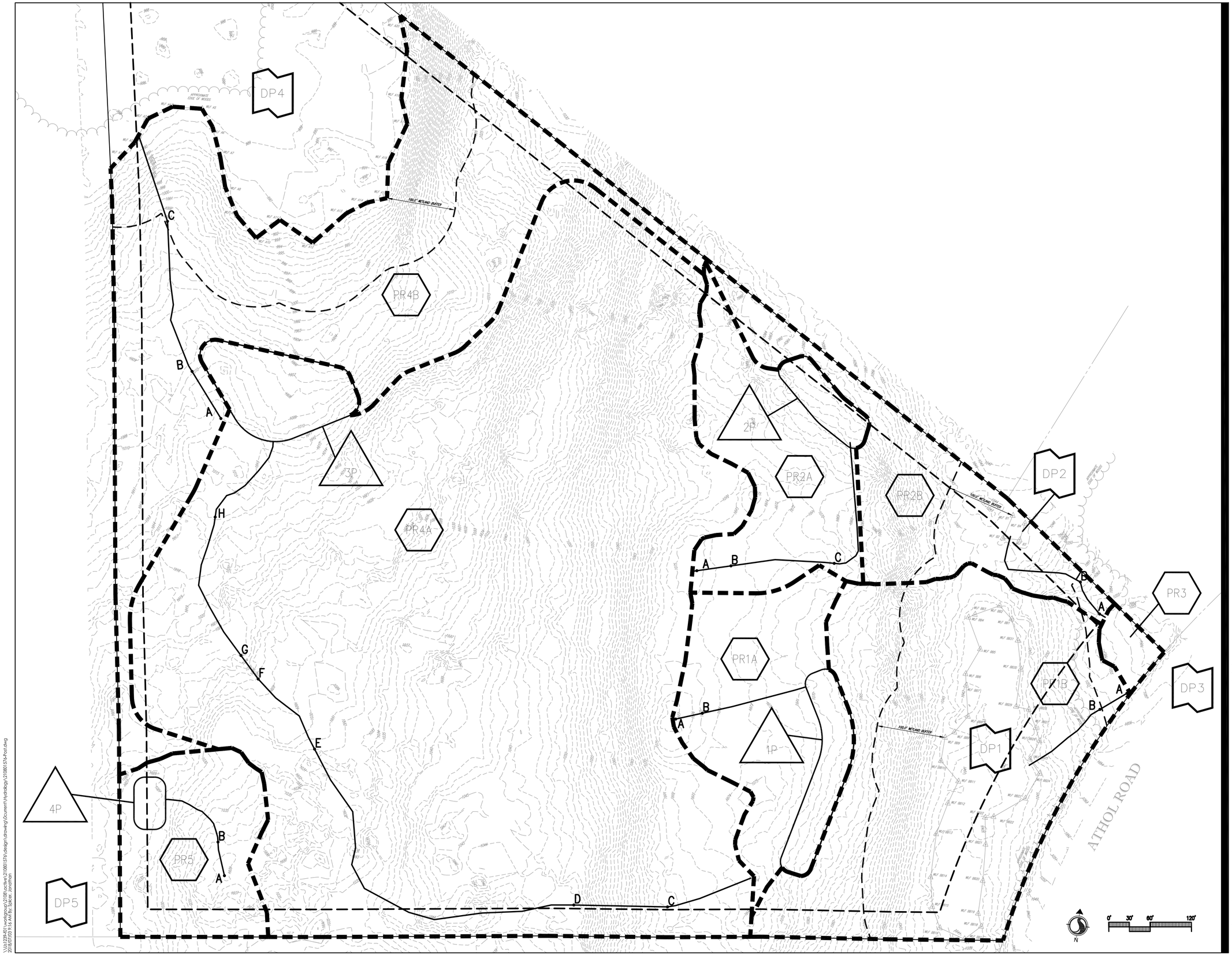
Inflow Area = 921,536 sf, 0.00% Impervious, Inflow Depth = 3.61" for 100-Year event
Inflow = 30.26 cfs @ 13.02 hrs, Volume= 277,201 cf
Outflow = 30.26 cfs @ 13.02 hrs, Volume= 277,201 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP5: Offsite to Southwest

Inflow Area = 53,515 sf, 0.00% Impervious, Inflow Depth = 3.21" for 100-Year event
Inflow = 3.56 cfs @ 12.20 hrs, Volume= 14,302 cf
Outflow = 3.56 cfs @ 12.20 hrs, Volume= 14,302 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs



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Consultants

Legend

- WATERSHED AREAS
- TIME OF CONCENTRATION PATH
- EX/PR — WATERSHED AREA LABEL
- DP — DESIGN POINT
- A — TIME OF CONCENTRATION
- P1 — POND/BASIN

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Permit-Seal

Client/Project
OYA Solar MA, L.P.

Title
PROPOSED WATERSHED PLAN

Project No. 210801576
Scale AS SHOWN
Sheet
Drawing No. WS-2

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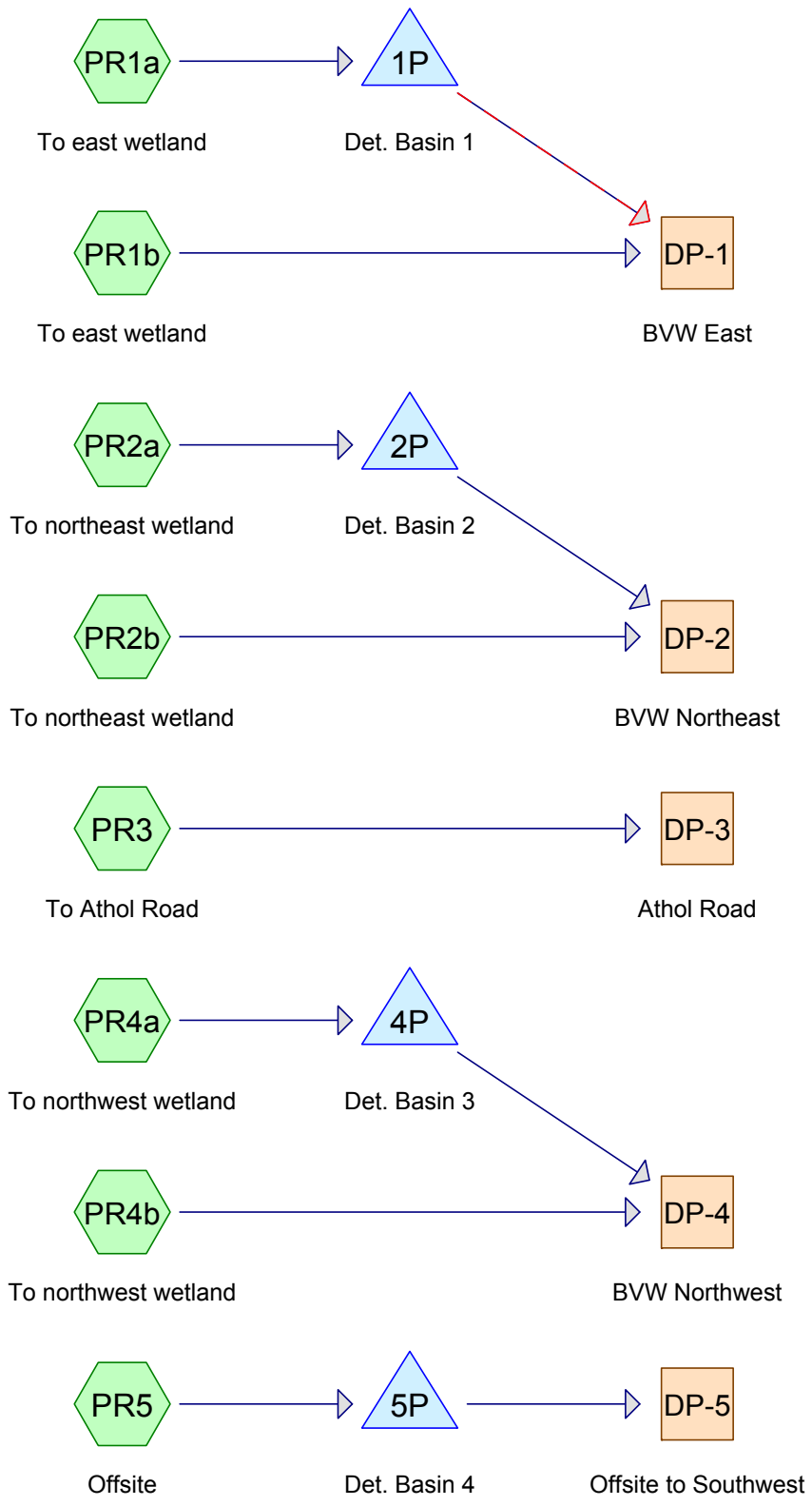

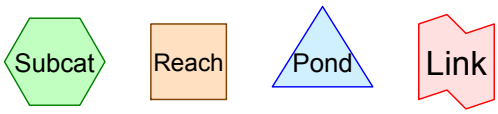

Routing Diagram for 201801576.....
Prepared by Stantec Consulting Ltd., Printed 7/3/2018
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Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
272,319	74	>75% Grass cover, Good, HSG C (PR1a, PR2a, PR2b, PR5)
6,419	74	>75% Grass cover, Good, HSG C/D (PR3)
682,806	77	>75% Grass cover, Good, HSG C/D (PR4a)
186,314	70	Woods, Good, HSG C (PR1b)
238,825	74	Woods, Good, HSG C/D (PR4b)
1,386,683	**75**	**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Sub Num
0	0	961,544	0	0	961,544	>75% Grass cover, Good	
0	0	425,139	0	0	425,139	Woods, Good	
0	**0**	**1,386,683**	**0**	**0**	**1,386,683**	**TOTAL AREA**	

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PR1a: To east wetland Runoff Area=80,503 sf 0.00% Impervious Runoff Depth=0.91"
Flow Length=179' Tc=7.1 min CN=74 Runoff=1.74 cfs 6,093 cf

Subcatchment PR1b: To east wetland Runoff Area=186,314 sf 0.00% Impervious Runoff Depth=0.71"
Flow Length=395' Tc=8.6 min CN=70 Runoff=2.79 cfs 11,090 cf

Subcatchment PR2a: To northeast wetland Runoff Area=76,739 sf 0.00% Impervious Runoff Depth=0.91"
Flow Length=407' Tc=11.7 min CN=74 Runoff=1.42 cfs 5,808 cf

Subcatchment PR2b: To northeast wetland Runoff Area=61,562 sf 0.00% Impervious Runoff Depth=0.91"
Flow Length=220' Tc=9.3 min CN=74 Runoff=1.23 cfs 4,659 cf

Subcatchment PR3: To Athol Road Runoff Area=6,419 sf 0.00% Impervious Runoff Depth=0.91"
Tc=6.0 min CN=74 Runoff=0.14 cfs 486 cf

Subcatchment PR4a: To northwest wetland Runoff Area=682,806 sf 0.00% Impervious Runoff Depth=1.07"
Flow Length=1,713' Tc=27.6 min CN=77 Runoff=11.08 cfs 60,943 cf

Subcatchment PR4b: To northwest wetland Runoff Area=238,825 sf 0.00% Impervious Runoff Depth=0.91"
Flow Length=400' Tc=9.5 min CN=74 Runoff=4.76 cfs 18,076 cf

Subcatchment PR5: Offsite Runoff Area=53,515 sf 0.00% Impervious Runoff Depth=0.91"
Flow Length=158' Tc=8.0 min CN=74 Runoff=1.11 cfs 4,050 cf

Reach DP-1: BVW East Inflow=2.79 cfs 15,382 cf
Outflow=2.79 cfs 15,382 cf

Reach DP-2: BVW Northeast Inflow=1.23 cfs 9,317 cf
Outflow=1.23 cfs 9,317 cf

Reach DP-3: Athol Road Inflow=0.14 cfs 486 cf
Outflow=0.14 cfs 486 cf

Reach DP-4: BVW Northwest Inflow=6.04 cfs 78,247 cf
Outflow=6.04 cfs 78,247 cf

Reach DP-5: Offsite to Southwest Inflow=0.63 cfs 3,607 cf
Outflow=0.63 cfs 3,607 cf

Pond 1P: Det. Basin 1 Peak Elev=1,069.49' Storage=3,010 cf Inflow=1.74 cfs 6,093 cf
Outflow=0.16 cfs 4,292 cf

Pond 2P: Det. Basin 2 Peak Elev=1,062.64' Storage=2,289 cf Inflow=1.42 cfs 5,808 cf
Outflow=0.28 cfs 4,658 cf

Pond 4P: Det. Basin 3 Peak Elev=1,011.32' Storage=16,900 cf Inflow=11.08 cfs 60,943 cf
Outflow=5.16 cfs 60,172 cf

Pond 5P: Det. Basin 4 Peak Elev=1,027.80' Storage=938 cf Inflow=1.11 cfs 4,050 cf
Outflow=0.63 cfs 3,607 cf

Total Runoff Area = 1,386,683 sf Runoff Volume = 111,205 cf Average Runoff Depth = 0.96"
100.00% Pervious = 1,386,683 sf 0.00% Impervious = 0 sf

Summary for Subcatchment PR1a: To east wetland

Runoff = 1.74 cfs @ 12.11 hrs, Volume= 6,093 cf, Depth= 0.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
80,503	74	>75% Grass cover, Good, HSG C
80,503		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.00"
1.6	129	0.0390	1.38		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
7.1	179	Total			

Summary for Subcatchment PR1b: To east wetland

Runoff = 2.79 cfs @ 12.14 hrs, Volume= 11,090 cf, Depth= 0.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
186,314	70	Woods, Good, HSG C
186,314		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.00"
1.6	129	0.0390	1.38		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
1.5	216	0.1200	2.42		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
8.6	395	Total			

Summary for Subcatchment PR2a: To northeast wetland

Runoff = 1.42 cfs @ 12.18 hrs, Volume= 5,808 cf, Depth= 0.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
76,739	74	>75% Grass cover, Good, HSG C
76,739		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.00"
2.5	150	0.0200	0.99		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
2.8	207	0.0300	1.21		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
11.7	407	Total			

Summary for Subcatchment PR2b: To northeast wetland

Runoff = 1.23 cfs @ 12.15 hrs, Volume= 4,659 cf, Depth= 0.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
61,562	74	>75% Grass cover, Good, HSG C
61,562		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.00"
2.9	170	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.3	220	Total			

Summary for Subcatchment PR3: To Athol Road

Runoff = 0.14 cfs @ 12.10 hrs, Volume= 486 cf, Depth= 0.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

	Area (sf)	CN	Description
*	6,419	74	>75% Grass cover, Good, HSG C/D
	6,419		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment PR4a: To northwest wetland

Runoff = 11.08 cfs @ 12.41 hrs, Volume= 60,943 cf, Depth= 1.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

	Area (sf)	CN	Description
*	682,806	77	>75% Grass cover, Good, HSG C/D
	682,806		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.00"
1.0	78	0.0380	1.36		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
0.8	136	0.1700	2.89		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
7.5	540	0.0290	1.19		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
1.6	133	0.0370	1.35		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
0.3	42	0.0950	2.16		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
3.1	218	0.0280	1.17		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
5.9	441	0.0320	1.25		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
1.0	75	0.0350	1.31		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
27.6	1,713	Total			

Summary for Subcatchment PR4b: To northwest wetland

Runoff = 4.76 cfs @ 12.15 hrs, Volume= 18,076 cf, Depth= 0.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

	Area (sf)	CN	Description
*	238,825	74	Woods, Good, HSG C/D
	238,825		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.00"
3.0	220	0.0300	1.21		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
1.0	130	0.1000	2.21		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
9.5	400	Total			

Summary for Subcatchment PR5: Offsite

Runoff = 1.11 cfs @ 12.13 hrs, Volume= 4,050 cf, Depth= 0.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
53,515	74	>75% Grass cover, Good, HSG C
53,515		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0300	0.12		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.00"
0.8	108	0.1000	2.21		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
8.0	158	Total			

Summary for Reach DP-1: BVW East

Inflow Area = 266,817 sf, 0.00% Impervious, Inflow Depth > 0.69" for 2-Year event
Inflow = 2.79 cfs @ 12.14 hrs, Volume= 15,382 cf
Outflow = 2.79 cfs @ 12.14 hrs, Volume= 15,382 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP-2: BVW Northeast

Inflow Area = 138,301 sf, 0.00% Impervious, Inflow Depth > 0.81" for 2-Year event
Inflow = 1.23 cfs @ 12.15 hrs, Volume= 9,317 cf
Outflow = 1.23 cfs @ 12.15 hrs, Volume= 9,317 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP-3: Athol Road

Inflow Area = 6,419 sf, 0.00% Impervious, Inflow Depth = 0.91" for 2-Year event
Inflow = 0.14 cfs @ 12.10 hrs, Volume= 486 cf
Outflow = 0.14 cfs @ 12.10 hrs, Volume= 486 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP-4: BVW Northwest

Inflow Area = 921,631 sf, 0.00% Impervious, Inflow Depth > 1.02" for 2-Year event
Inflow = 6.04 cfs @ 12.48 hrs, Volume= 78,247 cf
Outflow = 6.04 cfs @ 12.48 hrs, Volume= 78,247 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP-5: Offsite to Southwest

Inflow Area = 53,515 sf, 0.00% Impervious, Inflow Depth > 0.81" for 2-Year event
Inflow = 0.63 cfs @ 12.33 hrs, Volume= 3,607 cf
Outflow = 0.63 cfs @ 12.33 hrs, Volume= 3,607 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Det. Basin 1

Inflow Area = 80,503 sf, 0.00% Impervious, Inflow Depth = 0.91" for 2-Year event
Inflow = 1.74 cfs @ 12.11 hrs, Volume= 6,093 cf
Outflow = 0.16 cfs @ 14.03 hrs, Volume= 4,292 cf, Atten= 91%, Lag= 114.8 min
Primary = 0.16 cfs @ 14.03 hrs, Volume= 4,292 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 1,069.49' @ 14.03 hrs Surf.Area= 6,587 sf Storage= 3,010 cf

Plug-Flow detention time= 306.2 min calculated for 4,285 cf (70% of inflow)
Center-of-Mass det. time= 202.9 min (1,070.2 - 867.3)

Volume	Invert	Avail.Storage	Storage Description
#1	1,069.00'	25,474 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,069.00	5,684	0	0
1,070.00	7,524	6,604	6,604
1,071.00	9,421	8,473	15,077
1,072.00	11,374	10,398	25,474

Device	Routing	Invert	Outlet Devices
#1	Primary	1,069.00'	**12.0" Round Culvert** L= 30.0' Ke= 0.500 Inlet / Outlet Invert= 1,069.00' / 1,068.00' S= 0.0333 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

#2 Device 1 1,069.25' **6.0" Vert. Orifice/Grate** X 2 rows with 12.0" cc spacing C= 0.600

Primary OutFlow Max=0.16 cfs @ 14.03 hrs HW=1,069.49' (Free Discharge)
└─**1=Culvert** (Passes 0.16 cfs of 0.91 cfs potential flow)
└─**2=Orifice/Grate** (Orifice Controls 0.16 cfs @ 1.67 fps)

Summary for Pond 2P: Det. Basin 2

Inflow Area = 76,739 sf, 0.00% Impervious, Inflow Depth = 0.91" for 2-Year event
Inflow = 1.42 cfs @ 12.18 hrs, Volume= 5,808 cf
Outflow = 0.28 cfs @ 12.86 hrs, Volume= 4,658 cf, Atten= 80%, Lag= 40.6 min
Primary = 0.28 cfs @ 12.86 hrs, Volume= 4,658 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 1,062.64' @ 12.86 hrs Surf.Area= 3,884 sf Storage= 2,289 cf

Plug-Flow detention time= 207.0 min calculated for 4,650 cf (80% of inflow)
Center-of-Mass det. time= 126.4 min (998.0 - 871.5)

Volume	Invert	Avail.Storage	Storage Description
#1	1,062.00'	14,260 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,062.00	3,272	0	0
1,063.00	4,228	3,750	3,750
1,064.00	5,241	4,735	8,485
1,065.00	6,310	5,776	14,260

Device	Routing	Invert	Outlet Devices
#1	Primary	1,062.00'	**12.0" Round Culvert** L= 30.0' Ke= 0.500 Inlet / Outlet Invert= 1,062.00' / 1,061.00' S= 0.0333 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	1,062.30'	**6.0" Vert. Orifice/Grate** X 2 rows with 12.0" cc spacing C= 0.600

Primary OutFlow Max=0.28 cfs @ 12.86 hrs HW=1,062.64' (Free Discharge)
└─**1=Culvert** (Passes 0.28 cfs of 1.45 cfs potential flow)
└─**2=Orifice/Grate** (Orifice Controls 0.28 cfs @ 1.98 fps)

Summary for Pond 4P: Det. Basin 3

Inflow Area = 682,806 sf, 0.00% Impervious, Inflow Depth = 1.07" for 2-Year event
Inflow = 11.08 cfs @ 12.41 hrs, Volume= 60,943 cf
Outflow = 5.16 cfs @ 12.87 hrs, Volume= 60,172 cf, Atten= 53%, Lag= 27.2 min
Primary = 5.16 cfs @ 12.87 hrs, Volume= 60,172 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 1,011.32' @ 12.87 hrs Surf.Area= 13,817 sf Storage= 16,900 cf

Plug-Flow detention time= 72.8 min calculated for 60,172 cf (99% of inflow)
Center-of-Mass det. time= 65.5 min (941.6 - 876.1)

Volume	Invert	Avail.Storage	Storage Description
#1	1,010.00'	78,499 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,010.00	11,875	0	0
1,011.00	13,336	12,606	12,606
1,012.00	14,855	14,096	26,701
1,013.00	16,431	15,643	42,344
1,014.00	18,063	17,247	59,591
1,015.00	19,752	18,908	78,499

Device	Routing	Invert	Outlet Devices
#1	Primary	1,010.00'	**24.0" Round Culvert** L= 40.0' Ke= 0.500 Inlet / Outlet Invert= 1,010.00' / 1,009.00' S= 0.0250 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	1,010.00'	**10.0" Vert. Orifice/Grate X 2.00 columns** X 3 rows with 14.0" cc spacing C= 0.600

Primary OutFlow Max=5.15 cfs @ 12.87 hrs HW=1,011.32' (Free Discharge)
└─**1=Culvert** (Passes 5.15 cfs of 8.56 cfs potential flow)
└─**2=Orifice/Grate** (Orifice Controls 5.15 cfs @ 4.21 fps)

Summary for Pond 5P: Det. Basin 4

Inflow Area =	53,515 sf,	0.00% Impervious,	Inflow Depth =	0.91"	for 2-Year event
Inflow =	1.11 cfs @	12.13 hrs,	Volume=	4,050 cf	
Outflow =	0.63 cfs @	12.33 hrs,	Volume=	3,607 cf,	Atten= 43%, Lag= 12.3 min
Primary =	0.63 cfs @	12.33 hrs,	Volume=	3,607 cf	

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 1,027.80' @ 12.33 hrs Surf.Area= 1,340 sf Storage= 938 cf

Plug-Flow detention time= 99.6 min calculated for 3,601 cf (89% of inflow)
Center-of-Mass det. time= 48.1 min (916.2 - 868.1)

Volume	Invert	Avail.Storage	Storage Description
#1	1,027.00'	5,066 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,027.00	992	0	0
1,028.00	1,425	1,209	1,209
1,029.00	1,915	1,670	2,879
1,030.00	2,460	2,188	5,066

Device	Routing	Invert	Outlet Devices
#1	Primary	1,027.40'	**12.0" Round Culvert** L= 40.0' Ke= 0.500 Inlet / Outlet Invert= 1,027.40' / 1,027.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

#2	Device 1	1,027.40'	**6.0" Vert. Orifice/Grate X 2.00 columns** X 2 rows with 10.0" cc spacing C= 0.600

Primary OutFlow Max=0.63 cfs @ 12.33 hrs HW=1,027.80' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.63 cfs @ 3.15 fps)
  └─**2=Orifice/Grate** (Passes 0.63 cfs of 0.73 cfs potential flow)

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PR1a: To east wetland Runoff Area=80,503 sf 0.00% Impervious Runoff Depth=1.97"
Flow Length=179' Tc=7.1 min CN=74 Runoff=4.02 cfs 13,232 cf

Subcatchment PR1b: To east wetland Runoff Area=186,314 sf 0.00% Impervious Runoff Depth=1.67"
Flow Length=395' Tc=8.6 min CN=70 Runoff=7.27 cfs 25,987 cf

Subcatchment PR2a: To northeast wetland Runoff Area=76,739 sf 0.00% Impervious Runoff Depth=1.97"
Flow Length=407' Tc=11.7 min CN=74 Runoff=3.31 cfs 12,613 cf

Subcatchment PR2b: To northeast wetland Runoff Area=61,562 sf 0.00% Impervious Runoff Depth=1.97"
Flow Length=220' Tc=9.3 min CN=74 Runoff=2.84 cfs 10,118 cf

Subcatchment PR3: To Athol Road Runoff Area=6,419 sf 0.00% Impervious Runoff Depth=1.97"
Tc=6.0 min CN=74 Runoff=0.33 cfs 1,055 cf

Subcatchment PR4a: To northwest wetland Runoff Area=682,806 sf 0.00% Impervious Runoff Depth=2.21"
Flow Length=1,713' Tc=27.6 min CN=77 Runoff=23.69 cfs 125,785 cf

Subcatchment PR4b: To northwest wetland Runoff Area=238,825 sf 0.00% Impervious Runoff Depth=1.97"
Flow Length=400' Tc=9.5 min CN=74 Runoff=10.97 cfs 39,254 cf

Subcatchment PR5: Offsite Runoff Area=53,515 sf 0.00% Impervious Runoff Depth=1.97"
Flow Length=158' Tc=8.0 min CN=74 Runoff=2.59 cfs 8,796 cf

Reach DP-1: BVW East Inflow=7.53 cfs 37,371 cf
Outflow=7.53 cfs 37,371 cf

Reach DP-2: BVW Northeast Inflow=3.24 cfs 21,567 cf
Outflow=3.24 cfs 21,567 cf

Reach DP-3: Athol Road Inflow=0.33 cfs 1,055 cf
Outflow=0.33 cfs 1,055 cf

Reach DP-4: BVW Northwest Inflow=14.79 cfs 164,199 cf
Outflow=14.79 cfs 164,199 cf

Reach DP-5: Offsite to Southwest Inflow=1.61 cfs 8,352 cf
Outflow=1.61 cfs 8,352 cf

Pond 1P: Det. Basin 1 Peak Elev=1,069.90' Storage=5,867 cf Inflow=4.02 cfs 13,232 cf
Outflow=0.60 cfs 11,384 cf

Pond 2P: Det. Basin 2 Peak Elev=1,063.28' Storage=4,954 cf Inflow=3.31 cfs 12,613 cf
Outflow=0.81 cfs 11,448 cf

Pond 4P: Det. Basin 3 Peak Elev=1,012.48' Storage=33,974 cf Inflow=23.69 cfs 125,785 cf
Outflow=12.67 cfs 124,945 cf

Pond 5P: Det. Basin 4 Peak Elev=1,028.33' Storage=1,702 cf Inflow=2.59 cfs 8,796 cf
Outflow=1.61 cfs 8,352 cf

Total Runoff Area = 1,386,683 sf Runoff Volume = 236,840 cf Average Runoff Depth = 2.05"
100.00% Pervious = 1,386,683 sf 0.00% Impervious = 0 sf

Summary for Subcatchment PR1a: To east wetland

Runoff = 4.02 cfs @ 12.11 hrs, Volume= 13,232 cf, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
80,503	74	>75% Grass cover, Good, HSG C
80,503		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.00"
1.6	129	0.0390	1.38		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
7.1	179	Total			

Summary for Subcatchment PR1b: To east wetland

Runoff = 7.27 cfs @ 12.13 hrs, Volume= 25,987 cf, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
186,314	70	Woods, Good, HSG C
186,314		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.00"
1.6	129	0.0390	1.38		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
1.5	216	0.1200	2.42		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
8.6	395	Total			

Summary for Subcatchment PR2a: To northeast wetland

Runoff = 3.31 cfs @ 12.17 hrs, Volume= 12,613 cf, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
76,739	74	>75% Grass cover, Good, HSG C
76,739		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.00"
2.5	150	0.0200	0.99		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
2.8	207	0.0300	1.21		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
11.7	407	Total			

Summary for Subcatchment PR2b: To northeast wetland

Runoff = 2.84 cfs @ 12.14 hrs, Volume= 10,118 cf, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
61,562	74	>75% Grass cover, Good, HSG C
61,562		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.00"
2.9	170	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.3	220	Total			

Summary for Subcatchment PR3: To Athol Road

Runoff = 0.33 cfs @ 12.10 hrs, Volume= 1,055 cf, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	6,419	74	>75% Grass cover, Good, HSG C/D
	6,419		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment PR4a: To northwest wetland

Runoff = 23.69 cfs @ 12.39 hrs, Volume= 125,785 cf, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	682,806	77	>75% Grass cover, Good, HSG C/D
	682,806		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.00"
1.0	78	0.0380	1.36		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
0.8	136	0.1700	2.89		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
7.5	540	0.0290	1.19		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
1.6	133	0.0370	1.35		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
0.3	42	0.0950	2.16		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
3.1	218	0.0280	1.17		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
5.9	441	0.0320	1.25		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
1.0	75	0.0350	1.31		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
27.6	1,713	Total			

Summary for Subcatchment PR4b: To northwest wetland

Runoff = 10.97 cfs @ 12.14 hrs, Volume= 39,254 cf, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	238,825	74	Woods, Good, HSG C/D
	238,825		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.00"
3.0	220	0.0300	1.21		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
1.0	130	0.1000	2.21		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
9.5	400	Total			

Summary for Subcatchment PR5: Offsite

Runoff = 2.59 cfs @ 12.12 hrs, Volume= 8,796 cf, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
53,515	74	>75% Grass cover, Good, HSG C
53,515		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0300	0.12		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.00"
0.8	108	0.1000	2.21		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
8.0	158	Total			

Summary for Reach DP-1: BVW East

Inflow Area = 266,817 sf, 0.00% Impervious, Inflow Depth > 1.68" for 10-Year event
Inflow = 7.53 cfs @ 12.14 hrs, Volume= 37,371 cf
Outflow = 7.53 cfs @ 12.14 hrs, Volume= 37,371 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP-2: BVW Northeast

Inflow Area = 138,301 sf, 0.00% Impervious, Inflow Depth > 1.87" for 10-Year event
Inflow = 3.24 cfs @ 12.15 hrs, Volume= 21,567 cf
Outflow = 3.24 cfs @ 12.15 hrs, Volume= 21,567 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP-3: Athol Road

Inflow Area = 6,419 sf, 0.00% Impervious, Inflow Depth = 1.97" for 10-Year event
Inflow = 0.33 cfs @ 12.10 hrs, Volume= 1,055 cf
Outflow = 0.33 cfs @ 12.10 hrs, Volume= 1,055 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP-4: BVW Northwest

Inflow Area = 921,631 sf, 0.00% Impervious, Inflow Depth > 2.14" for 10-Year event
Inflow = 14.79 cfs @ 12.51 hrs, Volume= 164,199 cf
Outflow = 14.79 cfs @ 12.51 hrs, Volume= 164,199 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP-5: Offsite to Southwest

Inflow Area = 53,515 sf, 0.00% Impervious, Inflow Depth > 1.87" for 10-Year event
Inflow = 1.61 cfs @ 12.26 hrs, Volume= 8,352 cf
Outflow = 1.61 cfs @ 12.26 hrs, Volume= 8,352 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Det. Basin 1

Inflow Area = 80,503 sf, 0.00% Impervious, Inflow Depth = 1.97" for 10-Year event
Inflow = 4.02 cfs @ 12.11 hrs, Volume= 13,232 cf
Outflow = 0.60 cfs @ 12.74 hrs, Volume= 11,384 cf, Atten= 85%, Lag= 38.0 min
Primary = 0.60 cfs @ 12.74 hrs, Volume= 11,384 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 1,069.90' @ 12.74 hrs Surf.Area= 7,342 sf Storage= 5,867 cf

Plug-Flow detention time= 201.0 min calculated for 11,384 cf (86% of inflow)
Center-of-Mass det. time= 138.5 min (982.2 - 843.8)

Volume	Invert	Avail.Storage	Storage Description
#1	1,069.00'	25,474 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,069.00	5,684	0	0
1,070.00	7,524	6,604	6,604
1,071.00	9,421	8,473	15,077
1,072.00	11,374	10,398	25,474

Device	Routing	Invert	Outlet Devices
#1	Primary	1,069.00'	**12.0" Round Culvert** L= 30.0' Ke= 0.500 Inlet / Outlet Invert= 1,069.00' / 1,068.00' S= 0.0333 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

#2 Device 1 1,069.25' **6.0" Vert. Orifice/Grate** X 2 rows with 12.0" cc spacing C= 0.600

Primary OutFlow Max=0.60 cfs @ 12.74 hrs HW=1,069.90' (Free Discharge)
└─**1=Culvert** (Passes 0.60 cfs of 2.41 cfs potential flow)
└─**2=Orifice/Grate** (Orifice Controls 0.60 cfs @ 3.05 fps)

Summary for Pond 2P: Det. Basin 2

Inflow Area = 76,739 sf, 0.00% Impervious, Inflow Depth = 1.97" for 10-Year event
Inflow = 3.31 cfs @ 12.17 hrs, Volume= 12,613 cf
Outflow = 0.81 cfs @ 12.66 hrs, Volume= 11,448 cf, Atten= 76%, Lag= 29.7 min
Primary = 0.81 cfs @ 12.66 hrs, Volume= 11,448 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 1,063.28' @ 12.66 hrs Surf.Area= 4,507 sf Storage= 4,954 cf

Plug-Flow detention time= 137.0 min calculated for 11,429 cf (91% of inflow)
Center-of-Mass det. time= 92.2 min (940.2 - 848.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,062.00'	14,260 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,062.00	3,272	0	0
1,063.00	4,228	3,750	3,750
1,064.00	5,241	4,735	8,485
1,065.00	6,310	5,776	14,260

Device	Routing	Invert	Outlet Devices
#1	Primary	1,062.00'	**12.0" Round Culvert** L= 30.0' Ke= 0.500 Inlet / Outlet Invert= 1,062.00' / 1,061.00' S= 0.0333 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	1,062.30'	**6.0" Vert. Orifice/Grate** X 2 rows with 12.0" cc spacing C= 0.600

Primary OutFlow Max=0.81 cfs @ 12.66 hrs HW=1,063.28' (Free Discharge)
└─**1=Culvert** (Passes 0.81 cfs of 3.33 cfs potential flow)
└─**2=Orifice/Grate** (Orifice Controls 0.81 cfs @ 4.10 fps)

Summary for Pond 4P: Det. Basin 3

Inflow Area = 682,806 sf, 0.00% Impervious, Inflow Depth = 2.21" for 10-Year event
Inflow = 23.69 cfs @ 12.39 hrs, Volume= 125,785 cf
Outflow = 12.67 cfs @ 12.77 hrs, Volume= 124,945 cf, Atten= 47%, Lag= 22.8 min
Primary = 12.67 cfs @ 12.77 hrs, Volume= 124,945 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 1,012.48' @ 12.77 hrs Surf.Area= 15,608 sf Storage= 33,974 cf

Plug-Flow detention time= 58.4 min calculated for 124,737 cf (99% of inflow)
Center-of-Mass det. time= 54.9 min (909.6 - 854.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,010.00'	78,499 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,010.00	11,875	0	0
1,011.00	13,336	12,606	12,606
1,012.00	14,855	14,096	26,701
1,013.00	16,431	15,643	42,344
1,014.00	18,063	17,247	59,591
1,015.00	19,752	18,908	78,499

Device	Routing	Invert	Outlet Devices
#1	Primary	1,010.00'	**24.0" Round Culvert** L= 40.0' Ke= 0.500 Inlet / Outlet Invert= 1,010.00' / 1,009.00' S= 0.0250 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	1,010.00'	**10.0" Vert. Orifice/Grate X 2.00 columns** X 3 rows with 14.0" cc spacing C= 0.600

Primary OutFlow Max=12.65 cfs @ 12.77 hrs HW=1,012.48' (Free Discharge)
└─**1=Culvert** (Passes 12.65 cfs of 18.37 cfs potential flow)
└─**2=Orifice/Grate** (Orifice Controls 12.65 cfs @ 5.49 fps)

Summary for Pond 5P: Det. Basin 4

Inflow Area =	53,515 sf,	0.00% Impervious,	Inflow Depth =	1.97"	for 10-Year event
Inflow =	2.59 cfs @	12.12 hrs,	Volume=	8,796 cf	
Outflow =	1.61 cfs @	12.26 hrs,	Volume=	8,352 cf,	Atten= 38%, Lag= 8.7 min
Primary =	1.61 cfs @	12.26 hrs,	Volume=	8,352 cf	

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 1,028.33' @ 12.26 hrs Surf.Area= 1,586 sf Storage= 1,702 cf

Plug-Flow detention time= 56.6 min calculated for 8,338 cf (95% of inflow)
Center-of-Mass det. time= 30.0 min (874.6 - 844.6)

Volume	Invert	Avail.Storage	Storage Description
#1	1,027.00'	5,066 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,027.00	992	0	0
1,028.00	1,425	1,209	1,209
1,029.00	1,915	1,670	2,879
1,030.00	2,460	2,188	5,066

Device	Routing	Invert	Outlet Devices
#1	Primary	1,027.40'	**12.0" Round Culvert** L= 40.0' Ke= 0.500 Inlet / Outlet Invert= 1,027.40' / 1,027.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

#2	Device 1	1,027.40'	**6.0" Vert. Orifice/Grate X 2.00 columns** X 2 rows with 10.0" cc spacing C= 0.600

Primary OutFlow Max=1.60 cfs @ 12.26 hrs HW=1,028.32' (Free Discharge)
└─**1=Culvert** (Passes 1.60 cfs of 2.41 cfs potential flow)
  └─**2=Orifice/Grate** (Orifice Controls 1.60 cfs @ 3.63 fps)

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PR1a: To east wetland Runoff Area=80,503 sf 0.00% Impervious Runoff Depth=2.61"
Flow Length=179' Tc=7.1 min CN=74 Runoff=5.35 cfs 17,481 cf

Subcatchment PR1b: To east wetland Runoff Area=186,314 sf 0.00% Impervious Runoff Depth=2.26"
Flow Length=395' Tc=8.6 min CN=70 Runoff=10.00 cfs 35,111 cf

Subcatchment PR2a: To northeast wetland Runoff Area=76,739 sf 0.00% Impervious Runoff Depth=2.61"
Flow Length=407' Tc=11.7 min CN=74 Runoff=4.42 cfs 16,664 cf

Subcatchment PR2b: To northeast wetland Runoff Area=61,562 sf 0.00% Impervious Runoff Depth=2.61"
Flow Length=220' Tc=9.3 min CN=74 Runoff=3.78 cfs 13,368 cf

Subcatchment PR3: To Athol Road Runoff Area=6,419 sf 0.00% Impervious Runoff Depth=2.61"
Tc=6.0 min CN=74 Runoff=0.44 cfs 1,394 cf

Subcatchment PR4a: To northwest wetland Runoff Area=682,806 sf 0.00% Impervious Runoff Depth=2.88"
Flow Length=1,713' Tc=27.6 min CN=77 Runoff=30.95 cfs 163,639 cf

Subcatchment PR4b: To northwest wetland Runoff Area=238,825 sf 0.00% Impervious Runoff Depth=2.61"
Flow Length=400' Tc=9.5 min CN=74 Runoff=14.60 cfs 51,861 cf

Subcatchment PR5: Offsite Runoff Area=53,515 sf 0.00% Impervious Runoff Depth=2.61"
Flow Length=158' Tc=8.0 min CN=74 Runoff=3.45 cfs 11,621 cf

Reach DP-1: BVW East Inflow=10.49 cfs 50,727 cf
Outflow=10.49 cfs 50,727 cf

Reach DP-2: BVW Northeast Inflow=4.40 cfs 28,862 cf
Outflow=4.40 cfs 28,862 cf

Reach DP-3: Athol Road Inflow=0.44 cfs 1,394 cf
Outflow=0.44 cfs 1,394 cf

Reach DP-4: BVW Northwest Inflow=20.25 cfs 214,636 cf
Outflow=20.25 cfs 214,636 cf

Reach DP-5: Offsite to Southwest Inflow=2.32 cfs 11,176 cf
Outflow=2.32 cfs 11,176 cf

Pond 1P: Det. Basin 1 Peak Elev=1,070.18' Storage=7,966 cf Inflow=5.35 cfs 17,481 cf
Outflow=0.78 cfs 15,616 cf

Pond 2P: Det. Basin 2 Peak Elev=1,063.62' Storage=6,573 cf Inflow=4.42 cfs 16,664 cf
Outflow=1.24 cfs 15,494 cf

Pond 4P: Det. Basin 3 Peak Elev=1,013.04' Storage=43,078 cf Inflow=30.95 cfs 163,639 cf
Outflow=17.71 cfs 162,775 cf

Pond 5P: Det. Basin 4 Peak Elev=1,028.56' Storage=2,079 cf Inflow=3.45 cfs 11,621 cf
Outflow=2.32 cfs 11,176 cf

Total Runoff Area = 1,386,683 sf Runoff Volume = 311,139 cf Average Runoff Depth = 2.69"
100.00% Pervious = 1,386,683 sf 0.00% Impervious = 0 sf

Summary for Subcatchment PR1a: To east wetland

Runoff = 5.35 cfs @ 12.11 hrs, Volume= 17,481 cf, Depth= 2.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
80,503	74	>75% Grass cover, Good, HSG C
80,503		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.00"
1.6	129	0.0390	1.38		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
7.1	179	Total			

Summary for Subcatchment PR1b: To east wetland

Runoff = 10.00 cfs @ 12.13 hrs, Volume= 35,111 cf, Depth= 2.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
186,314	70	Woods, Good, HSG C
186,314		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.00"
1.6	129	0.0390	1.38		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
1.5	216	0.1200	2.42		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
8.6	395	Total			

Summary for Subcatchment PR2a: To northeast wetland

Runoff = 4.42 cfs @ 12.17 hrs, Volume= 16,664 cf, Depth= 2.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
76,739	74	>75% Grass cover, Good, HSG C
76,739		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.00"
2.5	150	0.0200	0.99		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
2.8	207	0.0300	1.21		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
11.7	407	Total			

Summary for Subcatchment PR2b: To northeast wetland

Runoff = 3.78 cfs @ 12.14 hrs, Volume= 13,368 cf, Depth= 2.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
61,562	74	>75% Grass cover, Good, HSG C
61,562		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.00"
2.9	170	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.3	220	Total			

Summary for Subcatchment PR3: To Athol Road

Runoff = 0.44 cfs @ 12.09 hrs, Volume= 1,394 cf, Depth= 2.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

	Area (sf)	CN	Description
*	6,419	74	>75% Grass cover, Good, HSG C/D
	6,419		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment PR4a: To northwest wetland

Runoff = 30.95 cfs @ 12.39 hrs, Volume= 163,639 cf, Depth= 2.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

	Area (sf)	CN	Description
*	682,806	77	>75% Grass cover, Good, HSG C/D
	682,806		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.00"
1.0	78	0.0380	1.36		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
0.8	136	0.1700	2.89		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
7.5	540	0.0290	1.19		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
1.6	133	0.0370	1.35		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
0.3	42	0.0950	2.16		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
3.1	218	0.0280	1.17		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
5.9	441	0.0320	1.25		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
1.0	75	0.0350	1.31		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
27.6	1,713	Total			

Summary for Subcatchment PR4b: To northwest wetland

Runoff = 14.60 cfs @ 12.14 hrs, Volume= 51,861 cf, Depth= 2.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

	Area (sf)	CN	Description
*	238,825	74	Woods, Good, HSG C/D
	238,825		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.00"
3.0	220	0.0300	1.21		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
1.0	130	0.1000	2.21		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
9.5	400	Total			

Summary for Subcatchment PR5: Offsite

Runoff = 3.45 cfs @ 12.12 hrs, Volume= 11,621 cf, Depth= 2.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
53,515	74	>75% Grass cover, Good, HSG C
53,515		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0300	0.12		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.00"
0.8	108	0.1000	2.21		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
8.0	158	Total			

Summary for Reach DP-1: BVW East

Inflow Area = 266,817 sf, 0.00% Impervious, Inflow Depth > 2.28" for 25-Year event
Inflow = 10.49 cfs @ 12.13 hrs, Volume= 50,727 cf
Outflow = 10.49 cfs @ 12.13 hrs, Volume= 50,727 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP-2: BVW Northeast

Inflow Area = 138,301 sf, 0.00% Impervious, Inflow Depth > 2.50" for 25-Year event
Inflow = 4.40 cfs @ 12.15 hrs, Volume= 28,862 cf
Outflow = 4.40 cfs @ 12.15 hrs, Volume= 28,862 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP-3: Athol Road

Inflow Area = 6,419 sf, 0.00% Impervious, Inflow Depth = 2.61" for 25-Year event
Inflow = 0.44 cfs @ 12.09 hrs, Volume= 1,394 cf
Outflow = 0.44 cfs @ 12.09 hrs, Volume= 1,394 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP-4: BVW Northwest

Inflow Area = 921,631 sf, 0.00% Impervious, Inflow Depth > 2.79" for 25-Year event
Inflow = 20.25 cfs @ 12.66 hrs, Volume= 214,636 cf
Outflow = 20.25 cfs @ 12.66 hrs, Volume= 214,636 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP-5: Offsite to Southwest

Inflow Area = 53,515 sf, 0.00% Impervious, Inflow Depth > 2.51" for 25-Year event
Inflow = 2.32 cfs @ 12.24 hrs, Volume= 11,176 cf
Outflow = 2.32 cfs @ 12.24 hrs, Volume= 11,176 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Det. Basin 1

Inflow Area = 80,503 sf, 0.00% Impervious, Inflow Depth = 2.61" for 25-Year event
Inflow = 5.35 cfs @ 12.11 hrs, Volume= 17,481 cf
Outflow = 0.78 cfs @ 12.72 hrs, Volume= 15,616 cf, Atten= 85%, Lag= 37.1 min
Primary = 0.78 cfs @ 12.72 hrs, Volume= 15,616 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 1,070.18' @ 12.72 hrs Surf.Area= 7,860 sf Storage= 7,966 cf

Plug-Flow detention time= 188.4 min calculated for 15,616 cf (89% of inflow)
Center-of-Mass det. time= 137.4 min (973.0 - 835.6)

Volume	Invert	Avail.Storage	Storage Description
#1	1,069.00'	25,474 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,069.00	5,684	0	0
1,070.00	7,524	6,604	6,604
1,071.00	9,421	8,473	15,077
1,072.00	11,374	10,398	25,474

Device	Routing	Invert	Outlet Devices
#1	Primary	1,069.00'	**12.0" Round Culvert** L= 30.0' Ke= 0.500 Inlet / Outlet Invert= 1,069.00' / 1,068.00' S= 0.0333 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

#2 Device 1 1,069.25' **6.0" Vert. Orifice/Grate** X 2 rows with 12.0" cc spacing C= 0.600

Primary OutFlow Max=0.78 cfs @ 12.72 hrs HW=1,070.18' (Free Discharge)
└─**1=Culvert** (Passes 0.78 cfs of 3.11 cfs potential flow)
└─**2=Orifice/Grate** (Orifice Controls 0.78 cfs @ 3.96 fps)

Summary for Pond 2P: Det. Basin 2

Inflow Area = 76,739 sf, 0.00% Impervious, Inflow Depth = 2.61" for 25-Year event
Inflow = 4.42 cfs @ 12.17 hrs, Volume= 16,664 cf
Outflow = 1.24 cfs @ 12.61 hrs, Volume= 15,494 cf, Atten= 72%, Lag= 26.8 min
Primary = 1.24 cfs @ 12.61 hrs, Volume= 15,494 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 1,063.62' @ 12.61 hrs Surf.Area= 4,858 sf Storage= 6,573 cf

Plug-Flow detention time= 125.6 min calculated for 15,494 cf (93% of inflow)
Center-of-Mass det. time= 89.2 min (929.1 - 839.9)

Volume	Invert	Avail.Storage	Storage Description
#1	1,062.00'	14,260 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,062.00	3,272	0	0
1,063.00	4,228	3,750	3,750
1,064.00	5,241	4,735	8,485
1,065.00	6,310	5,776	14,260

Device	Routing	Invert	Outlet Devices
#1	Primary	1,062.00'	**12.0" Round Culvert** L= 30.0' Ke= 0.500 Inlet / Outlet Invert= 1,062.00' / 1,061.00' S= 0.0333 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	1,062.30'	**6.0" Vert. Orifice/Grate** X 2 rows with 12.0" cc spacing C= 0.600

Primary OutFlow Max=1.23 cfs @ 12.61 hrs HW=1,063.62' (Free Discharge)
└─**1=Culvert** (Passes 1.23 cfs of 4.00 cfs potential flow)
└─**2=Orifice/Grate** (Orifice Controls 1.23 cfs @ 3.75 fps)

Summary for Pond 4P: Det. Basin 3

Inflow Area = 682,806 sf, 0.00% Impervious, Inflow Depth = 2.88" for 25-Year event
Inflow = 30.95 cfs @ 12.39 hrs, Volume= 163,639 cf
Outflow = 17.71 cfs @ 12.74 hrs, Volume= 162,775 cf, Atten= 43%, Lag= 21.0 min
Primary = 17.71 cfs @ 12.74 hrs, Volume= 162,775 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 1,013.04' @ 12.74 hrs Surf.Area= 16,504 sf Storage= 43,078 cf

Plug-Flow detention time= 54.6 min calculated for 162,504 cf (99% of inflow)
Center-of-Mass det. time= 51.8 min (898.9 - 847.1)

Volume	Invert	Avail.Storage	Storage Description
#1	1,010.00'	78,499 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,010.00	11,875	0	0
1,011.00	13,336	12,606	12,606
1,012.00	14,855	14,096	26,701
1,013.00	16,431	15,643	42,344
1,014.00	18,063	17,247	59,591
1,015.00	19,752	18,908	78,499

Device	Routing	Invert	Outlet Devices
#1	Primary	1,010.00'	**24.0" Round Culvert** L= 40.0' Ke= 0.500 Inlet / Outlet Invert= 1,010.00' / 1,009.00' S= 0.0250 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	1,010.00'	**10.0" Vert. Orifice/Grate X 2.00 columns** X 3 rows with 14.0" cc spacing C= 0.600

Primary OutFlow Max=17.69 cfs @ 12.74 hrs HW=1,013.04' (Free Discharge)
└─**1=Culvert** (Passes 17.69 cfs of 21.62 cfs potential flow)
└─**2=Orifice/Grate** (Orifice Controls 17.69 cfs @ 5.58 fps)

Summary for Pond 5P: Det. Basin 4

Inflow Area = 53,515 sf, 0.00% Impervious, Inflow Depth = 2.61" for 25-Year event
Inflow = 3.45 cfs @ 12.12 hrs, Volume= 11,621 cf
Outflow = 2.32 cfs @ 12.24 hrs, Volume= 11,176 cf, Atten= 33%, Lag= 7.2 min
Primary = 2.32 cfs @ 12.24 hrs, Volume= 11,176 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 1,028.56' @ 12.24 hrs Surf.Area= 1,698 sf Storage= 2,079 cf

Plug-Flow detention time= 47.5 min calculated for 11,158 cf (96% of inflow)
Center-of-Mass det. time= 26.8 min (863.2 - 836.5)

Volume	Invert	Avail.Storage	Storage Description
#1	1,027.00'	5,066 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,027.00	992	0	0
1,028.00	1,425	1,209	1,209
1,029.00	1,915	1,670	2,879
1,030.00	2,460	2,188	5,066

Device	Routing	Invert	Outlet Devices
#1	Primary	1,027.40'	**12.0" Round Culvert** L= 40.0' Ke= 0.500 Inlet / Outlet Invert= 1,027.40' / 1,027.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

#2	Device 1	1,027.40'	**6.0" Vert. Orifice/Grate X 2.00 columns** X 2 rows with 10.0" cc spacing C= 0.600

Primary OutFlow Max=2.31 cfs @ 12.24 hrs HW=1,028.55' (Free Discharge)
└─**1=Culvert** (Passes 2.31 cfs of 3.06 cfs potential flow)
  └─**2=Orifice/Grate** (Orifice Controls 2.31 cfs @ 3.51 fps)

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PR1a: To east wetland Runoff Area=80,503 sf 0.00% Impervious Runoff Depth=3.61"
Flow Length=179' Tc=7.1 min CN=74 Runoff=7.44 cfs 24,216 cf

Subcatchment PR1b: To east wetland Runoff Area=186,314 sf 0.00% Impervious Runoff Depth=3.21"
Flow Length=395' Tc=8.6 min CN=70 Runoff=14.33 cfs 49,794 cf

Subcatchment PR2a: To northeast wetland Runoff Area=76,739 sf 0.00% Impervious Runoff Depth=3.61"
Flow Length=407' Tc=11.7 min CN=74 Runoff=6.14 cfs 23,083 cf

Subcatchment PR2b: To northeast wetland Runoff Area=61,562 sf 0.00% Impervious Runoff Depth=3.61"
Flow Length=220' Tc=9.3 min CN=74 Runoff=5.25 cfs 18,518 cf

Subcatchment PR3: To Athol Road Runoff Area=6,419 sf 0.00% Impervious Runoff Depth=3.61"
Tc=6.0 min CN=74 Runoff=0.61 cfs 1,931 cf

Subcatchment PR4a: To northwest wetland Runoff Area=682,806 sf 0.00% Impervious Runoff Depth=3.92"
Flow Length=1,713' Tc=27.6 min CN=77 Runoff=42.18 cfs 223,008 cf

Subcatchment PR4b: To northwest wetland Runoff Area=238,825 sf 0.00% Impervious Runoff Depth=3.61"
Flow Length=400' Tc=9.5 min CN=74 Runoff=20.29 cfs 71,839 cf

Subcatchment PR5: Offsite Runoff Area=53,515 sf 0.00% Impervious Runoff Depth=3.61"
Flow Length=158' Tc=8.0 min CN=74 Runoff=4.79 cfs 16,097 cf

Reach DP-1: BVW East Inflow=15.05 cfs 72,122 cf
Outflow=15.05 cfs 72,122 cf

Reach DP-2: BVW Northeast Inflow=6.10 cfs 40,426 cf
Outflow=6.10 cfs 40,426 cf

Reach DP-3: Athol Road Inflow=0.61 cfs 1,931 cf
Outflow=0.61 cfs 1,931 cf

Reach DP-4: BVW Northwest Inflow=27.89 cfs 293,955 cf
Outflow=27.89 cfs 293,955 cf

Reach DP-5: Offsite to Southwest Inflow=3.27 cfs 15,653 cf
Outflow=3.27 cfs 15,653 cf

Pond 1P: Det. Basin 1 Peak Elev=1,070.57' Storage=11,189 cf Inflow=7.44 cfs 24,216 cf
Outflow=1.23 cfs 22,328 cf

Pond 2P: Det. Basin 2 Peak Elev=1,064.08' Storage=8,894 cf Inflow=6.14 cfs 23,083 cf
Outflow=1.85 cfs 21,908 cf

Pond 4P: Det. Basin 3 Peak Elev=1,013.90' Storage=57,836 cf Inflow=42.18 cfs 223,008 cf
Outflow=23.44 cfs 222,116 cf

Pond 5P: Det. Basin 4 Peak Elev=1,028.87' Storage=2,639 cf Inflow=4.79 cfs 16,097 cf
Outflow=3.27 cfs 15,653 cf

Total Runoff Area = 1,386,683 sf Runoff Volume = 428,486 cf Average Runoff Depth = 3.71"
100.00% Pervious = 1,386,683 sf 0.00% Impervious = 0 sf

Summary for Subcatchment PR1a: To east wetland

Runoff = 7.44 cfs @ 12.11 hrs, Volume= 24,216 cf, Depth= 3.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
80,503	74	>75% Grass cover, Good, HSG C
80,503		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.00"
1.6	129	0.0390	1.38		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
7.1	179	Total			

Summary for Subcatchment PR1b: To east wetland

Runoff = 14.33 cfs @ 12.13 hrs, Volume= 49,794 cf, Depth= 3.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
186,314	70	Woods, Good, HSG C
186,314		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.00"
1.6	129	0.0390	1.38		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
1.5	216	0.1200	2.42		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
8.6	395	Total			

Summary for Subcatchment PR2a: To northeast wetland

Runoff = 6.14 cfs @ 12.16 hrs, Volume= 23,083 cf, Depth= 3.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
76,739	74	>75% Grass cover, Good, HSG C
76,739		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.00"
2.5	150	0.0200	0.99		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
2.8	207	0.0300	1.21		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
11.7	407	Total			

Summary for Subcatchment PR2b: To northeast wetland

Runoff = 5.25 cfs @ 12.13 hrs, Volume= 18,518 cf, Depth= 3.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
61,562	74	>75% Grass cover, Good, HSG C
61,562		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.00"
2.9	170	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.3	220	Total			

Summary for Subcatchment PR3: To Athol Road

Runoff = 0.61 cfs @ 12.09 hrs, Volume= 1,931 cf, Depth= 3.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	6,419	74	>75% Grass cover, Good, HSG C/D
	6,419		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment PR4a: To northwest wetland

Runoff = 42.18 cfs @ 12.38 hrs, Volume= 223,008 cf, Depth= 3.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	682,806	77	>75% Grass cover, Good, HSG C/D
	682,806		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0400	0.13		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.00"
1.0	78	0.0380	1.36		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
0.8	136	0.1700	2.89		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
7.5	540	0.0290	1.19		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
1.6	133	0.0370	1.35		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
0.3	42	0.0950	2.16		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
3.1	218	0.0280	1.17		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
5.9	441	0.0320	1.25		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
1.0	75	0.0350	1.31		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
27.6	1,713	Total			

Summary for Subcatchment PR4b: To northwest wetland

Runoff = 20.29 cfs @ 12.14 hrs, Volume= 71,839 cf, Depth= 3.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	238,825	74	Woods, Good, HSG C/D
	238,825		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0600	0.15		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.00"
3.0	220	0.0300	1.21		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
1.0	130	0.1000	2.21		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
9.5	400	Total			

Summary for Subcatchment PR5: Offsite

Runoff = 4.79 cfs @ 12.12 hrs, Volume= 16,097 cf, Depth= 3.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
53,515	74	>75% Grass cover, Good, HSG C
53,515		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0300	0.12		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.00"
0.8	108	0.1000	2.21		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
8.0	158	Total			

Summary for Reach DP-1: BVW East

Inflow Area = 266,817 sf, 0.00% Impervious, Inflow Depth > 3.24" for 100-Year event
Inflow = 15.05 cfs @ 12.13 hrs, Volume= 72,122 cf
Outflow = 15.05 cfs @ 12.13 hrs, Volume= 72,122 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP-2: BVW Northeast

Inflow Area = 138,301 sf, 0.00% Impervious, Inflow Depth > 3.51" for 100-Year event
Inflow = 6.10 cfs @ 12.14 hrs, Volume= 40,426 cf
Outflow = 6.10 cfs @ 12.14 hrs, Volume= 40,426 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP-3: Athol Road

Inflow Area = 6,419 sf, 0.00% Impervious, Inflow Depth = 3.61" for 100-Year event
Inflow = 0.61 cfs @ 12.09 hrs, Volume= 1,931 cf
Outflow = 0.61 cfs @ 12.09 hrs, Volume= 1,931 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP-4: BVW Northwest

Inflow Area = 921,631 sf, 0.00% Impervious, Inflow Depth > 3.83" for 100-Year event
Inflow = 27.89 cfs @ 12.50 hrs, Volume= 293,955 cf
Outflow = 27.89 cfs @ 12.50 hrs, Volume= 293,955 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach DP-5: Offsite to Southwest

Inflow Area = 53,515 sf, 0.00% Impervious, Inflow Depth > 3.51" for 100-Year event
Inflow = 3.27 cfs @ 12.23 hrs, Volume= 15,653 cf
Outflow = 3.27 cfs @ 12.23 hrs, Volume= 15,653 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Det. Basin 1

Inflow Area = 80,503 sf, 0.00% Impervious, Inflow Depth = 3.61" for 100-Year event
Inflow = 7.44 cfs @ 12.11 hrs, Volume= 24,216 cf
Outflow = 1.23 cfs @ 12.62 hrs, Volume= 22,328 cf, Atten= 83%, Lag= 31.1 min
Primary = 1.23 cfs @ 12.62 hrs, Volume= 22,328 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 1,070.57' @ 12.62 hrs Surf.Area= 8,603 sf Storage= 11,189 cf

Plug-Flow detention time= 178.3 min calculated for 22,328 cf (92% of inflow)
Center-of-Mass det. time= 138.5 min (964.7 - 826.2)

Volume	Invert	Avail.Storage	Storage Description
#1	1,069.00'	25,474 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,069.00	5,684	0	0
1,070.00	7,524	6,604	6,604
1,071.00	9,421	8,473	15,077
1,072.00	11,374	10,398	25,474

Device	Routing	Invert	Outlet Devices
#1	Primary	1,069.00'	**12.0" Round Culvert** L= 30.0' Ke= 0.500 Inlet / Outlet Invert= 1,069.00' / 1,068.00' S= 0.0333 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

#2 Device 1 1,069.25' **6.0" Vert. Orifice/Grate** X 2 rows with 12.0" cc spacing C= 0.600

Primary OutFlow Max=1.23 cfs @ 12.62 hrs HW=1,070.57' (Free Discharge)
└─**1=Culvert** (Passes 1.23 cfs of 3.91 cfs potential flow)
└─**2=Orifice/Grate** (Orifice Controls 1.23 cfs @ 3.75 fps)

Summary for Pond 2P: Det. Basin 2

Inflow Area = 76,739 sf, 0.00% Impervious, Inflow Depth = 3.61" for 100-Year event
Inflow = 6.14 cfs @ 12.16 hrs, Volume= 23,083 cf
Outflow = 1.85 cfs @ 12.58 hrs, Volume= 21,908 cf, Atten= 70%, Lag= 25.0 min
Primary = 1.85 cfs @ 12.58 hrs, Volume= 21,908 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 1,064.08' @ 12.58 hrs Surf.Area= 5,324 sf Storage= 8,894 cf

Plug-Flow detention time= 111.7 min calculated for 21,908 cf (95% of inflow)
Center-of-Mass det. time= 84.0 min (914.5 - 830.5)

Volume	Invert	Avail.Storage	Storage Description
#1	1,062.00'	14,260 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,062.00	3,272	0	0
1,063.00	4,228	3,750	3,750
1,064.00	5,241	4,735	8,485
1,065.00	6,310	5,776	14,260

Device	Routing	Invert	Outlet Devices
#1	Primary	1,062.00'	**12.0" Round Culvert** L= 30.0' Ke= 0.500 Inlet / Outlet Invert= 1,062.00' / 1,061.00' S= 0.0333 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	1,062.30'	**6.0" Vert. Orifice/Grate** X 2 rows with 12.0" cc spacing C= 0.600

Primary OutFlow Max=1.85 cfs @ 12.58 hrs HW=1,064.08' (Free Discharge)
└─**1=Culvert** (Passes 1.85 cfs of 4.75 cfs potential flow)
└─**2=Orifice/Grate** (Orifice Controls 1.85 cfs @ 4.72 fps)

Summary for Pond 4P: Det. Basin 3

Inflow Area = 682,806 sf, 0.00% Impervious, Inflow Depth = 3.92" for 100-Year event
Inflow = 42.18 cfs @ 12.38 hrs, Volume= 223,008 cf
Outflow = 23.44 cfs @ 12.74 hrs, Volume= 222,116 cf, Atten= 44%, Lag= 21.6 min
Primary = 23.44 cfs @ 12.74 hrs, Volume= 222,116 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 1,013.90' @ 12.74 hrs Surf.Area= 17,904 sf Storage= 57,836 cf

Plug-Flow detention time= 51.4 min calculated for 222,116 cf (100% of inflow)
Center-of-Mass det. time= 49.0 min (887.2 - 838.2)

Volume	Invert	Avail.Storage	Storage Description
#1	1,010.00'	78,499 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,010.00	11,875	0	0
1,011.00	13,336	12,606	12,606
1,012.00	14,855	14,096	26,701
1,013.00	16,431	15,643	42,344
1,014.00	18,063	17,247	59,591
1,015.00	19,752	18,908	78,499

Device	Routing	Invert	Outlet Devices
#1	Primary	1,010.00'	**24.0" Round Culvert** L= 40.0' Ke= 0.500 Inlet / Outlet Invert= 1,010.00' / 1,009.00' S= 0.0250 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	1,010.00'	**10.0" Vert. Orifice/Grate X 2.00 columns** X 3 rows with 14.0" cc spacing C= 0.600

Primary OutFlow Max=23.43 cfs @ 12.74 hrs HW=1,013.90' (Free Discharge)
└─**1=Culvert** (Passes 23.43 cfs of 25.76 cfs potential flow)
└─**2=Orifice/Grate** (Orifice Controls 23.43 cfs @ 7.16 fps)

Summary for Pond 5P: Det. Basin 4

Inflow Area = 53,515 sf, 0.00% Impervious, Inflow Depth = 3.61" for 100-Year event
Inflow = 4.79 cfs @ 12.12 hrs, Volume= 16,097 cf
Outflow = 3.27 cfs @ 12.23 hrs, Volume= 15,653 cf, Atten= 32%, Lag= 6.7 min
Primary = 3.27 cfs @ 12.23 hrs, Volume= 15,653 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 1,028.87' @ 12.23 hrs Surf.Area= 1,853 sf Storage= 2,639 cf

Plug-Flow detention time= 39.0 min calculated for 15,627 cf (97% of inflow)
Center-of-Mass det. time= 23.6 min (850.7 - 827.1)

Volume	Invert	Avail.Storage	Storage Description
#1	1,027.00'	5,066 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,027.00	992	0	0
1,028.00	1,425	1,209	1,209
1,029.00	1,915	1,670	2,879
1,030.00	2,460	2,188	5,066

Device	Routing	Invert	Outlet Devices
#1	Primary	1,027.40'	**12.0" Round Culvert** L= 40.0' Ke= 0.500 Inlet / Outlet Invert= 1,027.40' / 1,027.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

#2	Device 1	1,027.40'	**6.0" Vert. Orifice/Grate X 2.00 columns** X 2 rows with 10.0" cc spacing C= 0.600

Primary OutFlow Max=3.26 cfs @ 12.23 hrs HW=1,028.87' (Free Discharge)
└─**1=Culvert** (Passes 3.26 cfs of 3.66 cfs potential flow)
  └─**2=Orifice/Grate** (Orifice Controls 3.26 cfs @ 4.15 fps)

Rip-Rap Apron Sizing

Stantec Consulting Services, Inc.

226 Causeway Street
Boston MA 02114
Tel: (617) 523-8103

Project	OYA Raman Solar	Project #	210801576
Location	Royalston, Massachusettts	Sheet	1 of 1
Calculated by	JLS	Date	7/5/2018
Checked by	FH	Revised	
Title	Rip-Rap Apron Sizing		

Objective:

To size a rip-rap outfall that will decrease discharge velocity and prevent downstream erosion.

Methedology:

U.S. Federal Highway Administration, 2006, Hydraulic Design of Energy Dissipators for Culverts and Channels, Hydraulic Engineering Center Circular No. 14.

Design Criteria:

Location	Pipe Diameter (ft)	*Design Flow Q (cfs)
FES-1	1.00	1.3
FES-2	1.00	1.9
FES-3	2.00	23.4
FES-4	1.00	3.1

*100 Year storm design flows

Calculations:

Stone Sizing:

D50 = 0.02 * (Q/√g*Dia^2.5)^4/3 * (Dia/TW)

Where:
D50 = Median Stone Diameter
TW = Tailwater Height (ft)
Dia = Pipe Diameter (ft)
Q = Flow (cfs) based on the 100-yr storm event
g = acceleration due to gravity (32.2 ft/sec^2)
D100 = Max Stone Diameter = 1.5xD50

Location	D50 (ft)	D50(in)	D100 (in)
FES-1	0.07	0.8	1.2
FES-2	0.11	1.3	2.0
FES-3	0.66	7.9	11.8
FES-4	0.22	2.7	4.0

Assumes Specific gravity of stone to be: 2.65

Apron Dimensions

Using the Table 10.1 below, dimensions can be determined based on pipe diameter

D50 (in.)	Apron Length (ft.)	Apron Depth (in.)	
5	4D	3.5D50	(FES-1, FES-2, FES-4)
6	4D	3.3D50	
10	5D	2.4D50	(FES-3)
14	6D	2.2D50	
20	7D	2.0D50	
22	8D	2.0D50	

Table 10.1 (from reference material noted above)

Apron Width = 3D + (2/3) * Length

Location	Apron Dimensions		
	* Length (ft)	Width (ft)	Depth (in)
FES-1	4.0	6	3
FES-2	4.0	6	5
FES-3	10.0	13	19
FES-4	4.0	6	9

* Minimum length of 10' is provided

Appendix EOPERATION AND MAINTENANCE PLAN & LOG

E.1 OPERATION AND MAINTENANCE PLAN

E.2 OPERATION AND MAINTENANCE LOG

Operation and Maintenance Plan

OYA Solar MA, L.P.

OYA Raman Solar

0 Athol Road

Royalston, MA 01368

July 5, 2018

Prepared for:

Town of Roylaston Planning Board
P.O. Box 127
Royalston, MA 01368

Prepared by:

Stantec Consulting Services Inc.
226 Causeway St., 6th Floor
Boston, MA 02114

Table of Contents

1.0 GENERAL INFORMATION

1.1 INTRODUCTION

The goal of the Operation and Maintenance Plan is not only to protect resources on-site or nearby, but also to protect resources in the region that may be affected by the activities at the project area. An Operations and Maintenance Log is included at the end of this document.

The Stormwater Management System Owner is:

OYA Solar MA, L.P.
144 Front St. West, Suite 310
Toronto, ON M5J 2L7

The system owner will perform the inspections and maintenance as outlined in the Operations and Maintenance Plan with their own maintenance personnel.

2.0 MAINTENANCE AGREEMENT

2.1 RESPONSIBLE FOR OPERATION AND MAINTENANCE (24/7 CONTACT)

To be determined.

2.2 RESPONSIBLE FOR FINANCING MAINTENANCE AND EMERGENCY REPAIRS

To be determined.

2.3 INSPECTION AND MAINTENANCE LOG

An inspection and maintenance log is provided as an attachment to the Operation and Maintenance Plan.

3.0 OPERATION AND MAINTENANCE PLAN

Non-structural controls include detention basins and drainage swales. Structural pollutant controls include outlet control structures and detention basin outlets.

3.1 NON-STRUCTURAL POLLUTANT CONTROLS

The proposed stormwater management system is designed to protect the runoff water quality through the removal of sediment and pollutants. Non-structural pollutant controls used to separate and capture stormwater pollutants are described below.

3.1.1 Drainage Swales and Detention Basin

The detention basins and drainage swales will be inspected at least two times per year and after any storm event that results in a total rainfall of 3 inches or greater over a 24-hour period.

Initial Post-Construction Inspection

- Detention basin should be inspected after every major storm for the first few months to ensure proper stabilization and function.
- The detention basin shall be inspected during the first few months after construction to make sure the vegetation in the basin becomes adequately established.

Long-Term Maintenance

- Inspect detention basins at least once per year to ensure that the basins are operating as intended.
- Inspect extended dry detention basins during and after major storms to determine if the basin is meeting the expected detention times.
- Examine the outlet structure for evidence of clogging or outflow release velocities that are greater than design flow.
- Potential problems that should be checked include: subsidence, erosion, cracking or tree growth on the embankment; damage to the emergency spillway; sediment accumulation around the outlet; inadequacy of the inlet/outlet channel erosion control measures; changes in the condition of the pilot channel; and erosion within the basin and banks. Make any necessary repairs immediately.
- During inspections, note any changes to the extended dry detention basin or the contributing watershed, because these could affect basin performance.
- Mow the upper-stage, side slopes, embankment, and emergency spillway at least twice per year. Also remove trash and debris at this time.
- Remove sediment from the extended dry detention basin as necessary, but at least once every 5 years. Providing an on-site sediment disposal area will reduce the overall sediment removal costs.

3.2 STRUCTURAL POLLUTANT CONTROLS

The proposed stormwater management system is designed to mitigate peak runoff rate. Minimum operation and maintenance requirements for the structural pollutant controls used to capture and mitigate peak rate are described below.

3.2.1 Outlet Control Structure

Outlet control structures will be cleaned a minimum of four times and inspected monthly for the first year to determine the sediment loading for the site. Any sand, sediment, or debris that collects (when it reaches a depth of more than 50% of the sump depth) will be removed as needed. After the first year, the outlet control structures shall be

inspected two times per year and cleaned two times per year or whenever the depth of deposits is greater than or equal too to one half the depth from the bottom of the invert of the lowest pipe in the basin. The frequency of the outlet control structure cleaning should be reviewed and revised based upon the sediment loading observed in the first year. Any structural damage or other indication of malfunction will be reported to the site manager. During colder periods, the outlet control structure grates will be kept free of snow and ice.

Inspections and Cleaning

- All outlet control structures shall be inspected at least two times per year, at the end of the foliage and snow-removal seasons.
- Any structural damage or other indication of malfunction will be reported to the site manager and repaired as necessary
- During colder periods, the outlet control structure grates must be kept free of snow and ice.
- During warmer periods, the outlet control structure grates must be kept free of leaves, litter, sand, and debris.

3.2.2 Stormwater Outlets (Flared End Sections)

Inspect stormwater outlets regularly, especially after large rainfall events.

Inspections and Cleaning

- All stormwater outlets shall be inspected and cleaned, if need be, after large rainfall events.
- Any structural damage or other indication of malfunction will be reported to the site manager and repaired as necessary
- During colder periods, the stormwater outlets must be kept free of snow and ice.
- During warmer periods, the stormwater outlets must be kept free of leaves, litter, sand, and debris.

3.2.3 Vegetated Areas

Although not a structural component of the drainage system, the maintenance of vegetated areas may affect the functioning of stormwater management practices. This includes the health/density of vegetative cover and activities such as the application and disposal of lawn and garden care products, disposal of leaves and yard trimmings.

- Inspect planted areas on a semi-annual basis and remove any litter.
- Maintain planted areas adjacent to pavement to prevent soil washout.
- Immediately clean any soil deposited on pavement.
- Re-install plant material in bare areas; install appropriate erosion control measures when native soil is exposed or erosion channels are forming.
- Plant alternative shrubs or perennials in the event of unsuccessful establishment.

<u>Initial Post-Construction Inspection</u>

During the initial period of vegetation establishment pruning and weeding are required twice in first year by contractor or owner. Any dead vegetation/plantings found after the first year will be replaced. Proper mulching is mandatory and regular watering may be required initially to ensure proper establishment of new vegetation.

<u>Long-Term Maintenance</u>

The planted areas will be inspected on a semi-annual basis and any litter removed. Weeds and invasive plant species will be removed by hand. Maintain planted areas adjacent to pavement to prevent soil washout. Immediately clean any soil deposits on pavement. Leaf litter and other detritus shall be removed twice per year. If needed to maintain aesthetic appearance, perennial plantings may be trimmed at the end of the growing season.

Trees and shrubs will be inspected twice per year to evaluate health and attended to as necessary. Seeded ground cover or grass areas shall not receive mulching. Re-install plant material in bare areas; install appropriate erosion control measures when native soil is exposed, or erosion channels are forming. Plant alternative shrubs or perennials in the event of unsuccessful establishment.

Fertilizer usage will be avoided. If deemed necessary, slow release fertilizer will be used. Fertilizer will be used to begin the establishment of vegetation in bare or damaged areas but will not be applied on a regular basis unless necessary. Inspect planted areas on a semi-annual basis and remove any litter.

- Maintain planted areas adjacent to pavement to prevent soil washout.
- Immediately clean any soil deposited on pavement.
- Re-install plant material in bare areas; install appropriate erosion control measures when native soil is exposed or erosion channels are forming.
- Plant alternative shrubs or perennials in the event of unsuccessful establishment.

<u>Pesticide/Herbicide Usage</u>

The Redevelopment Project will require that landscaping maintenance contractors implement a program to test soils at the site annually and to limit the amount of fertilizer, pesticides, and herbicides to only what is needed to maintain healthy plant materials and landscaped areas.

No pesticides or herbicides are to be used unless a single spot treatment is required for a specific control application.

Fertilizer usage will be avoided. If deemed necessary, slow release fertilizer will be used, and applied only in the minimum amounts recommended by the manufacturer. Once applied, the fertilizer will be worked into the soil to limit exposure to stormwater. Storage will be in a covered area; and the contents of any partially used bags will be transferred to a sealable, plastic bin to avoid spills.

Fertilizer will be used to begin the establishment of vegetation in bare or damaged areas but will not be applied on a regular basis unless necessary.

Records of soil management, application dates, planting dates, preventive measures, treatments, and other appropriate information should be kept. This information will be used as a reference when fertilizer/pesticide/herbicide management decisions in the future.

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Operation and Maintenance Log

Structural Best Management Practice	Action	Date Completed	Completed By	Condition	Additional Action	Date Completed	Completed By	Comments
Detention Basins • Inspect once per year • Inspect after large storm events • Examine outlet structure for clogging • Inspect basin for erosion, cracking or tree growth in the embankment • Mow the berm and side slopes at least twice per year • Remove sediment every 5 years	Inspect							
	Inspect							
	Examine							
	Inspect							
	Mow							
	Remove							
Drainage Swales • Inspect once per year • Inspect after large storm events • Mow at least twice per year • Remove sediment every 5 years	Inspect							
	Inspect							
	Mow							
	Inspect							
Flared End Section • Inspect two times per year • Remove debris from outlet	Inspect							
	Inspect							
Outlet Control Structures • Inspect two times per year • Remove debris from outlet • Keep free of snow and ice • Keep free of leaves, liter, sand and debris	Inspect							
	Inspect							
	Inspect							
	Inspect							

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Operation and Maintenance Log

	Inspect							
	Inspect							
	Inspect							
	Inspect							