October 9, 2018

Dear Town Officials:

The Blackstone River Watershed Association (BRWA) advocates for the protection of water quality, the restoration of degraded ponds and streams, and public enjoyment of the waters and watershed of the Blackstone River and its tributaries. While we support solar energy as an important component of renewable energy, we have become concerned with the increase in large-scale solar facilities and the impacts they can have on the watershed and environment, particularly when these facilities are ground-based (as opposed to roof-mounted). We have done research and assembled the attached document that not only describes our position but gathers information from a range of reliable sources to provide information and guidance for town officials as they evaluate large-scale solar proposals.

There were at least 91 large-scale solar installations located in the towns that comprise the Blackstone River watershed as of July 2018. They are a combination of building-mounted and ground-based installations. Large-scale solar facilities are significant business ventures that involve millions of dollars in investments, hundreds of thousands of dollars in revenues, and significant amounts of land for ground-based installations. Many towns are currently considering new installations. It is our hope that this position paper and resource guide are helpful as you deliberate and decide how best to manage these installations in your towns, weighing both economic benefit and environmental impact.

If you have any questions or comments, please contact the following BRWA board members:

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For your convenience, we have also posted this document on our website and as we make changes it will be updated there. Please visit http://www.thebrwa.org/guides.htm for the latest version.

Sincerely,

JoAnne Holahan
President
Blackstone River Watershed Association

Enclosure: Blackstone River Watershed Association Large-Scale Solar Installations Position Paper and Resource Guide for Town Officials

Blackstone River Watershed Association
Large-Scale Solar Installations
Position Paper and
Resource Guide for Town Officials
October 9, 2018

Contents

Introduction

The Blackstone River Watershed Association's mission is to engage, educate and advocate for improved water quality in the Blackstone River watershed. As a result, we are concerned with activities within the watershed that can adversely impact water resources and water quality. Large-scale solar installations have the potential to cause harm to the watershed and water resources through changes in vegetative cover, creation of impermeable surfaces, loss of wildlife habitat, and increased erosion and sediment production.

Key Points

First, the BRWA supports solar and other renewable energy generation. This position paper is not focused on small-scale solar of less than 1 acre either on the roof of a residence or in the yard. Many towns allow for this use "by right".

Secondly, siting of large-scale solar installations (over 250 kW) is of critical importance and can be governed through town zoning bylaws.

Thirdly, where large-scale solar installations are allowed, towns can and should focus on measures that will protect the environment during the planning, design, construction, operation and decommissioning phases – in other words for the life-cycle of the project.

Background

There were at least 91 large-scale solar installations located in the towns that comprise the Blackstone River watershed as of July 2018. They are a combination of building mounted and ground mounted installations.

Proposals for new installations have been brought before town meetings in Sutton and other area towns in 2018. Some towns, such as Blackstone, have solar by-laws which allow for project proposals to go through the planning board and if wetlands are abutting then the Conservation Commission is involved. With the incentives offered by the Commonwealth for these types of installations (see Appendix), proposals are likely to continue in the years ahead. Many towns have not explicitly addressed this land use and are operating in a reactive mode by responding to proposals by landowners in partnership with solar companies. This puts town leadership and citizens at a disadvantage as they are not familiar with these types of developments and how best to handle proposals in a fair, balanced and consistent fashion that respects both landowner rights as well as the environment and the common good of the town.

The BRWA has studied this topic and located some very helpful and useful sources of information for town officials and interested citizens. These materials have been used throughout this position paper and are listed at the end.

We focused on six areas:

1. Zoning – where do towns want to allow this use and where do they want to prohibit it as part of the zoning bylaws?
2. Site Selection and Design - if an installation is allowed, what characterizes a "good" site and conversely, what are the characteristics of a "poor" site?
3. Mitigation and Remediation – once a site is selected, what measures should be required to ensure that there will be minimal environmental impacts? How can those measures be enforced?
4. Construction – how and when will construction proceed? Who is responsible for on-site monitoring of the construction site to ensure that all requirements are implemented and operating effectively?
5. Operation and Maintenance – what elements should the town require regarding ongoing erosion control, vegetation management, habitat protection and monitoring?
6. Decommissioning – what requirements should the town impose and how can this future expense be funded by the project proponent in a manner that will survive possible changes of ownership or bankruptcy by the solar company that did the original installation?

Zoning

Towns typically encourage commercial and industrial developments, which can include large-scale solar installations, within industrial parks and areas zoned for commercial and industrial use. Typically, these areas are readily accessible by the transportation system, have municipal sewer and water, have adequate electrical utility service, and ideally are not located within, or near, residential areas. The BRWA feels that large-scale solar installations should be encouraged within the commercial/industrial zone.

Towns also need to decide if large-scale solar is compatible with rural residential zoning. Generally, commercial and industrial uses are prohibited while residential development is allowed with a permit typically required.

Some towns have adopted, or are considering, solar overlay districts that could encompass areas zoned as rural residential. An overlay district is a zoning technique that allows a jurisdiction to superimpose additional requirements over a basic use zoning district without disturbing the requirements of the basic use district. In the instance of conflicting requirements, the stricter of the conflicting requirements applies.

The issue this approach creates is that a type of commercial/industrial use could then be allowed within a part of the town where such uses are otherwise not allowed. These solar overlay districts are typically proposed by a landowner working with a solar company that is proposing a large-scale installation. The result can be a hodge-podge of solar overlay districts across the rural residential landscape driven by project proponents rather than careful deliberation by the planning commission and other town leadership. It seems to the BRWA that this approach is fraught and ultimately seeks to undo the zoning that is already in place. For that reason, we recommend that large-scale solar should only be allowed within designated commercial/industrial zones with few exceptions.

One exception could be along highways and highway medians and interchanges. There are a number of large-scale solar installations along the Mass Pike and there may be other highways where this use could make sense. A second exception could be for roof-mounted large-scale solar installations where the amount of impervious surface is unchanged as a result of the installation.

Site Selection and Design

Once a town has addressed zoning considerations, then parameters for selecting sites should be developed and communicated to any prospective project proponent. In some towns zoning bylaws require a site plan review for any large-scale solar development. The planning board is in control of that review.

Some towns have adopted local wetlands bylaws that are typically more stringent than the state laws that apply to all jurisdictions. The town's Conservation Commission typically handles wetland, river, stream, lake and pond regulations.

Development in flood zones is covered in the Wetlands Protection Act under Bordering Lands Subject to Flooding. If the Army Corps of Engineers has flood easements in an area proposed to be developed, their review and/or approval may be required. Their goal is typically to avoid reduction of flood storage volume and/or displacement of flood waters to unintended recipients.

Typically, state regulations will require a storm water management plan. Handling runoff in an effective manner is a critical concern due to the large amount of impervious surface (solar panels), access roads and earth disturbance.

In addition to the site considerations related to access, connections to the electrical grid and other solar energy production constraints that the proponent needs to address, there are environmental considerations including the following:

- Slope
- Wetlands, water bodies, streams, vernal pools, etc.

- Important wildlife habitats and the preservation of wildlife corridors (see www.stayingconnectedinitiative.org and from Audubon RI: https://www.asri.org/about/audubon-report-stories.html/article/2017/11/22/the-balancing-act-renewable-energy-and-wildlife)
- Soils, and current vegetative cover, particularly the presence of mature forest, farmland, shrubland

The following are specific recommendations for Site Selection and Design:

- Avoid sites with steep topography and fine-grained soils;
- Exercise caution with sites adjacent to sensitive surface water receptors (e.g. cold-water streams);
- Avoid sites that may be within a floodplain (limits the ability to grade, may result in seasonal flooding);
- Avoid sites with shallow bedrock (if grading is anticipated);
- Avoid ecologically sensitive lands (rare vegetation or species at risk);
- Conduct advanced planning on the front end (advanced biological surveys); and
- Conduct pre-condition surveys – these are essential to ensure the concerns of neighboring landowners and municipalities may be adequately addressed.

Regulations

- The construction of solar farms is encouraged provided the activity is located more than 50 feet from the "mean annual high-water line within the riverfront area or from bordering vegetated wetland". Massachusetts General Laws Chapter 31, Section 40 does not allow the construction of any other kind or alteration within the 50-foot area buffer zone along any resource area.
- A stormwater management system is mandated by the Wetlands Protection Act both during construction of the project and over the long-term.

Wildlife

As with all construction projects, protection of wildlife and existing habitats should be a consideration during solar installation site selection and permitting. Many protection measures are covered under current law including the Massachusetts Endangered Species Act (MESA) and Wetlands Protection Act (WPA). When projects take place on lands that are not subject to these regulations (e.g., non-wetland or not mapped for rare species), protection measures and even habitat enhancements are encouraged. For example, an area that is being converted from non-habitat (i.e., unused industrial, parking lot, landfill) to solar could be developed to create habitat for ground nesting birds and monarch butterflies.

- Conduct a species inventory of flora and fauna as part of the site assessment and permitting process
- Identify nesting season(s) for wildlife found during inventories and schedule any land clearing outside of these periods.
- Sweep the area for species with low mobility (e.g., box turtles) and relocate when feasible.
- Where possible, replace native vegetation impacted during construction with the same species
- Re-seed as soon as possible and throughout the project as necessary to reduce the chance for invasive species introduction.

Native plants may add habitat on solar sites.
Photo: Guy Parker www.ecolandscaping.org

- Limit use of herbicides for vegetation control for all phases of the project (before, during and after construction).
- Where fencing is necessary, maintain an 8 to 10-inch bottom gap to allow movement of small animals such as turtles, salamanders, frogs, turkeys, and small mammals. Inspect fencing at regular intervals to ensure gaps are maintained for the life of the solar installation.
- Seed area under panels with diverse native seed mixes tailored to the area that include pollinator plants (Xerces Society).
- Plant bordering areas with native shrubs that provide habitat (i.e., nesting and food sources).

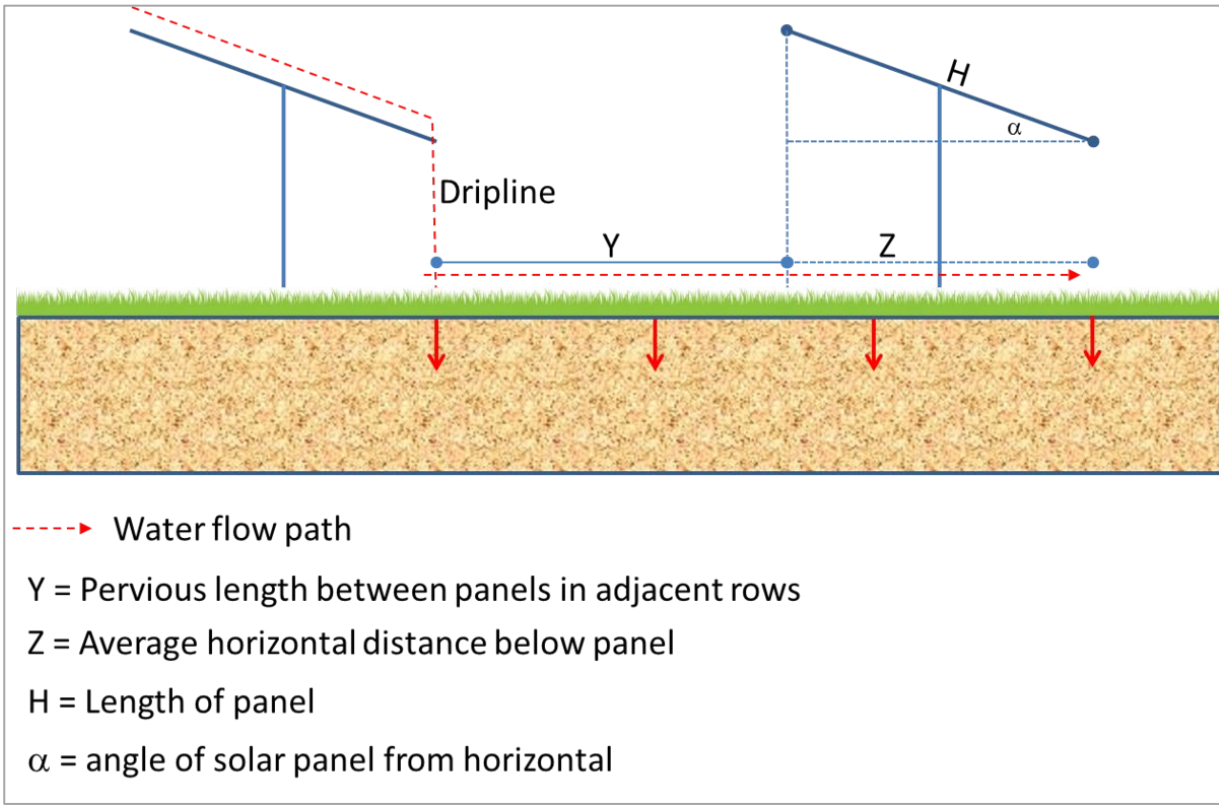
Storm water runoff

- Ensure that the design team (electrical design, civil, structural, etc.) communicate to ensure that the design meets all needs, including prevention of erosion and sediment transport;
- Effectively plan the location of stormwater management measures (e.g. a stormwater detention basin must be

Example of runoff at a solar installation in Rhode Island caused by lack of temporary swales and sediment traps according to RI DEM.
Image by Richard Jurczyk via www.thewesterlysun.com published online April 21, 2018

located downstream of the development; a basin on top of a hill is not much use);

- Ensure that the design is conservative with respect to runoff potential particularly in light of increased storm intensity due to climate change;
- Provide a reasonable degree of redundancy in designing stormwater management and erosion and sediment control measures;
- Ensure that stormwater management design criteria from the Commonwealth and other authoritative sources are followed;
- Execute reasonable engineering judgment with respect to the solar farm design; it is not an urban development, municipal road or highway. It should not be designed as such, but it does require a level of sophistication with respect to the collecting and conveying of runoff preferably through the use of nature-based stormwater management solutions;
- Review the stormwater design in the context of different storm events and the projected increases in storm intensity and duration due to climate change; in a number of situations, given the rural nature of most sites, the peak flows may be as a result of the shorter duration events but the stormwater management measures (ponds) will need to be sized for the volume of the longer events (24-hour);
- Ensure the design takes construction over winter months into account;
- Ensure the design uses “bare soils” calculations to account for runoff during construction;
- Ensure sufficient geotechnical data are available, including depth to groundwater and percolation rates (if designing infiltration trenches);
- Review the designs with operations and maintenance staff to ensure the facilities are accessible and operational;
- Provide guidelines to the contractor regarding staging of work to be completed on site;
- Design robust temporary erosion and sediment control measures that include quantity management and which require continued use and maintenance after commercial operation of the site if it is not fully re-vegetated;
- Emphasize that permanent stormwater management and erosion and sediment control measures are based on a fully vegetated site; and
- Ensure the design considers the laydown areas and specifically the fuel tanks and refueling stations to ensure they are in a location which is not prone to flooding or ponding runoff.



Solar panel hydrologic process schematic included in the Minnesota Stormwater Manual (https://stormwater.pca.state.mn.us)

Mitigation and Remediation

Once a site has been selected and the design process is underway, what measures should a town consider to mitigate the impacts of large-scale solar both during site preparation and construction as well us during the operation and maintenance phases?

Requiring certain measures would typically fall to the conservation commission as well as any state or federal jurisdiction that could be involved. Many of these measures are similar to any project that creates impermeable surfaces and consequently increased runoff and risk of on-site erosion. Others are unique to solar installations. A list of recommended measures follows:

- All large-scale solar installations should mitigate the impacts of the impervious surfaces they create. Nature-based solutions for stormwater management should be required.
- Vegetation should be maintained between rows with emphasis on native flowering plants that benefit pollinators.

- Solar panels should not be placed over wetlands, open water, vernal pools and other critical habitats nor should they eliminate or interrupt wildlife corridors. (see https://www.nps.gov/subjects/renewableenergy/solar.htm)
- Tree cutting should be minimized in developing large scale solar installations and for every acre of trees removed four acres should be conserved and protected in perpetuity, or at a minimum for the duration of the solar installation.
- Do not allow removal of topsoil from the site. If some topsoil must be removed temporarily during construction, it should be stockpiled and used on-site to establish a seedbed for revegetation.
- Construction of additional ditching and grading to provide positive drainage from low lying areas;
- Construction of additional piping (culverts, storm sewer) to direct runoff across roads or into storm sewer networks;
- Paving of low-level crossings to prevent erosion / granular washouts;
- Addition of topsoil and seeding;
- Placement of erosion control blankets on steep slopes to prevent erosion;
- Application of hydroseed with tackifier to prevent erosion on steep slopes;
- Construction of flow dissipation or flow spreading devices;
- Construction of dry and wet retention ponds;
- Construction of infiltration trenches;
- Placement of fill in low-lying areas to promote positive drainage;
- Construction of roads and roadside ditches to provide safe passage and convey runoff;
- Reconstruction of roadside ditches to ensure subgrade is drained;
- Relocation of arrays of panels;
- Re-alignment of ditches and movement of discharge points from the site;
- Reconnecting existing tile drains destroyed during construction;
- Placing berms to limit adjacent floodwater from entering the site;
- Removing berms to limit concentration of runoff within a site; and
- Use of flocculants to control total suspended solids in runoff water

Construction

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) will be developed and implemented

- Develop a spill containment and response plan prior to the start of construction;

- Ensure placement of all temporary stormwater management and erosion and sediment control measures prior to any construction; ensure regular maintenance of these measures during construction and through to full re-vegetation of the site;
- Ensure regular site inspections (especially during, or immediately after, storm or rapid thaw events) are completed by a civil engineering consultant to review construction, stormwater management and erosion and sediment control measures;
- Ensure additional materials for erosion and sediment control are on site, especially over winter months;
- Ensure contractor implements staged construction process;
- Minimize the removal of vegetation (and topsoil) prior to construction, especially over winter months;
- Provide sufficient detail on the plans to permit a contractor to construct the farm;
- Minimize construction truck traffic, especially over bare soils; and
- Do not construct during inclement weather or during spring thaw (if possible).

Operation and Maintenance

A long-term operation and maintenance plan will be developed and implemented to ensure that stormwater management systems function as designed.

- The vegetation, stormwater management features and outlets of the sites should be monitored throughout the life of the project;
- If total suspended solids/turbidity monitoring are conducted, ensure that a contingency plan is prepared and is implemented, if exceedances of limits are observed;
- At a minimum, bi-annual inspections should be performed, and the frequency should be increased if issues arise; and owner and operation and maintenance staff should contact appropriate town or Commonwealth officials if issues arise so that a suitable solution may be developed

Decommissioning

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.

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.

- 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. Towns should consult with legal counsel in these instances.

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.

Local governments may require 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.

Landowners and local governments can ensure appropriate decommissioning and reclamation by using financial and regulatory mechanisms. A local government should consult their municipal attorney when evaluating financial mechanisms.

Financial mechanisms include the following:

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.

A decommissioning plan should address the following:

- 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 non-utility owned equipment, conduit, structures, fencing, roads, and foundations.
- Restoration of property to condition prior to solar development.
- Timeframe for completion of decommissioning activities.
- Description of any agreement (e.g., lease) with landowner regarding decommissioning.
- 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.

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Appendix

As of July 2018, the largest 100 projects in the State authorized under the Solar II Carveout ranged from 2.595 to 5.999 megawatts (MW). The average cost per installed MW was $2.48 million. Projecting revenue streams for projects relying on Solar Renewable Energy Certificates (SRECs) can be difficult as the price of SRECs can vary, projects may opt to sell them via a long-term contract at varying discounts to their market value, and projects also have very different energy revenue streams, such as those from net metering. The average capacity factor for solar facilities operating in MA from 2010-2017 is 13.35%. This means that a typical solar facility will operate at its full rated capacity 13.35% of the time throughout the course of the year. As an example, let's say you have a 1 MW solar array, it's expected output using this average capacity factor would be 1 MW x 13.35% x 8,670 hr/year = 1,169 MWh/year. You would then multiply this by its SREC factor to get the expected number of SRECs it would generate. The largest 100 Solar II Carveout projects have SREC factors between 0.7 and 1.0 with an average of 0.86 which would create 1005 SRECs annually per installed MW. At a price of $250 each, SRECs alone would generate $251,250 annually.

The facility also sells electricity to the electrical distribution system. Wholesale price data was not available, but with retail rates around 11 cents per kWh (excluding distribution, transition, transmission, energy efficiency and renewable energy charges) wholesale rates could be 8 cents per kWh or more. Based on 8 cents per kWh and annual production of 1,169,000 kWh per installed MW, the sale of electricity could produce about $93,520 annually. Total revenue from SRECs and the sale of electricity could be around $345,000 per installed MW. Under these assumptions a facility would pay for the cost of installation in a little over seven years (excluding financing costs).