



CITY OF PHILADELPHIA
REQUEST FOR INFORMATION

This document contains a Request for Information (RFI) for a Photovoltaic Renewable Energy System. The information obtained from this RFI will be used by the City as a basis for further discussion and the development of an RFP. Suppliers wishing to respond to this RFI should read this document carefully and follow the guidance for responding.

**Photovoltaic Renewable Energy System Potential
at Northeast Philadelphia Airport (PNE)**

**Issued by:
Department of Commerce, Division
of Aviation September 10, 2019**

**Submission Date / Time:
November 1, 2019/ 5 PM (Local Philadelphia Time)**

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Request for Information (RFI): Photovoltaic Renewable Energy System Potential at Northeast Philadelphia Airport (PNE)

I. Introduction

The City of Philadelphia (“City”) is investigating the costs and benefits of a Solar Photovoltaic (PV) Renewable Energy System and/or Plant, as defined by the PA Public Utility Commission (“PUC”), for the Commerce Department Division of Aviation’s (“Aviation”) Northeast Philadelphia Airport (“PNE”). Over the past several years, Aviation has conducted solar assessment studies that identified areas of PNE that may allow for the installation of a 1 MW or larger PV renewable energy system, while complying with Federal Aviation Administration (FAA) requirements related to siting PV systems at airports, including compliance with airport glare guidelines and airfield geometries intended to preserve the safety of operating aircraft. Through this effort, the City ultimately seeks to confirm the financial and physical feasibility of installing a PV renewable energy system at PNE. The system may be ground-mounted, roof-mounted, or a combination of both. Confirmation of the feasibility of a PV renewable energy system will form the basis for an RFP. At such time, the City of Philadelphia may consider the value of entering into a contract, preferably using a power purchase agreement where the developer is responsible for installation, operation, and maintenance of the system.

Aviation is currently working on renewable energy systems, requirements, and procedures designed to reduce Aviation’s energy consumption and costs, improve resiliency of Aviation’s critical systems, and reduce Aviation’s overall carbon footprint. PNE has been identified as a potential site for a PV renewable energy system. Preliminary studies illustrate the general economics of a ground-mounted PV system appear feasible, however, all previous solar assessments lack a true understanding of the current solar and renewable energy market, particularly in the Philadelphia region. This RFI seeks to acquire that knowledge of the current market along with more specific details on building a PV renewable energy system on a site as unique as PNE and determining the value of a power purchase agreement to meet Aviation’s energy and emissions goals. Expertise from qualified vendors is essential in determining financial feasibility from the viewpoint of hard costs and the potential for a competitive energy price favorable to Aviation. A power purchase agreement is Aviation’s preferred method of procurement; however, other proposals will be considered and evaluated for financial feasibility.

In order to facilitate planning, drafting, and publishing a Request for Proposals (RFP) in the future, Aviation is seeking information from companies who have substantial experience designing, permitting, constructing, implementing, operating, and maintaining PV renewable energy systems on a commercial scale. Information provided by companies will inform Aviation with a high-level overview of the construction, financial, and operational feasibility of a PV renewable energy system at PNE. Companies submitting information should have substantial experience, knowledge, and understanding in the following areas:

- Opportunities for renewable energy systems within the Regional Transmission Organization (“RTO”) which is PJM Interconnection, LLC (“PJM”);

- PJM's marketplace with experience leveraging PV opportunities in that marketplace;
- Pennsylvania's Renewable Energy Credit market;
- PECO interconnection application process and requirements;
- PECO net metering tariff and associated requirements of the tariff;
- State of Pennsylvania and City of Philadelphia solar policies, laws, and regulations;
- Pennsylvania Public Utility Commission regulations;
- Installing a PV array with a successful implementation plan based on a power purchase agreement;
- Distributed Energy Resources and cost-effective energy storage solutions;
- Philadelphia International Airport ("PHL")/Aviation standards
- FAA Ocular Hazard Standards for glare within FAA's Interim Solar Policy and other FAA standards and policies pertaining to non-aeronautical development.

Respondents will be requested to demonstrate implementation capabilities in these areas through the demonstration of sample commercial scale PV renewable energy system(s) currently in operation or under construction. Specific information requests may be a part of this RFI process related to PV renewable energy systems. Please note that responses to this RFI need not be limited to the information outlined in the Responses section below but should include any information the Respondents believe are related to the subject matter of this RFI.

Note that any PV installation to be implemented on airport property will require additional planning and approvals, including conformance with the Airport Layout Plan (i.e. master plan), FAA's 14 CFR Part 77 regulations, FAA's Technical Guidance for Evaluating Selected Solar Technologies, the National Environmental Policy Act (NEPA), airport land or building lease requirements, & other local, state, & federal regulations as needed.

Aviation may, in its sole discretion, contact Respondents for further discussions and intends to request demonstrations of recommended services and solutions. This RFI will not result in a contract to provide any services to the City. The City is not obligated to conduct subsequent discussions with any Respondent to this RFI, and reserves the right to conduct discussions regarding its subject matter with firms that do not respond to this RFI.

II. Background

Aviation owns and operates both the Philadelphia International Airport (PHL) and PNE. According to data reported by Airports Council International – North America, PHL was ranked the twentieth busiest commercial airport in the United States, serving 29.6 million passengers in calendar year 2017. In 2018, PHL handled 31.7 million passengers and approximately 380,000 plane movements. PHL encompasses approximately 2,584 acres and its runway system consists of two parallel runways, a crosswind runway, a commuter runway, and interconnecting taxiways. PHL's terminal facilities consist of seven terminal units, totaling approximately 3.2 million square feet.

PNE is a general aviation facility that encompasses approximately 1,026 acres of land, 2 runways and associated taxiways, 85 T-hangers, 9 corporate hangers, 6 general aviation open hangers, and associated

roadways. PNE in 2018 saw 23,000 total plane movements and has approximately 175 based aircraft. It is located in the Ashton-Woodenbridge neighborhood of Northeast Philadelphia with frontage on Grant Avenue, Academy Avenue, and Roosevelt Boulevard (U.S. Highway Route 1).

The installation of on-site renewable energy at both PHL and PNE airports is being considered as it would contribute to the sustainability goals set by Aviation as part of the Re-PHL strategy. The Re-PHL strategy is Aviation's Strategic Energy and Emissions Reduction Plan aimed at reducing energy and emissions at both PHL and PNE to achieve long-term resilience and to transition to renewables. The overall objective of the Re-PHL strategy is to realize financial savings, increase operating efficiency, and achieve long-term resiliency. The relevant energy and emissions reduction goals include:

- Twenty percent reduction in energy use intensity, or EUI (energy use per square foot) in the terminal facilities by 2030;
- Ten percent reduction in total greenhouse gas ("GHG") emissions by 2030 from a 2006 baseline;
- Completion of at least one (1) renewable energy project at PNE or PHL by 2021, and an assessment of an additional renewable energy project or expansion by 2025.

In addition to Aviation's goals of reducing energy use and generating renewable energy at PHL and PNE, the City is committed to purchasing or generating 100 percent clean electricity by 2030 for General Fund properties (which includes Aviation's facilities) and is committed to achieving 100 percent clean energy City-wide. Aviation has adopted the first portion of this goal in alignment with the City.

The City of Philadelphia's commitment to purchasing clean electricity stems from our ever-increasing climate change challenge. The City of Philadelphia and Aviation's sustainability program are acutely aware of the challenges we face and therefore align our interests to combat climate change through carbon reduction. Aviation sees a PNE PV renewable energy system within the realm of possibility and strives to prove it through implementation. A PV renewable energy system should also achieve objectives such as reduce energy costs, meet renewable energy obligations, provide a level of resiliency, or hedge future market risks associated with the City's electricity procurement.

Based on information provided in response to this RFI, Aviation may choose to initiate a subsequent RFP solicitation process in which Aviation will seek to construct a PV renewable energy system and to potentially enter into a power purchase agreement for PNE.

Two (2) maps of PNE are included within this RFI as appendices. Figure 1 is a location map of PNE that includes the area identified by past solar assessment studies to be the best site for a PV system. Figure 2 is a map that indicates all buildings owned by Aviation that could potentially be used for roof-mounted PV systems. Finally, specific sections of the most recent solar assessment study are included to share information on glare and other useful information. Although past assessments have demonstrated the feasibility of siting a PV system at PNE without causing unacceptable glare, a developer will be required to submit a passing glare analysis for any specified proposed project as part of any future RFP.

This RFI is being supported by the Energy Office as part of the Office of Sustainability. The Energy Office frequently works on projects focused on large scale investments at City property. The overall mission of the Energy Office is to:

- Strategically procure cost effective, reliable, safe, clean energy and conventional energy systems for City government
- Promote energy conservation and efficiency within City facilities by providing education, technical expertise and analysis of energy used
- Develop and implement projects and programs that promote the efficient use of energy and reduce the City's environmental impact.

III. Administrative Requirements for Responses

RFI Informational Meeting

An RFI Informational Meeting and site visit to provide background regarding the PV Renewable Energy System Project at PNE and to review the requirements of this RFI will be held in Philadelphia, Pennsylvania on September 30, 2019, starting at 2 pm at the following location:

Northeast Philadelphia Airport
9800 Ashton Road
Philadelphia, PA 19114

The City believes that attendance at the RFI Informational Meeting is essential for successful participation in this RFI as it will include a site visit and Aviation will provide additional information relevant to Respondent submissions. We encourage every Respondent to attend.

Addenda to the RFI; Requests for Information; Inconsistencies

The City may, in its sole discretion, issue addenda to this RFI containing responses to questions & requests for information, addressing matters raised at the RFI Informational meeting(s), clarifications of the RFI, revisions to the RFI, or any matters that the City deems appropriate. Addenda will be posted on the City's website at <http://www.phila.gov/rfp/Pages/default.aspx> ("Additional Opportunities"). It is the Respondent's responsibility to monitor the Additional Opportunities site for Addenda and to comply with their terms.

All questions, requests for clarification, and requests for additional information regarding this RFI must be submitted to the City's Primary Contact not later than the deadline set forth in this RFI. All such questions and requests must be submitted **in writing**, by email to the City's Primary Contact. Responses to such questions and requests shall be at the City's sole discretion and nothing in this RFI shall create an obligation on the City to respond to the submitting party or at all. In the City's sole discretion, responses may be posted on the City's website without formal notification to prospective Respondents.

No oral response by any employee or agent of the City shall be binding on the City, or shall in any way constitute a commitment by the City.

If a Respondent finds any inconsistency or ambiguity in the RFI or an addendum to the RFI issued by the City, the Respondent is requested to notify the City's Primary Contact in writing.

IV. Minimum Qualifications for Participation

Respondent must have the following licenses and/or accreditation:

- i. Licensed Electrical Contractor in the City of Philadelphia;
- ii. NABCEP Certified or UL Certified Solar PV Installer; and
- iii. All necessary licenses and qualifications to construct a PV renewable energy system in the City of Philadelphia.

V. Submittals

In their submissions, Respondents should provide the following information:

- **Contact info:** Name, street address, mailing address if different, email address, and telephone numbers of the Respondent.
- **Organization info:** Information on Respondents firm, personnel, operations, organizational chart, and the company's operational history.
- **Documentation:** Proof of licenses and accreditations as referenced above in section IV minimum qualifications.
- **Sample Operational Commercial Scale PV Project:** The Respondent shall furnish one (1) or more sample commercial scale solar PV projects they installed currently operating within the City of Philadelphia or within Southeastern Pennsylvania. Projects submitted must include information such as location, size of PV system (rated capacity in kW DC), annual generation (kWh/year), material and installation costs, type and size of electrical equipment on site (inverters, transformers, etc.) current operation & maintenance requirements and costs (per kW per year and total annual), end users of PV system electricity generation, construction length, commercial operation date or start of electricity delivery, and any other pertinent information of the system such as power purchase agreements, solar leases, or agreements with utilities. Respondents are encouraged to provide information on sample projects installed in an airport environment, if applicable. The sample work products will be used by the City only to gather information regarding potential approaches and projects. However, these are for illustrative purposes only and are not expected to be wholly representative of the project the Respondent would employ on this effort. Respondents are encouraged to provide additional information on their projects that seem incidental or relevant to this RFI. Grid scale PV projects or other sample renewable energy projects the Respondent was involved in, such as battery storage solutions, may be submitted in addition to the required commercial scale PV project.
- **Indicative PNE Project Profile:** The Respondent shall provide information outlining what it believes is the best path forward for a project at PNE. This profile shall include the following:

- Recommendations on appropriate technology (fixed, single access tracking, battery storage, ancillary services such as frequency regulation, etc.)
- Proposed system size and location(s) (ground and/or roof mounted)
- Best value financing vehicle that delivers electricity cost savings (power purchase agreement, Aviation ownership). Financing options proposed should consider any applicable local, state or federal grants separately. If available, Respondent shall provide indicative pricing for its best value project profile.
- Outline any other high-level takeaways or fatal flaws associated with the implementation of a project at PNE.

The best value project profile should be creative to achieve more efficient systems that drive better pricing. This will be provided for information only. Innovative energy solutions are encouraged.

Firms may be asked to provide clarification of the material provided to the City or to present information to representatives of the City.

Demonstrations and Presentations

Responding firms may be invited to present demonstrations and other information on the topics to City representatives in Philadelphia. The presentations will be limited only to those topics identified in this RFI and the City will not entertain presentations that are focused upon marketing the presenting firm. At this time, the City's sole interest is to collect information which may inform the process in the future.

Any costs associated with the presentation (including travel) are the sole responsibility of Respondents.

Responses may not exceed 50 pages (not including resumes or sample work products) emailed to Dana.Bates-Jenkins@phl.org by 5 PM Local Philadelphia time on November 1, 2019. Respondents should submit their responses electronically (hard copies are unacceptable) in MS Word or Adobe PDF format, as a single document. Response document(s) are limited to 15 MB; if necessary, please submit multiple files or zip/compress the file(s).

VI. Anticipated Timeline

Proposed Timeline:

RFI Posted on Phila.gov	September 10, 2019
RFI Information Meeting	September 30, 2019 @ 2 pm
Submit questions to Primary Contact, in writing	October 9, 2019
Responses Issued to Questions and Requests for Clarification	October 15, 2019

Responses from Firms

November 1, 2019 @ 5 pm

Invitation to Firms to Present (Optional)

November 15, 2019

Presentations by Firms

Weeks of December 2 & 9, 2019

Note: Timeline subject to change.

VII. Rights and Options Reserved

In addition to the rights reserved elsewhere in this RFI, the City reserves and may, in its sole discretion, exercise any one (1) or more of the following rights and options with respect to this RFI if the City determines that doing so is in the best interest of the City:

1. to decline to consider any response to this RFI (“Response”); to cancel the RFI at any time; to elect to proceed or not to proceed with discussions or presentations regarding its subject matter with any Respondent and with firms that do not respond to the RFI; or to reissue the RFI or to issue a new RFI (with the same, similar or different terms);
2. to waive, for any Response, any defect, deficiency or failure to comply with the RFI if, in the City’s sole judgment, such defect is not material to the Response;
3. to extend the Submission Date/Time and/or to supplement, amend, substitute or otherwise modify the RFI at any time prior to the Submission Date/Time, by posting notice thereof on the City web page(s) where the RFI is posted;
4. to require, permit or reject amendments (including, without limitation, submitting information omitted), modifications, clarifying information, and/or corrections to Responses by some or all Respondents at any time before or after the Submission Date/Time;
5. to require, request or permit, in discussions with any Respondent, any information relating to the subject matter of this RFI that the City deems appropriate, whether or not it was described in the Response or this RFI;
6. at any time determined by the City, to discontinue discussions with any Respondent or all Respondents regarding the subject matter of this RFI, and/or initiate discussions with any other Respondent or with vendors that did not respond to the RFI;
7. to do any of the foregoing without notice to Respondents or others, except such notice as the City, in its sole discretion, may elect to post on the City web page(s) where this RFI is posted.

This RFI and the process it describes are proprietary to the City and are for the exclusive benefit of the City. No other party, including any Respondent, is intended to be granted any rights hereunder. Upon submission, Responses to this RFI shall become the property of the City, which shall have unrestricted use thereof. Responses may be subject to public disclosure under the Pennsylvania Right-to-Know Law. However, a “record that constitutes or reveals a trade secret or confidential proprietary information” is exempt from access by a requester under that law. Ultimate determination of the application of that exemption cannot be assured, but Respondents are advised to mark clearly any portions of any submittal believed to qualify for that exemption. By submitting its Response, the Respondent agrees to the terms and conditions of this RFI.

Figure 1

**Map of PNE with Potential Ground
Mounted PV Site**



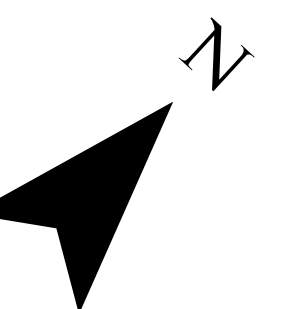
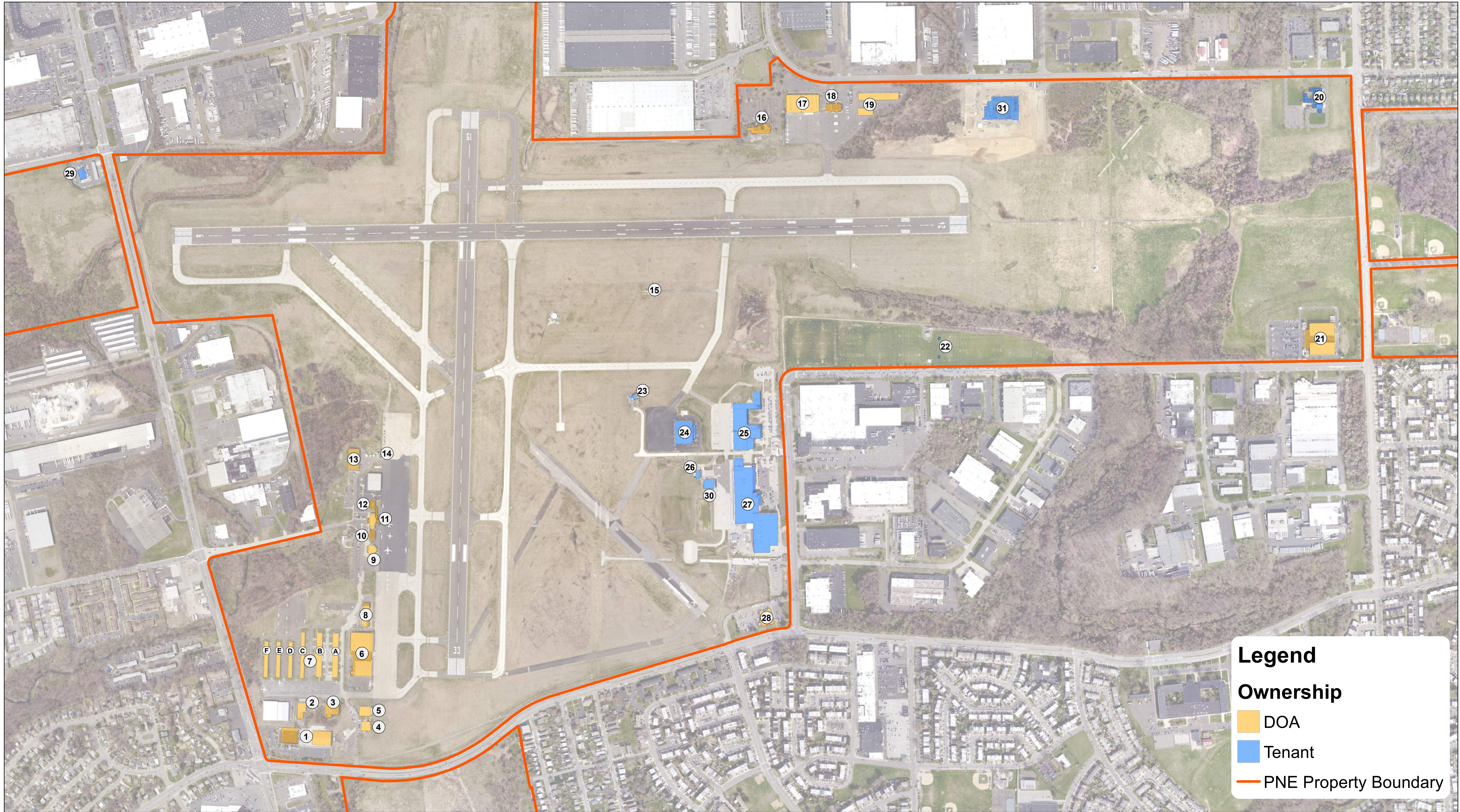
Legend

- PNE Property Boundary
- Optimal PNE Solar Location

PNE Sustainability/Non-Aeronautical Development Exhibit

Figure 2

PNE DOA Owned Buildings Map & Table



PNE DOA and Tenant Buildings - Size, Top Elevation, and DOA/Tenant Ownership

Facility Number	Building	Type	Size (sqft)	Top Elevation (ft)	DOA	Tenant
1	Aviation Institute of Maintenance (AIM) - Office	Office/Hanger (2 buildings)	41,025	176.00	X	
2	AIM Hanger	Hanger	8,530	151.75	X	
3	Dartswift Jet Services	Office/Hanger	11,872	163.54	X	
4	Keystone Aerial Surveys	Office/Hanger	6,700	143.30	X	
5	Keystone Aerial Surveys (Hanger)	Hanger	8,200	127.50	X	
6	Atlantic Aviation Hanger (TWE Hanger)	Hanger	74,130	127.00	X	
7	Atlantic Aviation T-Hangers	T-Hanger	84,750	AB - 123.67 CDEF - 119.67	X	
8	DOA Maintenance Building	Maintenance	10,500	121.75	X	
9	Legacy Aviation (Atlantic Av. Tenant)	Office/Hanger	5,100	109.83	X	
10	Aviation Institute of Maintenance (AIM)	Office/Hanger	3,900	110.00	X	
11	Atlantic Aviation GA Terminal Building	GA Terminal	7,100	114.00	X	
12	DOA Administration Building	Office	4,000	110.70	X	
13	DOA Maintenance Building	Maintenance	24,150	120.00	X	
14	Health Department Air Monitoring System	Office	100	104.00		X
15	Airfield Lighting Vault	Vault	560	117.33	X	
16	Former Flat Spin Restaurant	Restaurant	13,940	134.75	X	
17	North Philadelphia Jet Center (NORPAC) Hanger	Hanger	42,750	146.00	X	
18	NORPAC GA Terminal Building	GA Terminal	15,200	146.00	X	
19	NORPAC T-Hangers	T-Hanger (2)	28,800	141.76	X	
20	Washington Savings Bank	Bank	16,680	146.00		X
21	Flyers Skate Zone	Ice Rink	68,000	140.50	X	
22	PHL Soccer Club and Storage Building	Office/Storage	1,220	127.67		X
23	Airport Traffic Control Tower	Tower	4,340	200.00		X
24	Crown, Cork & Seal Hanger	Office/Hanger	34,300	164.00		X
25	Leonardo Helicopters	Office/Hanger (Maintenance)	101,170	143.00		X
26	Leonardo Helicopters	Storage	2,625	134.21		X
27	Leonardo Helicopters	Office/Hanger (Production)	203,775	139.50		X
28	Philadelphia Police	Police Station	14,765	138.58	X	
29	Wawa	Store	5,360	133.20		X
30	Leonardo Helicopters Washrack	Hanger	7,160	140.08		X
31	Chubb Corporation Hanger	Conventional Hangar	48,100	---		X

Figure 3

Northeast Philadelphia Airport Solar Analysis by HMMH (Abridged)

Northeast Philadelphia Airport Solar Analysis Refinement and Next Steps

HMMH Project No. 309120
March 2019

Prepared for:
City of Philadelphia Division of Aviation

Northeast Philadelphia Airport Solar Analysis Refinement and Next Steps

HMMH Project No. 309120
March 2019

Prepared for:
City of Philadelphia Division of Aviation

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1 Background

1.1 Introduction

The City of Philadelphia Division of Aviation (DOA) has prepared a strategic plan aimed at achieving energy and emissions reductions, improving resilience and increasing renewable energy production (termed the Re-PHL Strategy). The ultimate objective of the Re-PHL Strategy is to help the DOA realize financial savings, increase operating efficiency, and achieve infrastructure resiliency. The DOA is considering the implementation of on-site renewable energy as part of the overall strategy to achieve these goals.

Specifically, the DOA is investigating opportunities to install solar photovoltaic (PV) energy at Philadelphia Northeast Airport (PNE) and the Philadelphia International Airport (PHL). The installation of solar PV projects at one or both airports would contribute towards the goals set by the DOA as part of the Re-PHL strategy. The relevant energy and emissions reduction goals include:

- A 20-percent reduction in energy use intensity, or EUI (energy use per square foot) in the terminal facilities by 2030;
- A 10-percent reduction in total greenhouse gas (GHG) emissions by 2030 from a 2006 baseline;
- Completion of at least one renewable energy project at PNE or PHL by 2021, and assessment of an additional renewable energy project or expansion by 2025.

In addition to the DOA's goals of reducing energy use and generating renewable energy at PHL and PNE, the City of Philadelphia (the City) is committed to purchasing or generating 100 percent clean electricity by 2030 for General Fund properties (which includes the DOA facilities), and is committed to achieving 100 percent clean energy city-wide (no set deadline). The DOA has adopted the first portion of this goal in alignment with the City.

In December 2018, the City entered into a long-term Power Purchase Agreement (PPA) to purchase solar-powered electricity from a private renewable energy developer. The agreement ensures that the City will purchase all electricity from the developer's planned 70-Megawatt solar installation located in Adams County, PA. This project is expected to break ground in 2019 and once constructed, it is expected to provide power for about twenty-two percent of the City government's electricity load. Further details of this agreement are described in Section 5.2 of this report for reference.

As of 2019, there is no on-site renewable energy generation at either PHL or PNE; however, the DOA continues to gather information concerning potential opportunities for such power generation. The DOA has conducted solar and geothermal feasibility studies since these technologies are the most common forms of renewable energy currently employed at airports. In July 2018, HMMH prepared a Preliminary Solar Assessment Study (preliminary report) to identify and conduct preliminary analyses of potential PV project sites at both PHL and PNE.

The 2018 preliminary report included an initial screening of potential on-airport solar PV locations for both airports. Current and future uses of airport properties were considered as part of the study for determining site suitability. Ultimately, nine sites at which PV development might take place across both airports were identified, eight at PHL and one at PNE. **Figure 1** shows the potential site located at PNE, which this document further details.

The report also included preliminary solar PV design concepts for each location and related analysis. Each site was modeled using the Federal Aviation Administration (FAA) approved GlareGauge tool,

which showed that all nine sites can be developed in compliance with airport glare guidelines, although four of the sites would require slightly sub-optimal designs to comply. Please note that the preliminary study did not include an environmental resource review or analysis concerning the viability of interconnection of the solar PV generation systems to local electric infrastructure (including net metering, as required for sites without a large enough electric load to instantaneously consume all generation). For sites the airport chooses to analyze further, these items should be included as next steps.

Preliminary design and cost estimates, based on costs of similar-sized projects, were also presented in the 2018 report. These preliminary estimates did not include costs for interconnection, permitting, site clearing, and environmental reviews, however, operation and maintenance costs were estimated and included for informational purposes. Additionally, a sample triple-bottom line cost benefit analysis was performed for the potential PNE solar PV site using the software tool Autocase. Through Autocase, the social and environmental values in addition to the financial costs and benefits were calculated for a more holistic understanding of the project's true return on investment, results of which are included in Appendix B of the preliminary report.

This report builds on the findings of the preliminary report and is intended to outline the next steps concerning the solar PV opportunity identified at PNE specifically, due to its potential to provide up to 75 percent of the electricity needs for the airport and based on favorable payback predictions under both airport owned as well as third party ownership scenarios. This report includes information relevant to the solar site identified at PNE which was extracted from the preliminary report. Section 5 also outlines the next steps for consideration by the DOA for pursuing solar at PNE.



Figure 1 Prospective Solar PV Project Site Location at Northeast Philadelphia Airport

1.2 Summary of Previous DOA Solar Studies

The DOA has conducted several solar feasibility studies at PNE and PHL over the years. The most recent study, the Preliminary Solar Assessment Study, was prepared in 2018 to identify and conduct preliminary analyses of potential PV project sites at both PNE and PHL. The study concluded that there are nine potential sites for solar development that are compatible with existing and long-term growth of aviation activities at both PNE and PHL. **Table 1** identifies relevant information about the site at PNE, which is the subject of this report. This table includes estimated material and installation costs, kilowatt generation, kilowatt generation as a percent of total airport electricity consumption, lifecycle cost, and simple payback time on initial investment.

costs by engaging the DOA engineers or consultants to develop initial engineering plans and an electrical interconnection plan with costs.

The report further concluded that the most attractive development opportunity is the PNE ground mounted site, which can generate 1.55 MW of power for use on-site to offset approximately 75 percent of the airport's electricity usage. It also has one of the more favorable payback estimates at 16 years. In addition, this site has a relatively short interconnection path to the upgraded electrical sub-station and would require minimal site grading and tree clearing. A more detailed analysis of the interconnection costs, permitting costs, and an environmental review would still need to be conducted at this site to verify the viability and total cost estimate. Also, ownership options still need to be considered to determine if airport ownership or a partnership with a third party developer is more beneficial to the DOA. This document highlights further details of the PNE site analysis in subsequent sections.

In addition to the preliminary Solar Feasibility Study conducted as part of the Re-PHL Strategy, an earlier study was conducted in 2012 concerning two potential solar PV site locations at PNE. The 2012 study concluded the payback period for an airport-owned project was not desirable at any of the considered sites, and suggested the DOA use the land be used for other purposes, leased to a third-party operator, or that the DOA solicit third-party financing for the solar project. Potential solar sites were also evaluated at PHL in 2009 on the parking garage roof, ground-mounted sites, terminal roof, and other building roof locations. Similar to the PNE study, the economics of these solar projects did not justify the payback period at PHL at that time. However, the cost of solar panel installations has dramatically decreased from \$5.23 Watt-DC (Wdc) in 2009 to \$1.72 Wdc in 2018 for commercial systems of 1MW³, making solar more economically attractive than in prior years.

1.3 Federal Aviation Administration (FAA) Solar Policy and Guidance

The Federal Aviation Administration (FAA) has issued solar policy and guidance documents to minimize potential regulatory risks associated with the review of solar projects, as described in **Table 2**. These policies provide a clear path to approval, which has resulted in a continued increase in the number of solar projects deployed at U.S. airports.

Table 2 Summary of FAA Solar Policy and Relevant Guidance

Date	Title	Details
November 2010	Technical Guidance for Evaluating Selected Solar Technologies at Airports ⁴	Communicates to the aviation industry basic information on solar technology, information on projects deployed at airports in the U.S., and guidance for general siting and FAA oversight responsibility.
September 2012	Interim Guidance on Land Uses Within a Runway Protection Zone (RPZ) ⁵	States that certain unoccupied infrastructure, including solar PV proposed in the RPZ, would require an alternatives analysis for review by FAA's Office of Airports before proceeding.
October 2013	Interim Policy, FAA Review of Solar Energy System	Clarifies the FAA's jurisdiction in reviewing solar projects at airports. It specifies FAA standards for glare from solar projects on airport property, along with the methodology required to determine if glare is acceptable. It includes standards for measuring ocular impact at

³ National Renewable Energy Laboratory (NREL). November 2018. U.S. Solar Photovoltaic System Cost Benchmark: Q1 2018.

<https://www.nrel.gov/docs/fy19osti/72399.pdf>

⁴ FAA. November 2010. Technical Guidance for Evaluating of Selected Solar Technologies on Airports.

https://www.faa.gov/airports/environmental/policy_guidance/media/airport-solar-guide-print.pdf

⁵ FAA. September 27, 2012. Interim Guidance on Land Uses Within a Runway Protection Zone.

https://www.faa.gov/airports/planning_capacity/media/interimLandUseRPZGuidance.pdf

Date	Title	Details
	Projects on Federally Obligated Airports ⁶	the air traffic control tower (ATCT) and aircraft on final approach to each runway. These standards dictate where a solar PV project can be located on airport property to ensure the project will not result in a negative glare impact and affect airspace safety.

1.3.1 FAA Interim Solar Policy and Glare Standards

The FAA’s Interim Solar Policy published in the *Federal Register* on October 23, 2013, describes the methodology for evaluating potential glare impacts to sensitive airport receptors and the standards the FAA uses to determine if the glare will result in a significant impact. The FAA requires the use of its own Solar Glare Hazard Analysis Tool (SGHAT) (now referred to as GlareGauge), or a similar modeling tool, to evaluate glare from the proposed project site and the potential impact on existing and future sensitive receptors associated with the Airport Traffic Control Tower (ATCT) and aircraft on final approach to all airport runways.

The policy also includes the FAA’s ocular hazard standard, which states that the FAA will object to any project that produces glare on the ATCT, as well as projects that produce a potential for a temporary after-image (yellow glare recorded by the model), or potential for permanent eye damage (red glare recorded by the model) on aircraft. The model results should be submitted to the FAA to obtain formal approval of the project under Code of Federal Regulations (CFR) Part 77 before pursuing construction.

As listed in **Table 3**, two sensitive receptors – the ATCT cab and aircraft on approach – must be evaluated for glare, and there is a different standard for each receptor. Any glare recorded on the ATCT is not compliant with FAA Policy and the FAA will object to the project. Measurement of either no glare, or low potential for after-image, i.e. “Green”, is acceptable for aircraft on final approach, but greater levels (indicated in yellow and red) will be also be objected to by the FAA.

To evaluate potential feasibility of solar PV project sites at PNE and PHL for the purposes of the preliminary report, each site was evaluated for compliance with the glare and ocular standards contained in the FAA’s Interim Solar Policy. HMMH used GlareGauge to analyze each potential project to determine if the site and specific project design would comply with the FAA’s ocular hazard standard. Refer to Section 2.3 for results of the glare analysis specific to PNE; for PHL results refer to the preliminary report.

Table 3 Levels of Glare and Compliance with FAA Policy

Airport Sensitive Receptor	Model Recorded Level of Glare	Model Color Result	Does result comply with FAA Policy?
ATCT Cab	No glare	None	Yes
	Low Potential for After-Image	Green	No
	Potential for After-Image	Yellow	No

⁶ FAA. October 23, 2013. Interim Policy, FAA Review of Solar Energy System Projects on Federally-Obligated Airports. <https://www.federalregister.gov/documents/2013/10/23/2013-24729/interim-policy-faa-review-of-solar-energy-system-projects-on-federally-obligated-airports>

Airport Sensitive Receptor	Model Recorded Level of Glare	Model Color Result	Does result comply with FAA Policy?
	Potential for Permanent Eye Damage	Red	No
Aircraft on approach	No glare	None	Yes
	Low Potential for After-Image	Green	Yes
	Potential for After-Image	Yellow	No
	Potential for Permanent Eye Damage	Red	No

2 Solar Energy Potential at PNE

This section provides details concerning solar energy potential at PNE extracted from the 2018 Preliminary Solar Assessment Study. Some details related to solar PV sites at PHL are maintained for clarity and to illustrate methodology included in the report. High level conclusions of the preliminary report are summarized in Section 1. Please refer to the full report for complete details.

2.1 Site identification at PNE

The Re-PHL Strategy project team met with the Airport Manager at PNE in August of 2017 to discuss the previous (2012) solar feasibility study and obtain input on current potential solar opportunities at the airport. The Airport Manager stated that up to five sites were evaluated; however, the project team did not pursue more in-depth studies for these three additional sites beyond those discussed earlier.

Based on PNE staff's knowledge of the five previously evaluated sites, four of the sites are not conducive for solar for a variety of reasons, including proximity to runway protection areas, existing structures at the site (e.g., well heads and localizers), FAA obstruction issues, long interconnections, and potential future development opportunities. The site identified as the most promising by airport staff is located on land to the northwest of the terminal building and south of the taxiway to Runway 6 as shown in **Figure 2**.

The identified area is sizeable, open, away from aviation activities (e.g., runway approaches and ATCT), not slated for future airport development, and would require minimum clearing and site grading. It is also located relatively close to the recently upgraded substation near the butterfly gardens south of the Terminal parking lot area. Some additional due diligence may be needed to verify the environmental conditions of this site, which were not conducted as part of this analysis.

The current evaluation of this site includes an assessment of the potential size of a ground mount array (in MW) along with the project design parameters (e.g., orientation and tilt angle), estimated material, and installation and lifecycle costs. All parameters are aimed at ensuring compliance with the FAA ocular standards at the ATCT and aircraft on final approach.



Figure 2 Solar PV Project Site Location at PNE

2.2 Physical Constraints Analysis

The physical constraints analysis typically evaluates the feasibility of locating solar installations on airport property based on the physical characteristics of the airport. The primary reason for conducting the physical constraints analysis at the outset of the study is to identify sites that can easily be reevaluated in the future, as economic conditions (e.g., price of electricity, cost to develop solar) can change rapidly. The four criteria used to identify feasible sites are:

1. Airport Planning
2. Environmental Resources
3. Electrical Infrastructure
4. FAA Interim Solar Policy and Glare Standards

In this section a brief description of each criteria is provided, however the preliminary study only considers the FAA Interim Solar Policy in the evaluation of each site. Ultimately, a complete constraints analysis should be conducted including Airport Planning, Environmental Resources and Electrical Infrastructure evaluations prior to moving forward with the development at any of the sites. Further information concerning next steps for development of the PNE site are included in Section 5.

To develop the preliminary report, HMMH used the information provided by PNE staff and the DOA Sustainability Committee for selecting sites for evaluation. HMMH then modeled the potential for glare from each site using the FAA approved GlareGauge tool to determine individual project compatibility with the FAA's Interim Solar Policy.

2.2.1 Airport Planning

The Airport Layout Plan (ALP) and Master Plan are typically reviewed to identify areas of airport property where the non-aeronautical use of solar generation may be acceptable either based on the existing use designations on the ALP or a reasonable update to re-classify an area currently identified as aeronautical use to non-aeronautical use. The Master Plan serves as a development guide for the airport's short- and long-term development strategy. It includes the ALP, which shows FAA safety zones, existing airport infrastructure and facilities, and future development such as a terminal development and runway extensions. All development on airport property must comply with approved FAA design standards contained in FAA Advisory Circular 150/5300-13A, *Airport Design*. As of March 2019, the PNE ALP is being reviewed and updated.

2.2.2 Environmental Resources

The presence of environmental resources can prohibit development from some sites and make other sites costlier and time consuming to develop. Solar projects are subject to review under the National Environmental Policy Act (NEPA), and therefore must demonstrate that environmental impacts have been considered, avoided, minimized and/or mitigated as necessary. Environmental resources that are most likely to trigger an extended NEPA review and other federal, state, and local environmental reviews include existence of wetlands, endangered species, historic resources, and environmental contamination.

2.2.3 Electrical Infrastructure

Solar projects produce electricity, and must therefore be connected to the existing electrical infrastructure. The capacity of electrical lines will vary, not unlike our roadway infrastructure, depending on how much electricity is being carried. Large transmission lines are like interstate highways that carry large amounts of electricity (at high voltage) from central power plants across long distances. At various points along its path, the large transmission lines distribute electricity to medium voltage lines, which are like state highways, to carry power to specific regions. Finally, low voltage power is delivered along smaller capacity distribution lines to individual buildings and homes, like the neighborhood streets that they run along. Small solar projects located on airport property may be able to connect directly to buildings served by low voltage lines. Large solar farms must be connected to high or medium voltage lines. Therefore, it is important to understand the existing electrical infrastructure and its proximity to buildings and the airfield in order to determine the feasibility of connecting the solar project to the existing local electricity network.

2.2.4 FAA Interim Solar Policy and Glare Standards

As described in Section 1.3.1, any potential site for solar development must prove to be in compliance with the glint and glare standards contained in the FAA's Interim Solar Policy.

2.3 Glare Analysis

A critical step in the screening analysis of viable sites is an evaluation of each proposed site location for compliance with the glare standards contained in the FAA's Interim Solar Policy. HMMH used the FAA approved Solar Glare Hazard Analysis Tool, also referred to as GlareGauge, on each potential project site to determine if the site and a specific design would comply with the FAA's ocular hazard standard as discussed above in Section 1.3.1.

The glare modeling performed for each site is accurate for the design parameters that have been input into GlareGauge. Should the DOA decide to pursue any of the sites for solar PV development, the project proponent will need to replicate the glare modeling results and submit to the FAA to obtain formal approval of the project before pursuing construction.

Based on discussions with PNE and PHL staff, HMMH originally identified nine potential PV sites, one at PNE and eight at PHL. After modeling each site in GlareGauge, some of the sites were determined to be too large and did not comply with the FAA ocular standards. Some of the sites had to be split up into multiple parcels for consideration or reduced in size, and preferred design parameters had to be altered from the original assumptions in order to pass the FAA ocular standards. **Tables 6 and 7**, below, indicate which PNE sites and design parameters passed the FAA ocular standards, both as originally proposed and as amended. More details concerning Site 1 as modeled in GlareGauge is discussed in Section 3.

Table 4 provides a brief description of the PNE PV site location and its characteristics. For planning purposes, a projected nameplate capacity (i.e., maximum DC generation measured in kW of power at maximum output) is included for each site, based on the estimated project area using Google Earth as a site size-measuring tool. Using standard siting practices, 3.8 acres of land is assumed required to build a 1,000 kW ground-mounted project,⁷ 2.6 acres of parking for a 1,000 kW canopy, and 1.7 acres of rooftop for a 1,000 kW building-mounted system.⁸

Table 4 Potential Solar Project Site at Northeast Philadelphia

Site	Airport	Location	Area (acres)	Nameplate Maximum Power (kW)	Design	On-Site or Grid ¹
1	Northeast Philadelphia	West of Terminal	5.9	1,550	Ground mounted	On-Site or Grid
¹ Grid refers to a solar project that would be directly connected to the regional grid adjacent to the airport and would require net metering (see section 4.1.2), while on-site denotes that the amount of electricity generated at that location, relative to local loads, would be small enough to be wholly used on-site to offset electricity demand at airport buildings.						

⁷ Kiatreungwattana, K., et al. 2013. Best Practices for Siting Solar Photovoltaics on Municipal Solid Waste Landfills. Technical Report. NREL/TP-7A30-52615, February 2013. National Renewable Energy Laboratory. Golden, CO.
<http://www.nrel.gov/docs/fy13osti/52615.pdf>

⁸ Kandt, A., et al. 2011. Implementing Solar PV Projects on Historic Buildings and in Historic Districts. Technical Report. NREL/TP-7A40-51297, September 2011. National Renewable Energy Laboratory. Golden, CO.

2.3.1 Modeling Methodology

For the proposed project, GlareGauge was used to assess individually the potential glare impact of each proposed project location on airport sensitive receptors. The airport sensitive receptors analyzed were controllers in the ATCT, controllers in the ramp tower cabs, and pilots on final descent to each runway end. In preparing for the model runs, HMMH outlined the footprint of each project array on the model's interactive Google map and input details on the project design, including azimuth angle and tilt angle, as described below in the design considerations. HMMH then proceeded to evaluate specific airport sensitive receptors. **Figure 3** shows the layout of the proposed PV location at PNE, as input into the GlareGauge model.

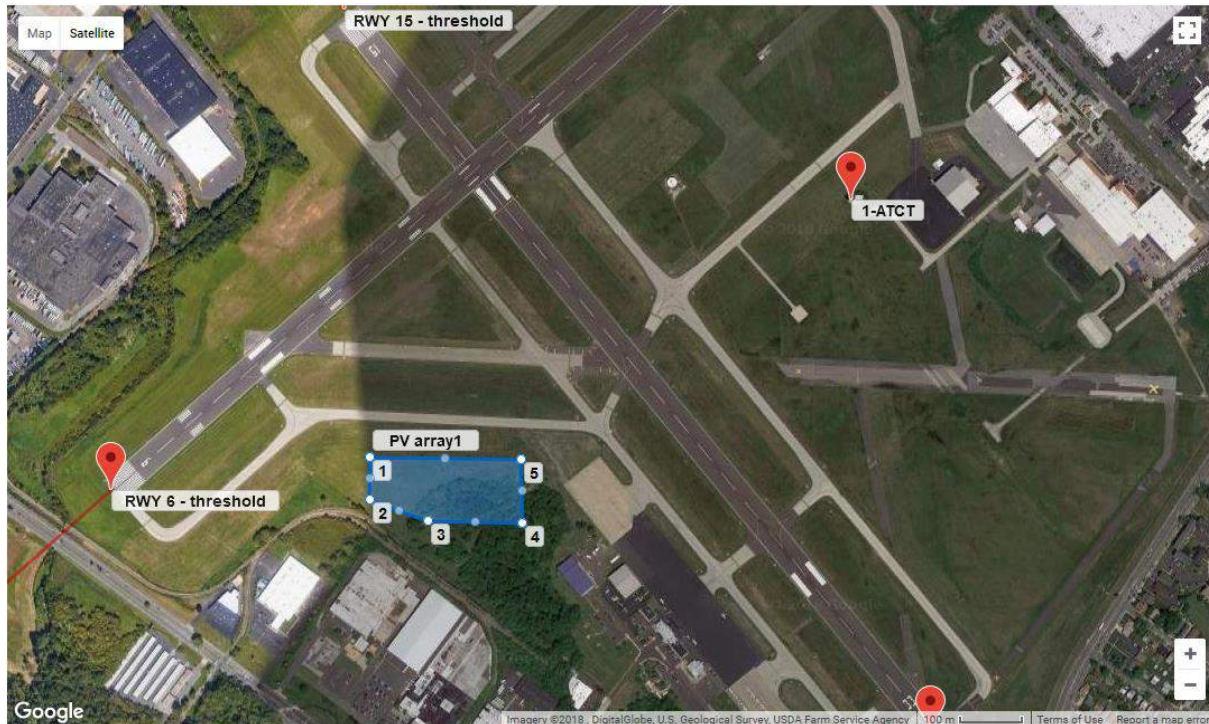


Figure 3 Proposed PV Site Locations as Input into GlareGauge at PNE

For the ATCTs and ramp towers, the towers were located on the model's aerial map and inputs included the height of the observer at each location. PNE provided the ATCT cab eye level height of 75 feet above ground level (AGL).

For the pilot analysis, the runway threshold was selected with the flight path tool, and a second point away from the runway was identified to represent the direction of the flight path. The model then automatically identified the location and height above ground of the flight path, based on a 3-degree glide slope out two miles from the threshold, and determines if the pilot along the flight path would be exposed to glare. The tool provides default assumptions for the pilot's view to screen out any results that are beyond view.

The flight path analyzed by the model for each runway at PNE is shown in **Figure 4**. The ATCT location at PNE is denoted as 1 in **Figure 4**.



Figure 4 ATCT and Pilot Flight Paths Assessed For Glare for PNE

2.3.2 Design Considerations

Design considerations generally vary for different types of sites, with an overall preference for the solar panels being tilted toward and facing south for projects in the northern hemisphere. The southern orientation is referred to as the azimuth, and is measured based on a compass heading with south being 180 degrees (°). Project design components, particularly related to azimuth and tilt angle, affect the potential for glare and need to be identified prior to assessing compliance with the FAA's Solar Policy.

Projects mounted on poles on the ground (i.e. ground-mounted designs) have the greatest flexibility in siting and design, and will customarily have an azimuth facing south (180°) in the northern hemisphere, and a tilt angle ranging from 5° to 35° at the latitude of PNE. Ground-mounted solar projects can also be designed with tracking systems, which adjust the panel's position to follow the sun throughout the day and vary with the seasons (as opposed to fixed panels that do not move). Tracking systems maximize solar access and electricity generation, but are costlier to build, operate, and maintain. For PNE, only fixed systems were considered in the preliminary study.

HMMH evaluated fixed ground mounted systems at each airport for comparison to the FAA glare standards. Analysis started with a preferred layout design of 180° orientation and a tilt angle of 35°. For reference, **Figure 5** shows a typical example of the ground mount fixed systems with a tilt angle of 25°.

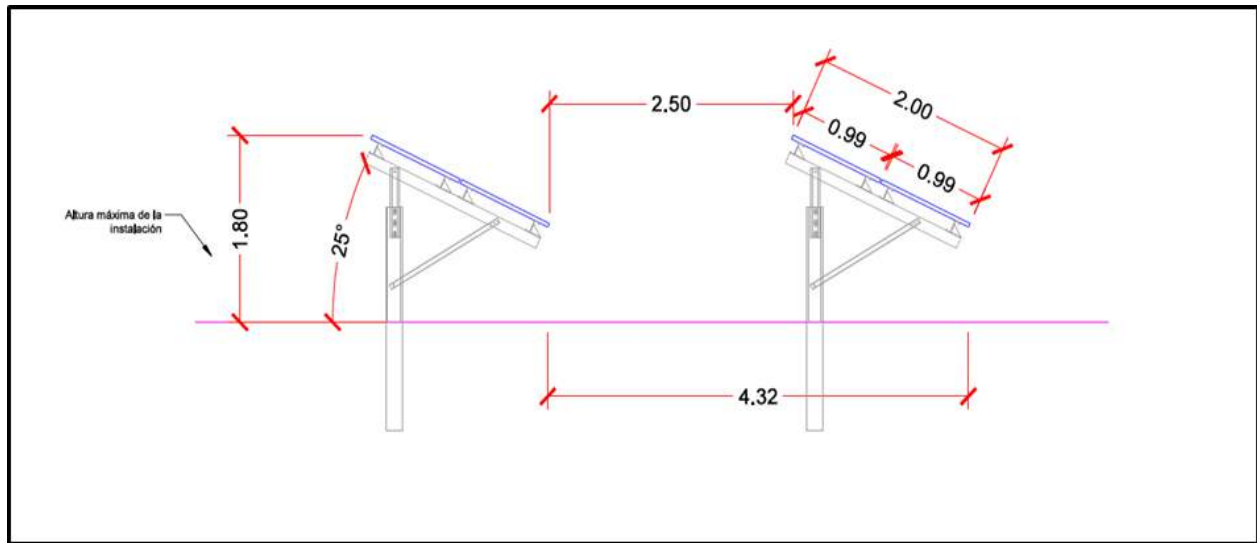


Figure 5 Typical Fixed Ground Mount System Panels

Although no canopy projects were identified at PNE, relevant information is included in case there are future opportunities at the Airport. Projects located over surface parking would include a canopy structure that is aligned to the parking design layout (or orientation) such that vehicles can park under the structures. Canopies also have a lower tilt angle to maximize shading benefits to vehicles and limit engineering stress from wind loads, with tilt angles typically being 10° or less. **Figure 6** shows a cross-sectional view of a typical canopy structure. Panels on building rooftops will typically conform to the roof design, with panels on flat roofs being tilted at 5° to permit drainage and minimize wind loads, while projects on slope roofs are fastened directly to the roof. For this analysis, a preferred tilt angle of 5° for each canopy design is assumed.

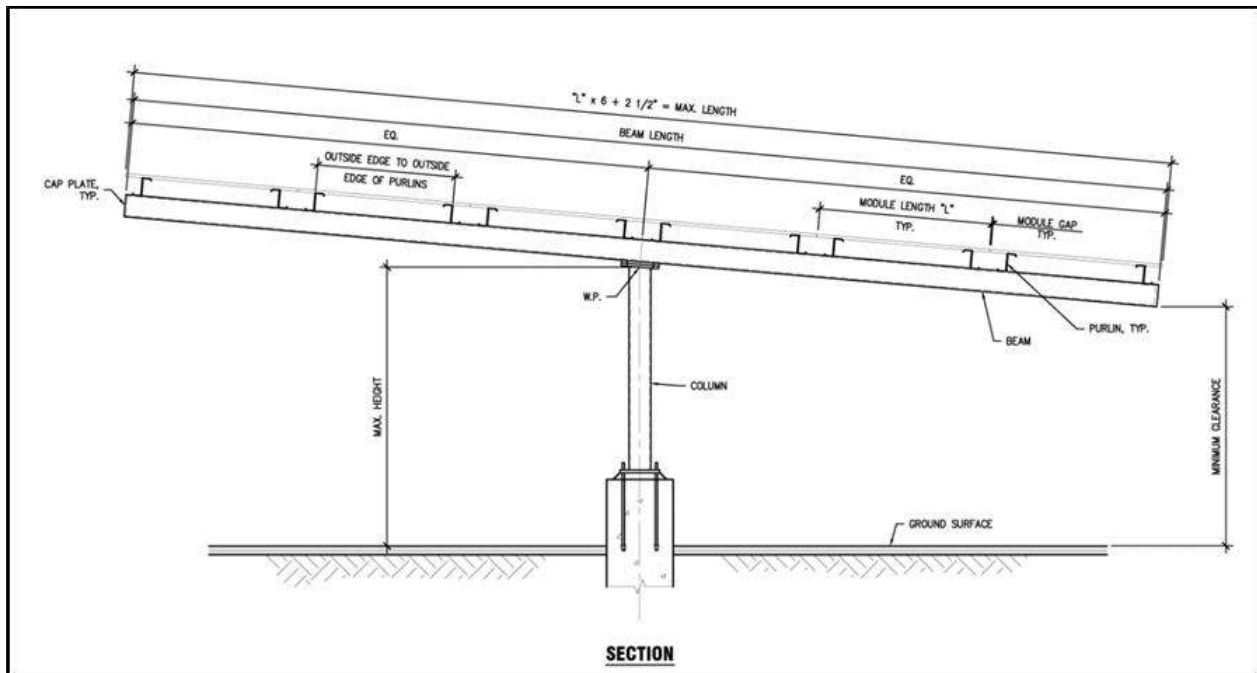


Figure 6 Cross-section of a Typical Solar Canopy Structure

The preferred design characteristics at PNE are shown in **Table 5**.

Table 5 PNE Preferred Design

Site	Airport	Location	Mounting System	Orientation	Tilt Angle	Building Height (AGL) in Feet ¹	Panel Height (AGL) in feet
1	PNE	West of Terminal	Ground Mount	180°	35°	NA	10
Notes:							
1. Building Heights are estimates as provided by DOA staff in emails.							

For the solar module surface material, HMMH started with “smooth glass without ARC” (anti-reflective coating) to provide the installer with maximum flexibility in selecting a solar module.

Because larger surface areas produce higher intensity glare in the glare modeling, projects with larger footprints are modeled first, and can then be decreased size as needed if glare does not meet FAA standards. Once the appropriate size is selected, the preferred design parameters are input into the tool (for ground mounted fixed system that includes an orientation of 180° and tilt angle of 35°). For the canopy structures, an orientation consistent with the parking area orientation and 5° tilt angle would be assumed in order to maximize electricity generation and minimize structure costs and potential loss of parking spaces.

2.3.3 Results

The GlareGauge modeling results demonstrated that the solar PV project site at PNE can be designed to be compatible with the FAA’s Interim Solar Policy and the associated ocular hazard standard. **Table 6** presents the glare results with the preferred design parameters, under which the PNE site fails. However, **Table 7** presents glare results showing that the alternative design evaluated would be acceptable assuming alternative design parameters for the site. The GlareGauge modeling files for the PNE site are presented in Appendix A of the 2018 Preliminary Solar Assessment Study.

Table 6 GlareGauge Results for the Proposed Solar Project Site Assuming the Preferred Design*

No	Site	Azimuth / Tilt	ATCT	Rwy 15	Rwy 24	Rwy 33	Rwy 6	Comply?
1	PNE – West of Terminal	180° / 35°	0	0	0	0	243	No (see Table 7)
* These results are evaluated in comparison to the ocular hazard standards listed in Table 3. ** numbers represent hours per year of predicted glare. Notes: G (Green) = Low Potential for Temporary After-Image Y (Yellow) = Potential for Temporary After-Image R (Red) = Potential for Permanent Eye-Damage								

The PNE ground mounted location northwest of the terminal showed results, using the optimal design, that were not compatible with the FAA Policy (i.e. yellow glare results on the approach to RWY 6). For this site, HMMH identified a suitable, albeit less optimal, alternative design assuming an orientation of 160° and the same tilt angle of 35°. This alternative would ensure compliance with FAA policy for this site. **Table 7** shows a summary of the results from GlareGauge with the alternative design.

Table 7 GlareGauge Results for Proposed Solar Project Site Assuming Alternative Design Parameters*

Site No.	Site Name	Azimuth / Tilt	ATCT	RWY 15	Rwy 24	Rwy 33	Rwy 6	Comply?
1	West of Terminal	160° / 35°	0	0	0	0	175	Yes
* These results are evaluated in comparison to the ocular hazard standards listed in Table 3. ** Numbers in columns to the right of Azimuth and Tilt angles represent hours per year of predicted glare. Notes: G (Green) = Low Potential for Temporary After-Image Y (Yellow) = Potential for Temporary After-Image R (Red) = Potential for Permanent Eye-Damage								

In summary, the ground mount Site 1 at PNE (shaded in blue) can be made compliant with FAA policy using an alternative design that varies the orientation angle to 160°. The alternative design parameters would slightly reduce energy production potential at this location compared to the 180° orientation however.

3 PNE Detailed Solar Site Review

This section provides a more detailed description of the prospective solar PV project site located at PNE, including its characteristics, benefits, and challenges, as extracted from the preliminary report. Some details related to solar PV sites at PHL are maintained for clarity and consistency with the preliminary report. For further details regarding the PHL sites, refer to the full report.

3.1 Background

Following identification of the possible feasible sites described throughout Section 2, HMMH conducted a more detailed solar site review of each of the potential solar project. A total of nine sites were analyzed which passed the FAA ocular standards. **Table 8** describes the PNE site, its design attributes, and expected electricity generation. **Figure 7** shows the PNE site location for reference.

Table 8 On-Site Potential PV Project Location at PNE

Site Number	Site Name	Design	Azimuth / Tilt	Nameplate (kW DC) ¹	Projected Annual Production (kWh)
1	PNE West of Terminal	Ground mounted	160° / 35°	1,550	2,094,541
Notes: 1. Denotes nameplate capacity (e.g. maximum DC generation potential in kW as calculated from NREL PVWatts). Note that the estimated average annual energy production in kilowatt-hours (kWh) varies per kW of nameplate capacity based on the specific location and design parameters, and that final energy production numbers will also depend on design details such as the specific solar panels and inverters selected. Production numbers shown in this table reflect the maximum energy generation that can be expected in an average year based on the design parameters deemed acceptable for each site following the analysis presented in section 2.					



Figure 5 Prospective Solar PV Project Site Location at PNE Airport

Based on the sites provided and the areas that complied with FAA solar guidance, project descriptions of each location's identifying site characteristics, benefits and challenges were prepared for inclusion in the preliminary report. This included site descriptions, including a map showing the parcel and a table outlining all of the site characteristics and related values. Please refer to the full report for details concerning all sites beyond the PNE site, which is the only one located included to meet the needs of this document.

3.2 Site 1: PNE Ground Area Northwest of Terminal

As a ground-mounted, pile supported project, the open land northwest of the terminal at PNE should be comparatively inexpensive to construct and is not designated for future development. The site is shown in **Figure 8** and the characteristics of the site are presented in **Table 9**. The site may require some grading depending on the solar design engineer's recommendations as the ground surface is uneven in segments. The area would require removal of vegetation and possibly some tree removal to the south to remove obstruction to solar exposure. There may be opportunities to expand the site or move it to the west if vegetation clearing becomes an obstacle. Preliminary environmental reviews may have been conducted in the past for this site area; however, confirmation of environmental impacts should be conducted to ensure no adverse impacts are expected and hazardous materials are removed.