

January 7, 2025

1. Call to Order of the Randolph County Planning Board.

There was a meeting of the Randolph County Planning Board on January 7, 2025, at 6:00 PM in the 1909 Historic Courthouse Meeting Room, 145-C Worth St, Asheboro, NC. Chairman Pell called the meeting to order and welcomed those in attendance. Pell reminded those in attendance that the *Planning Board Rules of Procedure* state that anyone wishing to speak must sign up to speak and that speakers other than the applicant are limited to three minutes.

2. Roll call of the Board members. (Completed by staff.)

The County Planning staff completed the roll call of the members of the Board as they arrived at the meeting. Reid Pell, Kemp Davis, John Cable, Reggie Beeson, Ken Austin, Brandon Hedrick, Susan Thompson and Nicholas Mooney were present. County Planning Director Tonya Caddle and County Attorney Ben Morgan were also present, along with County Planning staff members Kayla Brown, David Harris, Cory Hartsoe, Kim Heinzer, Tim Mangum, and Eric Martin.

3. Consent Agenda:

- Approval of agenda for the January 7, 2025 Planning Board meeting.
- Approval of the minutes from the December 3, 2024 Planning Board meeting.

*On the motion of Cable, seconded by Hedrick, the Planning Board voted 7-0 to **approve** the Consent Agenda as presented in the agenda.*

4. Conflict of Interest:

- Are there any Conflicts of Interest or *ex parte* communication that should be disclosed? *(If there is a Conflict of Interest, the Board must vote to allow the member with the Conflict of Interest to not participate in the hearing of the specific case where the Conflict of Interest has been identified.)*

There were no Conflicts of Interest or *ex parte* communication identified by any Planning Board member.

5. Old Business.

There was no old business for the Planning Board to consider.

6. New Business.

SPECIAL USE PERMIT REQUEST #2024-00022041

The Randolph County Planning Board will hold a duly published and notified quasi-judicial hearing on the request by **MARY KING**, Ramseur, NC, and their request to obtain a Special Use Permit at 437 NC Hwy 22 N, Columbia Township, Tax ID #8702133558, 26.35 acres, *RR - Residential Restricted District* and *RA - Residential Agricultural District*. The applicant desires to obtain a Special Use Permit to allow a second residence to remain on the property as a guest house.

Caddle presented the first case of the night, the Special Use Permit request of Mary King, Ramseur, NC.

Pell explained to the public that anyone wanting to speak in favor or against a request would be sworn in to give testimony for the case.

Pell opened the public hearing.

Morgan administered the oath to Mary King.

King explained that there are currently over twenty-six acres of property with a house and guest house on the property. She said they want to divide the property and have two new 8-acre tracts, leaving the remaining 10 acres or so with the existing house and guest house. King said that she wanted to divide the property so her daughter could build a house and that King had moved into the guest house as she can not handle the steps in the main house.

Caddle explained that the request was not for the subdivision of the property but to allow two residences to remain on the property if it was divided.

Morgan explained to King that once she had divided her property, the two homes would remain on the ten-acre parcel and could not be able to be sold individually without Board approval. King said she understood.

Pell asked if there were any questions from the Planning Board members.

Hearing none, Pell closed the public hearing.

*On the motion of Davis, seconded by Cable, with a vote of 7-0, the Planning Board voted to **approve** the request with the motions contained in the Planning Board packet.*

SPECIAL USE PERMIT REQUEST #2024-00022045

The Randolph County Planning Board will hold a duly published and notified

quasi-judicial hearing on the request by **JULIE & MICHAEL ROGERS**, Sophia, NC, and their request to obtain a Special Use Permit at 3215 Green Glade Rd, Back Creek Township, Tax ID #7734673504, 2.06 acres, *RM - Residential Mixed District*. The applicant desires to obtain a Special Use Permit to allow the replacement of a second residence on the property for a family member.

Caddle presented the next case of the night, the Special Use Permit request of Julie and Michael Rogers, Sophia, NC.

Pell opened the public hearing.

Morgan administered the oath to Michael Rogers, the applicant.

Rogers told the Board that he is trying to replace an old double-wide mobile home with a modular home and that his sister currently lives in the existing mobile home.

Morgan asked Rogers if he understood the approval from the Board, which would require the two homes to remain on the property, and he would not be able to sell either home individually without the Board's approval. Rogers said he understood.

Pell asked if there were any questions from the Board members.

Beeson asked Rogers if he planned to replace only one of the homes. Rogers said he would be replacing the double-wide only.

Pell closed the public hearing.

*On the motion of Beeson, seconded by Austin, with a vote of 7-0, the Planning Board voted to **approve** the request with the motions contained in the Planning Board packet.*

SPECIAL USE PERMIT REQUEST #2024-00022044

The Randolph County Planning Board will hold a duly published and notified quasi-judicial hearing on the request by **REBECCA C. SPIVEY**, Asheboro, NC, and their request to obtain a Special Use Permit at 1547 Cox Brothers Rd, Grant Township, Tax ID #7790769837, 6.7 acres, *RA - Residential Agricultural District*. The applicant desires to obtain a Special Use Permit to allow a third residence on the property for a family member.

Caddle presented the third case of the night, the Special Use Permit request of Rebecca C. Spivey, Asheboro, NC.

Pell opened the public hearing.

Morgan administered the oath to Rebecca Spivey, the applicant.

Rebecca Spivey, 1547 Cox Brothers Rd, Asheboro, said she and her husband are requesting to add a third residence to their property. She said they have the required acreage and road frontage.

Morgan asked Spivey if she understood that if the Board approved her request, she would not be able to sell the homes individually without coming back to the Board and requesting to do so. Spivey said she understood.

Pell asked if there were any questions from the Board members.

Beeson asked if there would be an additional driveway installed and if it would be on the north side of the property. Spivey said there would be an additional driveway, and it would be on the north side of 1545 Cox Brothers Rd.

Austin asked if there would be an additional well and septic installed for the third home. Spivey said they would install a new septic system but would share an existing well.

Pell asked if there were any additional questions from the Board.

Hearing none, Pell closed the public hearing.

Hedrick said it appears the new driveway would be installed on the portion of the property that appears to be cleared, and it should not have an impact on the line of sight in the curve. He said the applicants understand the homes cannot be sold individually, so he would make a motion.

*On the motion of Hedrick, seconded by Beeson, with a vote of 7-0, the Planning Board voted to **approve** the request with the motions contained in the Planning Board packet.*

SPECIAL USE PERMIT REQUEST #2024-00003493

The Randolph County Planning Board will hold a duly published and notified quasi-judicial hearing on the request by **NATHAN DAVIS**, Asheboro, NC, and their request to obtain a Special Use Permit at 2943 Monterey Rd, Cedar Grove Township, Tax ID #7657572797, 5.04 acres, *RA - Residential Agricultural District*. The applicant desires to obtain a Special Use Permit to obtain a federal firearms license in a proposed 1,000 sq ft accessory building.

Caddle presented the last Special Use Permit for the night, the request of Nathan Davis, Asheboro, NC.

Pell opened the public hearing.

Morgan administered the oath to Nathan Davis, the applicant.

N. Davis said he would like to buy and sell firearms legally by having a federal firearms license and the license requires this Special Use Permit to be approved. He said it would be an at-home business, allowing him to buy wholesale products instead of paying retail prices. N. Davis said that he travels quite a bit and would like to do this operation in his free time.

Pell asked if there were any questions from the Planning Board.

Cable asked if there would be a firing range or test range and N. Davis stated that there would not be a test range. Davis stated that the United States Bureau of Alcohol, Tobacco, Firearms and Explosives, the AFT, requires a minimum 1,000 sq ft building and the building would have a security system. N. Davis told the Board that he would order firearms after it has been purchased by a customer.

Austin asked about the hours of operation and N. Davis said that it would be mostly in the evenings but that he could not give a specific time other than he would be following the AFT guidelines. N. Davis also told the Board that he would be using the existing drive to access the proposed building and would only put up the necessary signage and that he does not want to advertise the business unless it is necessary as he wants to keep his family safe.

Morgan asked if the store would be open by appointment only and N. Davis said that Morgan was correct.

Cable stated that his seems to be a generally low-key operation.

Morgan stated that the Planning Board hears these types of requests frequently.

Cable said that his concerns about security and safety have been answered.

Pell asked if there were any other questions from the Planning Board.

Hearing none, Pell closed the public hearing.

Hedrick stated that the Board has heard many of these requests before and that N. Davis has given the operation a lot of thought.

*On the motion of Hedrick, seconded by Austin, with a vote of 7-0, the Planning Board voted to **approve** the request with the motions contained in the Planning Board packet.*

REZONING REQUEST #2024-00022042

The Randolph County Planning Board will hold a duly published and notified legislative hearing on the request by **CARSON EDWIN & ANGELA KIDD COCKMAN**, Ramseur, NC, and their request to rezone .72 acres out of 1.48 acres at 850 NC Hwy 22 S, Columbia Township, Tax ID #8701898377, Municipal Growth Area, from *RR - Residential Restricted District* to *HC - Highway Commercial District*. The applicant desires to rezone the property to allow any use allowed by right in the *HC - Highway Commercial District*.

Caddle presented the first rezoning case of the night, the request of Carson Edwin and Angela Kidd Cockman, Ramseur, NC.

Pell opened the public hearing.

C. Cockman addressed the Planning Board and told them that he did not know that the property was not all zoned *HC - Highway Commercial District*.

Pell asked if there were any questions from the Planning Board.

K. Davis asked if the request was to make the entire property the same zoning and C. Cockman answered yes.

Austin asked if there was access to Gracewood Rd and C. Cockman said there was no formal driveway but that he has access via another lot and that he owns the parcels on both sides of the request location.

Cable asked if C. Cockman could cut a drive and exit on Gracewood Rd and C. Cockman said that he could if necessary.

Pell asked if there were any other questions from the Planning Board.

Hearing none, Pell closed the public hearing.

K. Davis said that everyone knows that he is not a fan of straight rezoning, but in this case, the property owner is trying to clean up an existing zoning issue.

Hedrick said that C. Cockman is trying to fix a problem.

Cable said that he appreciated the Cockman's wanting to clean up the situation and make it right.

*On the motion of Cable, seconded by Hedrick, with a vote of 7-0, the Planning Board voted to **approve** the request with the motions contained in the Planning Board packet.*

REZONING REQUEST #2024-00022043

The Randolph County Planning Board will hold a duly published and notified legislative hearing on the request by **LOW BRIDGE SOLAR, LLC**, Durham, NC, and their request to rezone 308.64 acres at 6960 Ferguson Rd, Columbia Township, Sandy Creek Balance Watershed, Tax ID #8713255702, #8713273793, #8713398173, #8714210539, #8714200236, #8714311050, #8713298256, and #8714309162, Secondary Growth Area, from *RA - Residential Agricultural District* to *RIO-CD - Rural Industrial Overlay - Conditional District*. The proposed Conditional Zoning District would specifically allow a ground-mounted utility-scale photovoltaic solar farm and battery energy storage system. Property Owners: William D. & Judy O. Allred, JNB Holdings of Randolph, LLC, Allen Dean Wright and Allen D. & Ginger W. Wright

Caddle presented the next rezoning case of the night, the rezoning request for Low Bridge Solar, LLC, Durham, NC.

Pell opened the public hearing.

Tom Terrell, representing Low Bridge Solar, distributed binders to the Planning Board to reference during the presentation (Exhibit 1). He said the binder includes the application, a larger-scale site plan for review, a study on health and safety, an operations manual, a decommissioning plan, the consistency for the area, and some conditions to consider for the request.

Matt Dellafield, using a PowerPoint presentation, explained to the Board that this is the second project in Randolph County. He said they started working on the project in 2021 which is a 40 megawatt project which will supply approximately 6,000 homes. He said this facility may incorporate battery storage and proposed an increase of 1.6 million dollars in new net taxes over the life of the facility in addition to what the County is already receiving on the property.

Dellafield said they have completed several environmental engineering studies including wetland assessments, cultural resource assessment, threats to endangered species assessment, and the findings are reflected on the site plan, according to the County requirements.

Dellafield said they have had two neighborhood informational meetings, making adjustments based on the neighbors' feedback from those meetings, and after submitting their proposal to Duke Energy last year, they had been informed that their proposed project had made Duke's list as a finalist, although there is no guarantee from Duke to move forward. He said they should know more definitively in May or June of this year if their project is selected and plan to be on track for operation from 2028 to 2029.

Dellafield explained the site plan in more detail, pointing out the plan to leave existing vegetation, plant buffers where necessary and supplement vegetation in some areas as needed, and meet or exceed Randolph County standards. He also explained that the fencing will conform to the National Electrical Code, adequate roads for Emergency Services, and plans to get approval from the Fire Marshal's office for the design as well.

Dellafield said a decommissioning plan has been submitted and gave a brief description of the plan (also included in the exhibit provided).

Pell asked if there were any questions from the Board.

Hedrick said he appreciates the applicant's insight on the decommissioning and working with legislation to put those plans in place, removing the burden from the County.

Austin asked if the decommissioning plan would be filed with Randolph County and if there is a bond put in place for protection. Dellafield explained that they provide financial assurance through a bond, escrow, or cash and it is administered by the State if there is an issue.

Austin asked if the document would be recorded. Dellafield said it is not recorded in the Register of Deeds, but it is a document that could be shared.

Caddle explained that these issues used to be the County's responsibility before November 2024, and now it has become the burden of the State.

Austin asked about the connections for capturing and transferring power. Dellafield said there is only one point where Duke Energy connects to power lines due to the costs and he gave a brief description of converting the power.

Austin asked where the point of connection would be located. Dellafield said it would depend on Duke Energy's approval.

Austin asked if the easement would be fenced or underground. Dellafield said the easement would be underground, it would be surveyed and then recorded.

Austin said there have been issues in the past where power grids have been vandalized using high-power rifles and asked what protection is put in place for that type of situation. He said they try to locate the facility off the road but they try not to install more security than necessary because this is not a major distribution for power like the substations that were vandalized and wouldn't have much of an impact.

Austin asked where the emergency access would be located on the property. Tonya

said the Fire Marshal has reviewed the request with no issues and approval would have to be given before permitting. Dellafield said there are three points of access.

Terrell said he would add a condition that anything filed with the State would be provided to the County as well.

Cable asked if companies put up a bond with the County before it started being handled by the State. Morgan said the bond has been shifted from the County's responsibility to the State's responsibility.

Hedrick said the *Unified Development Ordinance* references the DEQ laws which can be used to satisfy the requirements.

Nick Kirkland, Kirkland Appraisals, said there is no impact on the adjoining property owners per his professional opinion.

Austin asked about the estimated increase in tax revenue and if the 1.6 million dollars would be new taxes. Dellafield answered yes and explained the calculations used to determine those values.

Hedrick said the tax values used don't seem to include the increase in property values. Dellafield said it is too hard to predict future values so they used a 2.5% increase which may be too low.

Austin asked if any of the property is currently in the volunteer agriculture district. Dellafield answered yes, and they would be responsible for paying back the tax deferments as well.

Davis asked if there had been any property condemnation. Dellafield answered no.

Tommy Cleveland said he had completed the health and safety assessments for the project which looks at the solar and battery aspects and concluded that the project is in line with leading technology and will not have any negative health and safety impacts as it is being proposed.

Cable said the request seems standard, and there have been no problems with the previous requests from this applicant. He said depending on what Duke wants regarding battery storage, they've stated they will work with the Fire Department. Dellafield said they have been working on outreach training for the fire team because battery storage is somewhat of a newer element to the solar facilities.

Austin asked if the property would be seeded before panel installation. Dellafield said it would depend on the soil. He said they normally move topsoil for grading and replace the topsoil before seeding.

Pell asked if there were any additional questions from the Board.

Morgan said that Kirkland and Cleveland's reports are part of the binders given to the Board and provided to the Clerk.

Amy Chrisman, daughter of one of the property owners, said she lost her father in November, after having a long illness. She said her mother kept him at home and used all their savings to do so. She said they feel this is a way for her mother to be able to stay in her family home.

Julie Burch, said they don't want to get rid of their farm, they are unable to run the farm, and this is a way for her and her sister to preserve their parent's and grandparents' legacy.

Albert Caviness said he is a retired Air Force veteran, said he has been spying on the applicants for six months, and is proud to say he is in favor of the request. He said he hopes the environment will not be affected and according to their experts, it will not. He asked about the pond on the solar site. Morgan said he would have the applicant address the question in just a moment. Mr. Caviness asked how the property owners nearby would be notified about the construction site and how they would be affected.

Morgan explained this was the public meeting regarding the site, and the two informational meetings provided to the neighboring properties. Austin said there were signs posted in multiple places for the meeting as well.

Christina Anderson, 7244 Ferguson Rd., said most of her concerns have been addressed tonight. She asked about access to Ferguson Rd and what impact construction will have on that access. She also asked in the event of decommissioning, would the property revert to agricultural use.

Morgan asked Dellafield if he could address the questions that had been asked about the water source on the property. Dellafield said the two ponds on the property will be maintained and preserved. He said these facilities do not need water to operate unless the panels need to be washed or water the lawn.

Dellafield said the primary entrances for the facility would be Whites Chapel Rd and Low Bridge Rd, and all the driveway entrances would require permitting through NCDOT, and they will decide if steps need to be taken for continued safety.

Morgan said the property is a conditional use request and no longer used as a solar farm, someone would have to come before the Board with a new request to change the use.

Cable asked how long it would take to decommission the facility. Dellafield said it would take approximately six to seven months for a facility of this size.

Pell asked if there were any additional questions from the Board.

Morgan said we would need to wait for Terrell to sign an updated application with the new conditions before a decision. Terrell reviewed and signed a new application.

Pell announced a five-minute recess which resumed at 7:54 pm.

Pell closed the public hearing.

Cable said the Board has considered quite a few solar facilities and this request seems like a good plan. He said there were questions about safety and concerns about the environment which have been addressed. He expressed his appreciation for working with the families, trying to keep their family farms. He said this seems like a good project and all the boxes have been checked.

Hedrick said the binder provided to the Board that will be part of the Minutes was fantastic, which has addressed all the concerns as well as the items that are required from our *Unified Development Ordinance*, which is greatly appreciated.

Austin said he has concerns about the loss of agricultural property due to these projects. He said he appreciates the position of the families and the hard work it takes to maintain a farm. He also said he doesn't want to see these types of projects take over our agricultural land.

Beeson said we need to always consider what draws people to our County, which is the scenic corridor, and the rolling hills. He commended the applicants on their presentation, taking buffers into account. He agreed that he hates losing agricultural land.

*On the motion of Cable, seconded by Hedrick, with a vote of 7-0, the Planning Board voted to **approve** the request with the motions contained in the Planning Board packet.*

REZONING REQUEST #2024-00022046

The Randolph County Planning Board will hold a duly published and notified legislative hearing on the request by **SKYE EQUIPMENT**, Asheboro, NC, and their request to amend the Conditional District Permit on 7.83 acres at 5175 NC Hwy 49 S, Concord Township, Tax ID #7618281985, Secondary Growth Area, *LI-CD - Light Industrial - Conditional District*. The proposed amendment to the Conditional Zoning District would specifically allow for wholesale/retail sales and rentals of heavy equipment and on-road trucks including a repair garage. Property Owner: ACBC, LLC.

Caddle presented the last rezoning case of the night, the request of Skye Equipment, Asheboro, NC.

Pell opened the public hearing.

Jeff Branson, the applicant, said that he wanted to change the conditions to be able to buy equipment and that he would obtain a dealer's license from the State.

Pell asked if there were any questions from the Planning Board.

Hearing none, Pell closed the public hearing.

*On the motion of Davis, seconded by Beeson, with a vote of 7-0, the Planning Board voted to **approve** the request with the motions contained in the Planning Board packet.*

REQUIRED UPDATES TO THE RANDOLPH COUNTY WATERSHED PROTECTION ORDINANCE

Updates to the *Randolph County Watershed Protection Ordinance* are required due to changes made by the North Carolina Environmental Management Commission. These changes are necessary to keep the *Randolph County Unified Development Ordinance, Article 800: Watershed Protection Ordinance* compliant.

Caddle presented the updates to the *Randolph County Watershed Protection Ordinance*. She stated that the State agencies had reviewed the Ordinance and it needs some changes to clarify the rules.

Cable stated that Caddle described the changes clearly and that staff had worked on the updates for several months.

*On the motion of Cable, seconded by Thompson, with a vote of 7-0, the Planning Board voted to recommend **approval** by the Board of County Commissioners.*

7. Update from the Planning Director.

There were no updates from the Planning Director.

8. Adjournment.

Pell stated that Thompson is now a regular member of the Planning Board and that he wanted to thank the Planning staff for all of their hard work.

Pell also introduced the new alternate member, Nick Mooney, from the Ramseur area.

At 8:14 p.m. on motion of Cable, seconded by Hedrick, the Board voted 7-0 to adjourn.

Chairman

Clerk to the Planning Board

**Approved by Randolph County Planning Board
March 4, 2025**

Exhibit #1

Low Bridge Solar LLC

Request for Rezoning from RA to RIO-CD



Before the Randolph County Planning Board
January 7, 2025

To whom it may concern:

As I am unable to attend the planning board meeting regarding the Low Bridge Solar due to an out of state business meeting I did want to give some input as a property owner in the project.

This land has been in my family for over 75 years and being a life-long resident of Randolph County, I do not want to sell it. In fact, I live right next to it and will continue to. The solar project provides my wife and I an opportunity for a long-term income which is not possible with other uses like farming, hunting, or timber, which simply do not provide substantial income. My wife and I both are approaching retirement age and being self employed we do not have pensions etc so the income is needed for retirement.

I also believe it is important that with all the economic development going on in Randolph County and the pressure to build housing, if the solar project moves forward, the land would be locked down for decades and not be at risk of being developed into a subdivision, which has been an important point of concern to several of my neighbors who I have spoken to about the project. The solar project, though long-term, is still temporary in a way a subdivision is not, and the decision about what to do with the land after the solar project will be left to the next generation.

The project has been very thoughtfully designed and has very little road frontage. What little it does have will be buffered with planted or preserved vegetation to minimize the visual impact on the community. The project is very low impact, creating no light or noise, yet it creates substantial tax revenue for the county plus pollution-free energy which will support the other forms of development going on in the area.

In closing, for the reasons above for us personally, the economic benefit to the county long term, the green energy aspects and the design of the project all make this a benefit to this area and I would appreciate your support of the project.



Allen Wright
1484 Low Bridge road
Liberty, NC 27298



COUNTY OF RANDOLPH
Department of Planning & Development
204 E Academy St • Asheboro NC 27204-0771

APPLICATION FOR ZONING CHANGE

Date: 10/30/2024
Parcel number: Refer to attached document
Application number: _____

Job contact name: Tom Delafield
Job contact phone number: (919) 723-7473
Job contact e-mail: tdelafield@r-e-services.com

Owner: Low Bridge Solar LLC
Address: 5315 Highgate Dr, STE 202
City, ST ZIP: Durham, NC 27713

Applicant: Low Bridge Solar LLC
Applicant Address: 5315 Highgate Dr, STE 202
City, ST ZIP: Durham, NC 27713

LOCATION INFORMATION:

Township: Columbia Subdivision name: N/A
Subdivision lot #: N/A
Address: Near 1460 Low Bridge Rd, Liberty, NC 27298

DEED INFORMATION:

Date recorded: Refer to attached document Deed acreage: Refer to attached document

ZONING INFORMATION:

Zoning District(s): Residential Agricultural District
Growth Management Area(s): Secondary Growth Area
Specialty District: None
Watershed Name: Sandy Creek Watershed
Flood Map #: 3710871300J, 3710871400J
Class A Flood Plain On Prop? No

REQUESTED CHANGE:

Area to be rezoned: The entirety of parcel numbers 8713273793, 8713255702, 8713398173, 8714210539, 8714200236, 8714311050, 8713298256 & 8714309162.
Proposed Zoning District(s): Rural Industrial Overlay District - Conditional District
Proposed Use(s): Ground-mounted utility-scale photovoltaic solar farm and battery energy storage system used to produce renewable energy.
Condition(s): Refer to attached document, file name "Low Bridge Solar_Rezoning Application Conditions.pdf"

The undersigned owner/applicants do hereby make an application for a PROPERTY ZONING CHANGE as allowed by the Randolph County Zoning Ordinance.

Matthew Delafield Digitally signed by Matthew Delafield
Date: 2024.10.30 13:52:22 -04'00'

Signature of Owner/Applicant

October 30, 2024

Date

Authorized County Zoning Official

Date

Please e-mail the signed and completed form to
planning@randolphcountync.gov.

Submit

LOCAL TELEPHONE NUMBER
Asheboro: (336) 318-6555
<http://www.randolphcountync.gov>



COUNTY OF RANDOLPH
Department of Planning & Development
204 E Academy St • Asheboro NC 27204-0771

SITE PLAN REQUIREMENTS

Detailed site plans for property rezonings must be submitted to Randolph County Planning Staff before applications are considered final and accepted. The *Randolph County Unified Development Ordinance*, Article 600, Section 621 contains the detailed regulations and items that must be included on submitted site plans.

PLANNING BOARD REQUIREMENTS FOR APPROVING OR DENYING PROPERTY REZONING

According to the *Randolph County Unified Development Ordinance*, Article 400, Sections 411 and 412, and applicable North Carolina General Statutes, the Randolph County Planning Board must find the following on all rezoning requests for the request to be approved:

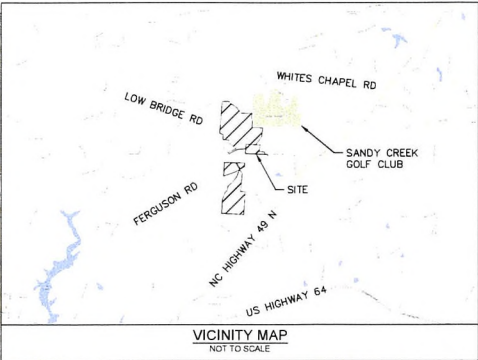
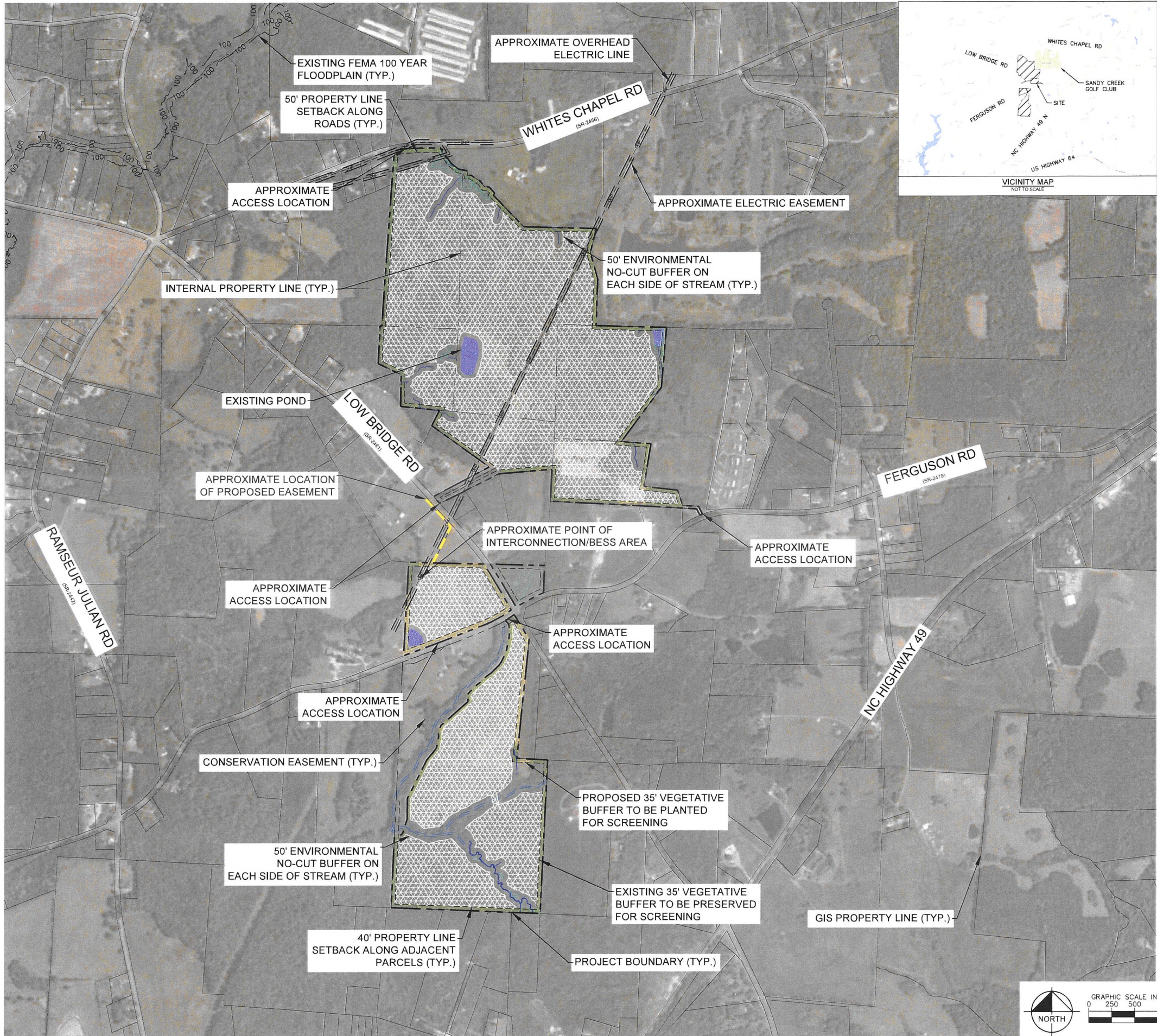
1. *That the request is consistent with the adopted Randolph County Growth Management Plan; and*
2. *That the request is reasonable and in the public interest.*

If the request is inconsistent with the *Randolph County Growth Management Plan* or the request is unreasonable or not in the public interest, the Randolph Planning Board must deny the request.

Any appeals of the decision of the Randolph County Planning Board on matters of property rezoning may be made to the Randolph County Manager's Office as outlined in the *Randolph County Unified Development Ordinance*, Article 400, Section 411, Item A. Any appeal must be made within fifteen days of the decision by the Randolph County Planning Board.

LOCAL TELEPHONE NUMBER
Asheboro: (336) 318-6555
<http://www.randolphcountync.gov>
Rev. 1/31/2024

Landscaping Plan



SITE DATA TABLE	
PROJECT AREA	± 278 ACRES
PARCEL ID #	8714210539, 8714311050, 8714200236, 8714309162, 8713298256, 8713388173, 8713273793, 8713255702
ZONING JURISDICTION	RANDOLPH COUNTY
CURRENT ZONING	RA (RESIDENTIAL AGRICULTURAL)
PROPOSED ZONING	RIO (RURAL INDUSTRIAL OVERLAY)
ADJACENT PROPERTY ZONING	RA / RM / RR / LI-CD / CVOE-CD
CURRENT LAND USE	AGRICULTURAL / FORESTED
PROPOSED LAND USE	SOLAR ENERGY
REQUIRED SETBACKS (SECTION 613, TABLE 9)	FRONT: 35' SIDE: 10' REAR: 30' 50' ENVIRONMENTAL NO-CUT BUFFER ON EACH SIDE OF STREAM
PROPOSED SETBACKS	50' ALONG ROADS 40' ALONG ADJACENT PARCELS 50' ENVIRONMENTAL NO-CUT BUFFER ON EACH SIDE OF STREAM
LANDSCAPE REQUIREMENTS (SECTION 612, LEVEL III)	35' WIDE, TWO STAGGERED ROWS OF FAST-GROWING EVERGREEN TREES EVENLY SPACED 10' APART, WITH 10' BETWEEN EACH ROW, AND 1 ROW OF MIXED VEGETATION INCLUDING EVERGREEN TREES, SHRUBS, CANOPY TREES, AND UNDER-STORY TREES
PROPOSED LANDSCAPE BUFFER	35' WIDE, WHERE POSSIBLE, EXISTING MATURE VEGETATION WILL BE PRESERVED FOR SCREENING AT A MINIMUM 35' WIDTH. IN OTHER AREAS, BUFFER WILL BE PLANTED PER REQUIREMENTS ABOVE

LEGEND	
	PROJECT BOUNDARY
	GIS PROPERTY LINE
	PERIMETER SETBACK
	PROPOSED EASEMENT A
	APPROXIMATE ELECTRIC EASEMENT
	APPROXIMATE EXISTING OVERHEAD TRANSMISSION LINE
	FEMA 100 YEAR FLOODPLAIN
	NATIONAL WETLAND INVENTORY (NWI) STREAMS
	DELINEATED STREAMS
	DELINEATED WETLANDS
	PONDS
	MAXIMUM ARRAY EXTENTS
	EXISTING NATURAL WOODED BUFFER TO BE PRESERVED
	PROPOSED VEGETATIVE BUFFER TO BE PLANTED
	CONSERVATION EASEMENT

- NOTES
- PROJECT BOUNDARY SHOWN IS BASED ON FILES RECEIVED FROM RENEWABLE ENERGY SERVICES, LLC ON 10/14/2024.
 - PARCEL BOUNDARIES SHOWN ARE BASED ON PUBLICLY AVAILABLE NORTH CAROLINA GIS DATA ACCESSED ON 10/15/2024.
 - ALL EXISTING TRANSMISSION LINES SHOWN ARE APPROXIMATE LOCATIONS BASED ON PUBLICLY AVAILABLE GIS DATA ACCESSED ON 10/15/2024.
 - 100-YR FLOODPLAIN LINEWORK IS BASED ON PUBLICLY-AVAILABLE FEMA GIS DATA, ACCESSED ON 10/15/2024.
 - WETLANDS AND WATERS ARE BASED ON FILES RECEIVED FROM RENEWABLE ENERGY SERVICES, LLC ON 10/28/2024 AND PUBLICLY AVAILABLE DATA ACCESSED 11/26/2024. DELINEATED WETLANDS AND WATERS ARE SUBJECT TO CHANGE BASED ON USAGE CONFIRMATIONS AND FINDINGS.
 - THE LOCATION OF PROPOSED EQUIPMENT INCLUDING BUT NOT LIMITED TO: FENCING, SOLAR ARRAY RACKING, ELECTRICAL EQUIPMENT, VEGETATIVE BUFFER, AND OVERHEAD POLES & LINE, ETC. SHOWN ARE APPROXIMATE AND MAY BE SUBJECT TO MODIFICATIONS DUE TO SITE CONDITIONS, ADDITIONAL PERMITTING REQUIREMENTS, DETAILED DESIGN, EQUIPMENT AND/OR OTHER CONSTRAINTS.
 - THIS PLAN IS PRELIMINARY AND WILL NOT BE RELEASED FOR CONSTRUCTION.
 - THE POINT OF INTERCONNECTION IS APPROXIMATE AND MAY INCLUDE AN ELECTRICAL SUBSTATION. THE POINT OF INTERCONNECTION MAY ALSO INCLUDE A BATTERY ENERGY STORAGE SYSTEM (BESS).
 - THE PROJECT SITE WILL BE ENCLOSED BY A MINIMUM 8' HIGH SECURITY FENCE.
 - THE SECURITY FENCE WILL BE INSTALLED ALONG THE DUKE ENERGY'S RIGHT OF WAYS IN ACCORDANCE WITH DUKE ENERGY'S POLICIES.
 - ACCESS POINTS ARE APPROXIMATE AND SUBJECT TO CHANGE BASED ON SURVEYED TOPOGRAPHY, UTILITIES, NCDOT PERMITTING, OR ENVIRONMENTAL FEATURES.
 - THERE WILL BE A MAXIMUM GROUND COVERAGE OF 55% OF THE PROJECT AREA, AND 30% OF THE PROJECT AREA WILL BE HELD IN OPEN SPACE.
 - THE IMPERVIOUS SURFACE COVERAGE IS ANTICIPATED TO BE LESS THAN 24% AS REQUIRED BY THE WATERSHED ORDINANCE.
 - THERE WILL NOT BE ANY PERMANENT SECURITY LIGHTING WITHIN THE PROJECT SITE.
 - THERE WILL BE NO PLANTED VEGETATION WITHIN THE WETLANDS AND WETLAND SETBACK AREAS, SO NATURAL VEGETATION WILL BE PRESERVED WITHIN THOSE AREAS.



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#1-0102

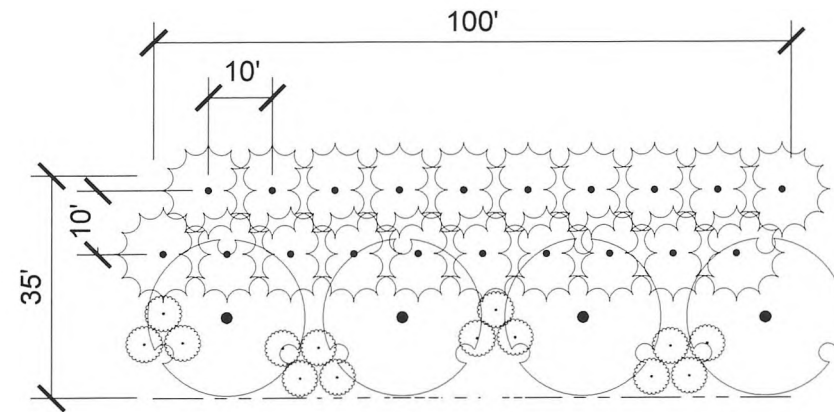
PRELIMINARY
NOT FOR
CONSTRUCTION

KHA PROJECT	DATE	SCALE	AS SHOWN	DESIGNED BY	NSP	DRAWN BY	NSP	CHECKED BY	LCL
016458010	12/05/2024								

LOW BRIDGE SOLAR
CONSTRAINTS MAP

LOW BRIDGE SOLAR
CONSTRAINTS MAP

SHEET NUMBER
EX1.0



PLAN VIEW

TYP. PLANT SCHEDULE PER 100 LINEAR FOOT

TREES	QTY	COMMON NAME	CONT.	HEIGHT AT PLANTING
	20	EVERGREEN UNDERSTORY TREE	CONT. OR B & B	4' MIN.
	4	LARGE DECIDUOUS TREE	B & B	8' MIN.
SHRUBS	QTY	COMMON NAME	CONT.	
	14	EVERGREEN SHRUB	3 Gal.	

LIST OF PLANT SPECIES ALTERNATIVES

LARGE DECIDUOUS TREE
QUERCUS NUTALLII
ACER RUBRUM
ZELKOVA SERRATA

EVERGREEN SHRUB
ILEX CRENATA 'HOOGENDORN'
PRUNUS LAUROCERASUS
VIBURNUM AWABUKI 'CHINDO'

UNDERSTORY EVERGREEN TREE
ILEX X 'OAKLEAF'
MAGNOLIA GRANDIFLORA 'LITTLE GEM'
OSMANTHUS X FORTUNEI

NOTES:

1. THE PROPOSED VEGETATIVE BUFFER REPRESENTED IN THIS EXHIBIT IS BASED OFF OF THE STANDARDS SET FORTH IN THE RANDOLPH COUNTY UNIFIED DEVELOPMENT ORDINANCE.
2. EXISTING VEGETATION IS TO BE PRESERVED AND PROTECTED IN PLACE TO MEET THE INTENT OF THE BUFFER REQUIREMENTS WHEREVER APPLICABLE. THE PROPOSED BUFFER STANDARD IS MEANT TO SUPPLEMENT EXISTING VEGETATION TO MEET THE SCREENING INTENT OF THE CODE REQUIREMENTS FOR SOLAR ARRAY FACILITIES AS NECESSARY.
3. LANDSCAPE MATERIAL TO BE LOCATED AND MAINTAINED SO AS TO NOT INTERFERE WITH ANY UTILITIES, STREET LIGHTING, TRAFFIC CONTROL DEVICES, OR SIGHT TRIANGLES.
4. PROPOSED LANDSCAPE MATERIAL MAY BE SUBSTITUTED WITH APPROVAL FROM THE PROJECT LANDSCAPE ARCHITECT BASED ON THE AVAILABILITY OF MATERIAL DURING THE TIME OF INSTALLATION. ALL SUBSTITUTED MATERIAL SHALL HAVE SIMILAR CHARACTERISTICS TO THE ORIGINALLY SPECIFIED MATERIALS AND SIZE.
5. THE PURPOSES OF THIS ILLUSTRATIONS IS TO DEPICT AN ESTIMATE OF THE OPAQUENESS, LAYERING, AND SIZE OF THE PROPOSED VEGETATIONS AT 1 YEAR, 3 YEARS, AND 5 YEARS GROWTH FROM TIME OF PLANTING.



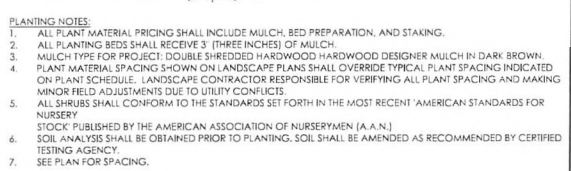
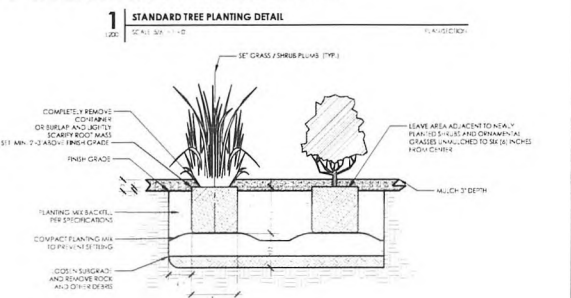
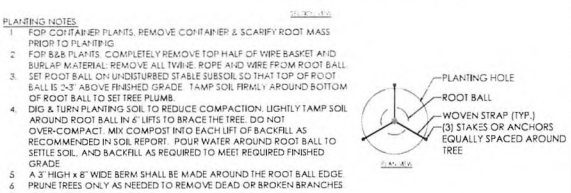
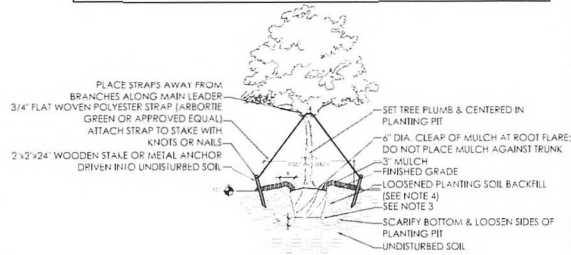
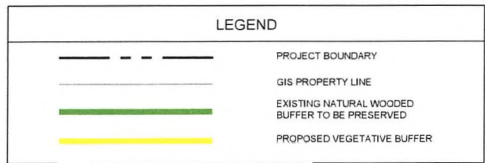
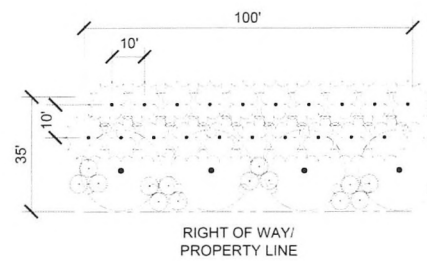
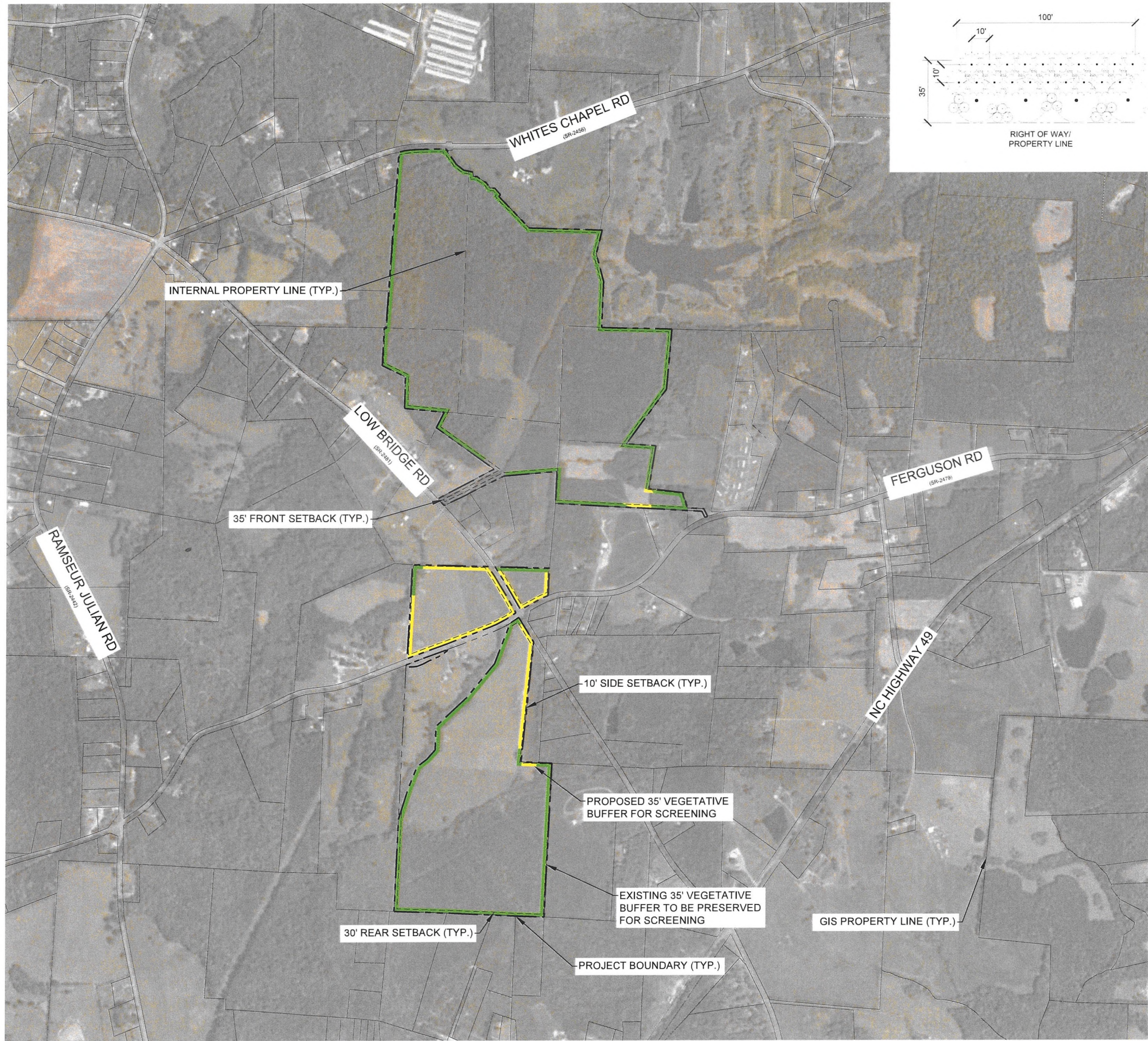
TYP. 100FT SECTION AT 1-YEAR GROWTH



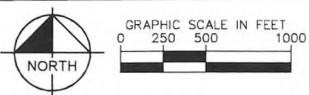
TYP. 100FT SECTION AT 3-YEAR GROWTH



TYP. 100FT SECTION AT 5-YEAR GROWTH



- NOTES**
- EXISTING VEGETATION IS TO BE PRESERVED AND PROTECTED IN PLACE TO MEET THE INTENT OF THE BUFFER REQUIREMENTS WHEREVER APPLICABLE. THE PROPOSED BUFFER STANDARD IS MEANT TO SUPPLEMENT EXISTING VEGETATION TO MEET THE SCREENING INTENT OF THE CODE REQUIREMENTS FOR SOLAR ARRAY FACILITIES AS NECESSARY.
 - ALL PLANTS MUST BE HEALTHY, VIGOROUS MATERIAL, FREE OF PESTS AND DISEASE.
 - ALL TREES MUST HAVE A STRAIGHT TRUNK AND FULL HEADED AND MEET ALL REQUIREMENTS SPECIFIED.
 - ALL PLANTS ARE SUBJECT TO THE APPROVAL OF THE LANDSCAPE ARCHITECT OR OWNER'S REPRESENTATIVE BEFORE, DURING AND AFTER INSTALLATION.
 - ALL TREES MUST BE GUIED OR STAKED AS SHOWN IN THE DETAILS.
 - ALL TREE RINGS MUST BE COMPLETELY MULCHED AS SPECIFIED. MULCH TO BE THREE(3) INCHES OF DOUBLE SHREDDED HARDWOOD DESIGNER MULCH IN DARK BROWN.
 - THE CONTRACTOR IS RESPONSIBLE FOR FULLY MAINTAINING ALL PLANTING (INCLUDING BUT NOT LIMITED TO: WATERING, SPRAYING, MULCHING, WEEDING, FERTILIZING, ETC.) OF THE PLANTING AREAS AND LAWN UNTIL SUBSTANTIAL COMPLETION OF PROJECT.
 - THE CONTRACTOR SHALL COMPLETELY WARRANTY ALL PLANT MATERIAL FOR A PERIOD OF ONE (1) YEAR, BEGINNING ON THE DATE OF SUBSTANTIAL COMPLETION. THE CONTRACTOR SHALL PROMPTLY MAKE ALL REPLACEMENTS BEFORE OR AT THE END OF THE WARRANTY PERIOD.
 - ANY PLANT MATERIAL WHICH DIES, TURNS BROWN, OR DEFOLIATES (PRIOR TO SUBSTANTIAL COMPLETION OF THE WORK) SHALL BE PROMPTLY REMOVED FROM THE SITE AND REPLACED WITH MATERIAL OF THE SAME SPECIES, QUANTITY, AND SIZE MEETING ALL PLANT SCHEDULE SPECIFICATIONS.
 - CONTRACTOR SHALL COMPLY WITH ALL APPLICABLE CODES & ORDINANCES REGARDING LANDSCAPING. GENERAL CONTRACTOR IS TO CLEAN THE INDICATED BUFFER AREA OF ALL CONSTRUCTION DEBRIS PRIOR TO FINAL INSPECTION.
 - THE CONTRACTOR SHALL INSTALL NON-WOVEN PERMEABLE GEOTEXTILE UNDER PLANTING BED MULCH IN ALL LANDSCAPE BEDS TO PREVENT WEED GROWTH.
 - THE CONTRACTOR SHALL BE RESPONSIBLE FOR INSTALLING TREES AND SHRUBS THAT WILL MEET BOTH MINIMUM SIZE AND SPACING REQUIREMENTS AS SET FORTH IN THE COUNTY OF RANDOLPH, NC UNIFIED DEVELOPMENT ORDINANCE (UDO). FAILURE TO INSTALL PLANT MATERIAL PER THIS PLAN WILL JEOPARDIZE ISSUANCE OF FINAL CERTIFICATE OF OCCUPANCY. CONTRACTOR SHALL BE RESPONSIBLE FOR SCHEDULING INSPECTIONS OF PLANT MATERIAL.
 - SURFACE MATERIAL FOR THE GROUNDPLANE APPLICATION WITHIN THE FENCE LIMITS OF THE SOLAR DEVELOPMENT WILL CONSIST OF NATIVE TURFGRASS SEED TO BE ESTABLISHED WITHIN THE WARRANTY PERIOD AND BE MAINTAINED BENEATH THE PANEL MODULES. FREQUENCY OF MAINTENANCE/MOWING OF THE TURFGRASS WILL BE DONE AS NEEDED TO MAINTAIN A UNIFORM STAND OF VEGETATION THAT DOES NOT EXCEED A MAXIMUM HEIGHT OF 30\"/>





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#0102

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CONSTRUCTION

KHA PROJECT	DATE	SCALE	DESIGNED BY	DRAWN BY	CHECKED BY
016458010	10/25/2024	AS SHOWN	BCB	BCB	LCL

LANDSCAPE PLAN

LOW BRIDGE SOLAR

NORTH CAROLINA

RANDOLPH COUNTY

SHEET NUMBER
EX1.0



HEALTH AND SAFETY ASSESSMENT REPORT

Low Bridge Solar
40 MW_{AC} Photovoltaic Facility with
~15 MW_{AC} / 4-hour Battery
Randolph County, NC

ABSTRACT

This is an assessment of the potential health and safety impacts of the proposed 40 MW_{AC} Low Bridge Solar photovoltaic facility with battery energy storage (BES) in Randolph County, NC. Considering the project design and location, the assessment evaluates the potential positive and negative impacts of the project on public health and safety. Most of the project area will be covered by solar equipment, which produces valuable electricity without producing any air, water, or soil emissions. The primary health and safety risk of the solar equipment is toxicity, which is considered in detail in this assessment. The battery equipment will occupy a tiny portion of the site's footprint and will provide many benefits to the electric grid. The primary health and safety risk of the battery equipment is fire, which is minimized by advanced battery technologies, 24/7 monitoring, new battery regulations, and the long distance between the equipment and the public. The conclusion of the assessment is that the Low Bridge Solar facility will not create negative health and safety impacts. The clean electricity the project will produce will reduce the burning of fossil fuels, which will reduce pollution and provide millions of dollars' worth of local public health benefits as a result, based on U.S. Environmental Protection Agency estimates.

Tommy Cleveland, PE

Consulting Engineer

Solar Health and Safety Expert

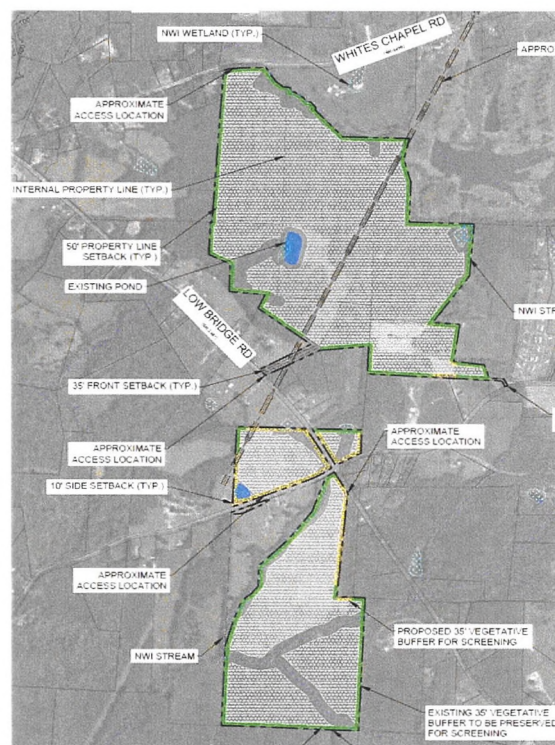
October 25, 2024

Health & Safety Assessment Report

Low Bridge Solar (with batteries) – Randolph County, NC

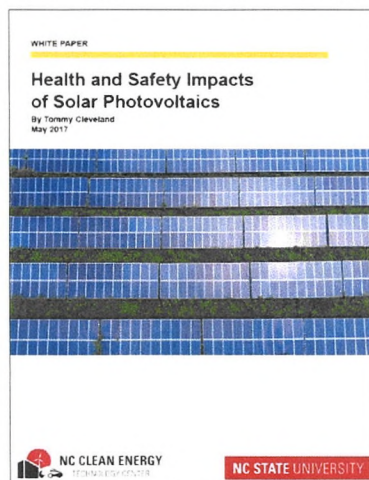
Project Overview:

- **Project Name:** Low Bridge Solar
- **Developer:** Renewable Energy Services
- **Project Area (inside fence):** ~202 acres
- **PV Capacity:** 40 MW_{AC} (~52 MW_{DC})
- **Solar Panels:** bi-facial crystalline silicon: Canadian Solar TOPBiHiKu7 700 watt, or equivalent
- **Structure:** single-axis trackers (north-south rows, 52° E to 52° W)
- **Solar Inverters:** central station type: SMA Sunny Central 4000 (4.0 MW), or equivalent
- **Battery Energy Storage (BES):** 14 to 16 MW_{AC} with 4-hour duration (~60 MWh), AC-coupled
- **Battery Type:** lithium-ion batteries, LFP chemistry, manufactured by a Duke Energy-approved battery cell vendor, located at interconnection substation
- **Point of Interconnection (POI) to Grid:** Duke Energy Progress 115 kV transmission line passing diagonally through the project area
- **Interconnection Equipment:** Duke Energy Progress 115 kV switchyard and project's 34.5kV/115kV substation adjacent to POI



Report Author

The author of this report is **Tommy Cleveland, PE**, (the "Author") a consulting engineer licensed as a professional engineer in NC since 2007. Mr. Cleveland graduated from North Carolina State University (NC State) with undergraduate and master's degrees in mechanical engineering, where he focused on energy. His solar career started with his master's thesis, which led to working over 12 years at the North Carolina Clean Energy Technology Center at NC State University. While at the university, Tommy worked on nearly every aspect of solar energy; from teaching, to testing equipment, to research & development, to leading a statewide stakeholder group in the development of a template solar ordinance. During his time at NC State, North Carolina installed more photovoltaic (PV) capacity than any state other than California, mostly in the form of 2-5 MW_{AC} utility-scale solar facilities covering around 40 acres each. Utility-scale solar was unfamiliar to the hundreds of communities around the state where the systems were proposed, and many of those communities had questions about the technology and its potential to harm public health or the environment in their community. Many of those questions found their way to Mr. Cleveland and he expanded his already broad knowledge of PV to research and find answers to the questions being asked. Over time he became an expert on the potential health and safety impacts of PV and was the lead author of the 2017 NC State white paper on the topic (pictured to the left). Since mid-2017 Mr. Cleveland has worked as a solar engineer at an energy engineering firm conducting interconnection commissioning of utility-scale solar and battery facilities for utilities in North and South Carolina. In this role Mr. Cleveland was the engineer responsible for (interconnection) commissioning over 60 PV sites and 4 battery sites.



Executive Summary

This report assesses the potential health and safety impacts of the proposed Low Bridge Solar 40 MW_{AC} solar photovoltaic with battery energy storage project. The Low Bridge Solar facility, located in Randolph County North Carolina, will install crystalline silicon solar panels on single-axis tracking racks that slowly rotate each row of panels to follow the sun across the sky. Large central station inverters will convert the DC solar electricity generated by the solar panels into grid-synced AC electricity. Containerized battery systems, capable of storing and discharging energy, will be located by the system substation at the point of interconnection to the grid. Transformers will boost the voltage of the output from the PV and battery inverters for connection to an onsite substation that connects to a transmission power line.



Photovoltaic (PV) panels are not new. They have been used and studied for over 40 years and are well understood by the scientific community. Utility-scale solar facilities are newer, but they too have been installed and studied for well over a decade, and scientists also have a clear understanding of their function and impacts.

Utility-scale battery energy storage systems are newer still but have been maturing very quickly in the last few years. Low Bridge Solar will use a leading lithium-ion battery technology from a top manufacturer.

Photovoltaic systems produce emission-free electricity. This replaces electricity production from fossil fuel power plants that produce harmful emissions. The health benefits of clean solar electricity are hard to put a dollar figure on, but the EPA's best attempt at doing just that puts the value in the Carolinas between 1.7 and 3.8 cents per kWh produced. Even at the bottom end of this range, this equates to approximately \$1.5 million of public health benefit per year for the Low Bridge Solar project, and over \$45 million in 30 years.

The only identifiable risks to health and safety of the PV aspects of the Low Bridge Solar project are not unique to solar but exist for any source or use of electricity. These are electric shock, arc flash, and fire. Due to world-class safety regulations in the U.S. and an experienced solar industry, these risks are extremely low, and the secure and isolated nature of ground-mounted PV facilities, including Low Bridge Solar, results in minimal risk to the general public.

Common concerns about toxicity and EMF from solar facilities are understandable, but the operating characteristics and materials present in the equipment means that neither toxicity nor EMF pose a material risk to public health or safety. Research and experience regarding heat island effect and solar glare shows that, like other utility-scale PV projects, the Low Bridge Solar project will not create either of these potential impacts. The single-axis trackers at Low Bridge Solar that will keep the panels facing in the direction of the sun minimizes the potential for the project to create any glare.



Modern US battery codes and standards minimize the risk of fire, effectively removing the risk of explosion. A battery fire would damage equipment but due to the distance between the batteries and the public, a fire would not negatively impact public health or safety.

Based on my knowledge of engineering and science, personal experience with PV and battery technology, review of academic research, and review of project materials provided by Renewable Energy Services my findings and opinions are summarized as follows:

- The Low Bridge Solar facility will result in a significant reduction of regional air pollution.
- The Low Bridge Solar facility will not result in any negative impacts to public health or safety.
- The Low Bridge Solar facility will not increase the temperature of the area surrounding the site.
- The Low Bridge Solar facility is not expected to create any glare hazards.
- The Low Bridge Solar facility is not expected to create bothersome noise for any neighbors.

Introduction

Purpose:

This report assesses the potential health and safety impacts of the proposed Low Bridge Solar ("Low Bridge") 40 MW_{AC} solar with battery energy storage (BES) project. It also seeks to educate readers on the health and safety impacts of photovoltaic and battery energy storage systems using accurate scientific sources of information, including providing resources for further reading.

System Overview: Solar with Batteries

The proposed Low Bridge Solar facility is a utility-scale photovoltaic generation facility with lithium-ion battery energy storage. The energy storage is in the form of containerized battery systems with inverters separate from the PV inverters, which is referred to as "AC-coupled" batteries. The batteries will all be in a single area near the point of interconnection to the grid. In general, the batteries are charged by solar during peak hours and by low-cost electricity at night and then discharged when there is little or no sun shining but grid electricity is in high demand, such as summer evenings, and it repeats this cycle daily.

Battery Assessment

FOLLOW THE BATTERY ICON FOR
ASSESSMENT OF BATTERIES



Overview of Potential Impacts:

The proposed solar photovoltaic (PV) and BES system is likely to remain in operation at least 30 years, and this report considers its potential impacts in Randolph County from the start of construction onward, including decommissioning of the project and restoration of the land. This assessment considers all aspects of the project but focuses on those unique to solar with battery energy storage projects.

Potential Positive Health and Safety Impacts:

Every utility-scale PV project significantly reduces pollution by producing emission-free electricity that replaces electricity that otherwise would have been largely produced by burning coal and natural gas. Burning these fossil fuels for electricity production is a significant source of air, water, and soil pollution, so reducing their use is a clear public health benefit.

The US Environmental Protection Agency (EPA) conducted a study to determine how much pollution PV systems save and to estimate the public health value of the cleaner air, water, and soil they provide. These experts calculated that in the Carolinas, based on the sunshine available, the way electricity is produced, and the public health impacts of fossil fuel-fired electricity, every kilowatt-hour (kWh) of solar electricity produced provides 1.7 to 3.8 cents of public health benefit.¹ At this rate of benefit, **the Low Bridge Solar project will produce \$1.5 - \$3.4 million of public health benefits every year, which would add up to \$45 - \$101 million over the life of the project.** The public health benefits of generating pollution-free electricity with PV are very significant.

It is relatively simple to replace a small amount of grid energy with utility-scale solar energy, but as the portion of grid energy provided by solar becomes more significant it becomes increasingly challenging to integrate more solar without sacrificing reliability or power quality. Energy storage is a simple solution to overcome most of these challenges, and recent cost reductions and increased experience makes it feasible to integrate significant energy storage into solar facilities. While many types of energy storage are technically possible, battery energy storage has proven to be most practical. So, the inclusion of battery energy storage in projects like Low Bridge Solar improve the economics of the projects, such that some projects may not be feasible without the benefits of the batteries.

The positive benefits of photovoltaics are widely understood and well documented, so this report will not address them further. Furthermore, the positive public health impacts of the Low Bridge Solar project significantly outweigh any health and safety risks, as described below. The ability of energy storage to facilitate increased solar energy on the grid is widely understood and well documented, but direct analysis of the positive benefits of a battery system is less common. A life



¹ US Environmental Protection Agency, Public Health Benefits-per-kWh of Energy Efficiency and Renewable Energy in the US: A Technical Report. 2nd Ed, May 2021, www.epa.gov/statelocalenergy/public-health-benefits-kwh-energy-efficiency-and-renewable-energy-united-states

cycle environmental impacts assessment of utility-scale battery energy storage in California found that when the positive and negative carbon impacts of batteries are considered, that the batteries reduce the carbon footprint of the grid due to the storage's ability to store and release solar energy that otherwise would have gone unproduced due to curtailment.²

Potential Negative Health and Safety Impacts:

All electricity generating facilities, including photovoltaics and batteries, provide some potential for negative health and safety impacts, however the Low Bridge project does not present negative health and safety risks to the general public due to its location or technology (photovoltaic generation with battery energy storage). The only aspect of the PV portion of the system at Low Bridge Solar that presents risk of physical harm is the potential for electrical shock, arc flash, or fire, which are hazards present with any electrical system and not unique to solar. There are several other aspects of PV systems that often raise public health and safety concerns, but no other aspect of PV systems poses any material risk of negative public health or safety impacts.

Like PV systems, battery systems also produce a limited electrical shock and arc flash hazard, however unlike PV systems, batteries also have the potential for toxicity, fire, and explosion hazards. While it is possible for lithium-ion batteries to catch fire, release toxic gases, and even explode, these hazards at the Low Bridge Solar site do not pose any risk to the general public because the battery systems are outdoors and many hundreds of feet from the closest neighbor.

The major health and safety risk of the project is not due to the solar or battery technologies but is standard construction hazards for construction workers building the site, which does not pose any safety risk to the general public.

Utility-scale PV is becoming a mature industry, but still rapidly growing. The underlying PV technologies of silicon and cadmium telluride have been studied in the laboratory and in the field for well over 30 years. So, the products, practices, regulations, and policies in the PV industry have a well-established base to build upon. Also, research literature on potential negative impacts of PV goes back decades. Modern utility-scale battery energy storage is a rapidly emerging industry, largely building on the success of lithium-ion batteries in consumer products and electric vehicles. So, the products, practices, regulations, and policies in the BES industry are changing extremely rapidly, often with technology change leading policy and regulations. Even though there have been years of experience with batteries in laptops and phones, stationary multi-megawatt battery systems are still somewhat new. The industry is only a handful of years old, with equipment to be installed in 2024 or later being much more mature than technology installed just 3 or 4 years ago. In that time, codes and standards have gone from being designed for small lead-acid battery emergency back-up power to being robust regulations built on several years of early BES experience with input from a wide array of battery stakeholders and experts. Just 3-4 years ago the regulations for stationary battery left system safety to the equipment manufacturers. During this "wild west" period of utility-scale BES development many valuable safety lessons were learned. See below for several publications on the potential health and safety impacts of battery energy storage systems.

Sources for Further Reading on Battery Impacts:

- US Department of Energy, Office of Electricity: [Energy Storage Safety Strategic Plan](#), April 2024
- Sandia National Lab: [Grid-scale Energy Storage Hazard Analysis & Design Objectives for System](#), August 2020
- Energy Response Solutions, Inc.: [Energy Storage System Safety: Comparing Vanadium Redox Flow and Lithium-Ion Based Systems](#), Aug 2017
- National Fire Protection Association (NFPA): [Energy Storage Systems Safety Fact Sheet](#), June 2020
- New York State Energy Research and Development Authority: [New York Battery Energy Storage System Guidebook for Local Governments](#), December 2020
- Electric Power Research Institute (EPRI): [Energy Storage Integration Council \(ESIC\) Energy Storage Implementation Guide](#), March 2019
- EPRI: [Lessons Learned: Lithium Ion Battery Storage Fire Prevention and Mitigation – 2021](#), June 2021

² Balakrishnan, Brutsch, Jamis, et al, Environmental Impacts of Utility-Scale Battery Storage in California, 2019 IEEE 46th Photovoltaic Specialists Conference (PVSC), June 2019, www.firstsolar.com/-/media/First-Solar/Sustainability-Documents/Environmental-Impacts-of-Utility-Scale-Battery-Storage-in-California.ashx

Evidence for the lack of any significant environmental, health, or safety impact of the proposed Low Bridge project is provided by the required State Environmental Review Clearinghouse (the "State Clearinghouse") review, which is required as a part of the project's Certificate of Public Convenience and Necessity ("CPCN") application process. The North Carolina Environmental Policy Act of 1971 (G.S. 113A 1-13), also known as the State Environmental Policy Act ("SEPA"), defines the state policy designed to maintain and protect the state's environment. The statute requires state agencies to the fullest extent possible identify significant environmental effects of their actions and to implement measures to minimize negative effects. The State Clearinghouse consists of all applicable state agencies, who review and comment on every request for a CPCN. The State Clearinghouse includes the North Carolina Department of Natural and Cultural Resources, NC Wildlife Resources Commission, The Division of Waste Management, North Carolina Department of Agriculture and Consumer Services, and others. The Low Bridge project has not yet applied for a CPCN, but before this required certificate is granted by the NC Utilities Commission, the State Clearinghouse must review the proposed project and find it to be in compliance with the North Carolina Environmental Policy Act.

In addition to the State Clearinghouse review, the Project has many environmental regulations and permitting processes that it must comply with. One notable environmental protection regulation is the Sedimentation Pollution Control Act of 1973.³ This act requires construction projects, including utility-scale solar facilities, to meet requirements designed to keep sediment from entering our natural watercourses (e.g. streams, rivers, lakes, etc.) and to keep sediment from washing onto adjacent property. The North Carolina Department of Environmental Quality (DEQ) enforces the act through their local offices spread around the state, which includes requiring DEQ approval of a site-specific erosion and sedimentation control plan before disturbing any soil. The approved Erosion and Sedimentation Control plan must be adhered to throughout construction and until adequate groundcover to stabilize the soil is established.

This assessment report will address all the potential health and/or safety risks of the Low Bridge project, including common concerns that have no potential for public health impact. Specifically, this report addresses the following possible negative impacts/concerns:

- Electrical Shock and Arc Flash
- Toxicity / Chemical
- Heat Island Effect
- Fire and Emergency Response
- Electromagnetic Fields (EMF)
- Glare and noise

Low Bridge Solar is located in northeast Randolph County, in a rural area about 5 miles southwest of Liberty, NC. Low Bridge Solar will provide significant vegetative buffers along the site perimeter, in the form of either existing vegetation that surrounds much of the project or 35-foot wide buffer consisting of 2 staggered rows of evergreen trees spaced 10 feet apart and 1 row of mixed vegetation including shrubs, canopy trees, and understory trees. The facility will exceed the county setback requirements by locating solar panels at least 50 feet from the property line. The project will largely be out of sight due to the project area having a small amount of road frontage and very few residential neighbors. Additionally, because the land is fairly flat, the setback and vegetative buffer will combine to block significant view of the project from roads and neighboring parcels. This combination of setback and vegetative screening will separate the public from this project and minimize its impacts, including the visual/aesthetic impact of seeing the equipment.

Before addressing each of these impact categories, this report provides an overview of utility-scale photovoltaic and battery energy storage equipment and facility construction and operations. These photos should help introduce utility-scale PV and batteries to any reader who has not toured a facility during construction or operation.

³ North Carolina Environmental Quality webpage: Erosion and Sediment Control Laws and Rules, retrieved 2/8/2023, <https://deq.nc.gov/about/divisions/energy-mineral-and-land-resources/erosion-and-sediment-control/erosion-and-sediment-control-laws-and-rules>

Equipment, Construction, and Operations⁴

To understand the potential impacts of a utility-scale PV and battery system it is helpful to understand the components of the facility, as well as how a facility is constructed and maintained. The components and practices in this overview are typical of the industry and representative of the proposed Low Bridge Solar project. The initial site work occurs first, but the order of the other construction steps is flexible and may occur concurrently.

Initial Site Work (construction entrance/driveway, sedimentation and erosion control installation, clearing and grubbing, potentially some grading, perimeter fence, and internal roads)



Underground Work (trenching for wires from PV combiner boxes to inverters, inverter pad installation, medium voltage cables to interconnection equipment)



PV Panel Structure/Racking (driving of steel piles, installation of racking "tables", installation of PV panels)



⁴ Photo sources: author, ncre-usa.com, NC DEQ, blueoakenergy.com, solarbuildermag.com, hbc-inc.com, solarprofessional.com, enr.com, dynapower.com, ie-corp.com, ccrenew.com, and landiscontracting.com

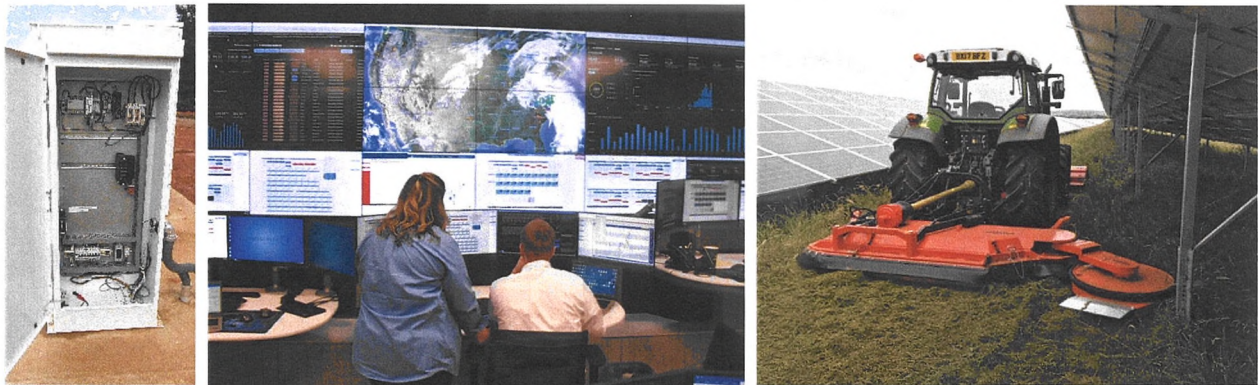
Electrical Work (connection of PV module wiring, combiner boxes, inverters, batteries, transformers, interconnection facilities)



Establishment of Ground Cover (required to close out sedimentation and erosion control permit)



Operations and Maintenance (24/7 monitoring, vegetation maintenance, preventative maintenance)



Electrical Shock and Arc Flash

Any electricity over 50 volts presents an electrical shock hazard, including the electricity in PV and battery facilities. However, like electrical systems in buildings, the solar and battery facility must adhere to the National Electrical Code (NEC) and the equipment must be certified to the appropriate UL safety standards. Unlike buildings, members of the public are restricted from entering a utility-scale solar facility. To help ensure that only qualified people have access to the equipment, the NEC requires a secure perimeter security fence with electrical warning signs. The lack of public access coupled with the high U.S. electrical safety standards essentially eliminates the risk of electric shock for the public.

In circuits with significant available fault current there is another electrical hazard, called arc flash, which is an explosion of energy that can occur due to a short circuit. This explosive release of energy causes a flash of light and heat, creating a shockwave that can knock someone off their feet. The risk of arc flash in a solar and battery facility is no different than the risk at commercial or industrial buildings, except that solar facilities are much less accessible. Equipment with an arc flash risk require arc flash warning labels, and only trained personnel wearing the proper personal protective equipment are allowed in it. Due to the secure perimeter and the high U.S. electrical safety standards there is essentially no arc flash risk to the public.



Figure 1. Perimeter Fence with Warning Signs



Fire Risk and Emergency Response

Every electrical system has some risk of starting a fire, including electrical systems in residential, commercial, and industrial buildings. It is this hazard that motivated creation of the National Electrical Code over 100 years ago. Due to the high standard required by the NEC, modern electrical systems rarely start fires. Like electrical systems in buildings, ground-mounted photovoltaic systems and battery energy storage systems must also adhere to the NEC, including sections of the NEC with specific rules for PV and for batteries.

Fire Risk: Solar

In the rare case that a PV system has a fault that starts a fire, there is very little combustible material present for it to ignite. The only flammable portions of PV panels are the few thin plastic layers, the plastic junction box, and the insulation on its wires. The inverters are also capable of igniting, however like PV modules, they consist primarily of non-flammable materials.

The inverters and transformers are located on concrete pads or raised steel platforms that are isolated from other equipment and vegetation, so a fire in this equipment poses little threat of spreading.

Heat from a small flame is not adequate to ignite a PV panel, but an intense fire or an electrical fault can ignite a PV panel. One real-world example illustrating the low flammability of PV panels occurred during July 2015 in an arid area of California. Three acres of grass under a utility-scale PV facility burned without igniting the panels mounted just above the grass.⁵ Another example occurred recently (2022) in Florida, where there was a 5-acre grass fire under a portion of a 400-acre PV facility that did not ignite any modules.⁶

Fire Risk: Transformers

The most significant fire hazard at a utility-scale solar facility may be the oil in the transformers. There are medium voltage transformers dispersed throughout the site located by each inverter, called inverter step-up (“ISU”) transformers, and there is a large transformer in the interconnection substation, known as the generator step-up (“GSU”) transformer. Traditionally these types of transformers are filled with a non-PCB mineral oil, which is derived from petroleum, and is electrically insulating but flammable. A popular alternative to mineral oil is a transformer fluid made of biodegradable vegetable oil, such as FR3 by Cargill or VG-100 by GE. This type of oil not only has several performance benefits over mineral oil, but it also dramatically reduces the fire hazard of transformers. These vegetable oils’ flash point of 330°C is dramatically hotter than mineral oil transformer fluid (160°C). Unlike mineral oil, FR3 and VG-100 are classified as a K-class, “high-fire-point”, “fire-resistant”, and “less-flammable” fluid. Also classified as “nonpropagating”, it is self-extinguishing, and will not continuously burn if ignited. Mineral oil, however, will keep burning for hours when ignited, with no feasible way to stop it until all the oil is consumed. However, neither mineral oil- or vegetable oil-filled transformers create a fire hazard for the community or property surrounding the solar facility because even in a worst-case scenario of a transformer fire, this equipment is located in the middle of a field, far from other flammable materials and far from neighboring properties. Typically, the only thing at risk of being ignited by a transformer fire in a utility-scale facility is the groundcover (i.e. grass, clover, etc.), which is only a risk in particularly dry conditions. A grass fire is relatively easy to control and poses negligible fire risk to the community.

There are best practices for how to prepare for and conduct an emergency response at a transformer. For example, see the NERC lessons learned document in the Sources for Further Reading at the end of this section.

Fire Risk: Batteries

Batteries can store a lot of energy, which makes them valuable but can also mean they have the potential to unintentionally release that energy very quickly, which can result in a fire. The degree of fire risk varies greatly not only between battery chemistries but also between different battery systems. There have been some fires at utility-scale batteries in recent years in the US and around the world, however newer battery systems have learned from these experiences and have corrected many of problems that led to these early fires.⁷ Our understanding of battery fires and how to avoid them has rapidly increased the last few years as experience has grown from near zero to many thousands of systems. With this experience has come improved battery systems and improved codes and standards.

Generally, all utility-scale batteries are packaged in outdoor-rated containerized enclosure with a battery management system (BMS) and any needed HVAC capabilities. By far the most common type of utility-scale battery is lithium-ion. While there are several different lithium-ion chemistries, all the varieties on the market today consist of cells that each contain a solid anode and cathode separated by liquid electrolyte, which is generally flammable. The specific LFP chemistry planned for Low Bridge has significantly less fire risk than chemistries commonly used for more portable lithium-ion batteries. Many of these cells are connected into a module, several modules are connected in a rack, and several racks are connected in the containerized battery system. Each level has physical barriers and a protective battery management system.

The fire risk starts at the cell level, where if a cell faults or is abused in some way it often produces heat. It is possible for the heating to continue until the cell is generating heat more quickly than it can dissipate the heat, resulting in a rapid,

⁵ Matt Fountain. The Tribune. Fire breaks out at Topaz Solar Farm. July 2015. www.sanluisobispo.com/news/local/article39055539.html

⁶ WBMM News 13, Fire breaks out at Jackson Co. solar farm. August 2022, www.youtube.com/watch?v=byE_BpUX2mc

⁷ EPRI, Lessons Learned: Lithium Ion Battery Storage Fire Prevention and Mitigation – 2021, June 2021
<https://www.epri.com/research/products/000000003002021208>



accelerating rise in temperature, which is known as thermal runaway. When the cell reaches high temperatures, the liquid electrolyte vaporizes and the cell vents gases that are often flammable and toxic. The heat from a single cell in thermal runaway could cause nearby cells to also go into thermal runaway, causing more heat and the potential to drive more cells into thermal runaway. However, there are early warning signs of problems before there is any smoke or fire, allowing for automatic protection systems to act early enough to avoid the worst impacts and potentially avoid thermal runaway all together. The national electrical code (NEC) requires that the battery be certified to UL 1973, the battery safety standard for stationary batteries, which includes a requirement that in a forced thermal runaway test the battery module does not allow fire outside of the module or any explosion. The NEC also requires the battery system to be certified to UL 9540 that addresses the safety of the entire battery system.

In addition to updated equipment standards, there are new installation standards, notably the (National Fire Protection Association) NFPA 855 Standard for the Installation of Stationary Energy Storage Systems which covers the "design, construction, installation, commissioning, operation, maintenance, and decommissioning of stationary ESS." This standard addresses everything from hazard assessment to emergency response planning, and determines when large scale fire testing per UL 9540A is required. UL 9540A is the U.S.'s "Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems", which was first published in late 2017 and has recently had a significant impact on the safety of battery systems. The test starts with a cell level test and only proceeds to module, unit, and installation level tests if the lower-level tests find a fire risk. The UL 9540A test for the cell level consists of attempts to cause the battery to burn or emit flammable gas. The abuse tests include driving a 2.5-inch nail through the battery, overcharging the battery to 200% of nominal charge, and short circuiting the positive and negative terminals of the battery. Any off gassing is captured and analyzed to determine the gases released, and the tests are videoed, with all this data included in the test results.

With lithium-ion batteries there is always some risk of fire, however when built and installed in compliance with the modern US battery safety codes and standards the risk of fire is extremely small, and the risk of explosion is practically zero. Due to the isolation of the Low Bridge Solar batteries from the public due to being located inside of the solar facility and proper emergency response planning and training, even a battery explosion would not impact the public. In a worst-case scenario of a large fire in a battery enclosure that destroys the entire unit, the only potential impact to the public is due to the smoke emitted by the fire. The smoke from a lithium-ion battery fire is very similar to the smoke from a fire of a similar mass of common plastics⁸, which is more toxic than wood smoke and likely more toxic than the smoke from a burning building. However, at Low Bridge Solar the significant distance (at least 500 feet) from each battery enclosure to the nearest neighbors makes the potential health impact from smoke from a battery fire insignificant.⁹

Thus, there is very little chance of a fire in the batteries at Low Bridge Solar, and even the worst-case situation of a fire in a single battery enclosure would not produce enough smoke for long enough to have a material impact on public health.

Emergency Response: Solar

No special equipment is required to respond to a fire incident at a utility-scale PV facility. The most important thing for first responders to know is that as long as the sun is shining on the PV panels they will produce voltage that is dangerous to touch, but there is no danger in touching undamaged panels. There are multiple electrical disconnect switches in PV systems which allows problem areas to be electrically isolated quickly.

Risks of fire associated with vegetative ground cover are reduced by landscaping plans that keep this vegetation low. Local emergency responders typically have access to open locked gates and training on the electrical hazards within the site. So, they are able to safely extinguish grass fires inside of the facility, or monitor and protect the areas surrounding the facility, to ensure the fire does not spread to surrounding areas. The solar facility is remotely monitored around the clock, and

⁸ Sandia National Laboratories, Grid-scale Energy Storage Hazard Analysis & Design Objectives for System Safety, August 2020, <https://www.osti.gov/servlets/purl/1662020>

⁹ An example of toxic smoke impact analysis for a project using Tesla MegaPack lithium-ion battery with a church and residences approximately 200 feet from the batteries: Hazards Assessment Final Report Orni 34 LLC Battery Energy Storage System Prepared for Santa Barbara County, Nov. 2019, https://files.ceganet.opr.ca.gov/257908-2/attachment/ID6EjpwCFrLAn_Z0Z-SNkEMFUIsW7hhYR-SowwCukaV4k_p5sk_bElvYOC3UYKgeBtfprFm-FaYmK0eu0

responding personnel are available for emergencies. The International Association of Fire Fighters (IAFF) provides online training on responding to fires at photovoltaic facilities at www.iaff.org/solar-pv-safety.

Emergency Response: Batteries

No special equipment is needed to respond to a battery fire. In fact, many facilities direct firefighters to not fight the battery fire at all but to allow the fire to burn itself out. In this case, the site's emergency response plan likely calls for a defensive firefighting approach in which firefighters may spray adjacent equipment with water to ensure the fire doesn't spread beyond a single battery enclosure. When the plan calls for actively fighting the battery, the best method is to douse the fire with large volumes of water. The NFPA 855 installation standard requires that the facility create an emergency response plan and provide the plan and training to the local fire department. The appropriate first responders' actions will vary depending on the type of battery at the site, so it is vital that the facility create an emergency response plan specific to the equipment and procedures of that facility and educate the local fire departments on the equipment and the response plan. The National Fire Protection Association (NFPA) provides on-line training on PV and Energy Storage: <https://catalog.nfpa.org/Energy-Storage-and-Solar-Systems-Safety-Online-Training-P20882.aspx>



Sources for Further Reading on Fire and Emergency Response:

- Duke Energy: [Fire Safety Guidelines for Rooftop- and Ground-Mounted Solar PV Systems](#), September 2015
- North American Electric Reliability Corporation (NERC): [Lessons Learned, Substation Fires: Working with First Responders](#), February 2019
- Sandia National Lab: [Grid-scale Energy Storage Hazard Analysis & Design Objectives for System](#), August 2020
- American Clean Power (ACP): [First Responders Guide to Lithium-Ion Battery Energy Storage System Incidents](#), July 2023
- Electric Power Research Institute (EPRI): [Energy Storage Integration Council \(ESIC\) Energy Storage Implementation Guide](#), March 2019
- EPRI: [Proactive First Responder Engagement for Battery Energy Storage System Owners and Operators](#), Sept. 2021
- EPRI: [Insights from EPRI's Battery Energy Storage Systems \(BESS\) Failure Incident Database](#), May 2024
- Tesla: [Lithium-Ion Battery Emergency Response Guide](#), 2022 (Version 2.6)
- also see *Sources for Further Reading on Battery Impacts* on page 5 of this report



Toxicity (Equipment and Operations)

Toxicity is probably the most common health and safety concern about photovoltaic systems, although as detailed below the systems do not pose a material toxicity risk to the public or the environment. This report examines all possible sources of toxicity, from site construction to decommissioning at the end of the project life. The potential sources of toxicity are organized into two categories: equipment and operations and maintenance (O&M).

Toxicity: Equipment

The main equipment at a solar facility is PV modules (a.k.a. solar panels or PV panels), metal structures for mounting the solar panels, and wiring to collect the electricity they produce. The other major components are inverters and transformers. Inverters are enclosed power electronic equipment that do not contain liquids and are treated like other electronic waste at the end of their life. Transformers contain non-toxic mineral oil or vegetable oil and are no different than the typical transformers outside of most residences, schools, and shopping centers. Solar panels have raised the most public concerns related to toxicity, so they are covered in depth below, but since transformers contain liquid they are also addressed. The other components in the facility include the steel racking, the conduits (PVC plastic and galvanized steel), and copper and aluminum wires. The conduit and wires are normal construction materials. The racking for the PV panels is generally galvanized steel posts with galvanized steel or aluminum cross members. None of these supporting materials (wire, conduit, and racking) create a toxicity concern. The galvanized coating on the steel is a zinc coating, and zinc is a vital mineral for human health. PVC plastic and galvanized steel conduits and all types of copper and aluminum wiring have been building staples for many decades. These materials have not caused a toxicity concern in buildings where people are close to this

equipment day and night so there is no reason to think they have any risk of creating a toxicity concern when used at a utility scale solar facility.

Contents of PV Panels

The Low Bridge Solar project plans to install top of the line silicon-based PV panels sourced from a reputable manufacturer meeting established criteria including third-party ratings for performance, reliability, and bankability (Bloomberg Tier I, the highest rating¹⁰). Specifically, the project plans to use a bi-facial monocrystalline silicon module. The project plans are designed based on 700-watt modules manufactured by Canadian Solar, but other manufacturers make equivalent modules that could be used instead with no change in quality, should the project be unable to source that specific module. The PV panels are the most expensive and most important component in a solar facility, so the owner performs due diligence to ensure that the panels selected and delivered to the project are properly manufactured, certified, and tested.

The diagram below shows the components of a typical single-glass silicon PV panel, including a closeup of the solar cells and the electrical connections. Over 80% of the weight of a PV panel is the tempered front glass cover (or, front and back heat-strengthened glass) and the structural aluminum frame, which work together to create a strong, durable panel that outlasts its typical 25 to 30-year performance warranty. The encapsulation films are clear plastic lamination layers that protect the cells and electrical contacts from moisture for the life of the panel. These layers also maintain the panel as a single unit in the event of breakage of the glass cover(s), similar to the film in auto windshields that keeps them watertight and from fragmenting if the windshield shatters.

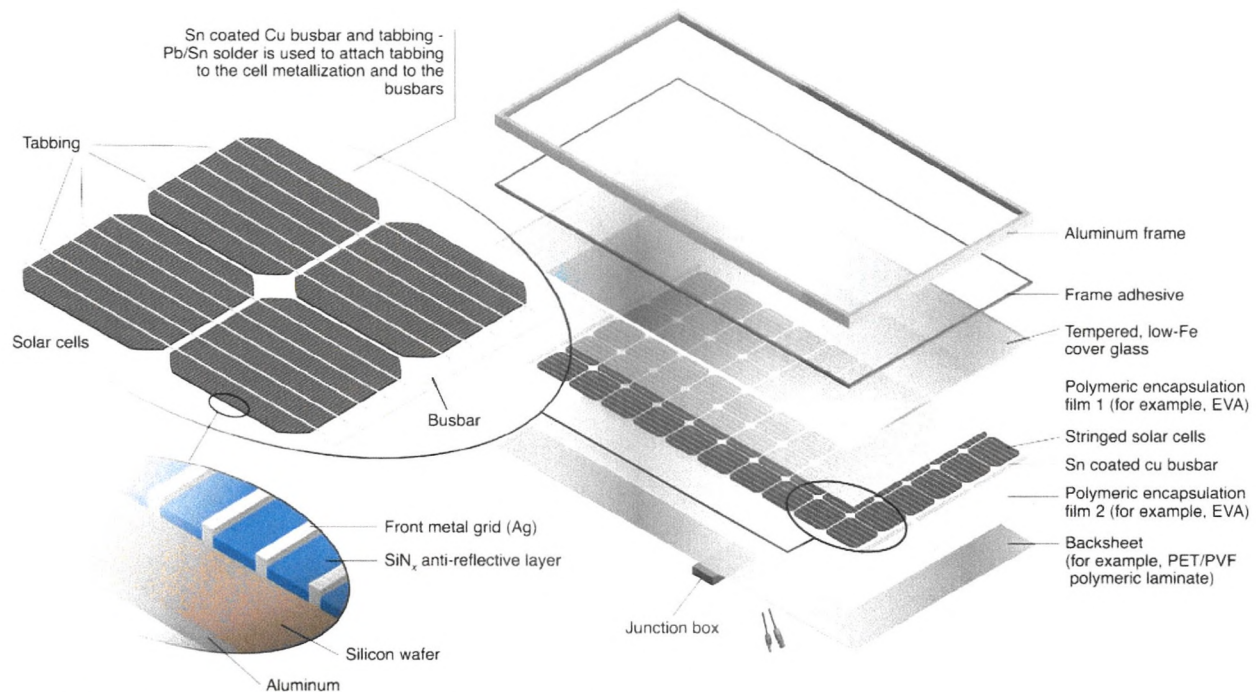


Figure 2. Contents of Framed Crystalline Silicon Panels (Source: NREL)

As can be seen in the above diagram, there are no liquids to leak from a broken panel. The plastic layers are inert. The silicon PV cells are nearly 100% silicon, which is harmless and is the second most common element in the Earth's crust. The only components of a PV panel that have any potential of toxic impact is the solder used to connect the solar cells together and to the busbars at the end of the panel, and the thin strips of silver that collect electricity from each cell. The solder, which is the

¹⁰ The financial information firm Bloomberg has developed a tiering system for PV module makers based on bankability that is the standard the PV industry uses to differentiate between the hundreds of manufacturers of solar modules on the market. Tier 1 is the highest of three tiers, which are determined by banks' confidence in a manufacturer's PV panels as demonstrated by their willingness to supply project financing backed only by the assets of the project. The details are described by BloombergNEF in this document: PV Module Tier 1 List Methodology https://data.bloomberglp.com/bnef/sites/4/2012/12/bnef_2012-12-03_PVModuleTiering.pdf

same tin-lead solder standard in the electronic industry, is 36% lead. The tiny amount of silver in a panel does not create a toxicity hazard, but it does add potential recycling value.

Even though there is only a tiny amount of lead in each panel, the total amount of lead in all the PV modules in a utility-scale project adds up to a considerable amount of lead. However, these PV panels are spread out over a large area and when the amount of lead in the PV panels is compared to the amount of lead naturally occurring in the soil under the PV array, it is obvious that even if all the lead somehow leached out of every module (which as explained below is impossible), the increase in total lead in the soil would be less than the naturally occurring difference between different soils. Across the US soils naturally have between about 10 and 50 mg of lead per kg of soil, with the average being somewhere in the 20s. Across 83 USGS survey locations across N.C., the values ranged from 5 to 46 with an average of 20 and a median of 18.¹¹ For a location that naturally has 15 mg of lead per kg of soil, all the lead in all the PV modules in the facility would have the same amount of lead as just the top 4 inches of soil at the site.¹²

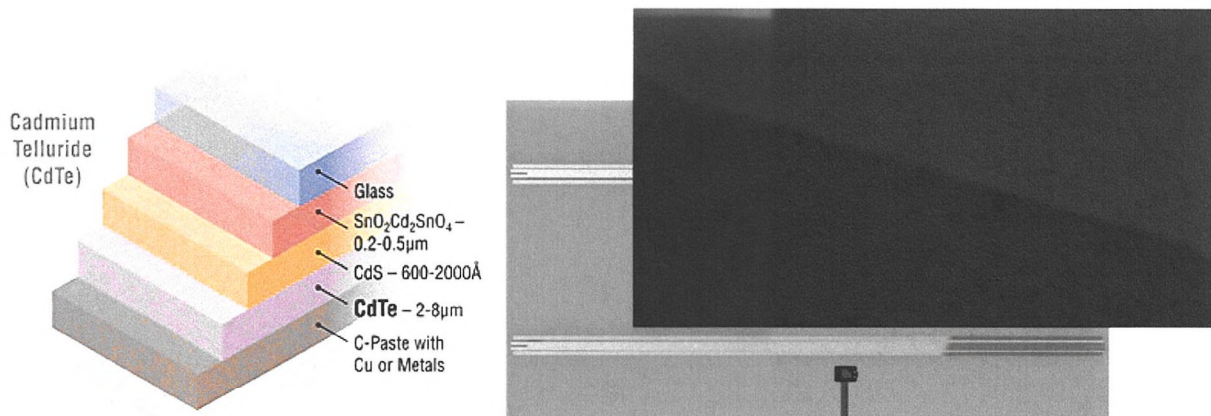


Figure 3. Contents of Cadmium Telluride Panels (Source: NREL); Front and Rear Photo of First Solar Series 7 CdTe Panels (Source: First Solar)

The leading alternative PV technology to silicon-based PV is Cadmium telluride (CdTe), which is by far the most common thin film PV technology. **While Low Bridge Solar plans to use silicon modules and not any CdTe modules, this assessment report is still providing a basic introduction to CdTe modules in case a switch is necessary and because it is not uncommon for stakeholders to have confusion about the differences in the two technologies.** CdTe is referred to as thin film because the active layers are less than 1/10th the thickness of a human hair. Figure 3 above contains two images, on the left is a not-to-scale diagram of the layers for a CdTe PV module (thickness dimension provided in image), and the right image is a photo of two First Solar CdTe modules showing the back of one module and the front of another. The PV cells consist of an incredibly thin layer of cadmium telluride with an even thinner coating of cadmium sulfide (roughly 1/60th the thickness of the CdTe film). Above these active layers is a transparent conducting metal oxide, commonly tin oxide (SnO₂), and below the active layers is a layer of metal to conduct away the electricity. This thin stack is sandwiched between two sheets of heat-strengthened glass that provides electrical insulation and physical protection. Like silicon modules there is no liquid to leak. The only aspect of CdTe modules that raises toxicity concern is the cadmium in the cadmium telluride and cadmium sulfide. Cadmium is a toxic heavy metal, but when cadmium is chemically bonded to tellurium in the crystalline cadmium telluride compound, it has only 1/100th toxicity to humans of cadmium on its own (i.e. not bonded to another element in a compound, also known as free cadmium).¹³ The compound cadmium telluride is very stable, so it does not easily break down into cadmium and tellurium.

¹¹ Smith, D.B., Cannon, W.F., Woodruff, L.G., Solano, Federico, Kilburn, J.E., and Fey, D.L., 2013, Geochemical and Mineralogical Data for Soils of the Conterminous United States: U.S. Geological Survey Data Series 801, 19 p., <http://pubs.usgs.gov/ds/801/>

¹² PV: 12 g of lead (per panel) per 65 ft² (panel footprint of 21.5 ft² / ground coverage ratio of 0.40) = 0.223 g of lead/ft²

Soil: 15 mg of lead per kg of soil * 45 kg of soil per ft³ * 4 inches (0.333 ft) soil depth * 65 ft² = 14.61 g of lead / 65 ft² = 0.225 g of lead/ft²

¹³ C. Miller, I.M. Peters, and S. Zaveri, Thin Film CdTe Photovoltaics and the U.S. Energy Transition in 2020, <https://qesst.org/resources/thin-film-pv-report-2020/>, June 2020

Cadmium telluride PV panels have been in use for decades, and their potential for creating a health hazard has been studied as long. As shown in the sections below and the some of the reading resources linked at the end of this section, CdTe panels are extremely safe and do not pose any risk to public health and safety, including when installed in large numbers.

Broken PV Panels

There is zero risk of toxicity escape from undamaged PV panels because any lead is sealed from air and water exposure. Individual panels damaged during the life of the solar facility are identified in days to months through either remote monitoring of system performance or from visual inspections during maintenance by onsite staff. In 2019 an international team of experts conducted an International Energy Agency - Photovoltaic Power Systems Programme (IEA-PVPS) study to assess if there is a public health hazard caused by lead leaching from the broken PV panels during the life of a utility-scale solar facility utilizing conservative assumptions to evaluate extreme scenarios.¹⁴ The study examined worst-case exposure routes of soil, air, and ground water for a typical 100 MW_{AC} PV facility. For example, the worst-case residential groundwater exposure assumed that all broken panels from the entire array were within 25 feet of the groundwater well, and the chemicals released from every broken panel transported to the same groundwater well. The study found that worst-case lead exposure via air, soil, and water were each orders of magnitude less than the levels defined by the US Environmental Protection Agency (EPA) to have no adverse health effects. In the case of water, the health-screening level is the same as the maximum concentration level (MCL) set by the EPA for water quality in public water systems. This study demonstrates that there is no risk to public health from lead leached from broken PV panels.

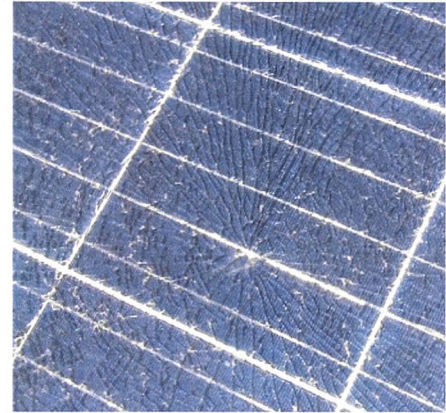


Figure 4. Close-up photo of impact point that broke the glass front of this PV panel

Smoke from burning PV Panels

Unlike most other electricity generation facilities, PV systems do not produce any air emissions. The only way they could produce emissions is in the case of a fire, and as explained in the fire section above, there is very little material in a PV panel that is flammable and they do not ignite very easily. This means that without a building under the panels to provide a hot sustained heat source, any PV fire in the PV array at a ground-mounted utility-scale PV facility will be very limited in size and intensity. The potential human health impacts from contact with smoke from burning PV panels was studied by the IEA-PVPS in their first report on human health risk assessment.¹⁵ In that study they did not study ground-mounted PV, presumably because of the extremely low risk of significant fire, but they did investigate the potential health impacts of lead in silicon modules and cadmium in cadmium telluride modules dispersing in smoke from a fire in a building that is covered in rooftop PV modules. The study considered several worst-case scenarios for different size buildings and different environments and found no risk of harmful health impacts from the smoke from PV panels.

PFAS

Some solar opponents have raised questions about the possibility of per- and poly-fluoroalkyl substances (“PFAS”) chemicals being emitted by solar panels. PFAS chemicals are a group of man-made chemicals informally known as “forever chemicals” due to their durability in the environment. These chemicals have been used in many industrial and consumer products for over 60 years, including food packaging materials, firefighting foam, waterproof clothing, stain resistant carpet treatments, and thousands more.

¹⁴ P. Sinha, G. Heath, A. Wade, K. Komoto, 2019, Human health risk assessment methods for PV, Part 2: Breakage risks, International Energy Agency (IEA) PVPS Task 12, Report T12-15:2019. ISBN 978-3-906042-87-9, September 2019

¹⁵ P. Sinha, G. Heath, A. Wade, K. Komoto, 2018, Human Health Risk Assessment Methods for PV, Part 1: Fire risks, International Energy Agency (IEA) PVPS Task 12, Report T12-14:2018, https://iea-pvps.org/wp-content/uploads/2020/01/HHRA_Methods_for_PV_Part1_by_Task_12.pdf

As explained in a fact sheet from the University of Michigan entitled “Facts about solar panels: PFAS contamination”, PV panels do not contain PFAS materials.¹⁶ Neither the self-cleaning coating on top of the solar panel, the adhesives in the panel, nor the front or rear covers/substrates contain PFAS. The “backsheet”, or traditional rear substrate of a silicon PV panel, is the thin opaque plastic layer on the rear of a single-glass PV panel that provides electrical insulation and physical protection for the rear of the PV cells. Polyvinyl fluoride (PVF) is the base material for the most common backsheet material (Tedlar), but several other materials have also been used as backsheets, some consisting of multiple layers. Depending on which definition of PFAS that is used, PVF may be classified as PFAS, however the most recent and applicable definition of what is and is not a PFAS material was created by the Organization for Economic Co-operation and Development (OECD)¹⁷ in 2021 and PVF does not meet this modern PFAS definition¹⁸.

However, not all PV panels even have a backsheet, in fact the trend in PV module design is to replace the backsheet with a thin sheet of glass so that the module has thinner front and rear sheets of glass instead of a thicker sheet of front glass and a thin plastic backsheet. Bi-facial modules like those planned for Low Bridge Solar, require a clear glass covering on their back to allow light to reach the rear of the PV cells and therefore do not have a backsheet. Thus, the bi-facial modules at Low Bridge Solar should not contain any PFAS, by any definition of PFAS.

PV Panel End-of-Life

PV panels last a very long time, but they do not last forever. Their output declines slightly each year, but panels rarely fail in less than 40 years. The expected economic life of utility-scale PV panels is 25–40 years, at which point they may be replaced by new panels or the entire project may be decommissioned, bringing the land back to how it was before the solar facility was installed. In both instances, the original PV panels are removed from the site. **To ensure funds are available if needed for decommissioning the project, the project will provide a decommissioning security, as estimated by a NC professional engineer, posted with the County for the duration of the project.** The surety may be in the form of cash, bond, irrevocable letter of credit, or other instrument readily converted to cash by the County.

There are three possible fates for solar panels at the end of their economic life at a project:

- **Reuse:** Most likely when the PV panels at the Low Bridge Solar project are decommissioned they will still produce at least 75% of their original output and have another decade of productive life, making them most valuable to be reused as solar panels on rooftops or ground-mounted applications. Markets for used solar panels exist today and are likely to be much more mature and widely available in 30–40 years when the Low Bridge Solar PV panels near the end of their life.
- **Recycling:** Any panels that are not reused as working panels could be recycled. Currently in the US, it is possible to recycle the largest constituents of silicon PV panels (glass, aluminum frame, copper wires) using the existing glass and metal recycling infrastructure. Today this recycling comes at a cost premium to disposing the panels in a landfill. However, as PV recycling technology improves and the number of panels reaching end-of-life increases dramatically, it is possible that in the future recycling PV panels will more than pay for itself. Recycling



Figure 5. PV Panels Waiting to be Recycled (Source: LuxChemtech GmbH)

¹⁶ “Clean Energy in Michigan” Series, Number 12, Facts about solar panels: PFAS contamination, By Dr. Annick Anctil, <https://graham.umich.edu/media/pubs/Facts-about-solar-panels--PFAS-contamination-47485.pdf>

¹⁷ OECD is an intergovernmental organization with representatives of 38 industrialized countries. OECD developed the updated definition in response to an international call for “programmes and regulatory approaches to reduce emissions and the content of relevant perfluorinated chemicals of concern in products...” OECD Portal on Per and Poly Fluorinated Chemicals: www.oecd.org/chemicalsafety/portal-perfluorinated-chemicals/

¹⁸ OECD (2021), Reconciling Terminology of the Universe of Per- and Polyfluoroalkyl Substances: Recommendations and Practical Guidance, OECD Series on Risk Management, No. 61, OECD Publishing, Paris. www.oecd.org/chemicalsafety/portal-perfluorinated-chemicals/terminology-per-and-polyfluoroalkyl-substances.pdf

plants built specifically to recycle PV panels can recycle nearly 100% of the panel, including the valuable silver and refined silicon they contain, and can be optimized for the task, significantly reducing the cost to recycle each panel. In 2018 the first industrial-scale PV-specific recycling plant was built, in France, and in 2022 the first large scale PV recycling plant in the US was built. These initial PV recycling plants will not have the capacity to recycle the millions of installed PV panels, but in the coming decades it is expected that PV-specific recycling plants will become much more commonplace. PV recycling technology is clearly still in its infancy. However, it is expected that when the Low Bridge PV panels reach the end of their useful life in 30+ years, the US PV recycling infrastructure will be robust, such that reuse or recycling of the PV panels will be the preferred options or required by new U.S. regulations, as it has been for years in Europe.

The Solar Energy Industries Association (SEIA) started the SEIA National PV Recycling Program several years ago to accelerate PV recycling in the US. Currently the program aggregates the services offered by recycling vendors and PV manufacturers, making it easier for the industry to select a cost-effective and environmentally responsible end-of-life management solution. **The program identifies Preferred Recycling Partners through an evaluation process. These partners are capable of recycling PV modules, inverters, and other related equipment today.** The current SEIA PV Recycling Partners are listed on the program's website, and full access to the program and the Preferred Recycling Partners is available to SEIA members.

- **Disposal:** If panels are not reused or recycled, federal waste management laws (Resource Recovery and Conservation Act, RCRA) require that PV panels, like any other commercial/industrial waste, be disposed of properly, which would typically be in a landfill. In order to determine the proper disposal method, RCRA requires that all commercial/industrial waste be identified as either hazardous or non-hazardous waste, which is generally determined for PV panels using the Toxic Characteristic Leaching Procedure (TCLP) test developed by the U.S. EPA. This test seeks to simulate landfill conditions and check for leaching of 8 toxic metals and 32 organic compounds. Limited data has been published about the TCLP test results of solar panels, but it is known that some older silicon panels that contain more lead than modern panels exceed the TCLP test limits for lead. Researchers at Arizona State University's Photovoltaic Reliability Laboratory have done the most robust investigation of methods for conducting accurate TCLP test on PV panels, and their latest research found that all three of the modern crystalline silicon PV panels tested passed the TCLP test, classifying them as non-hazardous waste.¹⁹

A worst-case scenario would be tons of PV panels being disposed of in a non-sanitary landfill, which is essentially a huge pile of garbage with little to no effort to minimize leaching from the waste. This type of landfill is illegal in many world regions, including in North Carolina. A recent IEA-PVS research study on PV panels disposal risks used this worst-case situation to evaluate the potential for cancer and non-cancer hazards through comparison of predicted exposure-point concentrations in soil, air, groundwater, and surface water with risk-based screening levels created by the EPA and the World Health Organization (WHO).²⁰ One of the report's authors, Gavin Heath with the US Department of Energy's National Renewable Energy Laboratory (NREL), summarized their findings about lead in silicon PV panels this way: "under the worst-case conditions, none of them exceeded health-screening thresholds, meaning they're not deemed to potentially have significant enough risk that you'd want to do a more detailed health risk assessment."²¹ The worst-case scenario defined in the research has many conservative assumptions, and thus likely overestimates the risk of disposal in a *non-sanitary* landfill. It is important to stress that North Carolina only allows solid waste disposal in sanitary landfills, which are engineered facilities with plastic liners, leachate collection systems, and covers, all of which dramatically reduce the potential for human exposure compared to the non-sanitary landfill assumed in the study. This and other research show that if the Low Bridge Solar PV panels are disposed of in a landfill they will not create any negative public health impact.

In 2019 the North Carolina legislature passed HB 329 (S.L. 2019-132), requiring the NC Department of Environmental Quality ("DEQ") to prepare a report to guide rulemaking regarding decommissioning of solar PV and other renewable energy facilities

¹⁹ Tamizhmani, G., et al. (2019). Assessing Variability in Toxicity Testing of PV Modules. In 2019 IEEE 46th Photovoltaic Specialists Conference (pp. 2475-2481). Institute of Electrical and Electronics Engineers Inc.. <https://doi.org/10.1109/PVSC40753.2019.8980781>
Publicly-accessible version: dev-pvrelability.ws.asu.edu/sites/default/files/93_assessing_variability_in_toxicity_testing_of_pv_modules.pdf

²⁰ P. Sinha, G. Heath, A. Wade, K. Komoto, Human health risk assessment methods for PV, Part 3: Module disposal risks, International Energy Agency (IEA) PVPS Task 12, Report T12-16:2020. ISBN 978-3-906042-96-1, May 2020

²¹ Green Tech Media, Landfilling Old Solar Panels Likely Safe for Humans, IEA Research Suggests, April 2020, www.greentechmedia.com/articles/read/solar-panel-landfill-deemed-safe-as-recycling-options-grow

and proper disposal of their equipment. The report issued January 1, 2021 and titled *Final Report on the Activities Conducted to Establish a Regulatory Program for the Management and Decommissioning of Renewable Energy Equipment*, provides a thorough discussion addressing many questions landowners and communities may have about solar decommissioning. DEQ compiled the input and commentary of numerous stakeholders, including the renewable energy industry, environmental organizations, and academia, including the author and NC State University's Clean Energy Technology Center. The report is well researched and very informative. DEQ provides several key findings and recommendations, but no recommendations for changes in NC regulations of solar facilities. **One of the report's key findings is that "According to Division of Waste Management experts, if every end-of-life PV module is disposed of in landfills, landfill capacities will not be negatively impacted."**

In South Carolina in 2021, the South Carolina legislature required the SC Department of Health and Environmental Control (DHEC) to prepare a report similar in scope to the NC DEQ report published 2021. While this report does not have any impact on regulations at Low Bridge, stakeholders may find value in the report. SC DHEC was required to prepare a report on research and recommendations on End-of-Life Management of Photovoltaic Modules and Energy Storage Systems, addressing six specific issues laid out by the legislature. The 50-page report titled *Final Report on the Activities Conducted to Establish a Program for End-of-Life Management of Photovoltaic Modules and Energy Storage Systems* was issued June 30, 2022. **The report describes end-of-life of PV modules topics that align with the content of this health and safety assessment, including the following conclusions: "The Department of Health and Environmental Control believes it is in the best interest of South Carolina to continue to promote the use of solar energy in our state to decrease energy costs, promote economic development, increase consumer choice in energy consumption and hopefully reduce pollution and emissions."** The report continues, "We must also be sure not to compromise human and environmental health in the process of installing and decommissioning solar energy facilities." Throughout the report DHEC suggests commonsense approaches to ensuring the long-term safety of utility-scale solar based on state and federal regulations.

Transformer Oil

While PV modules and inverters do not have any liquids that could leak into the environment, the generator step-up (GSU) transformer in the substation and the inverter step-up (ISU) transformers located with each inverter do contain an oil. Several types of oil can be used in transformers to provide the needed electrical insulation and cooling, but the most common type of transformer oil is mineral oil, which has been used in transformers since transformers were first manufactured in the 1890s. Due to the large volume of oil contained in a GSU transformer, they are installed with a secondary containment structure under them to contain any oil leaked or spilled. The smaller ISU transformers are approximately the same size as the transformers located throughout every community; behind schools, shopping centers, apartments, etc., and they typically do not provide secondary containment. However, ongoing monitoring of transformer temperature and pressure, and regular preventative maintenance, is likely to find the rare leak when it is still small before it has a chance to leak much oil.

There was a time when most transformer oil was toxic. From 1929 to 1977 polychlorinated biphenyls (PCBs), a man-made alternative to mineral oil, was commonly used as transformer oil instead of mineral oil. However, the toxicity of PCBs was eventually understood, leading to PCBs being banned in the US in 1979. Today, transformers either use mineral oil or vegetable oil, both of which are free of PCBs. Mineral oil is non-toxic to humans, in fact "baby oil" that is commonly used to soothe babies' skin is a scented mineral oil. Although non-toxic to humans, mineral oil is an environmental contaminant and harmful to aquatic ecosystems, so any release to the environment should be avoided. The potential for negative environmental impact from spilled vegetable oil is much less because these oils are biodegradable, so the time they impact the environment is short-lived. Federal regulations dating back to the Clean Water Act of 1973 require that facilities with



Figure 6. GSU Transformer with Secondary Containment to Capture any Leaked Oil

significant quantities of oil prevent pollution of water.²² The current EPA regulations require that facilities with over 1,320 gallons oil, and with the potential for spilled oil to impact surface water, develop and implement an oil spill prevention, control and countermeasure (SPCC) plan. While the risk of negative environmental impact from a transformer oil spill/leak cannot be eliminated entirely, these regulations along with standard industry practices result in a low probability for a substantial spill and a high probability for a quick clean-up response to minimize impact if a spill were to ever occur.

Contents of Batteries

The components of lithium-ion batteries vary because there are many different battery chemistries in use and several different cell construction types. And while lithium itself is non-toxic, some lithium-ion batteries do include some toxic heavy metals such as cobalt, nickel, or manganese. During the operational life of the batteries any metals in the cells are sealed inside of the batteries and thus have no impact on human health. The solvent-based liquid electrolyte in each cell is very difficult to get to leak out of a cell and will quickly evaporate if it does. In addition to the battery cells, the battery system also includes a battery management system that consists of sensors, switches, and similar controls equipment. The battery enclosure is typically an outdoor-rated steel enclosure.



Smoke from burning Batteries

See the “Fire Risk: Batteries” section for discussion of public health impacts of smoke from burning batteries.

Batteries End-of-Life

The performance of stationary batteries slowly degrades, eventually resulting in enough reduction of energy capacity that the battery is considered to have reached the end of its life. The expected lifespan of lithium-ion batteries is on the order of 10 to 20 years. **To ensure funds are available if needed for decommissioning the project, the project will provide a decommissioning security, as estimated by a NC professional engineer, posted with the County for the duration of the project.** The surety may be in the form of cash, bond, irrevocable letter of credit, or other instrument readily converted to cash by the County.



At the end of its life the batteries will be safely decommissioned, which will involve de-energizing the batteries to a low voltage, disconnecting each battery module from the system, removing battery modules and associated components, preparing the list of materials and components for removal, disposal, or recycling, and then shipping them to their next location. Transport of some battery components, including shipping via a shipping provider, is regulated by the United States Department of Transportation (U.S DOT).

Most of the non-battery components of the system have readily available scrap markets, such as steel, aluminum, and copper. Much like end-of-life PV modules, end-of-life batteries can be repurposed for second life applications, recycled, or landfilled.

- **Recycling** – Lithium-ion batteries are recyclable. Currently only a small percentage of lithium-ion batteries are recycled, but that is changing very quickly. The US is just starting to build facilities that can fully recycle lithium-ion batteries into battery constituents ready to build new lithium-ion batteries. While there are many challenges to creating a robust, cost-effective collection and recycling industry for lithium-ion batteries, it does appear to be technically possible. The US Department of Energy as well as several industry groups and private companies are investing in research and development that they hope will lead to widespread recycling of lithium-ion batteries in the US.
- **Disposal** – When batteries are not repurposed or recycled, batteries are disposed as waste. Battery disposal is governed by EPA Universal Waste rules, which require waste handlers to separate hazardous materials for disposal under federal laws but allow the disposal of the remaining non-hazardous waste per state and local requirements. Once the fire risk is removed from the batteries (either by mechanical or chemical means), non-hazardous materials not recovered for reuse or recycling can be disposed of through municipal waste streams. While some lithium chemistries are considered non-hazardous, many batteries have toxic constituents that require treatment as hazardous materials. The potential toxicity of Li-ion battery materials varies widely by chemistry; for example, where nickel, cobalt, or lead are present in battery

²² Environmental Protection Agency, webpage: Overview of the Spill Prevention, Control, and Countermeasure (SPCC) Regulation, www.epa.gov/oil-spills-prevention-and-preparedness-regulations/overview-spill-prevention-control-and

chemistries in significant quantities, precautions must be taken at disposal or incineration sites in line with the hazards of those individual materials.²³

Toxicity: Operations & Maintenance

The operations and maintenance (O&M) activities for a solar and battery energy storage site are rather limited. Often the most significant effort is maintenance of the vegetation on the site. The PV equipment and the battery equipment require some, but limited, scheduled and unscheduled maintenance.

Site and Solar Operations & Maintenance

The only two aspects of operations and maintenance (O&M) of solar system that have raised concerns about toxicity are the fluids used to wash PV panels and herbicides used to maintain vegetation.

- **Panel Washing** – Across North Carolina there is ample rain to keep the panels clean. If the panels need to be washed, it would occur infrequently and typically with use of only deionized water and cleaning brushes.
- **Herbicides** – The industry standard practice for maintaining the vegetation at solar facilities is similar to how most cities maintain their city parks, which is they primarily rely on mowing and string trimmers for vegetation management, and use herbicides along fences, in roads, and around some equipment. Parks and solar facilities also use herbicides to strategically remove problem weeds, especially woody weeds, to maintain a healthy cover of the desired species of grasses and other low-growing vegetation. This mode of herbicide use applies significantly less herbicide volume than is commonly applied in NC agriculture. For example, Round-Up-Ready crops are common row crops that have been engineered for the entire field, including the crops, to be sprayed with Round-Up (glyphosate) several times each season. Additionally, farmers applying most types of herbicides to their fields are not required to be certified or licensed, but a NC commercial pesticide applicators license is required to apply any herbicide to a solar facility.

Batteries Operation and Maintenance

Battery operation does not produce any emissions, and they require very little maintenance during their operating lifetime. The battery systems require some scheduled maintenance for things like cleaning HVAC air filters and annual or semi-annual visual checks of electrical connections. Some systems use an anti-freeze liquid coolant that might require replacement during the life of the system, but this does not pose a health or safety hazard.



Sources for Further Reading on Toxicity/End-of-Life:

- International Renewable Energy Agency (IRENA): [End-of-Life management: Solar Photovoltaic Panels](#), June 2016
- Electric Power Research Institute (EPRI): [Environmental and Economic Considerations for PV Module End-of-Life Management](#), December 2018
- EPRI: [Solar Photovoltaics End of Life Management Infographic](#), March 2021
- EPA: [End-of-Life Management of Photovoltaic Solar Panels in the United States](#), June 2023
- IEA PVPS: [Advances in Photovoltaic Module Recycling](#), June 2024
- National Renewable Energy Laboratory (NREL): [A Circular economy for PV system materials](#), April 2021
- North Carolina Department of Environmental Quality: [Final Report on the Activities Conducted to Establish a Regulatory Program for the Management and Decommissioning of Renewable Energy Equipment](#), January 2021
- Energy Storage Association (ESA): [End-of-Life Management of Lithium-ion Energy Storage Systems](#), April 2020
- EPRI: [Lithium Ion Battery Energy Storage End of Life Management Infographic](#), April 2021
- ReCell Center: [A national collaboration of industry, academia and national laboratories working together to advance recycling technologies along the entire battery life-cycle for current and future battery chemistries \(website\)](#)
- NAATBatt: [Laws, Regulations and Best Practices for Lithium Battery Packaging, Transport and Recycling in the United States and Canada \(webpage\)](#)



²³ Energy Storage Association (ESA), End-of-Life Management of Lithium-ion Energy Storage Systems, April 2020, <https://energystorage.org/wp/wp-content/uploads/2020/04/ESA-End-of-Life-White-Paper-CRI.pdf>

Electromagnetic Fields (EMF)

Exposure to EMF, or electric and magnetic fields, is a fact of everyday modern life. Electromagnetic fields come in many different frequencies, ranging from grid electricity with a frequency of 60 hertz to x-rays and gamma rays that are billions of billions of times faster. The faster the frequency the stronger the EMF. The EMF coming from grid electricity, including from the inverters, transformers, and AC wires to be used at the Low Bridge Solar facility, has much lower frequency and therefore much lower energy than the EMF from cell phones, wireless internet, and even radio and TV towers. The solar panels, the batteries, and the wires connecting both of them to the inverters carry direct current (DC) electricity, which has a frequency of zero hertz, and thus produces static electric and magnetic fields. The voltage and current of these circuits are both relatively low, so the electric and magnetic fields they produce are both rather weak. The static magnetic fields the PV panels generate are much weaker than the Earth's natural static magnetic field, which can be demonstrated by a compass still pointing north when placed near the panels.



Electric fields are created around wires and equipment wherever a voltage exists, however it is easily blocked with common materials such as metal, wood, and soil. The World Health Organization (WHO) in 2005 concluded that there were no substantive health issues related to electric fields (0 to 100,000 Hz) at levels generally encountered by members of the public.²⁴ The proposed solar project does not produce any voltages higher than the existing power lines, and therefore does not produce any electric fields not generally encountered by members of the public.

Magnetic fields are the other aspect of EMF, and they are created by electric current. Typical Americans are exposed to about 1 milligauss of magnetic field from grid electricity (60 Hz) on average during their day, primarily from sources at homes and work²⁵. The primary source of magnetic fields in a solar facility are the inverters and the short section of wires between each central inverter and its step-up transformer. To convert direct current to alternating current, inverters use a series of solid-state switches that turn off and on several thousand times a second, creating EMF in the range of 5 kHz to 100 kHz, which is much faster than the 60 Hz of grid electricity but still much slower than even the lowest frequency radio signals. The highest electrical current of any portion of the solar facility occurs in the inverters, ISU transformers, and the few feet of wire between them, making this the source for the strongest magnetic fields in the facility.

Since the strength of a magnetic field decreases dramatically with increasing distance from the source, these magnetic fields only extend about 50-300 feet from the inverter and ISU transformer, at which point the magnetic fields would be expected to measure less than 0.5 milligauss, which is less than half the typical American's average 60 Hz EMF exposure over a day.^{26, 27} The locations of the inverters and ISU transformers at the Low Bridge project have not yet been identified, based on the locations of the closest homes and the arrangement of the project array it is safe to assume no inverter will be closer than 300 feet from a home, and likely at least 500 feet from any home. The substation and the battery system are both over 500 feet from the closest home. Thus, the EMF from the inverters and ISU transformers are not expected to extend to any residential property. Similarly, the magnetic fields from substations generally do not extend far enough to leave the fence around the substation, so the same can be expected for the Project's substation.²⁸

The bottom line is that the EMF from the Low Bridge Solar PV system will not leave the solar site boundary, and thus will not increase the EMF exposure of any neighbors. Even if some EMF from the PV facility were to extend beyond the fenced perimeter of the site, there would still be no public health impact because low levels of extremely low frequency (ELF) EMF exposure are not harmful to humans. After extensive study of the potential health impacts of EMF from grid electricity the World Health Organization (WHO) concludes:

²⁴ WHO factsheet: Electromagnetic fields and public health, Exposure to extremely low frequency fields, June 2007, www.who.int/peh-emf/publications/facts/fs322/en/

²⁵ World Health Organization (WHO), webpage: Electromagnetic Fields – Typical exposure levels at home and in the environment, www.who.int/peh-emf/about/WhatisEMF/en/index3.html

²⁶ Study of Acoustic and EMF Levels from Solar Photovoltaic Projects. Tech Environmental, Inc., December 2012, <https://www.masscec.com/resources/study-acoustic-and-emf-levels-solar-photovoltaic-projects>

²⁷ EPRI technical report, Electric and Magnetic Field Exposure Levels (0 to 3 GHz) in Occupational Environments near Photovoltaic Energy Generation Facilities, November 2012, <https://www.epri.com/research/products/1023797>

²⁸ www.niehs.nih.gov/health/materials/electric_and_magnetic_fields_associated_with_the_use_of_electric_power_questions_and_answers_english_508.pdf

"Despite extensive research, to date there is no evidence to conclude that exposure to low level electromagnetic fields is harmful to human health."²⁹

Sources for Further Reading on EMF:

- Electric Power Research Institute: [EMF and Your Health: 2019 Update](#), December 2019
- World Health Organization: [Electromagnetic Fields](#) (accessed September 2022)

Heat Island Effect

The localized effects of large-scale PV facilities on temperature and moisture are not yet well understood. However, the localized micro-climate effects of large-scale PV facilities are understood well enough to determine that they do not create a heat island effect similar to the well-documented urban heat island effect from dark, massive, surfaces in urban environments, such as asphalt paved streets and parking lots, that cause urban areas to be significantly warmer than the surrounding rural area during the day and night. The changes that solar panels may make to the way land absorbs, reflects, and emits the energy from sunlight are minimal compared to the changes created by buildings, vehicles, and many miles of concrete and asphalt. By comparison, solar panels absorb and reflect a similar amount of solar energy as vegetation and soil. Solar panels are lightweight and cannot store large amounts of thermal energy, and the ground remains covered in vegetation with its natural exposure to air and water.

Initial research into the potential for PV systems to cause a heat island effect have used a variety of techniques, including conceptual energy flow calculations, advanced fluid dynamic computer simulations, and field measurements of temperature.^{30, 31, 32} This research found a range of different effects on temperature, but none indicate that a large PV system could affect the temperature of the surrounding community. Most found that compared to similar undeveloped land the air temperature in a solar facility increases during the day, but the nighttime results were mixed. Some studies found PV sites to be cooler than non-PV sites at night, but others found them to be warmer. Much of this variation is likely explained by the different climates studied but may also be due to the different methods of the studies. Much of the research on solar heat island effect occurred in arid regions of the U.S. southwest where the results are unlikely to translate perfectly to wetter climates in the southeast. In a written statement of evidence Greg Barron-Gafford, leading solar heat island effect researcher, says that he expects that when the area under the PV array is vegetated with grass that the localized heat island effect his research found in dry climates will be greatly reduced.³³

The available studies agree that the slight increase of air temperature in the PV site dissipates quickly with height and distance from the panels as natural processes remove and spread the heat. As a result, any temperature increase that may occur at the Low Bridge Solar project during the day will be limited to the site and will not increase the temperature of any of the surrounding community.

Sources for Further Reading on Heat Island Effect:

- EPA: [Learn About Heat Islands](#), (accessed September 2022)

²⁹ World Health Organization (WHO), webpage: Electromagnetic Fields – Summary of health effects, www.who.int/peh-emf/about/WhatIsEMF/en/index1.html

³⁰ Broadbent, Ashley & Kravynhoff, Eric & Georgescu, Matei & Sailor, David. (2019). The Observed Effects of Utility-Scale Photovoltaics on Near-Surface Air Temperature and Energy Balance. *Journal of Applied Meteorology and Climatology*. 58. 10.1175/JAMC-D-18-0271.1.

³¹ Barron-Gafford, G. A. et al. The Photovoltaic Heat Island Effect: Larger solar power plants increase local temperatures. *Sci. Rep.* 6, 35070; doi: 10.1038/srep35070 (2016).

³² V. Fthenakis and Y. Yu, "Analysis of the potential for a heat island effect in large solar farms," 2013 IEEE 39th Photovoltaic Specialists Conference (PVSC), Tampa, FL, 2013, pp. 3362-3366, doi: 10.1109/PVSC.2013.6745171.

³³ G. Barron-Gafford, Statement of Evidence by Greg Barron-Gafford on Solar Heat Islanding Issues, May 2018, www.planning.vic.gov.au/data/assets/pdf_file/0024/126555/301-Expert-Witness-Statement-of-G-Barron-Gafford-PVHI-May-2018-Lemnos.pdf

Glare

Photovoltaic panels are designed to absorb, and thus not reflect, the solar energy that they receive. However, when sunlight strikes the glass front of a solar panel at a glancing angle a significant portion of the solar radiation is reflected, which can potentially lead to solar glint (a brief flash) or glare. Glint or glare can temporarily impact a person's vision, including pilots landing aircraft, or motorists driving vehicles. However, the conditions required for a PV project to create glare rarely occur. PV facilities, such as Low Bridge Solar, that utilize single axis trackers to slowly rotate the solar panels to follow the sun have even less potential to create glare because the trackers help avoid a situation where sunlight hits the panels at a glancing angle. Most modern trackers implement an advanced control strategy known as "backtracking" that increases the electricity production of the site by flattening the tilt of the panels early and late in the day to keep the rows of solar panels from shading one another. Backtracking can result in brief periods near sunrise and sunset where the sun strikes the panels at a glancing angle, creating a situation that could result in a few minutes of visible glare at sunrise and sunset. For anyone to see this glare they must be looking across the solar panels in the direction of the rising or setting sun, which is a situation where the sun obviously will create significant glare for the viewer with or without the solar project.



Figure 7. 20 MW PV System at Indianapolis International Airport (Photo source: inhabitat.com)

A clear indication of the ability to avoid glare problems from large ground-mounted PV systems are the PV systems installed on airports across the U.S., including Denver International and Indianapolis International. While there is the potential for a PV system to create glare, there is also the ability to predict when and where a system may create glare and incorporate any needed mitigation before construction. The Federal Aviation Administration (FAA) and the U.S. Department of Energy (DOE) developed specialized solar glare analysis software to predict when and where a PV project may produce glint or glare for sensitive receptors nearby. That original software technology has been licensed to a 3rd firm (Forge Solar) that continues to improve and refine the software, which has been validated to accurately predict solar glare.

In May of 2021, the FAA replaced the long-standing interim solar glare policy with a (final) policy that no longer restricts solar developed on airport property from creating glare visible to pilots. The policy explains that the new acceptance of glare visible to pilots is in recognition that pilots often experience glare during landing from bodies of water and that glare from solar is not meaningfully different.³⁴ The new policy does still prohibit on-airport PV systems from creating any glare visible in an air traffic control tower. While the FAA policy only applies to PV developed on airport property, it is reasonable to follow the same policy for PV plants sited near airport property.

The two closest airports in the National Plan of Integrated Airport Systems (NPIAS)³⁵ are the Asheboro Regional Airport (HBI) and Siler City Municipal Airport (SCR). Asheboro Regional Airport is approximately 16 miles southwest of the closest solar panel and Siler City Airport is approximately 9 miles southeast of the closest solar panel. Neither airport has an air traffic control tower. Previous conservative FAA guidance was to conduct a software glare hazard analysis when a PV facility is proposed within 5 nautical miles (5.75 miles) of an airport.³⁶ With both airports being over 8 miles away from the project and neither having an air traffic control tower, there is no chance for Low Bridge to create a glare hazard at these airports.

³⁴ "Federal Aviation Administration Policy: Review of Solar Energy System Projects on Federally-Obligated Airports", <https://www.federalregister.gov/documents/2021/05/11/2021-09862/federal-aviation-administration-policy-review-of-solar-energy-system-projects-on-federally-obligated>

³⁵ The National Plan of Integrated Airport Systems (NPIAS) identifies nearly 3,310 existing and proposed airports that are included in the national airport system. The NPIAS contains all commercial service airports, all reliever airports, and selected public-owned general aviation airports. www.faa.gov/airports/planning_capacity/npias

³⁶ NC Template Solar Ordinance, Appendix F: Airports. <https://nccleantech.ncsu.edu/wp-content/uploads/2018/06/NC-Template-Solar-Ordinance.pdf>

In addition to the possibility of glare impacts to aviation, it is also possible for utility-scale PV facilities to cause brief periods of glare visible to motorists driving on nearby roads. However, like pilots, motorists are accustomed to occasionally seeing glare near the rising or setting sun, both from the sun itself and from reflection off flat objects such as a body of water or the windows of a building or vehicle, and motorists regularly safely adjust to this visual challenge. While it is difficult to accurately predict the existence of glare without the use of solar glare software, it can be assumed that a PV array with backtracking arrays might cause glare in a few locations very close to sunrise and sunset during a few months of the year. So, if there are sections of the Low Bridge Solar PV array that are visible to passing motorists, it must be assumed that motorists passing by the facility might occasionally experience some glare near sunrise and/or sunset, although it is unlikely for such glare to create a significant safety hazard. At Low Bridge Solar, the flat land and the vegetative buffers along the perimeter of the project adjacent to roads are expected to remove enough of motorists' view of the PV panels to block the potential for motorists to experience any intense glare. The location most likely to need vegetative buffer to avoid glare in front of drivers is on the east edge of the small array section located between the project substation and Ferguson Rd. The Low Bridge project does not plan to conduct a software glare hazard analysis of the project, which in the author's opinion is a reasonable plan that does not cause a public safety risk.

In conclusion, the Low Bridge Solar project is not expected to create a glare hazard for aviation or motorists.

Sources for Further Reading on Solar Glare:

- National Renewable Energy Laboratory (NREL): [Research and Analysis Demonstrate the Lack of Impacts of Glare from Photovoltaic Modules](#), July 2018
- ForgeSolar: [PV Planning and glare analysis software help documentation](#), (accessed September 2022)

Noise

Solar panels and batteries are silent, but some of the other components of a PV and BESS system produce some sound, although they are rarely heard by anyone outside of the project fence. The loudest equipment is the inverters (both PV and battery), but the transformers and tracking systems also make some sound³⁷. These numerous sources of sound are dispersed throughout the facility, but the physics of sound are such that these dispersed sources of sound are non-additive. For example, if there are 50 inverters spaced across a utility-scale solar facility and you are close enough to hear some inverter noise, in most cases you could turn off the 49 inverters farthest from you and you likely wouldn't notice the difference between the sound from 1 inverter and the sound from 50 inverters. Even if two inverters are right next to each other and an even distance from you, the perceived volume of the sound coming from the two inverters is very similar to the sound from just one inverter. So, the potential for someone offsite to hear any sound generated inside a utility-scale PV project is determined by the closest and loudest source of sound. Thus, some simple analysis of the sound coming from the closest sources to a point of interest, such as a home or property line, can effectively estimate the level of sound from the PV project at that location.

Before providing site-specific analysis of the potential for noise impacts from the Low Bridge project, it is useful to put the sound from the PV project in context. Our world is full of sounds, day and night, even in quiet rural areas, and any sounds from the PV project would be in concert with the existing sounds. The appropriate analysis metric is not if the sounds are audible, but if they are noticeable or bothersome, and US and international organizations have published guidance on this topic based on research on how sound impacts the public.

In 1972, the US passed the Noise Control Act, which required the EPA to define criteria for protecting the public health and wellbeing from noise interference. In response, the EPA developed guidance that included recommended sound levels limits

³⁷ Kaliski, et. al. Noise-Con 2020 Conference paper titled "An Overview of Sound From Commercial Photovoltaic Facilities", <https://rsginc.com/wp-content/uploads/2021/04/Kaliski-et-al-2020-An-overview-of-sound-from-commercial-photovoltaic-facilities.pdf>

at residential structures (or “places in which quiet is a basis for use”)³⁸. This guidance recommends that noises at residences be limited to 55 dBA L_{dn} , where L_{dn} is the average sound level of a 24-hour period with the inclusion of a 10-dB penalty during the nighttime hours of 10PM to 7AM. So, the 55 dBA L_{dn} limit could be met with 55 dBA daytime noise and 45 dBA nighttime noise, or a 24-hour noise (L_{eq}) of 48.6 dBA. In addition to the EPA guidance, the United Nations WHO published “Guidelines for Community Noise” (1999) which suggested daytime and nighttime protective noise levels, which are to be applied outside the bedroom window.³⁹ During the day (7AM to 11PM), the equivalent continuous sound level threshold to protect against serious annoyance is 55 dBA L_{eq} , and 50 dBA L_{eq} to protect against moderate annoyance. During the night (11PM to 7AM), the averaged equivalent continuous sound level threshold is 45 dBA L_{eq} . So, the EPA and the WHO recommend similar daytime noise limits (~55 dBA and 55 to 50 dBA, respectively), and similar nighttime limits as well (~45 dBA and 45 dBA, respectively).

These recommended noise limits from EPA and WHO provide well-established criteria for acceptable noise in rural residential areas. Local jurisdictions can establish their own sound requirements, but neither North Carolina nor Randolph County have any applicable noise limits, so this analysis will use the EPA and WHO guidelines as a benchmark.

At this stage of project development, the site plan can be used to conduct a preliminary screening level noise impact assessment. Both the PV panels and the batteries require inverters, which is the loudest piece of equipment in the facility. The PV inverters are planned to be a 4.0 MW central model made by SMA, which provides a sound pressure level data point on its datasheet, so this model-specific data is used in this assessment. The battery inverters are not yet specified but are not likely to be any larger or louder than the PV inverters, so the PV inverter sound data is used for analysis of the battery inverters as well. The battery inverters will be located in the project substation area. The ~10 PV inverters will be dispersed throughout the PV array along major project roads, but the exact locations have not yet been identified.

Each PV and battery inverter is paired with a medium voltage transformer, and industry-standard transformer sound data from NEMA was used for calculation of inverter transformer sound as well as for the single large high voltage transformer in the project substation.

The third and final component that makes some noise is the tracker system, primarily the tracker motors, which are often located in the center of each row of solar panels. There is a wide variety of tracker systems with varying numbers, sizes, and styles of motors. The make and model of the tracker system for this project has not yet been selected, so sound data from a leading solar tracker manufacturer with published sound data is used for the sound estimate from the tracker system.⁴⁰

The analysis is based on the sound *power* level of the equipment, which is measured in decibels but is different than sound *pressure* level, which is also measured in decibels and is used to describe how loud a sound is to humans. The sound *power* level of the equipment is a measure of the total acoustic energy emitted from a source of noise. The sound *power* level and the distance between the equipment and the location of interest is all that is needed to calculate an estimate of the loudness of the sound at the house/property line, which is the sound *pressure* level. In many cases, equipment sound data is provided in the form of sound *pressure* level at a certain distance from the equipment, for example the SMA inverter datasheet provides a sound *pressure* level of 67.0 dBA at 10 meters. To calculate sound *pressure* levels at other distances, this sound pressure level data must be used to calculate the sound *power* level, for example: the inverter sound *power* level = sound *pressure* level (67.0 dBA) – 20*log(32.808 ft), which is 97.3 dBA (sound *power* level).

The sound *power* levels of representative equipment used in this analysis are as follows: 4.0 MW SMA inverter: 97.3 dBA, 4.0 MW ISU transformer: 76.3 dBA, 67 MVA substation transformer: 81 dBA, and tracker motors: 79.9 dBA.

Since the EPA and WHO guidance are based on the sound pressure level at nearby homes, this sound assessment calculates a sound level at the closest home to each type of sound source. This sound estimate uses the following estimated distances between the equipment and the closest home, which were estimated using the site plan dated 9/26/2024 that includes highlights of all homes near the project boundary. Since this early stage site plan does not include locations of PV inverters, a minimum setback between PV inverter and homes of 500 feet was assumed.

³⁸ US Environmental Protection Agency (EPA), “Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare With An Adequate Margin of Safety”, 1974, <https://nepis.epa.gov/Exe/ZyPDF.cgi/2000L3LN.PDF?Dockey=2000L3LN.PDF>

³⁹ World Health Organization (WHO), “Guidelines for Community Noise”, 1999, <https://apps.who.int/iris/handle/10665/66217>

⁴⁰ NEXTracker’s Horizon Single Axis Tracker motor – 69.6 dB at 3.3 feet

- PV inverter (and ISU transformer) to house: 500 feet
- Center of Substation / Battery Energy Storage System (BESS) area to house: 650 feet
- Tracker motor to house: 125 feet

The sound pressure level is calculated based on the sound power level of the equipment and the distances listed above. The PV inverter calculation combines the sound of one inverter and the associated ISU transformer. The substation/BESS calculation combines the sound from 4 BESS inverters, 4 BESS ISU transformers, and 1 substation transformer.

- **Sound (sound pressure level) in dBA at closest house** = sound power level – $20 \times \log(\text{distance in feet})$
 - PV Inverter: $97.3 \text{ dBA} - 20 \times \log(500 \text{ feet}) = 43.34 \text{ dBA}$
 - ISU transformer: $76.3 \text{ dBA} - 20 \times \log(500 \text{ feet}) = 22.34 \text{ dBA}$
 - **Combination of PV inverter and ISU transformer:** $10 \times \log(10^{43.34/10} + 10^{22.34/10}) = 43.4 \text{ dBA}$
 - Battery Inverter: $97.3 \text{ dBA} - 20 \times \log(650 \text{ feet}) = 41.06 \text{ dBA}$
 - ISU transformer: $76.3 \text{ dBA} - 20 \times \log(650 \text{ feet}) = 20.06 \text{ dBA}$
 - Substation transformer: $81 \text{ dBA} - 20 \times \log(650 \text{ feet}) = 27.54 \text{ dBA}$
 - **BESS (4 inv. + 4 trans.) and Substation Trans.** = $10 \times \log(4 \times 10^{41.06/10} + 4 \times 10^{20.06/10} + \dots) = 47.2 \text{ dBA}$
 - **Tracker motor:** $79.92 \text{ dBA} - 20 \times \log(125 \text{ feet}) = 38.0 \text{ dBA}$

All three sound sources easily meet the EPA and WHO recommended guidelines for daytime noise in a residential setting (55 dBA), which is the only time the PV inverters and tracker motors are expected to make noise. The battery inverters will sometimes operate at night, so this is the only of the three sound sources that should also be compared to the EPA and WHO recommended guidelines for nighttime noise in a residential setting (45 dBA), and this simple screening level sound estimate finds that the battery energy storage system may at times create sound at the closest homes that is slightly above the 45 dBA EPA/WHO nighttime guidelines for a rural residential setting.

This is a simple sound assessment that is conservative in nature because it assumes a clear line-of-sight between the equipment and the homes, so any vegetation or other obstacles between the equipment and the residence will reduce the sound compared to these estimates. This simple noise impact assessment reflects the physics of sound propagation and uses noise data from representative equipment, allowing for a simple yet accurate estimate of worst-case sound impacts, but it is not as accurate as more complex sound analysis software.

In conclusion, the Low Bridge project is not expected to create noise that is bothersome to neighbors, with the possible exception of occasional nighttime noise at the homes closest to the substation/BESS area if no sound mitigation measures or vegetative buffers are included in the final design. If concerns remain, one should engage a sound engineer to analyze the project with advanced sound analysis software, and then consider design adjustments based on the results of that analysis.

Sources for Further Reading on Noise:

- World Health Organization (WHO), [Guidelines for Community Noise](#), 1999

Conclusions

Based on my knowledge of engineering and science, personal experience with PV and battery technology, review of academic research, and review of materials provided by Renewable Energy Services about the proposed Low Bridge Solar PV and battery energy storage facility in Randolph County, North Carolina, my findings and opinions are summarized as follows:

- The Low Bridge Solar facility will result in a significant reduction of regional air pollution.
- The Low Bridge Solar facility will not result in any negative impacts to public health or safety.
- The Low Bridge Solar facility will not increase the temperature of the area surrounding the site.
- The Low Bridge Solar facility is not expected to create any glare hazards.
- The Low Bridge Solar facility is not expected to create bothersome noise for any neighbors.





Kirkland Appraisals, LLC

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November 1, 2024

Kayla Marshall
Low Bridge Solar, LLC
5315 Highgate Drive, Suite 202
Durham, NC 27713

RE: Proposed Low Bridge Solar, LLC, Ramseur, Randolph County, NC

Mr. Forte,

At your request, I have considered the impact of a 40 MW solar farm and associated 60 MWH Battery Energy Storage System (BESS), proposed to be constructed on a portion of a 278-acre assemblage of land near Ramseur Road, Randolph County, North Carolina. Specifically, I have been asked to give my professional opinion on whether the proposed solar farm will “substantially injure the value of adjoining property” and whether the proposed solar farm will “be in harmony with the area in which it is located.” To address those questions, I have completed research and analyzed data to determine if the proposed solar farm will impact the property values of adjoining properties.

To form an opinion on these issues, I have researched and visited existing and proposed solar farms in North Carolina, researched articles through the Appraisal Institute and other studies, and discussed the likely impact with other real estate professionals. I have not been asked to assign any value to any specific property.

This letter is a limited report of a real property appraisal consulting assignment and subject to the limiting conditions attached to this letter. My client is Low Bridge Solar, LLC, represented to me by Ms. Kayla Marshall. My findings support the application. The effective date of this consultation is November 1, 2024.

I. Conclusion

The matched pair analysis in the attached report shows no impact in home values due to abutting or adjoining a solar farm as well as no impact to abutting or adjacent vacant residential or agricultural land where there are sufficient setbacks and buffering as identified in the analysis. The criteria that typically correlates with downward adjustments on property values such as noise, odor, and traffic all indicate that a solar farm is a compatible use for rural/residential transition areas and that it would function in a harmonious manner with this area.

Very similar solar farms in very similar areas have been found by hundreds of towns and counties not to have a substantial injury to abutting or adjoining properties, and many of those findings of no impact have been upheld by N.C. Courts or overturned by N.C. Courts when a board found otherwise (see for example *Dellinger. v. Lincoln County*). Similar solar farms have been approved adjoining agricultural uses, schools, churches, and residential developments. Industrial uses rarely absorb negative impacts from adjoining uses. This same pattern of development has been identified in this report showing that this is not a local phenomenon, but found in Virginia, North Carolina, Maryland, Tennessee, and Florida as representative of the Mid-Atlantic and Southeastern U.S.

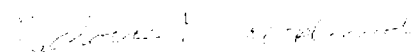
Based on the data and analysis in this report, it is my professional opinion that the solar farm proposed at the subject property will not substantially injure the value of adjoining property and will be in harmony with the area in which it is located. I note that some of the positive implications of a solar farm that have been expressed by people living next to solar farms include protection from future development of residential developments or other more intrusive uses, reduced dust, odor and chemicals from former farming operations, protection from light pollution at night, it is quiet, and there is no traffic.

If you have any questions please call me any time.

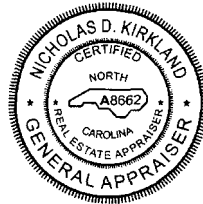
Sincerely,



Richard C. Kirkland, Jr., MAI
State Certified General Appraiser



Nicholas D. Kirkland
State Certified General Appraiser



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III. Proposed Project and Adjoining Uses

Proposed Use Description

This 40 MW solar farm and associated 60 MWH Battery Energy Storage System (BESS), proposed to be constructed on a portion of a 278-acre assemblage of land near Ramseur Road, Randolph County, North Carolina. Adjoining land is primarily a mix of residential and agricultural uses, which is very typical of solar farm sites.

Adjoining Properties

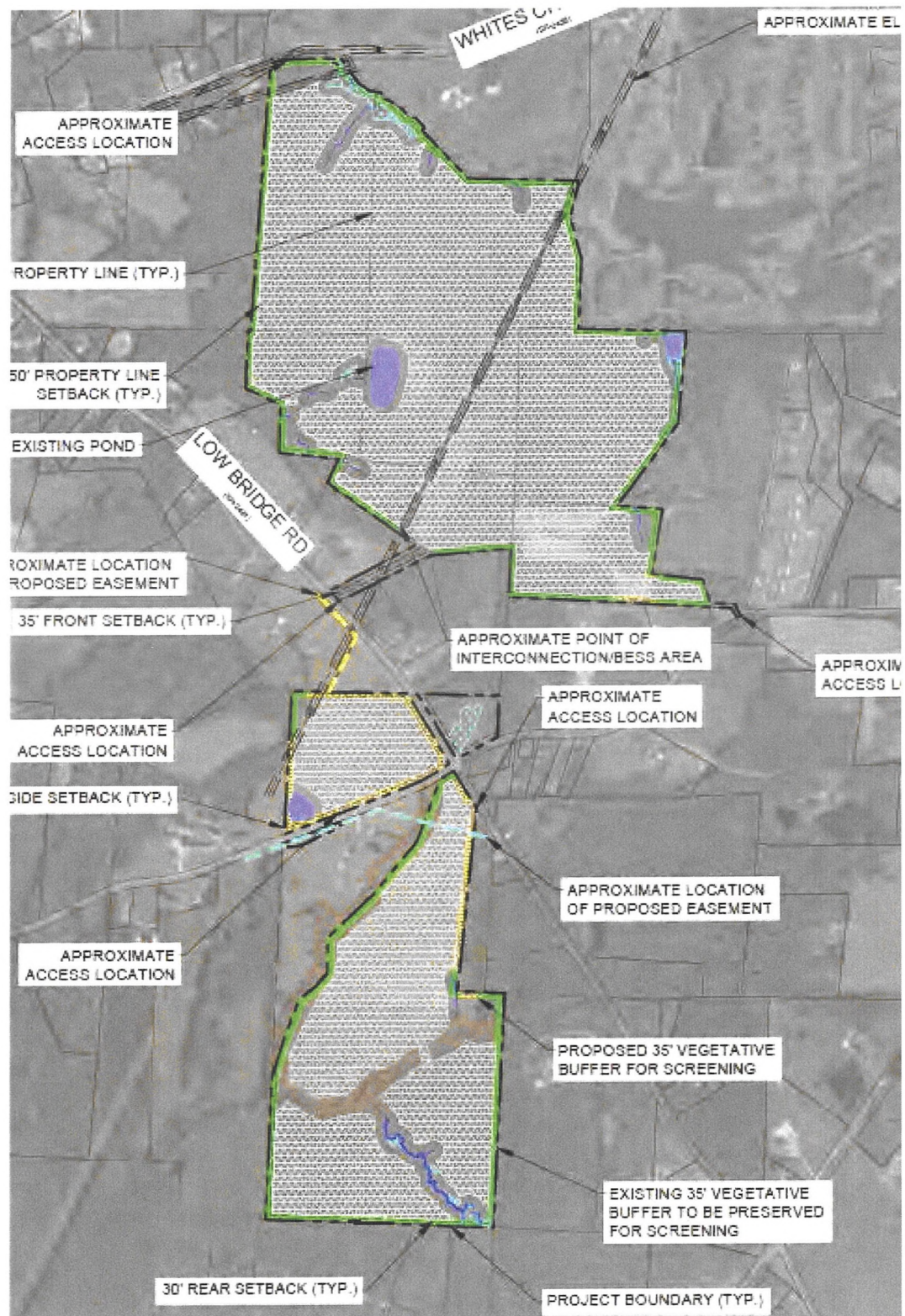
I have considered adjoining uses and included a map to identify each parcel's location. The closest adjoining home is to be 125 feet from the closest solar panel, the average distance is 418 feet.

The breakdown of those uses by acreage and number of parcels is summarized below.

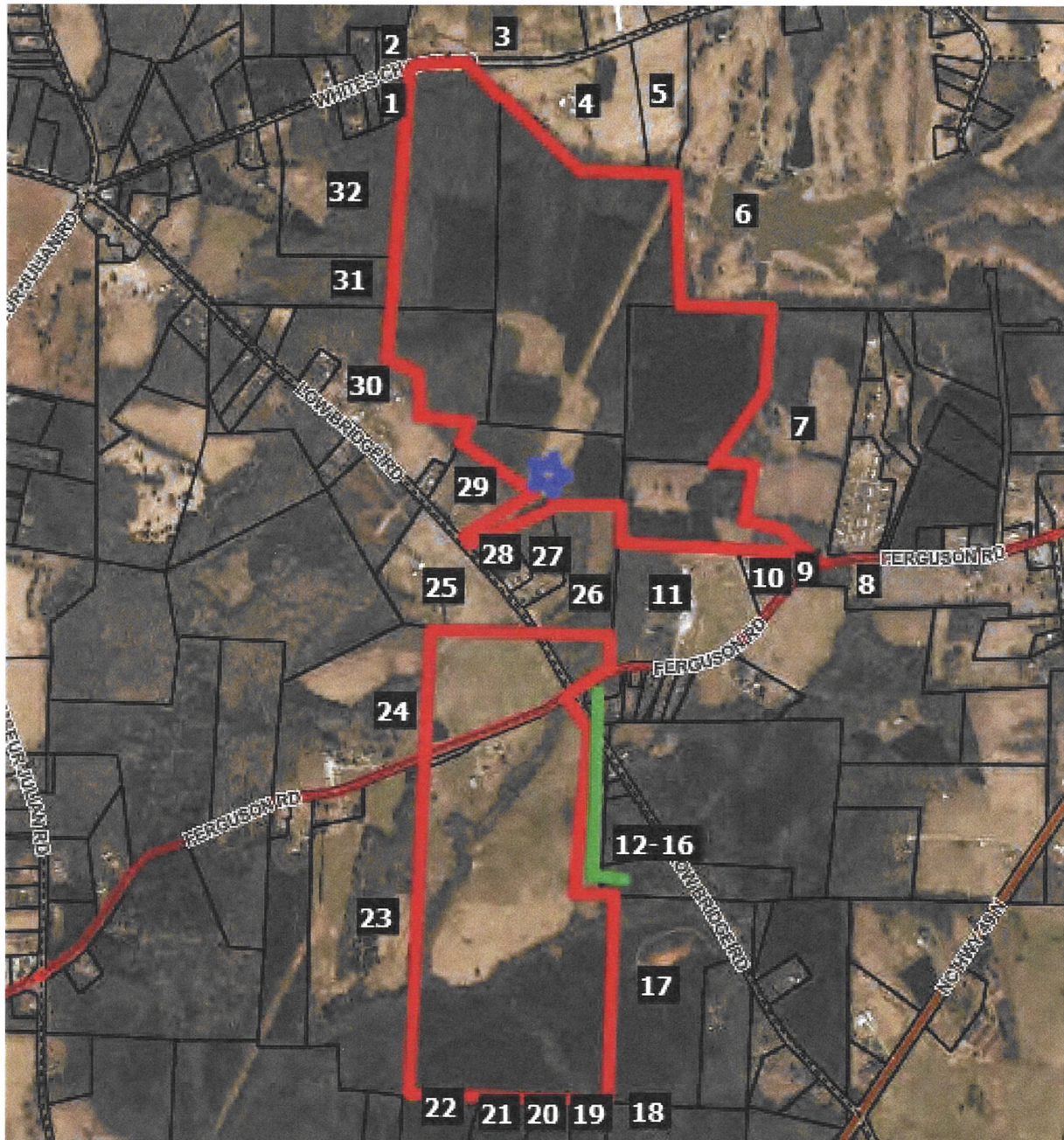
Adjoining Use Breakdown

	Acreage	Parcels
Residential	29.36%	71.88%
Agricultural	25.53%	15.63%
Agri/Res	45.11%	12.50%
Total	100.00%	100.00%

Site Plan – Shows panels north of Old Wire Road



Aerial GIS Map of Project Parent Tract Assemblage (Star is approximate location of BESS)

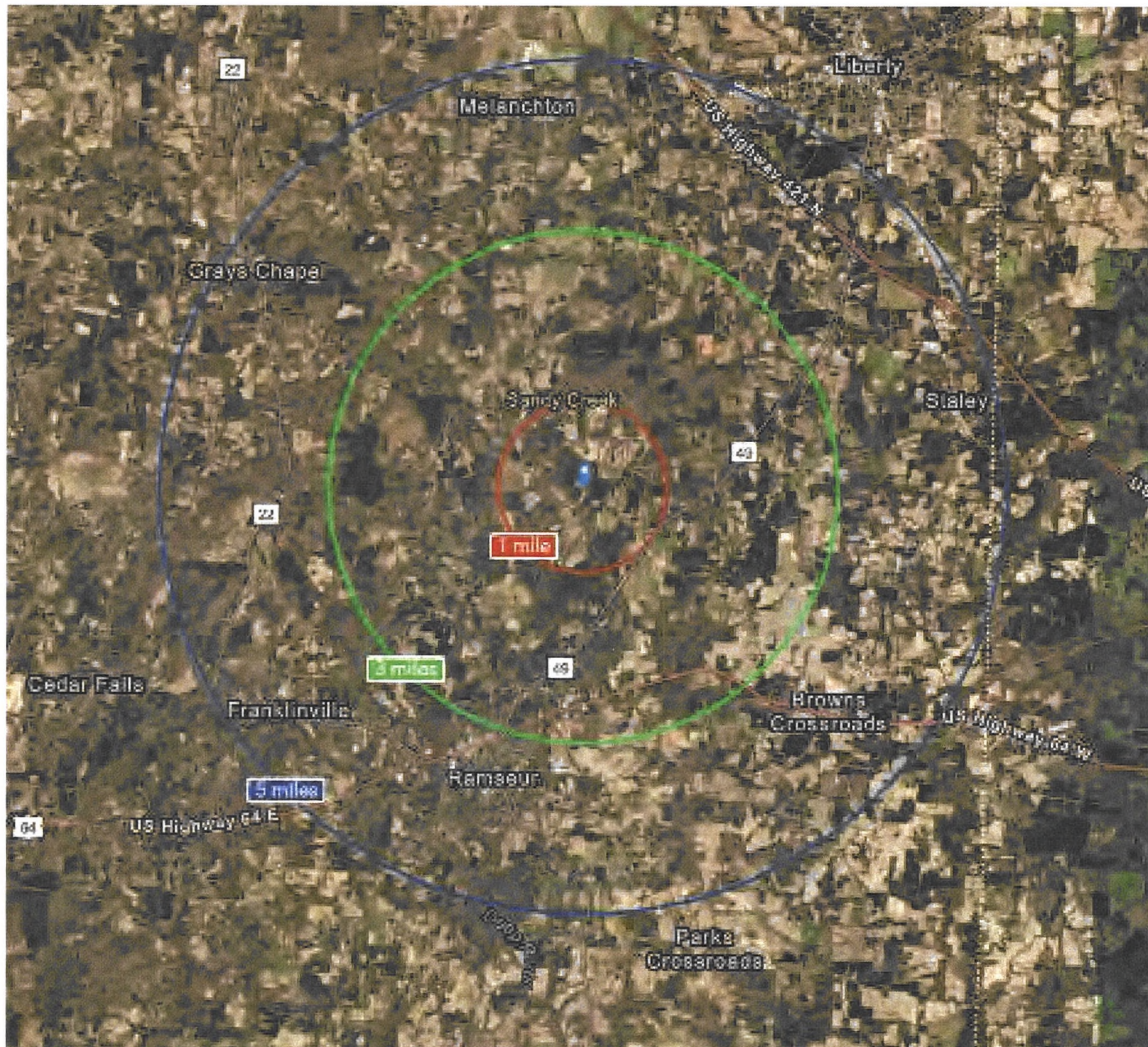


Surrounding Uses

#	MAP ID	Owner	GIS Data		Adjoin	Adjoin	Distance (ft)
			Acres	Present Use	Acres	Parcels	Home/Panel
1	8714125356	Ibsen	2.30	Residential	0.37%	3.13%	185
2	8714125756	Crossgrove	1.50	Residential	0.24%	3.13%	530
3	8714224957	Brady	14.43	Residential	2.29%	3.13%	N/A
4	8714321374	Hampton	19.76	Residential	3.14%	3.13%	425
5	8714328445	Hampton	10.18	Residential	1.62%	3.13%	N/A
6	8714517953	Faust	198.01	Agri/Res	31.44%	3.13%	680
7	8713497417	Kearns	33.37	Agri/Res	5.30%	3.13%	255
8	8713680473	Ellison	16.20	Residential	2.57%	3.13%	1,415
9	8713489614	Kearns	0.45	Residential	0.07%	3.13%	125
10	8713486589	Hicks	3.35	Residential	0.53%	3.13%	180
11	8713389217	Hicks	21.35	Residential	3.39%	3.13%	170
12	8713372548	Shields	1.00	Residential	0.16%	3.13%	N/A
13	8713372444	Shields	1.37	Residential	0.22%	3.13%	220
14	8713372269	Brewer	0.30	Residential	0.05%	3.13%	N/A
15	8713361546	Curtis	4.70	Residential	0.75%	3.13%	N/A
16	8713365089	Brewer	4.69	Residential	0.74%	3.13%	N/A
17	8713357102	Hill	30.00	Agricultural	4.76%	3.13%	N/A
18	8713338566	Goldston	33.29	Agricultural	5.29%	3.13%	N/A
19	8713331804	Caveness	6.20	Residential	0.98%	3.13%	N/A
20	8713238931	Caveness	7.48	Residential	1.19%	3.13%	N/A
21	8713232666	Gales	14.00	Residential	2.22%	3.13%	N/A
22	8713138703	Williams	14.60	Residential	2.32%	3.13%	N/A
23	8713153826	Lednum	40.00	Agricultural	6.35%	3.13%	N/A
24	8713172314	Goodson	28.82	Agri/Res	4.58%	3.13%	625
25	8713189429	Kimrey	14.27	Residential	2.27%	3.13%	335
26	8713381674	Brown	12.61	Residential	2.00%	3.13%	N/A
27	8713288705	J and H	4.96	Residential	0.79%	3.13%	305
28	8713284870	Stanley	1.52	Residential	0.24%	3.13%	N/A
29	8713292158	Wright	7.72	Residential	1.23%	3.13%	320
30	8714104144	Kivett	23.91	Agri/Res	3.80%	3.13%	500
31	8714015340	Caviness	32.82	Agricultural	5.21%	3.13%	N/A
32	8714112703	Ibsen	24.72	Agricultural	3.92%	3.13%	N/A
Total			629.880		100.00%	100.00%	418

Demographics Around Subject Property

I have pulled demographic data around a 1-mile, 3-mile and 5-mile radius from the middle of the project as shown on the following pages.





Housing Profile

27298
27298, Liberty, North Carolina
Ring: 1 mile radius

Prepared by Esri

Esri's ArcGIS Online
Community Edition 10.8.1

Population

2020 Total Population	424
2024 Total Population	438
2029 Total Population	461
2024-2029 Annual Rate	1.03%

Households

2024 Median Household Income	\$61,925
2029 Median Household Income	\$72,305
2024-2029 Annual Rate	3.15%

Housing Units by Occupancy Status and Tenure	Census 2020		2024		2029	
	Number	Percent	Number	Percent	Number	Percent
Total Housing Units	158	100.0%	167	100.0%	176	100.0%
Occupied	151	95.6%	161	96.4%	171	97.2%
Owner	126	79.7%	137	82.0%	149	84.7%
Renter	25	15.8%	24	14.4%	22	12.5%
Vacant	12	7.6%	6	3.6%	5	2.8%

Owner Occupied Housing Units by Value

	2024		2029	
	Number	Percent	Number	Percent
Total	137	100.0%	149	100.0%
<\$50,000	2	1.5%	1	0.7%
\$50,000-\$99,999	11	8.0%	3	2.0%
\$100,000-\$149,999	14	10.2%	5	3.4%
\$150,000-\$199,999	33	24.1%	15	10.1%
\$200,000-\$249,999	8	5.8%	6	4.0%
\$250,000-\$299,999	3	2.2%	3	2.0%
\$300,000-\$399,999	46	33.6%	72	48.3%
\$400,000-\$499,999	15	10.9%	31	20.8%
\$500,000-\$749,999	5	3.6%	13	8.7%
\$750,000-\$999,999	0	0.0%	0	0.0%
\$1,000,000-\$1,499,999	0	0.0%	0	0.0%
\$1,500,000-\$1,999,999	0	0.0%	0	0.0%
\$2,000,000+	0	0.0%	0	0.0%
Median Value	\$258,333		\$357,639	
Average Value	\$270,073		\$355,369	

Census 2020 Housing Units

	Number	Percent
Total	158	100.0%
Housing Units In Urbanized Areas	0	0.0%
Rural Housing Units	158	100.0%

Census 2020 Owner Occupied Housing Units by Mortgage Status

	Number	Percent
Total	127	100.0%
Owned with a Mortgage/Loan	72	56.7%
Owned Free and Clear	55	43.3%

Data Note: Persons of Hispanic Origin may be of any race.

Source: Esri forecasts for 2024 and 2029, U.S. Census Bureau 2020 decennial Census data.

November 01, 2024



Housing Profile

27298
27298, Liberty, North Carolina
Ring: 3 mile radius

Prepared by Esri

11/20/2024 10:25:21

27298, NC 27298

Population

2020 Total Population	3,053
2024 Total Population	3,190
2029 Total Population	3,318
2024-2029 Annual Rate	0.79%

Households

2024 Median Household Income	\$56,960
2029 Median Household Income	\$66,032
2024-2029 Annual Rate	3.00%

Housing Units by Occupancy Status and Tenure	Census 2020		2024		2029	
	Number	Percent	Number	Percent	Number	Percent
Total Housing Units	1,261	100.0%	1,334	100.0%	1,391	100.0%
Occupied	1,147	91.0%	1,209	90.6%	1,269	91.2%
Owner	918	72.8%	985	73.8%	1,068	76.8%
Renter	229	18.2%	224	16.8%	201	14.5%
Vacant	101	8.0%	125	9.4%	123	8.8%

Owner Occupied Housing Units by Value

	2024		2029	
	Number	Percent	Number	Percent
Total	983	100.0%	1,068	100.0%
<\$50,000	33	3.4%	17	1.6%
\$50,000-\$99,999	103	10.5%	33	3.1%
\$100,000-\$149,999	88	9.0%	30	2.8%
\$150,000-\$199,999	217	22.1%	96	9.0%
\$200,000-\$249,999	65	6.6%	48	4.5%
\$250,000-\$299,999	44	4.5%	45	4.2%
\$300,000-\$399,999	283	28.8%	447	41.9%
\$400,000-\$499,999	94	9.6%	197	18.4%
\$500,000-\$749,999	54	5.5%	149	14.0%
\$750,000-\$999,999	2	0.2%	6	0.6%
\$1,000,000-\$1,499,999	0	0.0%	0	0.0%
\$1,500,000-\$1,999,999	0	0.0%	0	0.0%
\$2,000,000+	0	0.0%	0	0.0%
Median Value	\$238,846		\$359,284	
Average Value	\$265,615		\$365,262	

Census 2020 Housing Units

	Number	Percent
Total	1,261	100.0%
Housing Units In Urbanized Areas	0	0.0%
Rural Housing Units	1,261	100.0%

Census 2020 Owner Occupied Housing Units by Mortgage Status

	Number	Percent
Total	918	100.0%
Owned with a Mortgage/Loan	514	56.0%
Owned Free and Clear	404	44.0%

Data Note: Persons of Hispanic Origin may be of any race.

Source: Esri forecasts for 2024 and 2029. U.S. Census Bureau 2020 decennial Census data.

November 01, 2024



Housing Profile

27298
27298, Liberty, North Carolina
Ring: 5 mile radius

Prepared by Esri

TABLE ID: 27298
TABLE: 27298

Population

2020 Total Population	10,226
2024 Total Population	10,546
2029 Total Population	10,816
2024-2029 Annual Rate	0.51%

Households

2024 Median Household Income	\$54,746
2029 Median Household Income	\$64,187
2024-2029 Annual Rate	3.23%

Housing Units by Occupancy Status and Tenure	Census 2020		2024		2029	
	Number	Percent	Number	Percent	Number	Percent
Total Housing Units	4,335	100.0%	4,513	100.0%	4,657	100.0%
Occupied	3,928	90.6%	4,088	90.6%	4,237	91.0%
Owner	2,977	68.7%	3,164	70.1%	3,398	73.0%
Renter	951	21.9%	924	20.5%	839	18.0%
Vacant	387	8.9%	425	9.4%	421	9.0%

Owner Occupied Housing Units by Value

	2024		2029	
	Number	Percent	Number	Percent
Total	3,165	100.0%	3,398	100.0%
<\$50,000	236	7.5%	186	5.5%
\$50,000-\$99,999	388	12.3%	167	4.9%
\$100,000-\$149,999	343	10.8%	163	4.8%
\$150,000-\$199,999	582	18.4%	297	8.7%
\$200,000-\$249,999	345	10.9%	264	7.8%
\$250,000-\$299,999	248	7.8%	277	8.2%
\$300,000-\$399,999	557	17.6%	924	27.2%
\$400,000-\$499,999	178	5.6%	483	14.2%
\$500,000-\$749,999	262	8.3%	539	15.9%
\$750,000-\$999,999	17	0.5%	65	1.9%
\$1,000,000-\$1,499,999	5	0.2%	21	0.6%
\$1,500,000-\$1,999,999	1	0.0%	2	0.1%
\$2,000,000+	3	0.1%	10	0.3%
Median Value	\$204,855		\$337,338	
Average Value	\$250,861		\$356,636	

Census 2020 Housing Units

	Number	Percent
Total	4,335	100.0%
Housing Units In Urbanized Areas	0	0.0%
Rural Housing Units	4,335	100.0%

Census 2020 Owner Occupied Housing Units by Mortgage Status

	Number	Percent
Total	2,977	100.0%
Owned with a Mortgage/Loan	1,655	55.6%
Owned Free and Clear	1,322	44.4%

Data Note: Persons of Hispanic Origin may be of any race.

Source: Esri forecasts for 2024 and 2029, U.S. Census Bureau 2020 decennial Census data.

November 01, 2024

IV. Methodology and Discussion of Issues

Standards and Methodology

I conducted this analysis using the standards and practices established by the Appraisal Institute and that conform to the Uniform Standards of Professional Appraisal Practice. The analyses and methodologies contained in this report are accepted by all major lending institutions, and they are used in North Carolina and across the country as the industry standard by certified appraisers conducting appraisals, market analyses, or impact studies and are considered adequate to form an opinion of the impact of a land use on neighboring properties. These standards and practices have also been accepted by the courts at the trial and appellate levels and by federal courts throughout the country as adequate to reach conclusions about the likely impact a use will have on adjoining or abutting properties.

The aforementioned standards compare property uses in the same market and generally within the same calendar year so that fluctuating markets do not alter study results. Although these standards do not require a linear study that examines adjoining property values before and after a new use (e.g. a solar farm) is developed, some of these studies do in fact employ this type of analysis. Comparative studies, as used in this report, are considered an industry standard.

The type of analysis employed is a Matched Pair Analysis or Paired Sales Analysis. This methodology is outlined in **The Appraisal of Real Estate**, Twelfth Edition by the Appraisal Institute pages 438-439. It is further detailed in **Real Estate Damages**, Third Edition, pages 33-36 by Randall Bell PhD, MAI. Paired sales analysis is used to support adjustments in appraisal work for factors ranging from the impact of having a garage, golf course view, or additional bedrooms. It is an appropriate methodology for addressing the question of impact of an adjoining solar farm. The paired sales analysis is based on the theory that when two properties are in all other respects equivalent, a single difference can be measured to indicate the difference in price between them. Dr. Bell describes it as comparing a test area to control areas. In the example provided by Dr. Bell he shows five paired sales in the test area compared to 1 to 3 sales in the control areas to determine a difference. I have used 3 sales in the control areas in my analysis for each sale developed into a matched pair.

Determining what is an External Obsolescence

An external obsolescence is a use of property that, because of its characteristics, might have a negative impact on the value of adjacent or nearby properties because of identifiable impacts. Determining whether a use would be considered an external obsolescence requires a study that isolates that use, eliminates any other causing factors, and then studies the sales of nearby versus distant comparable properties. The presence of one or a combination of key factors does not mean the use will be an external obsolescence, but a combination of these factors tends to be present when market data reflects that a use is an external obsolescence.

External obsolescence is evaluated by appraisers based on several factors. These factors include but are not limited to:

- 1) Traffic. Solar farms are not traffic generators.
- 2) Odor. Solar farms do not produce odor.
- 3) Noise. Solar farms generate no noise concerns with noise levels below ambient noise outside of the fence in most layouts and make even less noise at night.

- 4) Environmental. Solar farms do not produce toxic or hazardous waste. Grass is maintained underneath the panels so there is minimal impervious surface area.
- 5) Appearance/Viewshed. Solar farms are generally required to provide significant setbacks and landscaping buffers to address potential concerns. Furthermore, any consideration of appearance of viewshed impacts has to be considered in comparison with currently allowed uses on that site. For example if a residential subdivision is already an allowed use, the question becomes in what way does the appearance impact adjoining property owners above and beyond the appearance of that allowed subdivision or other similar allowed uses.
- 6) Other factors. I have observed and studied many solar farms and have never observed any characteristic about such facilities that prevents or impedes neighbors from fully using their homes or farms or businesses for the use intended.

Market Imperfection

Throughout this analysis, I have specifically considered the influence of market imperfection on data analysis. Market imperfection is the term that refers to the fact that unlike a can of soup at the supermarket or in your online shopping cart, real estate cannot be comparison shopped for the best price and purchased at the best price for that same identical product. Real estate products are always similar and never identical. Even two adjacent lots that are identical in almost every way, have a slight difference in location. Once those lots are developed with homes, the number of differences begin to multiply, whether it is size of the home, landscaping, layout, age of interior upfit, quality of interior upfit, quality of maintenance and so on.

Neoclassical economics indicates a perfectly competitive market as having the following: A large number of buyers and sellers (no one person dominates the market), no barriers or transaction costs, homogeneous product, and perfect information about the product and pricing. Real estate is clearly not homogeneous. The number of buyers and sellers for a particular product in a particular location is limited by geography, financing, and the limited time period within a property is listed. There are significant barriers that limit the liquidity in terms of time, costs and financing. Finally, information on real estate is often incomplete or partial – especially at the time that offers are made and prices set, which is prior to appraisals and home inspections. So real estate is very imperfect based on this definition and the impact of this are readily apparent in the real estate market.

What appear to be near-identical homes that are in the same subdivision will often sell with slight variations in price. When multiple appraisers approach the same property, there is often a slight variation among all of those conclusions of value, due to differences in comparables used or analysis of those comparables. This is common and happens all of the time. In fact, within each appraisal, after making adjustments to the comparables, the appraiser will typically have a range of values that are supported that often vary more than +/-5% from the median or average adjusted value.

Based on this understanding of market imperfection, it is important to note that very minor differences in value within an impact study do not necessarily indicate either a negative or positive impact. When the impacts measured fall within that +/-5%, I consider this to be within typical market variation/imperfection. Therefore it may be that there is a negative or positive impact identified if the impact is within that range, but given that it is indistinguishable from what amounts to the background noise or static within the real estate data, I do not consider indications of +/-5% to support a finding of a negative or positive impact.

Impacts greater than that range are however, considered to be strong indications of impacts that fall outside of typical market imperfection. I have used this as a guideline while considering the impacts identified within this report.

Relative Solar Farm Sizes

Solar farms have been increasing in size in recent years. Much of the data collected is from existing, older solar farms of smaller size, but there are numerous examples of sales adjoining 75 to 80 MW facilities that show a similar trend as the smaller solar farms. This is understandable given that the primary concern relative to a solar farm is the appearance or view of the solar farm, which is typically addressed through setbacks and landscaping buffers. The relevance of data from smaller solar farms to larger solar farms is due to the primary question being one of appearance. If the solar farm is properly screened, then little of the solar farm would be seen from adjoining property regardless of how many acres are involved.

Larger solar farms are often set up in sections where any adjoining owner would only be able to see a small section of the project even if there were no landscaping screen. Once a landscaping screen is in place, the primary view is effectively the same whether adjoining a 5 MW, 20 MW or 100 MW facility.

I have split out the data for the matched pairs adjoining larger solar farms only to illustrate the similarities later in this report.

Steps Involved in the Analysis

The paired sales analysis employed in this report follows the following process:

1. Identify sales of property adjoining existing solar farms.
2. Compare those sales to similar property that does not adjoin an existing solar farm.
3. Confirm sales as noted in the analysis write ups.
4. Include distances from the homes to panels as a measure of the setbacks.
5. Note topographic differences across the solar farms themselves along with demographic data for comparing similar areas.

There are a number of Sale/Resale comparables included in the write ups, but most of the data shown is for sales of homes after a solar farm has been announced (where noted) or after a solar farm has been constructed.

V. Research on Solar Farms

A. *Appraisal Market Studies*

I have also considered a number of impact studies completed by other appraisers as detailed below.

CohnReznick – Property Value Impact Study: Adjacent Property Values Solar Impact Study: A Study of Eight Existing Solar Facilities

Patricia McGarr, MAI, CRE, FRICS, CRA and Andrew R. Lines, MAI with CohnReznick completed an impact study for a proposed solar farm in Cheboygan County, Michigan completed on June 10, 2020. I am familiar with this study as well as a number of similar such studies completed by CohnReznick. I have not included all of these studies but I submit this one as representative of those studies.

This study addresses impacts on value from eight different solar farms in Michigan, Minnesota, Indiana, Illinois, Virginia and North Carolina. These solar farms are 19.6 MW, 100 MW, 11.9 MW, 23 MW, 71 MW, 61 MW, 40 MW, and 19 MW for a range from 11.9 MW to 100 MW with an average of 31 MW and a median of 31.5 MW. They analyzed a total of 24 adjoining property sales in the Test Area and 81 comparable sales in the Control Area over a five-year period.

The conclusion of this study is that there is no evidence of any negative impact on adjoining property values based on sales prices, conditions of sales, overall marketability, potential for new development or rate of appreciation.

Christian P. Kaila & Associates – Property Impact Analysis – Proposed Solar Power Plant Guthrie Road, Stuarts Draft, Augusta County, Virginia

Christian P. Kaila, MAI, SRA and George J. Finley, MAI developed an impact study as referenced above dated June 16, 2020. This was for a proposed 83 MW facility on 886 acres.

Mr. Kaila interviewed appraisers who had conducted studies and reviewed university studies and discussed the comparable impacts of other development that was allowed in the area for a comparative analysis of other impacts that could impact viewshed based on existing allowed uses for the site. He also discussed in detail the various other impacts that could cause a negative impact and how solar farms do not have such characteristics.

Mr. Kaila also interviewed county planners and real estate assessors in eight different Virginia counties with none of the assessor's identifying any negative impacts observed for existing solar projects.

Mr. Kaila concludes on a finding of no impact on property values adjoining the indicated solar farm.

Fred Beck, MAI, CCIM – Impact Analysis in Lincoln County, North Carolina, 2013

Mr. Fred Beck, MAI, CCIM completed an impact analysis in 2013 for a proposed solar farm that concluded on a negative impact on value. That report relied on a single cancelled contract for an adjoining parcel where the contracted buyers indicated that the solar farm was the reason for the cancellation. It also relied on the activities of an assessment impact that was applied in a nearby county.

Mr. Beck was interviewed as part of the Christian Kalia study noted above. From that I quote “Mr. Beck concluded on no effect on moderate priced homes, and only a 5% change in his limited research of higher priced homes. His one sale that fell through is hardly a reliable sample.”

Also noted in the Christian Kalia interview notes is a response from Mr. Beck indicating that in his opinion “the homes were higher priced homes and had full view of the solar farm.” Mr. Beck indicated in the interview if landscaping screens were employed he would not see any drop in value.

NorthStar Appraisal Company – Impact Analysis for Nichomus Run Solar, Pilesgrove, New Jersey, 2020

Mr. William J. Sapio, MAI with NorthStar Appraisal Company considered a matched pair analysis for the potential impact on adjoining property values to this proposed 150 MW solar farm. Mr. Sapio considered sales activity in a subdivision known as Point of Woods in South Brunswick Township and identified two recent new homes that were constructed and sold adjoining a 13 MW solar farm and compared them to similar homes in that subdivision that did not adjoin the solar farm. These homes sold in the \$1,290,450 to \$1,336,613 price range and these homes were roughly 200 feet from the closest solar panel.

Based on this analysis, he concluded that the adjoining solar farm had no impact on adjoining property value.

MR Valuation Consulting, LLC – The Kuhl Farm Solar Development and The Fischer Farm Solar Development – New Jersey, 2012

Mr. Mark Pomykacz, MAI MRICS with MR Valuation Consulting, LLC considered a matched pair analysis for sales near these solar farms. The sales data presented supported a finding of no impact on property value for nearby and adjoining homes and concludes that there is no impact on marketing time and no additional risk involved with owning, building, or selling properties next to the solar farms.

Mary McClinton Clay, MAI – McCracken County Solar Project Value Impact Report, Kentucky, 2021

Ms. Mary Clay, MAI reviewed a report by Kirkland Appraisals in this case and also provided a differing opinion of impact. Having testified opposite Ms. Clay, she has stated that she does not confirm her data and does not use an appropriate method for time adjustments.

The comments throughout this study are heavy in adjectives, avoids stating facts contrary to the conclusion and shows a strong selection bias.

Kevin T. Meeks, MAI – Corcoran Solar Impact Study, Minnesota, 2017

Mr. Kevin Meeks, MAI reviewed a report by Kirkland Appraisals in this case and also provided additional research on the topic with additional paired sales. The sales he considered are well presented and show that they were confirmed by third parties and all of the broker commentary is aligned with the conclusion that the adjoining solar farms considered had no impact on the adjoining home values.

Mr. Meeks also researched a 100 MW project in Chisago County, known as North Star Solar Garden in MN. He interviewed local appraisers and a broker who was actively marketing homes adjoining that solar farm to likewise support a finding of no impact on property value.

John Keefe, Chisago County Assessor, Chisago County Minnesota Assessor’s Office, 2017

This study was completed by the Chisago County Minnesota Assessor's Office on property prices adjacent to and in close vicinity of a 1,000-acre North Star solar farm in Minnesota. The study concluded that the North Star solar farm had "no adverse impact" on property values. Mr. Keefe further stated that, "It seems conclusive that valuation has not suffered."

Tim Connelly, MAI – Solar Impact Study of Proposed Solar Facility, New Mexico, 2023

This study is a detailed review of an Impact Study completed by Kirkland Appraisals, LLC for Rancho Viejo Solar. It goes through all of the analysis and confirms the applicability and reliability of the methods and conclusions. Mr. Connelly, MAI concurs that "the proposed solar project will not have a negative impact on market value, marketability, or enjoyment of property in the immediate vicinity of the proposed project."

Donald Fisher, ARA, 2021

Donald Fisher has completed a number of studies on solar farms and was quoted in February 15, 2021 stating, "Most of the locations were in either suburban or rural areas, and all of those studies found either a neutral impact or, ironically, a positive impact, where values on properties after the installation of solar farms went up higher than time trends."

Jennifer N. Pitts, MAI - Study of Residential Market Trends Surrounding Six Utility-Scale Solar Projects in Texas, 2023

This study was completed by Real Property Analytics with Ms. Pitts along with Erin M. Kiella, PhD, and Chris Yost-Bremm, PhD. This analysis considered these solar farms through different stages of the market from announcement of the project, during construction, and after construction. They found no indication of a negative impact on sales price, the ratio of sales price to listing price, or the number of Days on Market. They also researched individual sales and interviewed local brokers who confirmed that market participants were knowledgeable of the solar projects and did not result in a negative impact on sales price or marketing time.

Michael S. MaRous, MAI, CRE – Market Impact Analysis Langdon Mills Solar, Columbia County, Wisconsin, 2023

This study was completed by MaRous & Company and signed by Michael S. MaRous. This analysis included consideration of solar projects in 13 states and including 7 solar projects in Wisconsin. This includes 22 matched pairs with a conclusion on Page 70 that states "there does not appear to have been any measurable negative impact on surrounding residential property values due to the proximity of a solar farm."

This analysis was further supported by Assessor Surveys including assessors in Wisconsin which found no instance of an assessor in Wisconsin identifying any negative impacts from solar farms on adjoining property values.

Conclusion of Impact Studies

Of the 11 studies noted 9 included actual sales data to derive an opinion of no impact on value. The two studies to conclude on a negative impact includes the Fred Beck study based on no actual sales data, and he has since indicated that with landscaping screens he would not conclude on a negative impact. The other study by Mary Clay shows improper adjustments for time, a lack of confirmation of sales comparables, and exclusion of data that does not support her initial position.

I have relied on these studies as additional support for the findings in this impact analysis.

B. Articles

I have also considered a number of articles on this subject as well as conclusions and analysis as noted below.

Farm Journal Guest Editor, March 22, 2021 – Solar’s Impact on Rural Property Values

Andy Ames, ASFMRA (American Society of Farm Managers and Rural Appraisers) published this article that includes a discussion of his survey of appraisers and studies on the question of property value related to solar farms. He discusses the university studies that I have cited as well as Patricia McGarr, MAI.

He also discusses the findings of Donald A. Fisher, ARA, who served six years at the Chair of the ASFMRA’s National Appraisal Review Committee. He is also the Executive Vice President of the CNY Pomeroy Appraiser and has conducted several market studies on solar farms and property impact. He is quoted in the article as saying, “Most of the locations were in either suburban or rural areas, and all of those studies found either a neutral impact, or ironically, a positive impact, where values on properties after installation of solar farms went up higher than time trends.”

Howard Halderman, AFM, President and CEO of Halderman Real Estate and Farm Management attended the ASFMRA solar talk hosted by the Indiana Chapter of the ASFMRA and he concludes that other rural properties would likely see no impact and farmers and landowners shown even consider possible benefits. “In some cases, farmers who rent land to a solar company will insure the viability of their farming operation for a longer time period. This makes them better long-term tenants or land buyers so one can argue that higher rents and land values will follow due to the positive impact the solar leases offer.”

More recently in August 2022, Donald Fisher, ARA, MAI and myself led a webinar on this topic for the ASFMRA discussing the issues, the university studies and specific examples of solar farms having no impact on adjoining property values.

National Renewable Energy Laboratory – Top Five Large-Scale Solar Myths, February 3, 2016

Megan Day reports from NREL regarding a number of concerns neighbors often express. Myth #4 regarding property value impacts addresses specifically the numerous studies on wind farms that show no impact on property value and that solar farms have a significantly reduced visual impact from wind farms. She highlights that the appearance can be addressed through mitigation measures to reduce visual impacts of solar farms through vegetative screening. Such mitigations are not available to wind farms given the height of the windmills and again, those studies show no impact on value adjoining wind farms.

North Carolina State University: NC Clean Energy Technology Center White Paper: Balancing Agricultural Productivity with Ground-Based Solar Photovoltaic (PV) Development (Version 2), May 2019

Tommy Cleveland and David Sarkisian wrote a white paper for NCSU NC Clean Energy Technology Center regarding the potential impacts to agricultural productivity from a solar farm use. I have interviewed Tommy Cleveland on numerous occasions and I have also heard him speak on these issues at length as well. He addresses many of the common questions regarding how solar farms work and a detailed explanation of how solar farms do not cause significant impacts on the soils, erosion and other such concerns. This is a heavily researched paper with the references included.

North Carolina State University: NC Clean Energy Technology Center White Paper: Health and Safety Impacts of Solar Photovoltaics, May 2017

Tommy Cleveland wrote a white paper for NCSU NC Clean Energy Technology Center regarding the health and safety impacts to address common questions and concerns related to solar farms. This is a heavily researched white paper addressing questions ranging from EMFs, fire safety, as well as vegetation control and the breakdown of how a solar farm works.

C. *Broker Commentary*

In the process of working up the matched pairs used later in this report, I have collected comments from brokers who have actually sold homes adjoining solar farms indicating that the solar farm had no impact on the marketing, timing, or sales price for the adjoining homes. I have comments from 12 such brokers within this report including brokers from Kentucky, Virginia, Tennessee, and North Carolina.

I have additional commentary from other states including New Jersey and Michigan that provide the same conclusion.

VI. University Studies

I have also considered the following studies completed by four different universities related to solar farms and impacts on property values.

A. *University of Texas at Austin, May 2018*

An Exploration of Property-Value Impacts Near Utility-Scale Solar Installations

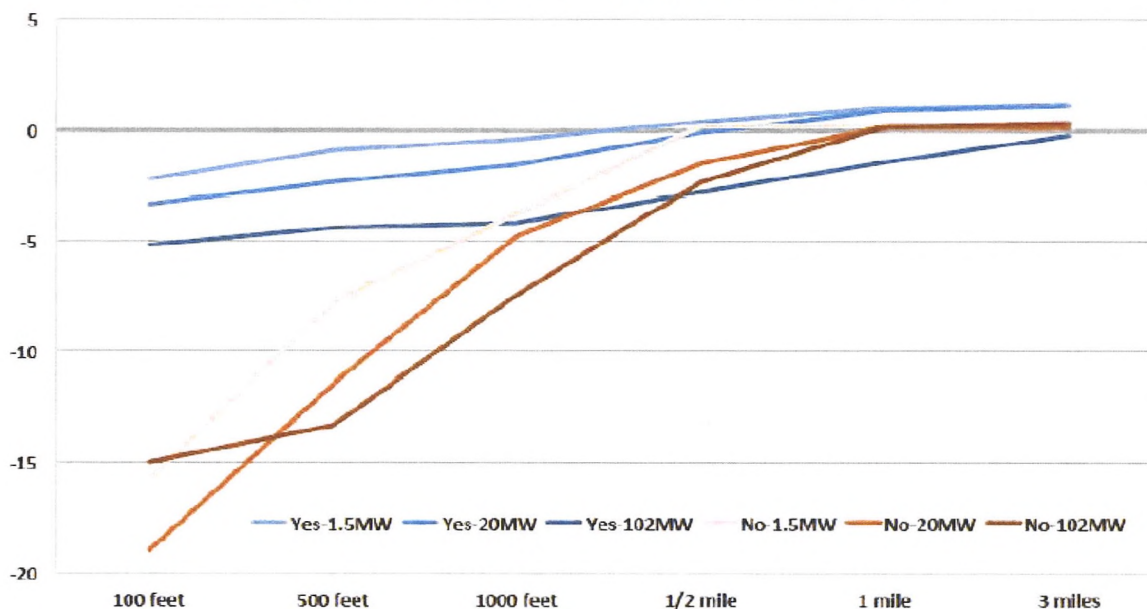
This study considers solar farms from two angles. First it looks at where solar farms are being located and concludes that they are being located primarily in low density residential areas where there are fewer homes than in urban or suburban areas.

The second part is more applicable in that they conducted a survey of appraisers/assessors on their opinions of the possible impacts of proximity to a solar farm. They consider the question in terms of size of the adjoining solar farm and how close the adjoining home is to the solar farm. I am very familiar with this part of the study as I was interviewed by the researcher's multiple times as they were developing this. One very important question that they ask within the survey is very illustrative. They asked if the appraiser being surveyed had ever appraised a property next to a solar farm. There is a very noticeable divide in the answers provided by appraisers who have experience appraising property next to a solar farm versus appraisers who self-identify as having no experience or knowledge related to that use.

On Page 16 of that study they have a chart showing the responses from appraisers related to proximity to a facility and size of the facility, but they separate the answers as shown below with appraisers with experience in appraising properties next to a solar farm shown in blue and those inexperienced shown in brown. Even within 100 feet of a 102 MW facility the response from experienced appraisers were -5% at most on impact. While inexperienced appraisers came up with significantly higher impacts. This chart clearly shows that an uninformed response widely diverges from the sales data available on this subject.

Chart B.2 - Estimates of Property Value Impacts (%) by Size of Facility, Distance, & Respondent Type

Have you assessed a home near a utility-scale solar installation?



Furthermore, the question cited above does not consider any mitigating factors such as landscaping buffers or screens which would presumably reduce the minor impacts noted by experienced appraisers on this subject.

The conclusion of the researchers is shown on Page 23 indicated that “Results from our survey of residential home assessors show that the majority of respondents believe that proximity to a solar installation has either no impact or a positive impact on home values.”

This analysis supports the conclusion of this report that the data supports no impact on adjoining property values.

B. University of Rhode Island, September 2020

Property Value Impacts of Commercial-Scale Solar Energy in Massachusetts and Rhode Island

The University of Rhode Island published a study entitled **Property Value Impacts of Commercial-Scale Solar Energy in Massachusetts and Rhode Island** on September 29, 2020 with lead researchers being Vasundhara Gaur and Corey Lang. I have read that study and interviewed Mr. Corey Lang related to that study. This study is often cited by opponents of solar farms but the findings of that study have some very specific caveats according to the report itself as well as Mr. Lang from the interview.

While that study does state in the Abstract that they found depreciation of homes within 1-mile of a solar farm, that impact is limited to non-rural locations. On Pages 16-18 of that study under Section 5.3 Heterogeneity in treatment effect they indicate that the impact that they found was limited to non-rural locations with the impact in rural locations effectively being zero. For the study they defined “rural” as a municipality/township with less than 850 population per square mile.

They further tested the robustness of that finding and even in areas up to 2,000 population per square mile they found no statistically significant data to suggest a negative impact. They have not specifically defined a point at which they found negative impacts to begin, as the sensitivity study stopped checking at the 2,000-population dataset.

Where they did find negative impacts was in high population density areas that was largely a factor of running the study in Massachusetts and Rhode Island which the study specifically cites as being the 2nd and 3rd most population dense states in the USA. Mr. Lang in conversation as well as in recorded presentations has indicated that the impact in these heavily populated areas may reflect a loss in value due to the scarce greenery in those areas and not specifically related to the solar farm itself. In other words, any development of that site might have a similar impact on property value.

Based on this study I have checked the population for the Columbia Township of Randolph County. This township has a population of 7,523 people for 2024 based on HomeTownLocator.com and a total area of 55.73 square miles for an indication population density of 135 people per square mile. This is well below the threshold of 2,000 people per square mile indicated by the Rhode Island Study for a finding of no impact on property value.

I therefore conclude that the Rhode Island Study supports the indication of no impact on adjoining properties for the proposed solar farm project.

Township Of Columbia Data & Demographics (As of July 1, 2024)

POPULATION		HOUSING	
Total Population	7,523 (100%)	Total HU (Housing Units)	3,235 (100%)
Population in Households	7,439 (98.9%)	Owner Occupied HU	2,278 (70.4%)
Population in Families	6,025 (80.1%)	Renter Occupied HU	680 (20.4%)
Population in Group Quarters ¹	84 (1.1%)	Vacant Housing Units	297 (9.2%)
Population Density	135	Median Home Value	\$192,578
Diversity Index ²	61	Average Home Value	\$235,294
		Housing Affordability Index ³	109
INCOME		HOUSEHOLDS	
Median Household Income	\$52,278	Total Households	2,938
Average Household Income	\$75,478	Average Household Size	2.53000000000
% of Income for Mortgage ⁴	23%	Family Households	2,018
Per Capita Income	\$29,496	Average Family Size	3
Wealth Index ⁵	62		

C. Georgia Institute of Technology, October 2020 Utility-Scale Solar Farms and Agricultural Land Values

This study was completed by Nino Abashidze as Post-Doctoral Research Associate of Health Economics and Analytics Lab (HEAL), School of Economics, Georgia Institute of Technology. This research was started at North Carolina State University and analyzes properties near 451 utility-scale ground-mount solar installations in NC that generate at least 1 MW of electric power. A total of 1,676 land sales within 5-miles of solar farms were considered in the analysis.

This analysis concludes on Page 21 of the study “Although there are no direct effects of solar farms on nearby agricultural land values, we do find evidence that suggests construction of a solar farm may create a small, positive, option-value for land owners that is capitalized into land prices. Specifically, after construction of a nearby solar farm, we find that agricultural land that is also located near transmission infrastructure may increase modestly in value.”

This study supports a finding of no impact on adjoining agricultural property values and in some cases could support a modest increase in value.

D. Master’s Thesis: ECU by Zachary Dickerson July 2018

A Solar Farm in My Backyard? Resident Perspectives of Utility-Scale Solar in Eastern North Carolina

This study was completed as part of a Master of Science in Geography Master’s Thesis by Zachary Dickerson in July 2018. This study sets out to address three questions:

1. Are there different aspects that affect resident satisfaction regarding solar farms?
2. Are there variations in satisfaction for residents among different geographic settings, e.g. neighborhoods adjacent to the solar farms or distances from the solar farms?
3. How can insight from both the utility and planning sectors, combined with knowledge gained from residents, fill gaps in communication and policy writing in regard to solar farms?

This was done through survey and interview with adjacent and nearby neighbors of existing solar farms. The positive to neutral comments regarding the solar farms were significantly higher than negative. The researcher specifically indicates on Page 46 “The results show that respondents generally do not believe the solar farms pose a threat to their property values.”

The most negative comments regarding the solar farms were about the lack of information about the approval process and the solar farm project prior to construction.

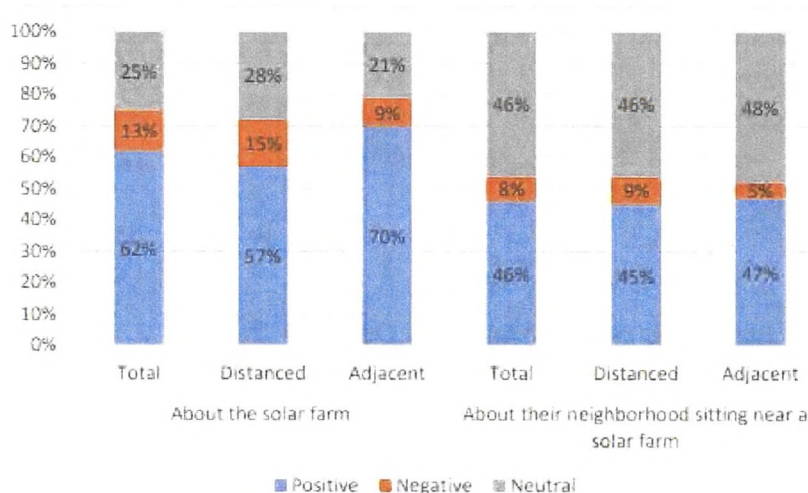
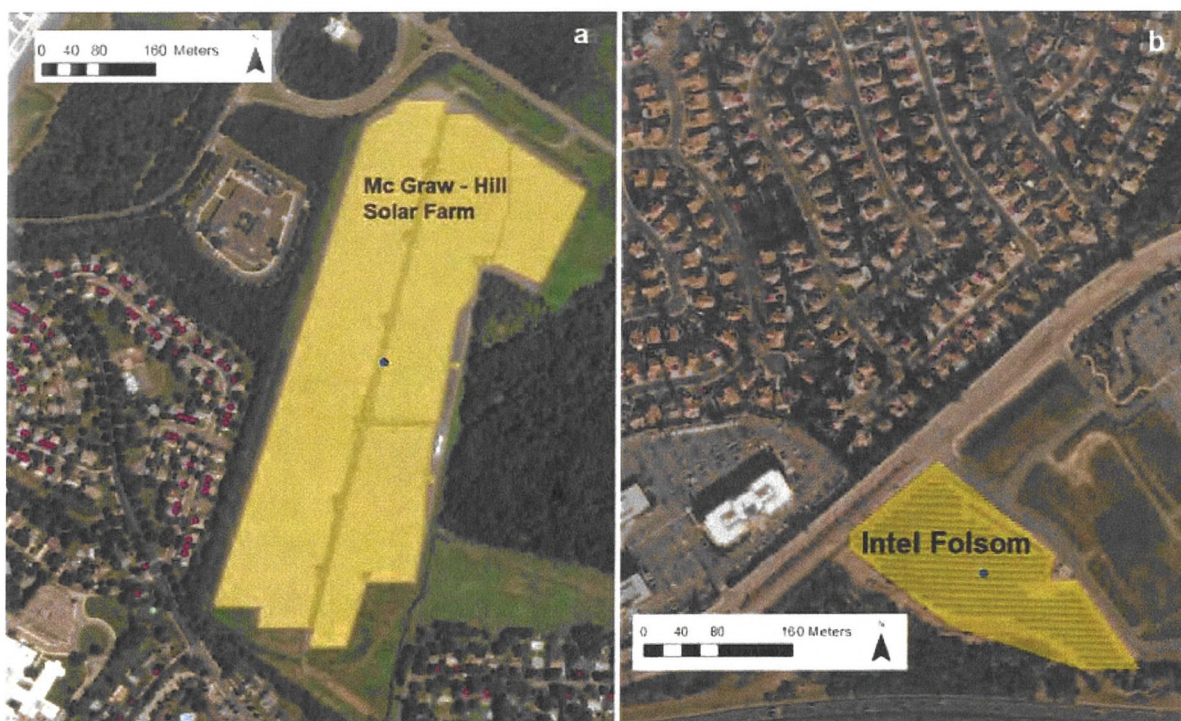


Figure 11: Residents' positive/negative word choices by geographic setting for both questions

E. Lawrence Berkeley National Lab, March 2023

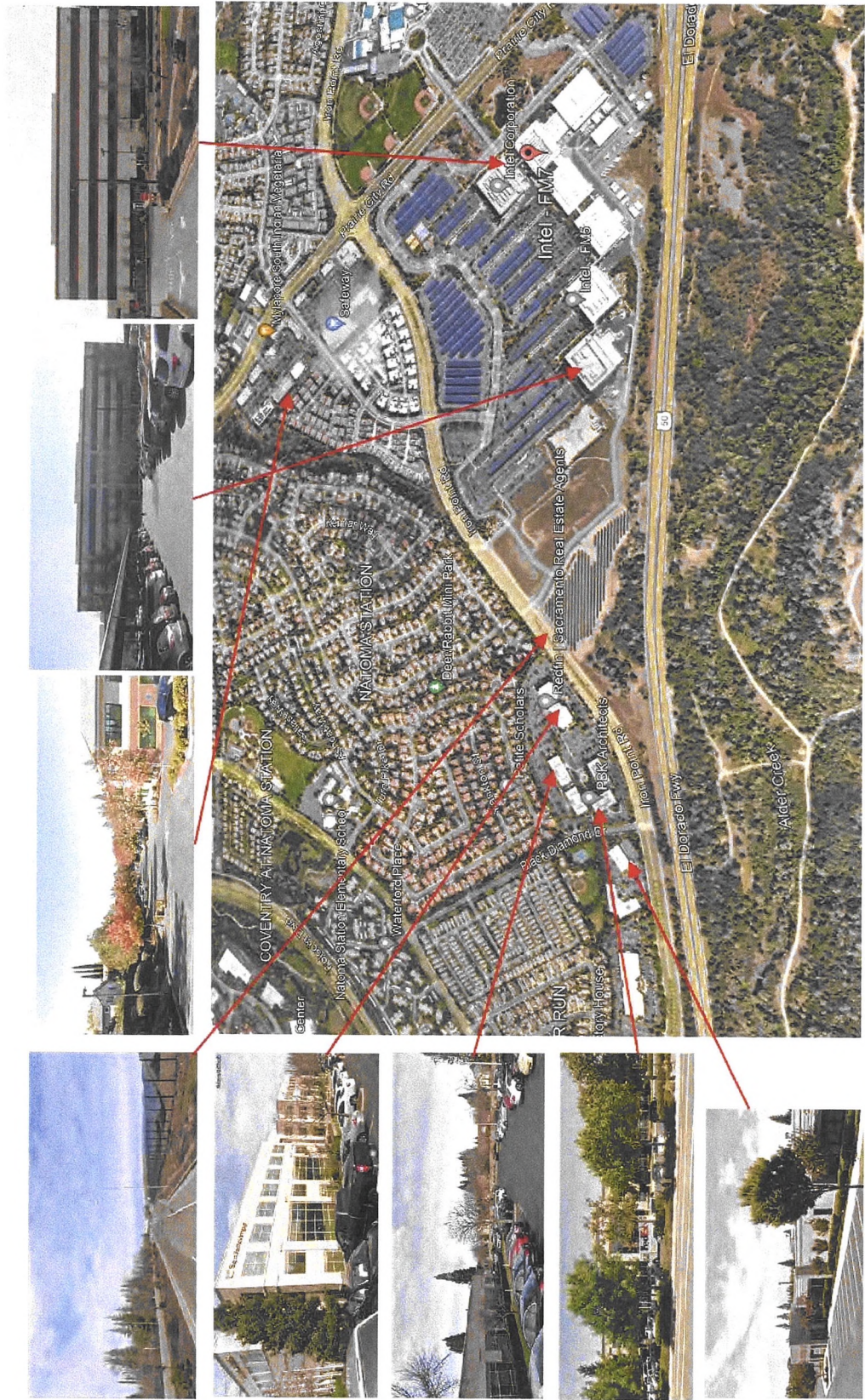
Shedding light on large-scale solar impacts: An analysis of property values and proximity to photovoltaics across six U.S. states

This study was completed by researchers including Salma Elmallah, Ben Hoen, K. Sydney Fujita, Dana Robson, and Eric Brunner. This analysis considers home sales before and after solar farms were installed within a 1 mile radius and compared them to home sales before and after the solar farms at a 2-4 mile radius. The conclusion found a 1.5% impact within 0.5 mile of a solar farm as compared to homes 2-4 miles from solar farms. This is the largest study of this kind on solar and addresses a number of issues, but also does not address a number of items that could potentially skew these results. First of all, the study found no impact in the three states with the most solar farm activity and only found impacts in smaller sets of data. The data does not in any way discuss actual visibility of solar farms or address existing vegetation screens. This lack of addressing this is highlighted by the fact that they suggest in the abstract that vegetative shading may be needed to address possible impacts. Another notable issue is the fact that they do not address other possible impacts within the radii being considered. This lack of consideration is well illustrated within the study on Figure A.1 where they show satellite images of McGraw Hill Solar Farm in NJ and Intel Folsom in CA. The Folsom image clearly shows large highways separating the solar farm from nearby housing, but with tower office buildings located closer to the housing being considered. In no place do they address the presence of these towers that essentially block those homes from the solar farm in some places. An excerpt of Fig. A.1. is shown below.



For each of these locations, I have panned out a little further on Google Earth to show the areas illustrated to more accurately reflect the general area. For the McGraw Hill Solar Farm you can see there is a large distribution warehouse to the west along with a large offices and other industrial uses. Further to the west is a large/older apartment complex (Princeton Arms). To the east there are more large industrial buildings. However, it is even more notable that 1.67 miles away to the west is Cranbury Golf Club. Given how this analysis was set up, these homes around the industrial buildings are being compared to homes within this country club to help establish impacts from the

solar farm. Even considering the idea that each set is compared to itself before and after the solar farm, it is not a reasonable supposition that homes in each area would appreciate at the same rates even if no solar farm was included. Furthermore the site where the solar farm is located and all of the surrounding uses not improved with residential housing to the south is zoned Research Office (RO) which allows for: manufacturing, preparation, processing or fabrication of products, with all activities and product storage taking place within a completely enclosed building, scientific or research laboratories, warehousing, computer centers, pharmaceutical operations, office buildings, industrial office parks among others. Homes adjoining such a district would likely have impacts and influences not seen in areas zoned and surrounded by zoning strictly for residential uses.



On the Intel Folsom map I have shown the images of two of the Intel Campus buildings, but there are roughly 8 such buildings on that site with additional solar panels installed in the parking lot as shown in that image. I included two photos that show the nearby housing having clear and close views of adjoining office parking lots. This illustrates that the homes in that 0.5 mile radius are significantly more impacted by the adjoining office buildings than a solar farm located distantly that are not within the viewshed of those homes. Also, this solar farm is located on land adjoining the Intel Campus on a tract that is zoned M-1 PD, which is a Light Industrial/Manufacturing zoning. Furthermore, the street view at the solar farm shows not only the divided four-lane highway that separates the office buildings and homes from the solar farm, but also shows that there is no landscaping buffer at this location. All of these factors are ignored by this study. Below is another image of the Folsom Solar at the corner of Iron Point Road and Intel West Driveway which shows just how close and how unscreened this project is.



Compare that image from the McGraw Hill Street view facing south from County Rte 571. There is a distant view and much of the project is hidden by a mix of berms and landscaping. The analysis makes no distinction between these projects.



The third issue with this study is that it identifies impacts following development in areas where they note that “more adverse home price impacts might be found where LSPVPS (large-scale

photovoltaic project) displace green space (consistent with results that show higher property values near green space.” The problem with this statement is that it assumes that the greenspace is somehow guaranteed in these areas, when in fact, they could just as readily be developed as a residential subdivision and have the same impacts. They have made no effort to differentiate loss of greenspace through other development purposes such as schools, subdivisions, or other uses versus the impact of solar farms. In other words, they may have simply identified the impact of all forms of development on property value. This would in fact be consistent with the comments in the Rhode Island study where the researchers noted that the loss of greenspace in the highly urban areas was likely due to the loss of greenspace in particular and not due to the addition of solar panels.

Despite these three shortcomings in the analysis – the lack of differentiating landscape screening, the lack of consideration of other uses within the area that could be impacting property values, and the lack of consideration of alternative development impacts – the study still only found impacts between 0 and 5% with a conclusion of 1.5% within a 0.5-mile radius. As discussed later in this report, real estate is an imperfect market and real estate transactions typically sell for much wider variability than 5% even where there are no external factors operating on property value.

I therefore conclude that the minor impacts noted in this study support a finding of no impact on property value. Most appraisals show a variation between the highest and lowest comparable sale that is substantially greater than 1.5% and this measured impact for all its flaws would just be lost in the static of normal real estate transactions.

***F. Loyola University Chicago by Simeng Hao and Gilbert Michaud, 2024
Assessing Property Value Impacts Near Utility-Scale Solar in the Midwest***

This was originally part of the Master’s Thesis by Simeng Hao in 2023 but updated for publication.

This study considered 70 utility-scale facilities built in the Midwest from 2009 to 2022 using data from the Lawrence Berkley National Laboratory. Using the difference-in-differences, method he found that proximity to solar project increased property values by 0.5% to 2.0%.

Furthermore, the research in this project shows that solar farms tend to be located in places with lower average home values by 2 to 3% compared to other random adjoining zip codes. This is not to say those areas are depressed, but those rural areas on average have lower prices than more suburban or urban areas nearby. This highlights the problem with a number of the studies on this issue in that they compare home values near the solar project to homes further from the solar project, but they are largely identifying the difference between rural and less-rural areas. The impact range identified by the Berkeley Study for example is exactly in line with that random difference identified by Simeng Hao.

The original Master’s Thesis included a summary of seven other studies including many of those noted above that considered a total of 3,296 projects with results ranging from 1.7% decline in value to no impact. Only 2 of the studies identified found negative results that ranged from 0.82% to 1.7% impact on property value, while the other five studies found no consistent negative impact.

Given that 5 of the 7 studies identified show no negative impact and the analysis by Mr. Hao shows a positive relationship up to 2%, I consider this analysis to support my conclusions on no impact on property value. While statistical studies note impacts of +/- 2%, as noted earlier in this report, market imperfection is generally greater than that rate and supports a conclusion of no impact. Essentially, while the statistical studies are showing minor variation, applying that to any one particular property whether plus or minus, would be unsupportable given that market imperfection is greater than that purported adjustment.

VII. Assessor Surveys

I have attempted to contact all of the assessor departments in North Carolina to determine how local assessors are handling solar farms and adjoining property values. I have spoken personally with a number of assessors, but much of this data was obtained via email. I have 39 counties in NC that have both responded to these questions on property value and also have solar farms in that county. I have excluded responses from assessors from counties where there are no current solar farms.

As can be seen in the chart below, of the 39 responses all of the responses have indicated that they make no adjustment to properties adjoining solar farms. Several assessors indicated that it would require an adjoining property owner to appeal their property value with data showing a negative impact before they would make any adjustment and to date they have not had that happen.

NC Assessor Survey on Solar Farm Property Value Impacts

County	Assessor's Name	Number of Farms	Change in Adjacent Property Value
Alexander	Doug Fox	3	No
Buncombe	Lisa Kirbo	1	No
Burke	Daniel Isenhour	3, 2 on 1 parcel, 1 on 3 parcels	No
Cabarrus	Justin	less than 10, more in the works	No
Caldwell	Monty Woods	3 small	No, but will look at data in 2025
Catawba	Lori Ray	14	No
Chatham	Jenny Williams	13	No
Cherokee	Kathy Killian	9	No
Chowan	Melissa Radke	3, 1 almost operational	No
Clay	Bonnie L. Lyvers	1	No
Davidson	Libby	1	No
Duplin	Gary Rose	34, 2 more in planning	No
Franklin	Marion Cascone	11	No
Gaston	Traci Hovis	3	No
Gates	Chris Hill	3	No
Granville	Jenny Griffin	8	No
Halifax	C. Shane Lynch	Multiple	No
Hoke	Mandi Davis	4	No
Hyde	Donnie Shumate	1 to supplement egg processing plant	No
Iredell	Wes Long	2, 3 others approved	No
Lee	Lisa Faulkner	8	No
Lincoln	Susan Sain	2	No
Moore	Michael Howery	10	No
New Hanover	Rhonda Garner	35	No
Orange	Chad Phillip	2 or 7 depending on breakdown	No
Pender	Kayla Bolick Futrell	6	No
Person	Russell Jones	9	No
Pitt	Russell D. Hill	8, 1 in planning	No
Randolph	Mark Frick	19	No
Rockingham	Mark C McClintock	6	No
Rutherford	Kim Aldridge	20	No
Sampson	Jim Johnson	9, 1 in construction	No
Scotland	James Brown	15, 1 in process	No
Stokes	Richard Brim	2	No
Surry	Penny Harrison	4, 2 more in process	No
Union	Robin E. Merry	6	No
Vance	Cathy E. Renn	13	No
Warren	John Preston	7	No
Wayne	Alan Lumpkin	32	No
Wilson	William (Witt) Putney	~16	No, mass appraisal standards applied

Responses: 39

Negative Impact on Adjoining Value = Yes: 0

Negative Impact on Adjoining Value = No: 39

I have completed similar surveys in a number of states and I have shown the breakdown of those responses below. I have not had any assessor indicate a negative adjustment due to adjacency to a solar farm in any state. These responses total 189 with 172 definitively indicating no negative adjustments are made to adjoining property values, 17 providing no response to the question, and 0 indicating that they do address a negative impact on adjoining property value.

Summary of Assessor Surveys

State	Responses	No Impact	Yes Impact	No Comment
North Carolina	39	39		
Virginia	17	17		
Indiana	31	31		
Colorado	15	8		7
Georgia	33	33		
Kentucky	10	6		4
Mississippi	4	2		2
New Mexico	5	5		
Ohio	24	20		4
South Carolina	11	11		
Totals	189	172	0	17

VIII. Randolph and Adjoining Counties Solar Farms Researched

Solar #	Name	County	City	Output (MW)	Total	Used	Avg. Dist	Closest	Adjoining Use by Acre				
					Acres	Acres	to home	Home	Res	Agri	Agri/Res	Com	
6	Strata	Chatham	Chapel Hill	1.57	14.154	14.154			100%	0%	0%	0%	
19	Vickers	Chatham	Chapel Hill	2	98.57	12.6			21%	58%	13%	8%	
39	Pit 64	Chatham	Siler City	5	47.92	47.92			2%	68%	30%	0%	
107	Haywood	Montgomery	Troy		99.16			625	275	25%	50%	26%	0%
142	Pine Valley	Moore	West End	4.996	89.44			830	140	7%	6%	80%	8%
143	Pinesage	Moore	West End	4.996	141.9	53	1,894	1,060	20%	80%	0%	0%	
148	Trinity	Randolph	Trinity		64.41	37.48		625	340	38%	29%	0%	33%
161	West Siler Suits	Chatham	Siler City		195.07			1,174	450	13%	57%	30%	0%
163	Siler 421	Chatham	Siler City		60.06			545	250	18%	78%	0%	4%
166	Moore I	Moore	Aberdeen	2.66	25.1			382	205	19%	81%	0%	0%
187	Bakatsias	Alamance	Graham	4.996	25.52			347	190	41%	0%	0%	59%
193	Climax	Randolph	Climax		48.07			661	191	17%	61%	22%	0%
202	Foxfire	Moore	West End	5	308.05			1,538	67	4%	96%	0%	0%
203	Spicewood	Moore	Candor	6.4	40.16			655	331	3%	0%	84%	13%
210	Sedberry Farm	Moore	Carthage	5	31.38	31.38		422	250	15%	51%	34%	0%
214	Henry	Randolph	Liberty	5	80.2	29.21		521	110	24%	50%	22%	4%
232	Dabestani	Moore	Biscoe	2.496	28.15			328	80	62%	38%	0%	0%
236	Mustang	Moore	Robbins	5	49.71			504	95	100%	0%	0%	0%
286	Pegasus	Chatham	Siler City	2.69	104.9	10.21		150	13%	87%	0%	0%	
307	Hopkins	Randolph	Denton		17	10	1,528	825	15%	64%	21%	0%	
308	Hopewell Friends	Randolph	Asheboro		16.2	11.8	288	255	100%	0%	0%	0%	
309	Morning View	Randolph	Seagrove		102.53		884	205	23%	71%	6%	0%	
313	Manning	Alamance	Elon		67.43	43.43	989	205	27%	37%	35%	0%	
326	Kendall	Randolph	Liberty	5	68.16	43.23	648	200	25%	75%	0%	0%	
327	Old Cedar	Randolph	Asheboro		45.48				49%	21%	0%	29%	
328	Zelda	Randolph	New Hope		21				10%	90%	0%	0%	
329	Spencer Meadow-Lo	Randolph	Asheboro		70.83				19%	0%	81%	0%	
349	Quincy	Davidson	Denton		189.02	38.81	1,255	445	41%	48%	10%	2%	
352	Gilead	Montgomery	Mount Gilead		102.61	22.71	792	235	3%	83%	12%	1%	
378	Lexington 64	Davidson	Lexington		117.13	43.19	1,082	520	30%	0%	64%	5%	
393	1003 Whitney	Alamance	Graham		142.47				30%	59%	11%	0%	
404	Flatwood	Chatham	Moncure		46.8	46.8	445	445	14%	6%	0%	79%	
453	Thomasville	Davidson	Thomasville	30	367.48	154	293	135	98%	0%	0%	2%	
464	Ridgeback	Randolph	Liberty		37.96		218	90	44%	53%	0%	3%	
481	West River Solar	Guilford	Whitsett		469.26	469.26	342	125	20%	45%	35%	0%	
487	Thunderhead	Randolph	Asheboro	2	37.3		629	175	63%	0%	0%	37%	
508	Clarksbury	Davidson	Thomasville	-	49.2	40.5	503	87	5%	40%	37%	18%	
522	Gladstone Farm	Moore	West End		72.48	32	3,975	470	8%	86%	6%	0%	
550	Whiskey Solar	Montgomery	Candor	6.986	85.19	55.2	344	175	13%	72%	15%	0%	
619	Healing Springs	Davidson	Denton		433.84	373.94	704	90	23%	73%	4%	0%	
623	Slider	Randolph	Trinity	5?	46.2	40.7	347	90	44%	35%	21%	0%	
694	Scout	Randolph	Staley	10	172.25	50	1,379	240	49%	36%	15%	0%	
705	County Farm	Guilford	Gibsonville		61.42	50.8	475	115	35%	52%	0%	14%	
718	Cabin Creek	Montgomery	Biscoe		117.47	117.47	-	-	3%	97%	0%	0%	
718	Cabin Creek Whole	Montgomery	Biscoe	70.5	929.9	834.2	-	-	13%	78%	9%	0%	
735	Quaker Creek	Alamance	Green Level		485.45	485.45	571	165	29%	38%	32%	1%	
820	Montgomery	Montgomery	Biscoe	25	196.85	196.85	1,860	1,475	18%	78%	5%	0%	
821	Biscoe	Montgomery	Star	6	49.15	49.15	1,213	770	9%	43%	48%	0%	
822	Filo	Montgomery	Troy	75	1207	1207	677	185	6%	80%	11%	3%	
867	South Davidson	Davidson	Denton	80	575	575	258	50	28%	60%	8%	4%	
869	Old River	Moore	Carthage	70	716.15	716.15	580	130	10%	49%	41%	0%	
978	Hoover	Davidson	Whitney	5	88.43	88.43	521	150	12%	65%	22%	2%	
998	Old Liberty	Randolph	Randleman	44	234.19	234.19	673	100	46%	33%	20%	1%	
1130	Slone	Davidson	Lexington		354.84	354.84	1326	180	8%	47%	45%	0%	
54													
Average				18.0	173.1	183.9	815	278	28%	48%	18%	6%	
Median				5.0	82.7	48.5	627	190	20%	51%	10%	0%	
High				80.0	1207.0	1207.0	3975	1475	100%	97%	84%	79%	
Low				1.6	14.2	10.0	218	50	2%	0%	0%	0%	

IX. Market Analysis of the Impact on Value from Solar Farms

I have researched hundreds of solar farms in numerous states to determine the impact of these facilities on the value of adjoining property. This research has primarily been in North Carolina, but I have also conducted market impact analyses in Virginia, South Carolina, Tennessee, Texas, Oregon, Mississippi, Maryland, New York, California, Missouri, Florida, Montana, Georgia, Louisiana, and New Jersey.

Wherever I have looked at solar farms, I have derived a breakdown of the adjoining uses to show what adjoining uses are typical for solar farms and what uses would likely be considered consistent with a solar farm use similar to the breakdown that I've shown for the subject property on the previous page. A summary showing the results of compiling that data over hundreds of solar farms is shown later in the Scope of Research section of this report.

I also consider whether the properties adjoining a solar farm in one location have characteristics similar to the properties abutting or adjoining the proposed site so that I can make an assessment of market impact on each proposed site. Notably, in most cases solar farms are placed in areas very similar to the site in question, which is surrounded by low density residential and agricultural uses. In my over 1,000 studies, I have found a striking repetition of that same typical adjoining use mix in over 90% of the solar farms I have looked at. Matched pair results in multiple states are strikingly similar, and all indicate that solar farms – which generate very little traffic, and do not generate noise, dust or have other harmful effects – do not negatively impact the value of adjoining or abutting properties.

On the following pages I have considered matched pair data specific to North Carolina.

In the next section I have considered matched pair data throughout the Southeast of the United States as being the most similar states that would most readily compare to North Carolina. This includes data from Florida, Georgia, South Carolina, North Carolina, Tennessee, Virginia and Maryland. I focused on projects of 5 MW and larger though I have significant supplemental data on solar farms just smaller than that in North Carolina that show similar results. This data is available in my files.

The primary reason I have focused on 5 MW and larger is that 5 MW is the most common size of a solar farm in NC and these larger projects have more data to show as well as more adjoining uses that may have sold. This substantially increases the amount of potential data that can be considered. Furthermore, the general expectation is that if a larger project has no negative impacts on property values, then smaller projects would have less cause for a negative impact. The data supports this expectation as outlined on Page 13 of this report.

I have additional supporting information from other states in my files that show a consistent pattern across the United States, but again, I have focused on the Southeast in this analysis with only a brief presentation of the national data.

A. North Carolina Data

The following pages detail the matched pairs and how they were derived.

1. Matched Pair – AM Best Solar Farm, Goldsboro, Wayne County, NC

This 5 MW solar farm adjoins Spring Garden Subdivision which had new homes and lots available for new construction during the approval and construction of the solar farm. The recent home sales have ranged from \$200,000 to \$250,000. This subdivision sold out the last homes in late 2014. The solar farm is clearly visible particularly along the north end of this street where there is only a thin line of trees separating the solar farm from the single-family homes.

Homes backing up to the solar farm are selling at the same price for the same floor plan as the homes that do not back up to the solar farm in this subdivision. According to the builder, the solar farm has been a complete non-factor. Not only do the sales show no difference in the price paid for the various homes adjoining the solar farm versus not adjoining the solar farm, but there are actually more recent sales along the solar farm than not. There is no impact on the sellout rate, or time to sell for the homes adjoining the solar farm.

I spoke with a number of owners who adjoin the solar farm and none of them expressed any concern over the solar farm impacting their property value.

The data presented on the following page shows multiple homes that have sold in 2013 and 2014 adjoining the solar farm at prices similar to those not along the solar farm. These series of sales indicate that the solar farm has no impact on the adjoining residential use.



The homes that were marketed at Spring Garden are shown below.

	Americana SqFt: 3,194 Bed / Bath: 3 / 3.5	Price: \$237,900 View Now »		Washington SqFt: 3,292 Bed / Bath: 4 / 3.5	Price: \$244,900 View Now »
	Presidential SqFt: 3,400 Bed / Bath: 5 / 3.5	Price: \$247,900 View Now »		Kennedy SqFt: 3,494 Bed / Bath: 5 / 3	Price: \$249,900 View Now »
	Virginia SqFt: 3,449 Bed / Bath: 5 / 3	Price: \$259,900 View Now »			

The homes adjoining the solar farm are considered to have a light landscaping screen as it is a narrow row of existing pine trees supplemented with evergreen plantings.

Matched Pairs

As of Date: 9/3/2014

Adjoining Sales After Solar Farm Completed

TAX ID	Owner	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	Style
3600195570	Helm	0.76	Sep-13	\$250,000	2013	3,292	\$75.94	2 Story
3600195361	Leak	1.49	Sep-13	\$260,000	2013	3,652	\$71.19	2 Story
3600199891	McBrayer	2.24	Jul-14	\$250,000	2014	3,292	\$75.94	2 Story
3600198632	Foresman	1.13	Aug-14	\$253,000	2014	3,400	\$74.41	2 Story
3600196656	Hinson	0.75	Dec-13	\$255,000	2013	3,453	\$73.85	2 Story
	Average	1.27		\$253,600	2013.4	3,418	\$74.27	
	Median	1.13		\$253,000	2013	3,400	\$74.41	

Adjoining Sales After Solar Farm Announced

TAX ID	Owner	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	Style
0	Feddersen	1.56	Feb-13	\$247,000	2012	3,427	\$72.07	Ranch
0	Gentry	1.42	Apr-13	\$245,000	2013	3,400	\$72.06	2 Story
	Average	1.49		\$246,000	2012.5	3,414	\$72.07	
	Median	1.49		\$246,000	2012.5	3,414	\$72.07	

Adjoining Sales Before Solar Farm Announced

TAX ID	Owner	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	Style
3600183905	Carter	1.57	Dec-12	\$240,000	2012	3,347	\$71.71	1.5 Story
3600193097	Kelly	1.61	Sep-12	\$198,000	2012	2,532	\$78.20	2 Story
3600194189	Hadwan	1.55	Nov-12	\$240,000	2012	3,433	\$69.91	1.5 Story
	Average	1.59		\$219,000	2012	2,940	\$74.95	
	Median	1.59		\$219,000	2012	2,940	\$74.95	

Nearby Sales After Solar Farm Completed

TAX ID	Owner	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	Style
3600193710	Barnes	1.12	Oct-13	\$248,000	2013	3,400	\$72.94	2 Story
3601105180	Nackley	0.95	Dec-13	\$253,000	2013	3,400	\$74.41	2 Story
3600192528	Mattheis	1.12	Oct-13	\$238,000	2013	3,194	\$74.51	2 Story
3600198928	Beckman	0.93	Mar-14	\$250,000	2014	3,292	\$75.94	2 Story
3600196965	Hough	0.81	Jun-14	\$224,000	2014	2,434	\$92.03	2 Story
3600193914	Preskitt	0.67	Jun-14	\$242,000	2014	2,825	\$85.66	2 Story
3600194813	Bordner	0.91	Apr-14	\$258,000	2014	3,511	\$73.48	2 Story
3601104147	Shaffer	0.73	Apr-14	\$255,000	2014	3,453	\$73.85	2 Story
	Average	0.91		\$246,000	2013.625	3,189	\$77.85	
	Median	0.92		\$249,000	2014	3,346	\$74.46	

Nearby Sales Before Solar Farm Announced

TAX ID	Owner	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	Style
3600191437	Thomas	1.12	Sep-12	\$225,000	2012	3,276	\$68.68	2 Story
3600087968	Lilley	1.15	Jan-13	\$238,000	2012	3,421	\$69.57	1.5 Story
3600087654	Burke	1.26	Sep-12	\$240,000	2012	3,543	\$67.74	2 Story
3600088796	Hobbs	0.73	Sep-12	\$228,000	2012	3,254	\$70.07	2 Story
	Average	1.07		\$232,750	2012	3,374	\$69.01	
	Median	1.14		\$233,000	2012	3,349	\$69.13	

Matched Pair Summary

	Adjoins Solar Farm		Nearby Solar Farm	
	Average	Median	Average	Median
Sales Price	\$253,600	\$253,000	\$246,000	\$249,000
Year Built	2013	2013	2014	2014
Size	3,418	3,400	3,189	3,346
Price/SF	\$74.27	\$74.41	\$77.85	\$74.46

Percentage Differences

Median Price	-2%
Median Size	-2%
Median Price/SF	0%

I note that 2308 Granville Drive sold again in November 2015 for \$267,500, or \$7,500 more than when it was purchased new from the builder two years earlier (Tax ID 3600195361, Owner: Leak). The neighborhood is clearly showing appreciation for homes adjoining the solar farm.

The Median Price is the best indicator to follow in any analysis as it avoids outlying samples that would otherwise skew the results. The median sizes and median prices are all consistent throughout the sales both before and after the solar farm whether you look at sites adjoining or nearby to the solar farm. The average size for the homes nearby the solar farm shows a smaller building size and a higher price per square foot. This reflects a common occurrence in real estate where the price per square foot goes up as the size goes down. So even comparing averages the indication is for no impact, but I rely on the median rates as the most reliable indication for any such analysis.

I have also considered four more recent resales of homes in this community as shown on the following page. These comparable sales adjoin the solar farm at distances ranging from 315 to 400 feet. The matched pairs show a range from -9% to +6%. The range of the average difference is -2% to +1% with an average of 0% and a median of +0.5%. These comparable sales support a finding of no impact on property value.

Adjoining Residential Sales After Solar Farm Approved

Parcel	Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	BR/BA	Park	Style	Other	Distance
	Adjoins	103 Granville Pl	1.42	7/27/2018	\$265,000	2013	3,292	\$80.50	4/3.5	2-Car	2-Story		385
	Not	2219 Granville	1.15	1/8/2018	\$260,000	2012	3,292	\$78.98	4/3.5	2-Car	2-Story		
	Not	634 Friendly	0.96	7/31/2019	\$267,000	2018	3,053	\$87.45	4/4.5	2-Car	2-Story		
	Not	2403 Granville	0.69	4/23/2019	\$265,000	2014	2,816	\$94.11	5/3.5	2-Car	2-Story		
	Solar	Address	Time	Site	YB	GLA	BR/BA	Park	Other	Total	% Diff	Avg % Diff	
	Adjoins	103 Granville Pl								\$265,000		-2%	
	Not	2219 Granville	\$4,382		\$1,300	\$0				\$265,682	0%		
	Not	634 Friendly	-\$8,303		-\$6,675	\$16,721	-\$10,000			\$258,744	2%		
	Not	2403 Granville	-\$6,029		-\$1,325	\$31,356				\$289,001	-9%		

Adjoining Residential Sales After Solar Farm Approved

Parcel	Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	BR/BA	Park	Style	Other	Distance
	Adjoins	104 Erin	2.24	6/19/2017	\$280,000	2014	3,549	\$78.90	5/3.5	2-Car	2-Story		315
	Not	2219 Granville	1.15	1/8/2018	\$260,000	2012	3,292	\$78.98	4/3.5	2-Car	2-Story		
	Not	634 Friendly	0.96	7/31/2019	\$267,000	2018	3,053	\$87.45	4/4.5	2-Car	2-Story		
	Not	2403 Granville	0.69	4/23/2019	\$265,000	2014	2,816	\$94.11	5/3.5	2-Car	2-Story		
	Solar	Address	Time	Site	YB	GLA	BR/BA	Park	Other	Total	% Diff	Avg % Diff	
	Adjoins	104 Erin								\$280,000		0%	
	Not	2219 Granville	-\$4,448		\$2,600	\$16,238				\$274,390	2%		
	Not	634 Friendly	-\$17,370		-\$5,340	\$34,702	-\$10,000			\$268,992	4%		
	Not	2403 Granville	-\$15,029		\$0	\$48,285				\$298,256	-7%		

Adjoining Residential Sales After Solar Farm Approved

Parcel	Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	BR/BA	Park	Style	Other	Distance
	Adjoins	2312 Granville	0.75	5/1/2018	\$284,900	2013	3,453	\$82.51	5/3.5	2-Car	2-Story		400
	Not	2219 Granville	1.15	1/8/2018	\$260,000	2012	3,292	\$78.98	4/3.5	2-Car	2-Story		
	Not	634 Friendly	0.96	7/31/2019	\$267,000	2018	3,053	\$87.45	4/4.5	2-Car	2-Story		
	Not	2403 Granville	0.69	4/23/2019	\$265,000	2014	2,816	\$94.11	5/3.5	2-Car	2-Story		
	Solar	Address	Time	Site	YB	GLA	BR/BA	Park	Other	Total	% Diff	Avg % Diff	
	Adjoins	2312 Granville								\$284,900		1%	
	Not	2219 Granville	\$2,476		\$1,300	\$10,173				\$273,948	4%		
	Not	634 Friendly	-\$10,260		-\$6,675	\$27,986	-\$10,000			\$268,051	6%		
	Not	2403 Granville	-\$7,972		-\$1,325	\$47,956				\$303,659	-7%		

Adjoining Residential Sales After Solar Farm Approved

Parcel	Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	BR/BA	Park	Style	Other	Distance
	Adjoins	2310 Granville	0.76	5/14/2019	\$280,000	2013	3,292	\$85.05	5/3.5	2-Car	2-Story		400
	Not	2219 Granville	1.15	1/8/2018	\$260,000	2012	3,292	\$78.98	4/3.5	2-Car	2-Story		
	Not	634 Friendly	0.96	7/31/2019	\$267,000	2018	3,053	\$87.45	4/4.5	2-Car	2-Story		
	Not	2403 Granville	0.69	4/23/2019	\$265,000	2014	2,816	\$94.11	5/3.5	2-Car	2-Story		
	Solar	Address	Time	Site	YB	GLA	BR/BA	Park	Other	Total	% Diff	Avg % Diff	
	Adjoins	2310 Granville								\$280,000		1%	
	Not	2219 Granville	\$10,758		\$1,300	\$0				\$272,058	3%		
	Not	634 Friendly	-\$1,755		-\$6,675	\$16,721	-\$10,000			\$265,291	5%		
	Not	2403 Granville	\$469		-\$1,325	\$31,356				\$295,500	-6%		

I have also considered the original sales prices in this subdivision relative to the recent resale values as shown in the chart below. This rate of annualized appreciation has been compared to the Federal Housing Finance Administration Home Price Index (FHFA HPI) for Goldsboro over the same time period. There are slight discrepancies given that the HPI is by quarter and especially in the 2021/2022 time period that could amount to as much as a 5 month difference which had significant variation in value in that time period. The appreciation rates in the non-2021/2022 time period are considered more reliable due to the atypical market in that time frame.

The average and median appreciation rates for the homes adjoining the solar farm are all higher than the FHFA HPI measured specifically for Goldsboro.

Furthermore, the home sale shown below at 2402 Granville Drive originally sold prior to the solar farm being announced or built. This Sale/Resale analysis not only shows no negative impact on the appreciation, but also shows no negative impact due to the solar farm being built at this location as the original 2012 sale was prior to any knowledge of a solar farm to adjoin this home.

Sale/Resale Appreciation

Address	Initial Sale		2nd Sale		Year Diff.	\$ Apprec.	% Apprec.	Annual Apprec.	FHFA HPI
	Date	Price	Date	Price					
1 103 Granville	Apr-13	\$245,000	Jul-18	\$265,000	5.32	\$20,000	8.16%	1.53%	0.56%
2 105 Erin	Jul-14	\$250,000	Jun-17	\$280,000	2.97	\$30,000	12.00%	4.04%	-0.34%
3 2312 Granville	Dec-13	\$255,000	May-15	\$262,000	1.41	\$7,000	2.75%	1.95%	-2.84%
4 2312 Granville	May-15	\$262,000	May-18	\$284,900	3	\$22,900	8.74%	2.91%	2.33%
5 2310 Granville	Aug-13	\$250,000	May-19	\$280,000	5.79	\$30,000	12.00%	2.07%	1.04%
6 2308 Granville	Sep-13	\$260,000	Nov-15	\$267,500	2.2	\$7,500	2.88%	1.31%	-0.91%
7 2304 Granville	Sep-12	\$198,000	Jun-17	\$225,000	4.75	\$27,000	13.64%	2.87%	-0.63%
8 102 Erin	Aug-14	\$253,000	Nov-16	\$270,000	2.25	\$17,000	6.72%	2.99%	1.33%
9 104 Erin	Jun-17	\$280,000	May-22	\$392,900	5.04	\$112,900	40.32%	8.00%	11.70%
10 2312 Granville	May-18	\$284,900	Sep-21	\$357,000	3.49	\$72,100	25.31%	7.26%	6.31%
11 2308 Granville	Nov-15	\$267,500	Apr-21	\$345,000	5.52	\$77,500	28.97%	5.25%	3.62%
12 2304 Granville	Jun-17	\$225,000	Apr-22	\$330,000	5.02	\$105,000	46.67%	9.29%	11.74%
13 2402 Granville	Dec-12	\$240,000	Jul-22	\$410,000	9.83	\$170,000	70.83%	7.21%	5.60%
							Avg	4.36%	3.04%
							Median	2.99%	1.33%

2. Matched Pair – Cookstown Solar Farm, Goldsboro, Wayne County, NC



This 5 MW solar farm was built between 2018 and 2019. I identified a series of sales of the home at 411 N Cottowood Drive over the last 8 years that I have researched with the most recent sale being in 2022. This home is 295 feet from the closest panel. I spoke with Natalie Barber with Statewide Realty (919-738-3270) who indicated that the solar farm had no impact on the sales price or marketing of the home. She noted that you could see the panels somewhat, but not much due to the landscaping.

On the chart below, I have included an analysis of the 2015 sale of the property prior to the solar farm to both the 2020 and the 2022 sales of this home. I have compared both of these sales prices to the FHFA HPI indicator of where the sales price should have appreciated to for comparison.

Cookstown Solar Farm

Address	Initial Sale		Second Sale		FHFA	\$	%
	Date	Price	Date	Price	HPI Value	Diff.	Diff.
1 411 N Cottonwood	6/30/2015	\$154,000	7/2/2020	\$182,000	\$172,000	\$10,000	5.81%
2 411 N Cottonwood	6/30/2015	\$154,000	10/31/2022	\$280,000	\$244,000	\$36,000	14.75%
3 411 N Cottonwood	7/2/2020	\$182,000	10/31/2022	\$280,000	\$259,000	\$21,000	8.11%
Average							9.56%
Median							8.11%
High							14.75%
Low							5.81%

This data shows that in every instance, the home adjoining the solar farm outperformed the expectation and this data strongly suggests a positive relationship between the solar farm and the adjoining home value.

3. Matched Pair – Solar Lee, Mt Olive, Wayne County, NC



This 4.9 MW solar farm was built between 2020 and 2021.

I identified a sale of a home at 296 Lees Country Club Road on April 13, 2022 for \$183,900. This home is across the street to the north near the east end of the project and is 185 feet from the closest solar panel.

Solar Lee, Lees Country Club Road, Mt. Olive, Wayne County, NC

Adjoining Residential Sales After Solar Farm Approved

Parcel	Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	BR/BA	Park	Style	Other	Distance
	Adjoins	296 Lees Cntry	0.93	4/13/2022	\$183,900	1969	1,975	\$93.11	4/2.5	Drive	Br-Rnch		185
	Not	601 Steele	0.41	5/12/2022	\$200,000	1964	1,966	\$101.73	3/2	2-Carprt	Br-Rnch		
	Not	106 College	0.50	2/11/2022	\$191,000	1960	2,050	\$93.17	3/2	Drive	Br-Rnch		
	Not	840 N Church	0.60	5/23/2022	\$210,000	1953	2,248	\$93.42	3/2	Crpt/Gar	Br-Rnch		
	Solar	Address	Time	Site	YB	GLA	BR/BA	Park	Other	Total	% Diff	Avg % Diff	
	Adjoins	296 Lees Cntry								\$183,900		-4%	
	Not	601 Steele	-\$1,466		\$5,000	\$458	-\$5,000		-\$10,000	\$188,991	-3%		
	Not	106 College	\$2,945		\$8,595	-\$3,494	-\$5,000			\$194,047	-6%		
	Not	840 N Church	-\$2,124		\$16,800	-\$12,751	-\$5,000		-\$15,000	\$191,925	-4%		

The paired sales all sold within a very similar time frame and support a difference of -4%, which is within the typical market imperfection and supports a finding of no impact at all.

4. Matched Pair – Gastonia Solar Center, Gastonia, Gaston County, NC



This 5 MW project is located on the south side of Neal Hawkins Road just outside of Gastonia. The property identified above as Parcel 4 was listed for sale while this solar farm project was going through the approval process. The property was put under contract during the permitting process with the permit being approved while the due diligence period was still ongoing. After the permit was approved the property closed with no concerns from the buyer. I spoke with Jennifer Bouvier, the broker listing the property and she indicated that the solar farm had no impact at all on the sales price. She considered some nearby sales to set the price and the closing price was very similar to the asking price within the typical range for the market. The buyer was aware that the solar farm was coming and they had no concerns.

This two-story brick dwelling was sold on March 20, 2017 for \$270,000 for a 3,437 square foot dwelling built in 1934 in average condition on 1.42 acres. The property has four bedrooms and two bathrooms. The landscaping screen is light for this adjoining home due to it being a new planted landscaping buffer.

Adjoining Residential Sales After Solar Farm Approved

Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GLA	BR/BA	Park	Style	Other
Adjoins	609 Neal Hawkins	1.42	3/20/2017	\$270,000	1934	3,427	\$78.79	4/2	Open	2-Brick	
Not	1418 N Modena	4.81	4/17/2018	\$225,000	1930	2,906	\$77.43	3/3	2-Crprt	2-Brick	
Not	363 Dallas Bess	2.90	11/29/2018	\$265,500	1968	2,964	\$89.57	3/3	Open	FinBsmt	
Not	1612 Dallas Chrv	2.74	9/17/2018	\$245,000	1951	3,443	\$71.16	3/2	Open	2-Brick	Unfin bath

Adjoining Sales Adjusted

[illegible]

I also considered the newer adjoining home identified as Parcel 5 that sold later in 2017 and it likewise shows no negative impact on property value. This is also considered a light landscaping buffer.

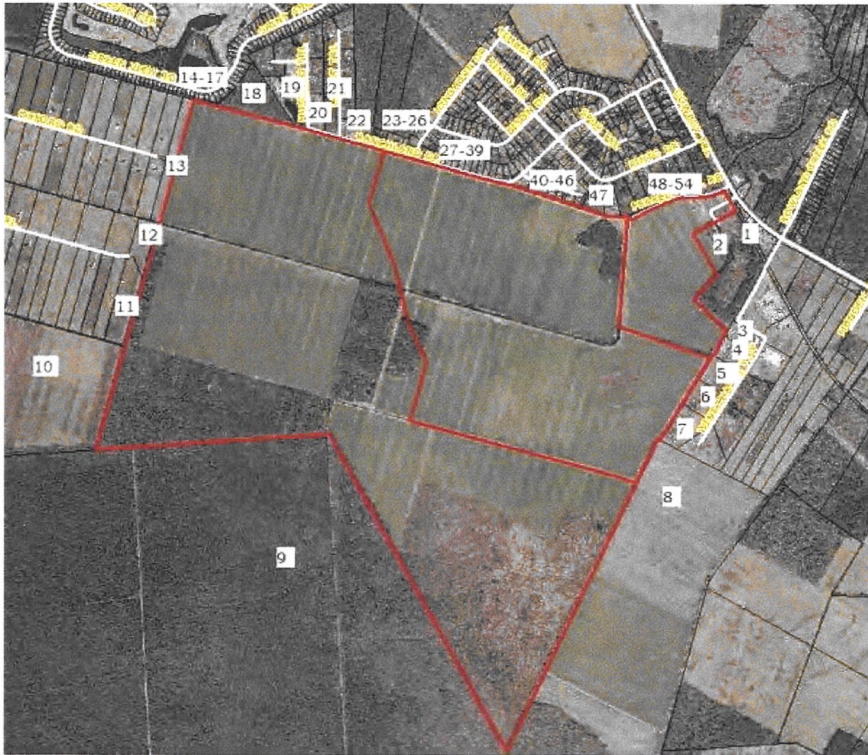
Adjoining Residential Sales After Solar Farm Approved

Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GLA	BR/BA	Park	Style
Adjoins	611 Neal Hawkins	0.78	7/6/2017	\$288,000	1991	2,256	\$127.66	5/3	2-Gar	1.5 Brick
Not	1211 Still Frst	0.51	7/30/2018	\$280,000	1989	2,249	\$124.50	3/3	2-Gar	Br Rnch
Not	2867 Colony Wds	0.52	8/14/2018	\$242,000	1990	2,006	\$120.64	3/3	2-Gar	Br Rnch
Not	1010 Strawberry	1.00	10/4/2018	\$315,000	2002	2,330	\$135.19	3/2.5	2-Gar	1.5 Brick

Adjoining Sales Adjusted

[illegible]

5. Matched Pair – Summit/Ranchlands Solar, Moyock, Currituck County, NC



This project is located at 1374 Caritoke Highway, Moyock, NC. This is an 80 MW facility on a parent tract of 2,034 acres. Parcels Number 48 and 53 as shown in the map above were sold in 2016. The project was under construction during the time period of the first of the matched pair sales and the permit was approved well prior to that in 2015.

I looked at multiple sales of adjoining and nearby homes and compared each to multiple comparables to show a range of impacts from -10% up to +11% with an average of +2% and a median of +3%. These ranges are well within typical real estate variation and supports an indication of no impact on property value.

Adjoining Residential Sales After Solar Farm Approved													
Parcel	Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	BR/BA	Park	Style	Other	Distance
48	Adjoins	129 Pinto	4.29	4/15/2016	\$170,000	1985	1,559	\$109.04	3/2	Drive	MFG		1,060
	Not	102 Timber	1.30	4/1/2016	\$175,500	2009	1,352	\$129.81	3/2	Drive	MFG		
	Not	120 Ranchland	0.99	10/1/2014	\$170,000	2002	1,501	\$113.26	3/2	Drive	MFG		
	Solar	Address	Time	Site	YB	GLA	BR/BA	Park	Other	Total	% Diff	Avg % Diff	
	Adjoins	129 Pinto								\$170,000		-3%	
	Not	102 Timber	\$276	\$10,000	-\$29,484	\$18,809				\$175,101	-3%		
	Not	120 Ranchland	\$10,735	\$10,000	-\$20,230	\$4,598				\$175,103	-3%		

Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GLA	BR/BA	Park	Style	Other
Adjoins	105 Pinto	4.99	12/16/2016	\$206,000	1978	1,484	\$138.81	3/2	Det G	Ranch	
Not	111 Spur	1.15	2/1/2016	\$193,000	1985	2,013	\$95.88	4/2	Gar	Ranch	
Not	103 Marshall	1.07	3/29/2017	\$196,000	2003	1,620	\$120.99	3/2	Drive	Ranch	
Not	127 Ranchland	0.00	6/9/2015	\$219,900	1988	1,910	\$115.13	3/2	Gar/3Det	Ranch	

Adjoining Sales Adjusted												Avg
Address	Time	Site	YB	GLA	BR/BA	Park	Other	Total	% Diff	% Diff	Distance	
105 Pinto								\$206,000			980	
111 Spur	\$6,747	\$10,000	-\$6,755	-\$25,359				\$177,633	14%			
103 Marshall	-\$2,212	\$10,000	-\$24,500	-\$8,227		\$5,000		\$176,212	14%			
127 Ranchland	\$13,399	\$10,000	-\$10,995	-\$24,523		-\$10,000		\$197,781	4%			
												11%

Adjoining Residential Sales After Solar Farm Built													
Parcel	Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	BR/BA	Park	Style	Other	Distance
15	Adjoins	318 Green View	0.44	9/15/2019	\$357,000	2005	3,460	\$103.18	4/4	2-Car	1.5 Brick		570
	Not	195 St Andrews	0.55	6/17/2018	\$314,000	2002	3,561	\$88.18	5/3	2-Car	2.0 Brick		
	Not	336 Green View	0.64	1/13/2019	\$365,000	2006	3,790	\$96.31	6/4	3-Car	2.0 Brick		
	Not	275 Green View	0.36	8/15/2019	\$312,000	2003	3,100	\$100.65	5/3	2-Car	2.0 Brick		
	Solar	Address	Time	Site	YB	GLA	BR/BA	Park	Other	Total	% Diff	Avg % Diff	
	Adjoins	318 Green View								\$357,000		4%	
	Not	195 St Andrews	\$12,040		\$4,710	-\$7,125	\$10,000			\$333,625	7%		
	Not	336 Green View	\$7,536		-\$1,825	-\$25,425			-\$5,000	\$340,286	5%		
	Not	275 Green View	\$815		\$3,120	\$28,986	\$10,000			\$354,921	1%		

Adjoining Residential Sales After Solar Farm Built

Parcel	Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	BR/BA	Park	Style	Other	Distance
29	Adjoins	164 Ranchland	1.01	4/30/2019	\$169,000	1999	2,052	\$82.36	4/2	Gar	MFG		440
	Not	150 Pinto	0.94	3/27/2018	\$168,000	2017	1,920	\$87.50	4/2	Drive	MFG		
	Not	105 Longhorn	1.90	10/10/2017	\$184,500	2002	1,944	\$94.91	3/2	Drive	MFG		
	Not	112 Pinto	1.00	7/27/2018	\$180,000	2002	1,836	\$98.04	3/2	Drive	MFG	Fenced	
													Avg
	Solar	Address	Time	Site	YB	GLA	BR/BA	Park	Other	Total	% Diff	% Diff	
	Adjoins	164 Ranchland								\$169,000		-10%	
	Not	150 Pinto	\$5,649		-\$21,168	\$8,085			\$5,000	\$165,566	2%		
	Not	105 Longhorn	\$8,816	-\$10,000	-\$3,875	\$7,175			\$5,000	\$191,616	-13%		
	Not	112 Pinto	\$4,202		-\$3,780	\$14,824			\$5,000	\$200,245	-18%		

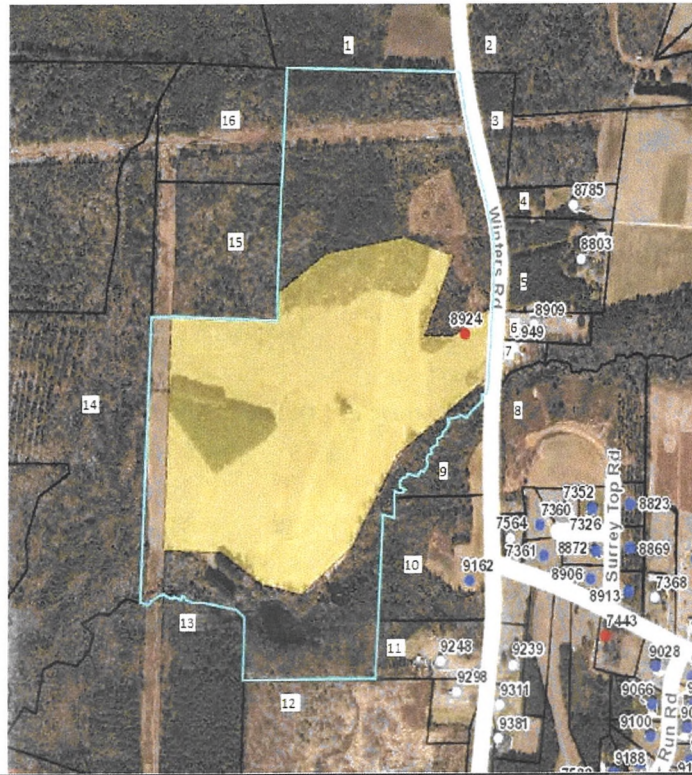
Adjoining Residential Sales After Solar Farm Built

Parcel	Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	BR/BA	Park	Style	Other	Distance
	Adjoins	358 Oxford	10.03	9/16/2019	\$478,000	2008	2,726	\$175.35	3/3	2 Gar	Ranch		635
	Not	276 Summit	10.01	12/20/2017	\$355,000	2006	1,985	\$178.84	3/2	2 Gar	Ranch		
	Not	176 Providence	6.19	5/6/2019	\$425,000	1990	2,549	\$166.73	3/3	4 Gar	Ranch	Brick	
	Not	1601 B Caratoke	12.20	9/26/2019	\$440,000	2016	3,100	\$141.94	4/3.5	5 Gar	Ranch	Pool	
													Avg
	Solar	Address	Time	Site	YB	GLA	BR/BA	Park	Other	Total	% Diff	% Diff	
	Adjoins	358 Oxford								\$478,000		5%	
	Not	276 Summit	\$18,996		\$3,550	\$106,017	\$10,000			\$493,564	-3%		
	Not	176 Providence	\$4,763		\$38,250	\$23,609		-\$10,000	-\$25,000	\$456,623	4%		
	Not	1601 B Caratoke	-\$371	\$50,000	-\$17,600	-\$42,467	-\$5,000	-\$10,000		\$414,562	13%		

Adjoining Residential Sales After Solar Farm Approved

Parcel	Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	BR/BA	Park	Style	Other	Distance
	Nearby	343 Oxford	10.01	3/9/2017	\$490,000	2016	3,753	\$130.56	3/3	2 Gar	1.5 Story	Pool	970
	Not	287 Oxford	10.01	9/4/2017	\$600,000	2013	4,341	\$138.22	5/4.5	8-Gar	1.5 Story	Pool	
	Not	301 Oxford	10.00	4/23/2018	\$434,000	2013	3,393	\$127.91	5/3	2 Gar	1.5 Story		
	Not	218 Oxford	10.01	4/4/2017	\$525,000	2006	4,215	\$124.56	4/3	4 Gar	1.5 Story	VG Barn	
													Avg
	Solar	Address	Time	Site	YB	GLA	BR/BA	Park	Other	Total	% Diff	% Diff	
	Adjoins	343 Oxford								\$490,000		3%	
	Not	287 Oxford	-\$9,051		\$9,000	-\$65,017	-\$15,000	-\$25,000		\$494,932	-1%		
	Not	301 Oxford	-\$14,995	-\$10,000	\$6,510	\$36,838				\$452,353	8%		
	Not	218 Oxford	-\$1,150		\$26,250	-\$46,036		-\$10,000	-\$10,000	\$484,064	1%		

6. Matched Pair – Tracy Solar, Bailey, Nash County, NC



This project is located in rural Nash County on Winters Road with a 5 MW facility that was built in 2016 on 50 acres. A local builder acquired parcels 9 and 10 following construction as shown below at rates comparable to other tracts in the area. They then built a custom home for an owner and sold that at a price similar to other nearby homes as shown in the matched pair data below. The retained woods provide a heavy landscaped buffer for this homesite.

Adjoining Land Sales After Solar Farm Completed

#	Solar Farm	TAX ID	Grantor	Grantee	Address	Acres	Date Sold	Sales Price	\$/AC	Other
9 & 10	Adjoins	316003	Cozart	Kingsmill	9162 Winters	13.22	7/21/2016	\$70,000	\$5,295	
		& 316004								
	Not	6056	Billingsly		427 Young	41	10/21/2016	\$164,000	\$4,000	
	Not	33211	Fulcher	Weikel	10533 Cone	23.46	7/18/2017	\$137,000	\$5,840	Doublewide, structures
	Not	106807	Perry	Gardner	Claude Lewis	11.22	8/10/2017	\$79,000	\$7,041	Gravel drive for sub, cleared
	Not	3437	Vaughan	N/A	11354 Old Lewis Sch	18.73	Listing	\$79,900	\$4,266	Small cemetery, wooded

Adjoining Sales Adjusted

Time	Acres	Location	Other	Adj \$/Ac	% Diff
				\$5,295	
\$0	\$400	\$0	\$0	\$4,400	17%
-\$292	\$292	\$0	-\$500	\$5,340	-1%
-\$352	\$0	\$0	-\$1,000	\$5,689	-7%
-\$213	\$0	\$0	\$213	\$4,266	19%
Average					7%

Adjoining Residential Sales After Solar Farm Completed

#	Solar Farm	n	Address	Acres	Date Sold	Sales Price	Built	GLA	\$/GLA	BR/BA	Style	Other
9 & 10	Adjoins	9	9162 Winters	13.22	1/5/2017	\$255,000	2016	1,616	\$157.80	3/2	Ranch	1296 sf wrkshp
	Not	iv	7352 Red Fox	0.93	6/30/2016	\$176,000	2010	1,529	\$115.11	3/2	2-story	

Adjoining Sales Adjusted

Time	Acres	YB	GLA	Style	Other	Total	% Diff
						\$255,000	
\$0	\$44,000	\$7,392	\$5,007	\$5,000	\$15,000	\$252,399	1%

The comparables for the land show either a significant positive relationship or a mild negative relationship to having and adjoining solar farm, but when averaged together they show no negative impact. The wild divergence is due to the difficulty in comping out this tract of land and the wide variety of comparables used. The two comparables that show mild negative influences include a property that was partly developed as a residential subdivision and the other included a doublewide with some value and accessory agricultural structures. The tax assessed value on the improvements were valued at \$60,000. So both of those comparables have some limitations for comparison. The two that show significant enhancement due to adjacency includes a property with a cemetery located in the middle and the other is a tract almost twice as large. Still that larger tract after adjustment provides the best matched pair as it required the least adjustment. I therefore conclude that there is no negative impact due to adjacency to the solar farm shown by this matched pair.

The dwelling that was built on the site was a build-to-suit and was compared to a nearby homesale of a property on a smaller parcel of land. I adjusted for that differenced based on a \$25,000 value for a 1-acre home site versus the \$70,000 purchase price of the larger subject tract. The other adjustments are typical and show no impact due to the adjacency to the solar farm.

The closest solar panel to the home is 780 feet away.

I note that the representative for Kingsmill Homes indicated that the solar farm was never a concern in purchasing the land or selling the home. He also indicated that they had built a number of nearby homes across the street and it had never come up as an issue.

7. Matched Pair – McBride Place Solar Farm, Midland, Cabarrus County, NC



This project is located on Mount Pleasant Road, Midland, North Carolina. The property is on 627 acres on an assemblage of 974.59 acres. The solar farm was approved in early 2017 for a 74.9 MW facility.

I have considered the sale of 4380 Joyner Road which adjoins the proposed solar farm near the northwest section. This property was appraised in April of 2017 for a value of \$317,000 with no consideration of any impact due to the solar farm in that figure. The property sold in November 2018 for \$325,000 with the buyer fully aware of the proposed solar farm. The landscaping buffer relative to Joyner Road, Hayden Way, Chanel Court and Kristi Lane is considered medium, while the landscaping for the home at the north end of Chanel Court is considered very light.

I have considered the following matched pairs to the subject property.

Adjoining Residential Sales After Solar Farm Approved

Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	BR/BA	Park	Style	Other
Adjoins	4380 Joyner	12.00	11/22/2017	\$325,000	1979	1,598	\$203.38	3/2	2xGar	Ranch	Outbldg
Not	3870 Elkwood	5.50	8/24/2016	\$250,000	1986	1,551	\$161.19	3/2.5	Det 2xGar	Craft	
Not	8121 Lower Rocky	18.00	2/8/2017	\$355,000	1977	1,274	\$278.65	2/2	2xCarprt	Ranch	Eq. Fac.
Not	13531 Cabarrus	7.89	5/20/2016	\$267,750	1981	2,300	\$116.41	3/2	2xGar	Ranch	

Adjoining Sales Adjusted

Time	Acres	YB	Condition	GLA	BR/BA	Park	Other	Total	% Diff
								\$325,000	
\$7,500	\$52,000	-\$12,250	\$10,000	\$2,273	-\$2,000	\$2,500	\$7,500	\$317,523	2%
\$7,100	-\$48,000	\$4,970		\$23,156	\$0	\$3,000	-\$15,000	\$330,226	-2%
\$8,033	\$33,000	-\$3,749	\$20,000	-\$35,832	\$0	\$0	\$7,500	\$296,702	9%
Average									3%

The home at 4380 Joyner Road is 275 feet from the closest solar panel.

I also considered the recent sale of a lot at 5800 Kristi Lane that is on the east side of the proposed solar farm. This 4.22-acre lot sold in December 2017 for \$94,000. A home was built on this lot in 2019 with the closest point from home to panel at 689 feet. The home site is heavily wooded and their remains a wooded buffer between the solar panels and the home. I spoke with the broker, Margaret Dabbs, who indicated that the solar farm was considered a positive by both buyer and seller as it ensures no subdivision will be happening in that area. Buyers in this market are looking for privacy and seclusion.

The breakdown of recent lot sales on Kristi are shown below with the lowest price paid for the lot with no solar farm exposure, though that lot has exposure to Mt Pleasant Road South. Still the older lot sales have exposure to the solar farm and sold for higher prices than the front lot and adjusting for time would only increase that difference.

Adjoining Lot Sales After Solar Farm Built

Parcel	Solar	Address	Acres	Date Sold	Sales Price	\$/AC	\$/Lot
	Adjoins	5811 Kristi	3.74	5/1/2018	\$100,000	\$26,738	\$100,000
	Adjoins	5800 Kristi	4.22	12/1/2017	\$94,000	\$22,275	\$94,000
	Not	5822 Kristi	3.43	2/24/2020	\$90,000	\$26,239	\$90,000

The lot at 5811 Kristi Lane sold in May 2018 for \$100,000 for a 3.74-acre lot. The home that was built later in 2018 is 505 feet to the closest solar panel. This home then sold to a homeowner for \$530,000 in April 2020. I have compared this home sale to other properties in the area as shown below.

Adjoining Residential Sales After Solar Farm Built

Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	BR/BA	Park	Style	Other
Adjoins	5811 Kristi	3.74	3/31/2020	\$530,000	2018	3,858	\$137.38	5/3.5	2 Gar	2-story	Cement Ext
Not	3915 Tania	1.68	12/9/2019	\$495,000	2007	3,919	\$126.31	3/3.5	2 Gar	2-story	3Det Gar
Not	6782 Manatee	1.33	3/8/2020	\$460,000	1998	3,776	\$121.82	4/2/2h	2 Gar	2-story	Water
Not	314 Old Hickory	1.24	9/20/2019	\$492,500	2017	3,903	\$126.18	6/4.5	2 Gar	2-story	

Solar	Address	Time	Site	YB	GLA	BR/BA	Park	Other	Total	% Diff	Avg % Diff
Adjoins	5811 Kristi								\$530,000		5%
Not	3915 Tania	\$6,285		\$27,225	-\$3,852		-\$20,000		\$504,657	5%	
Not	6782 Manatee	\$1,189		\$46,000	\$4,995	\$5,000			\$517,183	2%	
Not	314 Old Hickory	\$10,680		\$2,463	-\$2,839	-\$10,000			\$492,803	7%	

After adjusting the comparables, I found that the average adjusted value shows a slight increase in value for the subject property adjoining a solar farm. As in the other cases, this is a mild positive impact on value but within the typical range of real estate transactions.

I also looked at 5833 Kristi Lane that sold on 9/14/2020 for \$625,000. This home is 470 feet from the closest panel.

Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GLA	BR/BA	Park	Style	Other
Nearby	5833 Kristi	4.05	9/14/2020	\$625,000	2008	4,373	\$142.92	5/4	3-Car	2-Brick	
Not	4055 Dakeita	4.90	12/30/2020	\$629,000	2005	4,427	\$142.08	4/4	4-Car	2-Brick	4DetGar/Stable
Not	9615 Bales	2.16	6/30/2020	\$620,000	2007	4,139	\$149.79	4/5	3-Car	2-Stone	2DetGar
Not	9522 Bales	1.47	6/18/2020	\$600,000	2007	4,014	\$149.48	4/4.5	3-Car	2-Stone	

Adjoining Sales Adjusted

Address	Time	Site	YB	GLA	BR/BA	Park	Other	Total	% Diff	Avg % Diff	Distance
5833 Kristi								\$625,000			470
4055 Dakeita	-\$9,220		\$5,661	-\$6,138		-\$25,000		\$594,303	5%		
9615 Bales	\$6,455		\$1,860	\$28,042	-\$10,000	-\$15,000		\$631,356	-1%		
9522 Bales	\$7,233		\$1,800	\$42,930	-\$5,000			\$646,963	-4%		
										0%	

The average difference is 0% impact and the differences are all within a close range with this set of comparables and supports a finding of no impact on property value.

I have also looked at 4504 Chanel Court. This home sold on January 1, 2020 for \$393,500 for this 3,010 square foot home built in 2004 with 3 bedrooms, 3.5 bathrooms, and a 3-car garage. This home includes a full partially finished basement that significantly complicates comparing this to other sales. This home previously sold on January 23, 2017 for \$399,000. This was during the time that the solar farm was a known factor as the solar farm was approved in early 2017 and public discussions had already commenced. I spoke with Rachelle Killman with Real Estate Realty, LLC the buyer's agent for this transaction and she indicated that the solar farm was not a factor or consideration for the buyer. She noted that you could see the panels sort of through the trees, but it wasn't a concern for the buyer. She was not familiar with the earlier 2017 sale, but indicated that it was likely too high. This again goes back to the partially finished basement issue. The basement has a fireplace, and an installed 3/4 bathroom but otherwise bare studs and concrete floors with different buyers assigning varying value to that partly finished space. I also reached out to Don Gomez with Don Anthony Realty, LLC as he was the listing agent.

I also looked at the recent sale of 4599 Chanel Court. This home is within 310 feet of solar panels but notably does not have a good landscaping screen in place as shown in the photo below. The plantings appear to be less than 3-feet in height and only a narrow, limited screen of existing hardwoods were kept. The photograph is from the listing.

According to Scott David with Better Homes and Gardens Paracle Realty, this property was under contract for \$550,000 contingent on the buyer being able to sell their former home. The former home was apparently overpriced and did not sell and the contract stretched out over 2.5 months. The seller was in a bind as they had a home they were trying to buy contingent on this closing and were about to lose that opportunity. A cash buyer offered them a quick close at \$500,000 and the seller accepted that offer in order to not lose the home they were trying to buy. According to Mr. David, the original contracted buyer and the actual cash buyer never considered the solar farm as a negative. In fact Mr. David noted that the actual buyer saw it as a great opportunity to purchase a home where a new subdivision could not be built behind his house. I therefore conclude that this property supports a finding of no impact on adjoining property, even where the landscaping screen still requires time to grow in for a year-round screen.

I also considered a sale/resale analysis on this property. This same home sold on September 15, 2015 for \$462,000. Adjusting this upward by 5% per year for the five years between these sales dates suggests a value of \$577,500. Comparing that to the \$550,000 contract that suggests a 5% downward impact, which is within a typical market variation. Given that the broker noted no negative impact from the solar farm and the analysis above, I conclude this sale supports a finding of no impact on value.



8. Matched Pair – Mariposa Solar, Gaston County, NC



This project is a 5 MW facility located on 35.80 acres out of a parent tract of 87.61 acres at 517 Blacksnake Road, Stanley that was built in 2016.

I have considered a number of recent sales around this facility as shown below.

The first is identified in the map above as Parcel 1, which is 215 Mariposa Road. This is an older dwelling on large acreage with only one bathroom. I've compared it to similar nearby homes as shown below. The landscaping buffer for this home is considered light.

Adjoining Residential Sales After Solar Farm Approved

Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	BR/BA	Park	Style
Adjoins	215 Mariposa	17.74	12/12/2017	\$249,000	1958	1,551	\$160.54	3/1	Garage	Br/Rnch
Not	249 Mariposa	0.48	3/1/2019	\$153,000	1974	1,792	\$85.38	4/2	Garage	Br/Rnch
Not	110 Airport	0.83	5/10/2016	\$166,000	1962	2,165	\$76.67	3/2	Crprt	Br/Rnch
Not	1249 Blacksnake	5.01	9/20/2018	\$242,500	1980	2,156	\$112.48	3/2	Drive	1.5
Not	1201 Abernathy	27.00	5/3/2018	\$390,000	1970	2,190	\$178.08	3/2	Crprt	Br/Rnch

Adjoining Residential Sales After Solar Farm Approved					Adjoining Sales Adjusted								
Solar	Address	Acres	Date Sold	Sales Price	Time	YB	Acres	GLA	BR/BA	Park	Other	Total	% Diff
Adjoins	215 Mariposa	17.74	12/12/2017	\$249,000								\$249,000	
Not	249 Mariposa	0.48	3/1/2019	\$153,000	-\$5,583	-\$17,136	\$129,450	-\$20,576	-\$10,000			\$229,154	8%
Not	110 Airport	0.83	5/10/2016	\$166,000	\$7,927	-\$4,648	\$126,825	-\$47,078	-\$10,000			\$239,026	4%
Not	1249 Blacksnake	5.01	9/20/2018	\$242,500	-\$5,621	-\$37,345	\$95,475	-\$68,048	-\$10,000	\$5,000		\$221,961	11%
Not	1201 Abernathy	27.00	5/3/2018	\$390,000	-\$4,552	-\$32,760	-\$69,450	-\$60,705	-\$10,000			\$212,533	15%
Average													9%

The average difference after adjusting for all factors is +9% on average, which suggests an enhancement due to the solar farm across the street. Given the large adjustments for acreage and size, I will focus on the low end of the adjusted range at 4%, which is within the typical deviation and therefore suggests no impact on value.

I have also considered Parcel 4 that sold after the solar farm was approved but before it had been constructed in 2016. The landscaping buffer for this parcel is considered light.

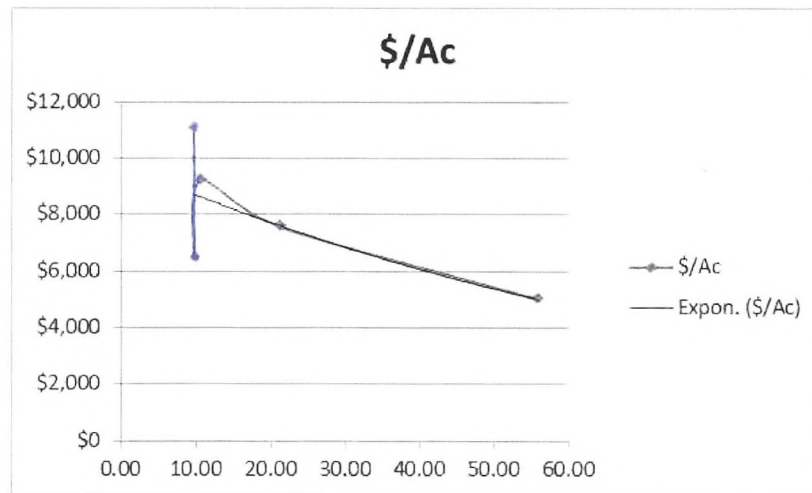
Adjoining Residential Sales After Solar Farm Approved					Adjoining Sales Adjusted								
Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	BR/BA	Park	Style	Other	Total	% Diff
Adjoins	242 Mariposa	2.91	9/21/2015	\$180,000	1962	1,880	\$95.74	3/2	Carport	Br/Rnch	Det Wrkshop		
Not	249 Mariposa	0.48	3/1/2019	\$153,000	1974	1,792	\$85.38	4/2	Garage	Br/Rnch			
Not	110 Airport	0.83	5/10/2016	\$166,000	1962	2,165	\$76.67	3/2	Crprt	Br/Rnch			
Not	1249 Blacksnake	5.01	9/20/2018	\$242,500	1980	2,156	\$112.48	3/2	Drive		1.5		

Adjoining Residential Sales After Solar Farm Approved					Adjoining Sales Adjusted								
Solar	Address	Acres	Date Sold	Sales Price	Time	YB	Acres	GLA	BR/BA	Park	Other	Total	% Diff
Adjoins	242 Mariposa	2.91	9/21/2015	\$180,000								\$180,000	
Not	249 Mariposa	0.48	3/1/2019	\$153,000	-\$15,807	-\$12,852	\$18,468	\$7,513		-\$3,000	\$25,000	\$172,322	4%
Not	110 Airport	0.83	5/10/2016	\$166,000	-\$3,165	\$0	\$15,808	-\$28,600			\$25,000	\$175,043	3%
Not	1249 Blacksnake	5.01	9/20/2018	\$242,500	-\$21,825	-\$30,555	-\$15,960	-\$40,942		\$2,000	\$25,000	\$160,218	11%
Average													6%

The average difference after adjusting for all factors is +6%, which is again suggests a mild increase in value due to the adjoining solar farm use. The median is a 4% adjustment, which is within a standard deviation and suggests no impact on property value.

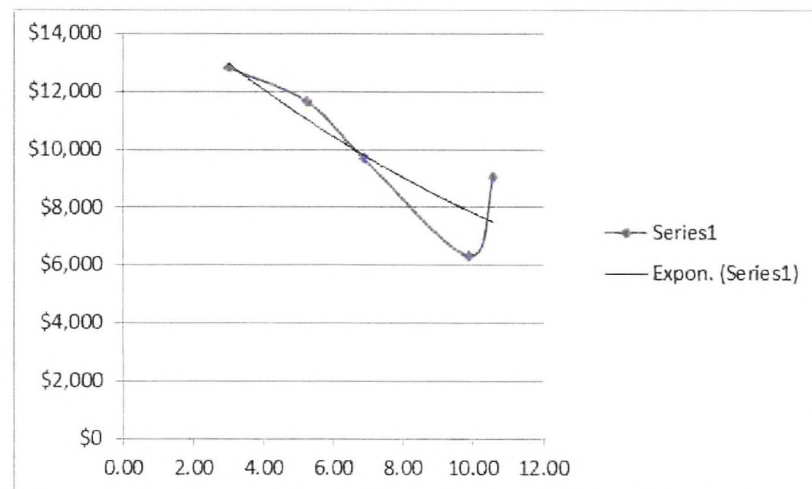
I have also considered the recent sale of Parcel 13 that is located on Blacksnake Road south of the project. I was unable to find good land sales in the same 20-acre range, so I have considered sales of larger and smaller acreage. I adjusted each of those land sales for time. I then applied the price per acre to a trendline to show where the expected price per acre would be for 20 acres. As can be seen in the chart below, this lines up exactly with the purchase of the subject property. I therefore conclude that there is no impact on Parcel 13 due to proximity to the solar farm.

Adjoining Residential Land Sales After Solar Farm Approved						Adjoining Sales Adjusted	
Solar	Tax/Street	Acres	Date Sold	Sales Price	\$/Ac	Time	\$/Ac
Adjoins	174339/Blacksnake	21.15	6/29/2018	\$160,000	\$7,565		\$7,565
Not	227852/Abernathy	10.57	5/9/2018	\$97,000	\$9,177	\$38	\$9,215
Not	17443/Legion	9.87	9/7/2018	\$64,000	\$6,484	-\$37	\$6,447
Not	164243/Alexis	9.75	2/1/2019	\$110,000	\$11,282	-\$201	\$11,081
Not	176884/Bowden	55.77	6/13/2018	\$280,000	\$5,021	\$7	\$5,027



Finally, I have considered the recent sale of Parcel 17 that sold as vacant land. I was unable to find good land sales in the same 7-acre range, so I have considered sales of larger and smaller acreage. I adjusted each of those land sales for time. I then applied the price per acre to a trendline to show where the expected price per acre would be for 7 acres. As can be seen in the chart below, this lines up with the trendline running right through the purchase price for the subject property. I therefore conclude that there is no impact on Parcel 13 due to proximity to the solar farm. I note that this property was improved with a 3,196 square foot ranch built in 2018 following the land purchase, which shows that development near the solar farm was unimpeded.

Adjoining Residential Land Sales After Solar Farm Approved						Adjoining Sales Adjusted		
Solar	Tax/Street	Acres	Date Sold	Sales Price	\$/Ac	Time	Location	\$/Ac
Adjoins	227039/Mariposa	6.86	12/6/2017	\$66,500	\$9,694			\$9,694
Not	227852/Abernathy	10.57	5/9/2018	\$97,000	\$9,177	-\$116		\$9,061
Not	17443/Legion	9.87	9/7/2018	\$64,000	\$6,484	-\$147		\$6,338
Not	177322/Robinson	5.23	5/12/2017	\$66,500	\$12,715	\$217	-\$1,272	\$11,661
Not	203386/Carousel	2.99	7/13/2018	\$43,500	\$14,548	-\$262	-\$1,455	\$12,832



9. Matched Pair – Candace Solar, Princeton, Johnston County, NC



This 5 MW solar farm is located at 4839 US 70 Highway just east of Herring Road. This solar farm was completed on October 25, 2016.

I identified three adjoining sales to this tract after development of the solar farm with frontage on US 70. I did not attempt to analyze those sales as they have exposure to an adjacent highway and railroad track. Those homes are therefore problematic for a matched pair analysis unless I have similar homes fronting on a similar corridor.

I did consider a land sale and a home sale on adjoining parcels without those complications.

The lot at 499 Herring Road sold to Paradise Homes of Johnston County of NC, Inc. for \$30,000 in May 2017 and a modular home was placed there and sold to Karen and Jason Toole on September 29, 2017. I considered the lot sale first as shown below and then the home sale that followed. The landscaping buffer relative to this parcel is considered medium.

Adjoining Land Sales After Solar Farm Approved							Adjoining Sales Adjusted				
Parcel	Solar	Address	Acres	Date Sold	Sales Price	Other	Time	Site	Other	Total	% Diff
16	Adjoins	499 Herring	2.03	5/1/2017	\$30,000					\$30,000	
	Not	37 Becky	0.87	7/23/2019	\$24,500	Sub/Pwr	-\$1,679	\$4,900		\$27,721	8%
	Not	5858 Bizzell	0.88	8/17/2016	\$18,000		\$390	\$3,600		\$21,990	27%
	Not	488 Herring	2.13	12/20/2016	\$35,000		\$389			\$35,389	-18%
Average											5%

Following the land purchase, the modular home was placed on the site and sold. I have compared this modular home to the following sales to determine if the solar farm had any impact on the purchase price.

Adjoining Residential Sales After Solar Farm Approved												
Parcel	Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	BR/BA	Park	Style	Other
16	Adjoins	499 Herring	2.03	9/27/2017	\$215,000	2017	2,356	\$91.26	4/3	Drive	Modular	
	Not	678 WC	6.32	3/8/2019	\$226,000	1995	1,848	\$122.29	3/2.5	Det Gar	Mobile	Ag bldgs
	Not	1810 Bay V	8.70	3/26/2018	\$170,000	2003	2,356	\$72.16	3/2	Drive	Mobile	Ag bldgs
	Not	1795 Bay V	1.78	12/1/2017	\$194,000	2017	1,982	\$97.88	4/3	Drive	Modular	

Adjoining Residential Sales After Solar Farm Approved												
Parcel	Solar	Address	Time	Site	YB	GLA	BR/BA	Park	Other	Total	% Diff	Avg % Diff Distance
16	Adjoins	499 Herring								\$215,000		488
	Not	678 WC	-\$10,037	-\$25,000	\$24,860	\$37,275	-\$5,000	-\$7,500	-\$20,000	\$220,599	-3%	
	Not	1810 Bay V	-\$2,579	-\$20,000	\$11,900	\$0				\$159,321	26%	
	Not	1795 Bay V	-\$1,063		\$0	\$21,964				\$214,902	0%	
											8%	

The best comparable is 1795 Bay Valley as it required the least adjustment and was therefore most similar, which shows a 0% impact, while the average impact was +8%. This signifies no impact related to the solar farm on the finished home and the average land value impact was +5%, which also supports a finding of no impact on property value.

10. Matched Pair – Innovative Solar 46, Roslin Farm Rd, Hope Mills, Cumberland County, NC



This project was built in 2016 and located on 532 acres for a 78.5 MW solar farm with the closest home at 125 feet from the closest solar panel with an average distance of 423 feet.

I considered the recent sale of a home on Roslin Farm Road just north of Running Fox Road as shown below.

Adjoining Residential Sales After Solar Farm Approved

Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	BR/BA	Park	Style	Other	Distance
Adjoins	6849 Roslin Farm	1.00	2/18/2019	\$155,000	1967	1,610	\$96.27	3/3	Drive	Ranch	Brick	435
Not	6592 Sim Canady	2.43	9/5/2017	\$185,000	1974	2,195	\$84.28	3/2	Gar	Ranch	Brick	
Not	1614 Joe Hall	1.63	9/3/2019	\$145,000	1974	1,674	\$86.62	3/2	Det Gar	Ranch	Brick	
Not	109 Bledsoe	0.68	1/17/2019	\$150,000	1973	1,663	\$90.20	3/2	Gar	Ranch	Brick	

Solar	Address	Time	Site	YB	GLA	BR/BA	Park	Other	Total	% Diff	Avg % Diff
Adjoins	6849 Roslin Farm								\$155,000		5%
Not	6592 Sim Canady	\$8,278		-\$6,475	-\$39,444	\$10,000	-\$5,000		\$152,359	2%	
Not	1614 Joe Hall	-\$2,407		-\$5,075	-\$3,881	\$10,000	-\$2,500		\$141,137	9%	
Not	109 Bledsoe	\$404	\$10,000	-\$4,500	-\$3,346		-\$5,000		\$147,558	5%	

This sale supports an indication of no impact on property value. The landscaping buffer is considered light.

11. Matched Pair – Innovative Solar 42, County Line Rd, Fayetteville, Cumberland County, NC



This project was built in 2017 and located on 413.99 acres for a 71 MW with the closest home at 135 feet from the closest solar panel with an average distance of 375 feet.

I considered the recent sales identified on the map above as Parcels 2 and 3, which is directly across the street these homes are 330 and 340 feet away. Parcel 2 includes an older home built in 1976, while Parcel 3 is a new home built in 2019. So the presence of the solar farm had no impact on new construction in the area.

The matched pairs for each of these are shown below. The landscaping buffer relative to these parcels is considered light.

Adjoining Residential Sales After Solar Farm Approved

Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	BR/BA	Park	Style	Other	Distance
Adjoins	2923 County Ln	8.98	2/28/2019	\$385,000	1976	2,905	\$132.53	3/3	2-Car	Ranch	Brick/Pond	340
Not	1928 Shaw Mill	17.00	7/3/2019	\$290,000	1977	3,001	\$96.63	4/4	2-Car	Ranch	Brick/Pond/Rental	
Not	2109 John McM.	7.78	4/25/2018	\$320,000	1978	2,474	\$129.35	3/2	Det Gar	Ranch	Vinyl/Pool,Stable	

Solar	Address	Time	Site	YB	GLA	BR/BA	Park	Other	Total	% Diff	Avg % Diff
Adjoins	2923 County Ln								\$385,000		3%
Not	1928 Shaw Mill	-\$3,055	\$100,000	-\$1,450	-\$7,422	-\$10,000			\$368,074	4%	
Not	2109 John McM.	\$8,333		-\$3,200	\$39,023	\$10,000		\$5,000	\$379,156	2%	

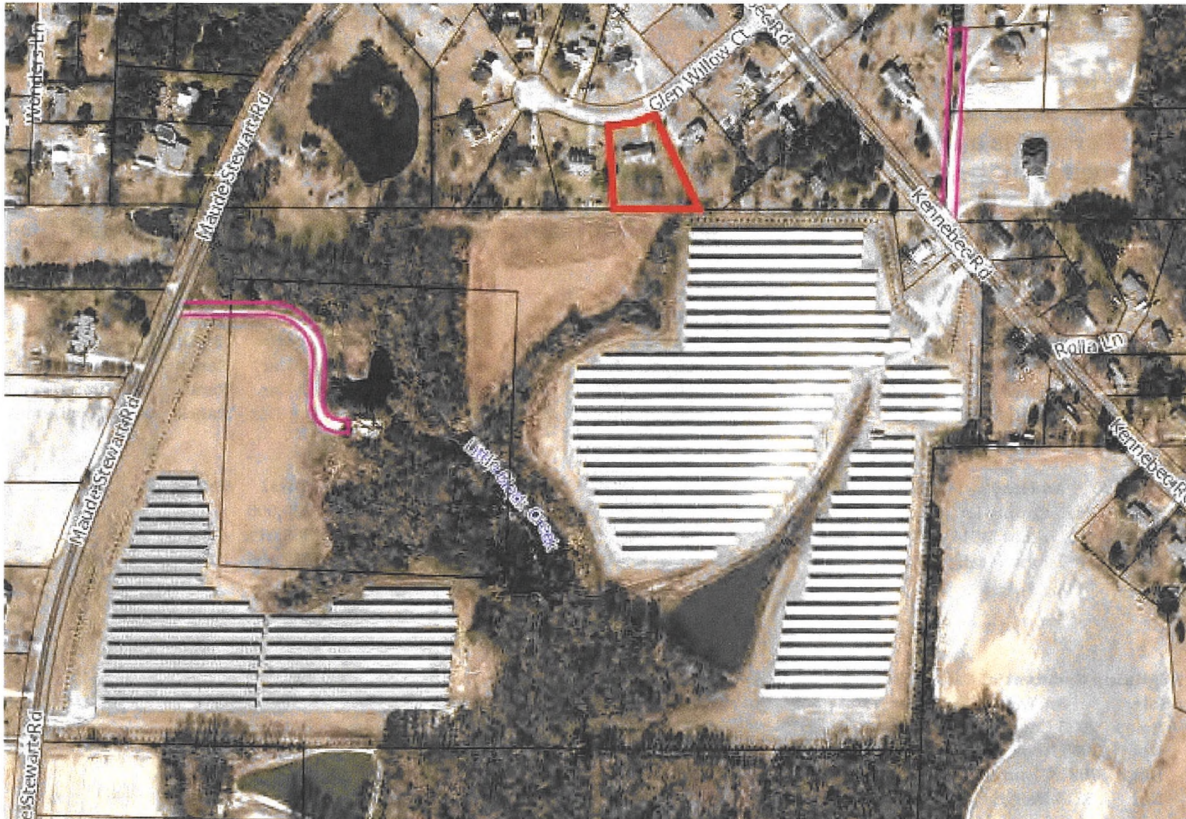
Adjoining Residential Sales After Solar Farm Approved

Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	BR/BA	Park	Style	Other	Distance
Adjoins	2935 County Ln	1.19	6/18/2019	\$266,000	2019	2,401	\$110.79	4/3	Gar	2-Story		330
Not	3005 Hemingway	1.17	5/16/2019	\$269,000	2018	2,601	\$103.42	4/3	Gar	2-Story		
Not	7031 Glynn Mill	0.60	5/8/2018	\$255,000	2017	2,423	\$105.24	4/3	Gar	2-Story		
Not	5213 Bree Brdg	0.92	5/7/2019	\$260,000	2018	2,400	\$108.33	4/3	3-Gar	2-Story		

Solar	Address	Time	Site	YB	GLA	BR/BA	Park	Other	Total	% Diff	Avg % Diff
Adjoins	2935 County Ln								\$266,000		3%
Not	3005 Hemingway	\$748		\$1,345	-\$16,547				\$254,546	4%	
Not	7031 Glynn Mill	\$8,724		\$2,550	-\$1,852				\$264,422	1%	
Not	5213 Bree Brdg	\$920		\$1,300	\$76			-\$10,000	\$252,296	5%	

Both of these matched pairs adjust to an average of +3% on impact for the adjoining solar farm, meaning there is a slight positive impact due to proximity to the solar farm. This is within the standard +/- of typical real estate transactions, which strongly suggests no impact on property value. I noted specifically that for 2923 County Line Road, the best comparable is 2109 John McMillan as it does not have the additional rental unit on it. I made no adjustment to the other sale for the value of that rental unit, which would have pushed the impact on that comparable downward – meaning there would have been a more significant positive impact.

12. Matched Pair – Sunfish Farm, Keenebec Rd, Willow Spring, Wake County, NC



This project was built in 2015 and located on 49.6 acres (with an inset 11.25-acre parcel) for a 6.4 MW project with the closest home at 135 feet with an average distance of 105 feet.

I considered the 2017 sale identified on the map above, which is 205 feet away from the closest panel. The matched pairs for each of these are shown below followed by a more recent map showing the panels at this site.

Adjoining Residential Sales After Solar Farm Approved

Parcel	Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	BR/BA	Park	Style
	Adjoins	7513 Glen Willow	0.79	9/1/2017	\$185,000	1989	1,492	\$123.99	3/2	Gar	BR/Rnch
	Not	2968 Tram	0.69	7/17/2017	\$155,000	1984	1,323	\$117.16	3/2	Drive	BR/Rnch
	Not	205 Pine Burr	0.97	12/29/2017	\$191,000	1991	1,593	\$119.90	3/2.5	Drive	BR/Rnch
	Not	1217 Old Honeycutt	1.00	12/15/2017	\$176,000	1978	1,558	\$112.97	3/2.5	2Carprt	VY/Rnch

Adjustments

Solar	Address	Time	Site	YB	GLA	BR/BA	Park	Other	Total	% Diff	Avg % Diff
Adjoins	7513 Glen Willow								\$185,000		
Not	2968 Tram	\$601		\$3,875	\$15,840		\$10,000		\$185,316	0%	
Not	205 Pine Burr	-\$1,915		-\$1,910	-\$9,688	-\$5,000			\$172,487	7%	
Not	1217 Old Honeycutt	-\$1,557		\$9,680	-\$5,965	-\$5,000		\$5,280	\$178,438	4%	
											3%

The average difference in the three comparables and the subject property is +3% after adjusting for differences in the sales date, year built, gross living area, and other minor differences. This data is supported by the comments from the broker Brian Schroeffer with Keller Williams that the solar farm had no impact on the purchase price. The landscaping screen is considered light.

13. Matched Pair – Camden Dam, Camden, Camden County, NC



This 5 MW project was built in 2019 and located on a portion of 49.83 acres.

Parcel 1 noted above along with the home on the adjoining parcel to the north of that parcel sold in late 2018 after this solar farm was approved but prior to construction being completed in 2019. I have considered this sale as shown below. The landscaping screen is considered light.

Adjoining Residential Sales After Solar Farm Approved

Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GLA	BR/BA	Park	Style	Other
Adjoins	122 N Mill Dam	12.19	11/29/2018	\$350,000	2005	2,334	\$149.96	3/3.5	3-Gar	Ranch	
Not	548 Trotman	12.10	5/31/2018	\$309,000	2007	1,960	\$157.65	4/2	Det2G	Ranch	Wrkshp
Not	198 Sand Hills	2.00	12/22/2017	\$235,000	2007	2,324	\$101.12	4/3	Open	Ranch	
Not	140 Sleepy Hlwr	2.05	8/12/2019	\$330,000	2010	2,643	\$124.86	4/3	1-Gar	1.5 Story	

Adjoining Sales Adjusted

Address	Time	Site	YB	GLA	BR/BA	Park	Other	Total	% Diff	Avg % Diff	Distance
122 N Mill Dam								\$350,000			342
548 Trotman	\$6,163		-\$3,090	\$35,377	\$5,000			\$352,450	-1%		
198 Sand Hills	\$8,808	\$45,000	-\$2,350	\$607		\$30,000		\$317,064	9%		
140 Sleepy Hlwr	-\$9,258	\$45,000	-\$8,250	-\$23,149	\$5,000	\$30,000		\$369,343	-6%		
										1%	

The comparable at 548 Trotman is the most similar and required the least adjustment shows no impact on property value. The other two comparables were adjusted consistently with one showing significant enhancement and another as showing a mild negative. The best indication is the one requiring the least adjustment. The other two sales required significant site adjustments which make them less reliable. The best comparable and the average of these comparables support a finding of no impact on property value.

14. Matched Pair – Grandy Solar, Grandy, Currituck County, NC



This 20 MW project was built in 2019 and located on a portion of 121 acres.

Parcels 40 and 50 have sold since construction began on this solar farm. I have considered both in matched pair analysis below. I note that the marketing for Parcel 40 (120 Par Four) identified the lack of homes behind the house as a feature in the listing. The marketing for Parcel 50 (269 Grandy) identified the property as "very private." Landscaping for both of these parcels is considered light.

Adjoining Residential Sales After Solar Farm Approved

Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GLA	BR/BA	Park	Style	Other
Adjoins	120 Par Four	0.92	8/17/2019	\$315,000	2006	2,188	\$143.97	4/3	2-Gar	1.5 Story	Pool
Not	102 Teague	0.69	1/5/2020	\$300,000	2005	2,177	\$137.80	3/2	Det 3G	Ranch	
Not	112 Meadow Lk	0.92	2/28/2019	\$265,000	1992	2,301	\$115.17	3/2	Gar	1.5 Story	
Not	116 Barefoot	0.78	9/29/2020	\$290,000	2004	2,192	\$132.30	4/3	2-Gar	2 Story	

Adjoining Sales Adjusted

Address	Time	Site	YB	GLA	BR/BA	Park	Other	Total	% Diff	Avg % Diff	Distance
120 Par Four								\$315,000			405
102 Teague	-\$4,636		\$1,500	\$910	\$10,000		\$20,000	\$327,774	-4%		
112 Meadow Lk	\$4,937		\$18,550	-\$7,808	\$10,000	\$10,000	\$20,000	\$320,679	-2%		
116 Barefoot	-\$12,998		\$2,900	-\$318			\$20,000	\$299,584	5%		

0%

Adjoining Residential Sales After Solar Farm Approved

Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GLA	BR/BA	Park	Style	Other
Adjoins	269 Grandy	0.78	5/7/2019	\$275,000	2019	1,535	\$179.15	3/2.5	2-Gar	Ranch	
Not	307 Grandy	1.04	10/8/2018	\$240,000	2002	1,634	\$146.88	3/2	Gar	1.5 Story	
Not	103 Branch	0.95	4/22/2020	\$230,000	2000	1,532	\$150.13	4/2	2-Gar	1.5 Story	
Not	103 Spring Lf	1.07	8/14/2018	\$270,000	2002	1,635	\$165.14	3/2	2-Gar	Ranch	Pool

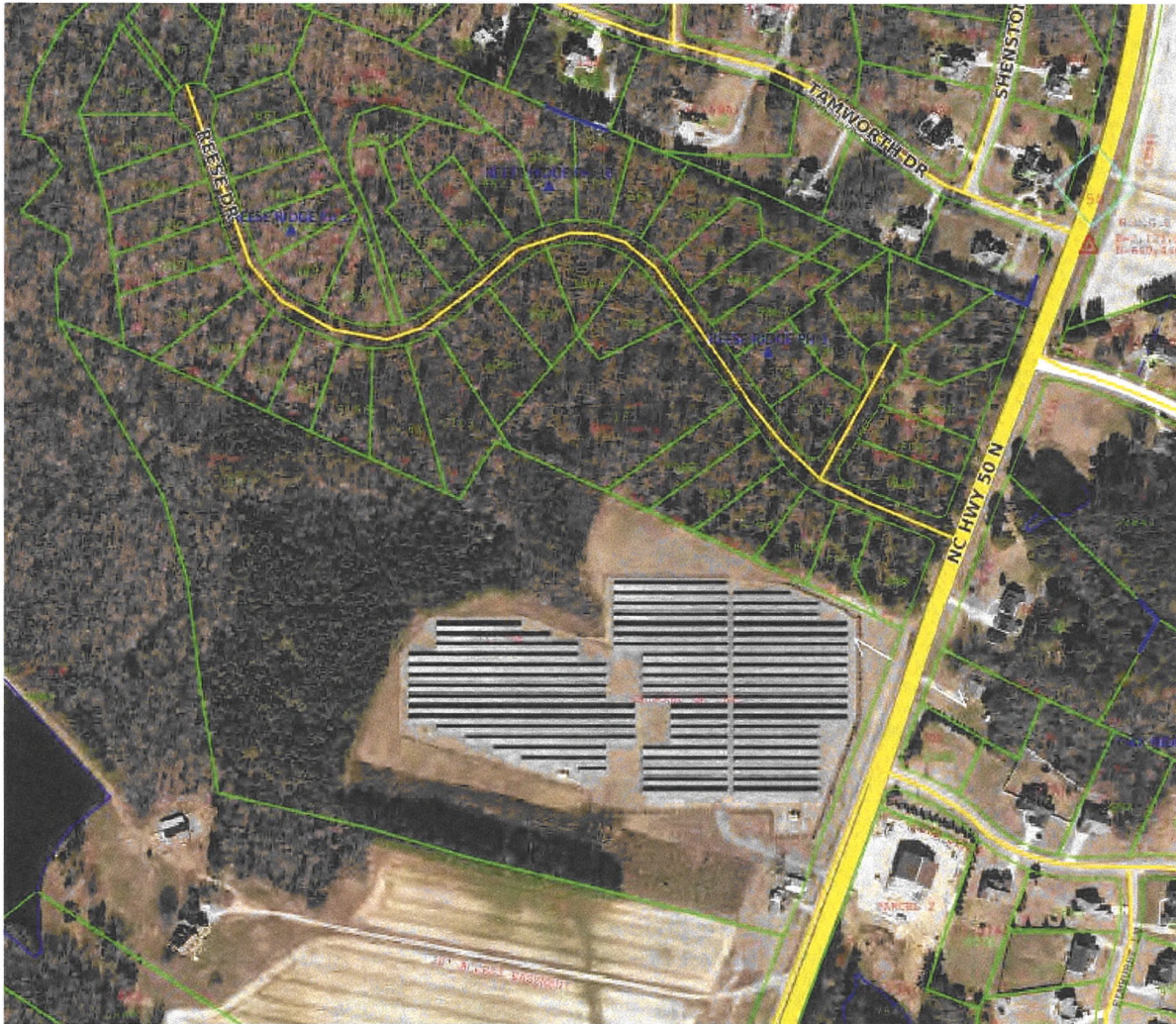
Adjoining Sales Adjusted

Address	Time	Site	YB	GLA	BR/BA	Park	Other	Total	% Diff	Avg % Diff	Distance
269 Grandy								\$275,000			477
307 Grandy	\$5,550		\$20,400	-\$8,725	\$5,000	\$10,000		\$272,225	1%		
103 Branch	-\$8,847		\$21,850	\$270				\$243,273	12%		
103 Spring Lf	\$7,871		\$22,950	-\$9,908	\$5,000		-\$20,000	\$275,912	0%		

4%

Both of these matched pairs support a finding of no impact on value. This is reinforced by the listings for both properties identifying the privacy due to no housing in the rear of the property as part of the marketing for these homes.

15. Matched Pair – HCE Johnston I, LLC, Benson, NC



This 2.6 MW project was built in 2015 and located on 30.55 acres.

There is a new subdivision that was developed in 2019 just north of this solar farm called Reese's Ridge. This location is near the McGees Crossroads near Mount Pleasant Road. As can be seen in the map below, the adjoining land to the north of this solar farm was purchased in 2017 and subdivided as Reese Ridge with 0.49 to 0.53 acre lots. Most of the trees on this site were cleared as part of the development with a single row of pine trees retained as a buffer along the solar farm. The first six lots on the south side of Reese Drive are around 115 feet from the center point in the lot to the nearest solar farm panel. This tract of land was purchased on September 7, 2017 for \$925,000 for 42.388 acres, or \$21,822 per acre.

The proposed homes will be custom homes starting at \$330,000. County water is available and the homes will use individual septic tanks. I spoke with Amanda with The Rodney Carroll Team who is marketing the homes and she indicated that 7 custom home builders had a lottery to purchase all of the lots.

Three different builders have purchased lots adjoining the solar farm for \$60,000 each. Similar lots across Reese Drive and further from the solar farm are selling at the same \$60,000 each. At \$60,000 this indicates a lot-to-home ratio of 18%, which is typical for new home construction in the county where there is no amenity package.



Since then a home was built and then sold at 63 Reese Drive, which is two lots off of NC 50 and backs up to the solar farm. Similarly, 107 Reese Drive which is six lots off of NC 50 and backs up to the solar farm. I have considered both of these for matched pairs as shown below. These homes are as closed as 105 feet from the solar panels.

Adjoining Residential Sales After Solar Farm Built

Parcel	Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	BR/BA	Park	Style	Other
	Adjoins	107 Reese Drive	0.69	11/27/2019	\$393,000	2019	2,960	\$132.77	3/3	2-Car	1.5 Vinyl	
	Not	200 Reese Drive	0.44	2/19/2020	\$400,000	2019	3,209	\$124.65	3/2.5	2-Car	1.5 Batten/Stone	
	Not	35 Pawnee Pl	0.65	5/30/2018	\$325,000	2017	2,609	\$124.57	4/3	2-Car	1.5 Vinyl/Stone	
	Not	278 Timber Wolf	0.88	1/24/2020	\$367,443	2019	2,983	\$123.18	3/3	2-Car	1.5 Vinyl/Stone	
												Avg
	Solar	Address	Time	Site	YB	GLA	BR/BA	Park	Other	Total	% Diff	% Diff
	Adjoins	107 Reese Drive								\$393,000		5%
	Not	200 Reese Drive	-\$2,831		\$0	-\$24,830	\$5,000			\$377,338	4%	
	Not	35 Pawnee Pl	\$14,954		\$3,250	\$34,979				\$378,183	4%	
	Not	278 Timber Wolf	-\$1,796		\$0	-\$2,266				\$363,381	8%	

Adjoining Residential Sales After Solar Farm Built

Parcel	Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GBA	BR/BA	Park	Style	Other
	Adjoins	63 Reese Drive	0.45	3/24/2020	\$410,000	2019	3,240	\$126.54	4/3	2-Car	Ranch/Wd	
	Not	200 Reese Drive	0.44	2/19/2020	\$400,000	2019	3,209	\$124.65	3/2.5	2-Car	1.5 Batten/Stone	
	Not	320 Wolf Den	0.97	9/27/2019	\$377,780	2019	3,122	\$121.01	4/3	2-Car	1.5 Vinyl/Stone	
	Not	37 Makers Way	0.59	5/29/2019	\$373,508	2019	3,122	\$119.64	4/3	3-Car	1.5 Vinyl/Stone	
												Avg
	Solar	Address	Time	Site	YB	GLA	BR/BA	Park	Other	Total	% Diff	% Diff
	Adjoins	63 Reese Drive								\$410,000		3%
	Not	200 Reese Drive	\$1,146		\$0	\$2,705	\$5,000			\$408,851	0%	
	Not	320 Wolf Den	\$5,699		\$0	\$9,995				\$393,474	4%	
	Not	37 Makers Way	\$9,443		\$0	\$9,882		-\$5,000		\$387,833	5%	

After adjustments, the two sales support a conclusion of no impact on property value due to the solar farm. I spoke with Rodney Carroll the broker marketing the homes and he indicated that the solar farm had zero impact on the sales price and they were marketing it as the best neighbor you could have.

16. Matched Pair – Mustang Solar, Robbins, Moore County, NC



This project was built in 2017-18 on 49.71 acres for a 5 MW project. The closest non-participating home is 110 feet from the nearest panel.

A nearby home located at 472 Gardenia Road sold on December 11, 2023 for \$195,000 for a one-story home with 1,561 s.f., 3 BR, 2 BA, built in 1938 on 0.52 acres. This home is 415 feet from the nearest solar panel. The main access for the solar facility is on the same street to the east.

I have compared this to 3 nearby sales to compare them to this property. I have utilized the actual year built per the tax cards for each of these.

Adjoining Residential Sales After Solar Farm Approved

Solar	Address	Acres	Date Sold	Sales Price	Built	GBA	\$/GLA	BR/BA	Park	Style
Nearby	472 Gardenia	0.52	12/11/2023	\$195,000	1938	1,561	\$124.92	3/2	Park	Ranch
Not	240 E Elm	0.30	9/6/2023	\$145,000	1950	1,340	\$108.21	3/2	Park	Ranch
Not	192 Hussey	0.99	6/2/2023	\$180,100	1980	1,184	\$152.11	4/2	Park	Ranch
Not	2063 S State 705	1.99	4/5/2023	\$198,000	1970	1,600	\$123.75	3/1	Park	Br Rnch

Adjoining Sales Adjusted						Avg			
Address	Time	YB	GLA	BR/BA	Other	Total	% Diff	% Diff	Distance
472 Gardenia						\$195,000			415
240 E Elm	\$1,525	-\$5,220	\$9,566			\$150,871	23%		
192 Hussey	\$3,790	-\$22,693	\$22,938			\$184,135	6%		
2063 S State 705	\$5,425	-\$19,008	-\$1,931	\$15,000		\$197,486	-1%		
								9%	

The matched pairs indicate no impact for being located nearby to the solar farm and some of the data suggests a positive impact.

I reached out to Kara Newton, the listing broker, and she indicated that it didn't impact the adjoining property value, list price or marketing time. This is consistent with the data and supports a finding of no impact on property value and actually supports a finding of a positive impact on property value.

Conclusion – NC Data

Matched Pair Summary						Adj. Uses By Acreage					1 mile Radius (2010-2019 Data)			
	Name	City	State	Acres	MW	Topo Shift	Res	Ag	Ag/Res	Com	Pop.	Med. Income	Avg. Housing Unit	Veg. Buffer
1	AM Best	Goldsboro	NC	38	5.00	2	38%	23%	0%	39%	1,523	\$37,358	\$148,375	Light
2	Cookstown	Goldsboro	NC	58	5.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Light
3	Solar Lee	Mt Olive	NC	38	4.90	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Light
4	Gaston SC	Gastonia	NC	35	5.00	48	33%	23%	0%	44%	4,689	\$35,057	\$126,562	Light
5	Summit	Moyock	NC	2034	80.00	4	4%	94%	0%	2%	382	\$79,114	\$281,731	Light
6	Tracy	Bailey	NC	50	5.00	10	29%	71%	0%	0%	312	\$43,940	\$99,219	Heavy
7	McBride	Midland	NC	627	75.00	140	12%	78%	10%	0%	398	\$63,678	\$256,306	Lt to Me
8	Mariposa	Stanley	NC	36	5.00	96	48%	52%	0%	0%	1,716	\$36,439	\$137,884	Light
9	Candace	Princeton	NC	54	5.00	22	76%	0%	24%	0%	448	\$51,002	\$107,171	Medium
10	Innov 46	Hope Mills	NC	532	78.50	0	17%	0%	83%	0%	2,247	\$58,688	\$183,435	Light
11	Innov 42	Fayetteville	NC	414	71.00	0	41%	0%	59%	0%	568	\$60,037	\$276,347	Light
12	Sunfish	Willow Spring	NC	50	6.40	30	35%	30%	35%	0%	1,515	\$63,652	\$253,138	Light
13	Camden Dam	Camden	NC	50	5.00	0	17%	11%	72%	0%	403	\$84,426	\$230,288	Light
14	Grandy	Grandy	NC	121	20.00	10	55%	0%	24%	21%	949	\$50,355	\$231,408	Light
15	HCE Johnston	Benson	NC	30	2.60	0	55%	45%	0%	0%	1,169	\$65,482	\$252,544	Light
16	Mustang	Robbins	NC	50	5.00	N/A	N/A	N/A	N/A	N/A	941	\$54,430	\$369,398	Medium
Average				264	23.65	28	35%	33%	24%	8%	1233	\$55,976	\$210,986	
Median				50	5.00	10	35%	23%	10%	0%	945	\$56,559	\$230,848	
High				2,034	80.00	140	76%	94%	83%	44%	4,689	\$84,426	\$369,398	
Low				30	2.60	0	4%	0%	0%	0%	312	\$35,057	\$99,219	

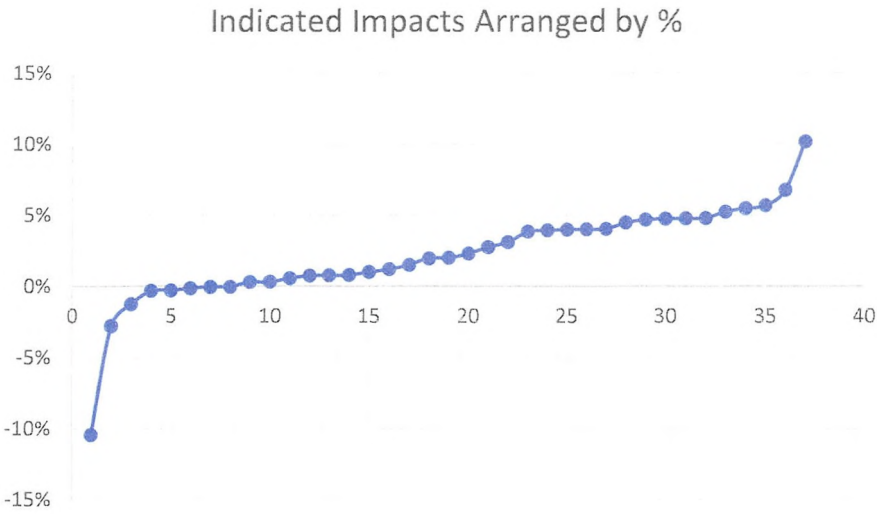
The solar farm matched pairs shown above have similar characteristics to each other in terms of population, but with several outliers showing solar farms in farm more urban areas. The median income for the population within 1 mile of a solar farm is \$56,559 with a median housing unit value of \$230,848. Most of the comparables are under \$300,000 in the home price, though I have matched pairs in multiple states over \$1,000,000 adjoining solar farms. The adjoining uses show that residential and agricultural uses are the predominant adjoining uses. These figures are in line with the larger set of solar farms that I have looked at with the predominant adjoining uses being residential and agricultural and similar to the solar farm breakdown shown for the southeast as shown later in this report.

Based on the similarity of adjoining uses and demographic data between these sites and the subject property, I consider it reasonable to compare these sites to the subject property.

I have pulled 37 matched pairs from the above referenced solar farms to provide the following summary of home sale matched pairs and land sales next to solar farms. The summary shows that the range of differences is from -10% to +10% with an average of +2% and median of +2%. This means that the average and median impact is for a slight positive impact due to adjacency to a solar farm. However, this +2% to rate is within the typical variability I would expect from real estate. I therefore conclude that this data shows no negative or positive impact due to adjacency to a solar farm.

While the range is seemingly wide, the graph below clearly shows that the vast majority of the data falls between 0% and +5%. There were only 2 indicators showing an impact below zero and they were -1% and -10%. The other thirty results ranged from zero to +10%.

I therefore conclude that these matched pairs support a finding of no impact on value at the subject property for the proposed project, which as proposed will include a landscaped buffer to screen adjoining residential properties.



B. Southeastern USA Data – Over 5 MW

Conclusion – Southeast Over 5 MW

Southeast USA Over 5 MW Matched Pair Summary

						Adj. Uses By Acreage					1 mile Radius (2010-2022 Data)		
	Name	City	State	Acres	MW	Topo Shift	Res	Ag	Ag/Res	Com/Ind	Pop.	Med. Income	Avg. Housing Unit
1	AM Best	Goldsboro	NC	38	5.00	2	38%	0%	23%	39%	1,523	\$37,358	\$148,375
2	Mulberry	Selmer	TN	160	5.00	60	13%	73%	10%	3%	467	\$40,936	\$171,746
3	Leonard	Hughesville	MD	47	5.00	20	18%	75%	0%	6%	525	\$106,550	\$350,000
4	Gastonia SC	Gastonia	NC	35	5.00	48	33%	0%	23%	44%	4,689	\$35,057	\$126,562
5	Summit	Moyock	NC	2,034	80.00	4	4%	0%	94%	2%	382	\$79,114	\$281,731
6	Tracy	Bailey	NC	50	5.00	10	29%	0%	71%	0%	312	\$43,940	\$99,219
7	Manatee	Parrish	FL	1,180	75.00	20	2%	97%	1%	0%	48	\$75,000	\$291,667
8	McBride	Midland	NC	627	75.00	140	12%	10%	78%	0%	398	\$63,678	\$256,306
9	Mariposa	Stanley	NC	36	5.00	96	48%	0%	52%	0%	1,716	\$36,439	\$137,884
10	Clarke Cnty	White Post	VA	234	20.00	70	14%	39%	46%	1%	578	\$81,022	\$374,453
11	Candace	Princeton	NC	54	5.00	22	76%	24%	0%	0%	448	\$51,002	\$107,171
12	Walker	Barhamsville	VA	485	20.00	N/A	12%	68%	20%	0%	203	\$80,773	\$320,076
13	Innov 46	Hope Mills	NC	532	78.50	0	17%	83%	0%	0%	2,247	\$58,688	\$183,435
14	Innov 42	Fayetteville	NC	414	71.00	0	41%	59%	0%	0%	568	\$60,037	\$276,347
15	Sunfish	Willow Spring	NC	50	6.40	30	35%	35%	30%	0%	1,515	\$63,652	\$253,138
16	Sappony	Stony Crk	VA	322	20.00	N/A	2%	98%	0%	0%	74	\$51,410	\$155,208
17	Camden Dam	Camden	NC	50	5.00	0	17%	72%	11%	0%	403	\$84,426	\$230,288
18	Grandy	Grandy	NC	121	20.00	10	55%	24%	0%	21%	949	\$50,355	\$231,408
19	Champion	Pelion	SC	100	10.00	N/A	4%	70%	8%	18%	1,336	\$46,867	\$171,939
20	Barefoot Bay	Barefoot Bay	FL	504	74.50	0	11%	87%	0%	3%	2,446	\$36,737	\$143,320
21	Miami-Dade	Miami	FL	347	74.50	0	26%	74%	0%	0%	127	\$90,909	\$403,571
22	Spotsylvania	Paytes	VA	3,500	617.00	160	37%	52%	11%	0%	74	\$120,861	\$483,333
23	Whitehorn	Gretna	VA	N/A	50.00	N/A	N/A	N/A	N/A	N/A	166	\$43,179	\$168,750
24	Altavista	Altavista	VA	720	80.00	N/A	N/A	N/A	N/A	N/A	7	\$50,000	\$341,667
25	Hattiesburg	Hattiesburg	MS	400	50.00	N/A	10%	85%	5%	0%	1,065	\$28,545	\$129,921
26	Solidago	Isle of Wight	VA	193	20.00	N/A	N/A	N/A	N/A	N/A	62	\$88,375	\$312,500
27	Buckingham	Cumberland	VA	240	39.80	50	4%	6%	90%	0%	120	\$59,445	\$251,562
28	Twiggs	Dry Branch	GA	N/A	200.00	N/A	N/A	N/A	N/A	N/A	15	\$55,000	\$50,000
29	Kings Bay	Kings Bay	GA	N/A	30.00	N/A	N/A	N/A	N/A	N/A	721	\$102,293	\$364,808
30	Dougherty	Albany	GA	N/A	120.00	N/A	N/A	N/A	N/A	N/A	30	\$60,354	\$204,167
31	Mustang	Robbins	NC	50	5.00	N/A	N/A	N/A	N/A	N/A	941	\$54,430	\$369,398
32	Bedford	Chesapeake	VA	N/A	70.00	N/A	N/A	N/A	N/A	N/A	993	\$127,047	\$509,365
Average				464	60.83	37	23%	47%	24%	6%	786	\$64,484	\$246,854
Median				234	25.00	20	17%	56%	11%	0%	458	\$59,067	\$241,485
High				3,500	617.00	160	76%	98%	94%	44%	4,689	\$127,047	\$509,365
Low				35	5.00	0	2%	0%	0%	0%	7	\$28,545	\$50,000

The solar farm matched pairs pulled from the solar farms shown above have similar characteristics to each other in terms of population, but with several outliers showing solar farms in more urban areas. The median income for the population within 1 mile of a solar farm is \$59,067 with a median housing unit value of \$241,485. Most of the comparables are under \$300,000 in the home price, with \$483,333 being the high end of the set, though I have matched pairs in multiple states over \$1,600,000 adjoining solar farms. The adjoining uses show that residential and agricultural uses are the predominant adjoining uses. These figures are in line with the larger set of solar farms that I have looked at with the predominant adjoining uses being residential and agricultural and similar to the solar farm breakdown shown for Virginia and adjoining states as well as the proposed subject property.

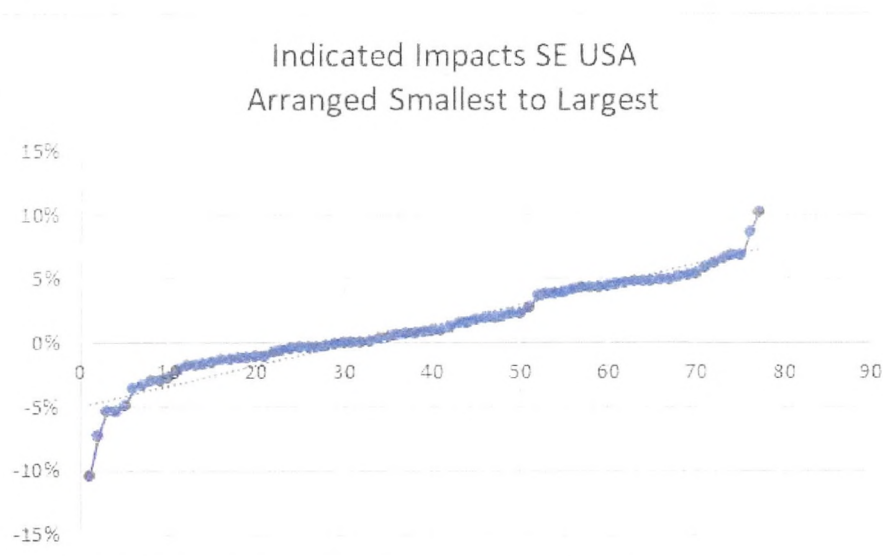
Based on the similarity of adjoining uses and demographic data between these sites and the subject property, I consider it reasonable to compare these sites to the subject property.

I have pulled 77 matched pairs from the above referenced solar farms to provide the following summary of home sale matched pairs and land sales next to solar farms. The summary shows that the range of differences is from -10% to +10% with an average of +1% and median of +1%.

While the range is seemingly wide, the graph below clearly shows that the vast majority of the data falls between -5% and +5% and most of those are clearly in the 0 to +5% range. As noted earlier in this report, real estate is an imperfect market and this 5% variability is typical in real estate. This data strongly supports an indication of no impact on adjoining residential uses to a solar farm.

Only 2 of the data points supports a negative impact on property value, while 7 support a positive impact. So 75 out of 77 data points support a finding of either no impact or a positive impact on property value.

I therefore conclude that these matched pairs support a finding of no impact on value at the subject property for the proposed project, which as proposed will include a landscaped buffer to screen adjoining residential properties.



C. Summary of National Data on Solar Farms

I have worked in 28 states related to solar project and I have been tracking matched pairs in most of those states. The solar farms summary is shown below with a summary of the matched pair data shown on the following page.

Matched Pair Summary						Adj. Uses By Acreage					1 mile Radius (2020 Data)		
	Name	City	State	Acres	MW	Topo Shift	Res	Ag	Ag/Res	Com/Ind	Population	Med. Income	Avg. Housing Unit
1	AM Best	Goldsboro	NC	38	5.00	2	38%	0%	23%	39%	1,523	\$37,358	\$148,375
2	Mulberry	Selmer	TN	160	5.00	60	13%	73%	10%	3%	467	\$40,936	\$171,746
3	Leonard	Hughesville	MD	47	5.00	20	18%	75%	0%	6%	525	\$106,550	\$350,000
4	Gastonia SC	Gastonia	NC	35	5.00	48	33%	0%	23%	44%	4,689	\$35,057	\$126,562
5	Summit	Moyock	NC	2,034	80.00	4	4%	0%	94%	2%	382	\$79,114	\$281,731
6	Tracy	Bailey	NC	50	5.00	10	29%	0%	71%	0%	312	\$43,940	\$99,219
7	Manatee	Parrish	FL	1,180	75.00	20	2%	97%	1%	0%	48	\$75,000	\$291,667
8	McBride	Midland	NC	627	75.00	140	12%	10%	78%	0%	398	\$63,678	\$256,306
9	Grand Ridge	Streator	IL	160	20.00	1	8%	87%	5%	0%	96	\$70,158	\$187,037
10	Dominion	Indianapolis	IN	134	8.60	20	3%	97%	0%	0%	3,774	\$61,115	\$167,515
11	Mariposa	Stanley	NC	36	5.00	96	48%	0%	52%	0%	1,716	\$36,439	\$137,884
12	Clarke Cnty	White Post	VA	234	20.00	70	14%	39%	46%	1%	578	\$81,022	\$374,453
13	Flemington	Flemington	NJ	120	9.36	N/A	13%	50%	28%	8%	3,477	\$105,714	\$444,696
14	Frenchtown	Frenchtown	NJ	139	7.90	N/A	37%	35%	29%	0%	457	\$111,562	\$515,399
15	McGraw	East Windsor	NJ	95	14.00	N/A	27%	44%	0%	29%	7,684	\$78,417	\$362,428
16	Tinton Falls	Tinton Falls	NJ	100	16.00	N/A	98%	0%	0%	2%	4,667	\$92,346	\$343,492
17	Simon	Social Circle	GA	237	30.00	71	1%	63%	36%	0%	203	\$76,155	\$269,922
18	Candace	Princeton	NC	54	5.00	22	76%	24%	0%	0%	448	\$51,002	\$107,171
19	Walker	Barhamsville	VA	485	20.00	N/A	12%	68%	20%	0%	203	\$80,773	\$320,076
20	Innov 46	Hope Mills	NC	532	78.50	0	17%	83%	0%	0%	2,247	\$58,688	\$183,435
21	Innov 42	Fayetteville	NC	414	71.00	0	41%	59%	0%	0%	568	\$60,037	\$276,347
22	Demille	Lapeer	MI	160	28.40	10	10%	68%	0%	22%	2,010	\$47,208	\$187,214
23	Turrill	Lapeer	MI	230	19.60	10	75%	59%	0%	25%	2,390	\$46,839	\$110,361
24	Sunfish	Willow Spring	NC	50	6.40	30	35%	35%	30%	0%	1,515	\$63,652	\$253,138
25	Picture Rocks	Tucson	AZ	182	20.00	N/A	6%	88%	6%	0%	102	\$81,081	\$280,172
26	Avra Valley	Tucson	AZ	246	25.00	N/A	3%	94%	3%	0%	85	\$80,997	\$292,308
27	Sappony	Stony Crk	VA	322	20.00	N/A	2%	98%	0%	0%	74	\$51,410	\$155,208
28	Camden Dam	Camden	NC	50	5.00	0	17%	72%	11%	0%	403	\$84,426	\$230,288
29	Grandy	Grandy	NC	121	20.00	10	55%	24%	0%	21%	949	\$50,355	\$231,408
30	Champion	Pelion	SC	100	10.00	N/A	4%	70%	8%	18%	1,336	\$46,867	\$171,939
31	Eddy II	Eddy	TX	93	10.00	N/A	15%	25%	58%	2%	551	\$59,627	\$139,088
32	Somerset	Somerset	TX	128	10.60	N/A	5%	95%	0%	0%	1,293	\$41,574	\$135,490
33	DG Amp Piqua	Piqua	OH	86	12.60	2	26%	16%	58%	0%	6,735	\$38,919	\$96,555
34	Barefoot Bay	Barefoot Bay	FL	504	74.50	0	11%	87%	0%	3%	2,446	\$36,737	\$143,320
35	Miami-Dade	Miami	FL	347	74.50	0	26%	74%	0%	0%	127	\$90,909	\$403,571
36	Spotsylvania	Paytes	VA	3,500	617.00	160	37%	52%	11%	0%	74	\$120,861	\$483,333
37	Whitehorn	Gretna	VA	N/A	50.00	N/A	N/A	N/A	N/A	N/A	166	\$43,179	\$168,750
38	Altavista	Altavista	VA	720	80.00	N/A	N/A	N/A	N/A	N/A	7	\$50,000	\$341,667
39	Hattiesburg	Hattiesburg	MS	400	50.00	N/A	10%	85%	5%	0%	1,065	\$28,545	\$129,921
40	Bremen	Bremen	IN	37	6.80	15	40%	60%	0%	0%	388	\$62,855	\$232,857

Matched Pair Summary

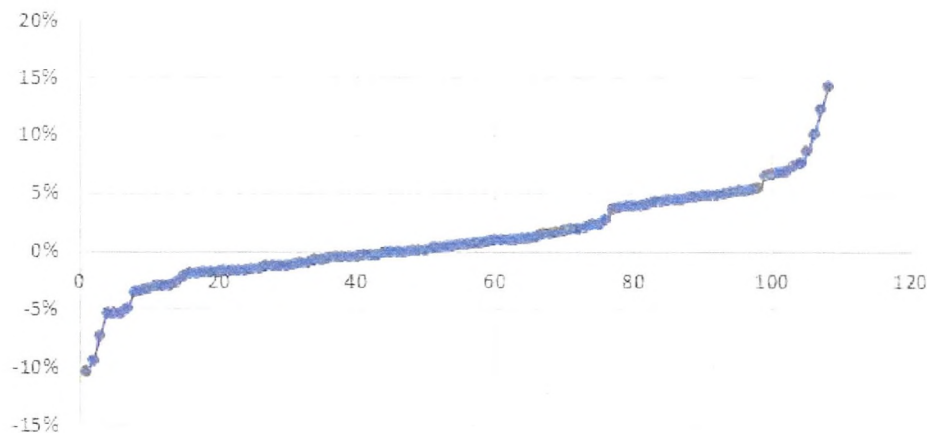
						Adj. Uses By Acreage					1 mile Radius (2020 Data)		
		State	Acres	MW	Topo		Res	Ag	Ag/Res	Com/Ind	Population	Med. Avg. Housing	
Name	City				Shift							Income	Unit
41	North Rock	Fulton	WI	472	50.00	N/A	3%	40%	57%	0%	236	\$86,238	\$370,062
42	Wood County	Saratoga	WI	1,200	150.00	N/A	N/A	N/A	N/A	N/A	187	\$74,110	\$204,545
43	Solidago	Isle of Wight	VA	193	20.00	N/A	N/A	N/A	N/A	N/A	62	\$88,375	\$312,500
44	Buckingham	Cumberland	VA	240	39.80	50	4%	6%	90%	0%	120	\$59,445	\$251,562
45	Crane	Burns City	IN	182	24.30	100	N/A	N/A	N/A	N/A	114	\$68,227	\$273,077
46	Kokomo 1	Kokomo	IN	83	5.40	5	30%	36%	0%	34%	8,656	\$50,193	\$168,723
47	White Tail 1	Mowersville	PA	135	13.50	20	2%	73%	25%	0%	254	\$81,086	\$354,297
48	Twiggs	Dry Branch	GA	N/A	200.00	N/A	N/A	N/A	N/A	N/A	15	\$55,000	\$50,000
49	Kings Bay	Kings Bay	GA	N/A	30.00	N/A	N/A	N/A	N/A	N/A	721	\$102,293	\$364,808
50	Dougherty	Albany	GA	N/A	120.00	N/A	N/A	N/A	N/A	N/A	30	\$60,354	\$204,167
51	Whitetail 2	St Thomas	PA	293	20.00	N/A	N/A	N/A	N/A	N/A	107	\$85,844	\$274,265
52	Elk Hill 1	Mercersburg	PA	N/A	20.00	N/A	N/A	N/A	N/A	N/A	791	\$72,722	\$372,932
53	Elk Hill 2	Mercersburg	PA	N/A	15.00	N/A	N/A	N/A	N/A	N/A	454	\$81,208	\$484,672
54	Cottontail 1	York	PA	N/A	20.00	N/A	N/A	N/A	N/A	N/A	1,495	\$84,872	\$315,508
55	Cottontail 2	York	PA	N/A	20.00	N/A	N/A	N/A	N/A	N/A	707	\$61,415	\$383,896
56	Grazing Yak	Calhan	CO	272	35.00	N/A	0%	97%	3%	0%	40	\$78,104	\$623,214
57	San Luis Villy	Hooper	CO	308	35.00	N/A	5%	95%	0%	0%	11	\$59,164	\$450,000
58	SR Jenkins	Ft. Lupton	CO	142	13.00	N/A	2%	90%	8%	0%	129	\$114,961	\$802,703
59	Big Horn 1	Pueblo	CO	2,760	240.00	N/A	0%	44%	2%	54%	20	\$75,000	\$400,000
60	Bison/Raw	Wellington	CO	1,160	52.00	N/A	0%	93%	7%	0%	0	\$0	\$0
61	Alamosa	Mosca	CO	163	30.00	N/A	0%	87%	13%	0%	7	\$0	\$0
62	Pioneer	Bennett	CO	611	110.00	N/A	3%	81%	16%	0%	67	\$82,329	\$497,991
63	Sandhill/SunE	Mosca	CO	N/A	10.00	N/A	N/A	N/A	N/A	N/A	4	\$0	\$0
64	Bellflower 1	Lewisville	IN	N/A	152.50	N/A	N/A	N/A	N/A	N/A	45	\$78,261	\$215,789
65	Riverstart	Winchester	IN	N/A	200.00	N/A	N/A	N/A	N/A	N/A	47	\$75,000	\$169,565
66	Mustang	Robbins	NC	50	5.00	N/A	N/A	N/A	N/A	N/A	941	\$54,430	\$369,398
67	North Star	North Branch	MN	1,099	100.00	N/A	18%	73%	7%	2%	218	\$119,700	\$323,413
68	Logansport	Logansport	IN	N/A	6.80	N/A	N/A	N/A	N/A	N/A	4,534	\$51,694	\$122,099
69	Anderson 6	Anderson	IN	N/A	6.80	N/A	N/A	N/A	N/A	N/A	736	\$77,343	\$181,635
70	Dunns Bdrge	Wheatfield	IN	N/A	435.00	N/A	N/A	N/A	N/A	N/A	208	\$71,098	\$203,986
71	Bedford	Chesapeake	VA	N/A	70.00	N/A	N/A	N/A	N/A	N/A	993	\$127,047	\$509,365
Average				421	55.63	33	20%	56%	19%	6%	1,100	\$66,854	\$265,581
Median				182	20.00	18	12%	66%	7%	0%	398	\$68,227	\$253,138
High				3,500	617.00	160	98%	98%	94%	54%	8,656	\$127,047	\$802,703
Low				35	5.00	0	0%	0%	0%	0%	0	\$0	\$0

From these 71 solar farms, I have derived 138 matched pairs. The matched pairs show no negative impact at distances as close as 145 feet between a solar panel and the nearest point on a home. The example I have at 105 feet distance is for a solar farm just under 5 MW so not included in this data presentation. The range of impacts is -10% to +14% with an average and median of +1%. Two of the recent data points I have included from WI shows significant positive impacts, but both of those are from distances of 1,530 feet to 2,000 feet. This goes to a question I have had on a couple of occasions about the possibility of positive impacts once the buffers are extended out to a certain distance. With a reasonable expectation of a protected buffer of significant size, there is a reasonable expectation of enhancement in some cases.

		Avg. Distance		
	MW			% Dif
Average	79.17	608	Average	1%
Median	20.00	440	Median	0%
High	617.00	2,020	High	14%
Low	5.00	145	Low	-10%

While the range is broad, the two charts below show the data points in range from lowest to highest. There are only 3 data points out of 138 that show a negative impact. The rest support either a finding of no impact or 17 of the data points suggest a positive impact due to adjacency to a solar farm. As discussed earlier in this report, I consider this data to strongly support a finding of no impact on value as most of the findings are within typical market variation and even within that, most are mildly positive findings.

National Impact Data on Solar Farms Over 5 MW
Arranged Smallest to Largest



A. Larger Solar project

I have also considered larger solar project to address impacts related to larger project. Project have been increasing in size and most of the project between 100 and 1000 MW are newer with little time for adjoining sales. I have included a breakdown of solar project with 20 MW to 80 MW facilities with one 617 MW facility.

Matched Pair Summary - @20 MW And Larger						Adj. Uses By Acreage					1 mile Radius (2010-2020 Data)		
Name	City	State	Acres	MW	Topo Shift	Res	Ag	Ag/Res	Com/Ind		Population	Med. Income	Avg. Housing Unit
1	Summit	Moyock	NC	2,034	80.00	4	4%	0%	94%	2%	382	\$79,114	\$281,731
2	Manatee	Parrish	FL	1,180	75.00	20	2%	97%	1%	0%	48	\$75,000	\$291,667
3	McBride	Midland	NC	627	75.00	140	12%	10%	78%	0%	398	\$63,678	\$256,306
4	Grand Ridge	Streator	IL	160	20.00	1	8%	87%	5%	0%	96	\$70,158	\$187,037
5	Clarke Cnty	White Post	VA	234	20.00	70	14%	39%	46%	1%	578	\$81,022	\$374,453
6	Simon	Social Circle	GA	237	30.00	71	1%	63%	36%	0%	203	\$76,155	\$269,922
7	Walker	Barhamsville	VA	485	20.00	N/A	12%	68%	20%	0%	203	\$80,773	\$320,076
8	Innov 46	Hope Mills	NC	532	78.50	0	17%	83%	0%	0%	2,247	\$58,688	\$183,435
9	Innov 42	Fayetteville	NC	414	71.00	0	41%	59%	0%	0%	568	\$60,037	\$276,347
10	Demille	Lapeer	MI	160	28.40	10	10%	68%	0%	22%	2,010	\$47,208	\$187,214
11	Turrill	Lapeer	MI	230	19.60	10	75%	59%	0%	25%	2,390	\$46,839	\$110,361
12	Picture Rocks	Tucson	AZ	182	20.00	N/A	6%	88%	6%	0%	102	\$81,081	\$280,172
13	Avra Valley	Tucson	AZ	246	25.00	N/A	3%	94%	3%	0%	85	\$80,997	\$292,308
14	Sappony	Stony Crk	VA	322	20.00	N/A	2%	98%	0%	0%	74	\$51,410	\$155,208
15	Grandy	Grandy	NC	121	20.00	10	55%	24%	0%	21%	949	\$50,355	\$231,408
16	Barefoot Bay	Barefoot Bay	FL	504	74.50	0	11%	87%	0%	3%	2,446	\$36,737	\$143,320
17	Miami-Dade	Miami	FL	347	74.50	0	26%	74%	0%	0%	127	\$90,909	\$403,571
18	Spotsylvania	Paytes	VA	3,500	617.00	160	37%	52%	11%	0%	74	\$120,861	\$483,333
19	Whitehorn	Gretna	VA	N/A	50.00	N/A	N/A	N/A	N/A	N/A	166	\$43,179	\$168,750
20	Altavista	Altavista	VA	720	80.00	N/A	N/A	N/A	N/A	N/A	7	\$50,000	\$341,667
21	Solidago	Isle of Wight	VA	193	20.00	N/A	N/A	N/A	N/A	N/A	62	\$88,375	\$312,500
22	Hattiesburg	Hattiesburg	MS	400	50.00	N/A	10%	85%	5%	0%	1,065	\$28,545	\$129,921
23	North Rock	Fulton	WI	472	50.00	N/A	3%	40%	57%	0%	236	\$86,238	\$370,062
24	Wood County	Saratoga	WI	1,200	150.00	N/A	N/A	N/A	N/A	N/A	187	\$74,110	\$204,545
25	Buckingham	Cumberland	VA	240	39.80	50	4%	6%	90%	0%	120	\$59,445	\$251,562
26	Crane	Burns City	IN	182	24.30	100	N/A	N/A	N/A	N/A	114	\$68,227	\$273,077
27	Twiggs	Dry Branch	GA	N/A	200.00	N/A	N/A	N/A	N/A	N/A	15	\$55,000	\$50,000
28	Kings Bay	Kings Bay	GA	N/A	30.00	N/A	N/A	N/A	N/A	N/A	721	\$102,293	\$364,808
29	Dougherty	Albany	GA	N/A	120.00	N/A	N/A	N/A	N/A	N/A	30	\$60,354	\$204,167
30	Whitetail 2	St Thomas	PA	293	20.00	N/A	N/A	N/A	N/A	N/A	107	\$85,844	\$274,265
31	Elk Hill 1	Mercersburg	PA	N/A	20.00	N/A	N/A	N/A	N/A	N/A	791	\$72,722	\$372,932
32	Cottontail 1	York	PA	N/A	20.00	N/A	N/A	N/A	N/A	N/A	1,495	\$84,872	\$315,508
33	Cottontail 2	York	PA	N/A	20.00	N/A	N/A	N/A	N/A	N/A	707	\$61,415	\$383,896
34	Grazing Yak	Calhan	CO	272	35.00	N/A	0%	97%	3%	0%	40	\$78,104	\$623,214
35	San Luis Vly	Hooper	CO	308	35.00	N/A	5%	95%	0%	0%	11	\$59,164	\$450,000
36	Big Horn 1	Pueblo	CO	2,760	240.00	N/A	0%	44%	2%	54%	20	\$75,000	\$400,000
37	Bison/Raw	Wellington	CO	1,160	52.00	N/A	0%	93%	7%	0%	0	\$0	\$0
38	Alamosa	Mosca	CO	163	30.00	N/A	0%	87%	13%	0%	7	\$0	\$0
39	Pioneer	Bennett	CO	611	110.00	N/A	3%	81%	16%	0%	67	\$82,329	\$497,991
40	Bellflower 1	Lewisville	IN	N/A	152.50	N/A	N/A	N/A	N/A	N/A	45	\$78,261	\$215,789
41	Riverstart	Winchester	IN	N/A	200.00	N/A	N/A	N/A	N/A	N/A	47	\$75,000	\$169,565
42	North Star	North Branch	MN	1,099	100.00	N/A	18%	73%	7%	2%	218	\$119,700	\$323,413
43	Dunns Bdrge	Wheatfield	IN	N/A	435.00	N/A	N/A	N/A	N/A	N/A	208	\$71,098	\$203,986
44	Bedford	Chesapeake	VA	N/A	70.00	N/A	N/A	N/A	N/A	N/A	993	\$127,047	\$509,365
Average			654	84.59		14%	66%	18%	5%		465	\$69,031	\$275,883
Median			347	50.00		7%	74%	5%	0%		147	\$73,416	\$275,306
High			3,500	617.00		75%	98%	94%	54%		2,446	\$127,047	\$623,214
Low			121	19.60		0%	0%	0%	0%		0	\$0	\$0

The breakdown of adjoining uses, population density, median income and housing prices for these projects are very similar to those of the larger set. The matched pairs for each of these were considered earlier and support a finding of no negative impact on the adjoining home values.

I have included a breakdown of solar project with 50 MW to 500 MW facilities adjoining.

Matched Pair Summary						Adj. Uses By Acreage					1 mile Radius (2010-2020 Data)		
	Name	City	State	Acres	MW	Topo Shift	Res	Ag	Ag/Res	Com/Ind	Population	Med. Income	Avg. Housing Unit
1	Summit	Moyock	NC	2,034	80.00	4	4%	0%	94%	2%	382	\$79,114	\$281,731
2	Manatee	Parrish	FL	1,180	75.00	20	2%	97%	1%	0%	48	\$75,000	\$291,667
3	McBride	Midland	NC	627	75.00	140	12%	10%	78%	0%	398	\$63,678	\$256,306
4	Innov 46	Hope Mills	NC	532	78.50	0	17%	83%	0%	0%	2,247	\$58,688	\$183,435
5	Innov 42	Fayetteville	NC	414	71.00	0	41%	59%	0%	0%	568	\$60,037	\$276,347
6	Barefoot Bay	Barefoot Bay	FL	504	74.50	0	11%	87%	0%	3%	2,446	\$36,737	\$143,320
7	Miami-Dade	Miami	FL	347	74.50	0	26%	74%	0%	0%	127	\$90,909	\$403,571
8	Spotylvania	Paytes	VA	3,500	617.00	160	37%	52%	11%	0%	74	\$120,861	\$483,333
9	Hattiesburg	Hattiesburg	MS	400	50.00	N/A	10%	85%	5%	0%	1,065	\$28,545	\$129,921
10	North Rock	Fulton	WI	472	50.00	N/A	3%	40%	57%	0%	236	\$86,238	\$370,062
11	Wood County	Saratoga	WI	1,200	150.00	N/A	N/A	N/A	N/A	N/A	187	\$74,110	\$204,545
12	Twiggs	Dry Branch	GA	N/A	200.00	N/A	N/A	N/A	N/A	N/A	15	\$55,000	\$50,000
13	Dougherty	Albany	GA	N/A	120.00	N/A	N/A	N/A	N/A	N/A	30	\$60,354	\$204,167
14	Big Horn 1	Pueblo	CO	2,760	240.00	N/A	0%	44%	2%	54%	20	\$75,000	\$400,000
15	Bison/Raw	Wellington	CO	1,160	52.00	N/A	0%	93%	7%	0%	0	\$0	\$0
16	Pioneer	Bennett	CO	611	110.00	N/A	3%	81%	16%	0%	67	\$82,329	\$497,991
17	Bellflower 1	Lewisville	IN	N/A	152.50	N/A	N/A	N/A	N/A	N/A	45	\$78,261	\$215,789
18	Riverstart	Winchester	IN	N/A	200.00	N/A	N/A	N/A	N/A	N/A	47	\$75,000	\$169,565
19	North Star	North Branch	MN	1,099	100.00	N/A	18%	73%	7%	2%	218	\$119,700	\$323,413
20	Dunns Brdge	Wheatfield	IN	N/A	435.00	N/A	N/A	N/A	N/A	N/A	208	\$71,098	\$203,986
21	Bedford	Chesapeake	VA	N/A	70.00	N/A	N/A	N/A	N/A	N/A	993	\$127,047	\$509,365
Average				1,123	146	41	13%	63%	20%	4%	449	\$72,272	\$266,596
Median				627	80	2	11%	74%	6%	0%	187	\$75,000	\$256,306
High				3,500	617	160	41%	97%	94%	54%	2,446	\$127,047	\$509,365
Low				347	50	0	0%	0%	0%	0%	0	\$0	\$0

The breakdown of adjoining uses, population density, median income and housing prices for these project are very similar to those of the larger set. The matched pairs for each of these were considered earlier and support a finding of no negative impact on the adjoining home values.

The data for these larger solar projects is shown in the SE USA and the National data breakdowns with similar landscaping, setbacks and range of impacts that fall mostly in the +/-5% range as can be seen earlier in this report.

Below is a summary of 238 projects ranging in size from 50 MW up to 1,000 MW with an average size of 119.7 MW and a median of 80 MW. The average closest distance for an adjoining home is 365 feet, while the median distance is 220 feet. The closest distance is 50 feet. The mix of adjoining uses is similar with most of the adjoining uses remaining residential or agricultural in nature. This is the list of solar projects that I have researched for possible matched pairs and not a complete list of larger solar project in those states.

Total Number of Solar Farms Researched Over 50 MW		238							
	Output (MW)	Total Acres	Used Acres	Avg. Dist to home	Closest Home	Adjoining Use by Acre			
						Res	Agri	Agri/Res	Com
Average	119.7	1521.4	1223.3	1092	365	10%	68%	18%	4%
Median	80.0	987.3	805.5	845	220	7%	72%	12%	0%
High	1000.0	19000.0	9735.4	6835	6810	98%	100%	100%	70%
Low	50.0	3.0	3.0	241	50	0%	0%	0%	0%

X. Scope of Research

I have researched over 1,000 solar farms and sites on which solar farms are existing and proposed in North Carolina, Virginia, Illinois, Tennessee, Kentucky as well as other states to determine what uses are typically found in proximity with a solar farm. The data I have collected and provide in this report strongly supports the assertion that solar farms are having no negative consequences on adjoining agricultural and residential values.

Beyond these references, I have quantified the adjoining uses for a number of solar farm comparables to derive a breakdown of the adjoining uses for each solar farm. The chart below shows the breakdown of adjoining or abutting uses by total acreage.

Percentage By Adjoining Acreage									
	Res	Ag	Res/AG	Comm	Ind	Avg Home	Closest Home	All Res Uses	All Comm Uses
Average	19%	53%	20%	2%	6%	887	344	91%	8%
Median	11%	56%	11%	0%	0%	708	218	100%	0%
High	100%	100%	100%	93%	98%	5,210	4,670	100%	98%
Low	0%	0%	0%	0%	0%	90	25	0%	0%
Res = Residential, Ag = Agriculture, Com = Commercial									
Total Solar Farms Considered: 705									

I have also included a breakdown of each solar farm by number of adjoining parcels to the solar farm rather than based on adjoining acreage. Using both factors provide a more complete picture of the neighboring properties.

Percentage By Number of Parcels Adjoining									
	Res	Ag	Res/AG	Comm	Ind	Avg Home	Closest Home	All Res Uses	All Comm Uses
Average	61%	24%	9%	2%	4%	887	344	93%	6%
Median	65%	19%	5%	0%	0%	708	218	100%	0%
High	100%	100%	100%	60%	78%	5,210	4,670	105%	78%
Low	0%	0%	0%	0%	0%	90	25	0%	0%
Res = Residential, Ag = Agriculture, Com = Commercial									
Total Solar Farms Considered: 705									

Both of the above charts show a marked residential and agricultural adjoining use for most solar farms. Every single solar farm considered included an adjoining residential or residential/agricultural use.

XI. Specific Factors Related To Impacts on Value

I have completed a number of Impact Studies related to a variety of uses and I have found that the most common areas for impact on adjoining values typically follow a hierarchy with descending levels of potential impact. I will discuss each of these categories and how they relate to a solar farm.

1. Hazardous material
2. Odor
3. Noise
4. Traffic
5. Stigma
6. Appearance

1. Hazardous material

A solar farm presents no hazardous waste byproduct as part of normal operation. Any fertilizer, weed control, vehicular traffic, or construction will be significantly less than typically applied in a residential development and even most agricultural uses.

The various solar farms that I have inspected and identified in the addenda have no known environmental impacts associated with the development and operation.

2. Odor

The various solar farms that I have inspected produced no odor.

3. Noise

Whether discussing passive fixed solar panels, or single-axis trackers, there is no negative impact associated with noise from a solar farm. The transformer has a hum similar to an HVAC that can only be heard in close proximity to this transformer and the buffers on the property are sufficient to make emitted sounds inaudible from the adjoining properties in most cases.

The various solar farms that I have inspected were inaudible from adjoining roadways.

4. Traffic

The solar farm will have no onsite employees or staff. The site requires only minimal maintenance. Relative to other potential uses of the site (such as a residential subdivision), the additional traffic generated by a solar farm use on this site is insignificant.

5. Stigma

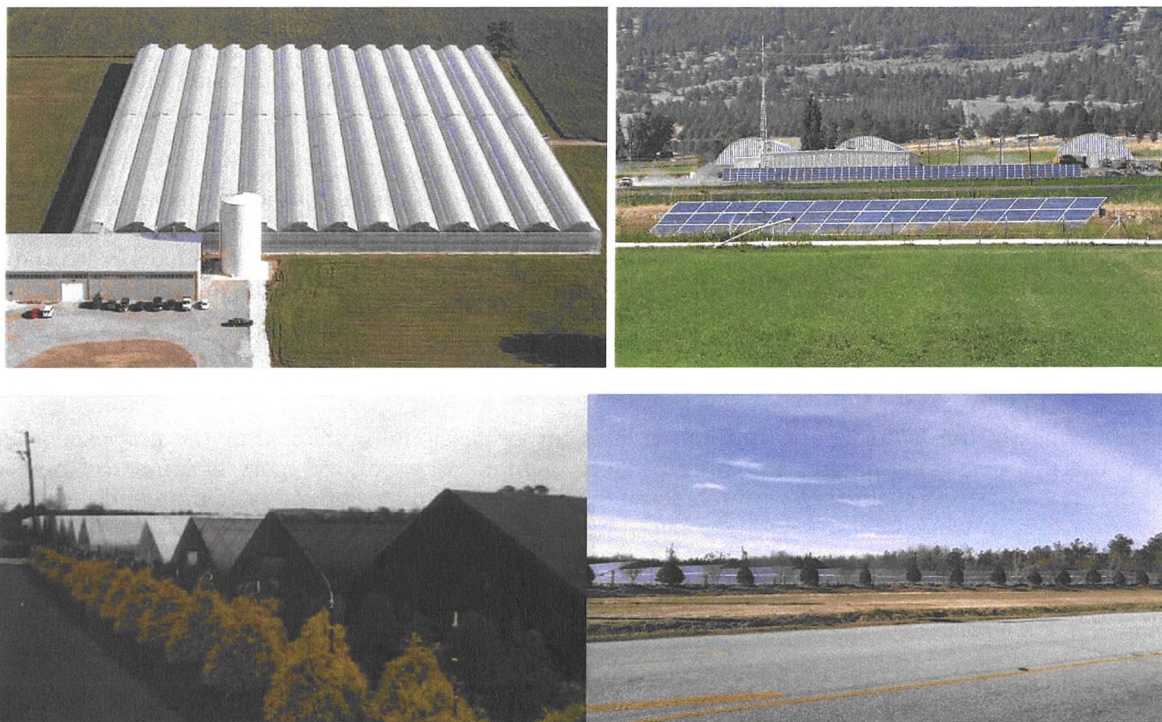
There is no stigma associated with solar farms and people generally respond favorably towards such a use. While an individual may express concerns about proximity to a solar farm, there is no specific stigma associated with a solar farm. Stigma generally refers to things such as adult establishments, prisons, rehabilitation facilities, and so forth.

Solar panels have no associated stigma and in smaller collections are found in yards and roofs in many residential communities. Solar farms are adjoining elementary, middle and high schools as well as churches and subdivisions. I note that one of the solar farms in this report not only adjoins a church, but is actually located on land owned by the church. Solar panels on a roof are often cited as an enhancement to the property in marketing brochures.

I see no basis for an impact from stigma due to a solar farm.

6. Appearance

I note that larger solar farms using fixed or tracking panels are a passive use of the land that is in keeping with a rural/residential area. As shown below, solar farms are comparable to larger greenhouses. This is not surprising given that a greenhouse is essentially another method for collecting passive solar energy. The greenhouse use is well received in residential/rural areas and has a similar visual impact as a solar farm.



The solar panels are all less than 15 feet high, which means that the visual impact of the solar panels will be similar in height to a typical greenhouse and lower than a single-story residential dwelling. Were the subject property developed with single family housing, that development would have a much greater visual impact on the surrounding area given that a two-story home with attic could be three to four times as high as these proposed panels.

Whenever you consider the impact of a proposed project on viewshed or what the adjoining owners may see from their property, it is important to distinguish whether or not they have a protected viewshed or not. Enhancements for scenic vistas are often measured when considering properties that adjoin preserved open space and parks. However, adjoining land with a preferred view today conveys no guarantee that the property will continue in the current use. Any consideration of the impact of the appearance requires a consideration of the wide variety of other uses a property already has the right to be put to, which for solar farms often includes subdivision development, agricultural business buildings such as poultry, or large greenhouses and the like.

Dr. Randall Bell, MAI, PhD, and author of the book **Real Estate Damages**, Third Edition, on page 146 provides that “[v]iews of bodies of water, city lights, natural settings, parks, golf courses, and other amenities are considered desirable features, particularly for residential properties.” Dr. Bell continues on Page 147 that “View amenities may or may not be protected by law or regulation. It is sometimes argued that views have value only if they are protected by a view easement, a zoning

ordinance, or covenants, conditions, and restrictions (CC&Rs), although such protections are relatively uncommon as a practical matter. The market often assigns significant value to desirable views irrespective of whether or not such views are protected by law.”

Dr. Bell concludes that a view enhances adjacent property, even if the adjacent property has no legal right to that view. He then discusses a “borrowed” view where a home may enjoy a good view of vacant land or property beyond with a reasonable expectation that the view might be partly or completely obstructed upon development of the adjoining land. He follows that with “This same concept applies to potentially undesirable views of a new development when the development conforms to applicable zoning and other regulations. Arguing value diminution in such cases is difficult, since the possible development of the offending property should have been known.” In other words, if there is an allowable development on the site then arguing value diminution with such a development would be difficult. This further extends to developing the site with alternative uses that are less impactful on the view than currently allowed uses.

This gets back to the point that if a property has development rights and could currently be developed in such a way that removes the viewshed such as a residential subdivision, then a less intrusive use such as a solar farm that is easily screened by landscaping would not have a greater impact on the viewshed of any perceived value adjoining properties claim for viewshed. Essentially, if there are more impactful uses currently allowed, then how can you claim damages for a less impactful use?

7. Conclusion on Specific Factors Related to Impacts on Value

On the basis of the factors described above, it is my professional opinion that the proposed solar farm will not negatively impact adjoining property values. The only category of impact of note is appearance, which is addressed through setbacks and landscaping buffers. The matched pair data supports that conclusion.

XII. Overall Conclusion

The matched pair analysis in the attached report shows no impact in home values due to abutting or adjoining a solar farm as well as no impact to abutting or adjacent vacant residential or agricultural land where there are sufficient setbacks and buffering as identified in the analysis. The criteria that typically correlates with downward adjustments on property values such as noise, odor, and traffic all indicate that a solar farm is a compatible use for rural/residential transition areas and that it would function in a harmonious manner with this area.

Very similar solar farms in very similar areas have been found by hundreds of towns and counties not to have a substantial injury to abutting or adjoining properties, and many of those findings of no impact have been upheld by N.C. Courts or overturned by N.C. Courts when a board found otherwise (see for example *Dellinger. v. Lincoln County*). Similar solar farms have been approved adjoining agricultural uses, schools, churches, and residential developments. Industrial uses rarely absorb negative impacts from adjoining uses. This same pattern of development has been identified in this report showing that this is not a local phenomenon, but found in Virginia, North Carolina, Maryland, Tennessee, and Florida as representative of the Mid-Atlantic and Southeastern U.S.

Based on the data and analysis in this report, it is my professional opinion that the solar farm proposed at the subject property will not substantially injure the value of adjoining property and will be in harmony with the area in which it is located. I note that some of the positive implications of a solar farm that have been expressed by people living next to solar farms include protection from future development of residential developments or other more intrusive uses, reduced dust, odor and chemicals from former farming operations, protection from light pollution at night, it is quiet, and there is no traffic.

XIII. Battery Energy Storage System (BESS)

I considered the following battery storage facilities in a variety of states for a comparison of similar battery energy storage systems (BESS) in proximity to residential uses. I have also searched these areas for recent sales to see if there is any impact on property values near these battery storage facilities, which will be addressed in the following section.

I have focused on stand alone BESS instead of BESS collocated with solar to better isolate the conditions associated with BESS versus solar.

The primary use of this larger set is to show compatibility of BESS and residential uses as well as showing typical setbacks between these uses. These measured distances are from the closest point on the home to the closest piece of equipment. Where I have N/A, the facility does not have an aerial image that I can use to measure that distance. These distances were measured using GoogleEarth.

The closest homes to the approximate location of the BESS are Adjoining Parcels 27 and 29 from earlier in this report with distances to those being 305 and 320 feet.

Summary of Battery Data

#	Name	City/State	Acres	Capacity	Distance from	Average Distance
					Closest Home	Adjoining Home
1	Medway Grid	Medway, MA	10.6	250 MW	150	N/A
2	Diablo	Concord, CA	11.45	200 MW	320	361
3	Fort Watt	Fort Worth, TX	47.94	200 MW	515	1,412
4	Cranberry	Carver, MA	34	150 MW	680	N/A
5	N Central Valley	Stockton, CA	N/A	132 MW	N/A	N/A
6	Silicon Hill	Pflugerville, TX	N/A	100 MW	350	N/A
7	Bat Cave	Mason, TX	N/A	101 MW	N/A	N/A
8	Gambit	Angleton, TX	6.24	100 MW	215	243
9	Chisholm	Ft Worth, TX	21.74	100 MW	840	875
10	Roughneck	W. Columbia, TX	4.55	50 MW	1,095	N/A
11	Vista	Vista, CA	0.88	40 MW	130	172
12	Outer Cape	Provincetown, M	N/A	25 MW	435	N/A
13	West Chicago	Chicago, IL	5	20 MW	430	450
14	McHenry	McHenry, IL	2.75	20 MW	260	283
15	Plumstead	Hornerstown, NJ	14.39	20 MW	155	943
16	Rush Springs	Marlow, OK	N/A	10 MW	N/A	N/A
17	Prospect	W. Columbia, TX	2.3	10 MW	400	400
18	Brazoria	Brazoria, TX	17.58	10 MW	130	438
19	Churchtown	Pennsville, NJ	3.13	10 MW	N/A	N/A
20	Port Lavaca	Prt Lavaca, TX	1.44	10 MW	N/A	N/A
21	Magnolia	Houston, TX	0.87	10 MW	180	190
22	Rabbit Hill	Georgetown, TX	5.99	10 MW	130	338
23	Asheville	Asheville, NC	12.36	9 MW	130	452
24	Micanopy	Micanopy, FL	22.5	8.25 MW	605	1,085
25	East Hampton	E. Hampton, NY	17.58	5 MW	470	733
26	Beebe	N/A	N/A	3 MW	N/A	N/A
27	Ozone Park	Queens, NY	0.35	3 MW	30	203
28	Pomona	Rockland, NY	28.5	N/A	270	1196
Average				42 MW	360	575
Median				20 MW	295	438
High				200 MW	1,095	1,412
Low				3 MW	30	172

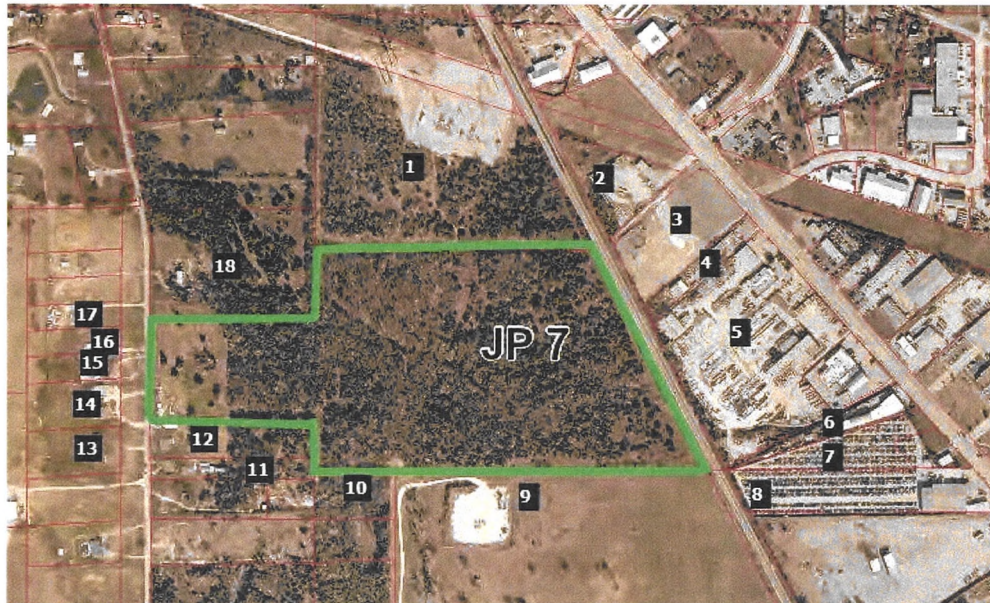
2 – Diablo Energy Storage System

This 200 MW battery storage system is located on a parcel with significant adjacency to industrial uses and residential uses. For these reasons it would be difficult to measure impacts due to the adjoining industrial uses that might also have an impact. Given that most of the adjoining uses are industrial, I have not dug further on this one.



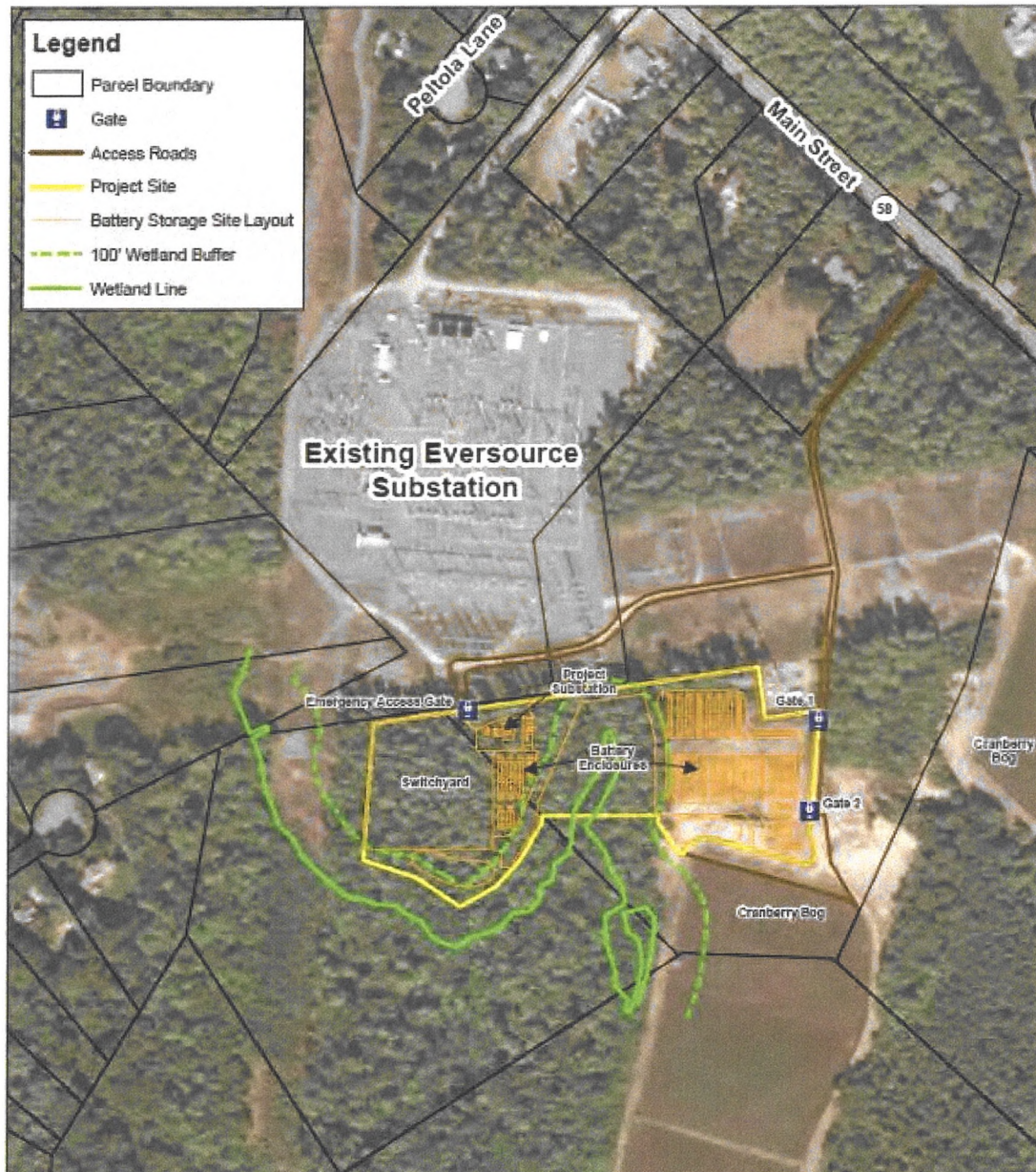
3 – Fort Watt Storage

This 200 MW/400 MWh battery storage system is located near Fort Worth, TX and is proposed to be built in 2024.



4 – Cranberry Point Energy Storage

This 150 MW battery storage system is proposed for Carver, Massachusetts. This is located on 6 acres out of 34-acre parent tracts. The closest adjoining home will be 680 feet away to the west.



5 – North Central Valley Energy Storage

This 132 MW battery storage system is located near Stockton California in the San Joaquin Valley. The map below shows the approximate area as this became operational in August 2023 and no aerial imagery of the battery facility was available.



6 – Silicon Hill Storage

This 100 MW battery storage system is located off Cameron Road, Pflugerville, Texas. There have not been any adjoining home sales since it was built so no analysis is currently possible. The closest adjoining home is 350 feet from the BESS equipment.



7 – Bat Cave Energy Storage

This 100.5 MW battery storage system is located near Mason, Texas and was built in 2021.



8 - Gambit Energy Storage

This 102.4 MW battery storage system is located off W. Live Oak Street, Angleton, Texas. This is a new facility and placed online in June 2021. This system is a good location as there are no other externalities adjoining it to potentially impact the analysis. The substation associated with this is located to the east along N. Walker Street.



The adjoining homes to the north were selling with new homes ranging from \$400,000 to \$600,000 in 2022.

The most recent adjoining home sale to the west was 852 Marshall Road that sold on April 5, 2021 and presumably they were aware of the battery storage facility as it would have been under construction at the time of sale. This brick ranch with 3 BR, 1 BA with 1,220 s.f. of gross living area and built in 1980 on 0.40 acres sold for \$165,000, or \$135 per s.f.

I have compared that sale to 521 Catalpa Street that sold on September 11, 2020 for \$155,000 for a 3 BR, 2 BA brick ranch with 1,220 s.f. built in 1973 with a single car garage. Adjusting this price upward by 9% for growth in the market for time, 3.5% for difference in age, downward by \$6,000 for the additional bathroom, and \$4,000 for the garage, the adjusted indicated value of this home is \$164,375, which is right in line with 852 Marshall Road and supports a finding of no impact on property value.

I have also compared that sale to 521 W Mimosa Street that sold on February 26, 2021 for \$150,000 for this brick ranch with 3 BR, 1.5 BA with 1,194 s.f. built in 1976. Adjusting this sale upward by 4% for growth in the market over time, upward 2% for difference in age, and downward by \$5,000 for the additional half bathroom, I derive an adjusted indication of \$154,000. This is 7%

less than the home price at 852 Marshall Road which suggests an enhancement due to proximity to the battery storage system.

I have also compared this sale to 1164 Thomas Drive that sold on May 20, 2020 for \$187,000 for this brick ranch with 2-car garage, 3 BR, 2 BA with 1,259 s.f. and built in 1998. Adjusting this upward by 13% for growth over time, downward by 9% for difference in age of construction, downward by \$8,000 for the garage, downward \$6,000 for the additional bathroom, I derive an indicated value of \$180,480. This is a 9% difference suggesting a negative impact on property value. However, this comparable required the largest amount of adjustments and is not considered as heavily as the other two comparables. This home is 18 years newer and with better bathroom situation as a 1-bathroom house is a significant issue for most buyers.

The second comparable considered required the least adjustment and suggests a positive impact on property value. The median indication is the first comparable which shows no impact on property value. Given this data set I conclude that the best indication from these matched pairs supports a finding of no impact on property value. The home at 852 Marshall is 180 feet from the project outline shown.

9 - Chisholm Grid Energy Storage

This 200 MW battery storage system is located at 9400 Asphalt Drive, Fort Worth, Texas. This is a new facility and in close proximity to those homes near the substation.

The property to the west of the BESS is an asphalt plant with a lot of vacant land separating the homes from the active plant. Still this complicates any analysis of this from an impact analysis standpoint. I therefore have not attempted to do so.



10 – Roughneck Storage

This 50 MW battery storage system is located off Hogg Ranch Road, West Columbia, Texas. There have not been any adjoining home sales since it was built and commercial/industrial uses in the vicinity would make it challenging for analysis in any case. The closest adjoining home is 1,095 feet from the BESS equipment.



11 - Vista Energy Storage System

This 40 MW battery storage system is located off Olive Avenue, Vista, California. This facility has significant commercial development around it but also housing to the south as close as 115 feet from the closest equipment as shown in the aerial map below.



12 – Outer Cape Community

This 25 MW battery storage system is located in Nantucket, Massachusetts. This adjoins an industrial building, small solar farm and small landfill. There are nearby houses to the east as close as 435 feet. The closest home sold on November 28, 2023 after the batteries were put in place for \$1,750,000 for this 2,454 s.f. home. I attempted a paired sales analysis but given the proximity to those other uses it was not possible to isolate those other possible issues from comparable sales. The best way to isolate those issues would be a Sale/Resale analysis of the same home, but the next earliest sale of this home was too far back for a valid Sale/Resale analysis.



13 - West Chicago Battery Storage

This 19.8 MW battery storage system is located off Pilsen Road, Chicago, Illinois. This facility has condominium and single family housing to the north and single family housing nearby to the south, but also adjoining an outdoor storage area and a large powerline easement. I was not able to do any analysis on this site as there have been no recent sales identified.



14 - McHenry Battery Storage

This 19.8 MW battery storage system is located off Illinois Highway 31, McHenry, Illinois that was built around 2016. This facility fronts on the highway but has rear adjacency to a number of houses.

There were two recent home sales along W. High Street, but they effectively adjoin the small commercial use between the battery storage facility. That complication makes it difficult to determine if the commercial use was the impact or if the commercial use buffered any impact making any finding off of analysis suspect and uncertain.



I have however considered the recent sale of 209 N Dale Avenue that adjoins the battery storage site and is 290 feet from the nearest equipment.

That home sold on June 30, 2021 for \$265,000 for a vinyl-siding ranch with 3 BR, 2.5 BA, built in 1960 with a gross living area of 1,437 square feet, or \$184.41 per s.f. The property has 5 attached garage spaces. As identified in the listing the home was completely renovated with stainless steel appliances and granite countertops. This was listed by Lynda Steidinger with Berkshire Hathaway HomeServices Starck Real Estate and the buyer's agent was Ivette Rodriguez Anderson with Keller Williams. The heavy renovations make it impossible to do a Before and After analysis, so I have looked at paired sales instead.

The home directly across the street, 208 N Dale Avenue, sold on June 16, 2021 for \$275,000 for a cedar siding and stone ranch with 3 BR, 2.5 BA, built in 1961, with a gross living area of 1,446 s.f., or \$190.18 per s.f. This home also has 1,101 square feet of finished basement space that is

currently used as an office but could be an additional bedroom. This home also has been updated and includes stainless steel appliances and granite counter tops.

The size difference is nominal and the additional 3-car garage bays at the 209 N Dale is considered to be balanced by the finished basement space at 208 N Dale, though the finished office space is somewhat superior to garage space. But balancing those two factors out the difference in price per square foot is 3%. This is considered negligible and attributable to the slightly superior finished basement space and not any impact relative to the battery storage facility.

I also looked at 3802 Clover Avenue, which is two blocks to the north. This stone and siding ranch with 3 BR, 2 BA, built in 1956, with a gross living area of 1,200 s.f. sold on October 21, 2021 for \$231,000 or \$192.50 per s.f. The property has been updated with a new kitchen and a new bay window and includes a partially finished basement with an additional bathroom in it and the total basement area is an additional 1,200 s.f. This is the smallest home in the neighborhood that I found and it further illustrates that the price per square foot typically goes up as the size goes down. Adjusting this gross sale price upward by \$36,498 for the smaller size based on 80% of the price per square foot for this purchase, I derive an adjusted sales price to compare to the subject property of \$267,498. I consider the basement to balance out the extra garage space at the subject. This indicates a difference of 1% from the purchase price of the 209 N Dale Avenue, which is attributable to the 4 months difference in time. I consider this comparable to further support a finding of no impact on value.

There are numerous recent home sales in the neighborhood ranging from \$172,000 to \$306,000, but most of these homes are also over 2,000 square feet in size. The subject property sold for more per square foot than most of these other sales partly due to the smaller overall size, partly due to the significant renovations, and partly due to the additional garage space. Still, this shows that the 209 N Dale Avenue sale is not being impacted by the battery storage facility and has in fact been updated above what is typical for the neighborhood, though given the similar updates at 208 N Dale Avenue, this may be the trend for the area.

The two sales compared to the 209 N Dale Avenue sale supports a finding of no impact on property value due to the battery storage facility.

I also looked at a more recent sale of 205 N Dale Avenue which adjoins 209 N. Dale to the south. This home sold on May 31, 2023 for \$255,000 for this 3 BR, 2 BA home with 1,592 s.f. with a 2-car garage built in 1962 on a 0.40-acre lot. This home sold earlier that year for significantly less and underwent heavy renovations. The property was advertised as backing up to woods, it is 1 lot off adjacent to the BESS and shows no sign of impact.

15 - Plumsted Energy Storage

This 19.8 MW battery storage system is located on Monmouth Road, Cream Ridge, New Jersey. There is only one adjoining home as shown in the image to the south, but it is located just 148 feet from the nearest piece of equipment and 96 feet from the fence line. There were existing trees, but they were supplemented with a 12-foot wooden privacy fence with smaller evergreens between the fence and property line. The privacy fence at this location is oversized as the battery units include HVAC units on top of the battery pods that extend the height of the units greater than required at the subject property. The road frontage was not landscaped and chain link fencing was used on the rest of the property.

The adjoining home at 797 Monmouth Road has not sold recently and no further analysis is possible at this site.



16 – Rush Springs Storage

This 10 MW battery storage system is located near a windfarm on SR 1600 near Marlow, Oklahoma. There have not been any adjoining home sales since it was built so no analysis is currently possible. The closest adjoining home is 660 feet from the BESS equipment.



17 – Prospect Energy Storage System

This 10 MW battery storage system is located on a parcel adjoining a large substation in Brazoria, TX. The only adjoining home is 400 feet away. This home has not sold since the BESS was completed in 2019. Furthermore, this home has an unobstructed view of the substation which would make it a difficult home for impact analysis.



18 – Brazoria Energy Storage System

This 9.95 MW battery storage system is located on a parcel adjoining multiple homes within 150 feet of the battery equipment. There have been no recent sales since this was built in 2020.



19 - Churchtown Battery Storage

This 10 MW battery storage system is located off N. Broadway, Pennsville, NJ. The aerial imagery does not show this system yet so I was not able to determine distances to adjoining homes or identify any adjoining homes. Given the large substation, adjoining baseball fields and religious facilities this would be a challenging site for an impact analysis in any case.



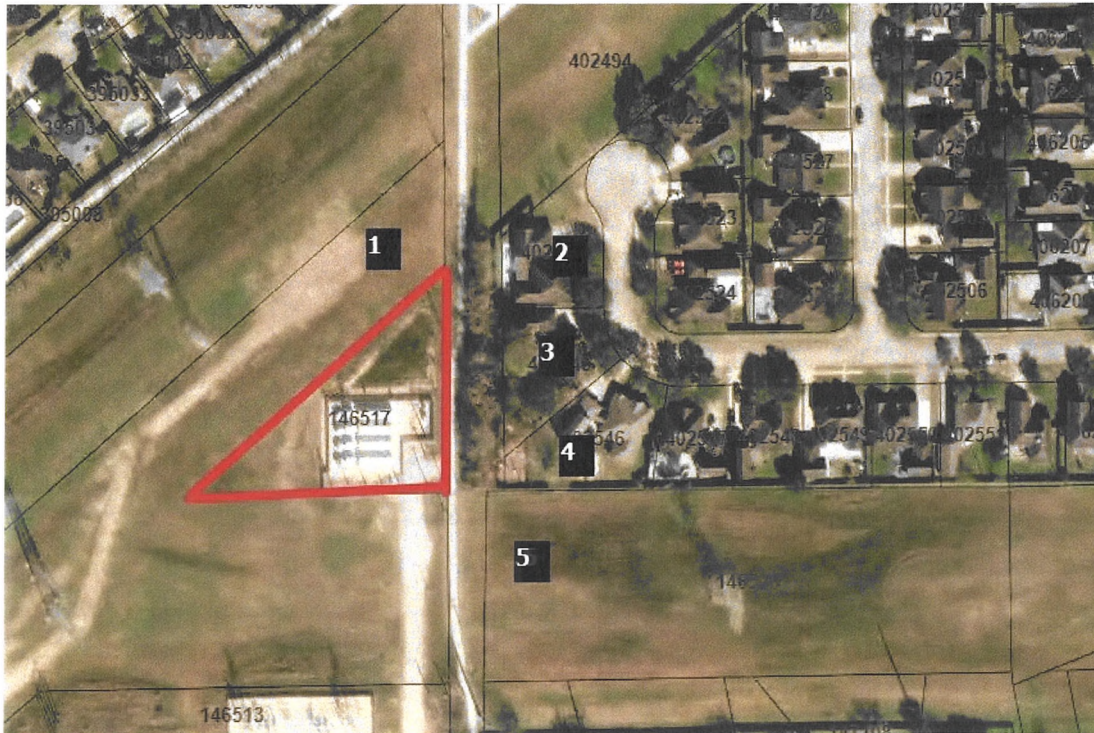
20 – Port Lavaca BESS

This 9.9 MW battery storage system is located in Port Lavaca, Texas. It was built in 2020 and is entirely surrounded by agricultural and utility uses. I have not attempted any impact analysis on this facility.



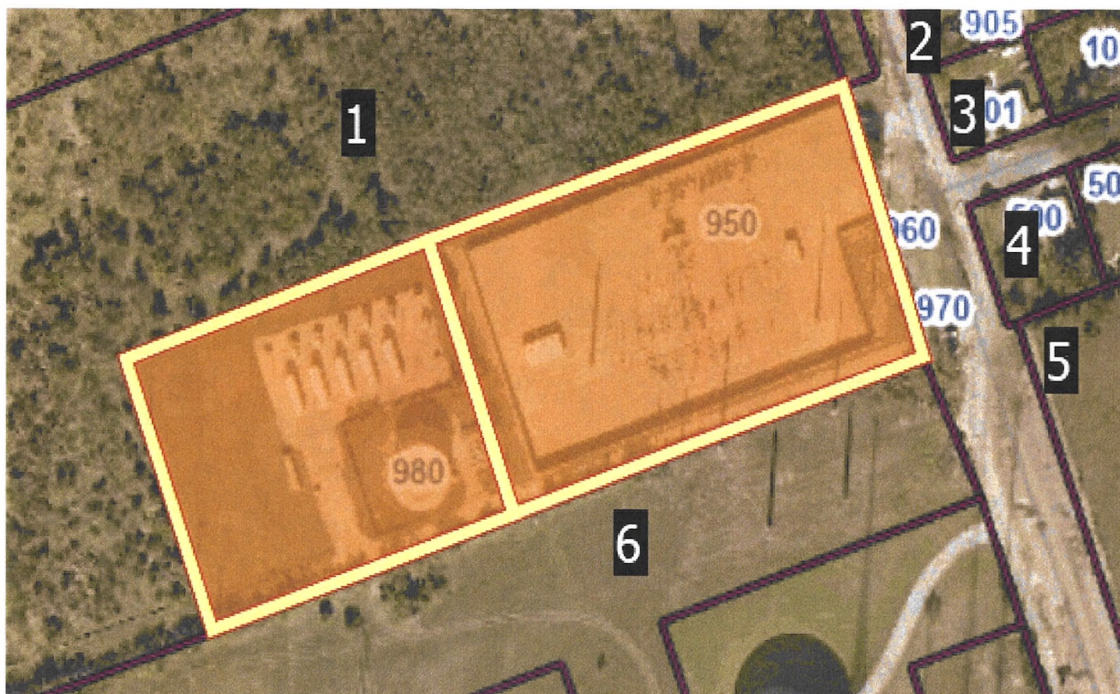
21 - BRP Magnolia BESS

This 9.95 MW battery storage system is located off Floyd Road, League City, near Houston, Texas. There have not been any adjoining home sales since it was built so no analysis is currently possible. The adjoining homes are between 180 and 200 feet from the BESS equipment.



22 –Rabbit Hill Storage

This 10 MW battery storage system is located near Georgetown, TX was built in 2020 with the closest home being 130 feet away.



23 - Asheville Energy Storage System

This 9 MW battery storage system is located on a parcel with a substation built in 2020 (substation was built much earlier). This facility has significant residential development around it but no recent sales to consider.



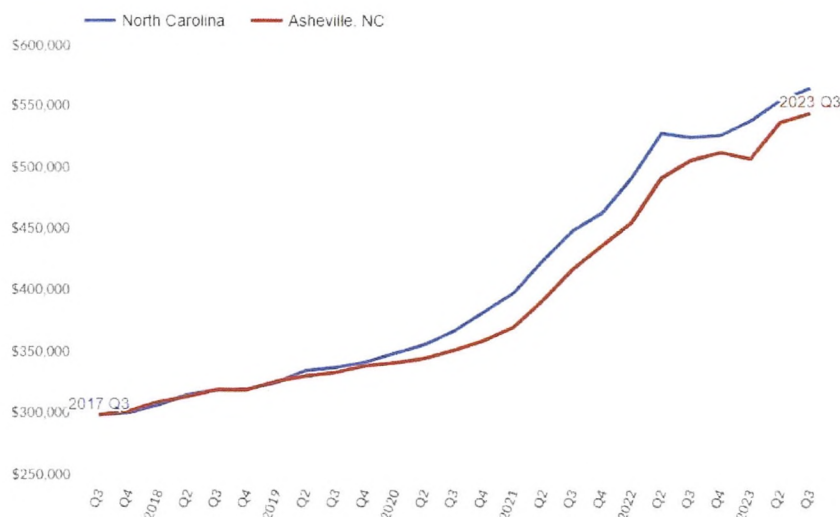
There is a nearby home sale that is located on Tax Parcel 8047 (just below the identifier for Parcel 9). This home is 550 feet from the nearest battery equipment and most of that distance is heavily wooded. This home has a street address of 95 Forest Lake Drive, Asheville, NC and it sold on April 26, 2022 for \$510,000 for this 4 BR/3 BA ranch with 1,931 square feet including the daylight basement area. The home also has a 2 car garage. I did not attempt a paired sale as this home has no visibility of the BESS despite the proximity and arguably has a better view with less screening to the substation, which is also closer to the home.

Similarly, new homes are being built to the south on Rangley Drive with prices ranging from \$431,000 to \$566,000. These homes include those that back up to the Parcels 11 through 14 in the adjacent parcel map.

Also, Parcel 4 sold in March of 2022, but it has the substation between it and the BESS, which makes it challenging to draw conclusions from and I attempted no analysis.

I did look at 129 Graham Lane, Asheville, which is adjoining Parcel 11. It sold on November 6, 2023 for \$550,000 for this 4 BR, 3 BA home with 2,913 s.f. with a 2 car garage built in 1970 on a 1.21-acre lot. This home last sold on August 2, 2017 for \$298,500 prior to the BESS being constructed. Adjusting this earlier sale using the Federal Housing Finance Agency Home Price Index over that time period, homes in the area indicate that the home should have appreciated to \$544,000 as shown below. The home actually sold for slightly more than this which supports a finding of no impact on property value. This home was 510 feet from the BESS and was screened.

Purchase Quarter	Valuation Quarter	Percentage Change
2017 Quarter 3	2023 Quarter 3	82.2%
Purchase Value	Estimated Value for MSA	
\$298,500	\$544,000	



24 – Micanopy

This 8.25 MW battery storage system is located at 304 NE US Highway 441 in Micanopy Florida on a 2.53 acre parcel for an 8.25 MW BESS with an 11.7 MWh capacity built in 2022. The closest adjoining home is 250 feet away. I did not identify any recent home sales.



25 – East Hampton Energy Storage System

This 5 MW battery storage system is located on a parcel with a substation and a natural gas peaker plant. This makes it difficult to use for analysis given the multiple uses on this parcel, but I have included a visual of homes in the general area that have sold recently for reference. There is significant wooded acreage separating this BESS and nearby homes.



26 – Beebe Substation Battery Storage

This 3 MW battery storage system is in Wakefield, Massachusetts built in 2019. The closest adjoining home is 150 feet away to the southwest.

I looked at 4 Twilight Road to the south that is 600 feet away. It sold in September 2023, but that home is closer to a large powerline easement that makes it difficult to complete a paired sales analysis.

I also looked at 22 Pheasant Wood Drive that sold on August 2023 for \$1,050,000 for a 3,038 s.f. brick ranch with 3 BR, 3.5 BA, 2 car garage built in 1992 on 0.33 acres. This home has a finished basement with a full in-law suite with kitchen. The price per square foot works out to \$345.62. This home is 480 feet to the north of the battery system.

I have compared this to 7 June Circle that sold December 2023 for \$1,109,000 for a 3,473 s.f. 2 story home built in 1971 on 0.36 acres. The home has 5 BR, 4.5 BA, 2 car attached garage and 2 car detached garage with finished basement and a pool. The purchase price works out to \$319.32 per s.f. Adjusting this price upward by 10% for the difference in year built, this price is adjusted to \$351.24 per s.f. This is within 1.6% of the Pheasant Wood sale and supports a finding of no impact on value.



27 - Ozone Park Batteries

This system is located on 99th Street in Jamaica, Queens, New York. The below image shows the battery pack parcel outlined in red with a bowling alley to the north, a school to the south and homes to the east and west as well as a church to the west. Based on aerial imagery, this site was installed in early to mid-2018.

The two closest structures are the school at 65 feet and a church at 30 feet from the batteries. The nearby homes are on the opposing blocks, but the proximity to the school does illustrate a high confidence in public safety related to the battery facility and acceptance within that community.



Surrounding Uses

#	Address	GIS Data		Adjoin		Distance (ft) Home/Battery
		Acres	Present Use	Acres	Parcels	
1	98-18 Rockaway	0.76	Bowling	11.69%	6.67%	N/A
2		0.95	Office	14.62%	6.67%	N/A
3	10735 100th St	0.06	Residential	0.92%	6.67%	245
4	10737 100th St	0.06	Residential	0.92%	6.67%	260
5	10739 100th St	0.06	Residential	0.92%	6.67%	275
6	10741 100th St	0.06	Residential	0.92%	6.67%	290
7	10743 100th St	0.06	Residential	0.92%	6.67%	305
8	10915 98th St	3.74	School	57.54%	6.67%	65
9		0.27	School	4.15%	6.67%	N/A
10	10656 98th St	0.06	Residential	0.92%	6.67%	200
11	10654 98th St	0.06	Residential	0.92%	6.67%	195
12	10650 98th St	0.06	Residential	0.92%	6.67%	190
13	10646 98th St	0.06	Residential	0.92%	6.67%	190
14	10636 98th St	0.06	Residential	0.92%	6.67%	195
15	10645 (8th St	0.18	Church	2.77%	6.67%	30
Total		6.500		100.00%	100.00%	203
						Min 30

The closest recent home sale is 10726 101st Street that sold on October 9, 2018, after the battery storage facility was installed. This home is 345 feet from the closest battery and has a very obstructed view of that area based on the shrubs around the battery storage site as well as a strip of landscape greenery between the two sites. The sales price was \$600,000 for this 3 BR/1.5 BA home that was built in 1930 on a 0.06-acre site.

I compared this to a similar home built in 1930 in the same style and same size that sold at 10762 101st Street on October 9, 2018 for \$590,000. This home is just down the street but further from the battery storage system and sold on the same day for \$10,000 less. The proximity to the battery does not correlate to value impact in this instance as the home further away sold for less. This second home is across the street from the three-story John Adams High School which likely accounts for the lower price for this second property compared to the first which was adjacent to the same school, but not across from the building itself.

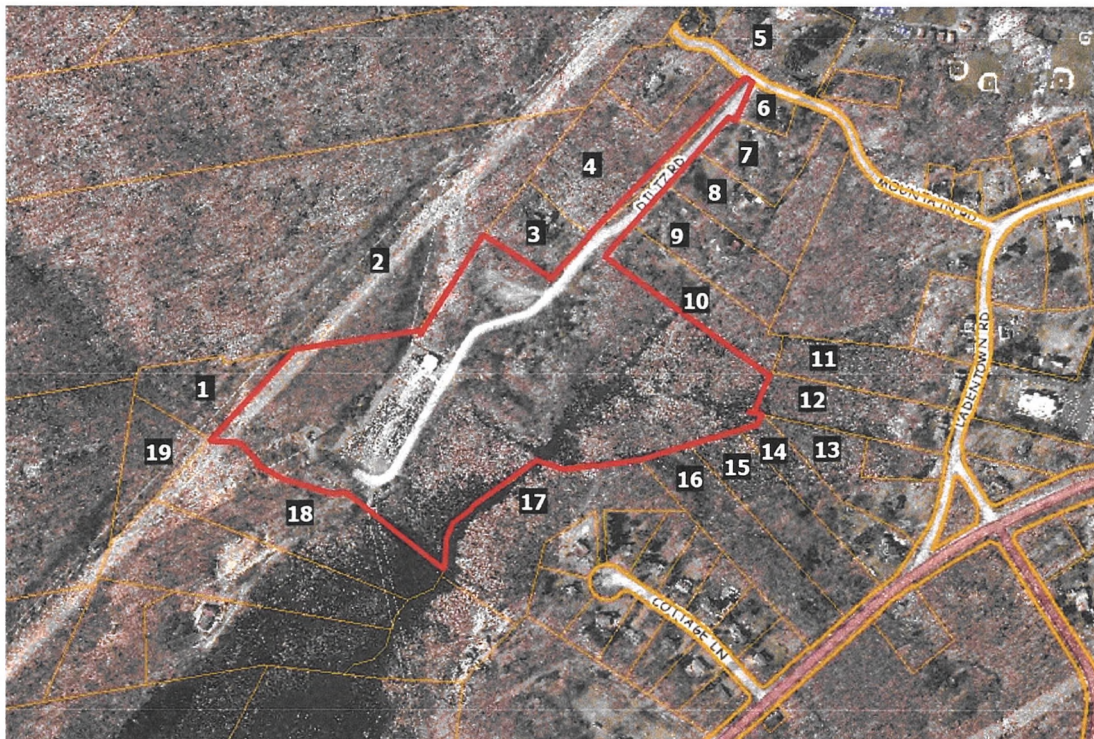
The matched pairs support a finding of no impact on value due to proximity to the battery system.

28 - Pomona Batteries

This battery storage system is located at 23 Diltz Road, Pomona, Rockland, New York. This location is more remote than the other system with greater distances separating homes from batteries, but all of the adjoining uses are residential or park. This battery site is located at the end of a road for estate-like homes on large acreage adjoining or in close proximity to Harriman State Park. There are some sales on Dritz Road adjoining the battery site and none of the broker statements identify that as a concern. But given the park, the Mahwah River exposure it is difficult to use these sales for matched pairs as there are too many unique factors and matched pairs require one unique factor.

Most recently I identified an October 11, 2022 sale of adjoining Parcel 4 that sold for \$500,000 for a 4.57-acre estate lot. This home adjoins Harriman State Park and the listing makes no mention of the nearby battery energy storage facility.

The site shows harmonious use in connection with residential uses. The closest identified home is 270 feet.



Summary

I was able to complete paired sales analysis on four of these situations with data coming from Ozone Park in NY, Asheville in NC, Gambit in TX, McHenry in IL, and Wakefield, MA.

The paired sales analysis identifies no impact on adjoining properties based on actual home sales adjoining similar projects.

Many of the situations identified showed homes in similar situations to the subject property where there is a large substation and powerlines nearby with no impact attributable to the inclusion of the BESS.

The sales data supports a finding of no impact on property value for homes ranging from 180 to 600 feet from the nearest equipment with a median distance of 345 feet.

The closest home to the proposed facility will be 305 feet away, which is very similar to the comparables noted. Furthermore, the range of similar stand alone BESS have numerous examples of closer homes with an average distance of 360 feet and a median distance of 295 feet.

I conclude that based on the comparable and data presented that the proposed BESS component of the facility will not have a negative impact on adjoining property values. Furthermore, there are numerous examples in the data set of homes that are much closer than that distance to batteries which reinforces the opinion developed based on the paired sales analysis and sale/resale analysis.

Specific Factors Related To Impacts on Value

I have completed a number of Impact Studies related to a variety of uses and I have found that the most common areas for impact on adjoining values typically follow a hierarchy with descending levels of potential impact. I will discuss each of these categories and how they relate to a battery energy storage system.

7. Hazardous material
8. Odor
9. Noise
10. Traffic
11. Stigma
12. Appearance

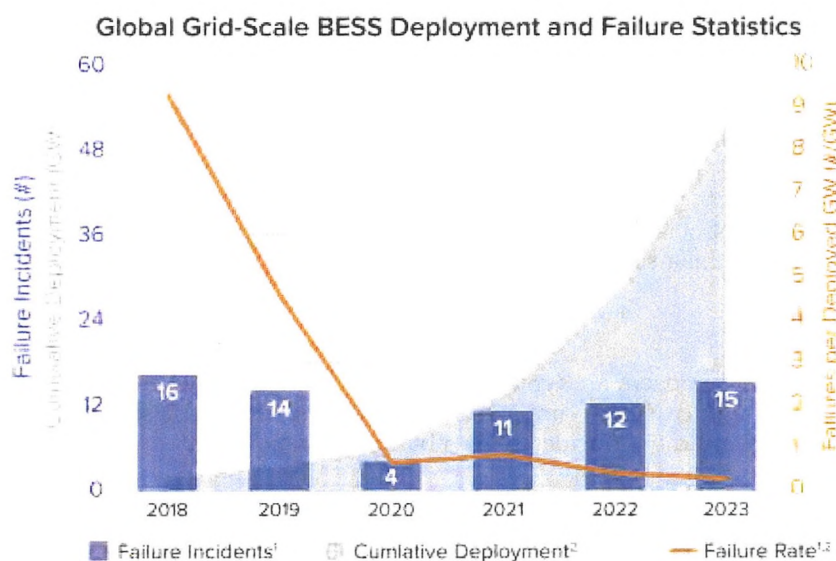
1. Hazardous material

Typically where hazardous material presents an impact on adjoining or nearby property values is due to pollution, risk of spillage, or other impacts that could get into the soil, water table, or into the air. Examples include heavy industrial uses, coal burning uses, or even some heavy agricultural uses.

According to Ms. Judy McElroy, president of Fractal Energy out of Austin Texas, she has been studying battery storage systems since 2012. Since that time there have only been two fires related to this type of system across the United States and both of those fires were in Arizona. Both of those fires were in non-monitored systems that had warnings going off for a week prior to the fire and both were owned and operated by the same company. She indicated that the risk of fire is very limited and that they typically use a closet system as a failsafe to contain and control if a fire did occur. She indicated that any of the gases that would escape from such a fire would be similar to the chemicals that would be released if your kitchen garbage caught on fire and therefore no risk to the surrounding properties even in such an extreme situation.

A battery storage facility presents no potential hazardous waste byproduct as part of normal operation. According to Ms. McElroy, there is no risk to the soils, water supply, or air from the operation of a battery storage facility.

The EPRI Battery Energy Storage System Failure Incidence Database was initiated in 2021 as part of BESS safety research and tracks data back to 2018 globally. The following chart shows that while incident rates are relatively consistent across the time period, the actual failure rate has dropped precipitously on a failure per GW. So despite substantial growth of over 8 times the GW installed since 2020 to 2023, the failure rate is dropping.



Based on that information I conclude that the proposed battery storage system does not have the characteristics of a hazardous material byproduct and no related external obsolescence on adjoining property value.

2. Odor

Odor is the next category that has the second highest potential impact on nearby property values. Odor is an impact often considered with waste water treatment facilities, solid waste facilities, manufacturing, and related uses. There is no significant odor related to a battery storage system and therefore no impact on adjoining or nearby properties related to odor.

3. Noise

Noise is the next category that has the next highest potential for impact on property values. Noise impacts are found near airports, railroads, heavy industry, or other significant generators of noise including outdoor music venues and the like.

I have reviewed three different noise studies by three different experts on this topic specific to BESS, which all support a finding of no impact on property value related to noise concerns.

The systems shown in the market data include a system adjoining a school, a church, and in close proximity to numerous homes including rural homes near park land. I conclude that the battery storage system is not a significant contributor to noise and therefore would not have a negative impact on adjoining property values.

4. Traffic

Traffic impacts come from traffic patterns related to a site that could cause queuing outside the property or putting too much new traffic within a confined area.

The battery storage system would be remotely monitored and other than occasional maintenance would not have a significant number of trips per day. In fact it would have fewer trips per day than

a single-family dwelling. I therefore conclude that traffic related to this use will not have a negative impact on adjoining property values.

5. Stigma

There is no stigma associated with battery storage facilities.

Stigma is most often associated with adult establishments and would not typically be connected with infrastructure like this use.

6. Appearance

Appearance or viewshed impacts are typically more for scenic areas where there could be premiums for a view, but also include negative impacts related to less aesthetic uses in proximity to housing. This is a category that could be considered for a battery storage facility.

However, the boxes will be 9 feet tall and will be screened by existing vegetation from the nearest homes. The distances to the nearest homes are further than what was identified in most of the other BESS examples, which substantially mitigates visual impacts even if there were not a landscaping screen.

Substations are much taller and harder to effectively screen, whereas the proposed battery storage use would be lower to the ground.

Given the similar use of screens for taller substations, I consider this a good mitigation method for the appearance of the subject property.

Whenever you consider the impact of a proposed project on viewshed or what the adjoining owners may see from their property it is important to distinguish whether or not they have a protected viewshed or not. Enhancements for scenic vistas are often measured when considering properties that adjoin preserved open space and parks. However, adjoining land with a preferred view today conveys no guarantee that the property will continue in the current use. Any consideration of the impact of the appearance requires consideration of the wide variety of other uses a property already has the right to be put to which could include significant agricultural structures.

Conclusion

The proposed use of the subject property is consistent with adjoining industrial and residential uses as shown by the similar projects. They also show compatibility with schools, churches, homes, and parks.

The paired sales in New York as well as the ones in Massachusetts, North Carolina, Illinois and Texas illustrate that the battery storage facilities had no impact on the nearby home sales prices at ranges of 180 to 600 feet. The closest home at the subject property will be 305 feet.

The breakdown of potential factors that cause a negative impact (or external obsolescence) on adjoining property value shows that the only area for consideration is the appearance, which is well addressed through the existing and proposed landscaping. Landscaping was a mitigating factor used with many of the projects identified. The existing mature tree buffer that is proposed to be maintained is superior to a planted tree buffer.

Based on those various considerations, I conclude that there is no reasonable basis to anticipate a negative impact on adjoining property value.

Certification

I certify that, to the best of my knowledge and belief:

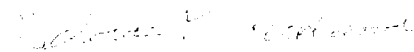
1. The statements of fact contained in this report are true and correct;
2. The reported analyses, opinions, and conclusions are limited only by the reported assumptions and limiting conditions, and are my personal, unbiased professional analyses, opinions, and conclusions;
3. I have no present or prospective interest in the property that is the subject of this report and no personal interest with respect to the parties involved;
4. I have no bias with respect to the property that is the subject of this report or to the parties involved with this assignment;
5. My engagement in this assignment was not contingent upon developing or reporting predetermined results;
6. My compensation for completing this assignment is not contingent upon the development or reporting of a predetermined value or direction in value that favors the cause of the client, the amount of the value opinion, the attainment of a stipulated result, or the occurrence of a subsequent event directly related to the intended use of the appraisal;
7. The reported analyses, opinions, and conclusions were developed, and this report has been prepared, in conformity with the requirements of the Code of Professional Ethics and Standards of Professional Appraisal Practice of the Appraisal Institute;
8. My analyses, opinions and conclusions were developed, and this report has been prepared, in conformity with the Uniform Standards of Professional Appraisal Practice.
9. The use of this report is subject to the requirements of the Appraisal Institute relating to review by its duly authorized representatives;
10. I have not made a personal inspection of the property that is the subject of this report, and;
11. No one provided significant real property appraisal assistance to the person signing this certification.
12. As of the date of this report Richard C Kirkland Jr has completed the continuing education program for Designated Members of the Appraisal Institute; As of the date of this report Nicholas Kirkland has completed the Standards and Ethics Education Requirements for Candidates of the Appraisal Institute.
13. I have not performed services, regarding the property that is the subject of this report within the three-year period immediately preceding acceptance of this assignment.

Disclosure of the contents of this appraisal report is governed by the bylaws and regulations of the Appraisal Institute and the National Association of Realtors.

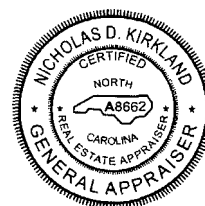
Neither all nor any part of the contents of this appraisal report shall be disseminated to the public through advertising media, public relations media, news media, or any other public means of communications without the prior written consent and approval of the undersigned.



Richard C. Kirkland, Jr., MAI
State Certified General Appraiser

Nicholas D. Kirkland
State Certified General Appraiser





Kirkland Appraisals, LLC

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PROFESSIONAL EXPERIENCE

Kirkland Appraisals, LLC , Raleigh, N.C. Commercial appraiser	2003 – Present
Hester & Company , Raleigh, N.C. Commercial appraiser	1996 – 2003

PROFESSIONAL AFFILIATIONS

MAI (Member, Appraisal Institute) designation #11796	2001
NC State Certified General Appraiser # A4359	1999
VA State Certified General Appraiser # 4001017291	
SC State Certified General Appraiser # 6209	
KY State Certified General Appraiser # 5522	
TN State Certified General Appraiser # 6240	
FL State Certified General Appraiser # RZ3950	
GA State Certified General Appraiser # 321885	
MI State Certified General Appraiser # 1201076620	
PA State Certified General Appraiser # GA004598	
OH State Certified General Appraiser # 2021008689	
IN State Certified General Appraiser # CG42100052	
IL State Certified General Appraiser # 553.002633	
LA State Certified General Appraiser # APR.05049-CGA	

EDUCATION

Bachelor of Arts in English , University of North Carolina, Chapel Hill	1993
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CONTINUING EDUCATION

Uniform Standards of Professional Appraisal Practice Update	2024
ASFMRA Integrated Approaches to Value (A360)	2024
ASFMRA Best in Business Ethics	2023
Appraising Natural Resources Series – Oil, Gas & Minerals	2023
Appraisal of Industrial and Flex Buildings	2023
Commercial Land Valuation	2023
Fair Housing, Bias and Discrimination	2023
Pennsylvania State Mandated Law for Appraisers	2023
What NOT to Do (NCDOT Course)	2023
The Income Approach – A Scope of Work Decision	2023
Valuation of Residential Solar	2022
Introduction to Commercial Appraisal Review	2022
Residential Property Measurement and ANSI	2022
Business Practices and Ethics	2022

Uniform Standards of Professional Appraisal Practice Update	2022
Sexual Harassment Prevention Training	2021
Appraisal of Land Subject to Ground Leases	2021
Michigan Appraisal Law	2020
Uniform Standards of Professional Appraisal Practice Update	2020
Uniform Appraisal Standards for Federal Land Acquisitions (Yellow Book)	2019
The Cost Approach	2019
Income Approach Case Studies for Commercial Appraisers	2018
Introduction to Expert Witness Testimony for Appraisers	2018
Appraising Small Apartment Properties	2018
Florida Appraisal Laws and Regulations	2018
Uniform Standards of Professional Appraisal Practice Update	2018
Appraisal of REO and Foreclosure Properties	2017
Appraisal of Self Storage Facilities	2017
Land and Site Valuation	2017
NCDOT Appraisal Principles and Procedures	2017
Uniform Standards of Professional Appraisal Practice Update	2016
Forecasting Revenue	2015
Wind Turbine Effect on Value	2015
Supervisor/Trainee Class	2015
Business Practices and Ethics	2014
Subdivision Valuation	2014
Uniform Standards of Professional Appraisal Practice Update	2014
Introduction to Vineyard and Winery Valuation	2013
Appraising Rural Residential Properties	2012
Uniform Standards of Professional Appraisal Practice Update	2012
Supervisors/Trainees	2011
Rates and Ratios: Making sense of GIMs, OARs, and DCFs	2011
Advanced Internet Search Strategies	2011
Analyzing Distressed Real Estate	2011
Uniform Standards of Professional Appraisal Practice Update	2011
Business Practices and Ethics	2011
Appraisal Curriculum Overview (2 Days – General)	2009
Appraisal Review - General	2009
Uniform Standards of Professional Appraisal Practice Update	2008
Subdivision Valuation: A Comprehensive Guide	2008
Office Building Valuation: A Contemporary Perspective	2008
Valuation of Detrimental Conditions in Real Estate	2007
The Appraisal of Small Subdivisions	2007
Uniform Standards of Professional Appraisal Practice Update	2006
Evaluating Commercial Construction	2005
Conservation Easements	2005
Uniform Standards of Professional Appraisal Practice Update	2004
Condemnation Appraising	2004
Land Valuation Adjustment Procedures	2004
Supporting Capitalization Rates	2004
Uniform Standards of Professional Appraisal Practice, C	2002
Wells and Septic Systems and Wastewater Irrigation Systems	2002
Appraisals 2002	2002
Analyzing Commercial Lease Clauses	2002
Conservation Easements	2000
Preparation for Litigation	2000
Appraisal of Nonconforming Uses	2000
Advanced Applications	2000
Highest and Best Use and Market Analysis	1999

Advanced Sales Comparison and Cost Approaches	1999
Advanced Income Capitalization	1998
Valuation of Detrimental Conditions in Real Estate	1999
Report Writing and Valuation Analysis	1999
Property Tax Values and Appeals	1997
Uniform Standards of Professional Appraisal Practice, A & B	1997
Basic Income Capitalization	1996



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PROFESSIONAL EXPERIENCE

Kirkland Appraisals, LLC , Raleigh, N.C.	2015 – Present
NC State Trainee Appraiser	2015 - 2020
NC State Licensed Residential Appraiser	2020 - 2021
NC State Certified General Appraiser	2021 – Present
VA Certified General Appraiser	2021 - Present

PROFESSIONAL AFFILIATIONS

NC State Certified General Appraiser # A8662	2021
VA Certified General Appraiser #4001018168	2021
KY Certified General Appraiser #287796	2023
Candidate for Designation through Appraisal Institute	2021

EDUCATION

Bachelor of Arts in Communication , North Carolina State University, Raleigh	2018
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CONTINUING EDUCATION

Appraisal Institute: Advanced Market Analysis & Highest and Best Use	2023
Appraisal Institute: Advanced Income Capitalization, Challenged Exam Full Credit	2023
Intermediate Income Approach Case Studies	2023
Fair Housing, Bias and Discrimination	2023
Appraisal Institute: Quantitative Analysis	2022
Appraisal Institute: Business Practice and Ethics	2022
Uniform Standards of Professional Appraisal Practice Update	2022
Commercial Appraisal Review	2021
Expert Witness for Commercial Appraisers	2021
General Appraiser Market Analysis Highest and Best Use	2021
General Report Writing and Case Studies	2021
General Appraiser Sales Comparison Approach	2021
General Appraiser Income Approach	2021
Statistics, Modeling and Finance	2021
General Appraiser Site Valuation and Cost Approach	2021
Uniform Standards of Professional Appraisal Practice Update	2020
Residential Report Writing and Case Studies	2019
Residential Appraiser Site Valuation and Cost Approach	2019
Residential Sales Comparison and Income Approaches	2019
Income Approach Case Studies for Commercial Appraisers	2019
Appraisal of Self-Storage Facilities	2019
The Basics of Expert Witness for Commercial Appraisers	2019
Introduction to Expert Witness Testimony for Appraisers	2019
Uniform Standards of Professional Appraisal Practice Update	2018

Fundamental Concepts of Analysis	2017
The Cost Approach	2017
Uniform Standards of Professional Appraisal Practice Update	2016
Uniform Standards of Professional Appraisal Practice	2015
Residential Market Analysis & Highest & Best Use	2015
Basic Appraisal Procedures	2015
Basic Appraisal Principles	2015

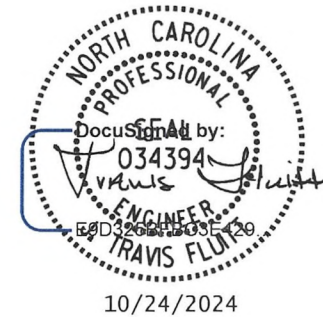
MEMORANDUM

To: Low Bridge Solar, LLC

From: Travis Fluitt, P.E., Kimley-Horn and Associates, Inc.

Date: October 24, 2024

Subject: Low Bridge Solar Farm – Trip Generation



Kimley-Horn has reviewed the trip generation potential of the proposed Low Bridge solar farm located off Low Bridge Road and Ferguson Road in Randolph County, NC. The ITE Trip Generation Manual does not provide trip generation rates for solar farms. Therefore, the trip generation was estimated based on the anticipated number of employees both during construction and a full build-out.

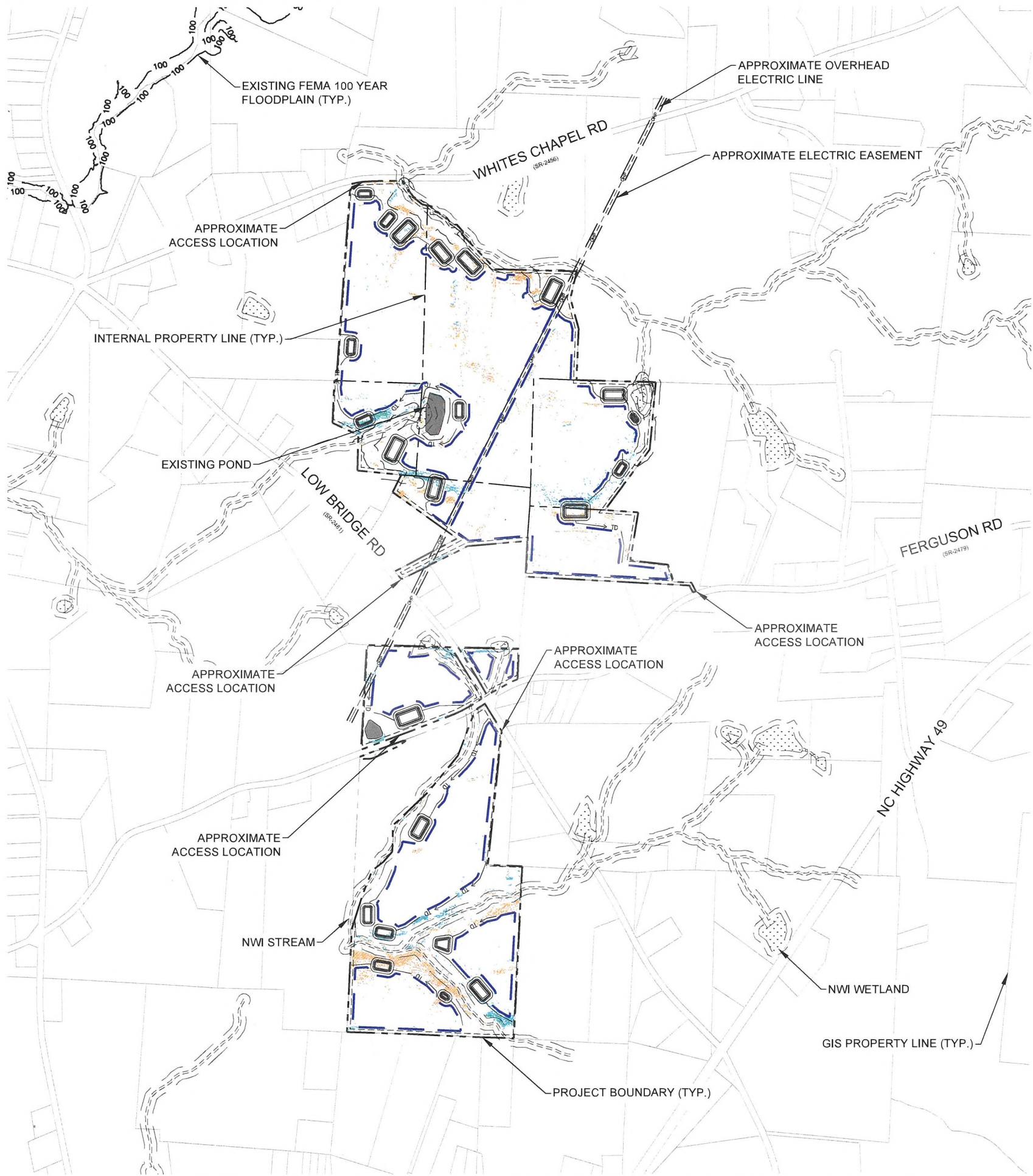
During construction it is estimated that a maximum of 40 workers will be on site each day. Though some workers will carpool, as a worst case it is assumed that all workers arrive individually in the AM peak hour and depart individually in the PM peak hour. There are also anticipated to be approximately 8 truck deliveries per day during construction with only 1 vehicle on-site at any given time. As a worst case, it is assumed that 2 trucks enter and exit during each peak hour. Therefore, it is anticipated that in a worst case condition, there will be approximately 42 entering trips and 2 exiting trips in the AM peak hour and 2 entering trips and 42 exiting trips in the PM peak hour. Proposed access points during and after construction will be located along Low Bridge Road and Ferguson Road.

Upon completion the site will have no full-time staff. There will be 1-2 employees that will service this site once every several months. The result is that this site is expected to generate less than 1 trip per day on average. Table 1 below summarizes the anticipated trip generation of the site.

Table 1 Solar Farm Traffic Generation (Vehicles)						
Scenario	Daily		AM Peak Hour		PM Peak Hour	
	In	Out	In	Out	In	Out
Construction	<100	<100	42	2	2	42
Build-out	<1	<1	<1	<1	<1	<1

Please feel free to contact me at 919-653-2948 or travis.fluitt@kimley-horn.com with any question or comments.

**Environmental
Constraints**



LEGEND

	PROJECT BOUNDARY
	GIS PROPERTY LINE
	APPROXIMATE BUILDABLE AREA
	PERIMETER SETBACK
	APPROXIMATE ELECTRIC EASEMENT
	APPROXIMATE EXISTING OVERHEAD TRANSMISSION LINE
	FEMA 100 YEAR FLOODPLAIN
	NWI STREAM
	NWI WETLAND
	APPROXIMATE PROPOSED TEMPORARY DIVERSION DITCH
	APPROXIMATE PROPOSED EROSION CONTROL BASIN

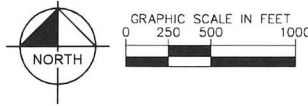
PRELIMINARY SITE DATA TABLE

PARCEL EXTENTS	±303 AC
PROJECT BOUNDARY	±285 AC
APPROXIMATE BUILDABLE AREA	±169 AC

NOTE:
1) SITE LAYOUT IS BASED ON PUBLICLY AVAILABLE GIS DATA. ALTA SURVEY WILL DETERMINE FINAL PROJECT EXTENTS AND RELATED SETBACKS, AND IDENTIFY EXISTING CONSTRAINTS AND INFRASTRUCTURE.
2) ENVIRONMENTAL FEATURES WERE DELINEATED BY KIMLEY-HORN ON 06/14/2023 AND BASED OFF OF PUBLICLY ACCESS NWI DATA ON 10/17/2024.

SLOPE HATCH LEGEND

	SLOPES BETWEEN 0-12%
	NORTH-FACING SLOPES 12%-25%
	SOUTH-FACING SLOPES 12%-25%
	SLOPES >25%



Kimley»Horn

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PHONE: 919-677-2000 FAX: 919-677-2050
WWW.KIMLEY-HORN.COM #0-0102

PRELIMINARY
NOT FOR
CONSTRUCTION

KHA PROJECT	017007007
DATE	10/25/2023
SCALE	AS SHOWN
DESIGNED BY	NSP
DRAWN BY	NSP
CHECKED BY	LCL

CONSTRAINTS MAP

LOW BRIDGE SOLAR
NORTH CAROLINA
RANDOLPH COUNTY

Stormwater Management Plan



MEMORANDUM

To: Randolph County Planning & Zoning
From: Luke Lukas, P.E.
Date: October 25, 2024
Subject: Proposed Low Bridge Solar Facility
Randolph County, NC
Preliminary Stormwater Analysis

This memorandum details a preliminary review of stormwater requirements and anticipated stormwater management design regarding the development of the proposed Low Bridge Solar Facility.

Project Understanding

The proposed Low Bridge Solar Facility is located on a ±285-acre site located west of Highway 49, approximately five miles to the west of the City of Stanley in Randolph County, North Carolina. The proposed site occupies land on eight parcels to the west of State HWY 49.

Based on publicly available aerial imagery, majority of the site is forested with some areas of dirt access roads. The existing topography consists of mostly flat land with natural drainage features. The drainage of the soils on site can be classified as well drained—the majority of soil within the project area is classified under Hydrologic Soils Groups B based on USGS Web Soil Survey maps.

It is our understanding that the construction of the proposed solar facility will consist of the following:

- Ground-mounted arrays of photovoltaic panels;
- BESS (Battery Energy Storage System)
- Inverters, combiners, and transformers;
- Substation facility;
- Utility switch yard;
- Electrical conduits;
- Onsite access roads and interior access paths;
- Wildlife permeable security fencing located along the site perimeter; and
- Access drives from the adjacent roadways

The proposed construction will require maximum disturbance of approximately 267 acres of land based on preliminary site layouts. It is anticipated that a conservative estimate of approximately 10% (28.5 acres) of the project area will be proposed as impervious, which includes new access roads and

equipment pads. The proposed solar panels on site are considered pervious as detailed in the following section.

DENSITY AND BUILT-UPON LIMITS				
Water Supply Classification	Location in the Watershed	Maximum Allowable Project Density or Minimum Lot Size		
		Low-Density Development	High-Density Development	
WS-I	Not Applicable: Watershed shall remain underdeveloped except for the following uses when they cannot be avoided: power transmission lines, restricted access roads, and structures associated with water withdrawal, treatment, and distribution of the WS-1 Water. Built-upon area shall be designed and located to minimize stormwater runoff impact on receiving waters.			
WS-II	Critical Area	One dwelling unit per 80,000 sq. ft.	Six percent	Six percent
	Balance of Watershed	One dwelling unit per 40,000 sq. ft.	Twelve percent	Twelve percent
WS-III	Critical Area	One dwelling unit per 80,000 sq. ft.	Twelve percent	Twelve percent
	Balance of Watershed	One dwelling unit per 40,000 sq. ft.	Twenty-four percent	Twenty-four percent
WS-IV	Critical Area	One dwelling unit per 40,000 sq. ft.	Twelve percent	Twelve percent
	Protected Area	One dwelling unit per 80,000 sq. ft.	Six percent	Six percent
WS-V	Not Applicable			

Table 23: Density and Built-Upon Limits

Figure 1: Randolph County UDO Density requirements

Stormwater Management Rules and Regulations

Since the proposed project disturbs over one acre, it is anticipated an erosion control permit will be required. To receive an erosion control permit, the site design will need to meet the requirements of the NCDEQ stormwater design manual, specifically the low density and Solar Farm chapters. Based on the NCDEQ Post Construction Stormwater Permitting Map accessed 10/24/2024, the project falls in an unincorporated region with the jurisdiction of the NCDEQ Winston Salem Regional Office.

The Solar Farm chapter of NCDEQ's stormwater design manual gives specific guidance for solar sites explaining that as long as panels are disconnected, they are not classified as built upon area and sheet flow should be maintained. NCDEQ defines disconnected as the width between the rows of panels

being greater than or equal to the panel width. The understanding that proposed solar panels on site are viewed as pervious can be reinforced by a report in the Journal of Hydrologic Engineering titled “Hydrologic Response of Solar Farms” dated May 2013. The conclusion of this report after various testing procedures were carried out is the addition of solar panels over a grassy field has very little effect on the volume of runoff, the peak discharge, and the time to peak. With each analysis, the runoff volume decreased slightly thus not requiring post construction storm-water management facilities. The Hydrologic Response of Solar Farms report is included for reference as Attachment A.

Preliminary Drainage Analysis

Based on available USGS soils maps, soils on site are a mix of Hydrologic Soils Groups A, B, C, B/D, and C/D, with the majority being soil groups B and C/D. The Hydrologic Soils Group is a factor of the curve numbers based on the US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) TR-55 Publication. These are used to calculate runoff quantity and are the basis of this in the preliminary stormwater analysis. In their natural/undrained state, the soils in the proposed area provide moderate infiltration and moderate runoff. Since the majority of soil on site is classified under soil group B, all of the soils have been considered Hydrologic Soil Group B for the purpose of this preliminary analysis—this generates more conservative storm runoffs since infiltration of the better soil groups are not taken into account.

Soil Conservation Service (SCS) Curve Numbers (CN):

PRE-DEVELOPMENT CN		
	Area (Acres)	CN
Woods/grass comb., Fair, HSG B	202.120	65
Pasture/grassland/range, Poor, HSG B	81.110	79
Water Surface, 0% imp, HSG B	1.940	98
Total Area/Weighted Composite Curve Number	285.17	69

POST-DEVELOPMENT CN		
	Area (Acres)	CN
Water Surface, 0% imp, HSG B	1.940	98
Meadow, non-grazed, HSG B	254.71	58
Impervious Area (inverter/substation pads), Soil B	28.52	98
Total Area/Weighted Composite Curve Number	285.17	62

Peak flow analyses for the 1-year, 10-year, and 100-year storms in Randolph County were conducted for the project site based on the previous soil and ground cover characteristics. Analyses were run in Bentley HydroCAD using SCS method and results are as follows:

	PEAK FLOW (ft ³ /s)		
	1-year	10-year	100-year
Pre	955	1,943	2,576
Post	677	1,569	2,167

The above analyses were run based on the entire project boundary. Runoff flows indicated are a representation of the site as a whole; sub-drainage areas within the overall drainage area were not delineated and analyzed independently. While some additional impervious area is proposed, the entire area under the panels will be converted to meadow grass resulting in no anticipated net increase in the weighted composite curve number or subsequent runoff in the post condition.

Anticipated Stormwater Management Design

Due to the NCDEQ regulations classifying solar panels as pervious areas, the site can be considered low-density for the purposes of stormwater management. As such, no permanent stormwater measures are anticipated. The goal for the proposed Low Bridge facility will be to maintain natural drainage patterns to the maximum extent possible while still accounting for array grading tolerances and access road grading criteria. As with all development, grading construction activities are cost-adders to the facility, and thus, developers are incentivized to minimize the need for those activities in their designs.

Conclusions

Based on the NCDEQ's stormwater permitting requirements, the anticipated stormwater design approach and the preliminary proposed site plan, Kimley Horn believes the proposed development's impact to existing drainage patterns in the final condition will be negligible. The intent of this memorandum is to show how land cover on site can be analyzed with the proposed project. The Pre-Development and Post-Development analysis in this memorandum is subject to change based upon design progression and will be compliant with local and state requirements.

Hydrologic Response of Solar Farms

Lauren M. Cook, S.M.ASCE¹; and Richard H. McCuen, M.ASCE²

Abstract: Because of the benefits of solar energy, the number of solar farms is increasing; however, their hydrologic impacts have not been studied. The goal of this study was to determine the hydrologic effects of solar farms and examine whether or not storm-water management is needed to control runoff volumes and rates. A model of a solar farm was used to simulate runoff for two conditions: the pre- and postpaneled conditions. Using sensitivity analyses, modeling showed that the solar panels themselves did not have a significant effect on the runoff volumes, peaks, or times to peak. However, if the ground cover under the panels is gravel or bare ground, owing to design decisions or lack of maintenance, the peak discharge may increase significantly with storm-water management needed. In addition, the kinetic energy of the flow that drains from the panels was found to be greater than that of the rainfall, which could cause erosion at the base of the panels. Thus, it is recommended that the grass beneath the panels be well maintained or that a buffer strip be placed after the most downgradient row of panels. This study, along with design recommendations, can be used as a guide for the future design of solar farms. DOI: 10.1061/(ASCE)HE.1943-5584.0000530. © 2013 American Society of Civil Engineers.

CE Database subject headings: Hydrology; Land use; Solar power; Floods; Surface water; Runoff; Stormwater management.

Author keywords: Hydrology; Land use change; Solar energy; Flooding; Surface water runoff; Storm-water management.

Introduction

Storm-water management practices are generally implemented to reverse the effects of land-cover changes that cause increases in volumes and rates of runoff. This is a concern posed for new types of land-cover change such as the solar farm. Solar energy is a renewable energy source that is expected to increase in importance in the near future. Because solar farms require considerable land, it is necessary to understand the design of solar farms and their potential effect on erosion rates and storm runoff, especially the impact on offsite properties and receiving streams. These farms can vary in size from 8 ha (20 acres) in residential areas to 250 ha (600 acres) in areas where land is abundant.

The solar panels are impervious to rain water; however, they are mounted on metal rods and placed over pervious land. In some cases, the area below the panel is paved or covered with gravel. Service roads are generally located between rows of panels. Although some panels are stationary, others are designed to move so that the angle of the panel varies with the angle of the sun. The angle can range, depending on the latitude, from 22° during the summer months to 74° during the winter months. In addition, the angle and direction can also change throughout the day. The issue posed is whether or not these rows of impervious panels will change the runoff characteristics of the site, specifically increase runoff volumes or peak discharge rates. If the increases are hydrologically significant, storm-water management facilities may be needed. Additionally, it is possible that the velocity of water

draining from the edge of the panels is sufficient to cause erosion of the soil below the panels, especially where the maintenance roadways are bare ground.

The outcome of this study provides guidance for assessing the hydrologic effects of solar farms, which is important to those who plan, design, and install arrays of solar panels. Those who design solar farms may need to provide for storm-water management. This study investigated the hydrologic effects of solar farms, assessed whether or not storm-water management might be needed, and if the velocity of the runoff from the panels could be sufficient to cause erosion of the soil below the panels.

Model Development

Solar farms are generally designed to maximize the amount of energy produced per unit of land area, while still allowing space for maintenance. The hydrologic response of solar farms is not usually considered in design. Typically, the panels will be arrayed in long rows with separations between the rows to allow for maintenance vehicles. To model a typical layout, a unit width of one panel was assumed, with the length of the downgradient strip depending on the size of the farm. For example, a solar farm with 30 rows of 200 panels each could be modeled as a strip of 30 panels with space between the panels for maintenance vehicles. Rainwater that drains from the upper panel onto the ground will flow over the land under the 29 panels on the downgradient strip. Depending on the land cover, infiltration losses would be expected as the runoff flows to the bottom of the slope.

To determine the effects that the solar panels have on runoff characteristics, a model of a solar farm was developed. Runoff in the form of sheet flow without the addition of the solar panels served as the prepaneled condition. The paneled condition assumed a downgradient series of cells with one solar panel per ground cell. Each cell was separated into three sections: wet, dry, and spacer.

The dry section is that portion directly underneath the solar panel, unexposed directly to the rainfall. As the angle of the panel from the horizontal increases, more of the rain will fall directly onto

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the ground; this section of the cell is referred to as the wet section. The spacer section is the area between the rows of panels used by maintenance vehicles. Fig. 1 is an image of two solar panels and the spacer section allotted for maintenance vehicles. Fig. 2 is a schematic of the wet, dry, and spacer sections with their respective dimensions. In Fig. 1, tracks from the vehicles are visible on what is modeled within as the spacer section. When the solar panel is horizontal, then the length longitudinal to the direction that runoff will occur is the length of the dry and wet sections combined. Runoff from a dry section drains onto the downgradient spacer section. Runoff from the spacer section flows to the wet section of the next downgradient cell. Water that drains from a solar panel falls directly onto the spacer section of that cell.

The length of the spacer section is constant. During a storm event, the loss rate was assumed constant for the 24-h storm because a wet antecedent condition was assumed. The lengths of the wet and dry sections changed depending on the angle of the solar panel. The total length of the wet and dry sections was set

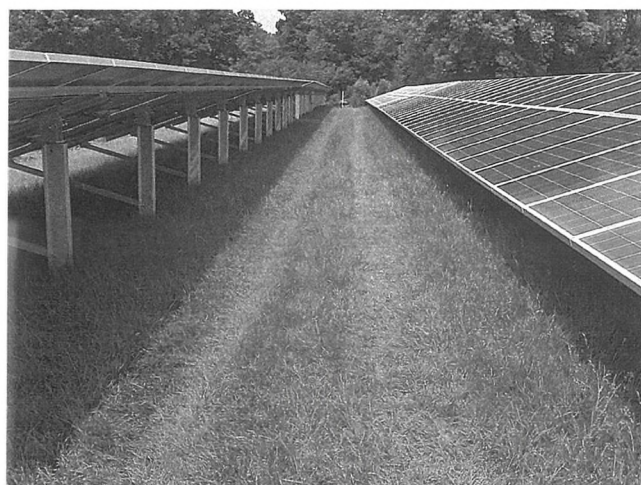


Fig. 1. Maintenance or “spacer” section between two rows of solar panels (photo by John E. Showler, reprinted with permission)

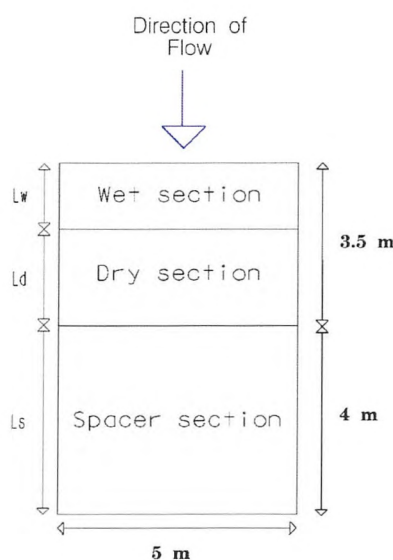


Fig. 2. Wet, dry, and spacer sections of a single cell with lengths L_w , L_s , and L_d with the solar panel covering the dry section

equal to the length of one horizontal solar panel, which was assumed to be 3.5 m. When a solar panel is horizontal, the dry section length would equal 3.5 m and the wet section length would be zero. In the paneled condition, the dry section does not receive direct rainfall because the rain first falls onto the solar panel then drains onto the spacer section. However, the dry section does infiltrate some of the runoff that comes from the upgradient wet section. The wet section was modeled similar to the spacer section with rain falling directly onto the section and assuming a constant loss rate.

For the presolar panel condition, the spacer and wet sections are modeled the same as in the paneled condition; however, the cell does not include a dry section. In the prepaneled condition, rain falls directly onto the entire cell. When modeling the prepaneled condition, all cells receive rainfall at the same rate and are subject to losses. All other conditions were assumed to remain the same such that the prepaneled and paneled conditions can be compared.

Rainfall was modeled after an natural resources conservation service (NRCS) Type II Storm (McCuen 2005) because it is an accurate representation of actual storms of varying characteristics that are imbedded in intensity-duration-frequency (IDF) curves. For each duration of interest, a dimensionless hyetograph was developed using a time increment of 12 s over the duration of the storm (see Fig. 3). The depth of rainfall that corresponds to each storm magnitude was then multiplied by the dimensionless hyetograph. For a 2-h storm duration, depths of 40.6, 76.2, and 101.6 mm were used for the 2-, 25-, and 100-year events. The 2- and 6-h duration hyetographs were developed using the center portion of the 24-h storm, with the rainfall depths established with the Baltimore IDF curve. The corresponding depths for a 6-h duration were 53.3, 106.7, and 132.1 mm, respectively. These magnitudes were chosen to give a range of storm conditions.

During each time increment, the depth of rain is multiplied by the cell area to determine the volume of rain added to each section of each cell. This volume becomes the storage in each cell. Depending on the soil group, a constant volume of losses was subtracted from the storage. The runoff velocity from a solar panel was calculated using Manning's equation, with the hydraulic radius for sheet flow assumed to equal the depth of the storage on the panel (Bedient and Huber 2002). Similar assumptions were made to compute the velocities in each section of the surface sections.

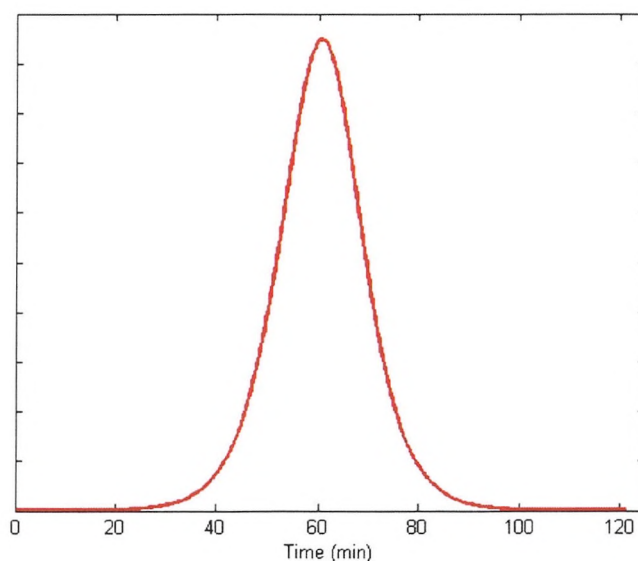


Fig. 3. Dimensionless hyetograph of 2-h Type II storm

Runoff from one section to the next and then to the next downgradient cell was routed using the continuity of mass. The routing coefficient depended on the depth of flow in storage and the velocity of runoff. Flow was routed from the wet section to the dry section to the spacer section, with flow from the spacer section draining to the wet section of the next cell. Flow from the most downgradient cell was assumed to be the outflow. Discharge rates and volumes from the most downgradient cell were used for comparisons between the prepaneled and paneled conditions.

Alternative Model Scenarios

To assess the effects of the different variables, a section of 30 cells, each with a solar panel, was assumed for the base model. Each cell was separated individually into wet, dry, and spacer sections. The area had a total ground length of 225 m with a ground slope of 1% and width of 5 m, which was the width of an average solar panel. The roughness coefficient (Engman 1986) for the silicon solar panel was assumed to be that of glass, 0.01. Roughness coefficients of 0.15 for grass and 0.02 for bare ground were also assumed. Loss rates of 0.5715 cm/h (0.225 in./h) and 0.254 cm/h (0.1 in./h) for B and C soils, respectively, were assumed.

The prepaneled condition using the 2-h, 25-year rainfall was assumed for the base condition, with each cell assumed to have a good grass cover condition. All other analyses were made assuming a paneled condition. For most scenarios, the runoff volumes and peak discharge rates from the paneled model were not significantly greater than those for the prepaneled condition. Over a total length of 225 m with 30 solar panels, the runoff increased by 0.26 m³, which was a difference of only 0.35%. The slight increase in runoff volume reflects the slightly higher velocities for the paneled condition. The peak discharge increased by 0.0013 m³, a change of only 0.31%. The time to peak was delayed by one time increment, i.e., 12 s. Inclusion of the panels did not have a significant hydrologic impact.

Storm Magnitude

The effect of storm magnitude was investigated by changing the magnitude from a 25-year storm to a 2-year storm. For the 2-year storm, the rainfall and runoff volumes decreased by approximately 50%. However, the runoff from the paneled watershed condition increased compared to the prepaneled condition by approximately the same volume as for the 25-year analysis, 0.26 m³. This increase represents only a 0.78% increase in volume. The peak discharge and the time to peak did not change significantly. These results reflect runoff from a good grass cover condition and indicated that the general conclusion of very minimal impacts was the same for different storm magnitudes.

Ground Slope

The effect of the downgradient ground slope of the solar farm was also examined. The angle of the solar panels would influence the velocity of flows from the panels. As the ground slope was increased, the velocity of flow over the ground surface would be closer to that on the panels. This could cause an overall increase in discharge rates. The ground slope was changed from 1 to 5%, with all other conditions remaining the same as the base conditions.

With the steeper incline, the volume of losses decreased from that for the 1% slope, which is to be expected because the faster velocity of the runoff would provide less opportunity for infiltration. However, between the prepaneled and paneled conditions, the increase in runoff volume was less than 1%. The peak discharge

and the time to peak did not change. Therefore, the greater ground slope did not significantly influence the response of the solar farm.

Soil Type

The effect of soil type on the runoff was also examined. The soil group was changed from B soil to C soil by varying the loss rate. As expected, owing to the higher loss rate for the C soil, the depths of runoff increased by approximately 7.5% with the C soil when compared with the volume for B soils. However, the runoff volume for the C soil condition only increased by 0.17% from the prepaneled condition to the paneled condition. In comparison with the B soil, a difference of 0.35% in volume resulted between the two conditions. Therefore, the soil group influenced the actual volumes and rates, but not the relative effect of the paneled condition when compared to the prepaneled condition.

Panel Angle

Because runoff velocities increase with slope, the effect of the angle of the solar panel on the hydrologic response was examined. Analyses were made for angles of 30° and 70° to test an average range from winter to summer. The hydrologic response for these angles was compared to that of the base condition angle of 45°. The other site conditions remained the same. The analyses showed that the angle of the panel had only a slight effect on runoff volumes and discharge rates. The lower angle of 30° was associated with an increased runoff volume, whereas the runoff volume decreased for the steeper angle of 70° when compared with the base condition of 45°. However, the differences (~0.5%) were very slight. Nevertheless, these results indicate that, when the solar panel was closer to horizontal, i.e., at a lower angle, a larger difference in runoff volume occurred between the prepaneled and paneled conditions. These differences in the response result are from differences in loss rates.

The peak discharge was also lower at the lower angle. At an angle of 30°, the peak discharge was slightly lower than at the higher angle of 70°. For the 2-h storm duration, the time to peak of the 30° angle was 2 min delayed from the time to peak of when the panel was positioned at a 70° angle, which reflects the longer travel times across the solar panels.

Storm Duration

To assess the effect of storm duration, analyses were made for 6-h storms, testing magnitudes for 2-, 25-, and 100-year return periods, with the results compared with those for the 2-h rainfall events. The longer storm duration was tested to determine whether a longer duration storm would produce a different ratio of increase in runoff between the prepaneled and paneled conditions. When compared to runoff volumes from the 2-h storm, those for the 6-h storm were 34% greater in both the paneled and prepaneled cases. However, when comparing the prepaneled to the paneled condition, the increase in the runoff volume with the 6-h storm was less than 1% regardless of the return period. The peak discharge and the time-to-peak did not differ significantly between the two conditions. The trends in the hydrologic response of the solar farm did not vary with storm duration.

Ground Cover

The ground cover under the panels was assumed to be a native grass that received little maintenance. For some solar farms, the area beneath the panel is covered in gravel or partially paved because the panels prevent the grass from receiving sunlight. Depending on the

volume of traffic, the spacer cell could be grass, patches of grass, or bare ground. Thus, it was necessary to determine whether or not these alternative ground-cover conditions would affect the runoff characteristics. This was accomplished by changing the Manning's n for the ground beneath the panels. The value of n under the panels, i.e., the dry section, was set to 0.015 for gravel, with the value for the spacer or maintenance section set to 0.02, i.e., bare ground. These can be compared to the base condition of a native grass ($n = 0.15$). A good cover should promote losses and delay the runoff.

For the smoother surfaces, the velocity of the runoff increased and the losses decreased, which resulted in increasing runoff volumes. This occurred both when the ground cover under the panels was changed to gravel and when the cover in the spacer section was changed to bare ground. Owing to the higher velocities of the flow, runoff rates from the cells increased significantly such that it was necessary to reduce the computational time increment. Fig. 4(a) shows the hydrograph from a 30-panel area with a time increment of 12 s. With a time increment of 12 s, the water in each cell is discharged at the end of every time increment, which results in no attenuation of the flow; thus, the undulations shown in Fig. 4(a) result. The time increment was reduced to 3 s for the 2-h storm, which resulted in watershed smoothing and a rational hydrograph shape [Fig. 4(b)]. The results showed that the storm runoff

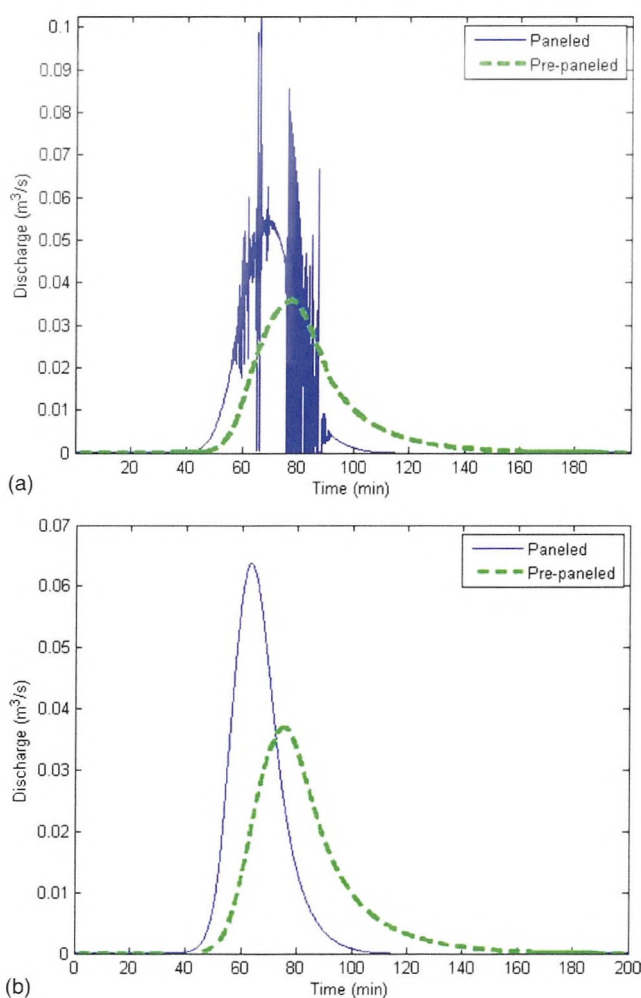


Fig. 4. Hydrograph with time increment of (a) 12 s; (b) 3 s with Manning's n for bare ground

increased by 7% from the grass-covered scenario to the scenario with gravel under the panel. The peak discharge increased by 73% for the gravel ground cover when compared with the grass cover without the panels. The time to peak was 10 min less with the gravel than with the grass, which reflects the effect of differences in surface roughness and the resulting velocities.

If maintenance vehicles used the spacer section regularly and the grass cover was not adequately maintained, the soil in the spacer section would be compacted and potentially the runoff volumes and rates would increase. Grass that is not maintained has the potential to become patchy and turn to bare ground. The grass under the panel may not get enough sunlight and die. Fig. 1 shows the result of the maintenance trucks frequently driving in the spacer section, which diminished the grass cover.

The effect of the lack of solar farm maintenance on runoff characteristics was modeled by changing the Manning's n to a value of 0.02 for bare ground. In this scenario, the roughness coefficient for the ground under the panels, i.e., the dry section, as well as in the spacer cell was changed from grass covered to bare ground ($n = 0.02$). The effects were nearly identical to that of the gravel. The runoff volume increased by 7% from the grass-covered to the bare-ground condition. The peak discharge increased by 72% when compared with the grass-covered condition. The runoff for the bare-ground condition also resulted in an earlier time to peak by approximately 10 min. Two other conditions were also modeled, showing similar results. In the first scenario, gravel was placed directly under the panel, and healthy grass was placed in the spacer section, which mimics a possible design decision. Under these conditions, the peak discharge increased by 42%, and the volume of runoff increased by 4%, which suggests that storm-water management would be necessary if gravel is placed anywhere.

Fig. 5 shows two solar panels from a solar farm in New Jersey. The bare ground between the panels can cause increased runoff rates and reductions in time of concentration, both of which could necessitate storm-water management. The final condition modeled involved the assumption of healthy grass beneath the panels and bare ground in the spacer section, which would simulate the condition of unmaintained grass resulting from vehicles that drive over the spacer section. Because the spacer section is 53% of the cell, the change in land cover to bare ground would reduce losses and decrease runoff travel times, which would cause runoff to amass as it

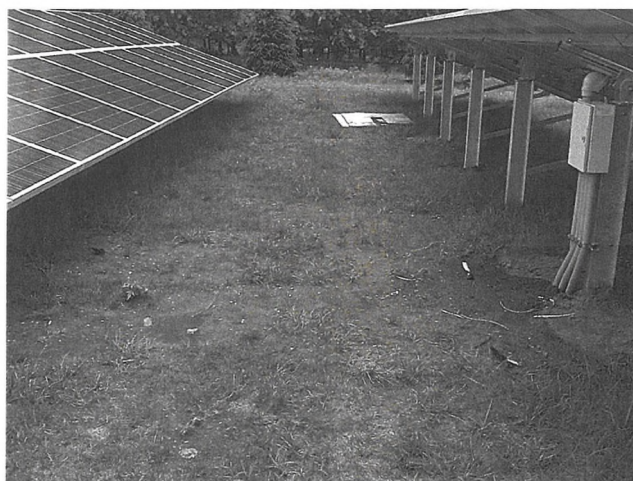


Fig. 5. Site showing the initiation of bare ground below the panels, which increases the potential for erosion (photo by John Showler, reprinted with permission)

moves downgradient. With the spacer section as bare ground, the peak discharge increased by 100%, which reflected the increases in volume and decrease in timing. These results illustrate the need for maintenance of the grass below and between the panels.

Design Suggestions

With well-maintained grass underneath the panels, the solar panels themselves do not have much effect on total volumes of the runoff or peak discharge rates. Although the panels are impervious, the rainwater that drains from the panels appears as runoff over the downgradient cells. Some of the runoff infiltrates. If the grass cover of a solar farm is not maintained, it can deteriorate either because of a lack of sunlight or maintenance vehicle traffic. In this case, the runoff characteristics can change significantly with both runoff rates and volumes increasing by significant amounts. In addition, if gravel or pavement is placed underneath the panels, this can also contribute to a significant increase in the hydrologic response.

If bare ground is foreseen to be a problem or gravel is to be placed under the panels to prevent erosion, it is necessary to counteract the excess runoff using some form of storm-water management. A simple practice that can be implemented is a buffer strip (Dabney et al. 2006) at the downgradient end of the solar farm. The buffer strip length must be sufficient to return the runoff characteristics with the panels to those of runoff experienced before the gravel and panels were installed. Alternatively, a detention basin can be installed.

A buffer strip was modeled along with the panels. For approximately every 200 m of panels, or 29 cells, the buffer must be 5 cells long (or 35 m) to reduce the runoff volume to that which occurred before the panels were added. Even if a gravel base is not placed under the panels, the inclusion of a buffer strip may be a good practice when grass maintenance is not a top funding priority. Fig. 6 shows the peak discharge from the graveled surface versus the length of the buffer needed to keep the discharge to prepaneled peak rate.

Water draining from a solar panel can increase the potential for erosion of the spacer section. If the spacer section is bare ground, the high kinetic energy of water draining from the panel can cause soil detachment and transport (Garde and Raju 1977; Beuselinck et al. 2002). The amount and risk of erosion was modeled using the velocity of water coming off a solar panel compared with the velocity and intensity of the rainwater. The velocity of panel

runoff was calculated using Manning's equation, and the velocity of falling rainwater was calculated using the following:

$$V_t = 120 d_r^{0.35} \quad (1)$$

where d_r = diameter of a raindrop, assumed to be 1 mm. The relationship between kinetic energy and rainfall intensity is

$$K_e = 916 + 330 \log_{10} i \quad (2)$$

where i = rainfall intensity (in./h) and K_e = kinetic energy (ft-tons per ac-in. of rain) of rain falling onto the wet section and the panel, as well as the water flowing off of the end of the panel (Wischmeier and Smith 1978). The kinetic energy (Salles et al. 2002) of the rainfall was greater than that coming off the panel, but the area under the panel (i.e., the product of the length, width, and cosine of the panel angle) is greater than the area under the edge of the panel where the water drains from the panel onto the ground. Thus, dividing the kinetic energy by the respective areas gives a more accurate representation of the kinetic energy experienced by the soil. The energy of the water draining from the panel onto the ground can be nearly 10 times greater than the rain itself falling onto the ground area. If the solar panel runoff falls onto an unsealed soil, considerable detachment can result (Motha et al. 2004). Thus, because of the increased kinetic energy, it is possible that the soil is much more prone to erosion with the panels than without. Where panels are installed, methods of erosion control should be included in the design.

Conclusions

Solar farms are the energy generators of the future; thus, it is important to determine the environmental and hydrologic effects of these farms, both existing and proposed. A model was created to simulate storm-water runoff over a land surface without panels and then with solar panels added. Various sensitivity analyses were conducted including changing the storm duration and volume, soil type, ground slope, panel angle, and ground cover to determine the effect that each of these factors would have on the volumes and peak discharge rates of the runoff.

The addition of solar panels over a grassy field does not have much of an effect on the volume of runoff, the peak discharge, nor the time to peak. With each analysis, the runoff volume increased slightly but not enough to require storm-water management facilities. However, when the land-cover type was changed under the panels, the hydrologic response changed significantly. When gravel or pavement was placed under the panels, with the spacer section left as patchy grass or bare ground, the volume of the runoff increased significantly and the peak discharge increased by approximately 100%. This was also the result when the entire cell was assumed to be bare ground.

The potential for erosion of the soil at the base of the solar panels was also studied. It was determined that the kinetic energy of the water draining from the solar panel could be as much as 10 times greater than that of rainfall. Thus, because the energy of the water draining from the panels is much higher, it is very possible that soil below the base of the solar panel could erode owing to the concentrated flow of water off the panel, especially if there is bare ground in the spacer section of the cell. If necessary, erosion control methods should be used.

Bare ground beneath the panels and in the spacer section is a realistic possibility (see Figs. 1 and 5). Thus, a good, well-maintained grass cover beneath the panels and in the spacer section is highly recommended. If gravel, pavement, or bare ground is

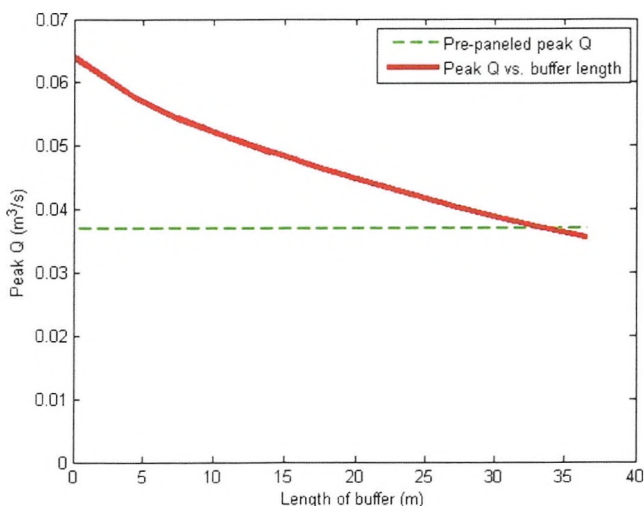


Fig. 6. Peak discharge over gravel compared with buffer length

deemed unavoidable below the panels or in the spacer section, it may necessary to add a buffer section to control the excess runoff volume and ensure adequate losses. If these simple measures are taken, solar farms will not have an adverse hydrologic impact from excess runoff or contribute eroded soil particles to receiving streams and waterways.

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**Proposed Operations and Maintenance Plan
Low Bridge Solar LLC
Randolph County, North Carolina**

Contact Information

For all non-emergency correspondence during the operation of the solar farm, parties should direct inquiries to the following Operations and Maintenance (O&M) Provider:

Company: TBD
Attention: TBD
Phone: TBD
Email: TBD
Address: TBD

Maintenance Services

During the operational life of the Low Bridge Solar project, the Operations and Maintenance Provider shall provide services at the approximated frequency outlined below, although the exact scope is subject to revision, pursuant to the final Operations and Maintenance contract executed by Low Bridge Solar with the O&M Provider at the time of commercial operation. It is expected that the O&M Provider shall make every effort to note items of concern outside of the scope of scheduled visits, inspecting, and assessing items that may be problematic. For the avoidance of doubt, any mention of reports or notifications shall be directed from the O&M Provider to the owner of Low Bridge Solar, and not to the County, unless obligated to do so by County, State, or Federal regulations.

Item	Service	Service Description	Frequency
1. Monitoring, Reporting, Inventory			
1.1	Daily Monitoring	Monitor inverter and meter output data for recordkeeping and to identify issues	Daily
1.2	Monthly Reporting	Provide monthly operating report for the project that may include a summary of the following: operations, weather data, project performance, any environmental or site disturbances, safety/accident reports, maintenance and inspection reports, any proposed maintenance for the upcoming month.	Monthly
1.3	Annual Reporting	Provide annual output/performance, maintenance, and inspection reports for the project's preceding operational year.	Annually
1.4	Incident and Maintenance Reporting	Provide a written report of any event involving unplanned services, personnel injury occurring on site, or any material damage to the project.	No later than five (5) business days after the occurrence, or immediately for

			OSHA recordable events, but no later than 24 hours.
1.5	Security Incident Reporting	Notify facility owner following O&M Provider receiving information indicating a security issue on site.	Immediately, but no later than 24 hours.
1.6	Spare Parts	Storage and maintenance of replacement equipment for the facility.	As Needed
2. Battery Energy Storage System (BESS) Monitoring, Reporting, Inventory			
2.1	Battery Cabinet Chiller	Check coolant quality.	Every 3 Months
2.2	BESS Block Noises	Check for abnormal noise during operation.	Monthly
2.3	BESS Block Alarm	Check cabinet front LED warnings/PCS HMI readings.	Monthly
2.4	BESS Block FSS	Check control panel FSS battery voltage.	Twice per Year
2.5	BESS Block Batteries	Balance batteries. Monitor daily, recalibrate at three weeks	Daily
2.6	BESS BCP and Site Controller UPS	Check batteries.	Every 3 Months
2.7	BESS FSS Controls	Check the function of the fire suppression devices. Additional checks performed, as needed, by contracted local service provider.	Annually
2.8	BESS Block	Check the grounding connections	Every 3 Months
2.9	Spare Parts	Check spare parts inventory level (A 3-month supply of main spare parts inventory is typical for BESS)	Every 3 Months
3.0	BESS Nameplates	Check for legibility	Annually
3. Site/Land Inspection and Maintenance			
3.1	Vegetation Management	Maintain vegetation, remove debris, and other general landscaping for all property within the fenced area as well all property immediately surrounding the fence, as required by local ordinances or project conditions.	As Needed (Typically 4-5x per Year)
3.2	Ground Inspection	Inspect project acreage for erosion, runoff, depressions, or other concerns. Inspect all drainage systems (culverts, basins, etc) and ensure they are functioning and free of debris that would prevent water from flowing unimpeded.	Twice per Year

3.3	Perimeter and Fence Inspection	Inspect all fencing for possible damage, intrusion, vandalism, and theft, as well as overgrowth of nearby vegetation. Inspect signage to ensure all originally installed signs are securely attached and legible	Twice per Year
3.4	Road Inspection	Inspect all roads for damage caused by erosion or severe weather.	Twice per Year
3.5	Security Inspection	Inspect the entire facility for signs of vandalism or other security related issues.	Twice per Year
4. Battery Energy Storage System (BESS) Maintenance			
4.1	Battery Cabinet Chiller	Use air gun to clean the condenser and air inlets.	Every 3 Months
4.2	Site Controller HVAC	Clean air filter.	Every 3 Months
4.3	BESS Block Signage	Check safety signage and arc flash stickers for wear and tear, replace if necessary.	Every 3 Months
4.4	PCS Air Filters	Check PCS air filters. Clean or replace filters. Note: Some environments may require more frequent servicing and frequency will be updated, as needed, during year 1.	Every 3 Months
4.5	PCS/ BCP/ Torque Check	Check the torque marks on all PCS/ BCP wiring connections. Tighten as needed.	Annually
4.6	BESS Torque Check	Check the torque marks on all BESS cabinet busbars and other wiring connections. Tighten as needed.	Annually
4.7	BESS Fire Suppression System Controls	Replace backup batteries.	Every 3 Years
4.8	BESS Fire Suppression System	Replace powder cannisters.	Every 10 Years
5. DC-Side System Inspection			
5.1	Racking Inspection	Inspect all racking, racking mounts, racking fasteners, actuators, motors, joints and conduiting affixed to racking to confirm proper operation, as well as for any signs of damage, corrosion, or instability. If issues are identified, perform maintenance in accordance with manufacturer's recommendations.	Annually
5.2	Racking Grounding	Measure and record grounding continuity between module, rack, and grounding conductor on one racking structure per enclosure.	Annually

5.3	Module Physical Inspection	Visually inspect 20% sampling of modules for soiling, breakage, delamination, and discoloring. The sample area shall systematically rotate each year so that the whole facility is inspected every 5 years. Inspections may be done on foot or by aerial visual analysis.	Annually
5.4	Broken Module Replacement	If broken modules have previously been identified or are identified at the time of routine inspection, O&M Provider will replace them with new modules at the sole expense of the facility owner.	As Needed
5.5	Module IR	Perform aerial infrared inspection of all solar modules to identify irregularities.	Annually
5.6	Module Electrical Inspection	Inspect underside of module arrays for properly secured conductors, home run splitters, and wire management or chafing concerns.	Annually
5.7	Insulation Testing	Perform insulation resistance testing on conductors, if issues suspected.	As needed
5.8	Module Degradation Testing	Permanently identify 5% of benchmark strings and IV Curve, trace those strings to gauge module degradation.	Annually
5.9	Wire Inspection	Visually inspect wiring for damage or exposed conductors.	Twice per Year
5.10	Combiner Box and Enclosure Inspections	Electrical and mechanical inspection of combiner boxes and associated disconnects. Visually inspect bonding bushings and grounding, door seals, conduit sealant. Inspect interior and exterior of all enclosures for signs of damage, water intrusion, corrosion, and correct signage. Check for wire damage especially at entrance/exit locations, terminal corrosion, any discoloration, and inspect fuses for proper functionality. Remove pest debris as needed.	Twice per Year
5.11	Combiner Box and Enclosure Torque Inspections	Confirm and correct terminal torque settings for both sides of all fuse holders, grounded terminal bar, grounding bar, PV output circuit, and DC disconnects. Re-torque, as needed.	Annually
5.12	IR Enclosure Inspection	Perform infrared thermal inspection of all terminations and current arresting devices in accordance with NETA-ATS Section 9.4.	Annually
6. AC-Side System Inspection			
6.1	Inverter Inspection	Perform routine maintenance work on all inverters. Maintenance shall be conducted in accordance with manufacturer's recommended	As outlined by manufacturer

		schedule and as dictated by any warranty requirements.	
6.2	Inverter Enclosure Inspection	Check all enclosures for loose or broken connections and for evidence of localized heating or water ingress. Check door seals, conduit bushings, and conduit sealant for integrity. If issues are identified, re-seal, correct, or otherwise repair	Annually
6.3	Inverter Air Filters and Transformer Heat Sinks	Inspect all air filters for each inverter and heat sinks. If necessary, clean and/or replace.	As outlined by manufacturer
6.4	Inverter IR Inspection	Perform infrared thermal inspection of all power generation terminations at each inverter in accordance with NETA-ATS Section 9.4 as PPE allows.	Annually
6.5	Inverter Cooling Fans	Inspect inverter cooling fans for proper operation	Annually
6.6	Inverter Comms Test	Verify HMI is operating correctly, and record phase input voltage	Annually
6.7	Inverter Fault	Record and clear all faults on inverter	Annually, or as needed
6.8	Inverter Signage Inspection	Visually inspect equipment and ensure all labels and safety instructions are affixed and legible.	Annually
6.9	Inverter Termination Inspection	Visually inspect all electrical termination fasteners for proper torque per existing torque marks. Re-torque or repair, if needed.	Annually
6.10	Transformer OEM Maintenance	Visually inspect, clean, and perform preventative maintenance, as needed, on all transformers as specified by manufacturer.	Annually
6.11	General Transformer Inspection	Inspect inside primary and secondary side of ground mounted transformer enclosures for signs of overheating, oil leakage, or pests.	Annually
6.12	Transformer Oil Monitoring	Record oil level, current and max pressure, and current and max temperature of transformer oil. Also, confirm proper operation of load break oil immersed rotary switch.	Annually
6.13	Inverter and Transformer Pad	Inspect pad is cleaned and free of cracks, erosion, or other structural damage.	Annually
6.14	AC Disconnect	Inspect all latches and seals on enclosure of disconnect to ensure it functions correctly. Visually inspect terminations and confirm	Annually

		terminal torque settings. Check for evidence of arcing.	
6.15	MV Isolation Devices	Check all grid isolation devices (GOAB, Recloser, Overhead Cutouts) for proper function	Twice per Year
6.16	Recloser Inspection	Inspect recloser and meter enclosures for moisture, re-seal if necessary. Record and confirm proper recloser setpoints per utility's requested settings.	Twice per Year
6.17	MV IR Inspection	Perform infrared thermal imaging of all MV system components and identify any irregularities.	Annually
6.18	Switchgear Preventative Maintenance	Conduct switchgear preventative maintenance in compliance with manufacturer's guidelines.	Annually
7. Battery Energy Storage Systems (BESS) Inspection			
7.1	BESS Block – Battery cabinets BCP and PCS Inspection	Inspect outsides of containers.	Every 3 Months
7.2	BESS Block – Battery cabinets BCP cabinets and PCS Inspection	Inspect interior and clean BESS Block inside containers.	Twice per Year
7.3	BESS Block Interior Inspection	Inspect doors on BESS Block (BESS, BCP, PCS). Check the latches, they should open and close properly. Inspect containers for door seals and clean if water present or if dirty.	Every 3 Months
8. DAS/SCADA Inspection			
8.1	General DAS Inspection	Perform monitoring system maintenance per manufacturer's suggested schedule. Verify attachment and general orientation of pyranometers and module temperature sensors, as well as check MET station and verify functionality of back-up power supply.	Twice per Year
8.2	Pyranometers	Clean pyranometer dome with an approved cloth and inspect connections.	Each site visit
8.3	Pyranometer Calibration	Provider to work with facility owner to calibrate pyranometer as per manufacturer's specifications.	As Specified by Manufacturer

8.4	Data/Instrument Accuracy and Communication Verification	Test MET station sensors (GHI and POA pyranometers, ambient temperature, back of each module sensor, anemometer, meter, and inverter communication).	Annually
8.5	Data Loggers and Comms	Inspect facility's data loggers and communication devices.	Twice per Year
9. Testing			
9.1	IV Curve String Testing or Module Level Thermal Audit	Test IV curve on all strings or thermal audit on all modules	Annually
9.2	Transformer Oil Testing	Sample transformer oil and test in accordance with nationally recognized testing standards and methods.	Once every 2 Years
9.3	Point-to-Point Testing	Inspect a randomly selected sample of combiner boxes (roughly 5-10%) and modules, checking the grounding for wear, corrosion, connection strength, and point-to-point resistance between modules, rack, and EGC. All locations and resistances shall be documented. Identify any resistance readings above 0.5 ohms.	Annually
10. Substation			
10.1	Substation Troubleshooting	Perform troubleshooting at the project collection substation for alarms, events of power loss / communication. Provide diagnostic summary based on logged plant data, relay event files, tracing wire connections, or findings from other testing equipment.	Ongoing
10.2	Substation HV	Monitor HV equipment. Utilize HV switching and grounding to isolate components for troubleshooting and failed component replacement.	Ongoing
10.3	Substation OEM Required Inspections	Complete the full visual/mechanical/electrical inspections and tests as recommended by ANSI/NETA and the OEM owner manuals per the respective intervals including but not limited to Generator Step-Up transformer, Switchgear, Circuit Breakers, Disconnect Switches, Metering, Capacitor Banks as applicable, Protective Relays, CTs/PTs, Control House, Station Power, and Substation Grounding.	Annually, or at manufacturer's recommended frequency



DECOMMISSIONING PLAN

LOW BRIDGE SOLAR

Randolph County

North Carolina

Prepared by:

Kimley»Horn

Kimley-Horn and Associates, Inc.

Contact: Luke Lukas, P.E.

Prepared: October 2024



PURPOSE

This decommissioning plan is provided by Low Bridge Solar, LLC (the “Project Company”) and details the projected decommissioning approach associated with the proposed Low Bridge Solar Project.

The purpose of this decommissioning plan is to provide procedures and an opinion of probable construction cost at the end of the project lifetime, which is defined in the Commencement of Decommissioning section. This decommissioning plan details general provisions and cost estimates for facility deconstruction and site restoration to satisfy the guidelines set forth in the land lease agreements, the County requirements, and State requirements, including new requirements such as North Carolina House Bill 130. Furthermore, this decommissioning plan shall be provided at the time of project registration with the North Carolina Department of Environmental Quality (NCDEQ) and shall be updated every five years at the time registration is updated.

SITE LOCATION

The Project Company proposes to build a photovoltaic (PV) solar facility (“Solar Facility” or “Project”) that spans through Randolph County, NC, situated about 5 miles north of Ramseur, NC. Within Randolph County, the Project has a rated capacity of approximately 40 MW_{AC}. Regarding land condition, The Project site features a mix of flat to moderate topography, cleared farmland, wooded areas, and smaller regions of forested wetlands.



Figure 1: Site Location

LANDOWNER CONTACT INFORMATION

- James Randall Kimrey
 - Address: 1409 Ramseur Julian Rd. Ramseur, NC 27316
 - Email: jamesrkimrey@yahoo.com
 - Phone: 336-963-2136
- William Daniel Allred & Judy Overman Allred (C/O Michael Allred)
 - Address: 7508 Stony Hill Rd. Wake Forest, NC 27587
 - Email: mikeallred367@gmail.com
 - Phone: 336-953-5433
- JNB Holdings of Randolph, LLC (C/O Julia Burch)
 - Address: 4626 Emerald Dr. Liberty, NC 27298
 - Email: jburch8387@gmail.com
 - Phone: 336-824-1880
- Magdalene L. Wright (C/O Allen Dean Wright)
 - Address: 1484 Low Bridge Rd. Liberty, NC 27298
 - Email: allen.wright@proforma.com
 - Phone: 336-824-4356
- Allen Dean Wright & Ginger W. Wright
 - Address: 1484 Low Bridge Rd. Liberty, NC 27298
 - Email: allen.wright@proforma.com
 - Phone: 336-824-4356

ANTICIPATED SERVICE LIFE OF THE PROJECT

At the end of its project life, the Solar Facility shall be decommissioned in accordance with this Decommissioning Plan ("Plan"), restoring the site to as close to its agreed-upon post-decommissioned state as practicably possible upon expiration or earlier termination of the lease

agreement. The Solar Facility carries an expected useful lifetime of 35-40 years, including potential replacement or upgrades to equipment during that time.

DECOMMISSIONING POTENTIAL OVER TIME

The probability of an event that would lead to abandonment or long-term interruption is extremely low, particularly during the first 20 to 30 years of the Project life. Accordingly, the risk of decommissioning the Project is extremely low during this period because:

- Project owners have financing structures that allow the lender or tax equity partner to step in and rectify an event that might otherwise lead to abandonment.
- The presence of a Power Purchase Agreement (PPA) within the first 15-25 years of the Project life, which contractually obligates a customer to purchase generation from the Project for a given period, helps mitigate energy price and revenue uncertainty over this time frame.
- Most critical solar components have original equipment manufacturer (OEM) warranties with long terms that include labor and parts.
 - These warranties assure the Project owner, financing parties, and other stakeholders, that equipment will perform as expected over the warranted period which minimizes the risk of a decommissioning event.
 - Average warranty lengths for critical solar components range from 5 to 10 years, with production warranties on solar panels extending to 25 years.
- Solar projects consist of many networked components designed to absorb solar energy and convert to electrical energy. The failure of any single component will not result in a substantial reduction of energy generation that could lead to a decommissioning event.
- Solar projects are required to maintain replacement value property damage insurance coverage and business interruption insurance coverage.
 - Business interruption insurance covers the loss of income that a business suffers after a disaster or equipment failure. Typical solar business interruption insurance covers income loss for twelve months from the date of the event triggering the loss.
- The replacement costs of solar components will typically decline over time, and accordingly, costs to replace failed or damaged equipment after lapsed OEM warranties will not create large financial hurdles for the Project.
- In the early stages of the Project, the resale value of the equipment is significantly higher than the decommissioning costs, resulting in a net positive (revenue).

Considering the reasons above, a decommissioning bond early in the life of a solar project life is often not required to assure the coverage facility removal and site restoration costs. However, if necessary, some form of financial assurance will be provided by the Project Company to ensure that sufficient funds are available to decommission the Project site

COMMENCEMENT OF DECOMMISSIONING

This Plan assumes that the Facility will be decommissioned under any of the following conditions:

1. The land lease (including the exercise of any extension options) ends and will either not be renewed, or a new lease will not be entered into for the Project.
2. The system is damaged and will not be repaired or replaced.
3. The Project fails to produce power for twelve consecutive months and is deemed abandoned, except if a *force majeure* event occurs or if substantial evidence that the project will be reinstated is provided to the Zoning Administrator.

REMOVAL OF EQUIPMENT

At the time of decommissioning, the Project Company will be required to submit detailed engineering plans and obtain construction permits as required by appropriate authorities. The Project Company will restore the Solar Facility to a similar condition present prior to the development of the Solar Facility unless the property owner provides a release waiver for certain improvements, such as access roads. Provided, however, the Project Company shall not be required to replace any structures that were removed to build the Solar Facility. All waste and excess materials will be disposed of in accordance with municipal, provincial, and federal regulations. Waste that can be recycled under municipal programs, such as copper, aluminum, and steel will be recovered and recycled accordingly. Meanwhile, components such as solar panels will likely be sold for reuse.

To decommission the Solar Facility, the Project Company will at a minimum:

- Disconnect from the utility power grid & de-energize solar arrays.
- Install temporary erosion perimeter controls and best management practices (BMPs) to protect sensitive resources.
- Dismantle and remove any equipment related to the Solar Facility including perimeter fences, steel piles, concrete foundations, metal structures (mounting racks and trackers), photovoltaic (PV) modules, aboveground and underground cables, transformers, inverters, fans, combiner boxes, tracker motors, project substation, weather monitoring, and control system apparatuses.
- Remove non-utility owned equipment (at point of interconnection): conduits, structures, fencing, roads, and foundations.
- Recontouring conducted with standard grading equipment and filling and compaction of all trenches and other excavations.
- Placing topsoil as needed and planting vegetation/seeding suitable for the location, native to the region, and which matches surrounding vegetation.

This decommissioning plan is based on current published regulations, along with best management practices and procedures. This Plan may be subject to revision based on new laws, standards and emergent best management practices at the time of decommissioning. Permits will be obtained by the Project Company as required and notification will be given to necessary stakeholders prior to decommissioning.

Prior to beginning construction activities, the Project Company will notify NCDEQ within 30 days of the cessation of operation and submit applicable demolition and construction plans which will outline the schedule and extents of demolition. All applicable permits needed to conduct the decommissioning process will also be submitted. Decommissioning activities will not begin prior to issuance of approved permits by the regulatory agencies with appropriate jurisdiction.

RESTORATION OF PROPERTY

The restoration of the property once equipment has been removed will consist of minor recontouring, de-compaction of the topsoil by disking or tilling, and re-vegetation of the property. At the end of the decommissioning process, the area will be seeded and fertilized with native vegetation as needed to return the site to as close as practicable to original or initially agreed-upon condition. Landscaping and entrance(s) will remain following site restoration. Access road improvements may also be left in place if requested or agreed to by the landowner. The future use of the land will be determined by the landowner at the time of decommissioning. Deciding factors will be influenced by County land use and comprehensive plans and regulations at such time in the future.

The Project Company will coordinate with the County to monitor vegetation and drainage following restoration until permanent vegetation is established. Erosion and sediment control, re-seeding, soil stabilization, weed control and fertilization will be provided by the Project Company as needed until the site is stabilized and approved to be completed by the Randolph County Erosion Control Department. The restored areas will be left free from any debris caused by the Project or decommissioning activities. The decommissioning process will maximize the recycling, reuse, and salvage of applicable facility components, which are summarized in the engineer's opinion of probable construction cost (Exhibit A). Upon completion of the site restoration, erosion & sediment control measures will be removed.

TIME PERIOD TO COMPLETE DECOMMISSIONING

The Project Company will have one (1) year after the cessation of operation to complete the decommissioning process.

PARTY RESPONSIBLE FOR DECOMMISSIONING

The Project Company is responsible for this decommissioning, provided that the Project Company may contract with a third-party to perform the decommissioning on its behalf. Nothing in this Plan relieves any obligation that the real estate property owner may have to remove the Facility as outlined in the event the operator of the Facility does not fulfill this obligation.

DECOMMISSIONING COST ESTIMATE AND BONDING

An engineer's opinion of probable construction cost (OPCC) and analysis, both with and without material salvage value, were prepared as part of this decommissioning plan – see Exhibit A. For expenses associated with decommissioning, the Project will be dependent on labor costs at the

time of decommissioning. For the purposes of this report, current RSMeans City Cost Index (CCI) data was used to estimate labor, material, and equipment expenses based on the project location.

While the expected lifetime of the Solar Facility is 35-40 years, the cost calculations in this Plan assume a project life of 20 years. This timeframe reflects a typical Power Purchase Agreement (PPA) and represents the project's minimum expected lifetime. The total probable cost of decommissioning without accounting for salvage value but including an inflation factor of 2.30%¹ at the end of the assumed 20-year project life is **\$1,394,000** with inflation accounting for approximately \$489,000 of this cost.

At least ninety (90) days prior to the commencement of construction, the Project Company will register the Project with NCDEQ and retain an independent engineer to determine the expected decommissioning cost. Additionally, the Project Company will establish and maintain financial assurance in the amount approved by NCDEQ. Furthermore, the Project Company shall update registration with NCDEQ every five years following initial registration, which will include an updated evaluation of decommissioning cost and financial assurance.

¹ <https://fred.stlouisfed.org/series/T30YIEM>

SALVAGE / RESALE VALUE ESTIMATES

While the decommissioning cost calculated is exclusive of salvage, there is a robust secondary market for resale of solar PV panels worldwide and a network of facilities available for recycling panels. Solar PV panels are estimated to degrade less than 0.5% per year, meaning they're expected to operate at 90% of capacity after 20 years. Panel manufacturers will guarantee the performance for each individual module and replace defective modules per the terms of warranty. Panels can therefore be sold for a price higher than their scrap value.

In general, the highest component value would be expected at the time of construction with declining value over the life of the Project. Over most of the Project's life, components such as the solar panels could be sold in the wholesale market for reuse or refurbishment. As panel efficiency and power production decrease due to aging and/or weathering, the resale value will decline accordingly. Secondary markets for used solar components include other utility scale solar facilities with similar designs that may require replacement equipment due to damage or normal wear over time; other buyers (e.g., developers, consumers) that are willing to accept a slightly lower power output in return for a significantly lower price point when compared to new equipment.

The solar facility's additional supporting components, such as inverters, transformers, racking and piles, can be dismantled and resold for scrap value. Inverters and transformers are comprised of salvageable materials such as copper, aluminum, and silver. Piles and other steel components can likewise be recovered and salvaged. Resale values at the end of Year 20 for equipment of significant value were calculated with straight-line depreciation after an instant depreciation of the original material cost.

A current sampling of reused solar panels indicates a wide range of pricing depending on age and condition (\$30 to \$150 per solar panel). Future pricing of solar panels is difficult to predict currently, due to the relatively young age of the market, changes to solar panel technology, and the ever-increasing product demand. To produce a conservative estimate for the value of solar panels in Year 20, exponential depreciation with a module depreciation rate of 10% per year was

used. With an initial assumed value of \$0.15 per Watt in Year 0, this depreciation schedule produces an assumed value of \$0.0182 per Watt in Year 20, which yields \$951,580 for overall module salvage value. Increased cost of removal for resale versus salvage would be expected to preserve the integrity of the panels; however, the net revenue would still be substantially higher than the estimated salvage value.

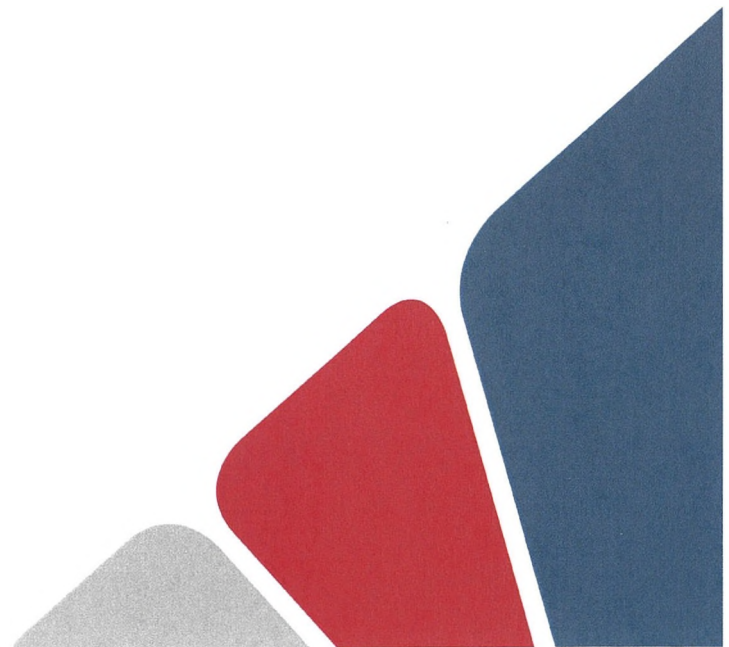
The resale value of components such as trackers, may decline more quickly; however, the salvage value of the steel that makes up a larger portion of the tracker is expected to stay at or above the value used in this report. The price used to value the steel in this OPCC is \$204.47 per ton. The price used to value copper in this OPCC is \$2.94 per lb.

Overall, the Net Revenue, calculated as the salvage value minus the removal costs, is valued at **\$753,000** at Year 20, with inflation accounting for **\$264,000** of this sum.



EXHIBIT A

Engineer's Opinion of
Probable Construction Cost



Low Bridge Solar
Randolph County, NC
Decommissioning Estimate Pro Forma At Year 20
October 2024



The Engineer has no control over the cost of labor, materials, equipment, or over the Contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs provided herein are based on the information known to Engineer at this time and represent only the Engineer's judgment as a design professional familiar with the construction industry. The Engineer cannot and does not guarantee that proposals, bids, or actual construction costs will not vary from its opinions of probable costs. LS = Lump Sum, HR = Hours, EA = Each, LF = Linear Feet.

Item	Quantity	Unit	Unit Cost	Estimated Salvage Value	Total Cost (incl. markups)	Total Net Price
Mobilization	1	LS			(\$38,530)	(\$38,530)
Administration	610	HR	(\$126.27)		(\$77,026)	(\$77,026)
Temporary Facilities	1	LS			(\$4,740)	(\$4,740)
Safety	1	LS			(\$3,210)	(\$3,210)
Legal Expenses	1	LS			(\$840)	(\$840)
General Liability Insurance	1	LS			(\$3,440)	(\$3,440)
Contractor's G&A	1	LS			(\$6,490)	(\$6,490)
SWPPP, Erosion Control Measures (Disturbed Area)	150	Ac	(\$670.00)		(\$143,380)	(\$143,380)
Seeding	11	Ac	(\$1,291.78)		(\$13,822)	(\$13,822)
Tilling 6" topsoil/scarifying access road and rough grading existing soil	11	Ac	(\$642.18)		(\$6,871)	(\$6,871)
Remove and Recycle Chain link Fence, 6' High	41,482	LF	(\$2.87)	\$6,969	(\$119,038)	(\$112,069)
Removal and Recycle AC Cables	36,000	LF	(\$0.16)	\$2,922	(\$5,642)	(\$2,720)
Removal and Recycle Above Ground DC Cables	3,130,800	LF	(\$0.07)	\$254,158	(\$213,566)	\$40,592
Removal and Recycle Under Ground DC Cables	80,000	LF	(\$0.09)	\$6,494	(\$6,861)	(\$366)
Backfill AC and DC trenches	116,000	LF	(\$0.11)		(\$13,110)	(\$13,110)
Removal and Recycle of Combiner boxes	96	EA	(\$167.10)		(\$16,042)	(\$16,042)
Remove and Recycle Inverters	8	EA	(\$3,939.65)	\$6,707	(\$31,517)	(\$24,811)
Removed and Recycle Photovoltaic Modules	72,414	EA	(\$1.32)	\$951,580	(\$95,677)	\$855,904
Remove and Recycle Piles (10' W6x7 piles @ 25' OC assumed)	10,080	EA	(\$2.19)	\$72,137	(\$22,111)	\$50,026
Remove and Recycle Support Assemblies	1,645,155	LB	(\$0.01)	\$82,258	(\$24,021)	\$58,237
Soils Testing	1	LS			(\$2,000)	(\$2,000)
Reclamation Monitoring and Maintenance	1	LS			(\$5,000)	(\$5,000)
Year 20 cost in current dollars				\$ 1,394,000.00	\$ (905,000.00)	\$ 489,000.00
Projected inflation (2.30%)				\$ 753,000.00	\$ (489,000.00)	\$ 264,000.00
Year 20 cost in future dollars				\$ 2,147,000.00	\$ (1,394,000.00)	\$ 753,000.00

General Notes:

1. Similarly sized sites were used to derive potential quantities for erosion and sediment control. Quantities were determined by comparing "unit/MW" quantities directly.
2. Labor productivity and unit rates were derived from BLS 2024.
3. Labor, material, and equipment rates are based on the nearest available RS Means City Cost Index (CCI).
4. Equipment rental rates were determined from various rental facility websites.
5. Assumption of module quantity is based on preliminary layout.
6. Estimated values are based on Zoning Site Plan dated 10/23/2024.
7. Unit values shown in this exhibit are rounded representations of those used in the underlying calculations.

Salvage Notes:

1. Material salvage values are based off of US salvage exchange rates from iscrapapp.com accessed on 10/22/2024.
2. PV module salvage rate is based on the exponential depreciation of modules.
3. PV module removal costs are computed at present values, then adjusted for inflation.
4. Material salvage values were determined using the most prevalent salvageable metal in each component.

Consistency with Growth Management Plan And Statement of Reasonableness

The following characteristics of Low Bridge Solar enable it to be consistent with many aspects of the Randolph County Growth Management Plan (2023) and to be reasonable and in the public's interest.

1. Screened from view
2. Inaudible
3. Fewer vehicle trips per day than one single family home.
4. Proximate to highway growth corridor
5. Strict environmental protections and engineering
6. Substantial increase in tax base
7. Property rights protected

A. Growth Management Plan Consistency

These tracts are in a Secondary Growth Area, which generally is considered available and suitable for major subdivisions if infrastructure is present. If developed to something other than low density homes or agriculture, the project should address the protections of the existing character of the area. This facility does just that.

Area 2: Secondary Growth Area

Transitional residential development is predominant in this area with major subdivisions scattered between agricultural and commercial land use patterns. Both public water and sewer infrastructure access is unlikely within the immediate future. The availability of large undeveloped tracts can substantially alter the development character of established residential areas. Development proposals should address how the existing character of the area can be preserved or enhanced.

Per GMP 3.1, the Plan cannot be read rigidly. Rather, it is a policy consideration to assist boards.

3.1 - Growth Management Area Categories and Map

The purpose of the Growth Management Area (GMA) Map is to provide guidance to the public, development community, and public boards on where growth and development should be directed, as well as the type and scale of such growth. When making rezoning decisions, acknowledging the institutional and cultural heritage of areas is important and should be considered in the rezoning decision.



A Growth Management Area Map:

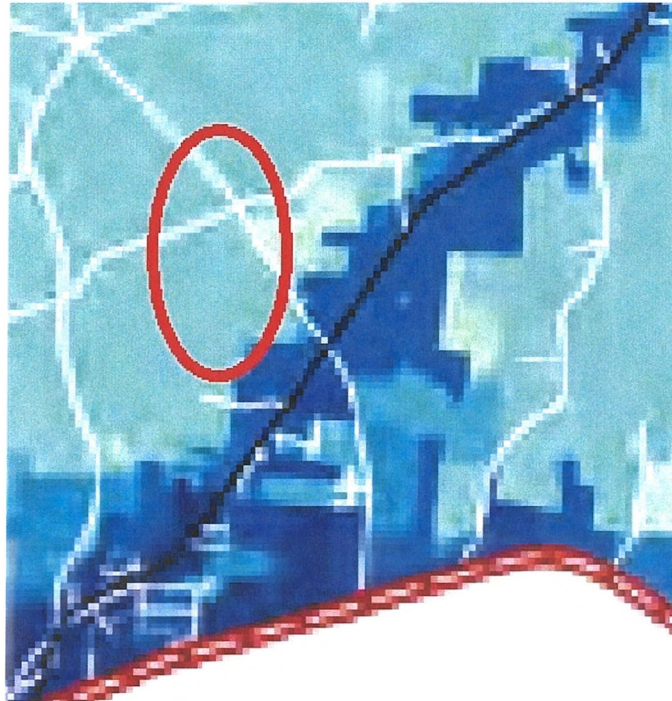
- Identifies development pressures
- Reflects on public infrastructure (existing/planned)
- Provides policy guidance to boards/commissions
- Reflects development patterns



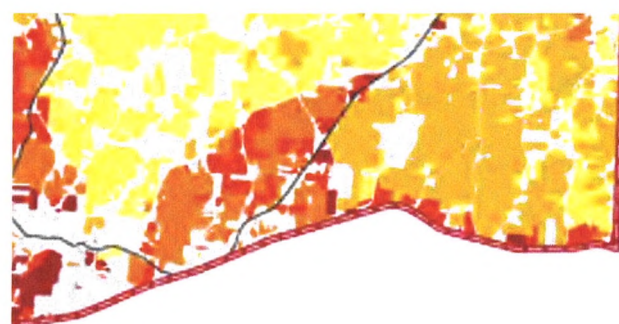
A Growth Management Area Map is NOT:

- A redistricting map
- A zoning map
- The sole factor in making rezoning decisions
- A future land use map

The GMP makes location a key factor. Low Bridge Solar sits on land that is adjacent to or **proximate to Highway 49**, considered to be a job and housing corridor. In other words, a corridor for development of various kinds.



Per the GMP map below, this location is identified as a possible **location for denser future housing**, and a quiet, well-concealed solar facility would have **far less impact on a rural area than a housing development**.



To the extent scenic views are considered, Low Bridge Solar proposes **setbacks and vegetative buffers that exceed the UDO requirements.**

1.5. Scenic Corridor Protection

Preserve scenic views and elements of the county's rural character by reducing views of new development from existing roads through use of natural buffers and open space.

The construction of this facility will certainly **minimize site disturbance** because panel frame support posts are driven into the ground, avoiding mass grading. Existing vegetation will be retained and/or replaced if disturbed by equipment.

1.7. Minimal Site Disturbance

Minimize site disturbance and erosion through retention of existing vegetation and avoiding the development of steep slopes and areas near protected water features.

The **GMP encourages RIO developments** if they increase the tax base, lessen impact to rural lands, and use natural buffers and landscaping to reduce impacts. Low Bridge Solar meets all three factors.

4.5. Rural - Industrial Uses

- a) Provide for sites in *Rural Growth Areas* where industrial activity requiring proximity to rural resources could be located with the goal of increasing economic activity, job creation, and the tax base of Randolph County.
- b) New rural industrial development shall be located in areas of the site that would lessen the impact on adjoining residential and agricultural lands and provide vegetated buffers or other landscaping designed to reduce substantial impacts to adjoining land uses.
- c) The use of the Rural Industrial Overlay (RIO) District is encouraged when the use of large acreage natural buffer and extensive landscaping would not have a substantial adverse impact on the general area.

This project will **diversify the economy and increase the tax base,** a point well-supported by the GMP.

5.1. Diversification of Economy

Encourage new and expanding industries and businesses which diversifies the local economy by utilizing a more highly skilled labor force which increases area residents' income and increases the tax base.

Such growth, by protecting existing vegetative buffers or planting new and substantial buffers creates an excellent balance with existing nearby residents.

5.5. Balancing Economic Growth with Quality of Life and Environmental Health

The benefits of economic development and employment opportunities should be balanced against the surrounding effects such development may have on the quality of life enjoyed by area residents and the health of the environment.

There will be no noise, no odors, no pollution, and no other harmful effects to begin with, and visual impacts will be mitigated through retention of or planting of vegetation.

8.2. Protect Environment from Industrial Nuisances

Industries that are potentially producing excessive noise, odor, air, and water pollution, or other harmful impacts should be discouraged unless such adverse impacts can be clearly overcome through effective mitigation.

Not only will all **federal and state regulations adopted post-Clean Water Act be strictly followed**, but solar panels are not considered impervious, allowing rain to be absorbed into the ground below.

8.6. Stormwater Runoff

Site planning and engineering and as-built design should minimize stormwater runoff impacts on streams and other receiving areas.

- a) Include stormwater impact information on pre-development flow and proposed development flow to calculate impact.
- b) Stormwater impact should be minimized and designed to maximize the length of stormwater sheet flow through vegetated buffer areas.

Finally, the owners of this land who pay the taxes on this land have made a carefully considered decision to diversify their land to include a use that works for them and that has little to no impact on neighbors.

Protecting property rights was a cornerstone of the resolution adopting the Growth Management Plan.

NOW, THEREFORE, BE IT RESOLVED BY THE RANDOLPH COUNTY BOARD OF COMMISSIONERS:

It is the intent of the Board of County Commissioners by establishing this Northeast Growth Management Plan to:

1. Recognize that sustainable economic growth, environmental protection, and the rural quality of life can be pursued together as mutually supporting public policy goals;
2. Recognize that growth management policies should afford flexibility to County boards and agencies; that will enable them to adapt to the practical requirements often necessary for rural development;
3. Ensure the opportunity for landowners to achieve the highest and best uses of their land that are consistent with growth management policies in order to protect the economic viability of the County's citizens and tax base;
4. Consider the costs as well as the benefits of growth management policies in order to preserve affordability for citizens real estate and housing needs; and
5. Recognize and respect constitutionally protected private **property rights** in the interpretation of all policies and to achieve community goals such as open space preservation through incentives to landowners in voluntary programs that recognize consumer demand.

B. Statement of Reasonableness

Because this proposed use does not harm or disrupt the lives of adjoining owners, it protects the environment, creates substantial jobs for approximately one year, produces substantially more taxes than land in agricultural deferment, and will assist in leveling the costs of electricity, it is therefore a reasonable use that is in the public's interest.

Conditions Offered

Low Bridge Solar: Rezoning Application Conditions for Approval

The applicant, Low Bridge Solar LLC, proposes the following conditions to be imposed to meet the standards of the Randolph County Unified Development Ordinance:

- 1) Low Bridge Solar will submit a complete Erosion and Sedimentation Control Plan to Randolph County prior to obtaining the required building and electrical permits.
- 2) Low Bridge Solar will submit a final site plan including all access road locations to the Randolph County Fire Marshall for approval prior to the construction of Low Bridge Solar.
- 3) Low Bridge Solar will apply for the required Watershed Protection and Watershed Protection Occupancy Permits in coordination with the Randolph County Watershed Administrator prior to the construction of the facility.
 - a) In accordance with the Watershed Protection and Watershed Protection Occupancy Permits, Low Bridge Solar will comply with the calculation of project density and the low-density project requirements of the Randolph County Watershed Protection Ordinance. Low Bridge Solar will adhere to these guidelines and submit the required plans to the Randolph County Watershed Administrator.
- 4) Low Bridge Solar shall have the flexibility to use any fencing which meets the requirements of the National Electric Code (NEC).
- 5) This permit shall carry five years of vesting.