

Navajo Nation

Navajo-Hopi Land Commission

**the Paragon-Bisti Solar Ranch**

webinar for DOE & WAPA:

“Exploring Your Energy Markets”

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*NHLC Office*

*Tetra Tech*



# 5-phase Renewable Energy (RE) Development Program @ Paragon-Bisti



- Phase I – preliminary critical issues analysis & pre-feasibility study (*COMPLETED*)
- Phase II – DOE-TEP-funded Feasibility Study (*COMPLETED*)
  - \* three phases to go:
- Phase III – Preconstruction (*HERE WE ARE*)
- Phase IV – Construction
- Phase V – long-term Operations and Maintenance



# Why PBR? Project's Background



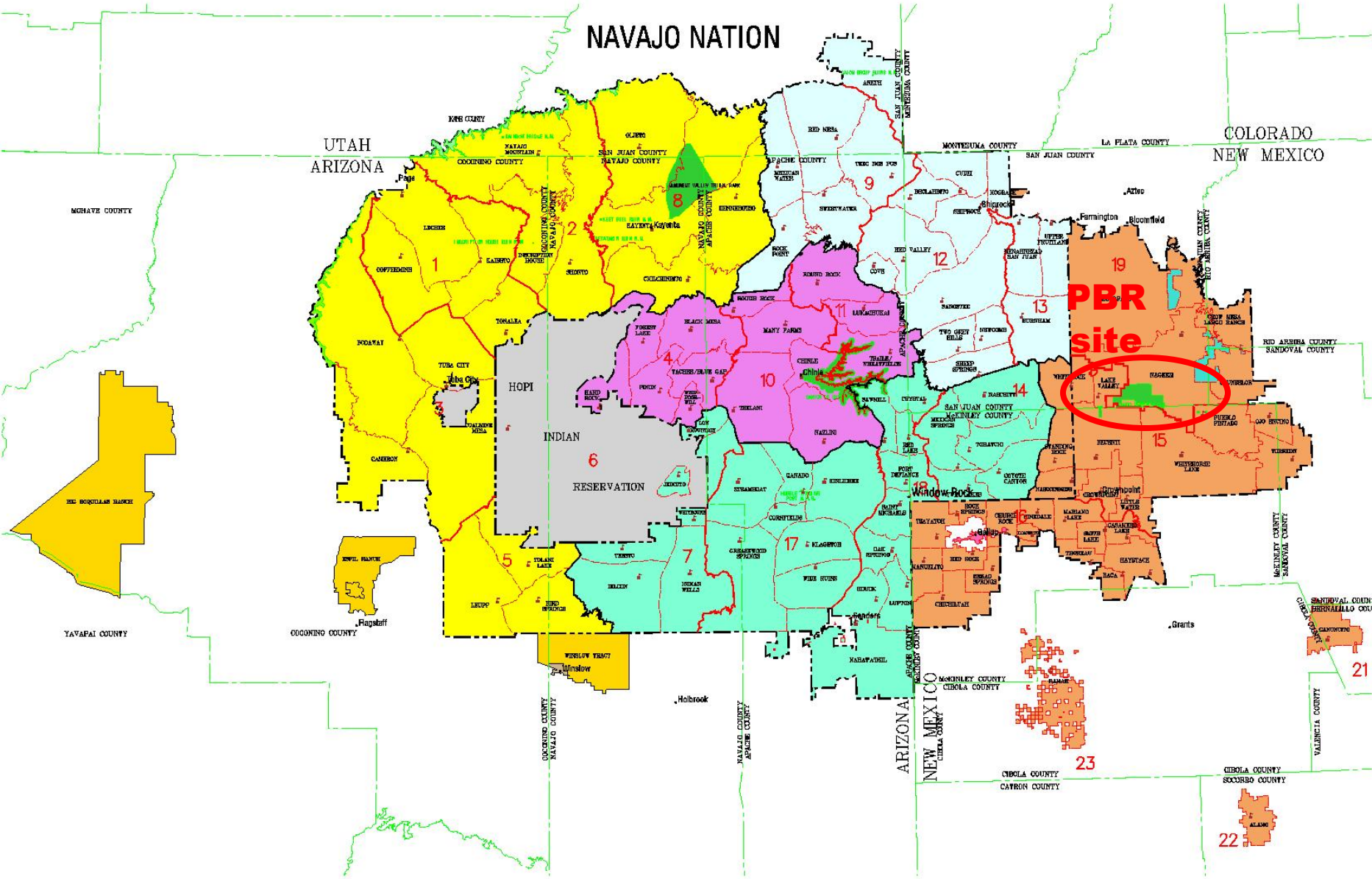
- ❖ THE NAVAJO-HOPI LAND SETTLEMENT ACT
  - Navajo-Hopi Land Settlement Act passed 1974 (P.L. #93-305)
  - Required relocation of Navajo and Hopi families living on land partitioned to the other tribe.
  - Set aside lands for the benefit of Relocates
  - *Proceeds from RE development on these lands are to benefit the Relocates*
  - The 22,000-acre Paragon-Bisti Ranch (PBR) is one of those “Selected and Conveyed” parcels

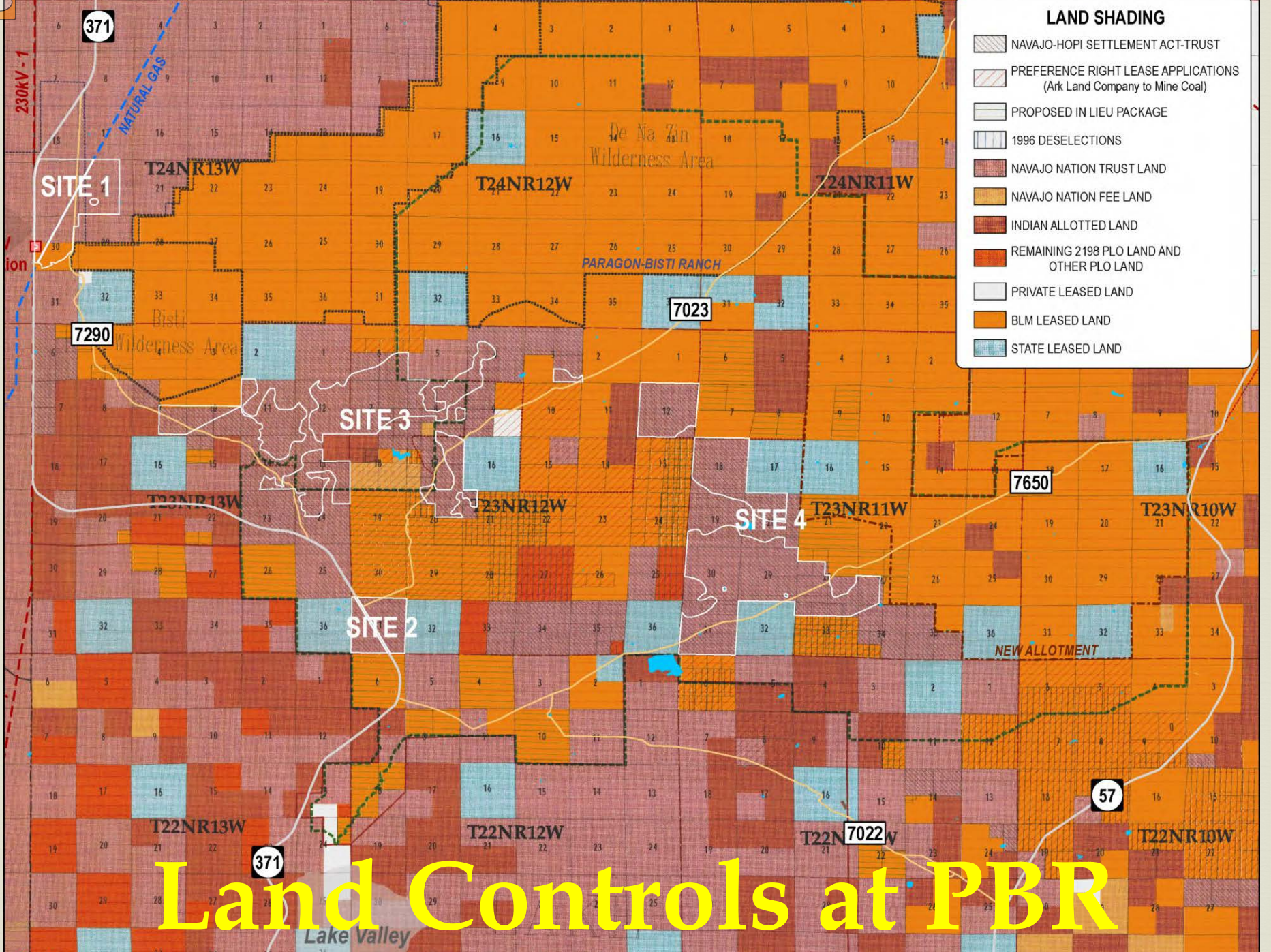


# NAVAJO NATION












UTAH  
ARIZONA

COLORADO  
NEW MEXICO



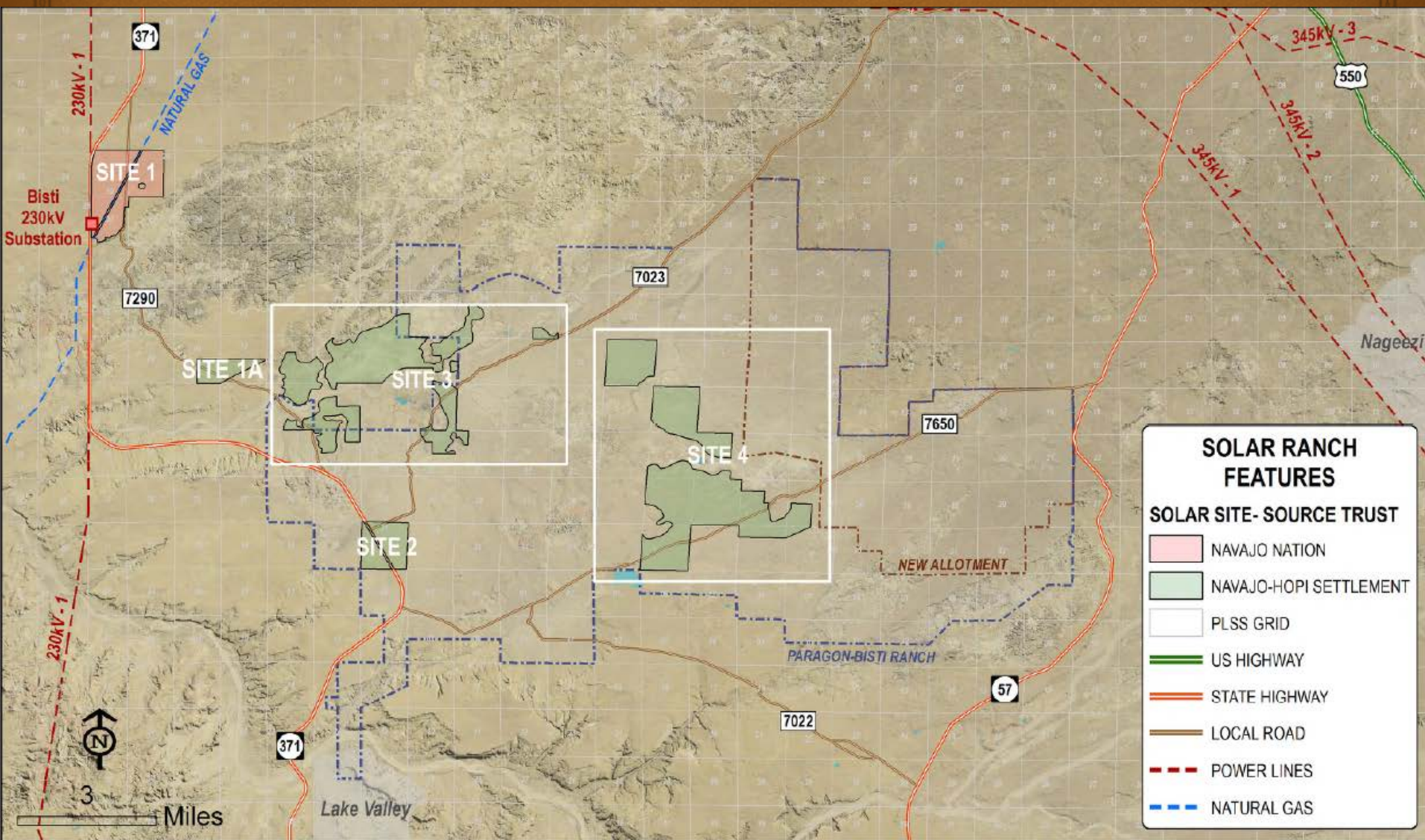


**LAND SHADING**

-  NAVAJO-HOPI SETTLEMENT ACT-TRUST
-  PREFERENCE RIGHT LEASE APPLICATIONS (Ark Land Company to Mine Coal)
-  PROPOSED IN LIEU PACKAGE
-  1996 DESELECTIONS
-  NAVAJO NATION TRUST LAND
-  NAVAJO NATION FEE LAND
-  INDIAN ALLOTTED LAND
-  REMAINING 2198 PLO LAND AND OTHER PLO LAND
-  PRIVATE LEASED LAND
-  BLM LEASED LAND
-  STATE LEASED LAND

**Land Controls at PBR**

# 5 Solar sites ID'ed after land screening





# Outline & Process of the Feasibility Study



- Site Selection / Land Screening
- Renewable Technology Screening
- Conceptual Design
- Transmission and Interconnection Analysis
- Economics & Investment-grade *pro forma*
- Business Plan for Implementation
- Environmental Study
- Socioeconomic Benefits
- Next Steps

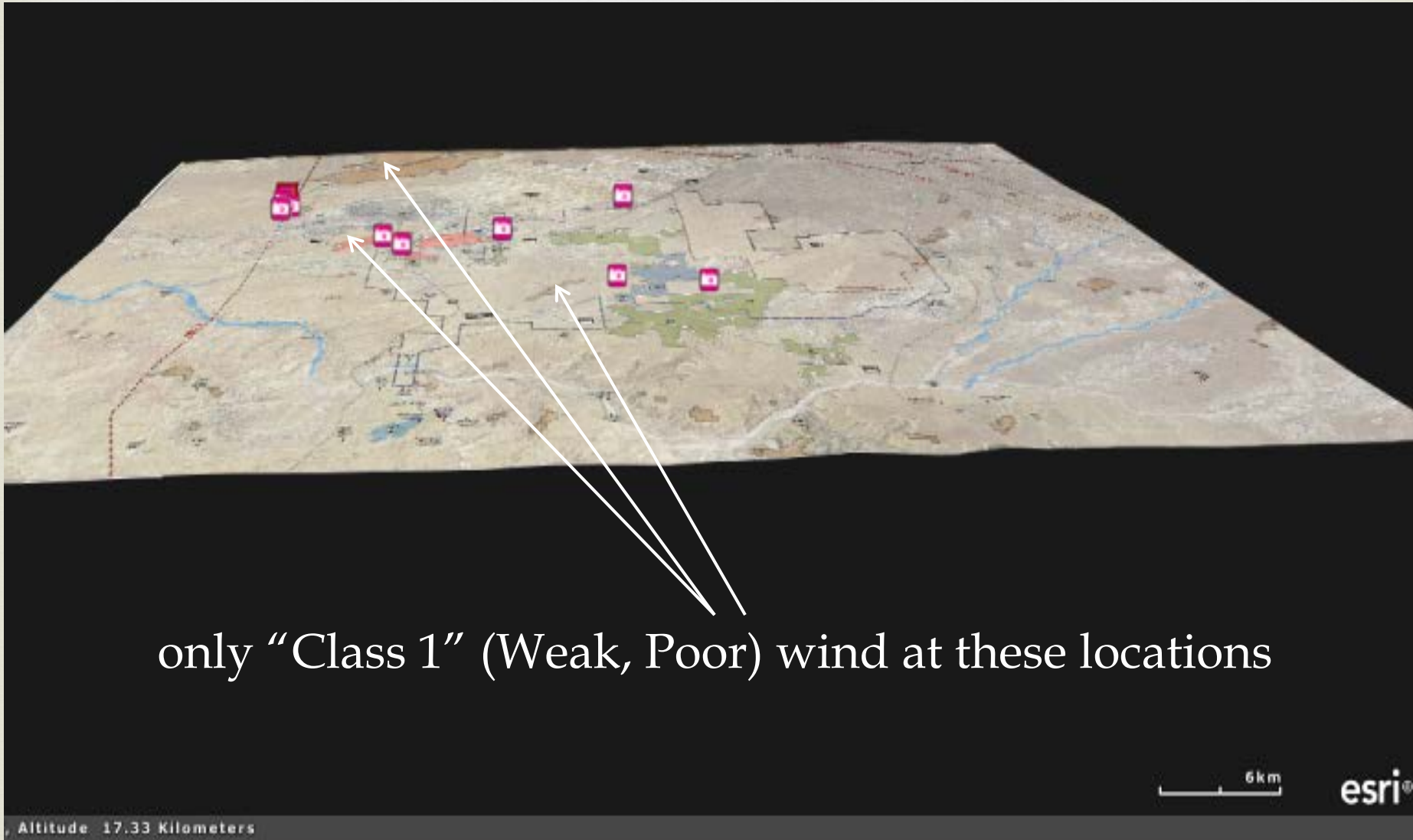


# RE technology screening

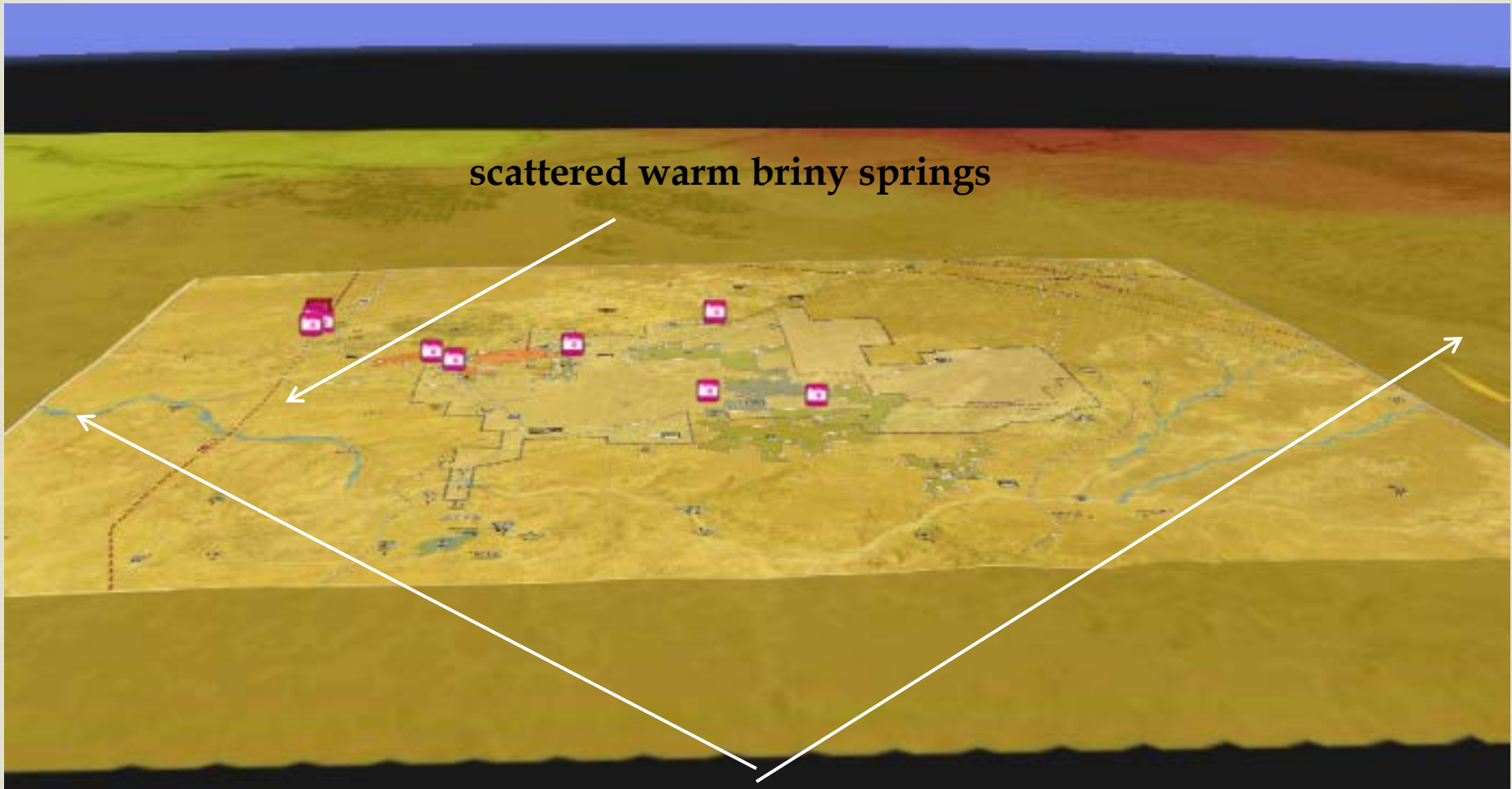
- Geothermal ruled out
  - geopower too deep
  - direct-use hydrothermal resource not utility-scale
- Wind-power and Biopower ruled out early due to lack of resource (shown on next 2 slides)
- **Solar**
  - fixed flat photovoltaic (PV) @ summer bias **selected**
  - neither concentrating nor tracking PV selected due to marginal cost
  - neither wet-cooled nor dry-cooled solar thermal selected due to marginal cost



# Wind resource



# Geothermal resource



**scattered warm briny springs**

**moderately hot but very deep & dry geothermal**

**distribution uniform across study area, no one location better than any other**

# PV Solar Radiation (Flat Plate, Facing South, Latitude Tilt)

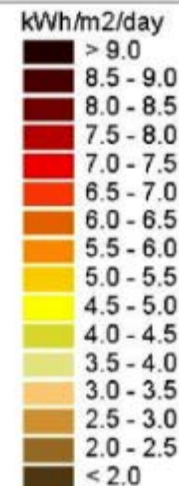
Annual

Model estimates of monthly average daily total radiation using inputs derived from satellite and/or surface observations of cloud cover, aerosol optical depth, precipitable water vapor, albedo, atmospheric pressure and ozone resampled to a 40km resolution. See [http://www.nrel.gov/gis/il\\_solar\\_pv.html](http://www.nrel.gov/gis/il_solar_pv.html) documentation for more details.

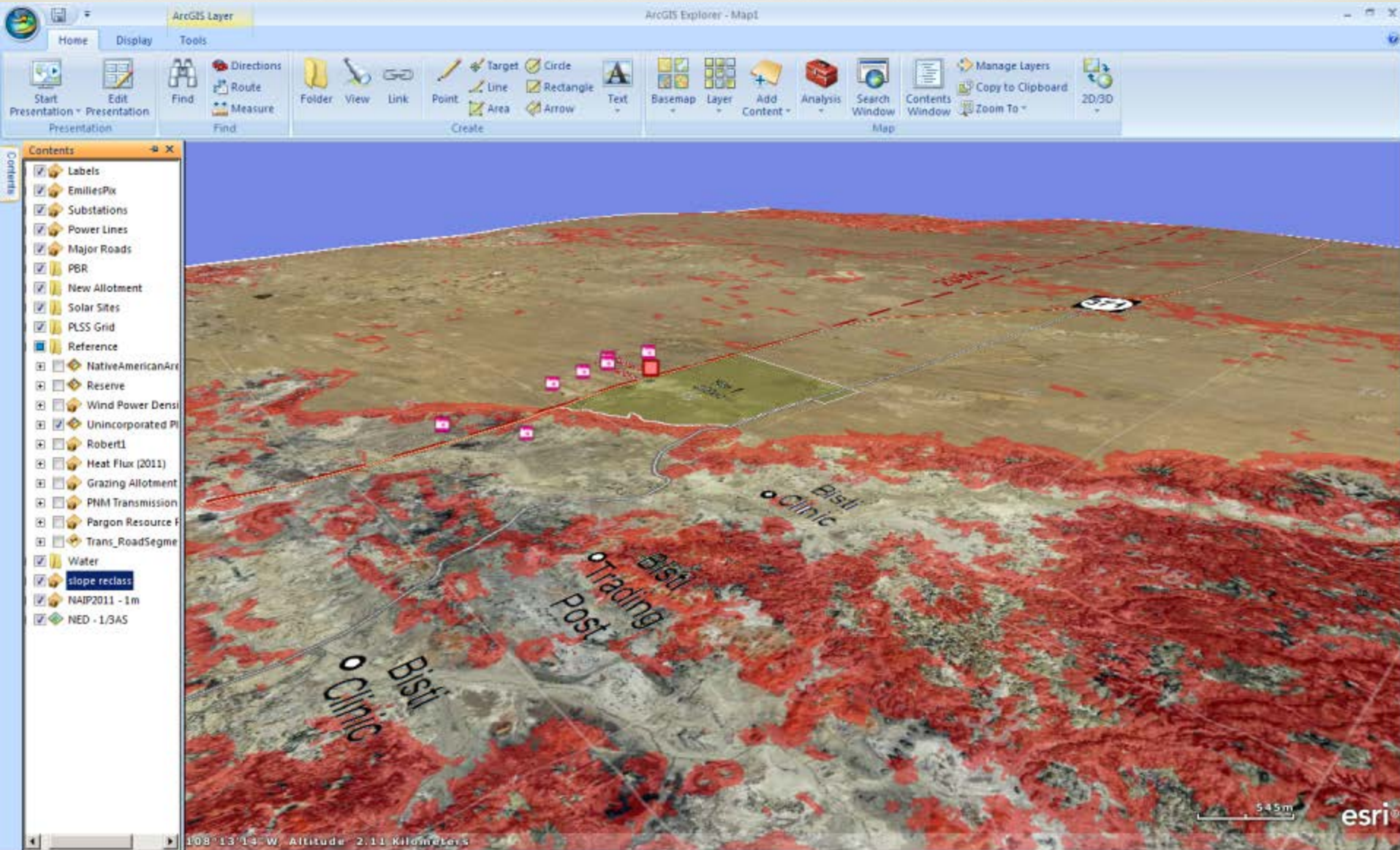
36.0 ° N Lat, 107.9 ° W long New Mexico  
annual insolation ave 6.58 sun hours  
Output peak 7.28 kWh/m<sup>2</sup>/day)

Paragon Bisti  
Solar Ranch Site

NM

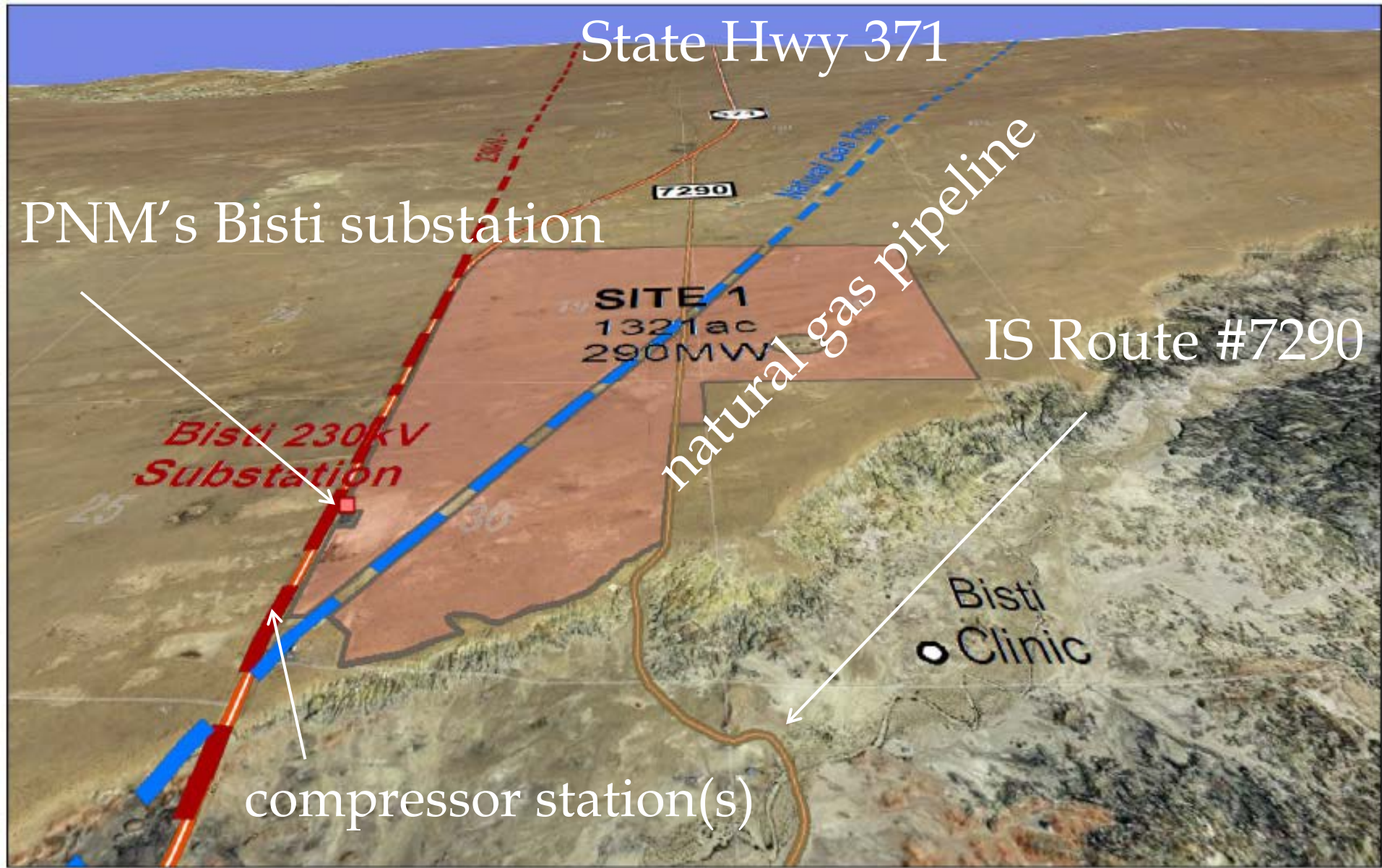


# screencap of AGX flyover

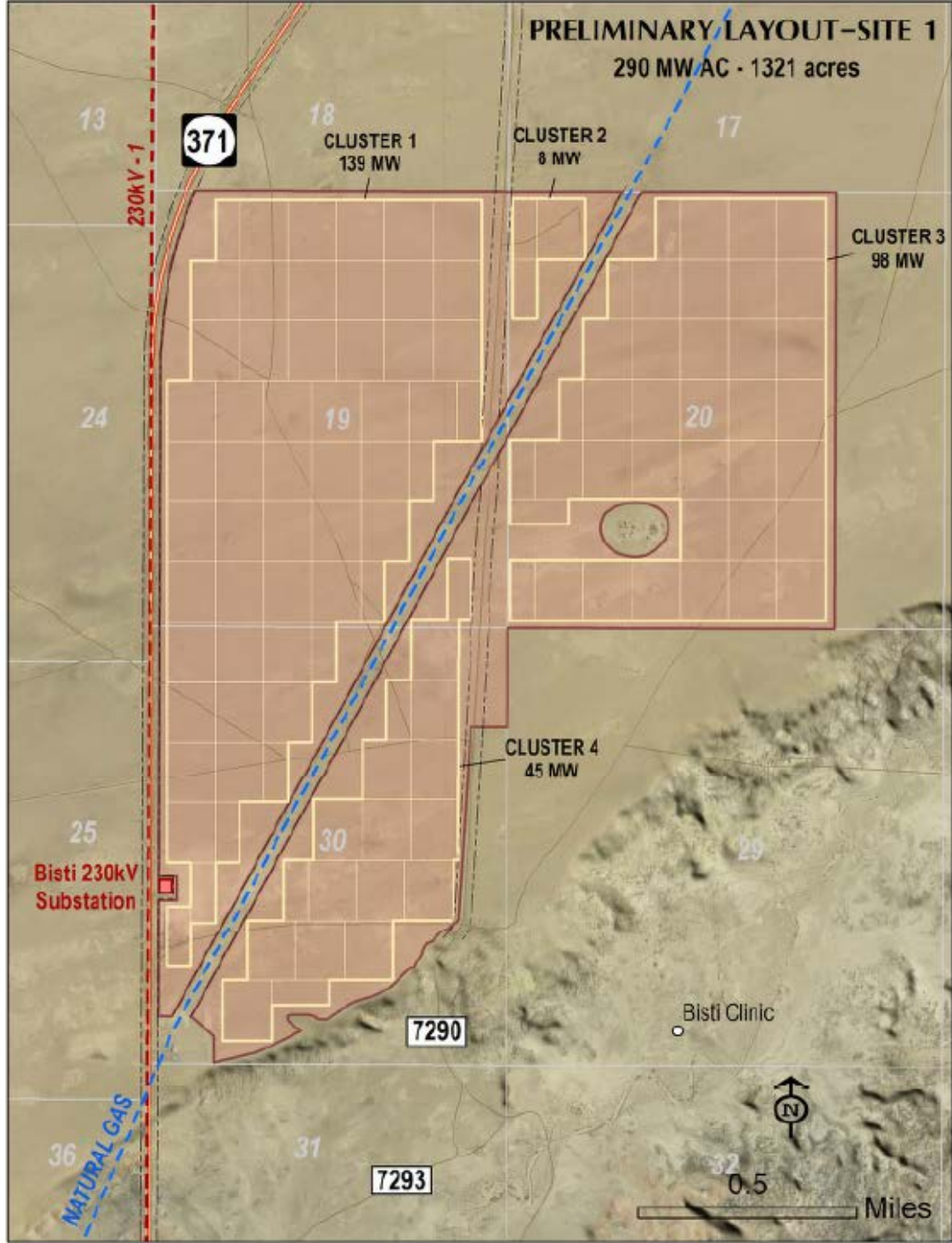


(data directory visible, slope layer turned on, >3% shown in red)

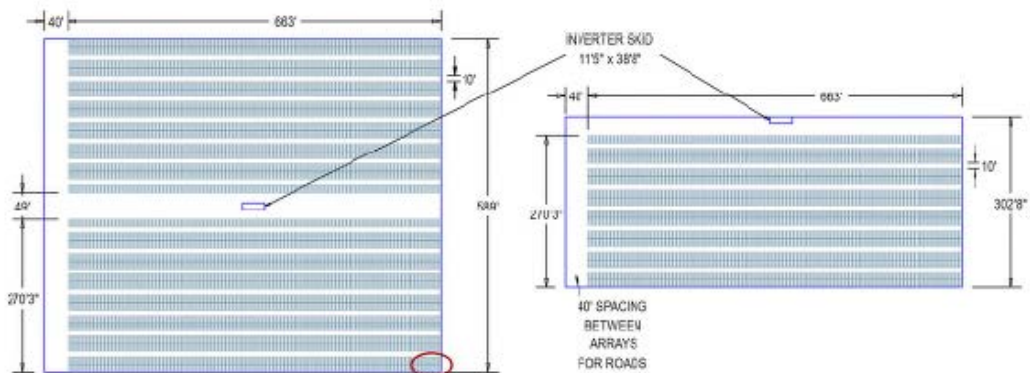
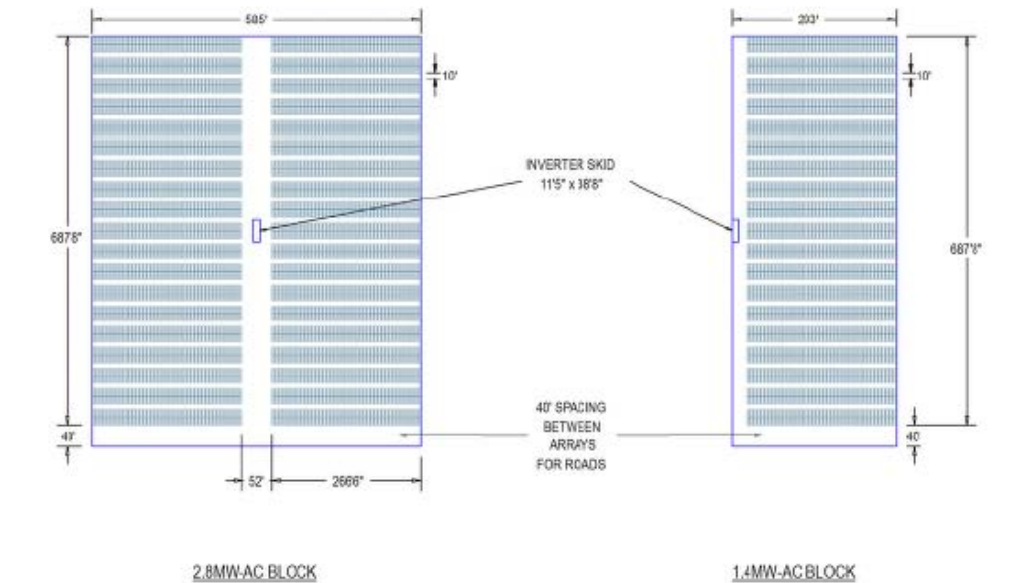
# screencap of AGX flyover



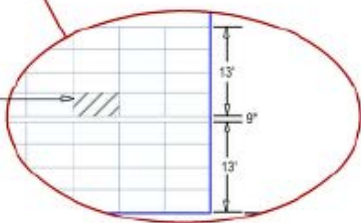
conceptual design / layout of  
Site 1 tiled with 1.4- & 2.8-MW  
power blocks



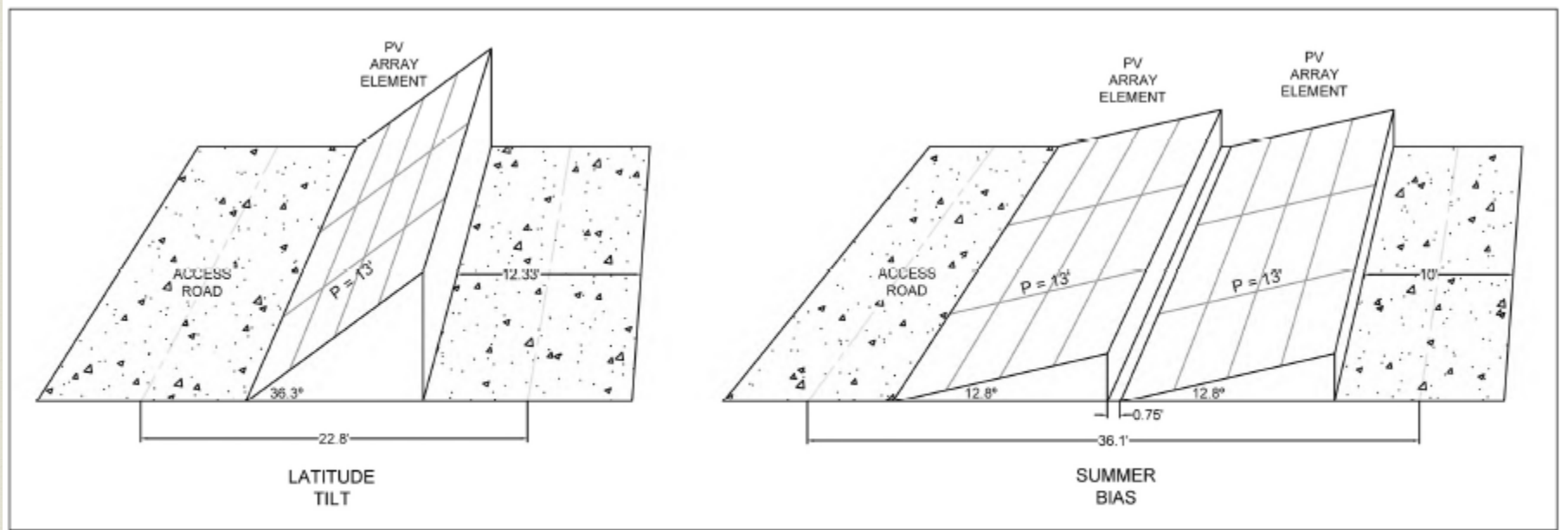
# basic 1.4- & 2.8-MW power blocks



TYPICAL PV MODULE  
(3.3' x 6.5' - 215W-AC)



# why summer bias?

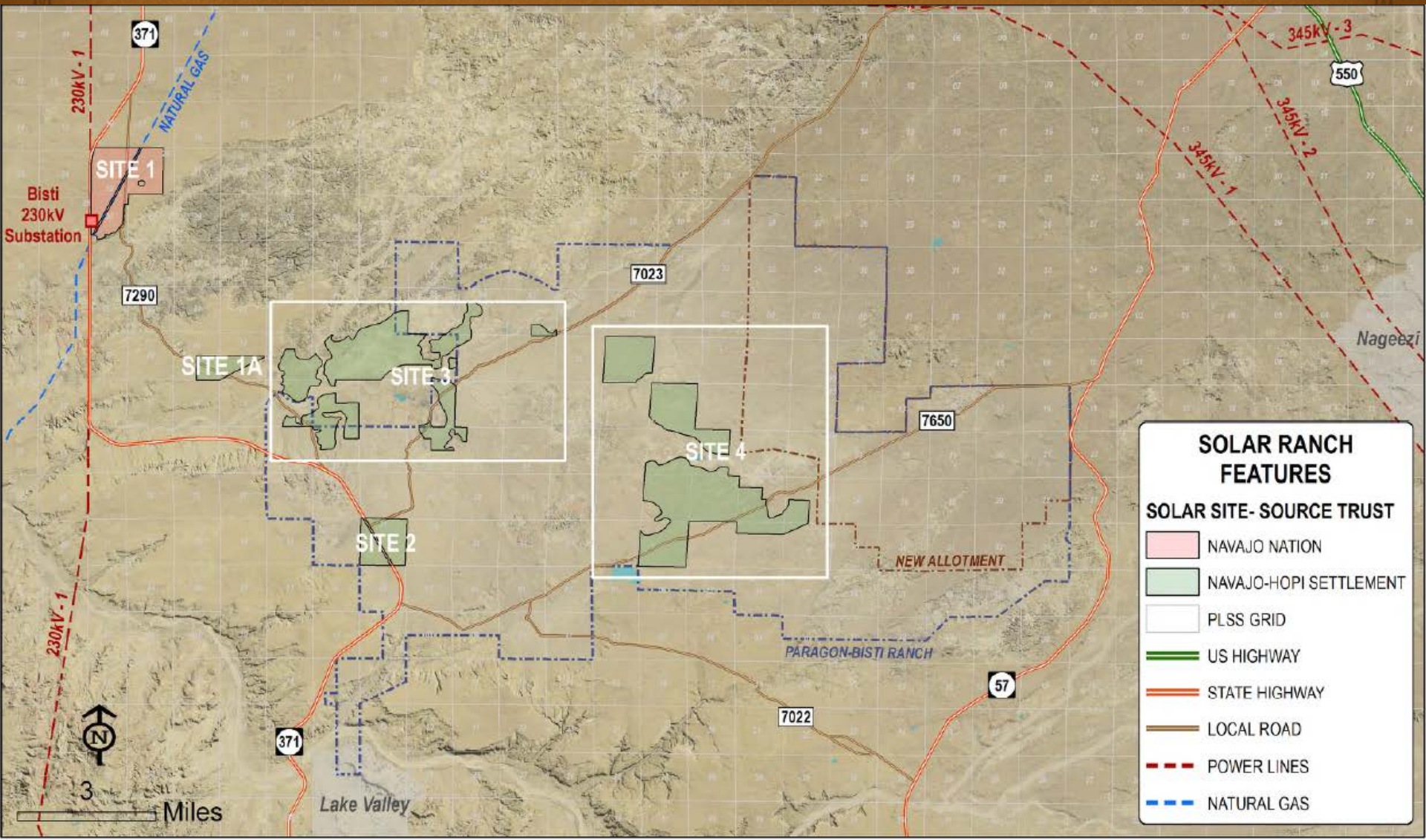


**Figure 2-31. Latitude-tilt (left) versus summer-bias (right), and service lanes for each**

much more efficient land use

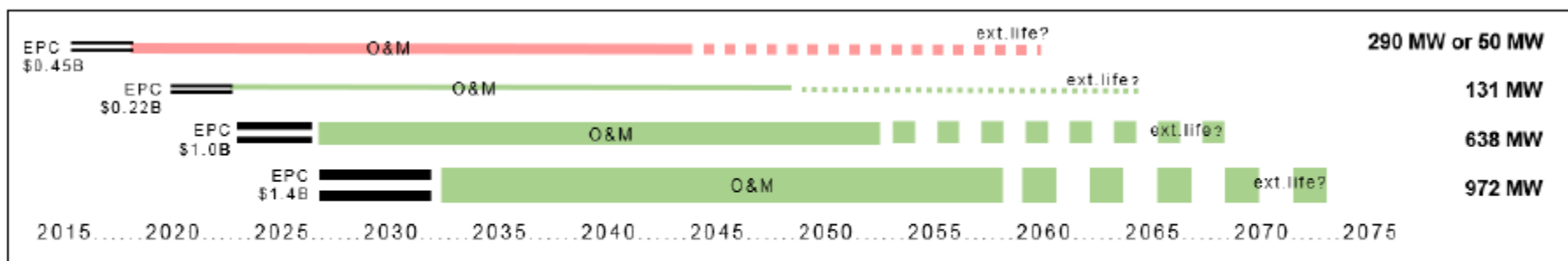


# recapping, here are the 5 Solar sites



# the 5 sites in summary numbers:

| Group Name                    | Site # | Devel-<br>opable<br>Acres | Power [MWe]<br>latitude tilt<br><i>summer bias</i> | Access                     | Development Potential and Status   |
|-------------------------------|--------|---------------------------|--|----------------------------|--|
| BISTI CORNERSTONE             | 1      | 1,321                     | 207<br><b>290</b>                                  | grid YES<br>paved road YES | <ul style="list-style-type: none"> <li>• Very high priority, goes 1<sup>st</sup></li> <li>• Non-Settlement, but still Tribal</li> </ul>                        |
| "the Wedge"                   | 1A     | 333                       | 36<br><b>50</b>                                    | grid NO<br>paved road YES  | <ul style="list-style-type: none"> <li>• Alternate to 1<sup>st</sup> if 1<sup>st</sup> not available</li> <li>• Settlement, Selected &amp; Conveyed</li> </ul> |
| "DOG-EYE SOLAR RANCH"         | 2      | 612                       | 94<br><b>131</b>                                   | grid NO<br>paved road YES  | <ul style="list-style-type: none"> <li>• High, goes 2<sup>nd</sup></li> <li>• Settlement, Selected &amp; Conveyed</li> </ul>                                   |
| TANNER LAKE/COAL<br>CREEK     | 3      | 3,161                     | 456<br><b>638</b>                                  | grid NO<br>paved road NO   | <ul style="list-style-type: none"> <li>• Moderate, goes 3<sup>rd</sup></li> <li>• Settlement, Selected &amp; Conveyed</li> </ul>                               |
| SPLIT LIP FLATS/BLACK<br>LAKE | 4      | 4,205                     | 694<br><b>972</b>                                  | grid NO<br>paved road NO   | <ul style="list-style-type: none"> <li>• Medium-low, goes last</li> <li>• Settlement, Selected &amp; Conveyed</li> </ul>                                       |
| TOTAL ALL SITES               |        | 9,632                     | 1,487<br><b>2,081</b>                              |                            |  |

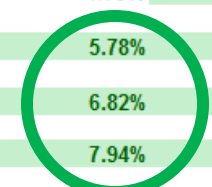


**Figure 2-34. Preliminary Waterfall Chart for Build-out of the PBR.**

master timeline

# Economic Analysis, Cost:Benefit, & *pro forma*

| Input Assumptions   |             | Summary Dashboard                   |                    |           |           |           |      |
|---|-------------|-------------------------------------|--------------------|-----------|-----------|-----------|------|
| IOC from groundbreaking [enter at least 1 yrs]                      |             | Output: Before-Tax IRR              |                    |           |           |           |      |
| Performance   |             | Equity %-age v                      | Elec price [¢/kWh] | 0.06      | 0.075     | 0.08      | 0.10 |
| System Size (kW DC)   |             | Enter equity ratios in teal cells v |                    |           |           |           |      |
| Yearly fuel consumption (tons)                                      | -           | 100%                                | 4.27%              | 7.19%     | 8.08%     | 11.36%    |      |
| Net Output after DC/AC & House Load                                 | 88.00%      | 50%                                 | 4.07%              | 9.01%     | 10.52%    | 16.17%    |      |
| Adjusted System Size (kWac)   | 88,000      | 20%                                 | 3.76%              | 12.62%    | 15.60%    | 27.92%    |      |
| Capacity Factor   | 19.50%      | 10%                                 | 3.55%              | 16.47%    | 21.71%    | 45.86%    |      |
| Performance degradation, %/year                                     | 0.50%       | 5%                                  | 3.40%              | 21.69%    | 31.67%    | 80.99%    |      |
| Capital Cost per nameplate watt                                     | \$ 1.60     | Output: After-Tax IRR               |                    |           |           |           |      |
| use for BEST CASE: \$1.50/W; LIKELY \$2.00; REASONABLY WORST \$2.50 |             | Equity %-age v                      | Elec price [¢/kWh] | 0.06      | 0.075     | 0.08      | 0.10 |
| Key Rates   |             | 100%                                | 1.46%              | 4.17%     | 4.99%     | 7.97%     |      |
| Internal Utility Electricity Price (\$/kWh, see ind.tabs)           | see tabs    | 50%                                 | -0.20%             | 4.70%     | 6.16%     | 11.65%    |      |
| Fuel Receipt Fee (\$/per ton)                                       | \$ -        | 20%                                 | -2.86%             | 5.78%     | 8.73%     | 21.54%    |      |
| O & M (\$/kWh)  | \$ 0.009    | 10%                                 | -4.29%             | 6.82%     | 11.89%    | 39.33%    |      |
| General Monetary Inflation Rate Americas est. (%/year)              | 3.90%       | 5%                                  | -5.11%             | 7.94%     | 17.50%    | 76.66%    |      |
| Electricity Price Inflation, US PPI 1950-2005 (%/year)              | 2.20%       | Output: sales cost per kWh          |                    |           |           |           |      |
| Discount Rate est. for WestHem.                                     | 4.90%       | Equity %-age v                      | Elec price [¢/kWh] | 0.06      | 0.075     | 0.08      | 0.10 |
| Assumed Corporate Tax Rate (%)                                      | 35.00%      | 100%                                | \$ 0.0158          | \$ 0.0158 | \$ 0.0158 | \$ 0.0158 |      |
| State Income Tax Rate (%)   | 0.00%       | 50%                                 | \$ 0.0419          | \$ 0.0419 | \$ 0.0419 | \$ 0.0419 |      |
| Local Jurisdiction Income Tax Rate (%)                              | 0.00%       | 20%                                 | \$ 0.0571          | \$ 0.0571 | \$ 0.0571 | \$ 0.0571 |      |
| Property Tax (%)  | 0.00%       | 10%                                 | \$ 0.0621          | \$ 0.0621 | \$ 0.0621 | \$ 0.0621 |      |
| REC Current Rate (\$/1000kwh)                                       | \$ -        | 5%                                  | \$ 0.0646          | \$ 0.0646 | \$ 0.0646 | \$ 0.0646 |      |
| REC Value Change (%/year)   | 0.00%       | Capital Costs                       |                    |           |           |           |      |
| Current Electricity Usage (kwh)                                     | -           | EPC Costs                           | \$ 160,000,000     |           |           |           |      |
| Land Lease & Royalty Escalation (%/year)                            | 2.90%       | Development & Equity Fees, %        | 5.00%              |           |           |           |      |
| Fuel / Feedstock Escalation (%/year)                                | 0.00%       | Loan Points, %                      | 1.00%              |           |           |           |      |
| Feedstock Receipt Fee Escalation (%/year)                           | 0.00%       |                                     |                    |           |           |           |      |
| Royalty Rate (\$/MW/yr)   | \$ 6,750.00 |                                     |                    |           |           |           |      |
| for BEST & LIKELY IOC use Year 1; for REASONABLY WORST use Year 2   |             |                                     |                    |           |           |           |      |



**TAKEAWAYS:**

- ☞ maximize PPA ¢/kWh
- ☞ maximize debt portion, minimize equity, (i.e., leverage)



# Socioeconomic Benefits

## (Employment & Social)



### ☞ Employment

- \* local, stable, healthy jobs
- \* 15-30 FTEs per 100-MW block, or ~8,000 – 16,000 man-years
- \* payroll \$500M+ over 25-year O&M Phase V

☞ Full engineering-procurement-construction build-out @ US\$1.60/watt:  
~\$2.2B to \$3.8B



# What's Going On Now in Phase III

---

- Working with BIA and new NN government to consolidate gains; integrated with other plans, e.g. the BoR Clean Energy Strategic Plan & Energy Task Force (week before last will create NN office of energy)
- Finalizing site boundaries & securing site control – esp. Site #1; legal survey
- Continuing to work with PNM re: interconnection issues, wheeling, negotiation of PPA
- Engaging developers & industry
- Refining financial model & develop lease agreement



# What's Next



- Draft and issue Requests for Information “RFI/Sources Sought”
- Draft, issue and review Request for Qualifications (RFQ)
- Draft and issue Request for Proposal (RFP)
- Review bids and proposals and select best-value developer(s).

# Thank you. Questions?



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**FOR IMMEDIATE RELEASE**

September 9, 2015

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**Navajo-Hopi Land Commission announces  
next steps for Paragon-Bisti Solar Ranch**

**WINDOW ROCK** – The Navajo-Hopi Land Commission announced that it will explore the next phase of activity, Pre-Construction, at Site 1 of the Paragon-Bisti Solar Ranch comprised of 22,000 acres of the Paragon-Bisti Ranch south of Farmington that was selected and conveyed to the Navajo Nation in the late 1980s under the Navajo-Hopi Land Settlement Act of 1974.

Site 1 consists of approximately 1,321-acres adjoining the Bisti Substation on New Mexico State Highway 371, north of De-Na-Zin Wash.

The announcement comes after a work session held in August in which NHLC members received a technical briefing on the Feasibility Study for the Paragon-Bisti Solar Ranch from Tetra Tech— a company hired to perform the study.

The Feasibility Study found that approximately 10,000 acres on five major sites are suitable for hosting 2,100 megawatts of solar photovoltaic power — equal to the entire generating capacity of the state of New Mexico. Site 1 could host as much as 290 megawatts of clean renewable power.

The study was funded by a grant from the U.S. Department of Energy's Tribal Energy Program, and was completed on June 30, 2015. The Pre-Construction phase includes meeting and recruiting solar developers, surveying, and environmental assessment.

"The Commissioners appreciate the magnitude of this project and we are thankful for the investment by the U.S. Department of Energy," stated NHLC chair Council Delegate Walter Phelps (Cameron, Coalmine Canyon, Leupp, Tolani Lake, Tsidi To ii).

Navajo-Hopi Land Commission Office executive director Wenona Benally, said the project will set the Nation "on a new path."

"There is extraordinary potential for the Navajo Nation to develop renewable energy resources on our lands," added Benally.

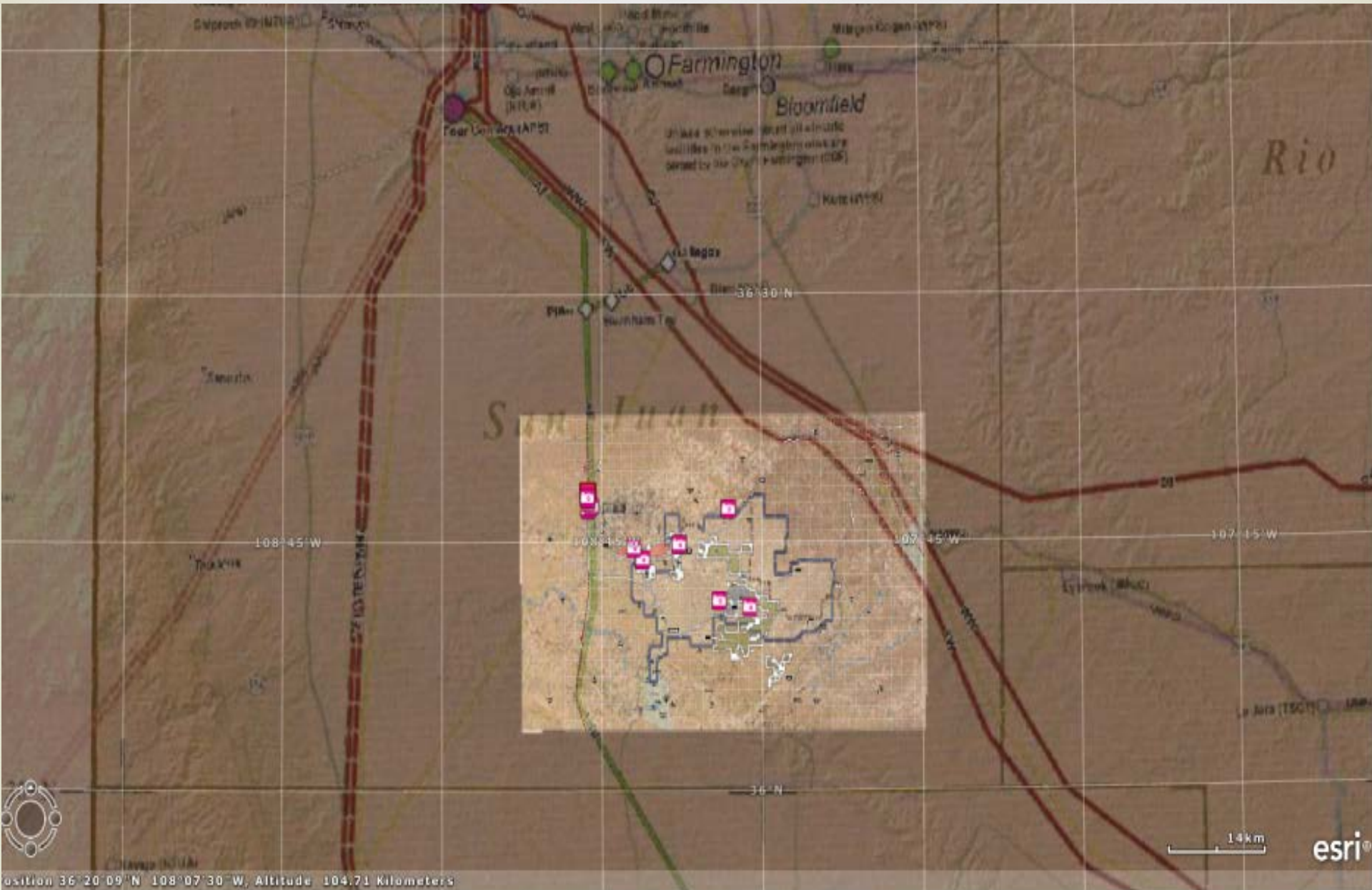
For more information about the Paragon-Bisti Solar Ranch project, please click [here](#).

###

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result 09 Sep 2015

# local transmission infrastructure



# Addendum: Transmission and Interconnection paperwork

- ❧ Generator must sign and comply with a Large Generator Interconnection Agreement (LGIA)
- ❧ Process approved by FERC and is included as provisions in each utility's Open Access Transmission Tariff (OATT). The general provisions are the same for all, but the circumstances are different in each case
- ❧ LGIA requires a system impact study to identify if any system upgrades are necessary to handle the new generation
- ❧ Improvements-(new a substation) costed and the generator's share is determined in a facilities study
- ❧ Timeline for completing
- ❧ Signed LGIA the party's agree on costs and time - must put down a deposit to begin.
- ❧ LGIA has a 3-year shelf life- per FERC rule
- ❧ LGIA is necessary, but it doesn't guarantee capacity on the system-only the right to connect.
- ❧ Generator-or buyer must sign a Transmission Service Agreement (TSA) which again is in a utility's OATT

# Addendum: Environmental Study



**Environmental Issue Areas - No major areas of concern**

**More Field Work Required - based on specific site**

- Cultural Resources- -  
Archaeological/Paleontological/Historical
- Avoidance of Sensitive Tribal Lands- -  
Grave Sites/Sacred Sites
- Biological Resources- -Vegetation and Wildlife

**Consider in the Design Phase**

- Hydrology and Flood Potential
- High Susceptibility of Soil to Erosion

# Construction – Phase IV



- Partnering meetings between NHLCO, Navajo Nation, developer and other stakeholders
- Sign lease and partnering agreement.
- Obtain environmental permits
- Construction preparation
- Engineering designs
- Submission of plans
- Mobilization
- Site preparation
- Infrastructure, improvements, construction & grid-tie