Utility-Scale Solar Development Environmental Constraints & Opportunity Analysis

Regional Screening & Site Prioritization Study
Prepared by: Touch of Green Environmental GIS, 2026
Location: Lubbock County, Texas
Scale: County-level renewable energy siting assessment

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1. Purpose of Analysis

This analysis evaluates environmental constraints and relative development suitability for utility-scale solar energy installations across Lubbock County, Texas using raster-based spatial modeling and vector site delineation techniques.

The objective of the study is to identify:

- environmentally suitable land for solar development
- viable solar site parcels meeting practical size thresholds
- strategic regional development opportunity zones

This assessment is intended as a screening-level planning tool to support renewable energy site selection, infrastructure feasibility evaluation, and land-use decision making at the county scale.

This analysis does not replace detailed engineering design, environmental permitting studies, transmission feasibility assessments, or regulatory environmental impact reviews.

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2. Study Area & Data Overview

2.1 Study Area Definition

The study area consists of Lubbock County located in the High Plains region of northwestern Texas.

The county is characterized by:

- predominantly agricultural land use
- relatively flat terrain suitable for large-scale infrastructure
- scattered playa lakes and drainage corridors
- urban development concentrated around the City of Lubbock

All analyses were spatially constrained to the county boundary to ensure results reflect conditions relevant to regional renewable energy planning.

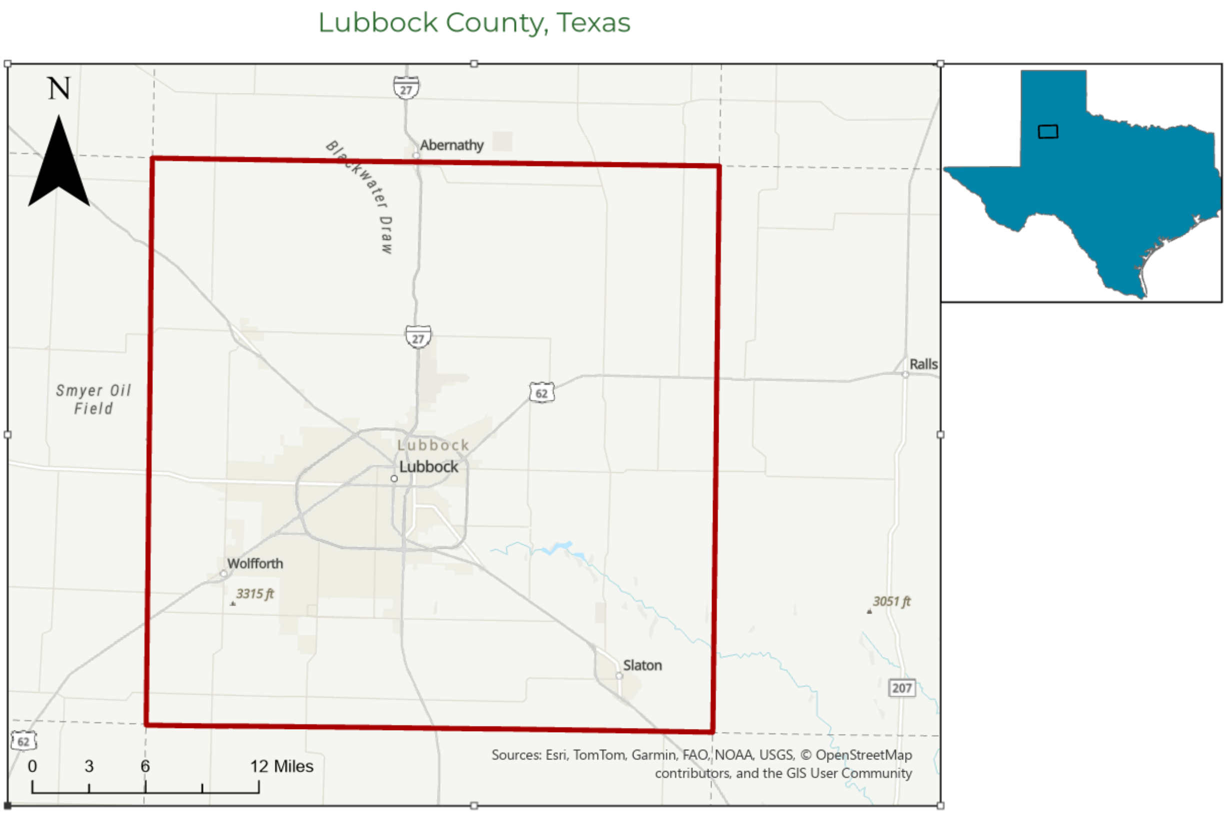

Figure 1. County study area boundary defining the spatial extent for all subsequent screening and modeling workflows.

2.2 Data Sources

Primary datasets used in this analysis include:

- USGS 3DEP Digital Elevation Model
  - used to derive slope and terrain feasibility
- National Hydrography Dataset (NHD)
  - used to model surface-water protection buffers
- FEMA National Flood Hazard Layer
  - used to identify regulatory flood risk zones
- NLCD Land Cover

    - used to evaluate incompatible land uses
- US Census TIGER County Boundary

Derived analytical layers include:

- slope constraint raster
- hydrologic setback zones
- floodplain exclusion zones
- land-cover suitability raster
- final solar suitability model
- developable solar site polygons
- strategic solar opportunity zones

All datasets were projected into a common UTM coordinate system and aligned using consistent raster snapping, extent, and cell size parameters.

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3. Analytical Approach

3.1 Terrain Feasibility Modeling

Slope was derived from the USGS DEM and reclassified to represent construction feasibility thresholds.

Areas with slopes greater than approximately 10 degrees were considered unsuitable due to:

- grading cost
- structural stability concerns
- erosion potential
- access limitations

The resulting terrain constraint raster provided the first environmental screening component.

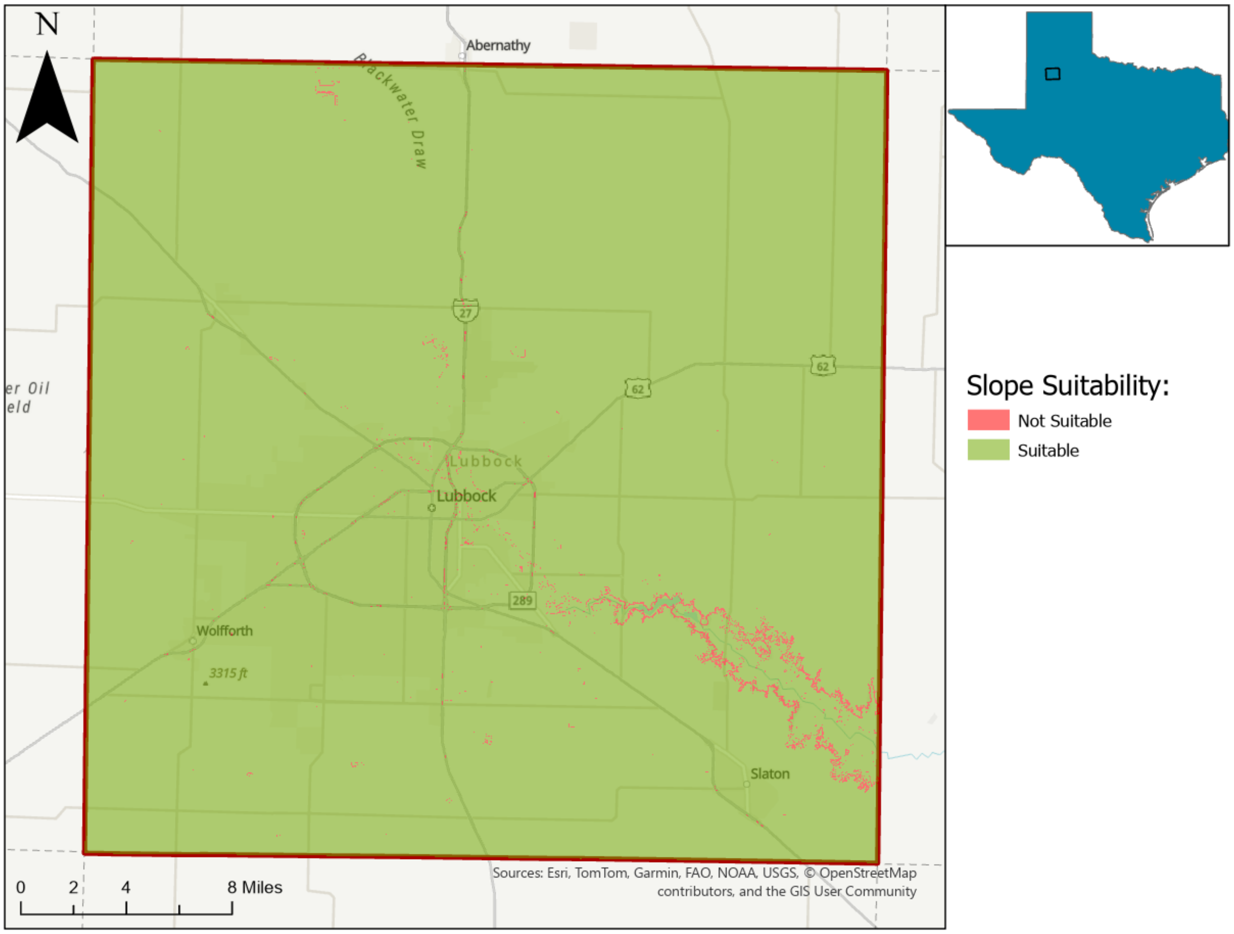

Figure 2. Terrain suitability classification derived from USGS elevation data identifying areas exceeding practical solar construction slope thresholds.

3.2 Hydrologic Protection Constraints

Surface-water protection buffers were created around streams, drainage features, and waterbodies using the National Hydrography Dataset.

A distance of approximately 150 meters was applied to represent:

- environmental protection considerations
- erosion risk mitigation
- typical solar development best practices

Buffered areas were converted to raster format and integrated into the suitability model as exclusion zones.

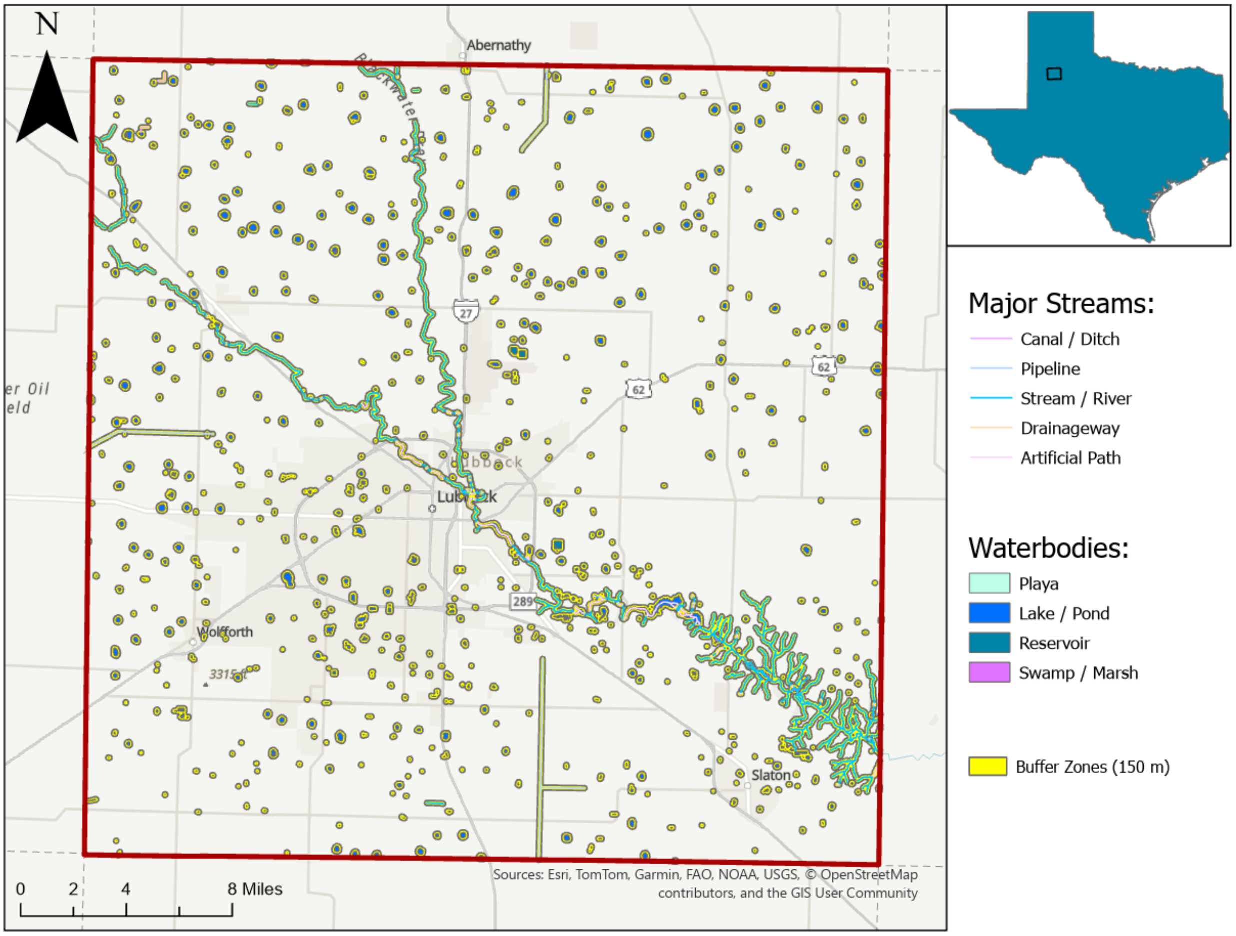

Figure 3. Hydrologic protection buffers applied to streams and waterbodies to represent environmental constraints.

3.3 Flood Risk Exclusion

Regulatory flood hazard zones were extracted from FEMA NFHL data and incorporated into the model as development constraints.

These areas represent increased infrastructure risk and potential regulatory limitations for solar installations.

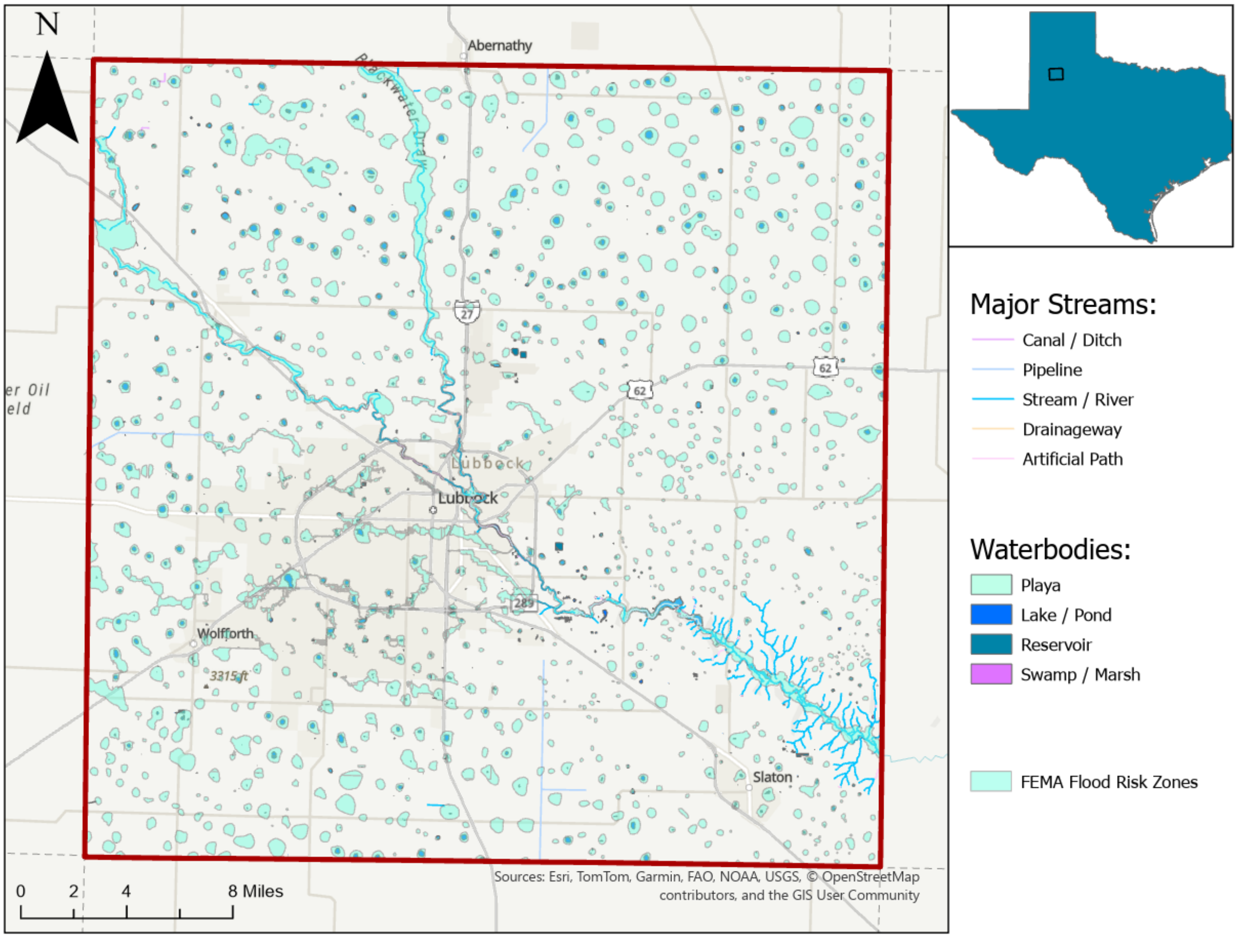

Figure 4. FEMA flood hazard zones incorporated as development constraints within the solar suitability model.

3.4 Land-Cover Compatibility Screening

Land-cover data were reclassified into solar development suitability categories.

Suitable land uses included:

- cultivated cropland
- pasture and grasslands
- barren land

Unsuitable categories included:

- urban development
- forest

- wetlands
- open water

This classification represents general compatibility with utility-scale solar infrastructure.

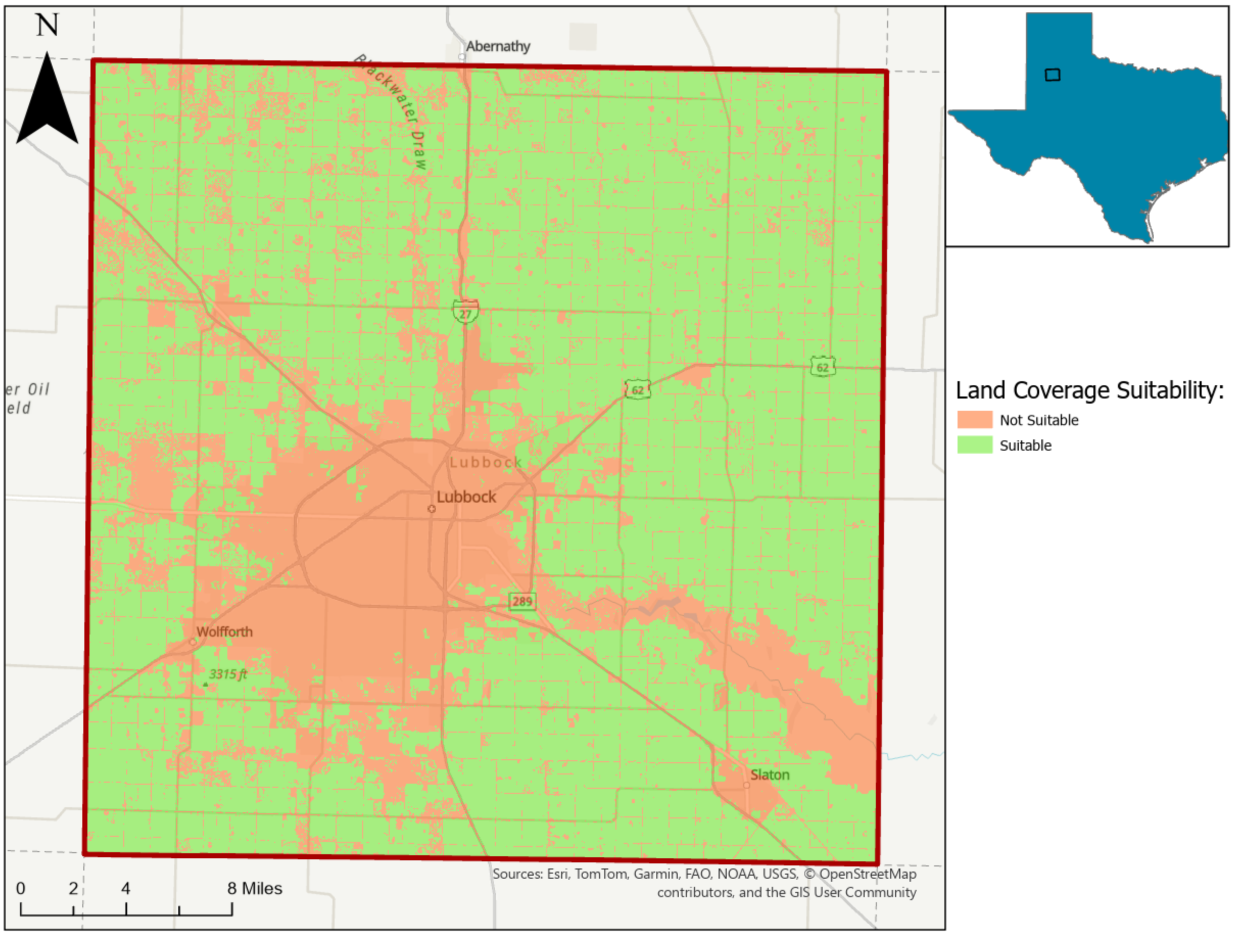

Figure 5. Land-cover-based suitability classification identifying compatible and incompatible development land uses.

3.5 Integrated Solar Suitability Model

All constraint layers were combined using Boolean raster multiplication to generate a final solar suitability surface.

Locations were considered suitable only where:

- terrain feasibility was acceptable
- hydrologic setbacks were avoided
- flood risk was absent

- land cover was compatible

This produced a county-wide screening model identifying environmentally suitable development areas.

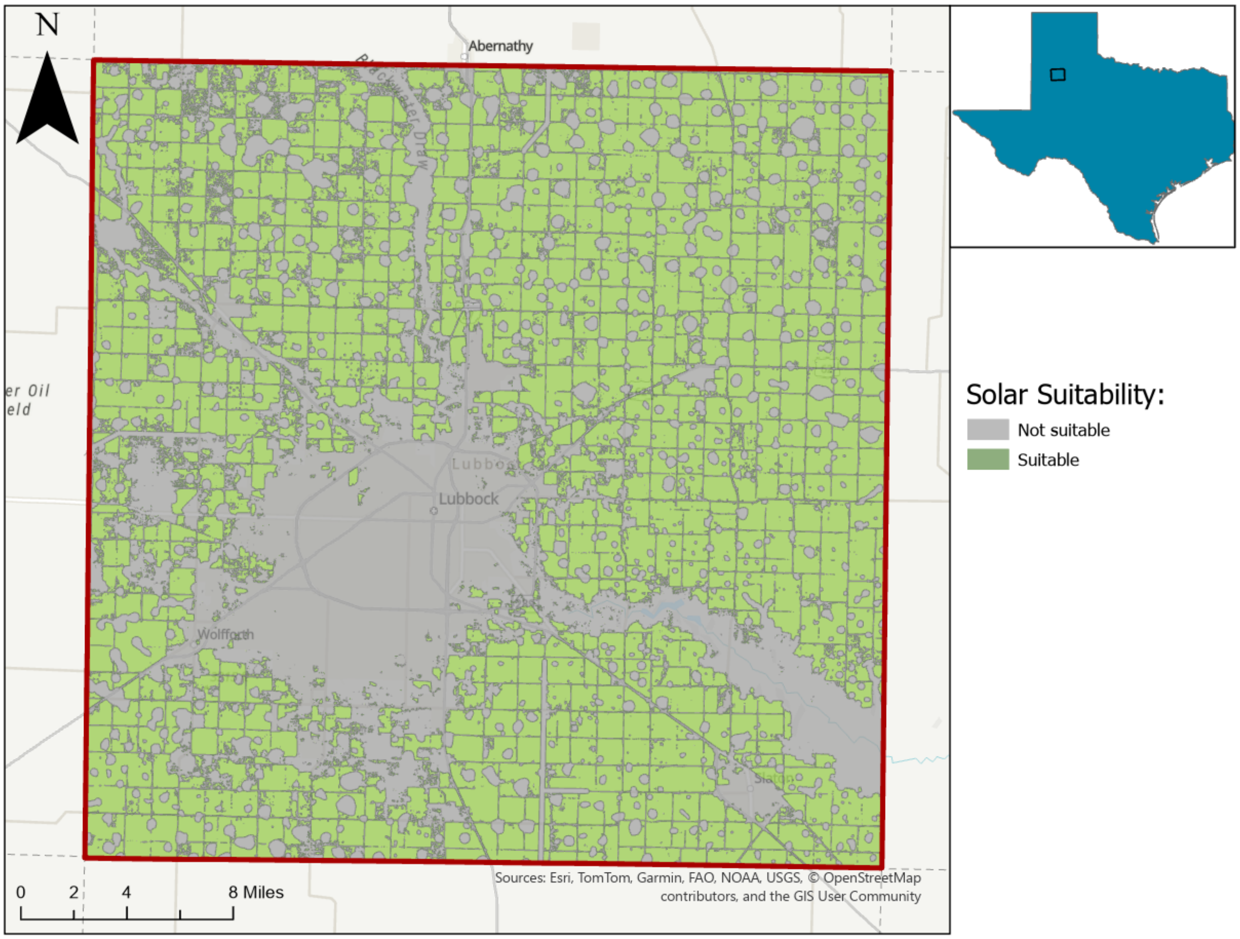

Figure 6. Integrated solar suitability model combining terrain, hydrology, flood risk, and land-cover constraints.

3.6 Developable Solar Site Delineation

Suitability raster output was converted to polygons and filtered using a minimum practical development threshold of approximately 50 acres.

This step reduced fragmented candidate patches and produced realistic site parcels suitable for utility-scale solar development.

Results indicated:

- approximately 560 viable candidate sites

- total suitable area ≈ 351,310 acres
- average site size ≈ 627 acres
- largest individual site exceeding 5,400 acres

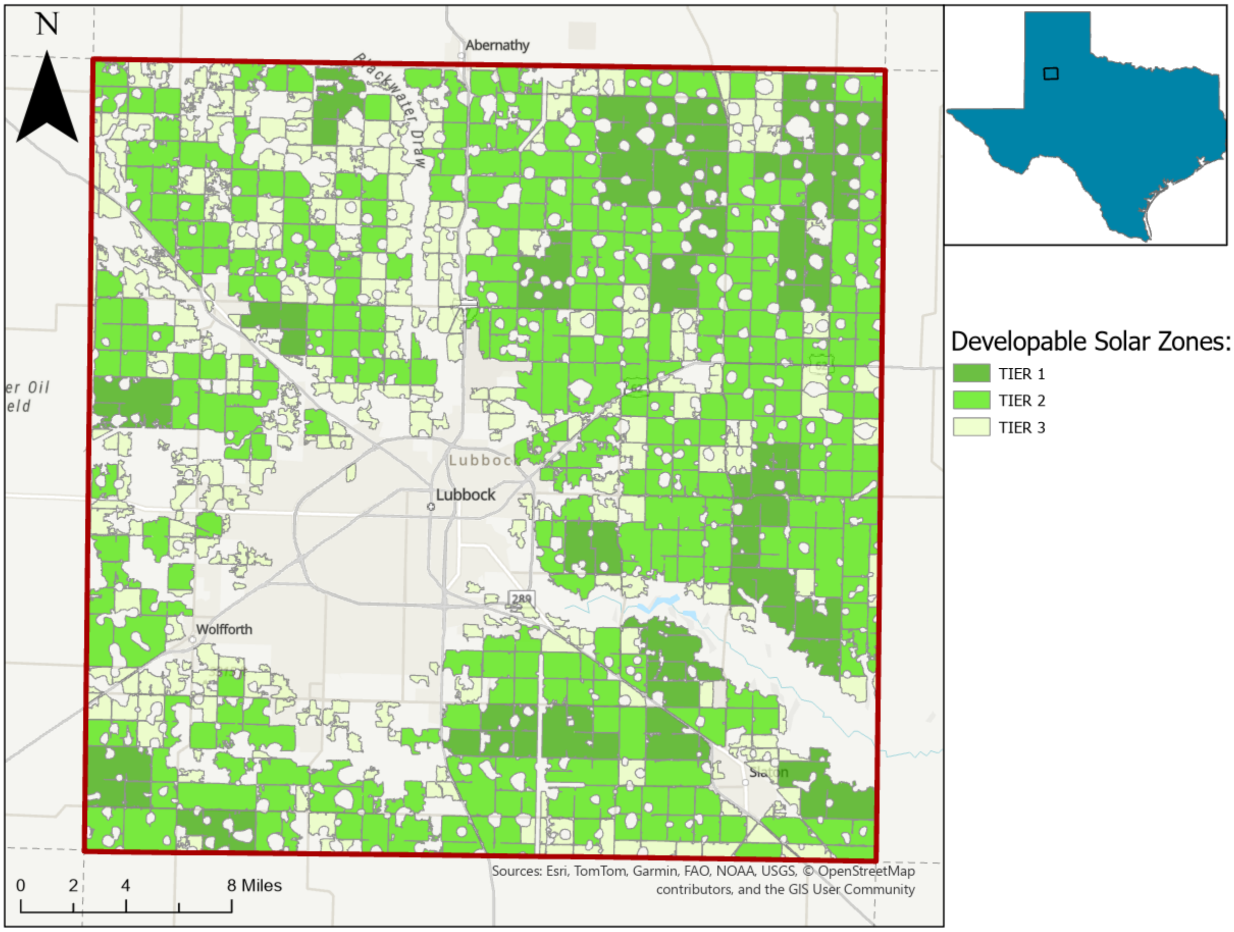

Figure 7. Final developable solar site polygons after applying practical minimum development size thresholds.

3.7 Strategic Solar Opportunity Zoning

Tier-1 candidate sites (≥ 2,000 acres) were aggregated using spatial clustering techniques to identify regional solar development opportunity zones.

This step reflects realistic infrastructure planning considerations and highlights areas capable of supporting large-scale renewable energy investment.

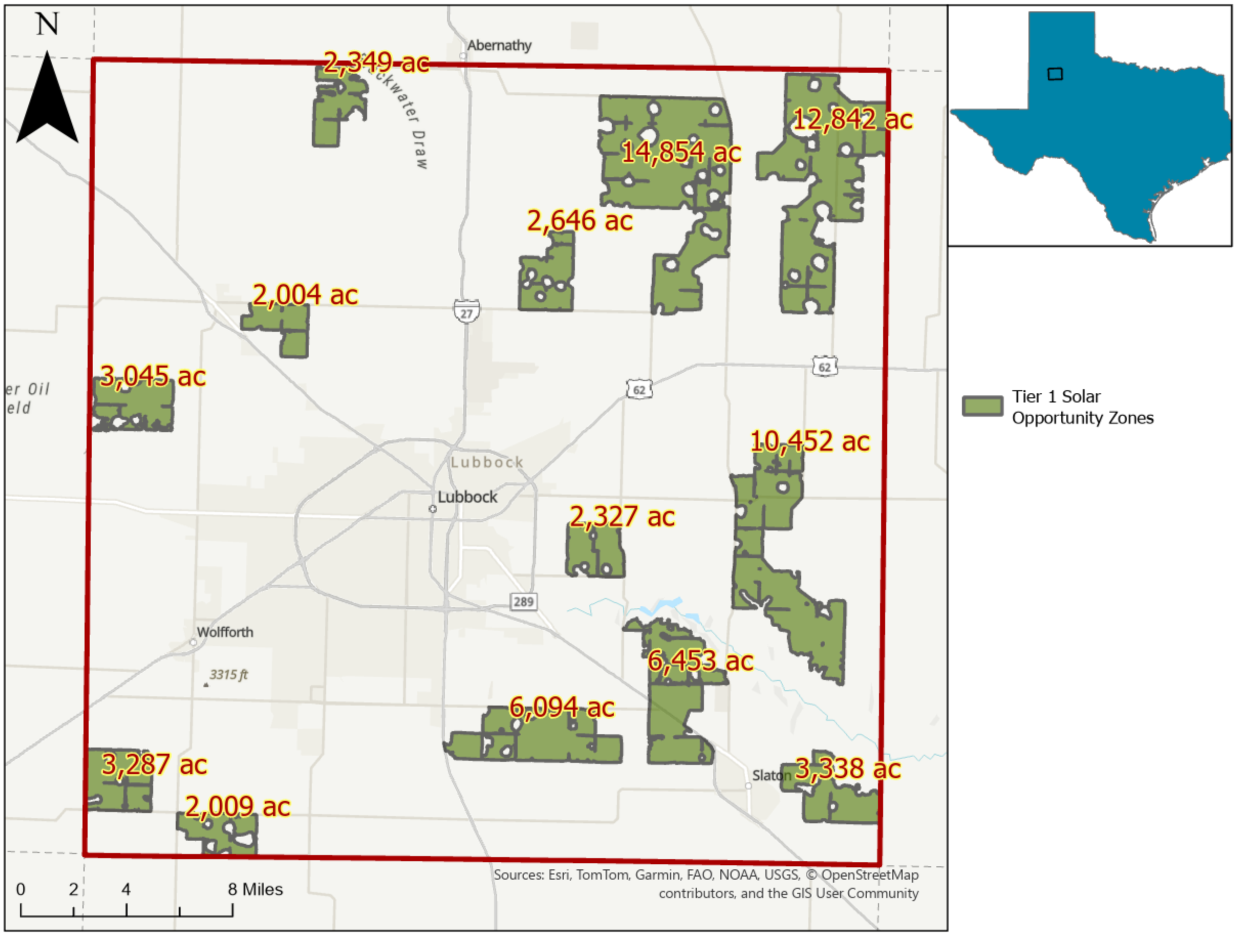

Figure 8. Strategic solar development opportunity regions derived from aggregation of high-priority candidate sites.

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4. Integrated Interpretation

The analysis reveals several spatial patterns:

- environmentally suitable solar development land is widespread across agricultural plains
- constraints are concentrated near drainage systems, flood corridors, and urbanized areas
- large contiguous development regions occur primarily in rural agricultural zones
- high-priority solar opportunity zones are spatially clustered rather than evenly distributed

These patterns suggest strong regional potential for renewable energy expansion while highlighting key environmental sensitivities.

5. Summary of Findings

- Approximately 351,310 acres of environmentally suitable land were identified
- 560 viable solar candidate sites met practical development thresholds
- 24 high-priority Tier-1 sites were delineated
- Aggregation analysis identified multiple strategic solar development regions
- Terrain limitations were minimal due to flat High Plains topography

At a screening level, Lubbock County demonstrates substantial potential for utility-scale solar development.

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6. Limitations & Data Resolution Considerations

6.1 Raster Resolution

All raster analyses were conducted using ~10-meter DEM data and ~30-meter land-cover data.

As a result:

- parcel-level microtopography is not resolved
- small infrastructure features are not represented
- suitability patterns should be interpreted comparatively

6.2 Development Feasibility Factors Not Modeled

This study does not evaluate:

- transmission infrastructure proximity
- substation capacity
- land ownership patterns
- soil geotechnical conditions
- local zoning regulations

6.3 Intended Use

Results are intended for planning and site screening purposes.
They are not a substitute for engineering feasibility studies or environmental permitting analyses.

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7. Conclusion

This regional environmental constraints analysis demonstrates that Lubbock County possesses **significant** spatial potential for utility-scale solar development.