CSSA Wood Products Campus
Siting and Financial Risk Analysis

Prepared by:
Wildephor Consulting Services, LLC

25 August 2025

Wildephor Consulting

- Founded in 2015 specifically to assist clients with all phases of community-scale biomass utilization project development
- Combines engineering, project management, and public policy expertise to produce integrative, sustainable solutions
- Pursues collaborative approaches utilizing local knowledge to inform and enhance triple bottom line analyses
- Wildephor literally translates to “what nature can sustain”

Topics

1. Siting & Supply Optimization
2. Feedstock Storage Model
3. Financial Sensitivity Analysis
4. Summary of Findings
5. Proposed Applications

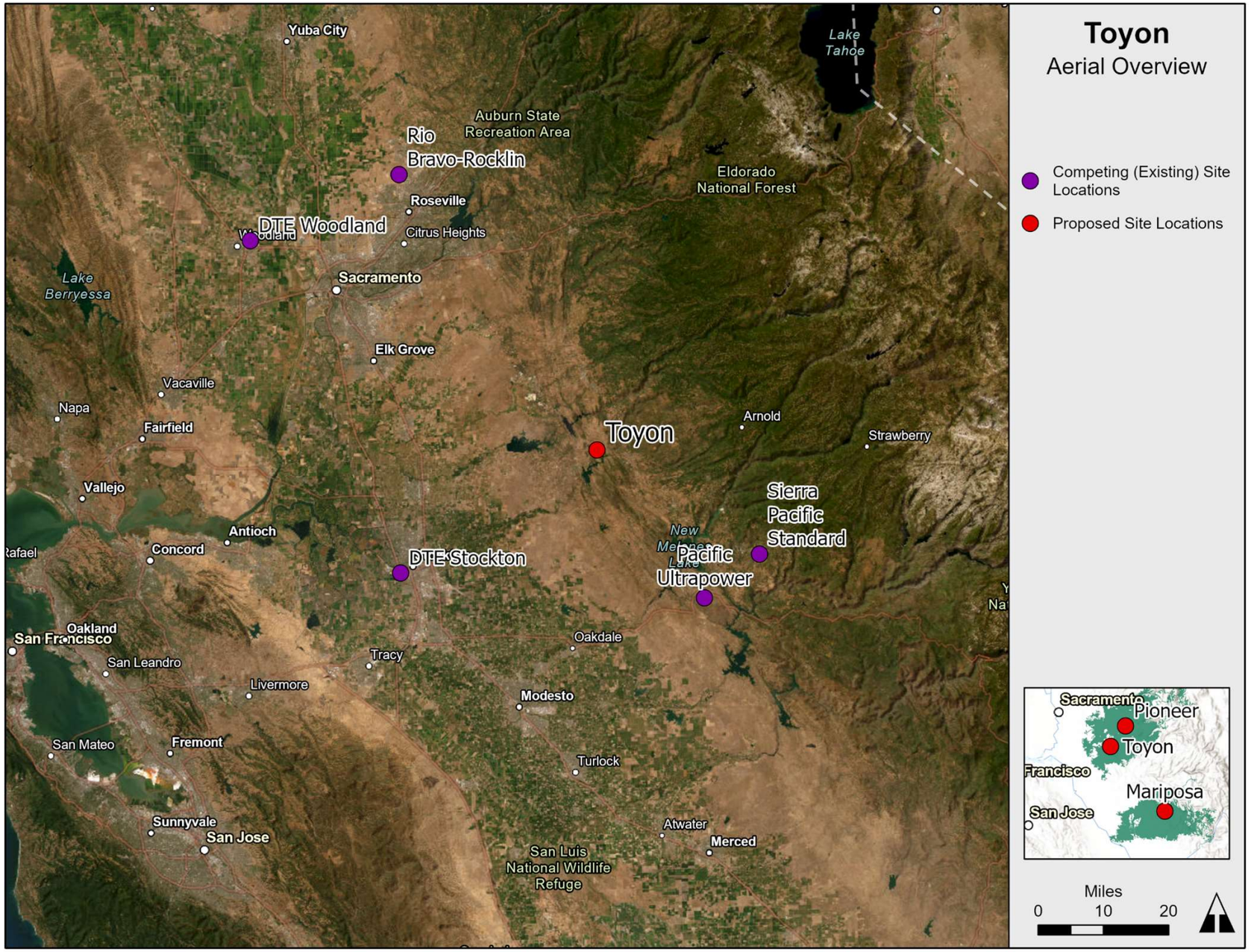
1. Siting & Supply Optimization

- Joint effort with Tukman Geospatial LLC
  - C-BREC forest residues (Schatz Energy Research Center)
  - Orchard removals (CA Statewide Crop Mapping)
- Mapping of economically feasible feedstocks
  - Two-hour maximum trucking drive time
  - No closer existing biomass utilization sites

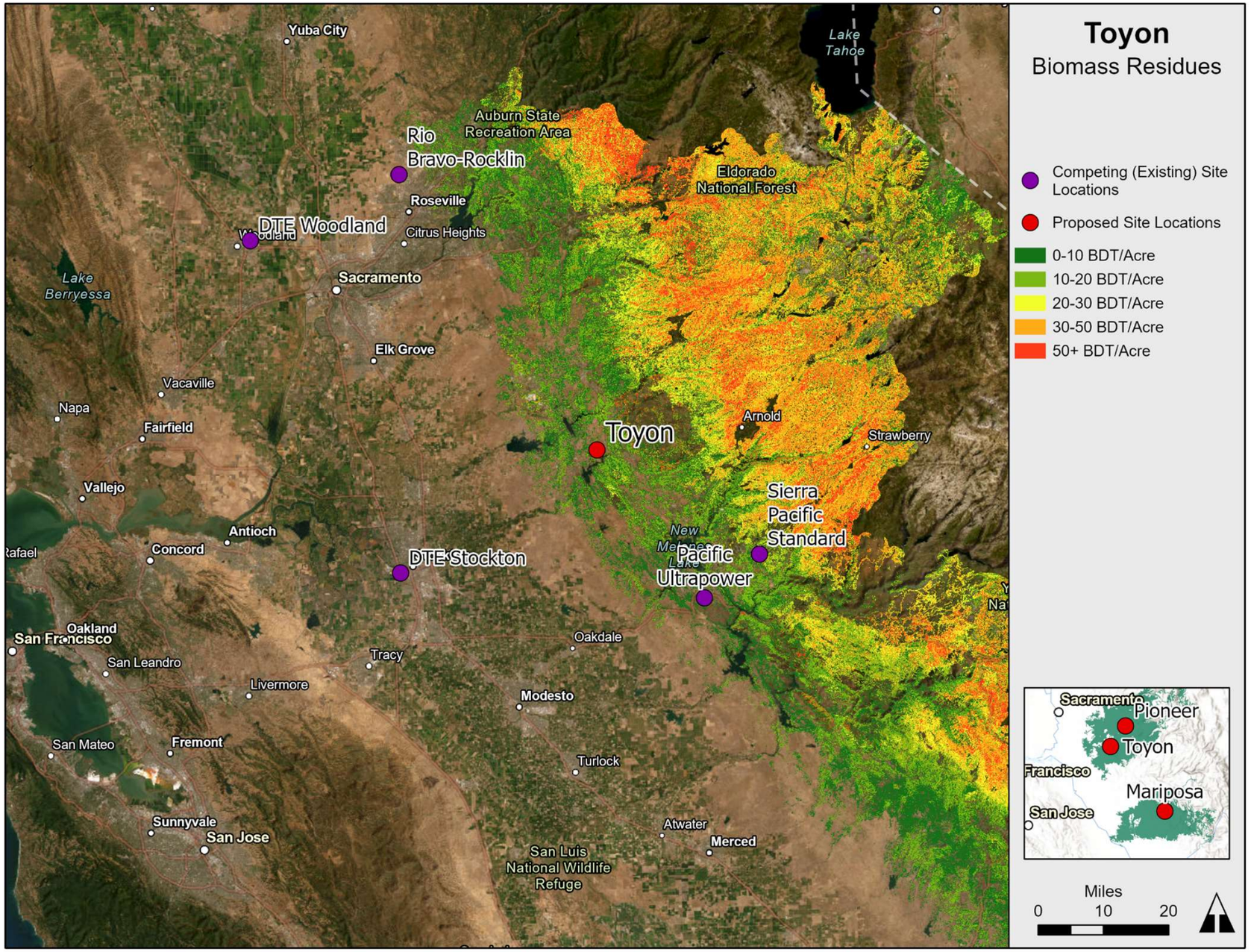
Competition for Feedstock Supply

	Candidate Campus Sites	City	County	BDT/Year	Output	
1	Toyon Industrial	Valley Springs	Calaveras	-	-	-
2	P&M Cedar Sawmill *(former)*	Pioneer	Amador	-	-	-
3	Mariposa Biomass	Mariposa	Mariposa	30,000	3	MWe
	Existing Utilization Sites			**1,069,000**	**148**	**MWe**
1	Pacific Ultrapower	Jamestown	Tuolumne	175,000	22	MWe
2	Sierra Pacific Standard	Sonora	Tuolumne	65,000	8	MWe
3	Rio Bravo-Fresno	Fresno	Fresno	192,000	24	MWe
4	Rio Bravo-Rocklin	Lincoln	Placer	192,000	24	MWe
5	DTE Stockton	Stockton	San Joaquin	360,000	45	MWe
6	DTE Woodland	Woodland	Yolo	85,000	25	MWe

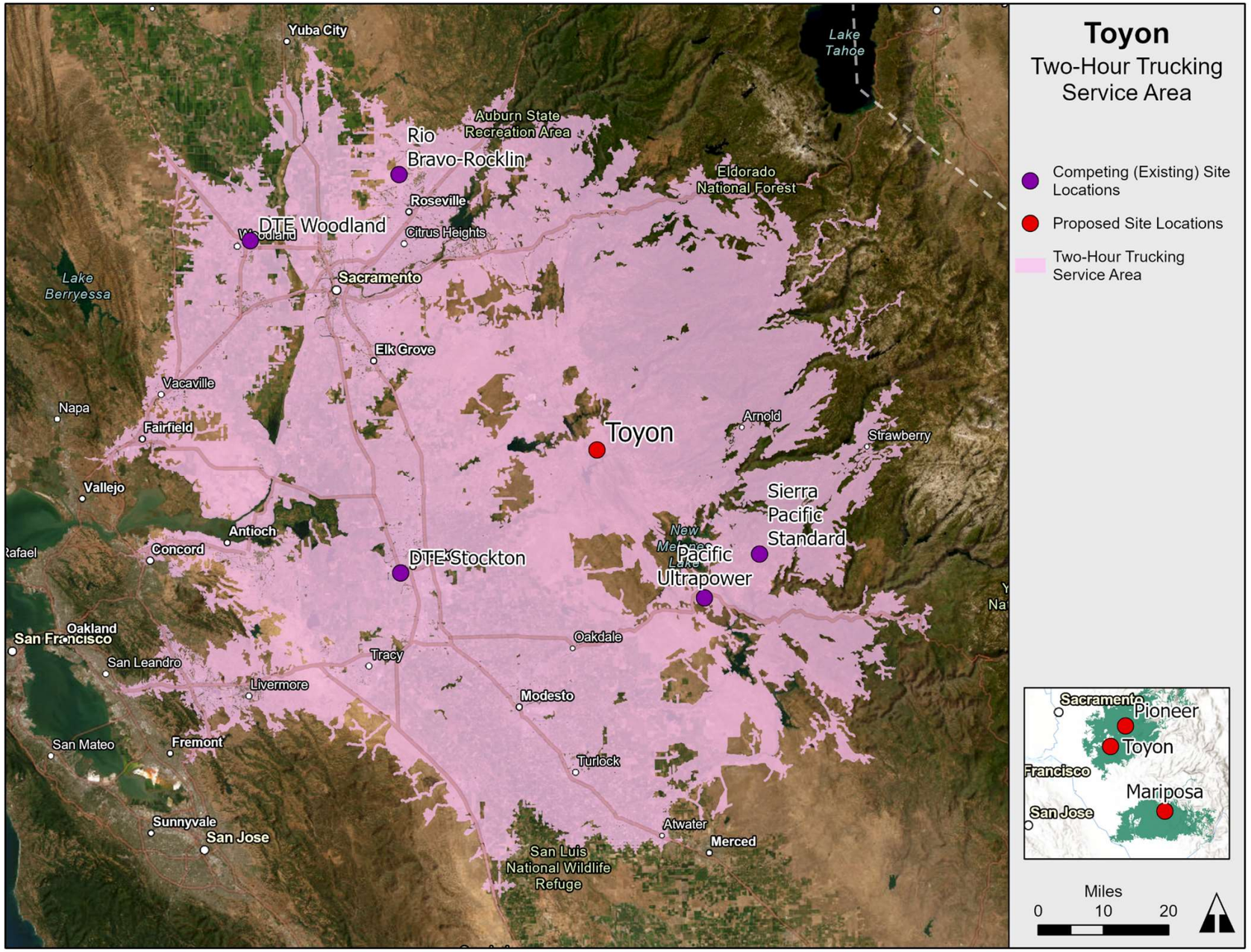
Sites Within Central Sierra Study Area

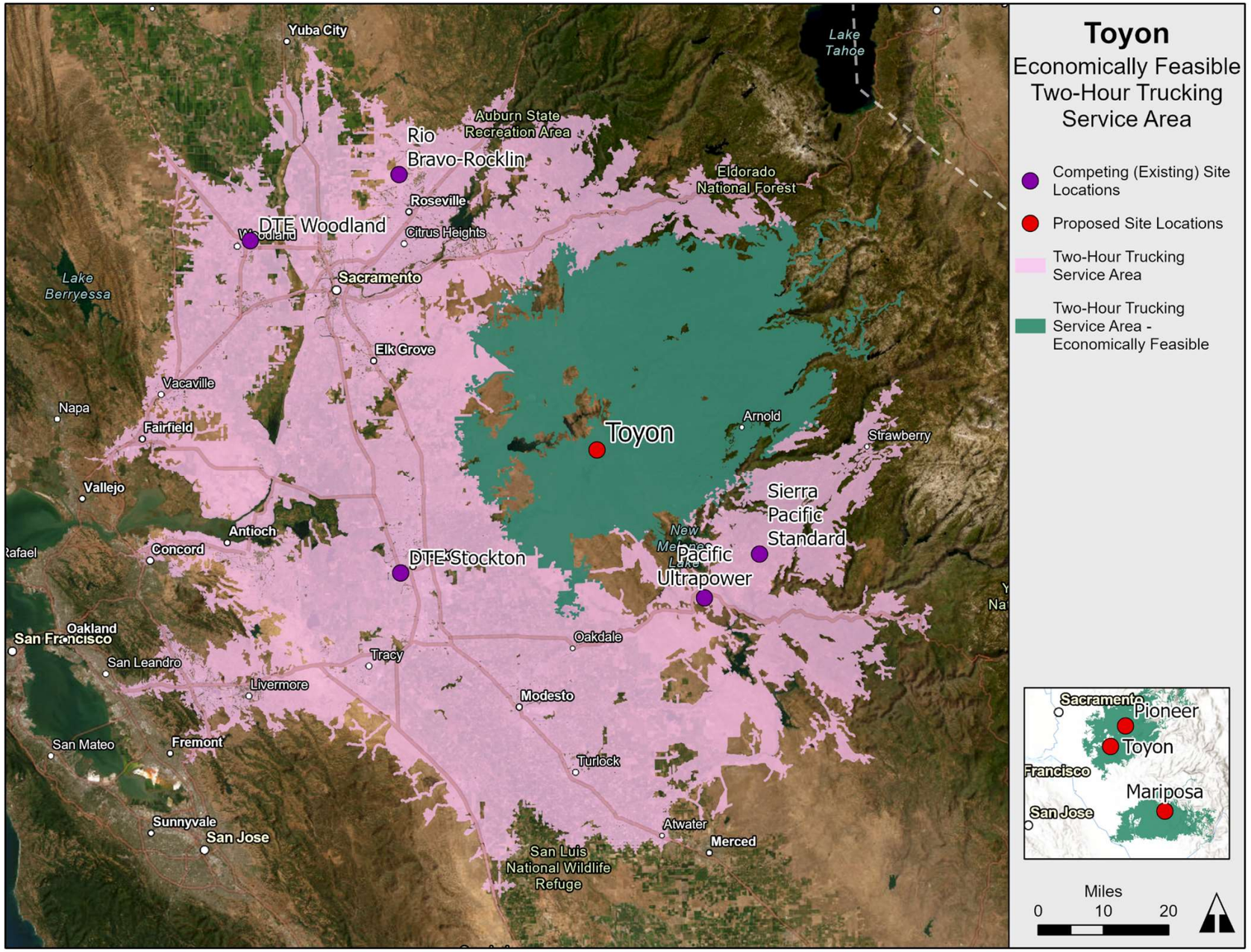


Date Exported: 1/31/2025

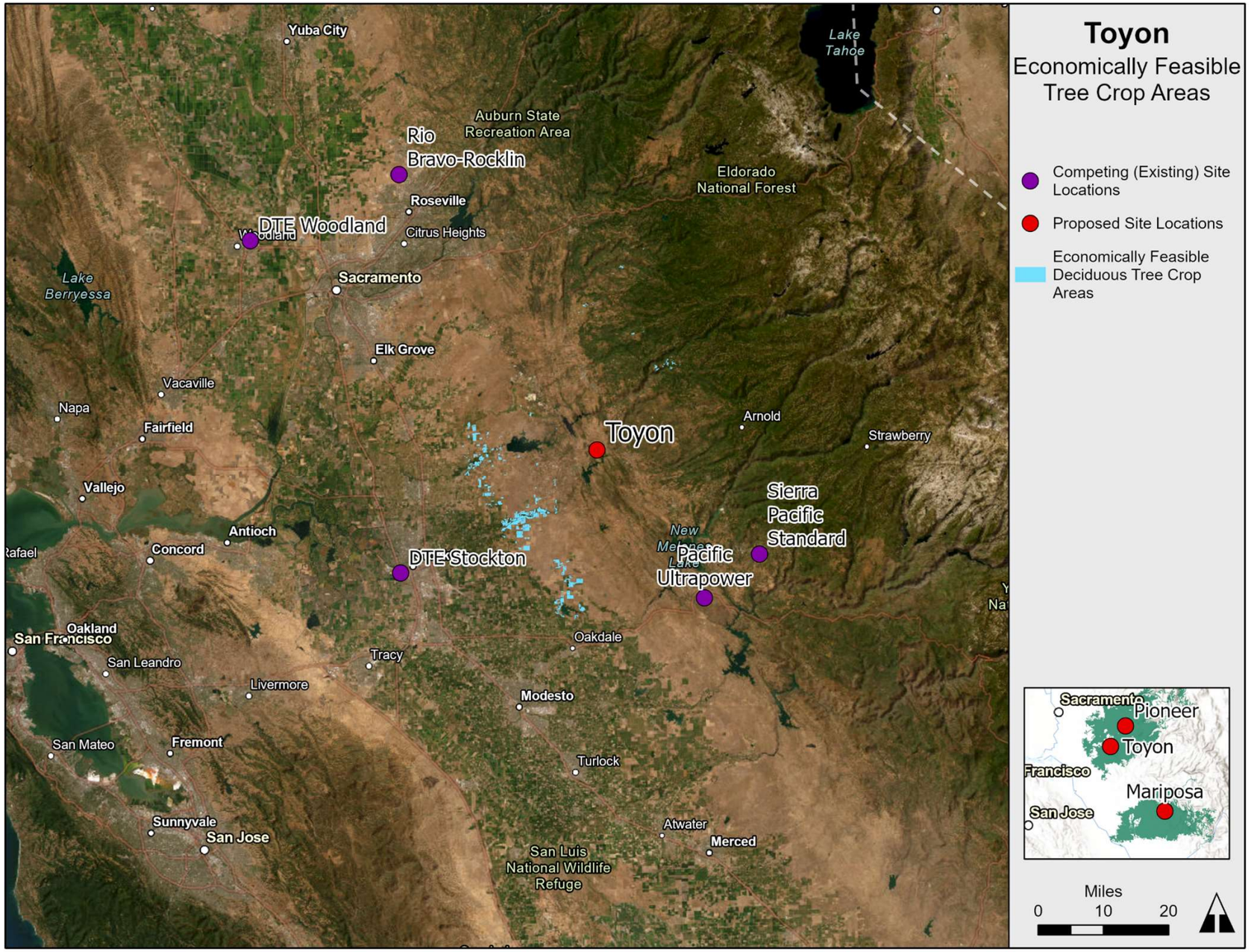


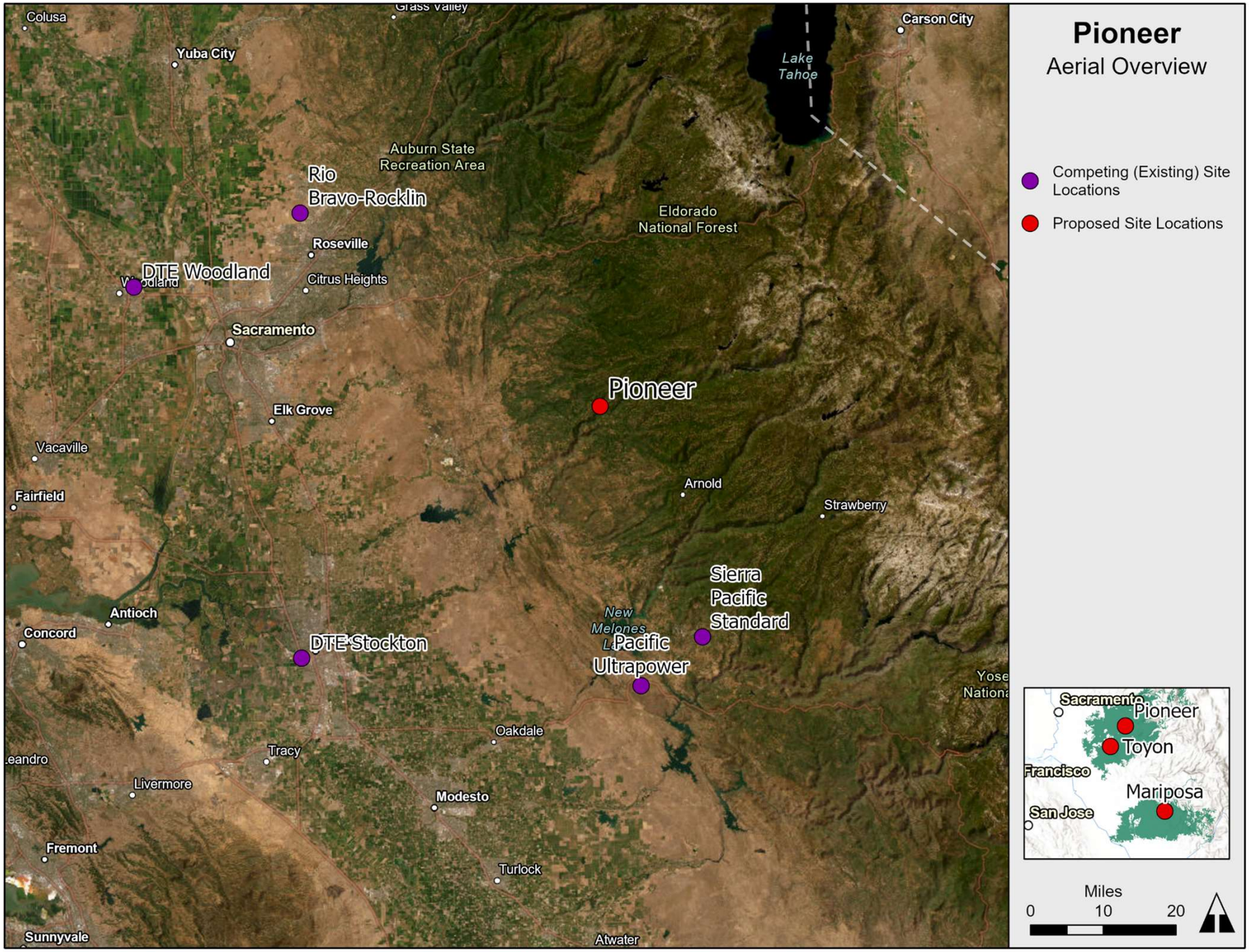
Date Exported: 1/31/2025

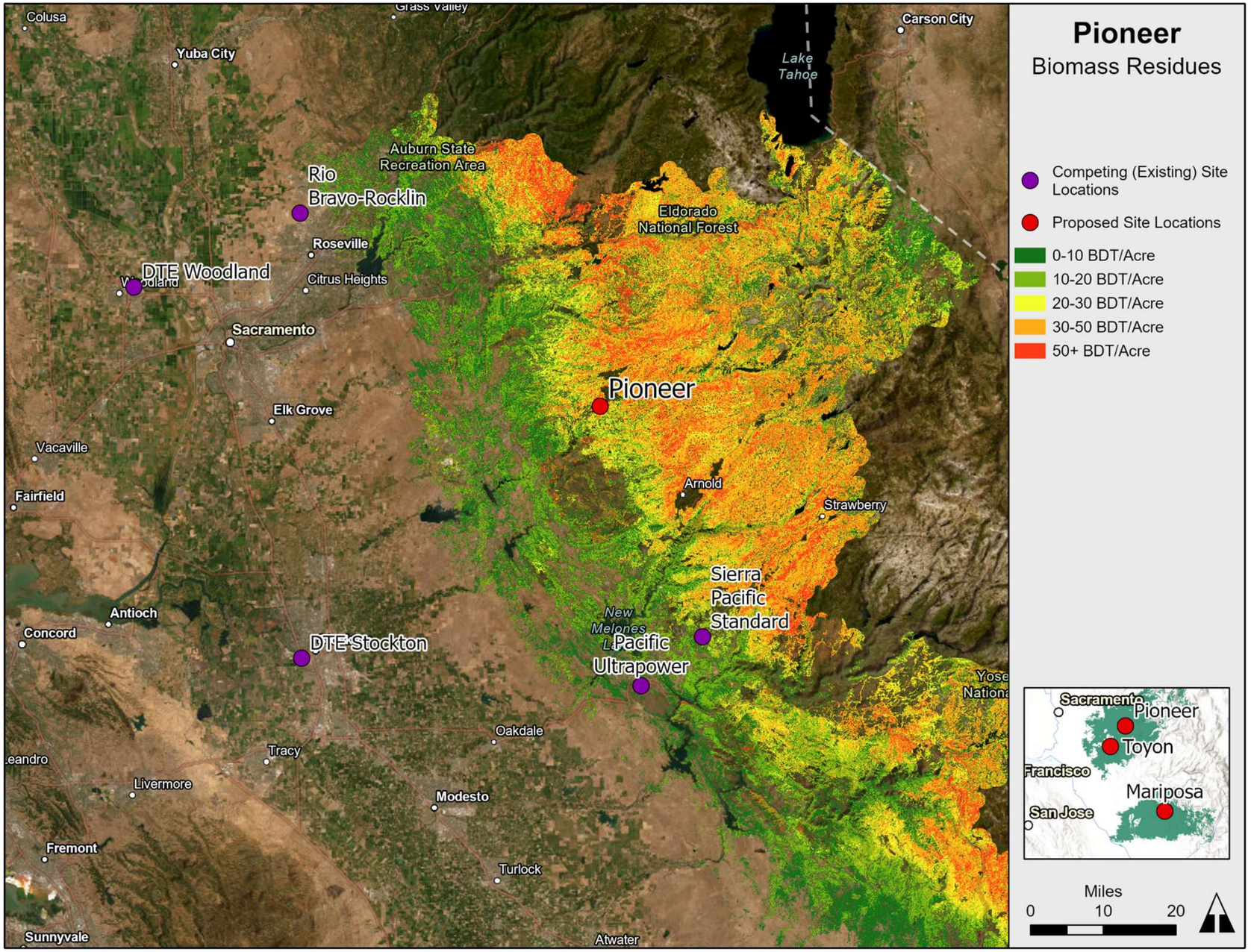

Toyon
Two-Hour Trucking Service Area
Competing (Existing) Site Locations
Proposed Site Locations
Two-Hour Trucking Service Area
Yuba City
Lake Tahoe
Auburn State Recreation Area
Rio Bravo-Rocklin
Eldorado National Forest
Roseville
DTE Woodland
Citrus Heights
Sacramento
Lake Berryessa
Elk Grove
Vacaville
Napa
Fairfield
Toyon
Arnold
Strawberry
Vallejo
Sierra Pacific
Standard
Antioch
Concord
DTE Stockton
Pacific Ultrapower
Oakland
San Francisco
Oakdale
Tracy
San Leandro
Livermore
Modesto
San Mateo
Fremont
Turlock
Sunnyvale
San Jose
Atwater
Merced
San Luis National Wildlife Refuge
Sacramento
Pioneer
Toyon
Mariposa
San Jose
Miles
0
10
20
Date Exported: 1/31/2025

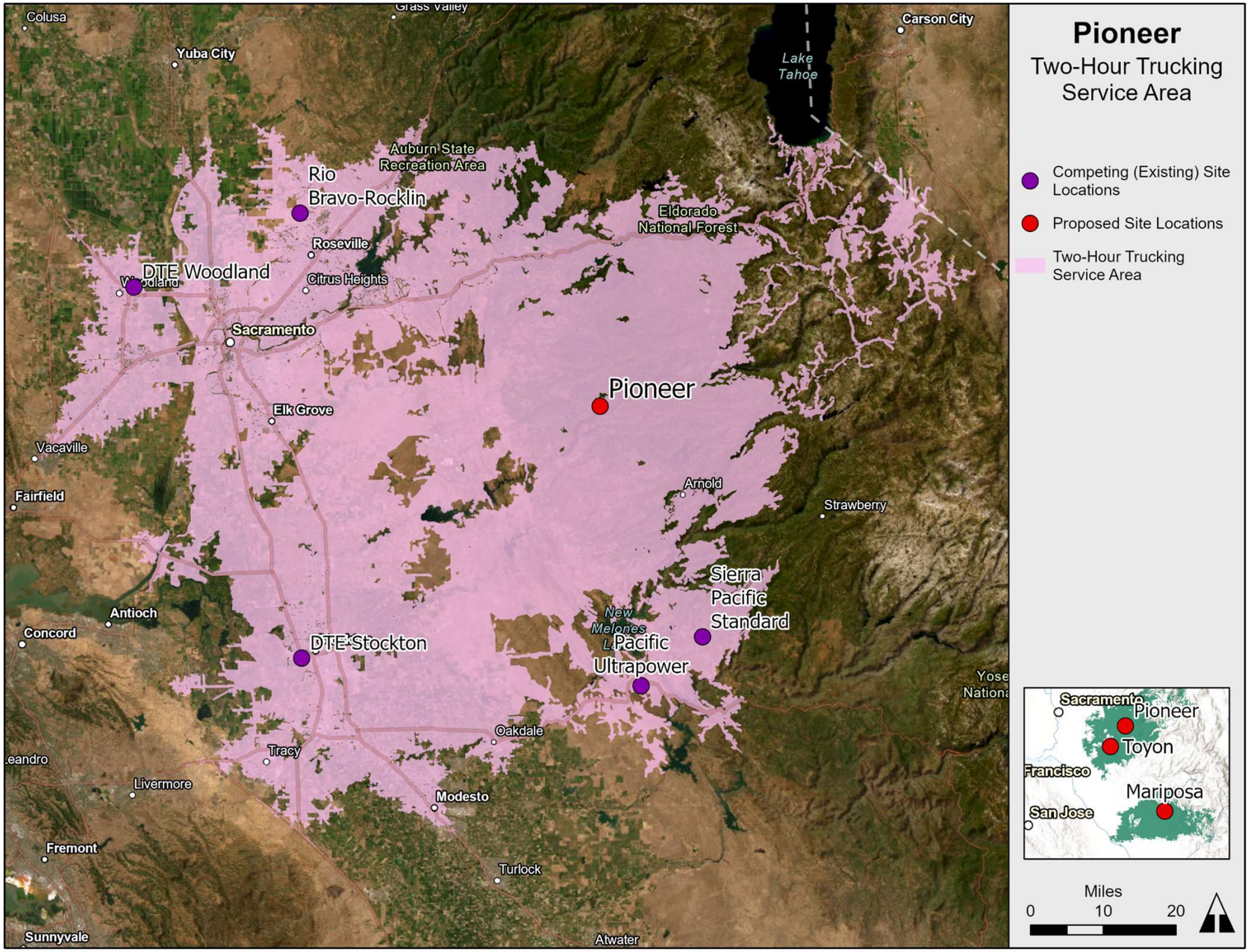


Date Exported: 1/31/2025

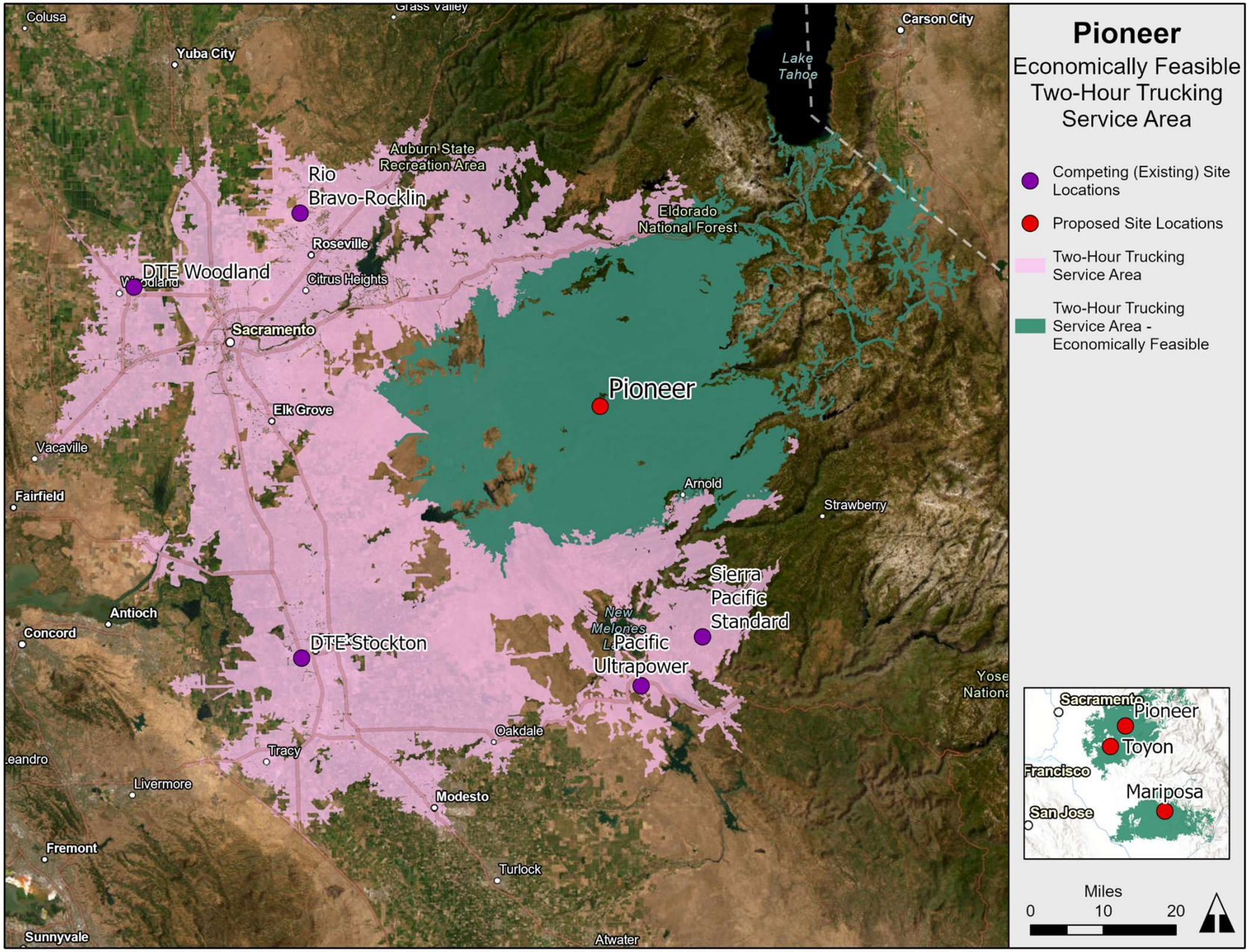

Toyon
Economically Feasible Tree Crop Areas
Competing (Existing) Site Locations
Proposed Site Locations
Economically Feasible Deciduous Tree Crop Areas
Yuba City
Lake Tahoe
Auburn State Recreation Area
Rio Bravo-Rocklin
Eldorado National Forest
Roseville
DTE Woodland
Citrus Heights
Lake Berryessa
Sacramento
Elk Grove
Vacaville
Napa
Fairfield
Arnold
Strawberry
Toyon
Vallejo
Sierra Pacific Standard
Antioch
Concord
DTE Stockton
Pacific Ultrapower
Oakland
San Francisco
Oakdale
Tracy
San Leandro
Livermore
Modesto
San Mateo
Fremont
Turlock
Sunnyvale
San Jose
Atwater
Merced
San Luis National Wildlife Refuge
Sacramento
Pioneer
Toyon
Mariposa
San Jose
Miles
0
10
20
Date Exported: 1/31/2025

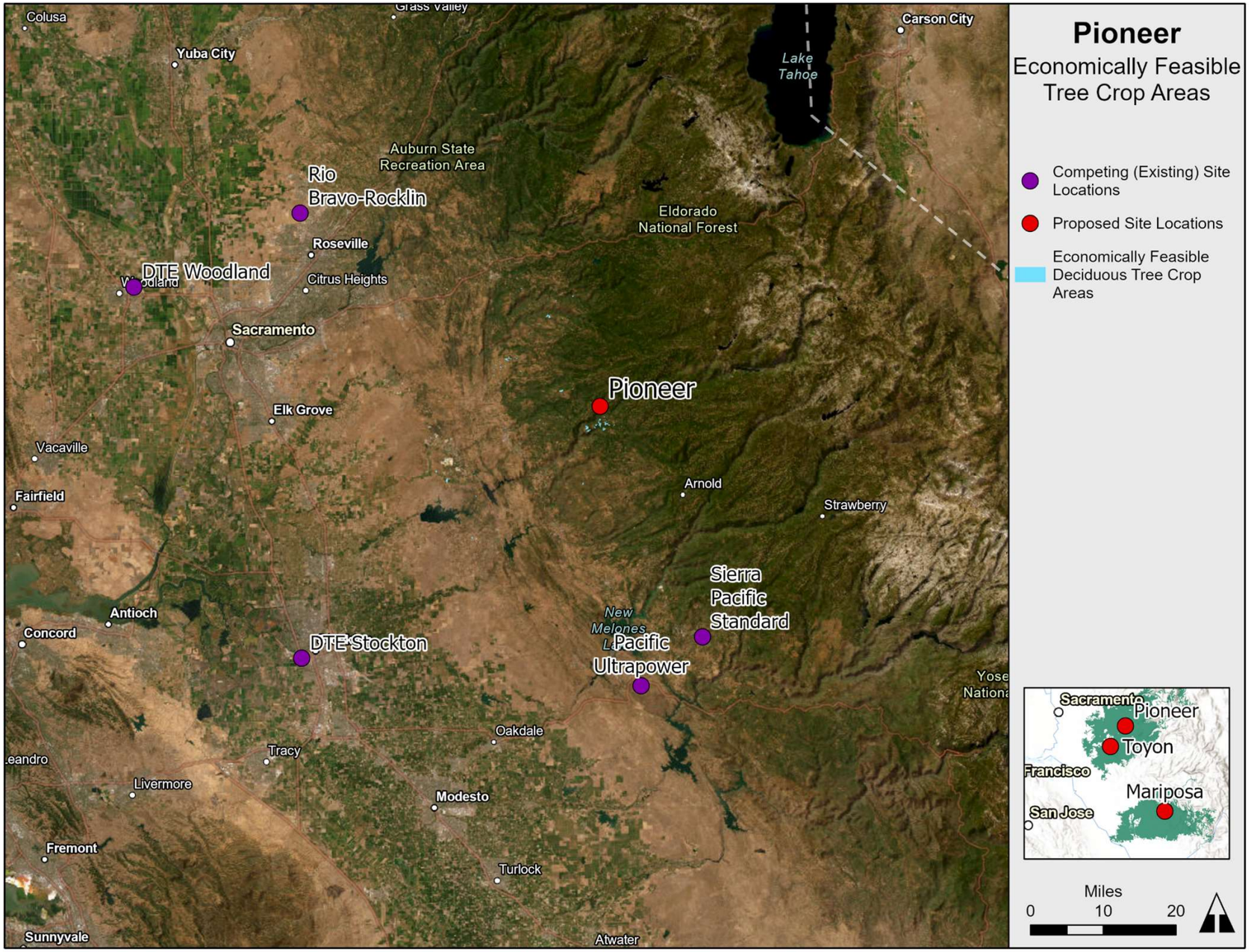

Pioneer
Aerial Overview
Competing (Existing) Site Locations
Proposed Site Locations
Colusa
Yuba City
Grass Valley
Carson City
Lake Tahoe
Auburn State Recreation Area
Rio Bravo-Rocklin
Eldorado National Forest
Roseville
DTE Woodland
Citrus Heights
Sacramento
Pioneer
Elk Grove
Vacaville
Fairfield
Arnold
Strawberry
Sierra Pacific Standard
Antioch
Concord
DTE Stockton
New Melones Lake
Pacific Ultrapower
Oakdale
Tracy
Livermore
Modesto
Fremont
Turlock
Sunnyvale
Atwater
San Francisco
San Jose
Toyon
Mariposa
Miles
0
10
20
Date Exported: 1/31/2025

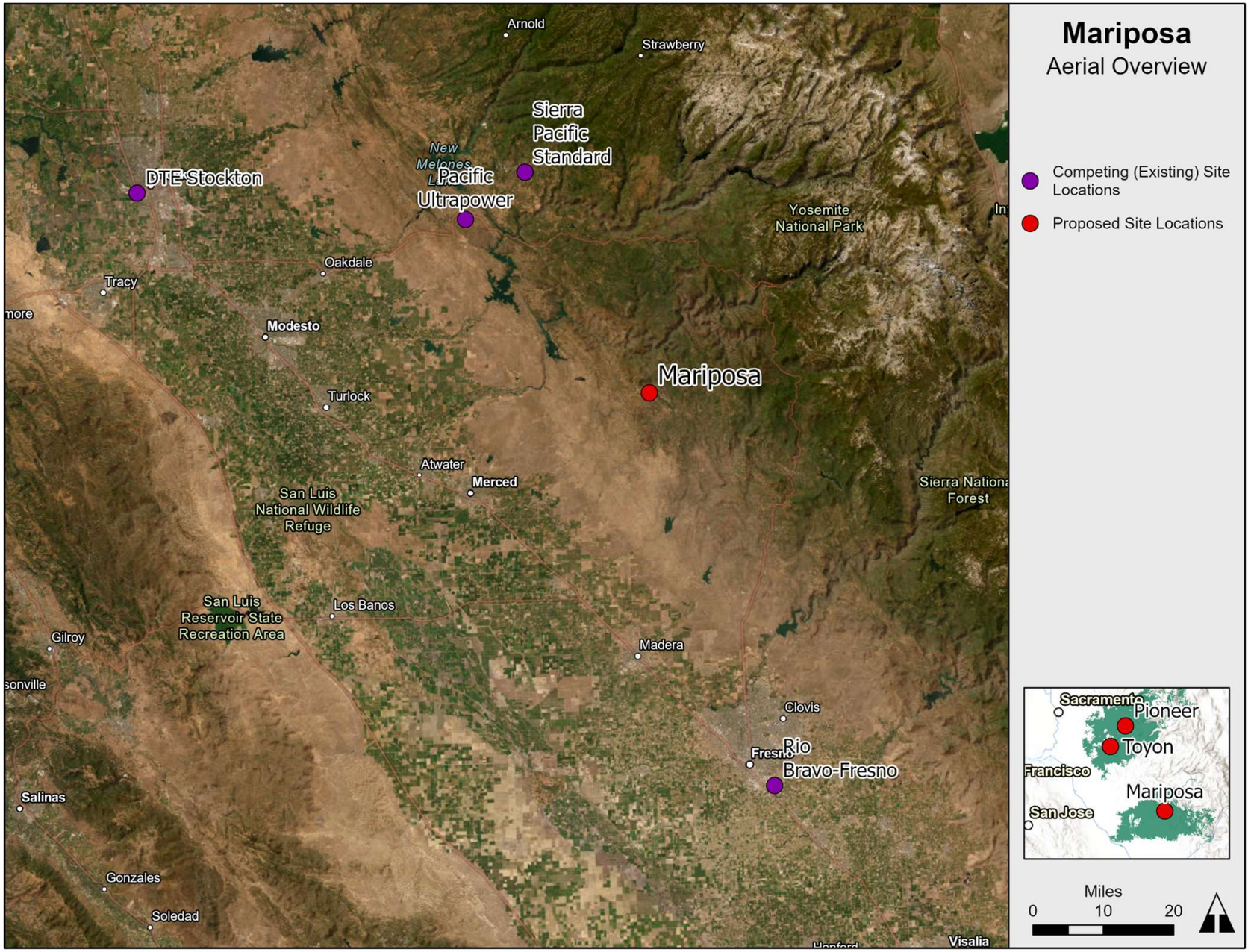

Pioneer
Biomass Residues
Competing (Existing) Site Locations
Proposed Site Locations
0-10 BDT/Acre
10-20 BDT/Acre
20-30 BDT/Acre
30-50 BDT/Acre
50+ BDT/Acre
Colusa
Yuba City
Grass Valley
Carson City
Lake Tahoe
Auburn State Recreation Area
Rio Bravo-Rocklin
Eldorado National Forest
Roseville
DTE Woodland
Citrus Heights
Sacramento
Pioneer
Elk Grove
Vacaville
Fairfield
Arnold
Strawberry
Sierra Pacific Standard
Antioch
Concord
DTE Stockton
New Melones Lake
Pacific Ultrapower
Oakdale
Tracy
Livermore
Modesto
Fremont
Turlock
Sunnyvale
Atwater
Sacramento
Pioneer
Toyon
Mariposa
San Jose
Miles
0
10
20
Date Exported: 1/31/2025

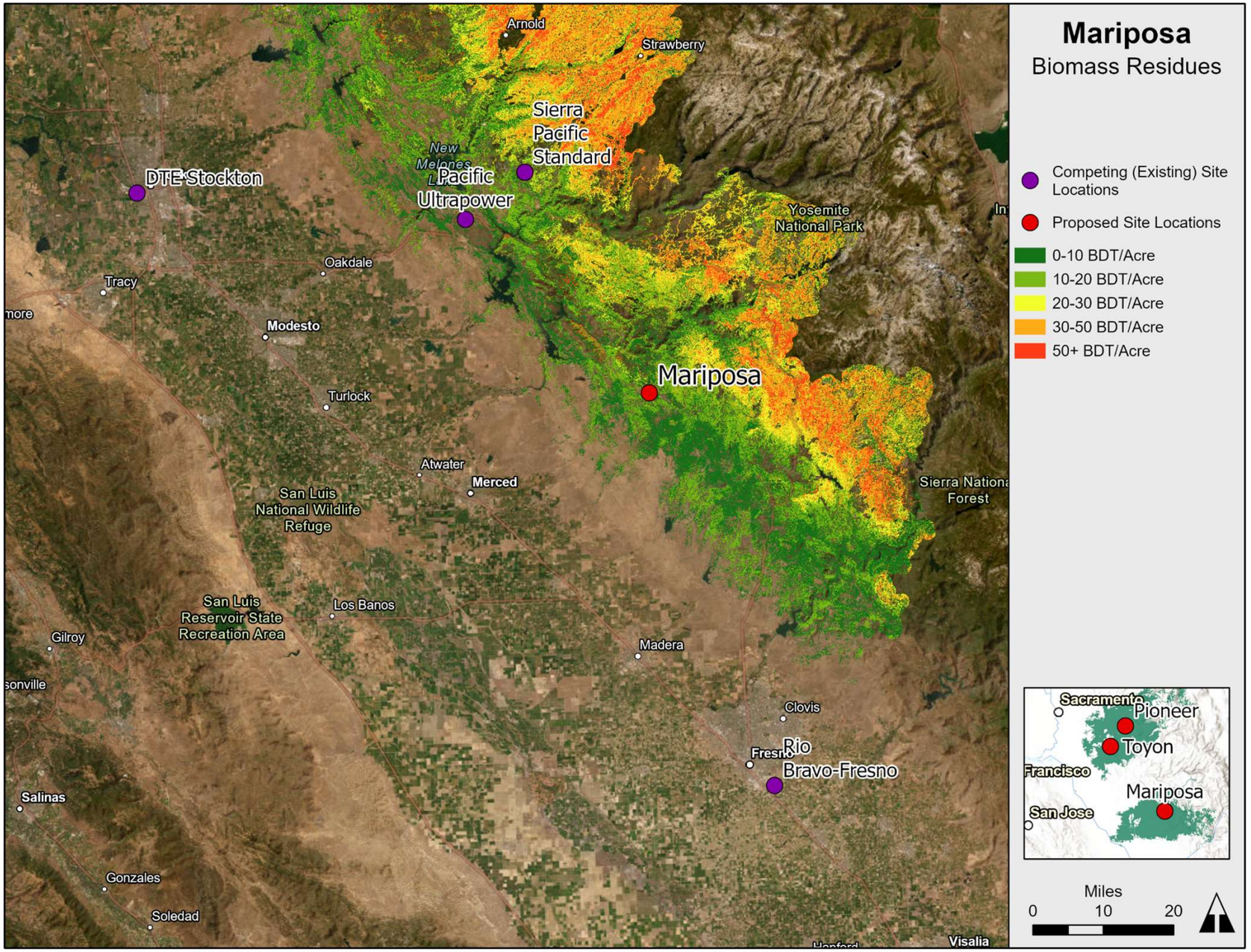


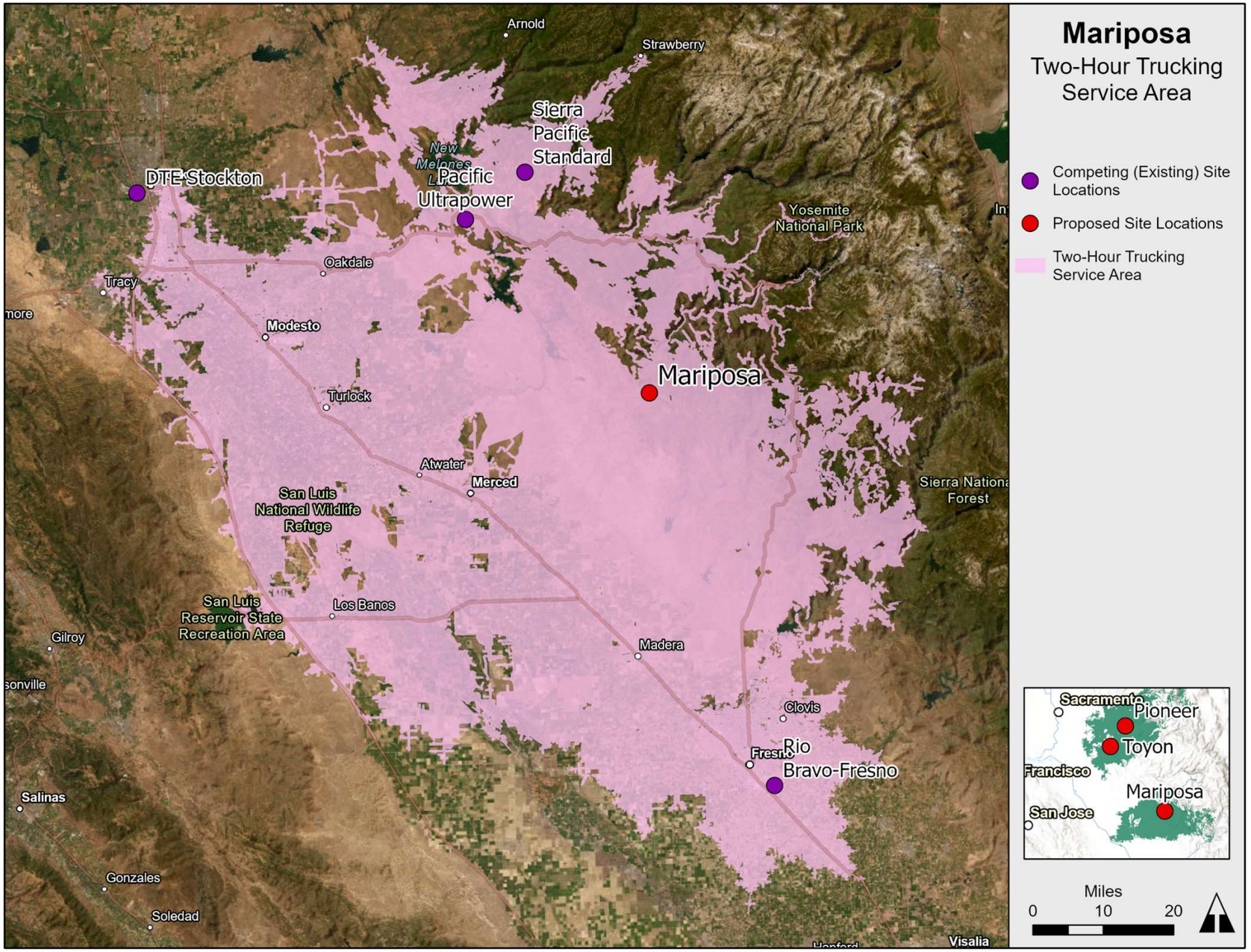
Date Exported: 1/31/2025

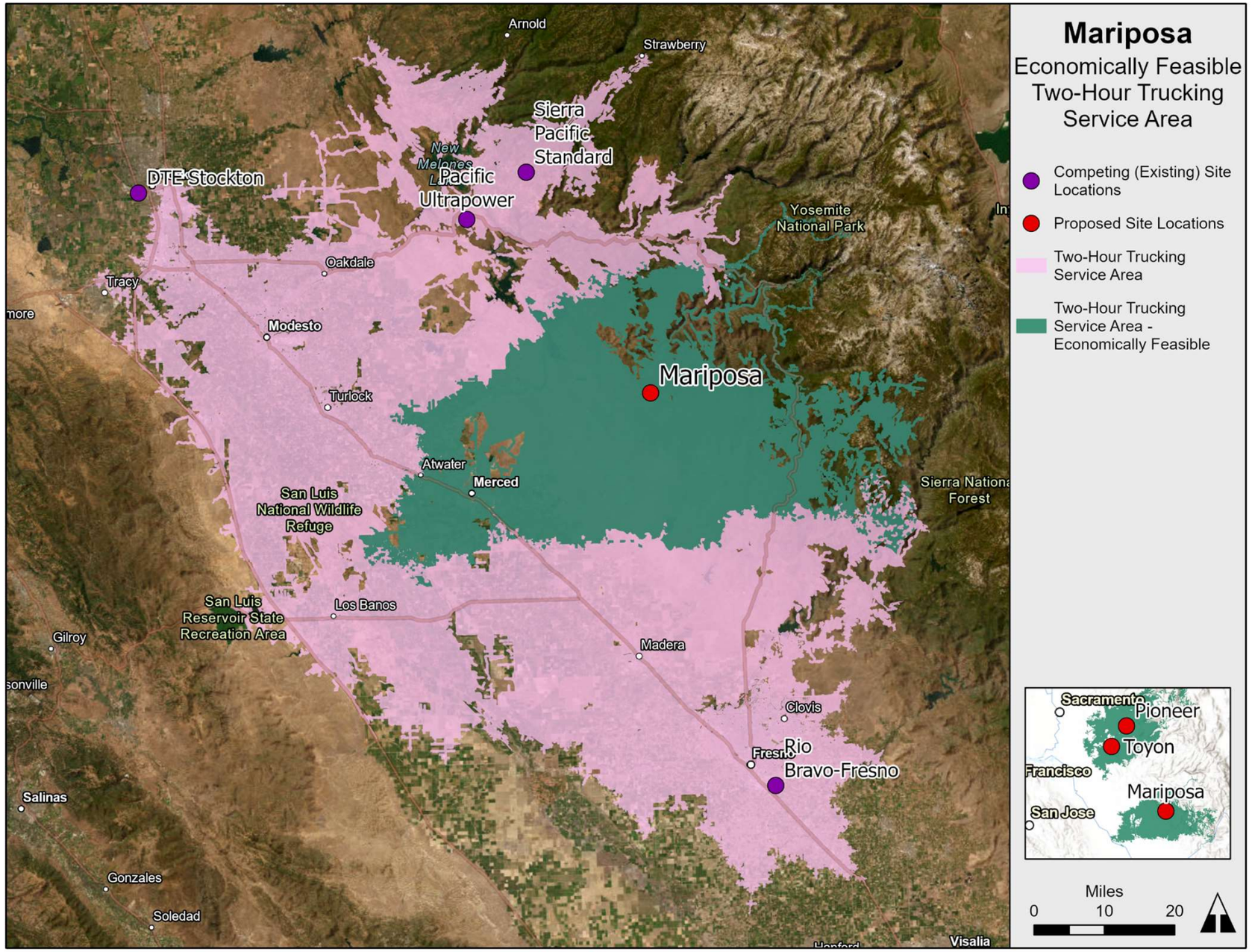

Pioneer
Economically Feasible Two-Hour Trucking Service Area
Competing (Existing) Site Locations
Proposed Site Locations
Two-Hour Trucking Service Area
Two-Hour Trucking Service Area - Economically Feasible
Colusa
Yuba City
Grass Valley
Carson City
Lake Tahoe
Auburn State Recreation Area
Rio Bravo-Rocklin
Eldorado National Forest
Roseville
DTE Woodland
Citrus Heights
Sacramento
Pioneer
Elk Grove
Vacaville
Fairfield
Arnold
Strawberry
Sierra Pacific
Standard
Antioch
Concord
New Melones Lake
Pacific Ultrapower
DTE Stockton
Oakdale
Tracy
Livermore
Modesto
Fremont
Turlock
Sunnyvale
Atwater
Sacramento
Pioneer
Toyon
Mariposa
San Jose
Miles
0
10
20
Date Exported: 1/31/2025

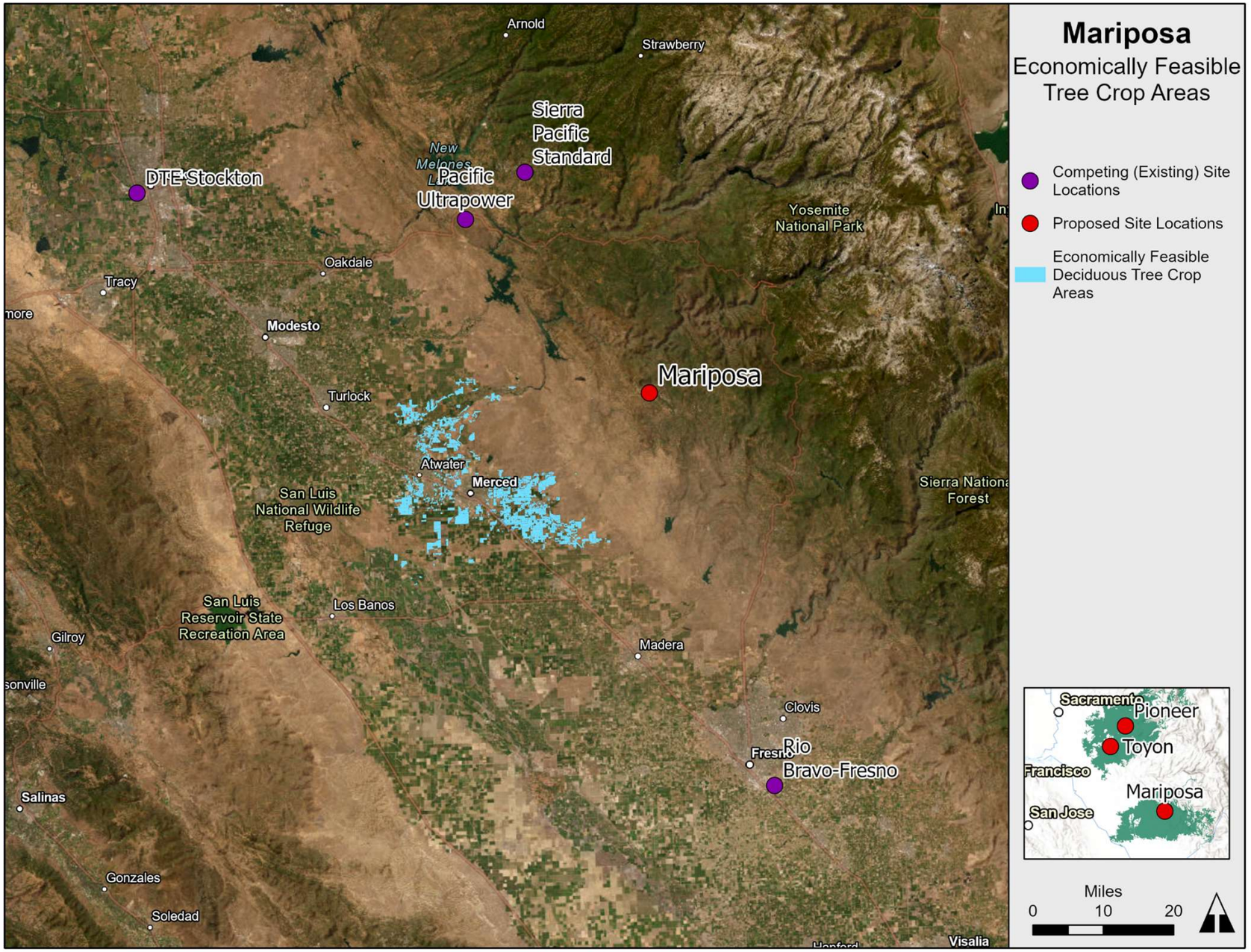

Pioneer
Economically Feasible Tree Crop Areas
Competing (Existing) Site Locations
Proposed Site Locations
Economically Feasible Deciduous Tree Crop Areas
Colusa
Yuba City
Grass Valley
Carson City
Lake Tahoe
Auburn State Recreation Area
Rio Bravo-Rocklin
Eldorado National Forest
Roseville
DTE Woodland
Citrus Heights
Sacramento
Pioneer
Elk Grove
Vacaville
Fairfield
Arnold
Strawberry
Sierra Pacific Standard
Antioch
Concord
DTE Stockton
New Melones Lake
Pacific Ultrapower
Oakdale
Tracy
Livermore
Modesto
Fremont
Turlock
Sunnyvale
Atwater
Sacramento
Pioneer
Toyon
Mariposa
San Jose
Miles
0
10
20
Date Exported: 1/31/2025


Mariposa
Aerial Overview
Competing (Existing) Site Locations
Proposed Site Locations
Arnold
Strawberry
Sierra Pacific Standard
New Melones Lake
DTE Stockton
Pacific Ultrapower
Yosemite National Park
Oakdale
Tracy
Modesto
Mariposa
Turlock
Atwater
Merced
San Luis National Wildlife Refuge
Sierra National Forest
San Luis Reservoir State Recreation Area
Los Banos
Gilroy
Madera
Clovis
Fresno
Rio Bravo-Fresno
Salinas
Gonzales
Soledad
Visalia
Sacramento
Pioneer
Toyon
Francisco
Mariposa
San Jose
Miles
0
10
20
Date Exported: 1/31/2025


Mariposa
Biomass Residues
Competing (Existing) Site Locations
Proposed Site Locations
0-10 BDT/Acre
10-20 BDT/Acre
20-30 BDT/Acre
30-50 BDT/Acre
50+ BDT/Acre
Arnold
Strawberry
Sierra Pacific Standard
New Melones Lake
Pacific Ultrapower
DTE Stockton
Yosemite National Park
Oakdale
Tracy
Modesto
Mariposa
Turlock
Atwater
Merced
San Luis National Wildlife Refuge
Sierra National Forest
San Luis Reservoir State Recreation Area
Los Banos
Gilroy
Madera
Clovis
Fresno
Rio Bravo-Fresno
Salinas
Gonzales
Soledad
Visalia
Sacramento
Pioneer
Toyon
Francisco
Mariposa
San Jose
Miles
0
10
20
Date Exported: 1/31/2025


Mariposa
Two-Hour Trucking Service Area
Competing (Existing) Site Locations
Proposed Site Locations
Two-Hour Trucking Service Area
Arnold
Strawberry
Sierra Pacific Standard
New Melones L.
DTE Stockton
Pacific Ultrapower
Yosemite National Park
Oakdale
Tracy
Modesto
Mariposa
Turlock
Atwater
Merced
San Luis National Wildlife Refuge
Sierra National Forest
San Luis Reservoir State Recreation Area
Los Banos
Gilroy
Madera
Clovis
Fresno
Rio Bravo-Fresno
Salinas
Gonzales
Soledad
Visalia
Sacramento
Pioneer
Toyon
Francisco
Mariposa
San Jose
Miles
0
10
20
Date Exported: 1/31/2025


Mariposa
Economically Feasible
Two-Hour Trucking
Service Area
Competing (Existing) Site Locations
Proposed Site Locations
Two-Hour Trucking Service Area
Two-Hour Trucking Service Area - Economically Feasible
Arnold
Strawberry
Sierra Pacific Standard
New Melones L.
Pacific Ultrapower
DTE Stockton
Yosemite National Park
Oakdale
Tracy
Modesto
Turlock
Mariposa
Atwater
Merced
San Luis National Wildlife Refuge
Sierra National Forest
San Luis Reservoir State Recreation Area
Los Banos
Gilroy
Madera
Clovis
Fresno
Rio Bravo-Fresno
Salinas
Gonzales
Soledad
Visalia
Sacramento
Pioneer
Toyon
Francisco
Mariposa
San Jose
Miles
0
10
20
Date Exported: 1/31/2025


Mariposa
Economically Feasible Tree Crop Areas
Competing (Existing) Site Locations
Proposed Site Locations
Economically Feasible Deciduous Tree Crop Areas
Arnold
Strawberry
Sierra Pacific Standard
New Melones Lake
DTE Stockton
Pacific Ultrapower
Yosemite National Park
Oakdale
Tracy
Modesto
Mariposa
Turlock
Atwater
Merced
San Luis National Wildlife Refuge
Sierra National Forest
San Luis Reservoir State Recreation Area
Los Banos
Gilroy
Madera
Clovis
Fresno
Rio Bravo-Fresno
Salinas
Gonzales
Soledad
Visalia
Sacramento
Pioneer
Toyon
Francisco
Mariposa
San Jose
Miles
0
10
20
Date Exported: 1/31/2025

Economically Feasible Feedstock Supply

FOREST RESIDUES (BDT)					Annual (BDT/year)		
Facility	**Small DBH**	**Med DBH**	**Large DBH**	**Total**	**Forest**	**Orchard**	**Combined**
Toyon	3,423,774	2,845,005	5,040,234	**11,309,014**	565,451	16,490	**581,940**
Pioneer	3,720,144	3,030,296	5,497,656	**12,248,096**	612,405	910	**613,315**
Mariposa	1,207,507	969,868	1,787,739	**3,965,113**	198,256	79,066	**277,322**

Site-specific geospatial analysis shows a range of between 277,000 and 613,000 BDT/year (assuming 20-year removal interval).

2. Feedstock Storage Model

- Wood chips for bioenergy plant
  - Bulk covered storage
  - Pole barn sizing model
- Capital cost of storage facility
  - Materials cost estimate
  - Construction cost estimate

Pole Barn Sizing

FEEDSTOCK STORAGE AREA

Number of bioenergy projects served	1
Quantity of chips per project (tons/yr)	30,000
Months of storage required	0.5
Maximum quantity of stored chips (tons)	1,250
Bulk density of wood chips (lb/cy)	410
Maximum quantity of stored chips (cy)	6,100
Average depth of stored chips (ft)	15
Total area of stored chips (sf)	11,000
Square dimension of stored chips (ft)	110
Square dimension of floor slab (ft)	140
Estimated chip storage area (sf)	**20,000**

Bulk chip storage at average depth of 15’ estimated to require 20,000 sf covered area (roughly 120’ wide by 160’ long).

Pole Barn Cost

CAPITAL COST ESTIMATE	Carter	DIY	Armour	AVERAGE
Materials Cost				
Barn	$ 270,000	$ 315,000	$ 312,000	$ 299,000
Slab	$ 233,000	$ 233,000	$ 234,000	$ 234,000
Subtotal	**$ 503,000**	**$ 548,000**	**$ 546,000**	**$ 533,000**
Construction Cost				
Freight	$ 39,000	$ -	$ 39,000	$ 26,000
Labor	$ 279,000	$ 279,000	$ 243,000	$ 267,000
Subtotal	**$ 318,000**	**$ 279,000**	**$ 282,000**	**$ 293,000**
BASE COST	**$ 821,000**	**$ 827,000**	**$ 828,000**	**$ 826,000**
Contingency (30%)	**$ 247,000**	**$ 249,000**	**$ 249,000**	**$ 248,000**
TOTAL COST	**$ 1,068,000**	**$ 1,076,000**	**$ 1,077,000**	**$ 1,074,000**

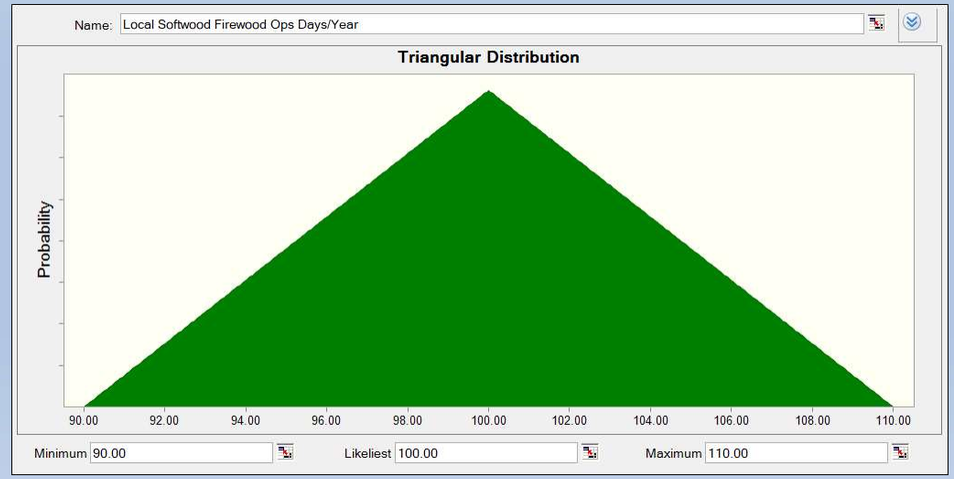
Parametric cost estimates developed for three pole barn suppliers, with average risk-adjusted installed cost of about $1.1 million.

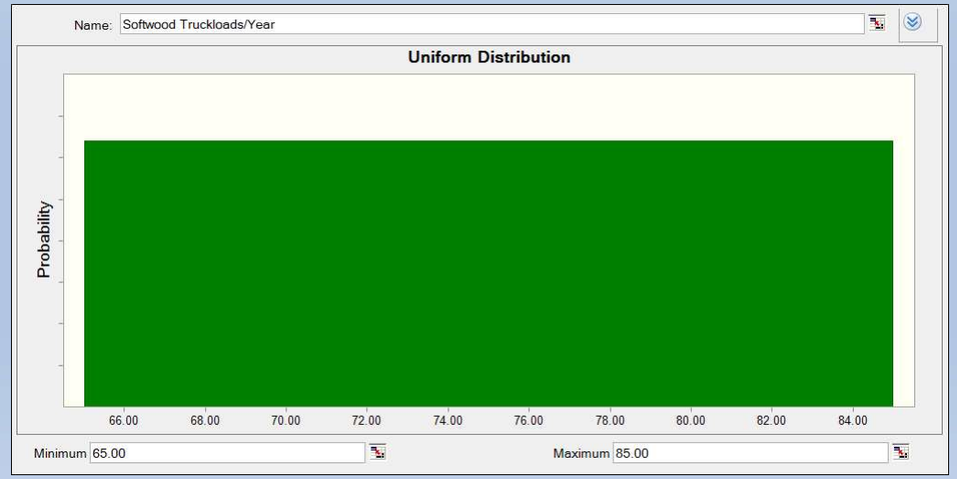
3. Financial Sensitivity Analysis

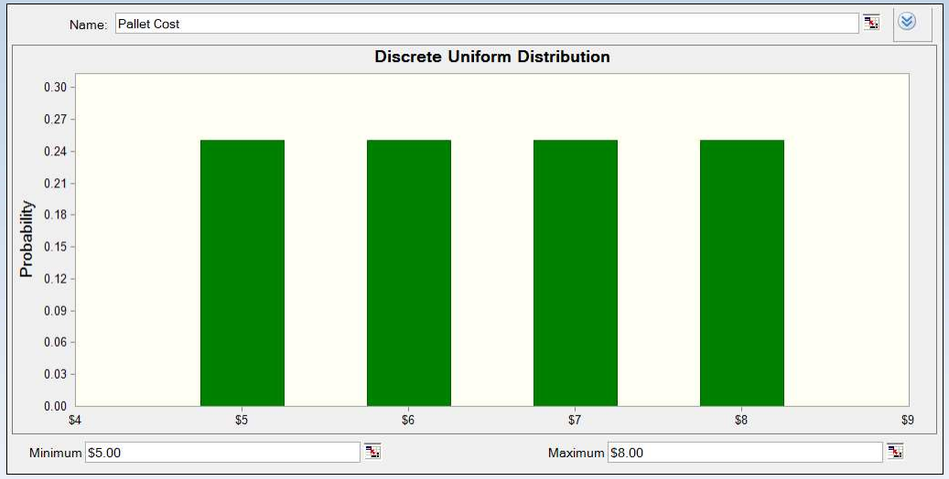
- Two proposed wood products campus businesses
  - Firewood processing
  - Small-scale sawmill
- Goal is to de-risk projects prior to implementation
  - Monte Carlo simulation of risk-adjusted costs
  - Sensitivity of project NPV to input assumptions

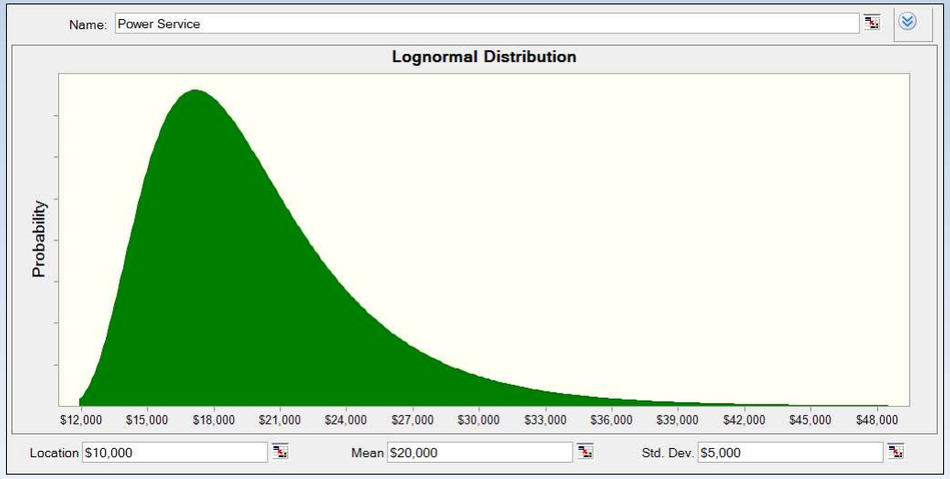
Demonstrated proof of concept for more rigorous Biomass Utilization Financial Feasibility and Sensitivity (BUFFS™) analysis approach.

Financial Model Assumptions

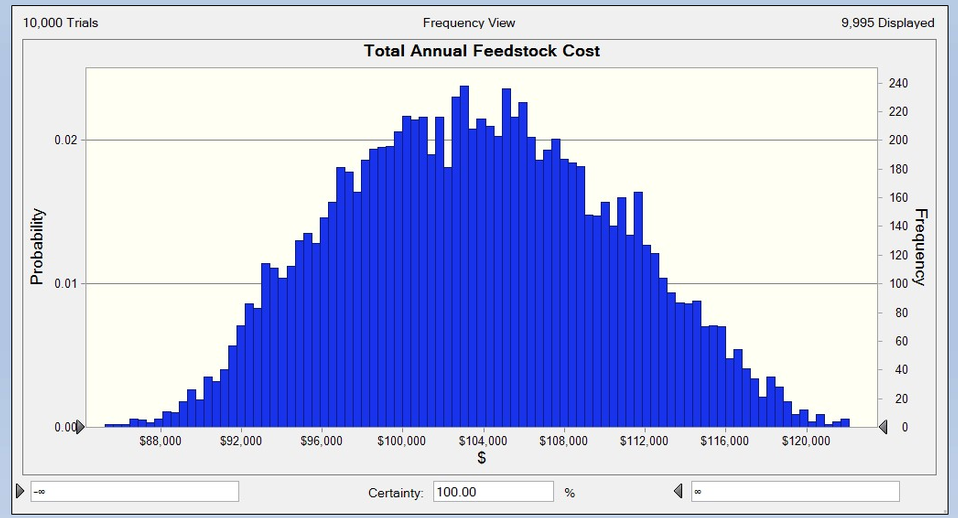


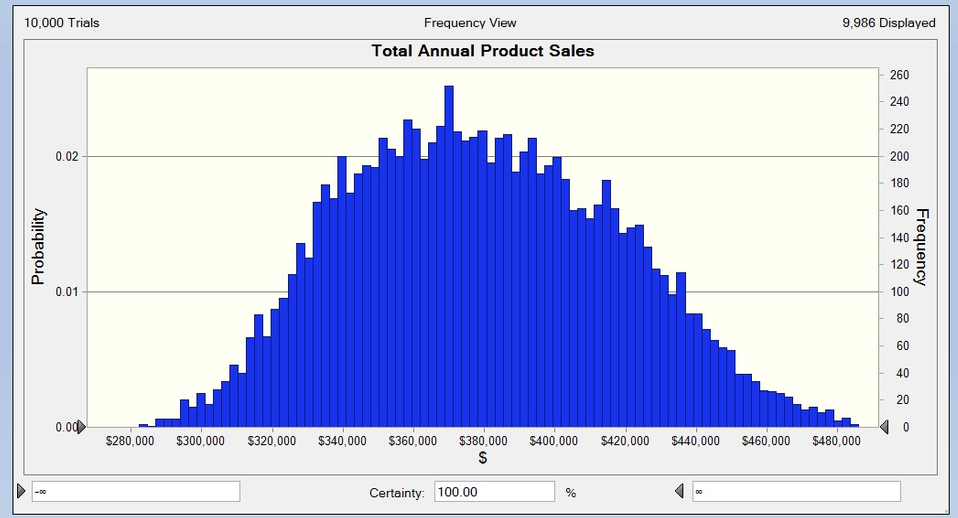


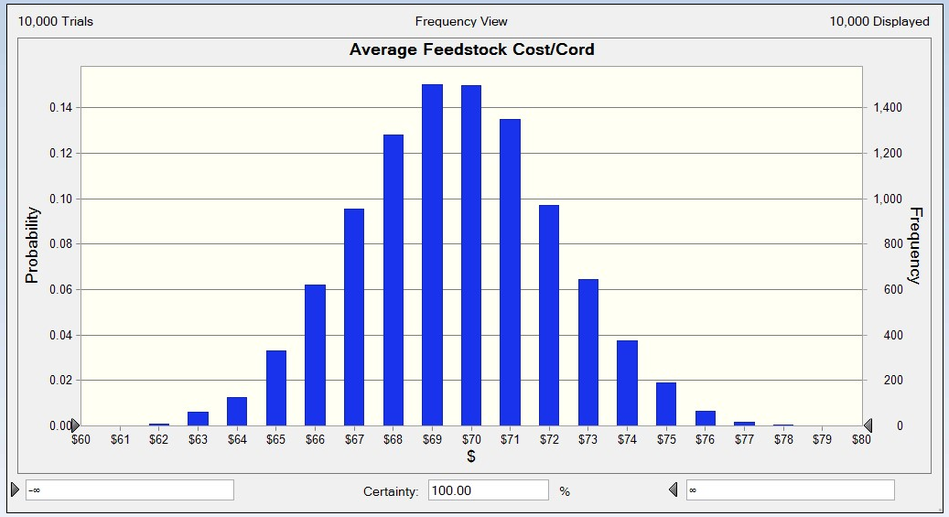


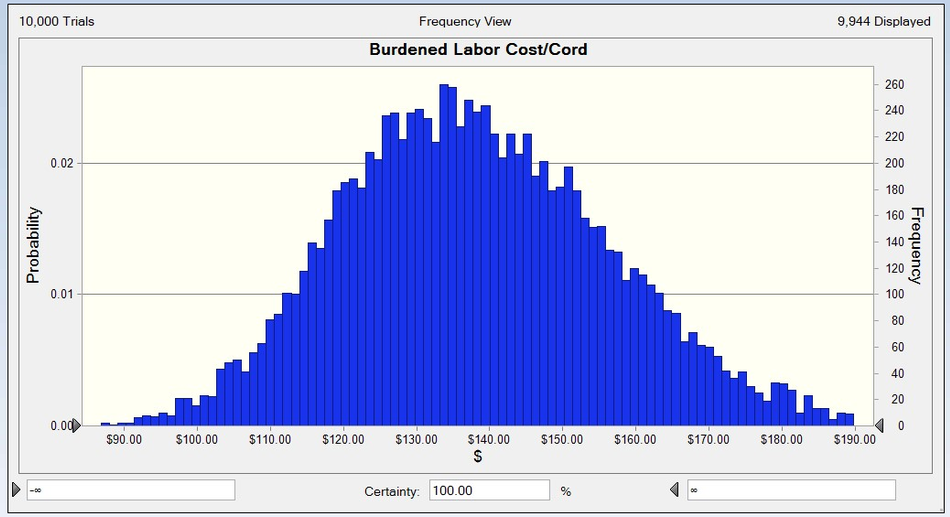


Financial Model Forecasts

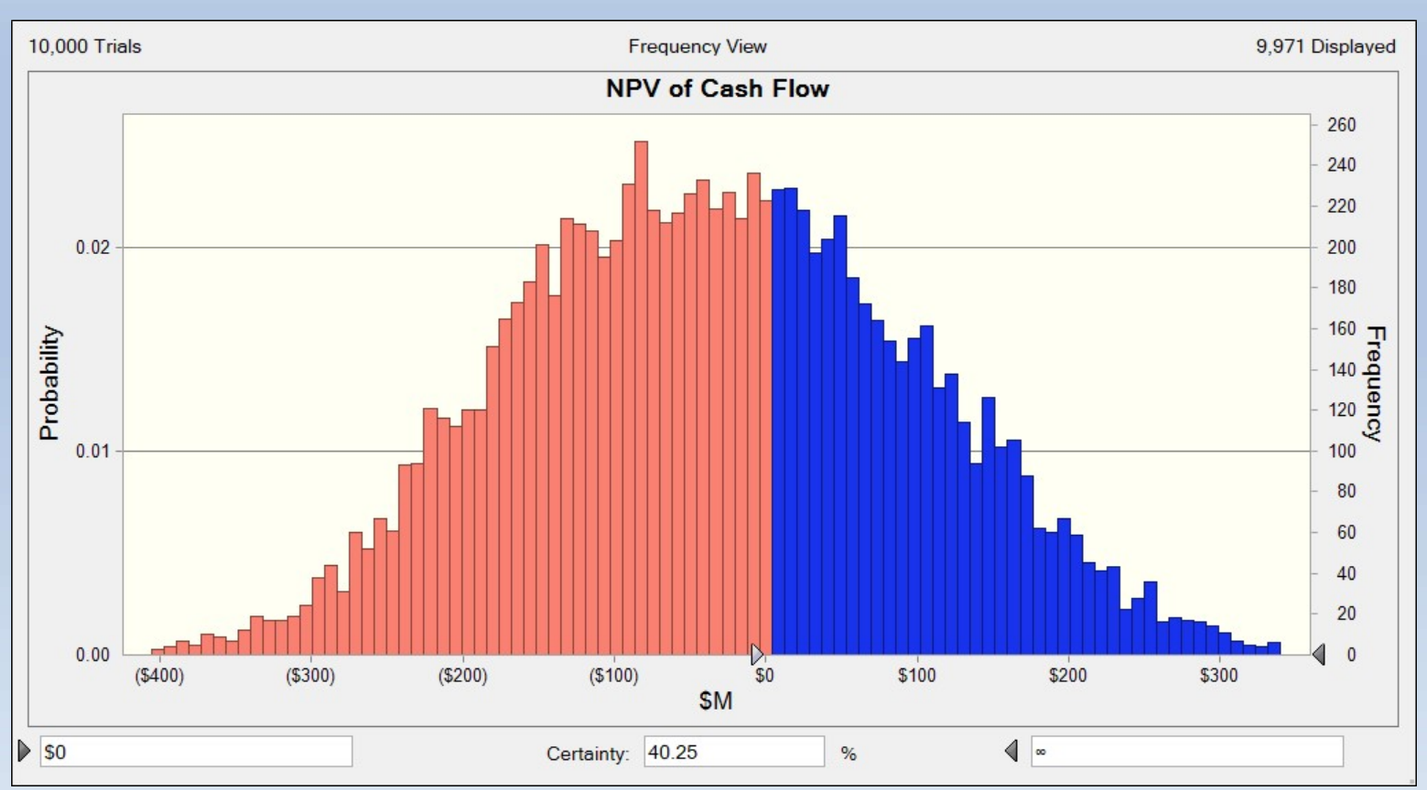






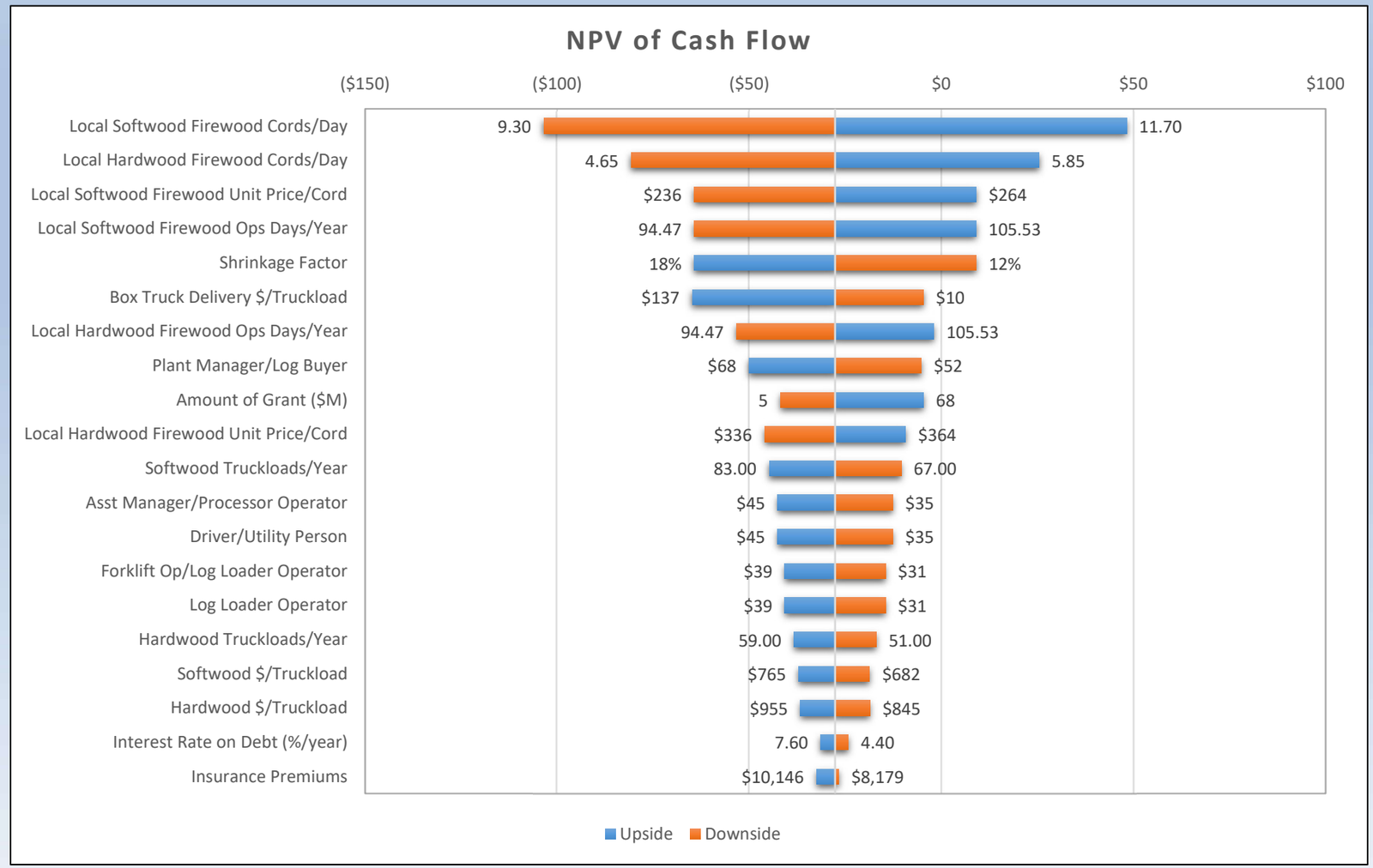


Probability of Project Success



BUFFS™ analysis indicates that firewood processing operation has just a 40% likelihood of being profitable based on model input parameters.

Relative Impact of Risk Factors

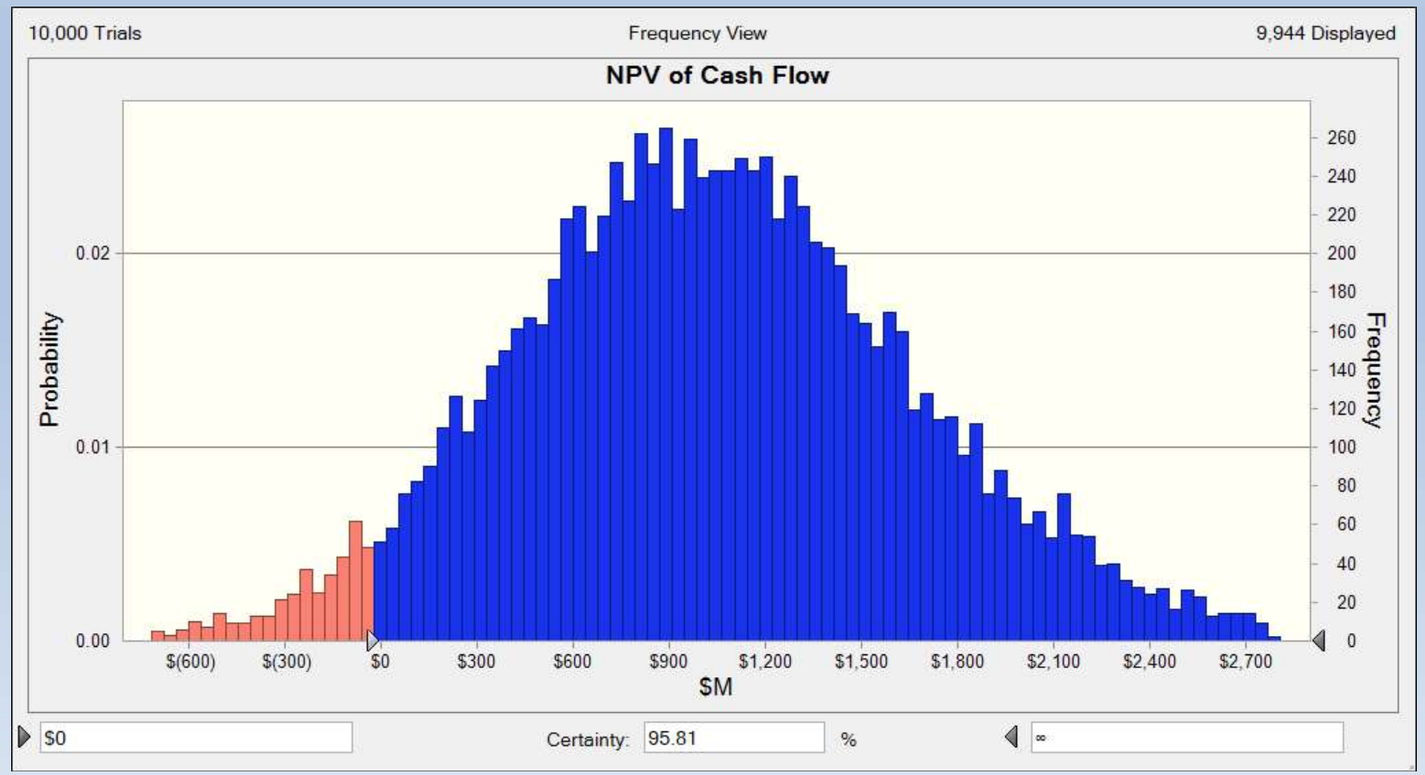


Risk Factors Driving Profitability

Input Variable	Downside NPV	Upside NPV	NPV Range	Cumulative Variation
Local Softwood Firewood Cords/Day	($103)	$48	$152	34.31%
Local Hardwood Firewood Cords/Day	($81)	$25	$106	51.12%
Local Softwood Firewood Unit Price/Cord	($64)	$9	$73	59.14%
Local Softwood Firewood Ops Days/Year	($64)	$9	$73	67.17%
Shrinkage Factor	$9	($64)	$73	75.19%

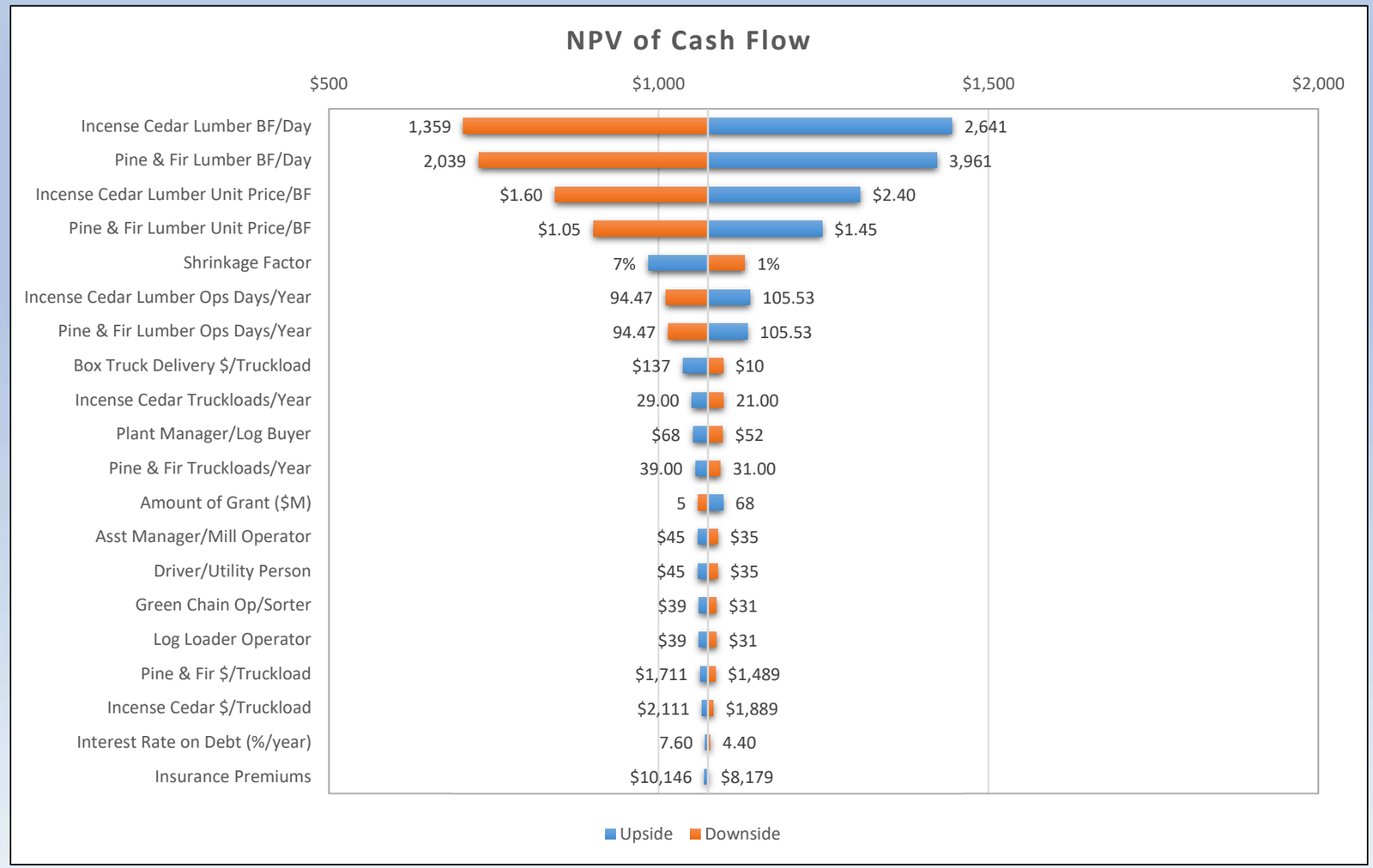
Top five risk drivers (of 26 total input assumptions) account for 75% of modeled variation in NPV for firewood processing.

Probability of Project Success



BUFFS™ analysis indicates that small-scale sawmill has a greater than 95% likelihood of being profitable based on model input parameters.

Relative Impact of Risk Factors



Risk Factors Driving Profitability

Input Variable	Downside NPV	Upside NPV	NPV Range	Cumulative Variation
Incense Cedar Lumber BF/Day	$704	$1,444	$740	38.32%
Pine & Fir Lumber BF/Day	$728	$1,421	$694	72.00%
Incense Cedar Lumber Unit Price/BF	$843	$1,305	$462	86.93%
Pine & Fir Lumber Unit Price/BF	$901	$1,248	$346	95.33%

Top four risk drivers (of 25 total input assumptions) account for 95% of modeled variation in NPV for small-scale sawmill.

4. Summary of Findings

- Reliability of economically feasible feedstock supply projected to be much higher at Pioneer and Toyon sites versus Mariposa site.
- Central bioenergy plant should anticipate needing up to 20,000 sf of covered chip storage costing upwards of $1 million.
- Small-scale sawmill much more likely (95%) to be profitable than firewood processing operation (40%) at same location.

5. Proposed Applications

- Adopting more advanced geospatial analysis tools
  - Top-down approach to complement “on the ground” interviews
  - Refine estimates to be site-specific in light of competing outlets
- Estimating required size and cost of feedstock storage
- Applying more robust financial sensitivity analysis (BUFFS™)
  - Enhance point estimates typically used in financial models
  - Proactively identify and manage key project risk drivers

These approaches can substantially de-risk future biomass utilization projects.

Study Partners

Tukman Geospatial

MARIPOSA COUNTY RESOURCE CONSERVATION DISTRICT

CLERE
California Law Empowering Renewable Energy

WILDEPHOR

W. David Featherman, Principal

+1 510 845 0016 | david.featherman@wildephor.com

BIOENERGY - SUSTAINABILITY - PUBLIC POLICY - RISK ANALYSIS - PROJECT MANAGEMENT