BIOMASS FEEDSTOCK SUPPLY AVAILABILITY AND COST ANALYSIS FOR THE MAMMOTH LAKES REGION

Prepared for:

California Trout

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INTRODUCTION

The Mammoth Lakes region is a very unique area, one that is blessed with eastern Sierra Nevada forests and shrubland. This region provides significant recreational opportunities while supplying a consistent domestic water supply to much of Southern California. In order to maintain the ecological integrity of this region, forest thinning and dead tree removal are required. In recent years the Inyo National Forest formulated plans to increase the number of acres treated to reduce unnatural accumulations of forest biomass. In addition, Southern California Edison has increased tree trimming and removal operations along power distribution and transmission lines in the region to mitigate fire ignition potential.

TSS has been retained by California Trout (Cal Trout) to conduct a forest biomass feedstock supply availability and cost analysis for the region. In 2013, TSS completed a similar analysis on behalf of Mono County and found that there was only enough sustainably available feedstock to support biomass thermal projects in the region. As a result of the 2013 findings, Mono County installed a biomass boiler at their Bridgeport maintenance facility to provide thermal heating to the facility.

Since 2013 there have been several key policy and resource management initiatives started that impact the Mammoth Lakes region:

- In late 2013, the California Public Utility Commission, working with California Investor Owned Utilities and potential project stakeholders, commenced implementation of Senate Bill 1122 in support of community-scale biomass power generation facilities. This represents a very significant opportunity to strategically site biomass power generation facilities (scaled at 1 to 3 MW of net generation capacity), near forested landscapes in need of fuels treatment and/or forest restoration.

- In 2019 the Inyo National Forest issued the Updated Land Management Plan (LMP). This LMP sets forth a 15 year plan to guide land management activities on the Forest, including increased emphasis on fuels reduction activities.

- In 2021 the Eastern Sierra Climate and Communities Resilience Project (ESCCRP) received state funding support to implement forest restoration and fuels treatment activities across 55,000 acres of the Inyo National Forest. This watershed-scale restoration effort is being implemented by the Plumas Corporation in partnership with the Inyo National Forest and other stakeholders.

- In 2022 Mono County plans to close a major landfill in the region (Benton Crossing) which places additional urgency on the need to find alternative disposal and utilization options for biomass material.

STUDY OBJECTIVES

Summarized below are the tasks that TSS implemented in support of this biomass feedstock supply analysis.

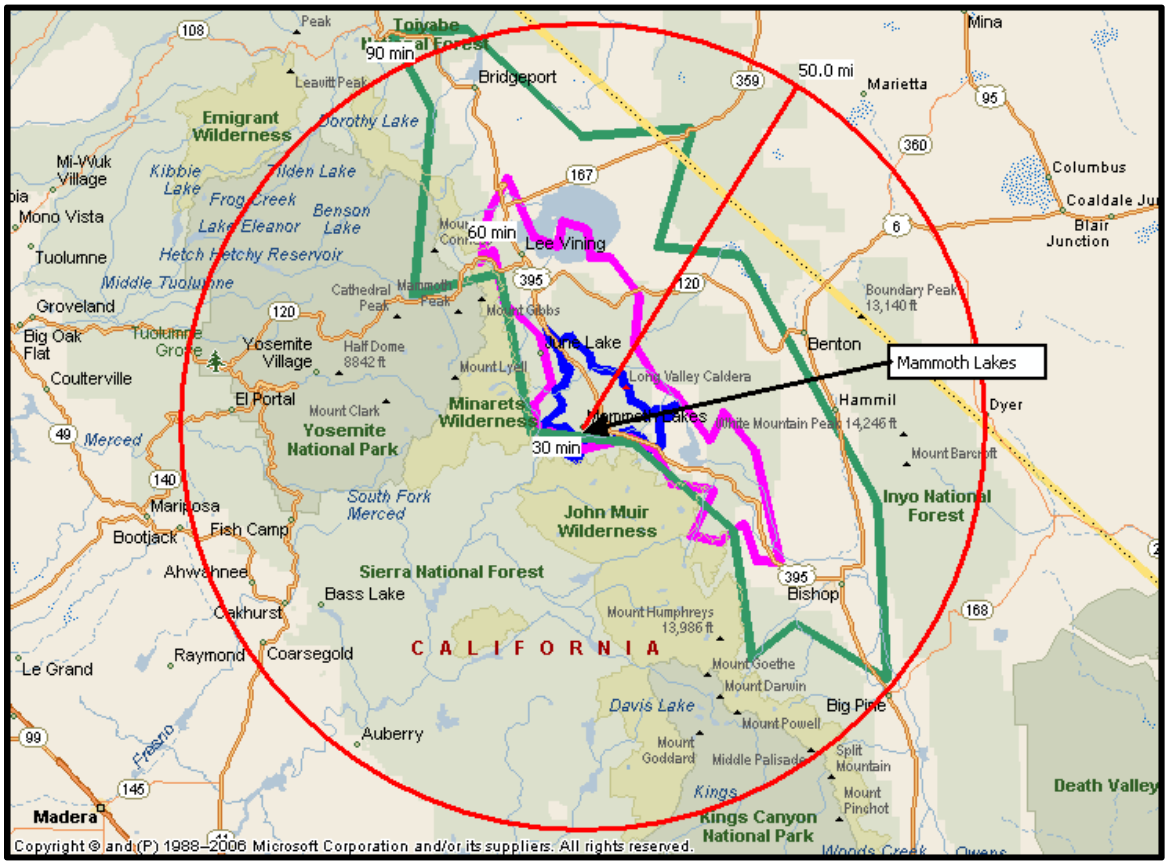
- Conduct a woody biomass feedstock supply market analysis to determine current feedstock pricing and availability trends within the feedstock study area as selected in the siting area analysis.
- Perform a competition analysis of feedstock currently available in the target area in relation to competing plants and/or competing uses. Estimate current delivered prices ($/bone dry ton) for woody biomass feedstock.
- Identify future feedstock supply sources and risks. Provide a five-year feedstock pricing forecast using an optimized blend of feedstock types. Summarize potential and economically available feedstocks compared with projected annual feedstock use to ascertain the feedstock coverage ratio. Recommend the optimized project scale considering sustainable, economically available feedstocks and the targeted site's heat load and/or energy load.

FEEDSTOCK STUDY AREA

The Feedstock Study Area is defined as that region from which economic and sustainable woody feedstocks can be sourced on a long-term basis. The 2014 investigation that TSS conducted for Mono County utilized a 50-mile radius FSA. For the purposes of this analysis, the same FSA was utilized. Vegetation cover and land ownership data presented here is gleaned from the 2014 investigation.

Figure 1 is a map of the FSA. Note that drivetime zones (30, 60, and 90 minute) are highlighted along with the 50-mile radius boundary in red. A 90-minute one-way transport is considered the economic range when transporting logs or biomass feedstock.

Figure 1. Feedstock Study Area



Note that the 30-minute, 60-minute and 90-minute drive time zones are highlighted in blue, pink and green (respectively). Transport cost is typically the most significant cost center when evaluating the all-in cost of sourcing biomass feedstocks. Other cost centers include harvest, collection, and processing.

Vegetation Cover

The FSA includes portions of the eastern slope of the Sierra Nevada Range and the northern portion of the Owens Valley. Using geographic information system (GIS) data provided by the US Geological Survey and Landfire database, TSS conducted an analysis of vegetation cover. Figure 2 is a map highlighting vegetation cover by type within the FSA.

Woody biomass availability for any given region is heavily dependent on vegetation cover, land management objectives, and land ownership. Vegetation cover within the Mammoth Lakes FSA is predominantly shrub and nonforested (primarily desert) at 51%, coniferous at 25%, and pinyon juniper at about 10% of the landscape. The predominant vegetation cover types within the FSA are shown graphically in Figure 2 and in a map in Figure 3.

Figure 2. Vegetation Cover as a Percentage of Total Cover within the FSA

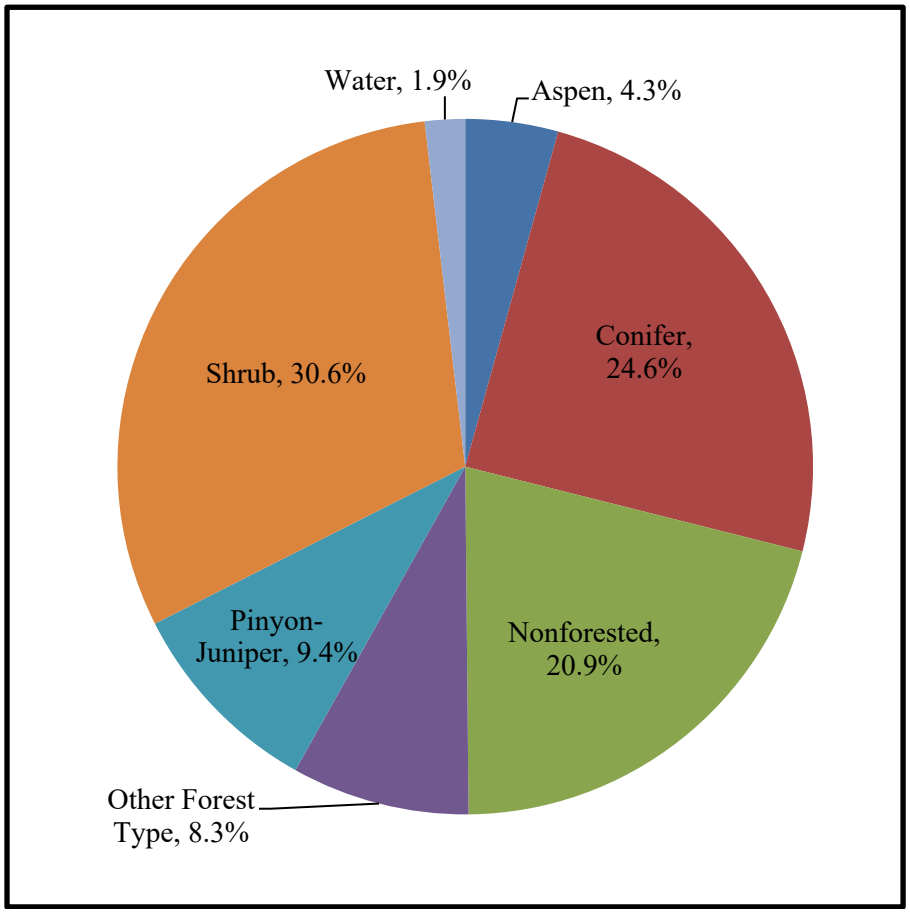
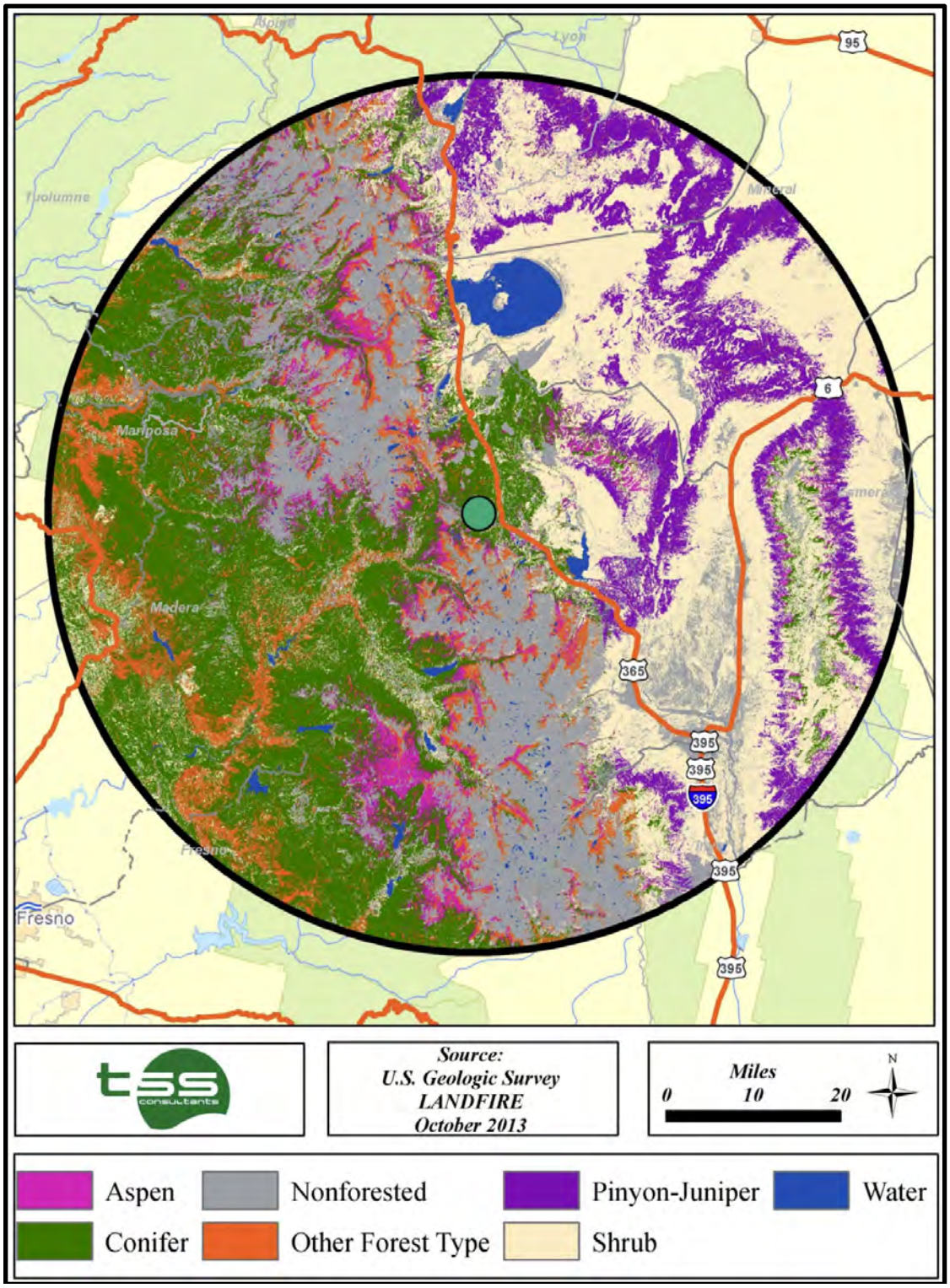


Figure 3. Vegetation Cover within the FSA



Vegetation cover types significantly influence woody biomass availability. Depending on management objectives, certain cover types could generate significant volumes of woody biomass material for use as feedstocks for value-added utilization. Table 1 summarizes vegetation cover by category within the FSA.

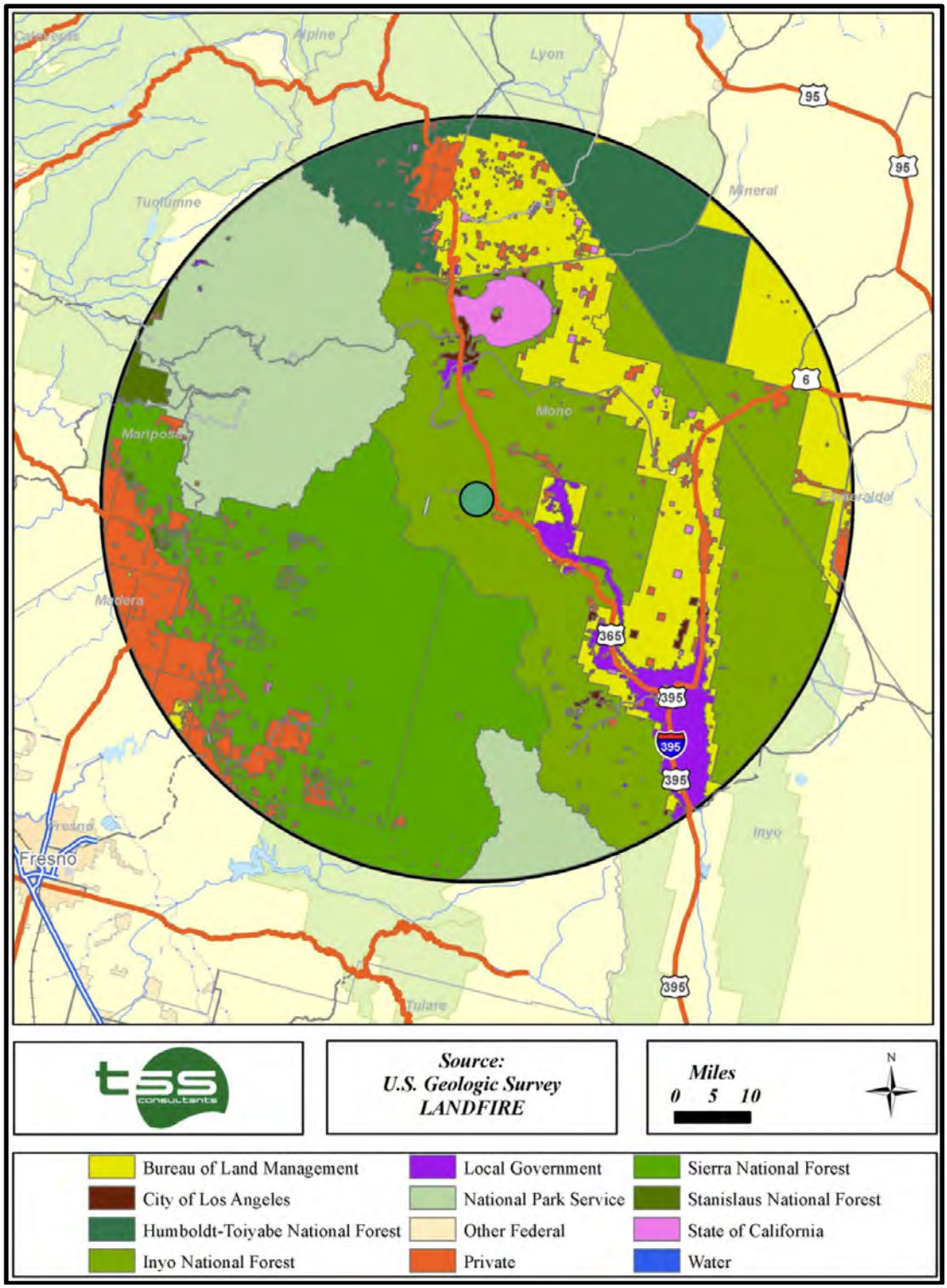
Table 1. Vegetation Cover Summary within the FSA

Cover Categories	Acres	Percent
Aspen	216,657	4.3%
Conifer	1,237,034	24.6%
Other Forest Type	415,924	8.4%
Pinyon Juniper	473,883	9.4%
Shrub	1,537,747	30.6%
Nonforested	1,052,187	20.9%
Water	93,766	1.9%
Totals	**5,027,198**	**100%**

Land ownership influences vegetation management objectives and within the FSA, the USFS is the prevalent land manager with responsibility for approximately 57% of the landscape. Private land makes up about 7% and the Bureau of Land Management (BLM) makes up 14%. Federal land management agencies (USFS and BLM) together manage approximately 71% of the landscape. Federal jurisdiction and management objectives have a significant influence regarding woody biomass material availability within the FSA.

Figure 4 highlights the locations of the various ownerships and jurisdictions.

Figure 4. Land Ownership/Jurisdiction within the FSA



Due to transport logistics (e.g., topography, road systems) associated with the crest of the Sierra Nevada Range, much of the FSA is not economically accessible for the recovery and transport of woody biomass material. The area shown as cross-hatched landscape in Figure 5, highlights acreage that is considered un-economical for recovery woody biomass material. In addition, certain jurisdictions such as state parks, national parks and USFS wilderness areas will not be generating sustainable volumes of forest biomass material due to the fact that management objectives for these jurisdictions do not include active vegetation management.

Adjustments were made to the FSA base map (50-mile radius of Mammoth Lakes) to develop a Core Feedstock Study Area (CFSA) map and database.

- Only include those counties that are within economic haul distance of Mammoth Lakes (Mono, Inyo); and
- Remove state parks, national parks and USFS wilderness areas.

TSS developed a CFSA map (Figure 5) that excludes land outside the economic haul distance of Mammoth Lakes (cross-hatched region). Figure 6 highlights land ownership within the CFSA. Table 2 and Table 3 provide vegetation cover data and forestland ownership.

Figure 5. Core Feedstock Study Area Vegetation Cover

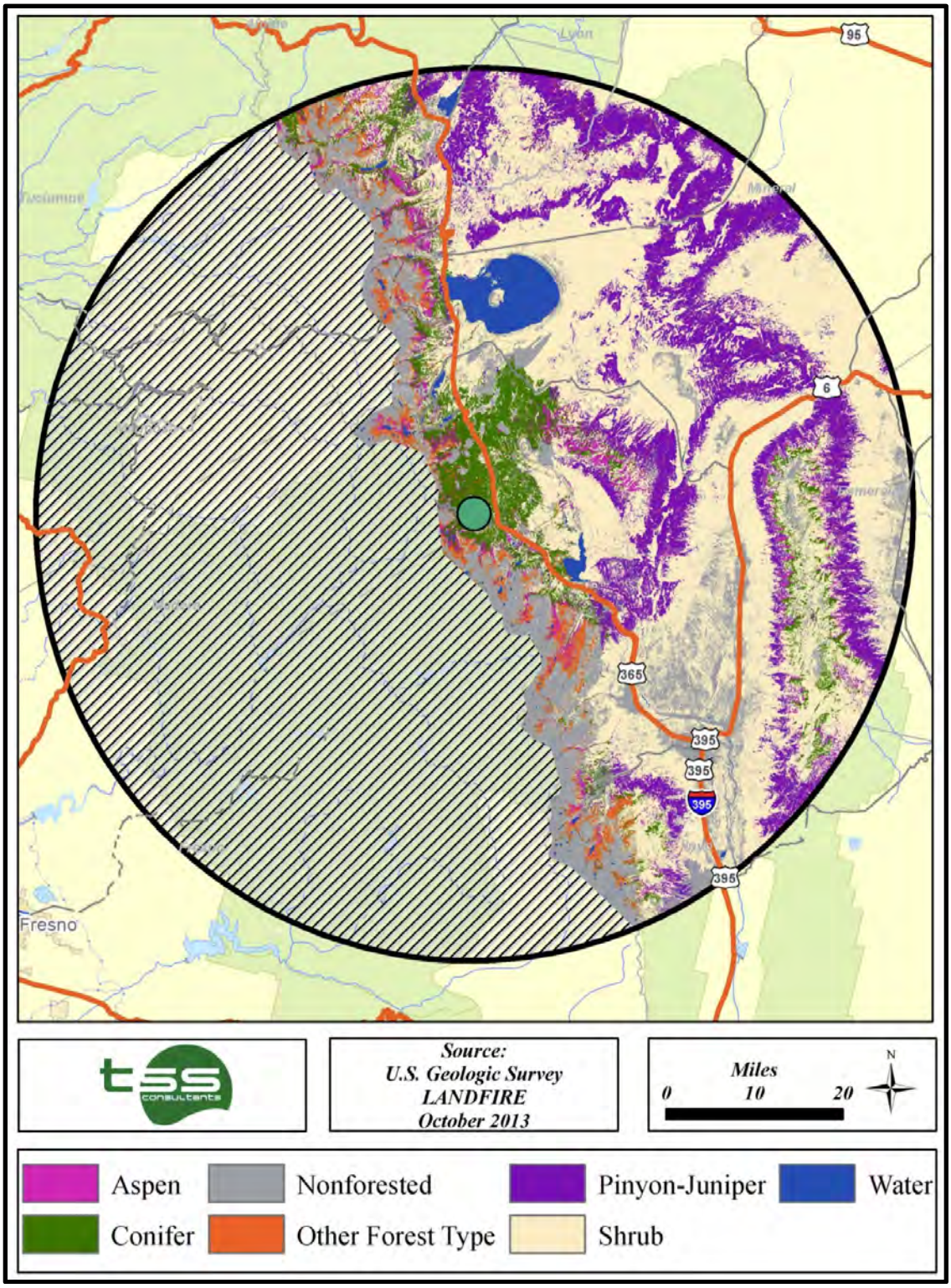


Figure 6. Core Feedstock Study Area Ownership Map

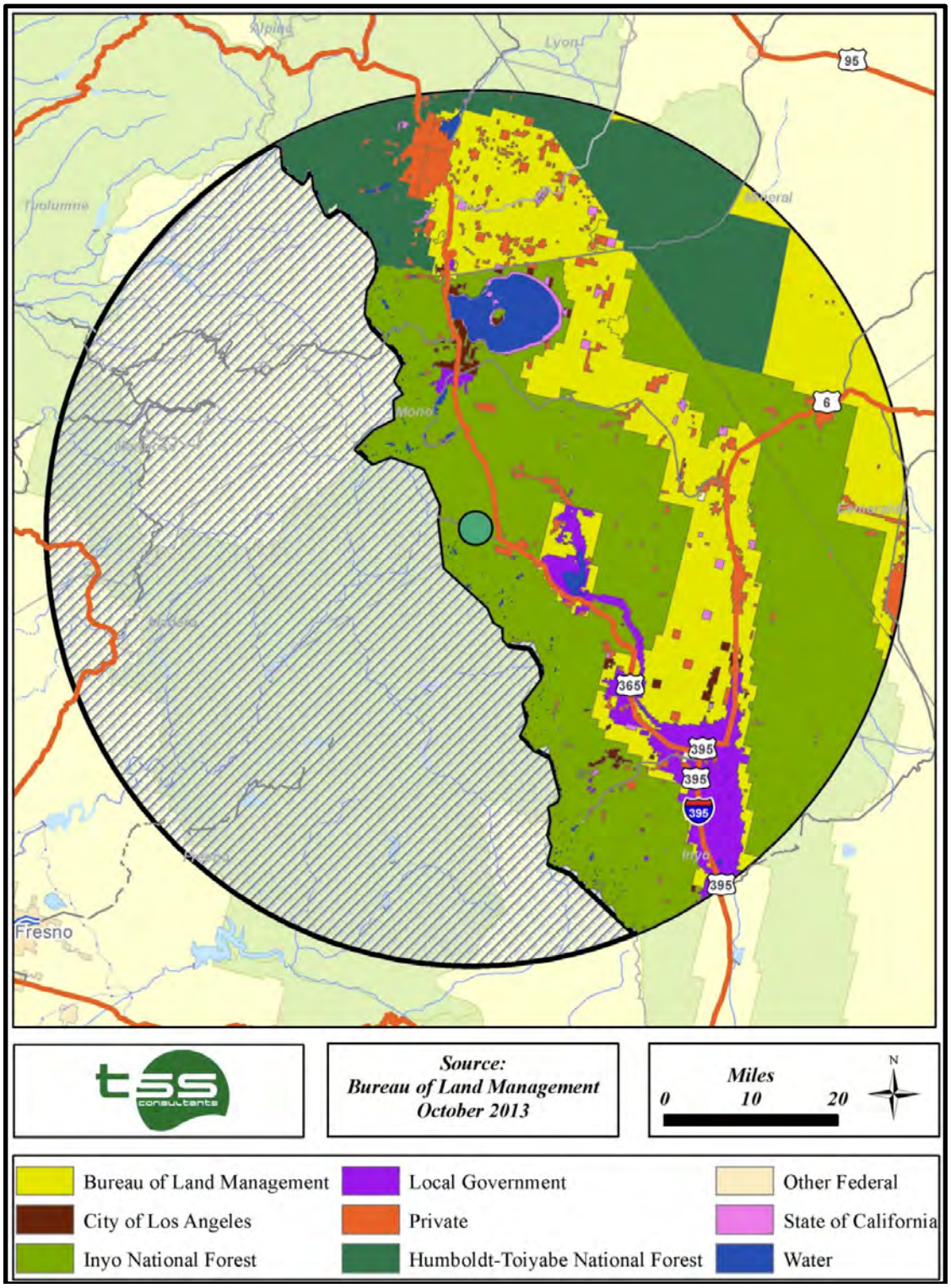


Table 2. Vegetation Cover Summary within the CFSA

Cover Categories	Acres	Percent
Aspen	64,094	2.4%
Conifer	182,610	6.8%
Nonforested	448,882	16.8%
Other Forest Type	78,784	2.9%
Pinyon Juniper	470,874	17.6%
Shrub	1,370,369	51.2%
Water	63,305	2.3%
TOTALS	**2,678,918**	**100.0%**

Conifer vegetation cover (6.8% or 182,610 acres) will likely provide the best opportunity for collection and processing of excess forest biomass material from timber harvest operations and fuels reduction activities. Pinyon juniper cover (17.6% or 470,874 acres) could provide excess biomass but due to very limited road access, the opportunities to economically utilize this material are minimal (see Forest Fuels Reduction Residuals section for more on this). Table 3 highlights the ownership of forestland (aspen, conifer, pinyon juniper and other forest) within the CFSA.

Table 3. Land Ownership/Jurisdiction Forest Vegetation Cover within the CFSA

Land Owner/Manager	Forested Acres	Percent
BLM	84,677	10.6%
Humboldt-Toiyabe NF	201,286	25.3%
Inyo NF	462,895	58.1%
Other Public	13,677	1.7%
Private	33,826	4.3%
TOTALS	**796,362**	**100.0%**

Note that the USFS and BLM, jointly manage approximately 94% of forestland within the CFSA. Clearly, any vegetation management plans on federal lands will impact forest biomass feedstock availability.

BIOMASS FEEDSTOCK SUPPLY

This analysis focused on five types of biomass feedstock supply currently available within the CFSA as follows.

- Timber harvest residuals (limbs, tops)
- Forest fuels reduction residuals (small stems/dead and dying trees)
- Forest products manufacturing residuals

- Urban wood waste and tree trimmings
- Powerline corridor maintenance

Timber Harvest Residuals

Timber harvest residuals in the form of limbs, tops and sub-merchantable stems are generated on a regular basis as a byproduct of commercial timber harvest activities. Once collected and processed, these residuals are an excellent fuel (low moisture, high heating value). Discussions with area foresters and timber sale purchasers confirmed that very little timber harvest residual volume is currently recovered (post harvest) for value-added utilization. Much of the residual is left piled on the landing (adjacent to roads) or piled (for burning) within the harvest units. Processing of the timber harvest residuals takes place at the roadside landing, with feedstock typically reduced to three inch minus size chips for delivery to the end-use facility.

As a byproduct of commercial timber harvests, the availability of timber harvest residuals rises and falls with timber harvests within the CFSA. TSS reviewed USFS Cut & Sold reports[1] to confirm timber harvest trends for the last five years (that data is available), 2016 through 2020 on USFS managed lands within the CFSA. Note that USFS records track commercial timber harvest by National Forest. Only the Inyo National Forest has timber sales that are tributary to the Mammoth Lakes region.

Table 4 provides historic timber harvest volumes from the Inyo National Forest. Note that harvest estimates are presented in thousand board feet[2] measure (MBF).

Table 4. 2016 to 2020 Timber Harvest for the Inyo National Forest

National Forest	2016 (MBF/Yr)	2017 (MBF/Yr)	2018 (MBF/Yr)	2019 (MBF/Yr)	2020 (MBF/Yr)	Five-Year Avg (MBF/Yr)
Inyo	2,115	2,165	2,460	2,161	1,995	**2,179**

A review of the University of Montana database[3] (timber harvest by county) confirmed that no private timber volume was harvested in Mono and Inyo counties from 2016 to 2020. This is not surprising considering that private forestland ownership makes up only 4.3% within the CFSA.

As noted in Table 4, TSS estimates that the five-year average timber harvest within the CFSA is approximately 2,179 MBF/year. Based upon TSS' experience working with logging and chipping contractors in the West, the recovery factor for biomass feedstock processed from timber harvest residuals is approximately 0.9 BDT/MBF of woody biomass (treetops and limbs) that could be generated from each MBF of timber harvested.

[1] https://www.fs.fed.us/forestmanagement/products/cut-sold/index.shtml
[2] Thousand board feet (MBF) is a common unit of measure used in the timber industry to express relative volume of sawtimber. One board foot measure is approximately equal to a board that measures 12" by 12" and 1" thick.
[3] http://www.bber.umt.edu/fir/H_Harvest.asp

Using the 0.9 BDT per MBF recovery factor and the 2,179 MBF/year (five-year average) harvest estimate, there are 1,961 BDT/year of timber harvest residuals potentially available within the CFSA. Not all timber harvest residuals are recoverable, as topography and road systems will impact economic collection and transport. TSS review of the topography and road systems within the CFSA estimates that approximately 90% of the forestland have road systems that will accommodate economic collection and transport (using chip van trailers) of forest biomass. Using the 90% figure results in a practically available timber harvest residual estimate of 1,765 BDT/year.

Interviews with southern Sierra Nevada contractors that manage timber harvest residual collection and processing operations confirmed that costs range from $32 to $35/BDT FOB[4] truck at the landing. Assuming a 30-mile one-way transport[5] from the forest to a biomass utilization facility near Mammoth Lakes, the delivered cost will range from approximately $50 to $55/BDT. At the farthest reaches of the FSA a 50-mile one-way transport[6] from the forest to a Mammoth Lakes facility will result in a delivered cost ranging from about $58 to $61/BDT. Note that these cost estimates do not include cost offsets such as transportation cost support provided by USFS sponsored service contracts or grant funding.

Forest Fuels Reduction Residuals

Due to high fire danger conditions and overstocked forests, there are concerted efforts across all forest ownerships to proactively reduce hazardous forest fuels in support of fire resilient forest ecosystems. Forest landowners are regularly conducting forest thinning activities to achieve fuels treatment and stocking control (reduce the number of trees per acre as forest stands age over time and tree size increases). In California, the state has allocated $1 billion over five years to address hazardous forest fuels across all ownership types. This investment is primarily allocated through grants administered by the state and will increase the opportunities for fire safe councils, resource conservation districts and national forests to administer forest fuels reduction projects at landscape scale. Federal funding through the Natural Resources Conservation Service (NRCS) is available and targets non-industrial private forestland.

TSS interviewed both private and federal land managers to secure information regarding current forest management and fuels reduction activities within the CFSA. These discussions confirmed a strong interest to increase acres treated across the landscape with an emphasis on creating fire resilient landscapes which support fire defensible communities. Mitigating wildfire behavior is clearly driving vegetation management within the CFSA. With the USFS and BLM managing 94% (see Table 3) of forestland within the CFSA, there is a clear emphasis on treating federally managed lands.

[4] FOB = freight on board.
[5] Chip transport costs average $110 per hour with total roundtrip cost of $275 per delivery (2.5 hours). At 15 BDT per load, the haul cost is $18.33/BDT for the 60-mile roundtrip transport.
[6] Chip transport costs average $110 per hour with total roundtrip cost of $385 per delivery (3.5 hours). At 15 BDT per load, the haul cost is $25.67/BDT for the 100-mile roundtrip transport.

Inyo National Forest

Using data collected through interviews with USFS staff and the California Forestry Association, TSS was able to confirm historic levels of fuels treatment for the Inyo National Forest. Between 2016 and 2020, the Inyo National Forest treated an average of 3,349 acres per year. Much of these treated acres are part of commercial firewood timber sales or personal use firewood removals. Most of the forest biomass material removed will be utilized as firewood with only the smaller stems, limbs and tops available for processing into biomass fuel. This volume was accounted for in the calculations of timber harvest residuals (above).

Discussions with Humboldt-Toiyabe National Forest staff[7] confirmed that all forest fuels reduction projects tributary to Mammoth Lakes are focused on sage grouse habitat improvement. Habitat improvement includes removal of juniper stems (Utah juniper and western juniper) on a landscape-scale basis. Currently, excess juniper stems are loped and scattered[8] as well as piled and burned. Forest staff[9] estimated that approximately 2,000 acres per year of juniper removals could be tributary to Mammoth Lakes with about 4 green tons per acre of juniper stems removed. Assuming 30% moisture content, this volume amounts to about 3 BDT/acre or about 6,000 BDT/year if 2,000 acres are treated per year.

Eastern Sierra Climate & Communities Resilience Project

In August 2021, Plumas Corporation was awarded $4.9 million from Cal Fire in support of the Eastern Sierra Climate & Communities Resilience Project (ESCCRP). The ESCCRP seeks to treat approximately 44,000 acres of forestland[10] within and adjacent to the town of Mammoth Lakes. Appendix A provides an overview of the project.

All of the 44,000 acres targeted for treatment are within the Inyo National Forest. Discussions with Inyo NF staff[11] confirmed that a recent forest inventory stand exam had been conducted within the ESCCRP project boundaries. Using the recent stand exam data, USFS staff was able to forecast forest biomass removal volume of 15.8 BDT/acre. TSS estimates that a full 30% of the biomass removed will likely be utilized as firewood, with the sub-merchantable stems (<14" diameter) available for processing into biomass feedstock. Approximately 11 BDT/acre is potentially available.

Plumas Corporation staff[12] confirmed plans to treat 2,000 acres per year as the ESCCRP is implemented across 44,000 acres of forest. This amounts to approximately 22,000 BDT/year of forest biomass potentially available over a 20-year project timeline. Not all forest biomass will be available, as topography and road systems may limit accessibility. However, most of the

[7] Annabelle Monti, Forest Fuels and Vegetation Program Manager, Humboldt-Toiyabe National Forest.
[8] Lop and scatter is a fuels reduction technique whereby hand crews use chainsaws to reduce slash to a size that can then be scattered by hand.
[9] Ibid.
[10] Jeffrey pine, lodgepole pine and red fir vegetation types.
[11] Stephen Calkin, Forester, Inyo National Forest.
[12] Janet Hatfield, Southern Sierra Project Manager, Plumas Corporation.

ESCCRP treatment area is accessible and relatively flat. TSS estimates that 90% of the forest biomass will be recoverable, yielding 19,800 BDT/year as practically available.

Interviews with southern Sierra Nevada contractors that manage forest fuels reduction operations confirmed that costs range from $35 to $45/BDT loaded onto the truck at the landing. Assuming a 10-mile one-way transport[13] from the forest to a biomass utilization facility near Mammoth Lakes, the delivered cost will range from approximately $46 to $56/BDT. Note that this cost estimate does not include cost offsets such as transportation cost incentives provided by USFS service contracts or grant funding.

The ESCCRP has garnered support from a range of stakeholders, including the Eastern Sierra Council of Governments (ESCOG). ESCOG is the fiscal agent for the NEPA planning effort in support of ESCCRP which is funded through the Eastern Sierra Pace & Scale Accelerator.

Eastern Sierra Pace & Scale Accelerator

In June 2021, the Eastern Sierra Council of Governments was awarded approximately $3.4 million from the California Department of Fish and Wildlife in support of the Eastern Sierra Pace & Scale Accelerator. The primary goal of the Accelerator is to complete the required National Environmental Policy Act analysis (NEPA) required as the planning step ahead of ESCCRP implementation. In addition, the Accelerator will support the buildup of regional capacity to conduct environmental planning in the Eastern Sierra. Appendix B provides an overview of the Eastern Sierra Pace & Scale Accelerator.

Inyo NF Land Management Plan

The Inyo National Forest issued an updated Land Management Plan (LMP) in September 2019. Each national forest is managed based on standards, guidelines and objectives laid out in each forest's LMP. LMPs are typically updated every 10 to 15 years and are produced as a result of a very structured planning process involving a range of stakeholders.

The Inyo LMP, Terrestrial Ecosystems and Vegetation section, includes an objective to:

"Restore species composition and structure on at least 20,000 acres of vegetation within 10 to 15 years following plan approval."[14]

Assuming this objective is implemented, then vegetation management/fuels treatment will occur on 1,333 to 2,000 acres per year.

[13] Chip transport costs average $110 per hour with a total roundtrip cost of $165 per delivery (1.5 hours). At 15 BDT per load, the haul cost is $11/BDT for the 20-mile roundtrip transport.
[14] Page 15 of the Inyo NF Land Management Plan.

Shared Stewardship Agreement

TSS anticipates that there will be additional forest fuels treatment projects (besides ESCCRP) on the Inyo National Forest. In August 2020, the state of California and the USFS signed the Shared Stewardship Agreement (see Appendix C for complete agreement) which sets out a coordinated strategy to increase the pace and scale of forest fuels treatment activities across the state. Ultimately, as laid out in the agreement, the state hopes to facilitate treatment of 500,000 acres/year of fuels treatment on private and state lands, with the USFS completing 500,000 acres/year of fuels treatment on federal lands. Considering that 4.4 million acres in California were impacted by wildfire in 2020 and over 2.2 million acres has been impacted year to date in 2021, the timing of this agreement is critical and when implemented, it will help make available forest biomass and sawlogs (including within the CFSA). The Inyo and Humboldt-Toiyabe National Forests will be part of the Shared Stewardship Agreement implementation, resulting in more acres treated and more forest biomass removed.

Forest Products Manufacturing Residuals

Forest products manufacturing residuals in the form of sawdust, bark, and chips represent a traditionally cost effective source of quality feedstock. Currently there are very few commercial forest products manufacturing operations in Mono County or Inyo County. The only facilities in the region that appear to be in consistent operation are a small sawmill and post/pole operation managed by GC Forest Products, located in the Town of Mammoth Lakes.

Interviews with the owner of GC Forest Products[15] confirmed that approximately 90 to 100 cubic yards (about 15 BDT) of manufacturing residuals (primarily sawdust, bark, slabs, post/pole peelings) are generated weekly between May and October. Some of this material is sold as landscape cover and some is currently transported to the Benton Crossing Landfill for disposal. For the purpose of this biomass feedstock availability analysis, TSS finds that approximately 360 BDT per year of forest manufacturing residuals are potentially and practically available.

Urban Wood

Tree service companies, local residents, and businesses in the Mammoth Lakes area regularly generate wood waste in the form of tree trimmings, construction wood, and woody debris from demolition projects. Much of this wood waste is currently deposited at the Benton Crossing Landfill, which is managed by the Mono County Solid Waste Division. Discussions with Solid Waste Division staff[16] indicated that the landfill receives volumes of wood waste on a year round basis. However, Benton Crossing landfill is slated for closure by the end of 2022 and wood waste is likely to be diverted to the Pumice Valley landfill and transfer station, although plans have not been finalized.[17]

[15] Greg Cook, Owner, GC Forest Products.
[16] Justin Nalder, Solid Waste Superintendent, Dave Campbell, Supervisor, Solid Waste Department, Mono County.
[17] Ibid. rt

Mono County staff provided historic data in the form of quarterly reports of waste collected countywide. County-managed landfills and transfer stations monitor incoming waste (including wood waste) by type for reporting to the state of California. TSS reviewed 2016 to 2020 quarterly reports and found that approximately 1,864 BDT/year of clean wood waste is received at county operations. Not all wood waste is recoverable, but because County Solid Waste Department staff has experience sorting and processing wood waste, it is likely that 90% of this wood waste (1,678 BDT/year) is practically available.

County staff is currently sorting and processing wood waste fuel for a county-owned biomass boiler thermal heating plant at the county's Bridgeport maintenance facility. Wood waste is currently sorted and processed for fuel at Benton Crossing, with about 100 BDT/year of fuel delivered to the Bridgeport facility.

Powerline Corridor Maintenance

Southern California Edison (SCE) maintains significant powerline infrastructure within the CFSA. SCE actively manages vegetation (including trees) along these powerlines in order to mitigate any potential tree/powerline interaction. A very robust vegetation management program has been in place since 2016. TSS conducted interviews with SCE staff[18] to discuss ongoing vegetation removal along powerlines. Due to recent vegetation management initiatives (known as the Heavy Tree Program), most of the heavy pruning and tree removal within the Mammoth Lakes region has been completed. However, there will be ongoing vegetation management, and SCE staff estimates that approximately 1,000 trees will be removed annually for the foreseeable future. TSS estimates that approximately 350 BDT/year of powerline vegetation maintenance material is potentially available. Not all of this material is readily accessible, as some of the powerlines are fairly remote. Assuming 70% of this material is accessible, approximately 245 BDT/year is considered practically available.

Seasonal Availability

Biomass fuel in the form of timber harvest residuals, forest fuels reduction residuals, urban wood waste, sawmill residuals and powerline vegetation maintenance are not necessarily available year round. Winter weather conditions within the greater Mammoth Lakes region are such that most all types of woody biomass fuel is available May through October. Urban wood waste is available year round; however, during winter months availability tends to drop off as construction and tree trimming activities are minimal.

Summary of Biomass Feedstock Availability

Utilizing findings from this analysis, TSS summarized biomass feedstock potentially and practically available. Posted below in Table 5 is a summary of biomass feedstock availability by type within the CFSA.

[18] Don Dukleth, Vegetation Manager and USFS Liaison, Southern California Edison.

Table 5. Feedstock Supply Potentially and Practically Available

	Timber Harvest Residuals (BDT/Yr)	Forest Fuels Reduction (BDT/Yr)	Forest Products Manufacturing Residuals (BDT/Yr)	Urban Wood (BDT/Yr)	Powerline Corridor Maintenance (BDT/Yr)	Totals (BDT/Yr)
Potentially Available	1,961	28,000	360	1,864	350	32,535
Practically Available	1,765	25,800	360	1,678	245	29,848

BIOMASS FEEDSTOCK COMPETITION ANALYSIS

Current competition for biomass fuel produced within the CFSA is primarily compost/soil amendment and landscape products. This competition is relatively minor and is served primarily by the Benton Crossing landfill operation. In addition, the county owned and operated biomass thermal heating boiler at Bridgeport takes in approximately 100 BDT/year as fuel (as discussed in the Urban Wood section of this report).

As for potential future competition, the Town of Mammoth Lakes has retained a consulting firm to complete a feasibility assessment to site a facility utilizing wood waste, organic waste, and biosolids for power generation and biochar production. Discussions with Town Of Mammoth Lakes staff[19] confirmed a high level of interest and a forecasted feedstock demand of up to 25,000 BDT/year needed for the potential biomass and solid waste conversion facility.

BIOMASS FEEDSTOCK SUPPLY PRICING

While sufficient biomass fuel is available to sustain a biomass power plant at Mammoth Lakes, the key question is at what price? There are relatively few existing markets for most of the biomass feedstocks available within the CFSA (see Competition Analysis above). Based on TSS experience and knowledge of the CFSA, estimates of delivered biomass fuel prices were calculated. Table 18 summarizes current biomass fuel (by type) market pricing (delivered to the end users).

[19] Daniel Holler, Town Manager, Town of Mammoth Lakes.

Table 6. Biomass Fuel Current Delivered Pricing by Fuel Type

Feedstock Type	Low Range ($/BDT)	High Range ($/BDT)	Average Delivered Price to Mammoth Lakes ($/BDT)
Timber Harvest Residuals	$50.00	$55.00	$52.50
Forest Fuels Reduction	$46.00	$56.00	$51.00
Forest Products Manufacturing Residuals	$10.00	$20.00	$15.00
Urban Wood	$10.00	$20.00	$15.00
Powerline Corridor Maintenance	$5.00	$10.00	$7.50

Note that the delivered price estimate includes collection, processing and transport costs. Forest fuels reduction feedstock does not include any cost adjustment for cost-share from USFS service contracts or stewardship agreements.

FUTURE FEEDSTOCK SUPPLY SOURCES AND RISKS

Additional Feedstock Sources

Summarized below are factors that will influence additional woody biomass feedstock supply across the CFSA in the coming years.

Closure of Benton Crossing Landfill

The Benton Crossing Landfill is projected to close Q4 2022. One of the alternative waste disposal options being considered by Mono County is the transport of municipal solid waste to the Lockwood Landfill. Located in Sparks, Nevada, the Lockwood Landfill is not far from Reno, Nevada. There may be an opportunity to backhaul urban wood from Reno to Mammoth Lakes.

Feedstock Supply Chain Risks

Potential woody biomass feedstock supply chain risks are summarized below.

Potential Feedstock Competition

As noted earlier in this report, the Town of Mammoth Lakes is considering installation of a community-scale biomass and solid waste to power generation facility. Discussions with the Town confirm that this facility could utilize up to 25,000 BDT/year of feedstock. In addition to power, the town would like to produce biochar.

Seasonal Availability of Forest Feedstocks

As noted earlier in this report, forest operations are typically seasonal (May through October) within the CFSA. Inclement weather conditions (rain/snow) will impact operations. In addition, timber harvest operations and fuels treatment activities will be curtailed during high fire hazard conditions (high temperatures/low humidity/high winds). Onsite storage of feedstock should be scaled to accommodate seven months of operations. Storage of logs onsite is an alternative to consider, as logs are very stable (do not oxidize easily like wood chips) and can be stored (decked) for multiple years.

Feedstock Transport Cost

The cost of transport represents the most significant expense when procuring biomass feedstocks. Variables such as diesel fuel cost (currently at $4.37+/gallon),[20] workers compensation expense and maintaining a workforce (finding drivers) are all factors that significantly impact the cost to transport commodities such as biomass fuel. Interviews with forest feedstock processors confirms that transport costs are now ranging from $110 to $125/hour. Diesel fuel costs are currently the single most significant risk factor impacting transport costs.

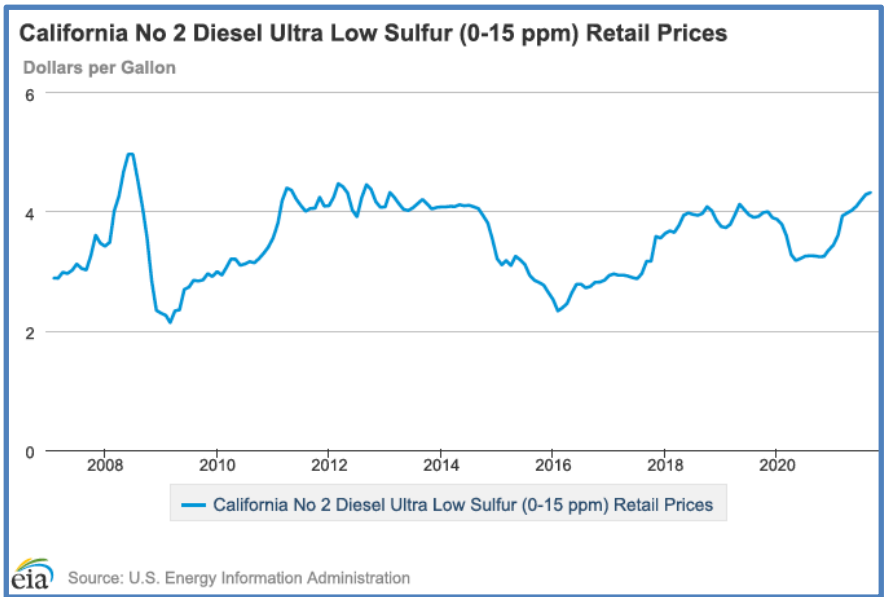
Diesel Fuel Cost

As noted above, the cost of diesel is a major cost variable. Most of the equipment utilized to harvest, collect, process and transport biomass feedstock utilizes diesel fuel. Analysis previously conducted by TSS confirms that a $1.00/gallon increase in diesel fuel pricing will increase the cost of delivered urban wood fuel by $1.88/BDT and for forest fuel $2.25/BDT.[21]

Posted below in Figure 7 are 2008 through 2020 California retail diesel fuel prices.

[20] October 4, 2021 pricing for California, as reported by the Energy Information Administration.
[21] This assumes 75-mile round trip transport distance.

Figure 7. California Retail Diesel Fuel Prices 2008 through 2020



As noted in Figure 7, diesel fuel costs will fluctuate over time.

Labor Cost

Labor cost is a significant cost variable. Skilled workers demand price competitive wages. Discussions with contractors in the Mammoth Lakes region confirmed that recruiting skilled labor is a challenge. In addition, the cost of living within the region is significant as the area is a major recreation destination. Median household income for the town of Mammoth Lakes is $59,620.[22] In addition, median home costs in the region are quite elevated, and come in at $557,875[23] for a single family residence. Discussions with local contactors confirms skilled labor rates ranging from $20 to $24/hour (entry level pay scale).

Biomass Feedstock Cost

The delivered cost of biomass feedstock is sensitive to external factors such as the cost of skilled labor and diesel fuel pricing. These represent the two most potentially impactful economic risks and both are accounted for in the five-year forecast by escalating delivered fuel cost by 1.5%/year. TSS has found this escalation factor to be appropriate and indicative of market conditions over time.

High-Severity Wildfire

Wildfire is a very real threat throughout the Sierra Nevada range, including the Mammoth Lakes region. There may be an opportunity to utilize forest material damaged by fire (a common

[22] 2019 data as reported by the US Census Bureau.
[23] https://www.zillow.com/mammoth-lakes-ca/home-values/

practice throughout the Sierra Nevada), however, this is not an assured outcome. Alternative forest feedstock sources, located outside the CFSA[24] could serve as viable backup sources.

Risk Analysis

TSS conducted a risk analysis addressing feedstock supply risks, including likelihood of occurrence and mitigation measures. Table 7 summarizes the risk analysis findings.

Table 7. Feedstock Risk Analysis Findings

Risk	Likelihood of Occurrence			Mitigation
	Low	Medium	High	
Potential Feedstock Competition	X			Consider joint venture with TOML.
Seasonal Feedstock Availability			X	Establish seven-month fuel inventory capacity onsite. Store logs onsite.
Feedstock Transport Cost		X		Work with transport contractors to assure use of fuel efficient equipment.
Diesel Fuel Cost		X		Work with transport contractors to assure use of fuel efficient equipment.
Labor Cost		X		Actively develop local workforce.
Biomass Feedstock Cost		X		Consider long-term feedstock purchase agreements.
High-Severity Wildfire		X		Monitor alternative feedstock sources located outside of the CFSA.

FIVE-YEAR FUEL PRICING FORECAST

TSS completed a five-year biomass fuel pricing forecast for a biomass power generation facility with an annual fuel demand of 24,000 BDT/year.

Fuel Supply Pricing Forecast

Summarized in Table 8 is the 2023 biomass fuel blend for a facility utilizing 24,000 BDT/year.

[24] Marine Corp Mountain Warfare Training Center Forest Restoration Project on the Humboldt-Toiyabe National Forest. 18,000 acres are targeted for fuels reduction treatment.

Table 8. 2023 Biomass Fuel Blend and Pricing

Fuel Type	Volume (BDT/Year)	Percent of Total	$/BDT
Timber Harvest Residuals	1,000	4%	$52.50
Forest Fuels Reduction	21,600	90%	$51.00
Forest Products Manufacturing Residuals	300	1%	$15.00
Urban Wood	900	4%	$15.00
Powerline Corridor Maintenance	200	1%	$7.50
Total	**24,000**	100%	
Blended Fuel Pricing			**$48.90**

Assumptions used to generate the base case scenario estimate are as follows.

- All feedstock pricing reflects delivery of 3" minus material.
- Feedstock usage is 24,000 BDT/year.
- Fuel is primarily sourced from suppliers located within the CFSA.
- Forest fuels reduction feedstock does not include any cost adjustment for cost-share from USFS service contracts or stewardship agreements.
- Delivered feedstock prices escalate at 1.5%/year commencing in 2024 to reflect increased diesel and labor costs over time.

Five-Year Fuel Cost Forecast

Summarized in Table 9 is the five-year biomass fuel price forecast for feedstock delivered to Mammoth Lakes.

Table 9. 2023 to 2027 Fuel Price Forecast

Year	2023 ($/BDT)	2024 ($/BDT)	2025 ($/BDT)	2026 ($/BDT)	2027 ($/BDT)
	$48.90	$49.63	$50.38	$51.13	$51.90

CONCLUSIONS

The CFSA is dominated by forest acreage managed by federal agencies: the USFS (83%) and BLM (11%) as noted in Table 3. Biomass feedstock supply availability will rise and fall based on vegetation management decisions made primarily by the USFS – Inyo National Forest.

Considering feedstock supply availability, TSS found that approximately 30,000 BDT/year is practically available. Approximately 66% of the practically available feedstock supply is sourced from the Inyo National Forest (see Table 5).

RECOMMENDATIONS

Summarized below are recommendations regarding key factors to consider when siting a biomass utilization facility within the Mammoth Lakes region.

Workforce Development

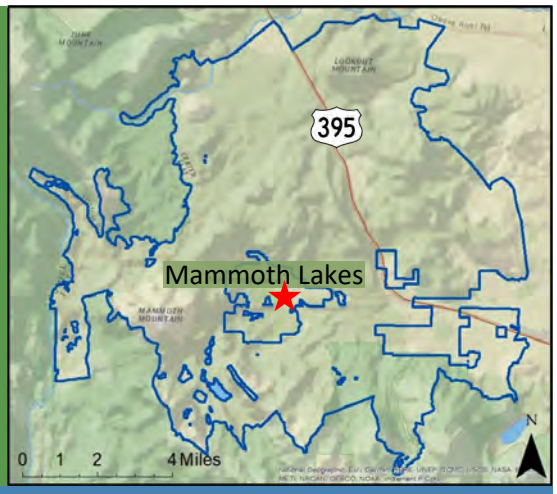
The skilled labor required to conduct forest fuels reduction and restoration within the Mammoth Lakes region will be significant. Plumas Corp and the other stakeholders supporting the ESCCRP are developing a Timber Contractor Workforce Development Work Plan, and hope to implement the work plan commencing 2022. TSS applauds this effort, as a skilled workforce is critical to successful forest restoration efforts. In addition, training (and hiring) local workers will create good will within the Mammoth Lakes community.

Sizing of Value-Added Utilization Facility

A key finding of this feedstock supply availability and cost analysis is that approximately 30,000 BDT/year is practically available. TSS recommends that a community-scale facility built to utilize 24,000 BDT/year represents a long-term sustainable scale.

Appendix A. Eastern Sierra Climate & Communities Resilience Project

EASTERN SIERRA CLIMATE & COMMUNITIES RESILIENCE PROJECT



A BOLD AND PROACTIVE STEP TOWARDS CLIMATE RESILIENCE IN THE EASTERN SIERRA

ABOUT THE ESCCRP

The project sets forth to plan for ecological forest restoration on over 55,000 acres surrounding the Town of Mammoth Lakes. In the face of rapidly increasing climate stressors, the need for proactive forest management action is urgent. Supported by a robust stakeholder group that shares a vision to promote both community and ecological resilience, the ESCCRP is in its early planning phases.

CURRENT FOREST CONDITIONS

- Overstocked forests propelled by our national history of fire suppression
- Declining forest health resulting in a landscape highly susceptible to climate stressors and primed for catastrophic wildfire
- Large fuel loads allow fires to burn at high severity over vast areas with limited options for suppression

Declining forest health across the West, coupled with a rapidly intensifying wildfire trajectory fueled by climate change, continue to underscore the imperative need for increased pace and scale of proactive vegetation management.

SCAN ME

www.eswildfirealliance.org/esccrp

PROJECT GOALS

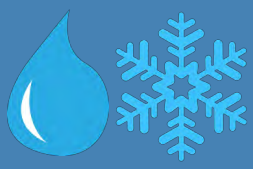
1. Protect the Town of Mammoth Lakes
2. Allow for Safe and Effective Fire Management
3. Promote Community Fire Resilience
4. Restore Ecosystem Health and Resilience
5. Use Best Available Science
6. Create a Fire-Conscious Community
7. Cultivate Long-Term, Sustainable Partnerships
8. Build Local Capacity

FORESTS ARE AT RISK

In the past, fire maintained Sierra Nevada landscapes. Now, with more than a century of fire suppression, many forested areas have missed multiple natural fire cycles, resulting in historic fuel accumulation that leads to more severe fires that are difficult and dangerous to fight. The absence of fire, combined with other climate driven factors, has led to an increase in fire severity when fire inevitably returns to the landscape. This situation leaves both forests and local communities at risk of catastrophic loss.

BENEFITS OF HEALTHY FORESTS

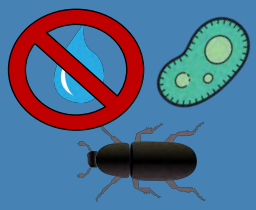
Ecosystem services offered by healthy forests provide immense economic, social, and ecosystem value.



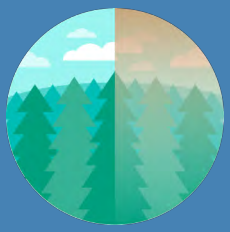
WATER QUALITY & SUPPLY

FISH & WILDLIFE HABITAT

REDUCED WILDFIRE RISK



MORE RESILIENT TO STRESSORS



AIR QUALITY

CARBON SEQUESTRATION

RECREATION VALUE

STRONG COMMUNITIES

SPIRITUAL VALUE

ROAD TO RESILIENCE

The Eastern Sierra Climate & Communities Resilience Project (ESCCRP) aims to intercept declining forest health in the Eastern Sierra. Our project seeks to safeguard the priceless ecosystem services of this landscape and the livelihoods of local communities. Through landscape scale forest restoration and strategic prescribed fire, the project will return natural processes to the declining forest landscapes surrounding Mammoth Lakes and put the Eastern Sierra on the path to achieving regional resilience.

Appendix B. Eastern Sierra Pace & Scale Accelerator



EASTERN SIERRA PACE & SCALE ACCELERATOR

Meeting Environmental Restoration Needs of the Eastern

Eastern Sierra Pace & Scale Accelerator

Eastern Sierra Council of Governments

Ecosystem Health

Regional Forest & Fire Capacity Program
Community Wildfire Protection + Watershed Restoration

Regional Prioritized Projects

Sustainable Recreation

Sustainable Recreation and Tourism Initiative & Eastern Sierra Sustainable Recreation Partnership

Regional Prioritized Projects

#1 Priority Rec projects

Strategic Partner Investments

NEPA

Third Party Interdisciplinary Environmental Planning Team

NEPA

Implementation Ready Projects (#1=ESCCRP)

Eastern Sierra Climate & Communities Resilience Project (ESCCRP)

Grants + Private Investments

Biomass Utilization Technology

ESCCRP Ad Hoc Focal Team Action Plan Implementation

Managing Headwaters for Multiple Benefits

- Forest health
- Diverse fish and wildlife habitat
- Water supply
- Water quality
- Air quality
- Carbon sequestration
- Sustainable recreation

Eastern Sierra Forests
"Roadmap to Resilience"

Forest Resiliency

Pre-European Montane Forests

FIRE PRESENT

natural fire regime

MODERATED FUEL LOADS

FOREST HETEROGENITY

"BENEFICIAL"
- low/moderate severity
- frequent fire

BIODIVERSITY
NUTRIENTS
HABITAT
VIGOR

Increase available resources

Decrease available resources

Return to Resilience

Post-European Montane Forests

FIRE ABSENT

75-100+ years of suppression

INCREASING FUEL LOADS

FOREST HOMOGENITY

"CATASTROPHIC"
- high severity
- infrequent fire

BIODIVERSITY
NUTRIENTS
HABITAT
VIGOR

Managed Natural Ignitions

Rx fire

Mechanical Tx

Accelerator Goals

Complete NEPA for the Eastern Sierra Climate & Communities Resilience Project (ESCCRP)

Build Regional Capacity to Support Pace & Scale Environmental Planning Needs in the Eastern Sierra

Use science and technology to maximize understanding of the project benefits and guide appropriate adaptive management response.

Ensure ESCCRP is implementation ready upon NEPA Decision

Accelerator Scope of work

Task 1

Project Management & Administration

Task 2

Build Regional Capacity to Conduct Environmental Planning

Task 3

Conduct NEPA Analysis ESCCRP

- Field surveys
- Specialist reports
- Environmental Assessment
- Decision document

Task 4

Prepare ESCCRP for implementation

- Biomass planning advancement
- CEQA planning prep
- Monitoring Plan development
- Outreach & Education
- Finance & Marketing Plan
- Local workforce development

Total Budget Request *(Draft)* $3,715,329

- ESCOG Admin $117,750
- Project Management $ 264,000
- Environmental Services $2,631,016
- INF Staff Time $289,733
- Implementation Preparations $364,280
- Biomass Planning Advancement $229,940
- ESCOG Indirect Cost Recovery $48,550

Appendix C. Shared Stewardship Agreement

AGREEMENT FOR SHARED STEWARDSHIP OF CALIFORNIA'S FOREST AND RANGELANDS
Between the
STATE OF CALIFORNIA
And the
USDA, FOREST SERVICE
PACIFIC SOUTHWEST REGION

This MEMORANDUM OF UNDERSTANDING (MOU) is hereby made and entered into by and between the State of California, hereinafter referred to as "the State," and the United States Department of Agriculture (USDA), Forest Service, Pacific Southwest Region, hereinafter referred to as "the U.S. Forest Service" and together referred to as "The Parties."

TITLE: Agreement for Shared Stewardship of California's Forests and Rangelands

PURPOSE:

This MOU establishes a joint framework to enhance science-based forest and rangeland stewardship in California. The U.S. Forest Service and the State of California commit to maintain and restore healthy forests and rangelands that reduce public safety risks, protect natural and built infrastructure, and enhance ecological habitat and biological diversity. The Parties agree to develop shared tools, coordinated processes, and innovative approaches to increase the pace, scale, and effectiveness of forest and rangeland stewardship in California.

The U.S. Forest Service and the State of California, through the California Natural Resources Agency, make this commitment in accordance with the following provisions.

STATEMENT OF MUTUAL BENEFIT AND INTERESTS:

Restoring healthy forests and rangelands in California will yield both ecological and community benefits. Healthy forests will improve climate resilience and reduce the risk of catastrophic wildfire, safeguard water quality and air quality, protect fish and wildlife habitat, enhance biological diversity, sequester carbon, improve recreational opportunities, and generate good jobs and economic opportunities.

BACKGROUND:
Home to some of the largest, tallest and oldest trees in the world, rich biological diversity, vast watersheds, and spectacular recreation, the grandeur of California's wildlands has captivated generations. California's forests naturally adapted to low-intensity fire, nature's preferred management tool, but Gold Rush-era clearcutting followed by a wholesale policy of fire suppression resulted in the overly dense, ailing forests that dominate the landscape today.

Compounding risks have made it nearly impossible for nature to self-correct. A cycle of catastrophic wildfires, longer fire seasons, severe drought, intense wind, tree mortality, invasive species, and human population pressure threaten to convert conifer forests to shrublands and shrublands to invasive grasses.

The health and wellbeing of California communities and ecosystems depend on urgent and effective forest and rangeland stewardship to restore resilient and diverse ecosystems.

With California's landscape heavily divided among multiple landowners, coordinated stewardship is critical to success. The U.S. Forest Service's Pacific Southwest Region manages over 20 million acres across 18 National Forests in California. The State of California has nearly14 million acres of private or state-owned forested lands within its jurisdiction. Together this represents over one-third of California's landmass.

In August 2018, the USDA announced a new Shared Stewardship Investment Strategy, committing to establish shared stewardship agreements with state partners throughout the nation. The USDA strategy outlined three core elements:

1. Manage together. Establish a joint forest stewardship plan to combine capacity and assets to achieve shared goals across jurisdictions.

2. Do the right work in the right places at the right scale. Identify and prioritize forest treatments and other investments that can do the most good to protect the most vulnerable communities, watersheds, fish and wildlife habitat, and economies.

3. Use all available tools for better stewardship. Utilize all available authorities, investments and programs to do more work on the ground, which includes carefully managed fire, appropriate timber harvest, non-commercial mechanical treatments, infrastructure maintenance and improvement, and other habitat and watershed restoration activities. Work with partners and stakeholders to utilize appropriate tools for each project.

California's Shared Stewardship Agreement will enable the Parties to increase pace and scale of science-based forest and rangeland stewardship efforts, and better protect California's people, infrastructure, and ecosystems. It is incumbent upon us to restore California's forest through stewardship that returns natural fire regimes to the landscape and restores the natural functions of California's ecosystems.

PRINCIPLES:

1. **Utilize Science:** Use science to inform and prioritize stewardship decisions. Adapt stewardship tools and techniques around improvements in scientific understanding. Support long-term research and studies to deepen our understanding of forest management. Use the best technology and tools to acquire accurate and detailed data. Share data, maps, and analyses and assess any gaps or duplication. Apply this science to all management techniques to ensure the right management plan support the right ecology, including taking into account California's wide variance in fire return intervals for shrublands vs. conifer forests.

2. **Prioritize Community Safety and Ecology:** Manage risk across broad landscapes by prioritizing vulnerable communities and ecosystems for improved fire suppression and

prevention capabilities. Protect vulnerable communities by expanding wildfire risk models beyond fire-prone topography and vegetation to include socioeconomic factors such as age, car ownership, disability, and ingress or egress corridors that hinder evacuation. Ensure that all management plans and projects incorporate ecological goals and protections to avoid solving one problem by creating another.

3. **Improve Efficiency:** Adopt efficiencies and streamlined regulatory procedures to quickly and effectively complete environmental review while maintaining environmental safeguards and opportunities for public engagement. Streamline and synchronize permits through on-line permitting systems. Utilize all tools available including but not limited to, state-delivered landowner technical assistance, forest health assistance, wildland fire suppression, prescribed fire, State and private forestry programs, Good Neighbor Authority and other Farm Bill authorities.

4. **Scale Up Ecologically-based Forestry Across Sectors:** Evaluate and deploy available resources such as staff and funding for targeted investment to help local governments, small landowners, tribal governments, and businesses scale up sustainable ecological forest management efforts that deliver multiple ecological and social co-benefits. Explore opportunities to leverage public-private partnerships and investments. Government investments should act as a force multiplier for private and local funds.

5. **Coordinate Land Management:** Wildfires don't stop at jurisdictional boundaries. Work with landowners, including small landowners, tribal governments, utility companies and owners of road rights-of-way to promote consistent, efficient, economic and environmental forest stewardship across a contiguous landscape.

6. **Collaborate and Innovate with all Stakeholders:** Utilizing the Governor's Forest Management Task Force, coordinate and collaborate with environmental and non-governmental organizations, academic institutions and other federal and state agencies, tribal governments, local governments, and private landowners. Consistent and clear communication and collaboration will result in more effective policy outcomes, foster better public understanding, encourage constructive engagement across multiple stakeholders and promote effective stewardship, problem-solving and decision-making. The Parties will embrace new thinking, innovation, and take measured risks to seize opportunities for shared success.

ACTIONS:

The Parties commit to the following actions to advance shared stewardship opportunities:

1. **Treat One Million Acres per Year:** The Parties will scale up vegetation treatment to one million acres of forest and wildlands annually by 2025, committing to each sustainably treat 500,000 acres per year. Treatments will follow a joint plan and will be driven by public safety and ecological goals including reducing wildfire impacts in high priority areas and maintaining or restoring healthy, resilient forests and rangelands.

2. **Develop a Joint Plan:** The Parties will develop a coordinated, statewide, 20-year project plan by 2021 for forest and vegetation management. This plan will be based on landscape level analysis, risk assessment and other relevant methods and will be updated at five-year intervals. This plan will be captured on a master map that includes recently completed, ongoing and planned vegetation management and forest thinning projects across State, Federal and private landowners. This project map will overlay landscape level risk assessments including ecological, wildfire and community risks, identifying any gaps and highlighting the highest priority areas. The Parties will consult with, and seek input from, tribal governments, local governments, other state and federal agencies, NGOs and other stakeholders in developing and updating this map. This map will be shared publicly to foster coordinated planning, dialogue and feedback among community and environmental stakeholders.

3. **Use Sustainable Vegetation Treatments:** The Parties will use science-based management to ensure vegetation treatment tools are ecologically appropriate to specific vegetation and landscapes. Treatments will include thinning in excessively dense stands, timber harvesting, mechanical fuel reduction, prescribed fire, grazing, and reforestation.

    a. Expand Prescribed Fire: Expanding and accelerating the use of prescribed fire is key to effective stewardship at scale. The Parties will build public awareness about prescribed fire and develop tools to support expanding natural fire on the landscape.

    b. World Class Research Forests: To effectively monitor treatment types and climate change, the Parties will establish a world-class monitoring and research program. Coordinating and expanding the existing network of 50-plus experimental forests in California, the Parties will partner with state and national parks, universities, and non-profits. Future sites can focus on non-forested areas like Southern California chaparral systems, ensuring that treatments are ecologically appropriate for non-conifer ecosystems.

4. **Expand Forest Management and Associated Infrastructure:** To increase the pace and scale of forest stewardship, especially for small landowners, the entire infrastructure behind forestry and vegetation management will need to expand, including the workforce, investments in projects and equipment, and technical support for small landowners to manage their land.

    a. Improve Sustainable Timber Harvest: Californians purchase 7 billion board feet of lumber annually, but only 2 billion board feet is produced in the state. Given that California has some of the highest environmental standards for timber harvest in the world, producing California lumber could decrease demand for timber harvested with lower ecological standards. Given California's increasing housing needs and greenhouse gas emission goals, California has a direct interest in consuming ecologically sourced lumber. Improving ecologically and financially sustainable timber harvest in California will support rural economies, reduce transportation emissions from imported lumber, stem conversion of forestland to developments, improve air and water quality, promote carbon sequestration, protect biodiversity and

most importantly reduce wildfire risk.

To enable landowners to better harvest and thin their forestland, the Parties will work to streamline permitting, support public-private partnerships, continue to incorporate the latest science-based management standards and provide technical support to help small landowners design and execute timber harvest. The Parties will explore incentives for ecologically beneficial harvest outcomes like multi-age class stands, stable carbon storage, and biological diversity. The Parties will identify tools to promote timber as a California agricultural product using labels like "California Grown" and better integrate timber into policies that prevent conversion of agricultural land. The Parties can also better support landowners adjacent to or within State or Federal land to achieve contiguous forest health.

b. Increase Access to Capital: Shortages of equipment and resources for forest treatment is driving up the price per acre and slowing California's capacity to restore forests. Parties will explore ways to incentivize investment in vegetation treatment equipment like masticators, chippers, and bulldozers and forest products processing facilities like mills. Parties will also support finance mechanisms like loan guarantees, revolving loan funds, and cooperative models to attract private investment.

c. Grow the Workforce: The Parties will support training and workforce development to increase the current labor pool available to meet the challenge of forest management, forest health and fuels reduction. The Parties will develop career pathways into forestry through high schools, community colleges, the California Conservation Corps, local certified conservation corps, and the Public Land Corps. Parties will promote alternative education venues such as vocational training targeted to specific professions such as timber faller, heavy machine operator, vegetation treatment crews, and ecological restorationists. State and Federal entities will work to avoid bottlenecks or oversight gaps.

d. Expand Landowner Agreements: Build on the existing fuels reduction MOUs and Good Neighbor Authority agreements to achieve efficiencies and increase support in forest and rangeland stewardship. Expand MOUs to include local governments, tribal governments, utility companies, consortiums of small landowners, and owners of road rights-of-way, like CalTrans and County Governments.

5. **Promote Ecological Co-Benefits:** In addition to public safety, recreation, job creation, and economic opportunity, restoring the ecological function of California forests will yield multiple ecological co-benefits. These include habitat protection, watershed health, air quality, and carbon sequestration.

    a. Protect Biodiversity: California is a world biodiversity hotspot. Among the 50 states, California is home to more species of plants and animals and the highest number of species found nowhere else. Protecting and fostering that diversity is both fundamental to the citizens of California and will help to reduce wildfire risk. The California Biodiversity Initiative highlights state agencies roles to understand the

threats to biodiversity, protect native species, manage natural and working lands to promote biodiversity, and promote partnerships to achieve biodiversity protection. The Parties will incorporate increased biodiversity into forest management plans and prioritize vulnerable habitats and species for protection and restoration.

b. Protect Water Resources: California's forested watersheds function as critical natural infrastructure for wildlife and people. Catastrophic wildfire devastates both the natural and built infrastructure endangering California's drinking water. By prioritizing vulnerable watersheds for restoration and vegetation treatment, our work will protect and purify California's water supply for communities, agriculture, and critical fish and wildlife habitat. Much of California's physical water infrastructure including reservoirs and pipelines run through high risk fire zones. The Parties will focus on protecting water systems against damaging wildfire effects from the forest to the faucet.

c. Carbon Sequestration: The mega-fire phenomenon has turned California's forests into carbon emitters rather than carbon sinks. Well-managed forests provide a significant source of stable carbon storage. The Parties will manage for carbon sequestration by thinning dense stands and undergrowth and promoting growth of large trees, which provide hundreds of years of carbon storage. The Parties will work with experts like the California Air Resources Board to establish forest-specific carbon accounting techniques to incentivize stable carbon storage.

6. **Develop Markets for Wood Products and Recycle Forest Byproducts:** The byproduct of forest management projects are limbs and small trees referred to as woody biomass. Currently woody biomass is either piled and burned in the forest or left to rot, diminishing air quality, increasing wildfire risk, or emitting green-house gasses. As pace and scale of forest management increases, it is imperative to develop cleaner and more sustainable alternative uses for woody biomass. Developing markets for wood products includes:

   a. Innovation: The Parties will explore innovative uses for wood products and establish a strategy to signal, subsidize, or incubate alternate uses for woody biomass products. Innovative products like cross-laminated timber, gasification, or cellular reconstruction, sequester carbon or provide carbon-efficient alternatives to fossil fuels and building materials such as steel and concrete.

   b. Biomass Energy: To avoid mass pile-burning, biomass energy will be a key component of forest recycling. To site or support new facilities, the Parties will use the principles of right scale, right place, right technology taking externalities into account like air quality impact, environmental justice, and wildfire avoidance. The Parties will help identify and untangle market distortions, inefficiencies, and obstacles to the use of forest waste for alternative energy.

   c. Supply Signals: Investors are unlikely to build wood product facilities for logs, small logs, and woody biomass without a sustainable, uninterrupted raw material supply. The Parties will make their Joint Plan public so investors will know when and where

wood supply will be available. The Parties will work with stakeholders to develop additional supply signal tools to guarantee multi-year supply contracts and incentivize new investments in wood processing facilities in California.

7. **Improve Access to Sustainable Recreation:** Foster a range of forest and wildland opportunities that reflect the needs of and better serve California's diverse population. The Parties will pursue mission-appropriate and sustainable recreation opportunities in ways that leverage resources and extend capacity through partnerships and alignment around a shared vision of access and diversity. Examples include improved transportation opportunities, more affordable lodging options, increasing accessible trails and facilities, and targeting low income communities that lack access.

8. **Fire-Adapted Communities:** Identify and protect communities most vulnerable to fire impacts. These vulnerability factors include proximity to high fire risk, communities without good ingress or egress corridors and socioeconomic factors that hinder evacuation such as age or car ownership. The Parties will work together to improve fire suppression and fire prevention capabilities that safeguard communities, including but not limited to, these vulnerable populations.

9. **Advance Science and Share Monitoring and Data Analytics**: Leverage scientific expertise and capacity to maintain healthy and resilient forests in a changing climate. Coordinated data will enable stakeholders to adapt priorities and management techniques to the dynamics of California's changing ecosystems. The Parties will:

    a. Consolidate Data: Consider co-locating data teams from State and Federal agencies to reduce redundancy and improve efficiency. Establish joint monitoring methods, joint protocols, and work on developing a single, statewide shared data set that all Parties can utilize and update.

    b. Ecological Monitoring: Consistently monitor forest health, carbon sequestration, biological diversity, watershed quality, and other parameters that impact forest and wildlands in California. The Parties will coordinate closely with environmental organizations and universities to ensure monitoring techniques are addressing the most current ecological concerns.

    c. Research and Innovation: Support long-term research and monitoring efforts. Enhance surveying and monitoring programs such as the Forest Inventory and Analysis program with joint funding contributions, allowing a greater number of monitoring installations to be remeasured more frequently.

MUTUAL UNDERSTANDING AND AGREEMENT BETWEEN THE PARTIES:

A. The Parties are bound by all applicable federal, state, and local statutes and regulations. If conflicts arise, the Parties will evaluate how authorities can best achieve the goals of a project.

B. The Parties will protect sacred sites and preserve cultural resources and take all necessary actions to protect data collected from Native American tribes.

C. All Parties will communicate on a regular basis to enhance and develop the institutional arrangements necessary to facilitate the purposes of this MOU.

D. The Parties will meet at least twice a year to evaluate progress on the MOU and will meet regularly with stakeholders including the environmental community, local government, tribal governments, and industry.

NONBINDING AGREEMENT. This MOU creates no right, benefit, or trust responsibility, substantive or procedural, enforceable by law or equity. The Parties shall manage their respective resources and activities in a separate, coordinated, and mutually beneficial manner to meet the purpose(s) of this MOU. Nothing in this MOU authorizes or requires either of the Parties to obligate or transfer anything of value.
Specific, prospective projects or activities that involve the transfer of funds, services, property, and/or anything of value to, from, or between the Parties requires the execution of separate agreements and are contingent upon numerous factors, including, as applicable, but not limited to: availability of appropriated funds and other resources and administrative, regulatory, and legal requirements (including authorization by statute). This MOU neither provides, nor meets these criteria. If the Parties elect to enter into an obligation agreement that involves the transfer of funds, services, property, and/or anything of value to, from, or between the Parties, then the applicable criteria must be met. Additionally, under a prospective agreement, each party operates under its own laws, regulations, and/or policies, and any obligation of the Parties is subject to the availability of appropriated funds and other resources. The negotiation, execution, and administration of these prospective agreements must comply with all applicable authorities.
Nothing in this MOU is intended to alter, limit, or expand the Parties' statutory and regulatory authority.

I. **AUTHORIZED REPRESENTATIVES**

Gavin Newsom, California Governor

Victoria C. Christiansen 8/12/2020
Victoria C. Christiansen, Chief, US Forest Service

8/12/20
Randy Moore, Regional Forester Pacific Southwest Region

8/12/2020
Frank R. Beum, Acting Regional Forester, Intermountain Region

8/12/20
Wade Crowfoot, California Natural Resources Agency Secretary