SHU Lightening Complex Fire
CA-SHU-004727

State Emergency Assessment Team (SEAT)

DRAFT

Affected Watersheds in Shasta County California

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DISCLAIMER

The scope of the assessment and the information contained in this report should not be construed to be either comprehensive or conclusive, or to address all possible impacts that might be ascribed to the fire effect. Post fire effects in each area are unique and subject to a variety of physical and climatic factors which cannot be accurately predicted. The information in this report was developed from cursory field examination by licensed resource professionals and should be viewed in conjunction with other relevant sources of information. Neither the State of California nor any other Agency or Department participating as a member of the State Emergency Assessment Team (SEAT) makes any warranty, expressed or implied, nor assumes any legal liability for the information disclosed herein.

EXECUTIVE SUMMARY

On the evening of June 20, 2008, a significant lightning storm entered Shasta County in Northern California. The storm, which did not pass until June 23, caused approximately 5,000 lightning strikes resulting in more than 150 confirmed fires within Shasta County and the eastern portion of neighboring Trinity County. The majority of the fires were quickly contained. However, some became larger fires and took several weeks to contain. This incident was called the Shasta Lightning Complex.

As a result of damages to Federally Responsibility Area Lands, a Federally sponsored interagency Burned Area Emergency Response (BAER) team was dispatched. The BAER team assessed the Motion, Moon, Deerlick, Deck, and Noble fires within Shasta County and issued a draft report of its findings on August 14, 2008.

On August 17, 2008 a State Emergency Assessment Team (SEAT) was deployed to assess the values at risk for the fires that occurred on State Responsibility Area and private lands. Among the post-fire assessments completed by the SEAT for the Shasta Lightening Complex Fire and other Shasta County fires, were the geological and watershed assessments. The purpose of these assessments was to identify potential threats caused from land slides, debris torrents, flooding and road hazards. In addition, these assessments became integral in identifying the associated potential threats of excessive erosion, and impaired water quality, and potential damage to wildlife, fisheries, botanical values and cultural resources. This information, along with the substantial work previously accomplished by the BAER team, was then utilized in developing some of the possible mitigation measures that might reduce or eliminate the threat to life, safety, property and natural resources.

The areas surveyed by the SEAT were selected based upon the analysis of available remotely sensed imagery, maps, publications, and documents, as well as consultation with individuals familiar with the fire areas and local communities. The fires considered in this report include the Motion, Moon, Deerlick, Noble, Deck, Kirkman, Withrow, Shingletown, Pine, Stein, and Venture fires. Three additional fires in eastern Shasta County, Backbone, Little, and Round, were excluded from field investigation because the fires occurred in isolated areas on comparatively gentle topography with generally low burn intensities.

Values at Risk

The SEAT considered the values at risk over approximately 93,000 acres of impacted lands located throughout Shasta County, but primarily on lands situated west of Redding.

The likelihood of an event occurring which would potentially be a threat to values at risk were evaluated on a scale of low rating (possibility of occurrence), a moderate rating (event is likely), and a high rating (near inevitability of the event or effect occurring). While most threats arise from pre-existing conditions which have been exacerbated by fire effects, some threats are directly attributable to fire effects alone.

A. Threats to Human Life, Property, and Infrastructure

The principal concern within the Shasta Lightning Complex, as with most fires, is the increased potential for in-channel floods and for debris slides, flows, and torrents that can adversely affect life, property, and natural resources.

As a result of its assessments, the SEAT identified the following primary threats:

- Damage or destruction from potential debris flows and floods to property improvements situated in low lying areas adjacent to stream channels; and
- Damage to or loss of watercourse crossings and drainage facilities due to the same mechanisms.

B. Risk to the Environment

In its assessments of the burn area, the SEAT identified potential risks to environmental quality. While many risks to the environment are independent of any other risks, many were identified as secondary effects from two sources. The first is a secondary result of direct damage to property. The second is effects generated by collateral and unavoidable damage caused by conducting mitigations and property protection measures (i.e. channel simplification for flood control may impact riparian habitat).

C. Watershed Evaluation

Where fires burned hot, such as in the upper elevations of the Moon Fire, the reduction in rainfall interception from the lack of vegetation may interact with the development of hydrophobic soils. However, hydrophobic soils were not found to be either extensive or contiguous over a significant area. Thus, the influence of hydrophobic soils was deemed slight compared to the larger effect from loss of vegetation and organic surface cover. In the more limited areas of severely burned watersheds and sub-basins it is still reasonable to expect an increase in risk of flooding, debris torrents, landslides, and mudslides where underlying geology, soils, topography, and weather come together synergistically. Detailed examination of hydrology is contained in the Federal Interagency BAER report. Neither a soil scientist nor a hydrologist was assigned to the Shasta SEAT although some of the technical specialists have expertise in these fields.

Overall Findings

The fires reviewed by the SEAT burned over a total of 93,000 acres. Burn severity corresponded with fuel type, aspect, and topography. Most of the severely burned area occurred in fire prone ecotypes - biotic communities that depend upon periodic fire to renew themselves. This chaparral dominated terrain was burned moderately to severely, with burn severity being highest on southerly and westerly aspects. Forested landscapes generally burned less intensely but increased in intensity along the same aspect trends as chaparral. Fires occurring in oak woodland were mostly located on rolling topography with resulting low to moderate burn intensities. Isolated areas of topography-driven fire resulted in severe

burning regardless of fuel type. Fuels-driven fires were evident in the areas of transition between chaparral and forest. These areas are typified by a brush component (primarily manzanita) with a sparse overstory of grey, Knobcone, and Ponderosa Pine.

The largest areas of high burn severity occurred within the Motion and Moon fires. While some small sub-basins have experienced severe burning almost in their entirety, extensive contiguous areas of severely burned terrain are not common within the Motion fire area. The expanse of moderately burned area is largely an expression of the fuel type (chaparral with sparse timber). Mining has been, and continues to be, a principal activity, resulting in exposed soils and tailings disposal sites. Soils are shallow and naturally erodible throughout the areas burned by these fires. Accelerated erosion in fire affected areas is likely. Debris flows and floods are likely in the incised severely to moderately burned sub-basins.

The northwest portion of the Moon fire exhibits areas of contiguous severe burning along the dividing ridge between the Shasta and Trinity County lines, primarily where chaparral occupying shallow, highly erodible granitic soils burned completely. Coniferous forests, including substantial commercial timber company holdings, were severely impacted, even in areas classified as moderate burn severity. If salvage does not occur, significant continuing mortality in coniferous species, notably Ponderosa Pine, and a risk of insect infestation should be expected. Accelerated erosion may impact private property in the Ono and Igo area. Specific properties are at risk of damage from debris flows or floods.

The Noble and Deerlick fires occupy steep terrain. If salvage does not occur, significant mortality in coniferous species, notably Ponderosa pine, and a risk of insect infestation should be expected. In the severely to moderately burned sub-basins, debris flows and floods are likely. Sediment mobilized and transported from the burned areas may also adversely affect fisheries in Beegum Creek.

Finally, the fires that were assessed in the eastern portion of Shasta County were subject to low and moderate burn severity. Remotely sensed Burned Area Reflectance Classification (BARC) maps were not available for these smaller fires. Severity estimates for these areas are based upon direct observation and interviews with fire suppression and suppression repair personnel. Increased flood flows may affect infrastructure, despite the burn severity rating, in at least one location associated with the Kirkman Fire.

A moderate potential for reburn exists within the larger fires due to large areas of moderate and low burn intensity with unburned fuels. Future fire suppression in these areas may require substantial resource responses.

Fire suppression repair was largely completed by the time the SEAT assessment was completed. Many individual property owners with direct fire effects have been, and continue to be, diligent in implementing mitigation and treatment of their own property. The observations and resulting recommendations contained in this report are based upon the conditions observed by the SEAT members at the time of the field assessment. The recommendations found in this report are meant to be used as a guideline for possible mitigation to decrease to risk of threat to life, property, and the environment. It is an initial assessment to disclose values at risk.

Mitigations suggested in this report falls into one of two broad categories: 1) Treatments which can be considered temporary (short-term) measures designed to be quickly and relatively inexpensively implemented; and 2) Long-term treatments designed to facilitate the recovery of the watershed at an accelerated pace while concurrently minimizing the exposure of the values at risk to the threats identified.

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Resource Conditions Description

A) Fire Information

Incident name:	Shasta Lightning Complex	
Size:	Approximately 93,000 acres within Shasta County	
Start date:	July 21, 2008	
Contained:	August 20, 2008	
Controlled:	August 25, 2008	
Ownership:*	Federal:**	30,113 acres
	Private:	60, 676 acres
	Local Government / Other:	10,084 acres

* extrapolated from Federal, State, and Local Responsibility Areas
** includes acres in Tehama and Trinity Counties (Noble, Deerlick and Moon Fires)

B) **Cal Water Watersheds** (Ver. 2.2) Affected by Fire

Noble

Watershed Name	Watershed ID	Acres Burned
* Baker Flat Creek	5524.360303	712
* Big Salt Creek	5524.360604	94
Cow Gulch	5524.360302	182
* Dutchman Gulch	5524.360101	729
* Lower Beegum Creek	5524.360606	1,376
* Lower Dry Creek	5524.340105	2
* Middle Beegum Creek	5524.360203	4,702
North Fork Beegum Creek	5524.360201	904
*Pole Corral Creek	5524.360102	46
* Upper Beegum Creek	5524.360202	3313
* Upper Dry Creek	5524.340102	2889
	Total:	**14,948**

* All or a portion of these watersheds lie within Tehama County.

Deerlick

Watershed Name	Watershed ID	Acres Burned
* Chanchelulla Creek	1106.310105	89
* East Fork Browns Creek	1106.310102	59
* Johnson Gulch	1106.310101	137
Knob Gulch	5524.360402	636
Rocky Creek	5524.360601	282
Swett Canyon	5524.360401	5,711
Upper Duncan Creek	5524.360502	7,022
	Total:	**13,936**

* These watersheds lie within Trinity County.

Moon

Watershed Name	Watershed ID	Acres Burned
Andrews Creek	5524.350202	6,752
Bee Creek	5524.620001	3,177
Boulder Creek	5524.630201	1,913
Brandy Creek	5524.630203	2,629
Crystal Creek	5524.630102	490
Ducket Creek	5524.350201	2,650
Eagle Creek	5524.350202	1,214
Grizzly Gulch	5524.630103	716
Jerusalem Creek	5524.350104	3,715
Lower Duncan Creek	5524.360501	56
Moon Fork Cottonwood Creek	5524.350101	3,844
North Fork Cottonwood Creek	5524.350102	6,089
Paige Boulder Creek	5524.620002	225
Taylor Gulch	5524.350103	2,204
Upper Dry Creek	5524.350303	4
Upper Duncan Creek	5524.360502	4
* Upper Grass Valley Creek	1106.310502	128
* Upper Indian Creek	1106.310404	78
	Total:	**35,888**

* These watersheds lie within Trinity County.

Deck

Watershed Name	Watershed ID	Acres Burned
Bee Creek	5524.350302	263

Motion

Watershed Name	Watershed ID	Acres Burned
Boulder Creek	5524.400005	8,927
Cline Gulch	5524.640204	6
East Fork Clear Creek	5524.640202	28
Flat Creek	5524.400002	1,026
Lower Squaw Creek	5506.200401	2,417
Motion Creek	5524.400001	3,934
Rock Creek	5524.400003	8
Upper Squaw Creek	5506.200402	5,452
Whiskey Creek	5524.630304	4,918
White Rock Gulch	5524.630306	1,599
* Whiskeytown /Shasta		15
	Total:	**28,330**

* These acres occur within the footprint of the reservoirs.

Stein

Watershed Name	Watershed ID	Acres Burned
Sugarpine Canyon	5506.200804	1,140
* Shasta Lake		8
	Total:	**1,148**

* These acres occur within the footprint of the reservoir.

Pine

Watershed Name	Watershed ID	Acres Burned
Ingot	5506.330203	1,752
Sugarpine Canyon	5506.200804	5
	Total:	**1,757**

Venture

Watershed Name	Watershed ID	Acres Burned
Chalk Reservoir	5526.310401	179
Long Valley	5526.320004	63
SW Side Lake Britton	5526.310102	959
Baum Lake	5526.340500	711
	Total:	**1,911**

Withrow

Watershed Name	Watershed ID	Acres Burned
North Fork Bear Creek	5507.220103	249

Shingletown

Watershed Name	Watershed ID	Acres Burned
Baldwin Creek	5507.120802	388

Kirkman

Watershed Name	Watershed ID	Acres Burned
Shingle Creek	5507.220101	153
Bear Creek Canyon	5507.220300	828
Lower South Cow Creek	5507.310200	1073
	Total:	**2054**

C) Soil Burn Severity

Soil Burn Severity is an indicator of the amount of heat that is released by a fire and can be used to help predict subsequent effect on other resources. Remotely sensed Burned Area Reflectance Classification data has been used to determine severity acres by fire.*

*Burned Area Reflectance Classification Data not available for all fires

Severity:	None	Low	Moderate	High
Noble Fire	4,888	5,172	4,634	254
Deerlick Fire	5,310	2,745	5,184	697
Moon Fire	5,993	12,345	13,637	3,876
Deck Fire	91	171	1	0
Motion Fire	6,771	9,576	10,539	1,558

*The remaining fires situated east of Redding displayed no to low burn severity with small inclusions of moderate burn severity based on observation in the field.

D) Environmental Setting

Fire Name	Slopes	Elevation	Soil Erodibility	Vegetation
Noble	20% to 100%	450 to1,250 feet	Moderate to High	Mixed chaparral Mixed conifer Oak woodland
Deerlick	10% to 95%	380 to 1,600 feet	High	Mixed conifer Mixed chaparral Oak woodland
Moon	5% to 100%	300 to 6,000 feet	High to Extreme some Moderate	Mixed chaparral Mixed conifer Montane hwd / conifer Oak woodland
Deck	5% to 35%	200 to 340 feet	Low	Oak woodland Mixed chaparral
Motion	15% to 100%	700 to 4,900 feet	High to Extreme some Moderate	Mixed chaparral Oak – Knobcone Montane hwd. Mixed conifer
Stein	25% to 85%	1,000 to 2,300 feet	Moderate to High	Montane hwd / conifer Knobcone Pine / shrubs
Pine	5% to 80%	1,100 to 1,900 feet	Moderate to High	Montane hwd / conifer Knobcone Pine / shrubs
Venture	0% to 70%	2,750 to 3,150 feet	Moderate to High	Mixed conifer Chaparral Grassland
Withrow	10% to 80%	2,400 to 3,300 feet	Moderate to High	Mixed conifer Brush
Shingletown	10% to 80%	650 to 1250 feet	Moderate to High	Mixed conifer Montane hwd. Brush
Kirkman	5% to 75%		Moderate to High	Oak woodland Mixed conifer

E) Soils:

Fire Name	Acres
Deck	**263.2**
Sehorn-Millsholm-Lodo	263.2
Deerlick	**13936.3**
Neuns-Kindig-Deadwood	124.9
Sehorn-Millsholm-Lodo	491.1
Sheetiron-Marpa-Barpeak	1485.7
Stonyford-Maymen-Henneke	11834.6
Kirkman	**2053.6**
McCarthy-Cohasset-Aiken	743.1
Sites-Kilarc	260.7
Toomes-Supan	1049.8
Moon	**35888.1**
Kanaka-Corbett-Chaix	28582.4
Neuns-Goulding-Boomer-Auburn	506.7
Sehorn-Millsholm-Lodo	490.9
Sheetiron-Marpa-Barpeak	5527.3
Tallowbox-Minersville-Bamtush	745.3
Valcreek-Minersville variant-Minersville-Choop	35.5
Motion	**28329.7**
Kanaka-Corbett-Chaix	4139.8
Neuns-Goulding-Boomer-Auburn	13389.2
Stonyford-Maymen-Henneke	1757.5
Water	110.0
Xerorthents-Sheetiron-Marpa-Jocal	8933.2
Noble	**14948.2**
Neuns-Kindig-Deadwood	3395.6
Parrish-Maymen-Los Gatos-Etsel	859.8
Sehorn-Millsholm-Lodo	2261.9
Stonyford-Maymen-Henneke	8430.9
Pine	**1757.3**
Neuns-Goulding-Boomer-Auburn	1203.4
Rock outcrop-Neuns-Marpa-Hohmann-Goulding-Boomer	19.6
Xerorthents-Sheetiron-Marpa-Jocal	534.2
Shingletown	**388.0**
McCarthy-Cohasset-Aiken	19.7
Toomes-Supan	368.3
Stein	**1147.8**
Rock outcrop-Neuns-Marpa-Hohmann-Goulding-Boomer	1107.1
Toomes-Supan	40.8
	1911.4

Venture	
Loveness-Lava flows-Hunsinger-Fleener-Chirpchatter	300.1
Scarface-Jimmerson-Gasper	1611.2
Withrow	**249.3**
McCarthy-Cohasset-Aiken	145.0
Sehorn-Millsholm-Lodo	104.3
Total	**100872.9**

*Soils information adapted from USDA Soils Conservation Service soil survey of Shasta County Area, CA. (1974)

Emergency Determination

Risks to people, property, and resources and suggested mitigations are outlined in the reports prepared by each technical specialty represented on the Shasta SEAT. The individual technical reports follow below.

Geology

I. Resource Setting:

The portion of the Shasta Lightning Complex included in this investigation is comprised of eleven separate fires that amount to approximately 93,000 burned acres within Shasta County, California. The eleven fires were spread over a large geographic area within Shasta County and occurred within three geomorphic provinces, including the Klamath Mountains, the Great Valley, and the Cascade Range. Each of these geomorphic provinces have unique geologic and topographic characteristics that demonstrate varying conditions of geologic concern related to floods, debris slides, flows, and torrents.

II. Survey Methods:

Field inspections were preceded by research and reference to pertinent publications and data. A helicopter flight over of portions of the Moon fire was also made.

III. Resource Condition after Fire:

Fire effects have the capacity to accelerate natural geologic processes.

IV. Emergency Determination:

The principal concern within the Shasta Lightning Complex is the increased potential for in-channel floods, debris slides, flows, and torrents that can adversely affect life, property, and natural resources. The primary mechanisms for this are the loss of mechanical support (root cohesion and anchoring) of the hill slope materials and the increase in runoff resulting from reductions in interception, infiltration, and evapotranspiration caused by the loss in vegetative cover.

Values at risk identified in this assessment included: 1) the possible loss of life and infrastructure related to isolated structures located adjacent to and down gradient of watercourses and debris-slide prone slopes, respectively; 2) the loss of infrastructure related to local roads, bridges, and domestic water supply sources; and 3) the loss of natural resources related to excessive sediment entering local watercourses. Each value at risk is discussed in detail in the attached Technical Specialist report.

V. Recommendations:

- Culvert crossings within the Noble, Deerlick, Moon, Motion, and Pine Fires:

  1. The controlling agency/owner of the roads within the burn area is encouraged to perform additional analyses to assess the capacity of each culvert and develop a rank based on flow alone that can be used to prioritize the treatment of culvert crossings within and down gradient of the burn area.

  2. Site-specific analyses should be performed by the controlling agency/owner to assess the potential impacts from debris torrents, debris flows, and sedimentation resulting from winter rains. The results of these focused assessments should also be used to prioritize the treatment of culvert crossings within and down gradient of the burn area. The controlling agency/owner is encouraged to include the State Resource Water Quality Control Board and Fish and Game in the review and prioritization of the culverts.

  3. The appropriate controlling agency/owner should perform consistent monitoring and maintenance of the crossings within and immediately down gradient of the burn area. Activities that are recommended to be incorporated in the monitoring and maintenance program include:
     (a) Performing inspections during the winter months, particularly after heavy rain storms;
     (b) Remove any material collected in the pipe that reduces its capacity; and
     (c) Remove debris within the channel immediately up gradient of the pipe to reduce the subsequent plugging potential.

     These measures should be performed only following an evaluation and inspection of the safety risks in the area.

  4. Depending on the circumstances behind suspect crossings that are determined to have a high risk of failure, possible treatments that could be applied include:
     a) Replacing the culvert with a rock-lined ford;
     b) Replacing the culvert with an appropriately sized culvert;
     c) Installing a relief culvert;
     d) Installing a debris rack or stand pipe on the existing culvert; and
     e) Constructing a critical dip to divert flow back into the channel as soon as possible.

- In order to reduce the impact of un-regulated off-highway use within the burn area, it is recommended that signs be placed to deter such activities. In particular, signs should be concentrated along the steep slopes of the escarpment located west of Hat Creek. Road access could also be limited by maintaining locked gates at the entrance point of the major roads. Point DL-1:

- Cabin adjacent to Ditch Fork Duncan Creek. To reduce the potential of excessive flows and slide/flow debris from impacting the cabin, it is recommended to:

  a) Replace the culvert with a rock-lined rolling dip, if possible;
  b) Place rock-slope protection along the bank of the swale to prevent debris from scouring out the foundation of the cabin and to direct flows and debris away from the cabin;
  c) Maintain the class II swale up gradient of the cabin to keep it free of large woody debris that could migrate down gradient and become lodged, creating a debris dam that increases the diversion potential within the channel; and
  d) Perform routine monitoring within the upper elevations of the class II swale to evaluate the presence of any slide activity that could migrate down gradient and compromise the cabin. This monitoring should be performed when conditions are safe to do so, and preferably prior to rain storms.

- Point MT-4: Road crossing that has a high risk of failing. To reduce the potential of excessive flows and slide/flow debris from impacting the culvert crossing and washing out the fill prism, it is recommended to:

  a) Remove the lobe of deposited sediments perched immediately up gradient of the culvert inlet;
  b) Replace the existing culvert with either a rock-lined rolling dip, if possible, or with a sufficiently sized culvert designed to convey additional fire-related flows and debris; and
  c) Perform routine monitoring within the upper elevations of the class III swales to evaluate the presence of any slide activity that could migrate down gradient and compromise the culvert.

- Point MT-7**:** Cabin adjacent to Whiskey Creek. To reduce the potential of excessive flows and slide/flow debris from impacting the cabin, it is recommended to:

  a) Design and place rock-slope protection along the bank of Whiskey Creek to prevent debris and flows from scouring out the foundation of the cabin;
  b) Maintain the class III swale up gradient of the cabin to keep it free of large woody debris that could migrate down gradient and become lodged, creating a debris dam that increases the diversion potential within the swale; and
  c) Perform routine monitoring within the upper elevations of the class III swale to evaluate the presence of any slide activity that could migrate down gradient and compromise the cabin.

- State Highway 299**:** To reduce the potential impact of rock and debris fall along Highway 299, it is recommended that the controlling agency monitor the 299 corridor for increased rock fall and debris slide hazards. As required, perform increased maintenance along problematic road segments to remove the debris and place signage warning travelers of the hazard.

- Point V-1: Road crossing at risk of failure. It is recommended that the damaged pipes at this location get replaced to reduce the potential of a catastrophic failure of the crossing.

References – See attached Geology Technical Report

Engineering

I. Resource Setting:

Resource settings varied by fire. Engineering assessments focused on particular fires (Moon, Motion, Pine, Venture and Kirkman) where structures and facilities were present within or proximate to the fire area, or subject to extended effect due to runoff.

II. Survey Methods:

In order to evaluate the risk to life, property and resources a preliminary risk assessment was done using geographic maps, BARC maps, contour maps, hydrologic data and other available resources before site visits. Selected sites were then visited and inspections made.

III. Resource Condition after Fire:

Eagle Creek Bridge on Platina Road (N40.47402, W122.61643 map point M-2) has a possibility of impact damage to the mid-span column of the bridge from debris flow.

Rainbow Lake Road Bridge north of Rector Creek Road (N40.48233, W122.63276 map point M-1) has a possible blockage of the bridge from debris flow, thus compromising the integrity of the bridge.

The concrete channel north of OHV Staging Area (N40.71403, W122.43731 map point MT-1) has burned dead trees in the channel, severely reducing the capacity of the channel.

Cottonwood Creek Bridge (Baily Bridge) on Coram Road (N40.70480, W122.45082 map point MT-2) is exposed to possible damage to the bridge from debris flow or floods.

Spring Creek Reservoir will experience increased expected runoff, higher debris flows and increased sediment (N40.63074, W122.48028 map point MT-5).
A private Benson Drive residence the South Fork of Spring Creek and a bridge (N40.635559, W122.50523 map point MT-6) with six feet freeboard close to the property have a low risk of flood damage.

Ingot Dismantlers is located off highway 299 (N40.72737, W122.07812 map point P-1). If blocked, a culvert under the property could result in flooding of the structures on top of the culvert.

The Clough Creek Bridge associated with the Kirkman fire (N40.54824, 122.07751 map point K-1) has an existing erosion problem on the east side abutment of the bridge. Higher flows from the fire will increase the erosion and will endanger the integrity of the bridge.

IV. Emergency Determination:

There is a heightened risk for property and natural resources due to increased runoff, debris flows, rock falls, floods and flash floods. The risk to the water resources of the state is a particular concern due to the importance of the Shasta complex to the economic well being of all Californians.

V. Recommendations:

- In order to minimize the post fire risks to life, property and resources a proactive and coordinated effort by private property owners, local government, state and federal agencies is recommended. These efforts include Early Alerts, Warning systems, and evacuation plans, monitoring of bridges, roads and culverts, clean up woody debris from channels and dams with approval of Fish and Game and other regulatory agencies, posting warning signs and closure of roads and bridges during forecasted high rainfall events. Other efforts include limiting public access to the burn areas, avoidance of soil disturbance by use of Off Highway Vehicles and closure of trails and restoration native vegetation. In areas where either stream or spring water is used by private property owners as a domestic water supply, a proactive approach is recommended to monitor water quality and to avoid usage of such water during rain events until such time when the water quality is returned to pre-fire conditions. Local municipal water users, Central Valley Project operators and other affected water users are advised to monitor water quality and to take appropriate steps to minimize the fire impacts to water supply and to mitigate the loss of water quality.

- Eagle Creek Bridge (map point M-2): The bridge should be monitored and inspected after flood or high flow events to make sure the column has not been compromised.

- Rainbow Lake Road Bridge (map point M-1): The stream area immediately upstream of the bridge and under the bridge should be cleared of debris and dead trees to allow the free flow of water. Blockage is possible during a rain event. The bridge should be monitored and inspected after flood or high flow events and kept cleared of woody debris.

- Concrete Lined Channel in OHV Staging Area (map point MT-1): The channel should be cleared of dead trees and woody debris, and channel capacity restored to designed specification.

- Cottonwood Creek Bridge (map point MT-2): According to the Federal Interagency BAER this bridge is at a risk of damage due to debris flows and floods. The SEAT concurs with the BAER report recommendation.

- Spring Creek Reservoir (map point MT-5): Water quality issues with Shasta Reservoir due to the fires and expected increased flows into Spring Creek Reservoir will create a unique problem. Mitigation of such a complex issue is outside of scope of this assessment. Responsible parties are urged to monitor the problem and find appropriate solutions.

- Benson Drive Residence (map point MT-6): The resident should be aware of the problem, monitor rain events and evacuate during forecasted high events. While the bridge is not expected to have any problems, if it does fail in a severe event the resident should seek shelter on higher ground

- Ingot Dismantlers (map point P-1): There are existing drainage problems with a culvert that runs under the facility according to the owner. These problems will be heightened due to debris flows and expected higher flows in rain events. The owner should be aware of the risks and have evacuation plans during forecasted intense rain events. The culvert should always be kept cleared of debris and sediments in order to maximize the flow capacity..

- Clough Creek Bridge (map point K-1): Shore up east bank of Clough Creek up to 50 feet upstream of the bridge with the same type of rocks that is used in the immediate vicinity of the bridge. Riprap the east abutment of the bridge.

References – See attached Engineering Technical Report

Wildlife

I. Resource Setting:

The area burned by the Shasta Lightning Complex Fires contains habitat for several State listed endangered or threatened species, Federal sensitive species, State species of special concern, and many common wildlife species.

II. Survey Methods:

Field surveys were conducted by biologists from August 19th through August 25th, 2008.

III. Resource Condition after Fire:

Many wildlife species, including endangered species, have been significantly impacted by the fires, but most of the native wildlife in the area (including the endangered species) have evolved to live in a fire-adapted ecosystem and over time they are likely to recover.

IV. Emergency Determination:

Emergency actions are not recommended for wildlife habitat and species recovery at this time, but recommendations have been made for treatments and monitoring of infrastructure (culverts, channel crossings, road maintenance) that should be implemented to prevent significant damage to the riparian zone and stream habitats that support listed and special status species.

- Road and channel infrastructure rehabilitation
- Population surveys and monitoring
- Coordinate with local wildlife experts/agencies on effectiveness

Treatment Objective

- Monitor wildlife populations that may be negatively affected by failure of road and channel infrastructures that are likely to be compromised by post fire increases in erosional processes

Treatment Description

- Implement road and channel infrastructural rehabilitation recommendations as found in the Geology Tech. Report
- Survey and monitor wildlife populations

References – See attached Wildlife Technical Report

Fisheries

I. Resource Setting:

This assessment is an evaluation of aquatic resources and fishery habitat in burn areas. The areas evaluated are located in Shasta County, along the eastern slopes of the Klamath Mountain Province, and the western slopes of the Cascade Range.

II. Survey Methods:

Field surveys were conducted by biologists from August 19th through August 25th, 2008. The prime areas examined during this study were along county roads such as A16, and state highways 299, 44, and 151. Local biologists with knowledge of fisheries resources in the tributaries to the Sacramento River were consulted for additional information.

III. Resource Condition after Fire:

After the wildfire burn, slopes were denuded of soil retaining forbes and grasses. Depending on the intensity of the burn, the shrubs and trees may be scorched or killed but are still standing, or burned to the ground, further reducing the ability of the slope to retain soil. In any case, the concern is that rainfall will cause erosion which will deliver sediment and debris into the stream channel and compromise the ability of fish, and other aquatic

organisms to thrive at each stage of their life history. This fall, after salmonid redds are constructed, will be a particularly sensitive time because sediment from the burned areas can smother eggs in the redd.

At this point, before the first rains and sediment delivery, creeks show little change. The water temperature has probably increased above average for this time of year because the shading canopy of the riparian zone may have been reduced or destroyed. Since about two months have transpired since the first fires burned through the areas surveyed, there is a remarkable recovery of new plant life and regeneration. Published studies indicate that nature will recover after fires like these, and furthermore the populations of most native fish and aquatic organisms present in this area have adapted to land slides and fires burning through their habitat every few years.

IV. Emergency Determination:

Emergency actions are not recommended at this time, but recommendations have been made for monitoring and implementation of recovery efforts based on monitoring results.

V. Recommendations:

Critical habitat for listed species and species of concern should be monitored for restoring pre-burn conditions and evaluated before adverse impacts occur in order to prevent damages due to excessive runoff and related stream pollution. Typical life stages for Chinook salmon and steelhead trout include spawning migration, spawning and redd construction, year-round rearing and emigration. Studies should be conducted to assess long-term population impacts and trends from the fire. Population surveys and long-term monitoring studies should be conducted in the drainage area where listed species occur. Methods for recovery should be coordinated with the Department of Fish and Game.

References – See attached Fisheries Tech. Report

Botany

I. Resource Setting:

The Shasta Lightning Complex Fires burned shrubland, forest, woodland, and grassland in Shasta County from the western border with Trinity County to eastern border with Lassen County.

II. Survey Methods:

Field inspections were performed subsequent to research.

III. Resource Condition after Fire:

Botanical values that are at risk include special status plant species and natural communities. The special status plants and natural communities should recover from

fires naturally. Human activities post-fire present the greatest threat due to the potential for damaging riparian vegetation, inhibiting regeneration of native plants, and introducing invasive weeds.

IV. Emergency Determination:

Emergencies to botanical resources related to the Shasta Lightning Complex Fires fall into three primary areas: 1) threats to the riparian zone from direct fire effects fire effects; 2) potential damage to riparian resources from post-fire effects and need to implement road infrastructure rehabilitation; and, 3) loss of natural community integrity due to potential spread of invasive weeds from post-fire effects.

V. Recommendations:

- Monitoring;
- Survey special status plant populations;
- Implementation of road infrastructure rehabilitation as describe in the Geology Tech. Report for North Fork Beegum Creek;
- Avoidance of clearing of burned wood in riparian zone in Eagle Creek;
- Erosion control on selected bulldozer lines;
- Surveys for invasive weeds in key areas and prompt weed control; and
- Monitoring and additional measures to avoid the expansion of existing weed populations due to post-fire effects and remediation of potential infrastructure damage from post-fire effects.

References – See attached Botany Technical Report

Forestry

I. Resource Setting:

Due to the large geographic area of these fires, there is a wide variety of vegetation types. They range from Klamath Mixed Conifer, Ponderosa Pine, Eastside Pine and Sierran Mixed Conifer forests, to Montane Hardwood-Conifer, Closed-Cone Pine, Valley Oak woodland, Mixed Oak woodland, Mixed Chaparral, Chamise Chaparral and Annual Grassland.

II. Survey Methods:

Selected areas within the broader fire complex were visited. In addition helicopter flights over of the west side fires allowed a landscape level view.

III. Resource Condition after Fire:

The mixed conifer forests associated with these fires had a range of effects from low to high. Those portions of forest that the fire burned from moderate to high have the most risk associated with them. Due to the steep nature of the topography along with various wind

events and increased temperatures during the fires, a good portion of the mixed conifer stands were subject to moderate to high levels of mortality. The conifers that were not killed by the fire and have fire-related injuries have an increased likelihood of mortality within several years. Fire injuries sustained to trees can have a longer lasting impact on tree health and may contribute to mortality beyond this time frame, especially when combined with other stressors such as drought and insects. Areas of fire that burned with low severity pose the least threat, with unlikely long-term effects.

IV. Emergency Determination:

The value at risk throughout most of these fires is the increased threat and loss of economic value within the Mixed Conifer stands. Although the stands may not fall under the exact timeframes outlined for hazard trees as defined by forest practice rules, increased mortality caused by fire damaged and the attack by insects such as wood borers and bark beetles over the next one to five years is expected.

V. Recommendations:

- Evaluate existing stands of mixed conifer forests to determine current mortality as well as future mortality. Trees that have been damaged but not killed by the fires should also be evaluated due to the inherent risk of bark beetle attack over the next one to three years. Areas that have increased mortality should be considered for fire salvage or other harvesting methods, including biomass where practical.

References – See attached Forestry Technical Report

Archeology

I. Resource Setting:

Many dozens of previously recorded cultural resources exist within the eleven fires subject assessment area. Additional sites were discovered during Fire Suppression and Suppression Repair activities. Additional unrecorded/undiscovered sites are thought to exist as much of the study area has never been systematically surveyed for cultural resources.

II. Survey Methods:

Specific methods for establishing the presence/absence of cultural resources in the proposed treatment areas included 1) a check of the archaeological database that was compiled by CAL FIRE archaeologists in June and July for the Shasta Lightning Complex and 2) a pedestrian field inspection to search for prehistoric and historic artifacts, features, and sites within the Area of Potential Effect (APE).

III. Resource Condition after Fire:

No cultural resources, either prehistoric or historic, were found to be at risk from proposals

made by the Shasta Lightning Complex SEAT Team. The technical report author is unaware of any emergency that exists in terms of threat to cultural resources within the study area.

IV. Emergency Determination:

No current emergency was identified. However a precautionary recommendation is offered in the event that ground disturbing activities in the unsurveyed areas occur during implementation of mitigation measures developed for other resources.

V. Recommendations:

- Proponents for projects that involve ground disturbance outside of the project areas identified in this report check the archaeological data base maintained by the Northeast Information System (CHRIS) office located at California State University, Chico ((530) 898-6256). This contact, called an "Archaeological Records Check", will determine 1) whether known/recorded cultural resources exist in the project area and 2) whether or not the area has been previously surveyed for cultural resources. If this contact results in the determination that no sites are known and that a cultural resource survey has already taken place in the project area no further cultural resource work would be required. If the records check results in the determination that an archaeological site is present in the proposed project area, or that the area has never been the subject of an archaeological survey, input from an archaeologist should be sought.

References – See attached Archaeology Technical Report

Other

The following general recommendation is offered as an advisory to individual property owners and residents whose properties occupy highly erosive soils such as those derived from decomposed granite, a prevalent condition in the Ono and Igo areas:

- Treatments to stabilize surface soils and prevent sheet and gully erosion are recommended. Treatments should be designed to coincide with local conditions, primarily slope and drainage patterns. Gentle slopes can be treated with straw mulch and grass seed. Seed alone may be ineffective the first year. Moderate slopes (20% to 40%) may require additional treatment such as installation of staked erosion mats or wattles. Steep areas are problematic and expensive to treat. Consultation with an erosion control specialist is highly recommended. USDA Forest Service publication is a useful reference and is available through the following web address.

http://www.fs.fed.us/eng/pubs/pdf/BAERCAT/lo_res/TOContents.pdf

REFERENCES

USDA Soils Conservation Service soil survey of Shasta County Area, CA. (1974)

USDA Forest Service. December 2006. Burned Area Emergency Response Treatments Catalog. United States Department of Agriculture. http://www.fs.fed.us/eng/pubs/pdf/BAERCAT/lo_res/TOContents.pdf

CALFIRE Fire and Resource Assessment Program (FRAP) web site (http://frap.cdf.ca.gov/)

California Spatial Information Library (CASIL) web site (http://gis.ca.gov/)

United States Department of Agriculture, Natural Resources Conservation Service Soil Data Mart web site (http://soildatamart.nrcs.usda.gov/)

California Department of Conservation, California Geological Survey web site (http://www.conservation.ca.gov/cgs/information/publications/pub_index/Pages/gis_data.aspx)

United States Geological Survey web site (http://edc2.usgs.gov/geodata/index.php

DRAFT TECHNICAL SPECIALIST REPORT
STATE EMERGENCY ASSESSMENT TEAM (SEAT) Emergency Report

Resource: Geology

Fire Name: Shasta Lightning Complex CA-SHU-004727 **Month/Year:** June 2008

Author Name: Don Lindsay, Certified Engineering Geologist #2323
State Regional Water Quality Control Board
415 Knollcrest Drive, Suite 100
Redding, CA 96002
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OVERVIEW

The portion of the Shasta Lightning Complex included in this investigation is comprised of eleven separate fires with approximately 93,000 burned acres within Shasta County, California. The eleven fires are spread over a large geographic area within Shasta County (Map #1) and occur within three geomorphic provinces, each with unique geologic (attached map) and topographic characteristics that demonstrate varying predisposed conditions of geologic concern, which can be adversely affected by the reduction in vegetative cover resulting from fire.

Consequently, the goal of this assessment was to evaluate the possible elevated risk that the burned area within each fire poses to life, property, and resource from geologic hazards such as landslides, debris flows, rock falls, and localized debris torrents, floods, and hyperconcentrated flows.

Presented in the following is a synopsis of our investigation of each of the eleven fires, which includes: 1) a discussion of the physical setting of the fire area, 2) the survey methods performed in evaluating the fire, 3) our observations related to the local geomorphology and geologic concerns, 4) a discussion of the identified values at risk, and 5) our recommendations to reduce potential adverse effects caused by the fire

Due to the expedited nature of this evaluation, however, there are likely to be areas within the burn area and other locations of potential values at risk that were not observed or assessed, and other areas where the potential risks are either higher or lower than our initial reconnaissance-level review concludes.

NOBLE FIRE

1.1 Resource Condition Assessment

A. Resource Setting

The Noble fire encompasses about 14,948 acres of land, with approximately 7,395 acres in Shasta County and 7,553 acres in Tehama County (Map #1). Beegum Creek forms the boundary between Shasta and Tehama Counties and roughly bisects the burned area as it flows from west to east.

The burned area resides within two geomorphic provinces that include the Klamath Mountains located within the western 2/3 of the burn area and the Great Valley located within the eastern 1/3 of the burn area (CGS Note 36).

The burn area located within Shasta County is predominantly underlain by the Hayfork Bally Meta-andesite of Middle Jurassic age (Fraticelli, et. al., 1987). The Hayfork Bally Meta-andesite belongs to the Western Hayfork Subterrane of the Klamath Mountain geomorphic province and is composed of layered mafic volcanogenic rocks ranging in texture from coarse agglomerate to crystal tuff. It is thought this bedrock represents an island-arc deposit that was accreted against the western North American continent (Fraticelli, et. al., 1987; Ernst, 1990). Roughly paralleling Beegum Creek in the western 1/3 of the burn area is a thrust fault that separates and has juxtaposed the Hayfork Bally Meta-andesite from sheared melange and serpentinite rock belonging to the Rattlesnake Creek Terrane that is found mostly to the south side of Beegum Creek. Corresponding to the Great Valley geomorphic province in the eastern portion of the burn area is marine sedimentary rock of Lower Cretaceous age (Fraticelli, et. al., 1987). This rock is well-indurated and consists of interbedded mudstone, sandstone, and conglomerates.

Topographically, the Noble fire ranges in elevation from 450 feet to 1,250 feet above mean sea level. The dominant topographic expression located to the north and south of Beegum Creek exhibits alternating ridge and swale topography that is dominated by sub-parallel class II and class III watercourses separated by interfluvial ridges with moderate to steep side slopes. Slopes increase in gradient along the flanks of the local stream channels, particularly along Beegum Creek where it has incised into local bedrock. Within the lower elevations to the east, particularly where the bedrock is composed of marine sediments of the Great Valley province, the topographic expression is more irregular and can have low to moderate slopes.

Isolated and coalescing deep-seated slides have been identified and mapped by Fraticelli, et.al. (1987) within the Rattlesnake Creek Terrane on the south side of Beegum Creek. However, these slides are generally located outside of the burn area.

According to fire history records provided by CAL FIRE (http://frap.fire.ca.gov/data/frapgisdata/download.asp?rec=fire), portions of the Noble

fire had previously burned in the 1930's, 1940's, and again in the 1980's. This fire history suggests that the conditions present after the most recent Noble fire are not new to the watershed.

B. Survey Methods

A USFS Burn Area Emergency Response Team (BAER) initially investigated the Noble fire on 30 July 2008. That investigation, which the author of this report participated in, consisted of driving the main road (29N06) that accesses Beegum Creek to identify values at risk and determine geologic factors that may affect them.

1.2 Observations

A. General Observations

The focus of our field investigation was in the area of the burn that resides in Shasta County on the north side of Beegum Creek.

Prior to the fire, the north side of Beegum Creek was largely vegetated with a dense cover of mixed chaparral. Based on our observations and on burn area severity maps provided by the USFS (BEAR, 2008), the north side of Beegum Creek burned hot with an almost complete consumption of the chaparral vegetative cover.

As described, the north side of Beegum Creek is underlain by meta-volcanic rock and contains alternating ridge-swale topography that has moderate to steep slopes that are mantled by a thin veneer of gravely loam soils. Field observations indicate the presence of erosion features consisting of incised rills and channels occurring within the headwall and along the steep flanks of numerous swales within the watershed. Based on the geomorphic expression of these features, it appears that they form as a result of concentrated runoff eroding the soils rather as a result of mass-wasting processes.

Large-scale, deep-seated rotational slides do not generally occur on the north side of Beegum Creek; however, field evidence suggests that isolated debris flows, slides, and falls can occur along the steep channel walls of the local stream courses. Due to the steep nature of the surrounding hill slopes and tributary channels flanking Beegum Creek, sediment mobilized through riling and mass-wasting has little opportunity to deposit out and is assumed to deliver to Beegum Creek.

Both the riling and mass-wasting features described above, particularly since they occur within shallow, non-cohesive, gravelly soils, can be adversely affected by the loss of vegetative cover. The primary mechanisms for this are the loss of mechanical support (root cohesion and anchoring) of the hill slope materials and the increases in runoff resulting from reductions in interception, infiltration, and evapotranspiration caused by the loss in vegetative cover.

1.3 Emergency Determination

The values at risk considered in this assessment include the possible loss of infrastructure related to road 29N06 that accesses Beegum Creek and the loss of natural resources related to excessive sediment entering Beegum Creek, which is a recognized anadromous fishery.

Several culverted road crossings were observed along road 29N06. The size of the culverts do not appear to provide sufficient capacity to convey the likely increased flows and debris that will occur as a result of the burn. As a result, the capacity of the culverts is interpreted to have a high risk of getting overwhelmed and may lead to the culvert crossings either failing or causing flows to be re-routed to areas that are not conditioned to handle such flows. The net result being a loss in access, increased capital expenses related to repairing the failed crossings, and increased sediment entering Beegum Creek.

As a result of the steep and rocky nature of the slopes and soils present, respectively, direct treatment of the hillside using mulch, seed etc., is unlikely to be economically viable. However, root sprout of the chaparral plant species covering the hillsides within the burn area was observed. This rapid regeneration of the vegetation coverage is encouraging and it is anticipated that pre-fire conditions will likely be met within just a few years.

1.4 Recommendations

A. General Recommendations

1. Performing hydrologic and hydraulic analyses for each culvert was outside the scope of this investigation. However, the controlling agency/owner of road 29N06 is encouraged to perform such analyses to assess the capacity of each culvert and develop a rank based on flow alone that can be used to prioritize the treatment of culvert crossings inside the burn area.
2. Site-specific analyses within the watershed of each culvert should be performed to assess the potential impacts from debris torrents, debris flows, hyperconcentrated flows, and sedimentation resulting from winter rains. The results of these focused assessments should also be used to prioritize the treatment of culvert crossings inside the burn area.
3. It is recommended that the appropriate controlling agency/owner should perform consistent monitoring and maintenance of the crossings. Activities that are recommended to be incorporated in the monitoring and maintenance program should be performed when it is safe and the inspection team should be aware of possible hazards (i.e. eminent rainfall that may trigger debris slides and torants). These activities include:

    (a) Performing inspections during the winter months, particularly after heavy rain storms;

(b) Remove any material collected in the pipe that reduces its capacity to convey water and debris; and
(c) Remove debris within the channel immediately up gradient of the pipe to reduce subsequent plugging potential.

Depending on the circumstances behind suspect crossings that are determined to have a high risk, treatments that could be applied include:

(a) Replacing the culvert with a rock-lined ford;
(b) Replacing the culvert with an appropriately sized culvert;
(c) Installing a relief culvert;
(d) Installing a debris rack or stand pipe on the existing culvert; and
(e) Constructing a critical dip to divert flow back into the channel as soon as possible.

DEERLICK FIRE

2.1 Resource Condition Assessment

A. Resource Setting

The Deerlick fire encompasses about 13,936 acres of land, with approximately 13,619 acres in Shasta County and 317 acres in Trinity County (Map #4).

The burned area resides primarily within the Klamath Mountains geomorphic province (CGS Note 36) and is underlain by the Abrams Mica Schist of Devonian age and the Stuart Fork formation of late Jurassic (Fraticelli, et. al., 1987). A large thrust fault projects through the central portion of the fire area. This fault strikes northwest southeast, dips to the northeast, and forms the contact between the Abrams Mica Schist to the northeast and the Stuart Fork formation to the southwest. The Abrams Mica Schist is part of the Central Metamorphic Terrane within the Klamath Mountains geomorphic province and consists of micaceous and quartzitic schist with discontinuous lenses of micaceous marble (Fraticelli, et. al., 1987). The Stuart Fork formation consists of metasedimentary rocks including phyllitic quartzites and dark quartz-mica phyllites (Fraticelli, et. al., 1987).

Topographically, the Deerlick fire ranges in elevation from 380 feet to 1,600 feet above mean sea level and is drained by several sub-parallel creeks that include tributaries to Duncan and Cottonwood Creeks. The most dominant watercourses of interest include the main stem of Duncan Creek and the Ditch Fork of Duncan Creek. The dominant topographic expression in the burn area exhibits alternating ridge and swale topography with moderate to steep side slopes. Slopes increase in gradient along the flanks of the local stream channels where they have incised into local bedrock. Low gradient ground located along the top of ridges and within depositional zones along the main stream channels are present.

Isolated and coalescing deep-seated slides have been identified and mapped by Fraticelli, et.al. (1987) in the upper elevations of the Deerlick fire, southwest of Anderson Spring Ridge.

According to fire history records provided by CAL FIRE (http://frap.fire.ca.gov/data/frapgisdata/download.asp?rec=fire), portions of the Deerlick fire, which appear to have been mainly constrained to the lower elevations in the southeast corner of the fire, had previously burned in the 1950's.

B. Survey Methods

The Deerlick fire was investigated on 25 August 2008 and consisted of driving the main roads inside the burn area, including portions of the Grave's Ranch Road, portions of the Bully Choop Road, and portions of the Duncan Creek Road, to identify values at risk and determine geologic factors that may affect them. Due to limited field time, only the areas within the lower elevations of the burn area were assessed.

2.2 Observations

A. General Observations

Prior to the fire, the vegetative cover, starting at the lower elevations and moving upward, consisted largely of a dense cover of mixed chaparral that transitioned into mixed hardwoods followed by mixed conifers in the headwaters region of the watershed of Duncan and Ditch Fork Duncan Creek. Discussions of the vegetative cover are covered under other specialist reports.

Based on our observations and on burn area severity maps provided by the USFS (BAER, 2008), the south and west facing slopes burned hot compared to the north and east facing slopes. Moreover, the fire burned most severe in areas with a pre-existing high fire regime, which included the chaparral ground at low elevations. In areas that were mostly timbered, the burn severity was low to moderate. However, it appears that the timber mortality in areas that were listed as moderately burned is extremely high and we suspect that after only a few years a majority of remaining timber will succumb to wind damage, snow load, and bug kill. Thus, the true effects of the fire in regards to vegetative cover may be realized 5 to 10 years after the initial burn. The vegetative cover in areas within the riparian corridors appears to have sustained minimal burn damage.

Field observations indicate the presence of erosion features consisting of incised rills and channels occurring within the headwalls and along the steep flanks of swales within the watershed, particularly within the lower elevations that are vegetated by Chaparral. Based on the geomorphic expression of these features, it appears that they form as a result of concentrated runoff eroding the soils rather than linked to shallow debris slide failures.

Large-scale, deep-seated rotational slide failures were identified within the timbered ground in the upper elevations but they were not evaluated due to their remote setting and limited treatment potential. Field evidence suggests that isolated debris flows, slides, and falls can occur along the steep channel walls of the local stream courses. Many such failures appear to have culminated in mixed colluvial and alluvial deposits occurring at the mouth of tributary channels that drain into the main stem of Duncan Creek and Ditch Fork Duncan Creek.

The riling and mass-wasting features described above can be adversely affected by the loss of vegetative cover. The primary mechanisms for this are the loss of mechanical support (root cohesion and anchoring) of the hillslope materials and the increases in runoff resulting from reductions in interception, infiltration, and evapotranspiration caused by the loss in vegetative cover.

B. Specific Observations

Site-specific observations were made of several part-time residences comprised of remote cabins positioned along the corridors of Duncan Creek and Ditch Fork Duncan Creek. These high-value sites were evaluated in more detail from the regional overview to better assess potential risks from near-site debris flow, rock fall, floods, and other geologic hazards that may be present and that are not readily obvious after performing the regional overview. Of the several structures evaluated within or slightly down gradient of the burn area, only two structures were identified as being at risk. The locations of these structures are shown on Map #4 and are briefly described in the following.

2.3 Emergency Determination

The values at risk considered in this assessment include the possible loss of life and infrastructure related to two isolated structures within the burn area, the loss of infrastructure related to the local road system, and the loss of natural resources related to excessive sediment entering the local watercourses.

General

Several culverted road crossings were observed along the main road systems within the burn area. The size of the culverts do not appear to provide sufficient capacity to convey the likely increased flows and debris that will occur as a result of the burn. As a result, the capacity of the culverts is interpreted to have a high risk of getting overwhelmed and may lead to the culvert crossings either failing or causing flows to be re-routed to areas that are not conditioned to handle such flows. The net result being a loss in access, capital expenses related to repairing the failed crossings, and increased sediment entering the local watercourses.

The biologic assets present within the local watercourses are covered in other specialist reports.

As a result of the steep and rocky nature of the slopes and soils present, respectively, direct treatment of the hillside using mulch, seed etc., is unlikely to be economically viable.

Site-Specific

The two structures identified as values at risk include a cabin and a barn that are located immediately adjacent to Ditch Fork Duncan Creek (Map #4).

Point DL-1 is a cabin located at about W40.44870 and N-122.85419 (NAD 83 datum). The cabin is founded on an alluvial/colluvial fan deposit at the mouth of an unnamed class II swale. The class II swale up gradient of the cabin appears to have been moderately burned, resulting in an anticipated reduction in canopy of about 60%

or more. This reduction in canopy, coupled with the naturally steep slopes within the swale (i.e. 65% and greater), and the presence of an existing alluvial/colluvial deposit at its mouth with Ditch Fork Duncan Creek, suggests a high risk of increased flooding and debris slide/flow activity.

Currently a culvert directs flows exiting the swale beneath a road that bisects the slopes immediately up gradient of the cabin. After exiting the culvert, flows are directed down a swale that extends down gradient about 30 feet west of the cabin. Due to the high risk of increased flows and debris slide activity resulting from the fire within the class II swale, it is likely that there is a high risk of the culvert becoming plugged, resulting in excess flows and debris that could impact the western edge of the cabin.

Despite the high likelihood that the structure could be impacted by flows and debris emanating from the class II swale, representing a high risk to loss of infrastructure, there is likely only a low risk to loss of life based on the anticipated low occupancy rate of the cabin.

Point DL-2 is a barn located about 300 feet downstream of Point DL-1, at about W40.44843 and N-122.85359 (NAD 83 datum). The barn is founded within the channel zone of Ditch Fork Duncan Creek. It is founded within scour-prone alluvium composed of dense silty gravel, and is situated about 7 to 10 feet southwest of the channel's edge with a freeboard above the high water mark of about 3 feet. Currently protecting the structure is a crib wall composed of logs that are in a dilapidated condition. Based on the amount and severity of burn within the watershed up gradient of the barn, it is anticipated that there will be an increase in flows within Ditch Fork Duncan Creek that pose a high risk of undercutting the foundation of the barn, resulting in a loss of infrastructure.

2.4 Recommendations

A. General Recommendations

1. Performing hydrologic and hydraulic analyses for each culvert was outside the scope of this investigation. However, the controlling agency/owner of the roads within the burn area is encouraged to perform such analyses to assess the capacity of each culvert and develop a rank based on flow alone that can be used to prioritize the treatment of culvert crossings within and down gradient of the burn area.

2. Site-specific analyses should be performed by the controlling agency/owner to assess the potential impacts from debris torrents, debris flows, hyperconcentrated flows, and sedimentation resulting from winter rains. The results of these focused assessments should also be used to prioritize the treatment of culvert crossings within and down gradient of the burn area. The controlling agency/owner is

3. encouraged to include the State Resource Water Quality Control Board and Fish and Game in the review and prioritization of the culverts.
4. It is recommended that the appropriate controlling agency/owner should perform consistent monitoring and maintenance of the crossings within and immediately within the burn area. Activities that are recommended to be incorporated in the monitoring and maintenance program include:
    (a) Performing inspections during the winter months, particularly after heavy rain storms;
    (b) Remove any material collected in the pipe that reduced its capacity to convey water and debris; and
    (c) Remove debris within the channel immediately up gradient of the pipe to reduce subsequent plugging potential.

Depending on the circumstances behind suspect crossings that are determined to have a high risk of failure, treatments that could be applied, include:

(a) Replacing the culvert with a rock-lined ford;
(b) Replacing the culvert with an appropriately sized culvert;
(c) Installing a relief culvert;
(d) Installing a debris rack or stand pipe on the existing culvert; and
(e) Constructing a critical dip to divert flow back into the channel as soon as possible.

B. Site-Specific Recommendations:

Point DL-1: To reduce the potential of excessive flows and slide/flow debris from impacting the cabin, it is recommended to:

- Replace the culvert with a rock-lined rolling dip, if possible;
- Place rock-slope protection along the bank of the swale to prevent debris from scouring out the foundation of the cabin and to direct flows and debris away from the cabin;
- Maintain the class II swale up gradient of the cabin to keep it free of large woody debris that could migrate down gradient and become lodged, creating a debris dam that increases the diversion potential within the channel; and
- Perform routine monitoring within the upper elevations of the class II swale to evaluate the presence of any slide activity that could migrate down gradient and compromise the cabin.

Point DL-2: Although DL-2 represents a high risk to loss of infrastructure, its location within the channel zone makes it difficult to mitigate. It is interpreted that any mitigation will be expensive and will have added costs associated with permitting issues to perform work within the channel zone. Thus, it is anticipated that the costs of mitigation outweigh the value of the structure. For this reason, no recommendations are provided.

MOON FIRE

3.1 Resource Condition Assessment

A. Resource Setting

The Moon fire encompasses about 35,888 acres of land, with approximately 35,663 acres in Shasta County and 225 acres in Trinity County (Map #5). The burned area resides primarily within the Klamath Mountains geomorphic province (CGS Note 36) and is mostly underlain by bedrock belonging to the Shasta Bally Batholith of Early Cretaceous age. The Shasta Bally Batholith is an intrusive igneous rock that fluctuates from quartz diorite to granodiorite in composition. To a lesser extent, particularly in the southwestern corner of the fire, the burn area is underlain by bedrock composed of the Abrams Mica Schist, the Trinity ultramafics, and the Copley Greenstone. These bedrock materials are juxtaposed and separated by large northwest trending thrust faults that dip to the northeast (Fraticelli, et. al., 1987). The Abrams Mica Schist is part of the Central Metamorphic Terrane within the Klamath Mountains geomorphic province and consists of micaceous and quartzitic schist with discontinuous lenses of micaceous marble (Fraticelli, et. al., 1987). The Trinity ultramafics belong to the Trinity Terrane and represent strongly deformed and recrystallized peridotite with minor layered and intrusive gabbro, diabase dike-sill-complex. The Copley Greenstone is part of the Eastern Klamath Terrane and is composed chiefly of keratophyre and subordinate spilite pillow lavas and volcanic breccias (Fraticelli, et. al., 1987). A relatively small and insignificant portion of the burn area is underlain by marine sediments of the Great Valley province in the southeast corner of the fire, adjacent to Ono.

Topographically, the Moon fire can be subdivided into two topographically unique regions, the northwest domain and the southeast domain.

The northwest domain encompasses approximately 2/3 of the burn area and includes the area northwest of Rector Peak at elevations above about 2,800 feet in elevation. The topographic expression of this region consists of alternating ridge and swale topography that is dominated by sub parallel class I and class II watercourses separated by interfluvial ridges and mountaintops that have planar to rolling slopes ranging from 45% to 85% in gradient. Slope distances within this domain are generally long and cover large expanses of vertical relief. The upper elevations within this domain include the dominant ridgeline located to the southwest and northeast of Shasta Bally that forms the topographic divide between Trinity and Shasta Counties. The Moon Fork Cottonwood Creek and the North Fork Cottonwood Creek primarily drain the northwestern domain. Elevations within the northwestern domain range from about 2,800 feet to about 6,000 feet above mean sea level, located just beneath Shasta Bally.

The southeast domain encompasses approximately 1/3 of the burn area and includes the area southeast of Rector Peak at elevations below about 2,800 feet in elevation. The topographic expression of this region consists of rolling to abrupt ridge/swale

topography that exhibits a somewhat chaotic nature due to the erratic erosion of the underlying granitics. The ridgelines are generally smooth and rounded with steep flanks that range in gradient from 30% to about 85%. Unlike the northwestern domain, the slope distances in this domain are generally short and span limited vertical relief. Eagle Creek, Rector Creek, Hulling Creek, and the South Fork Clear Creek are the primary watershed within the southeastern domain. Elevations within the southeastern domain range from about 300 feet near the town of Ono to about 2,800 feet above mean sea level.

According to fire history records provided by CAL FIRE (http://frap.fire.ca.gov/data/frapgisdata/download.asp?rec=fire), portions of the Moon fire, which appear to have been mainly constrained to the lower elevations that are encompassed within the southeastern topographic domain, had previously burned in the 1940's.

B. Survey Methods

The Moon fire was investigated from the air via a helicopter provided by Sierra Pacific Industries, Inc. on 22 August 2008. This overview flight was followed by a ground inspection performed on 22 August 2008 and 24 August 2008. The ground inspection included driving the main roads within the fire area. Due to limited field time, only the areas within the mid to lower elevations of the burn area were assessed. Moreover, the area of the burn that overlaps into the Whiskeytown State Park was not assessed.

3.2 Observations

A. General Observations

Prior to the fire, the vegetative cover, starting at the lower elevations and moving upward, consisted largely of a dense cover of mixed chaparral that transitioned into mixed hardwoods followed by mixed conifers in the headwaters region of the northwestern domain. At the extreme upper elevations, along slopes located just below Shasta Bally and Bully Choop, the vegetative type consists mostly of brush. Discussions of the vegetative cover are covered under other specialist reports.

Based on our observations and on burn area severity maps provided by the USFS (BAER, 2008), the south and west facing slopes burned hot compared to the north and east facing slopes. Moreover, the fire burned most severe in areas with a pre-existing high fire regime, which included the chaparral ground at the low elevations encompassed within the southeastern domain and the brush covered slopes located at the extreme elevations within the northwestern domain. In areas that were mostly timbered, the burn severity was low to moderate. However, it appears that the timber mortality in areas that were listed as moderately burned is extremely high and we suspect that after only a few years a majority of remaining timber will succumb to wind damage, snow load, and bug kill. Thus, the true effects of the fire in regards to

vegetative cover may be realized 5 to 10 years after the initial burn. The vegetative cover in areas within the riparian corridors appears to have sustained very little burn damage.

Field observations indicate the presence of erosion features consisting of incised rills and channels occurring within the headwalls and along the steep flanks of swales within the watershed, particularly within the lower elevations that are vegetated by chaparral. Based on the geomorphic expression of these features, it appears that they form as a result of concentrated runoff eroding the soils rather than linked to shallow debris slide failures.

Large-scale, deep-seated rotational slide failures were identified within the timbered ground in the upper elevations but they were not evaluated due to their remote setting and limited treatment potential. Field evidence suggests that isolated debris flows, slides, and falls occur along the steep channel walls of the local stream courses and within the headwall slopes in the upper elevations of the northwestern domain. Many such failures appear to have culminated in mixed colluvial and alluvial deposits occurring at the mouth of tributary channels that drain into the main stem of Moon Fork Cottonwood Creek and the North Fork Cottonwood Creek. Moreover, several debris slides positioned high in the watershed were witnessed from the air to have traveled down gradient and adversely affected the road network by entraining fill prisms within several culverted crossings, rendering the roads inaccessible.

The riling and mass-wasting features described above can be adversely affected by the loss of vegetative cover. The primary mechanisms for this are the loss of mechanical support (root cohesion and anchoring) of the hillslope materials and the increases in runoff resulting from reductions in interception, infiltration, and evapotranspiration caused by the loss of vegetative cover.

B. Specific Observations

Site-specific observations were made of several part-time residences comprised of remote cabins positioned along the corridor of Eagle Creek. These high-value sites were evaluated in more detail from the regional overview to better assess potential risks from near-site debris flow, rock fall, floods, and other geologic hazards that may be present and that are not readily obvious after performing the regional overview. Of the several structures evaluated within or slightly down gradient of the burn area, only one structure was identified as being at risk. The location of this structure is shown on Map #5 and is briefly described in the following.

3.3 Emergency Determination

The values at risk considered in this assessment include the possible loss of life and infrastructure related to an isolated structure within the burn area, the loss of

infrastructure related to the local road systems, and the loss of natural resources related to excessive sediment entering the local watercourses.

General

Several culverted road crossings were observed along the main road systems within the burn area. Although many of the culverts within the timbered areas of the watershed have been recently replaced with culverts sized to handle large storm events, it is interpreted that they are still susceptible to excessive flows and slide debris as a result of the recent fire. Culverts within the lower elevations, particularly within the southeastern domain, do not appear to provide sufficient capacity to convey the likely increased flows and debris that will occur as a result of the burn. As a result, the capacity of the culverts within the entire burn area are interpreted to have a high risk of getting overwhelmed and may lead to the culvert crossings either failing or causing flows to be re-routed to areas that are not conditioned to handle such flows. The net result being a loss in access, capital expenses related to repairing the failed crossings, and increased sediment entering the local watercourses.

As a result of the steep and rocky nature of the slopes and soils present, respectively, direct treatment of the hillside using mulch, seed etc., is unlikely to be economically viable.

Site-Specific

Items identified as values at risk include a cabin located immediately adjacent to Eagle Creek and Rainbow Lake located on the North Fork Cottonwood Creek (Map #5).

Point M-3 is a cabin located at about W40.51781 and N-122.61573 (NAD 83 datum). The cabin is founded on an alluvial/colluvial fan deposit at the mouth of an unnamed class III swale. The class III swale up gradient of the cabin appears to have been moderately burned, resulting in an anticipated reduction in canopy of about 50% or more. This reduction in canopy, coupled with the naturally steep slopes within the swale (i.e. 65% and greater), and the presence of an existing alluvial/colluvial deposit at its mouth with Eagle Creek, suggests a high risk of increased flooding and debris slide/flow activity.

Currently an earthen berm directs flows exiting the swale to the northwest, away from the cabin. However, if this earthen berm was not present, the path of flow is directed to the western edge of the cabin and towards the rear of an abutment of a bridge that provides access to the cabin across Eagle Creek. Field evidence indicates that the earthen berm is currently almost entirely aggraded with sediment and has limited capacity to re-direct and convey flows. Thus, due to the high risk of increased flows and debris slide activity resulting from the fire within the class III swale above, it is likely that there is a high risk of the earthen berm being breached, resulting in excess

flows and debris that could impact the western edge of the cabin and bridge abutment.

The SEAT considered that a cabin that is positioned in a high likelihood area of impact to be a High Hazard to life. This assessment is based upon the fact that the cabin could feasibly be occupied during an event.

Point M-4 is Rainbow Lake located at about W40.51348 and N-122.68947 (NAD 83 datum). Rainbow Lake is discussed herein based on the potential loss of infrastructure (e.g. water quality and decreased storage capacity) as a result of the up gradient fires. Our general observations indicated that there is a high risk of debris slides and flows that can initiate high in the watershed and deposit material in Rainbow Lake. A condition analogous to this occurred in 1997 where, after significant storms had impacted the region, a debris slide was initiated high in the watershed. This debris slide traveled down gradient, entraining material as it progressed, and ultimately deposited in Rainbow Basin. Due to the reduction in vegetative cover, there is an increased risk that similar failures can occur.

3.4 Recommendations

A. General Recommendations

1. Performing hydrologic and hydraulic analyses for each culvert was outside the scope of this investigation. However, the controlling agency/owner of the roads within the burn area is encouraged to perform such analyses to assess the capacity of each culvert and develop a rank based on flow alone that can be used to prioritize the treatment of culvert crossings within and down gradient of the burn area.
2. Site-specific analyses should be performed by the controlling agency/owner to assess the potential impacts from debris torrents, debris flows, hyperconcentrated flows, and sedimentation resulting from winter rains. The results of these focused assessments should also be used to prioritize the treatment of culvert crossings within and down gradient of the burn area. The controlling agency/owner is encouraged to include the State Resource Water Quality Control Board and Fish and Game in the review and prioritization of the culverts.
3. It is recommended that the appropriate controlling agency/owner should perform consistent monitoring and maintenance of the crossings within and immediately down gradient of the burn area. Activities that are recommended to be incorporated in the monitoring and maintenance program include:
   (a) Performing inspections during the winter months, particularly after heavy rain storms;
   (b) Remove any material collected in the pipe that reduces its capacity; and
   (c) Remove debris within the channel immediately up gradient of the pipe to reduce subsequent plugging potential.

Depending on the circumstances behind suspect crossings that are determined to have a high risk of failure, treatments that could be applied, include:

(a) Replacing the culvert with a rock-lined ford;
(b) Replacing the culvert with an appropriately sized culvert;
(c) Installing a relief culvert;
(d) Installing a debris rack or stand pipe on the existing culvert; and
(e) Constructing a critical dip to divert flow back into the channel as soon as possible.

B. Site-Specific Recommendations

Point M-3: To reduce the potential of excessive flows and slide/flow debris from impacting the cabin, it is recommended to:

- Clean out the existing earthen berm to increase its capacity to convey flows and debris;
- Place rock-slope protection along the bank of the berm to increase its capacity to resist scour and to direct flows and debris away from the cabin;
- Maintain the class III swale up gradient of the cabin to keep it free of large woody debris that could migrate down gradient and become lodged creating a debris dam that increases the diversion potential within the channel; and
- Perform routine monitoring within the upper elevations of the class III swale to evaluate the presence of any slide activity that could migrate down gradient and compromise the cabin.

Point M-4: Due to the steep terrain and its natural propensity to erode and have debris slides over a large area, it is our opinion that direct treatment of the hillsides to reduce the slide potential is not economically feasible, or easy to predict. As a result, it is recommended to address the problem of sediment and debris entering Rainbow Lake based on an as needed basis. Dredging of the deposited material within the lake may be the only solution.

DECK FIRE

4.1 Resource Condition Assessment

A. Resource Setting

The Deck fire encompasses about 263 acres of land in Shasta County (Map #5).
The burned area resides primarily within the Great Valley geomorphic province (CGS Note 36) and is underlain by bedrock composed of marine sedimentary rock of Lower Cretaceous age (Fraticelli, et. al., 1987). This rock consists of interbedded mudstone, sandstone, and conglomerates.
The Deck fire exhibits rolling topography with minimal vertical relief. Elevations within the burn area range from 200 feet to about 340 feet above sea level.

B. Survey Methods

Through discussions with Mr. Bruce Beck, CalFire Branch Director, who witnessed the fire suppression activities, and our own desktop review of the local topographic and geologic setting, it was determined that the Deck fire represented little to no risk to human life, infrastructure, and resource as a result of geologic hazards. Consequently, an on-site review was not performed and no recommendations are provided.

MOTION FIRE

5.1 Resource Condition Assessment

A. Resource Setting

The Motion fire encompasses about 28,330 acres in Shasta County, north of Whiskeytown Lake (Map #6).

The burned area resides primarily within the Klamath Mountains geomorphic province (CGS Note 36) and is underlain by bedrock belonging almost entirely within the eastern Klamath Terrane. In descending order based on aerial coverage, the dominant bedrock consists of the Mule Mountain stock, the Balaklala Rhyolite, and the Copley Greenstone, all of Devonian age, followed by the Bragdon Formation of Mississippian age (Fraticelli, et. al., 1987). The Mule Mountain stock is defined by Fraticelli, et. al. (1987) as a highly altered phaneritic igneous body consisting of trondhjemite, albite granite, and quartz diorite; the Balaklala Rhyolite is composed of silicic flows, breccias, and tuffs, is intensely albitized, and is considered to be a cogenetic extrusive equivalent of the Mule Mountain stock. The Copley Greenstone is composed chiefly of keratophyre and subordinate spilite pillow lavas and volcanic breccias (Fraticelli, et. al., 1987). Lastly, the Bragdon Formation is present within the burn predominantly as black siliceous shale with interbedded mudstone.

Topographically, the Motion fire ranges in elevation from 700 to 4,900 and is drained by several sub-parallel creeks that are distributed in a sub-radial pattern and include Cottonwood Creek, South Squaw Creek, Motion Creek, South Fork Spring Creek, and Whiskey Creek. The dominant topographic expression exhibits alternating ridge and swale topography with moderate to steep side slopes. Slopes increase in gradient along the flanks of the local stream channels where they have incised into local bedrock. Low gradient ground located along the top of ridges and within depositional zones along the main stream channels are present.

Isolated and coalescing deep-seated slides have been identified and mapped by Fraticelli, et.al. (1987) in the upper elevations of the Motion fire, particularly within the northeastern 1/3 of the burn area.

According to fire history records provided by CAL FIRE (http://frap.fire.ca.gov/data/frapgisdata/download.asp?rec=fire), portions of the Motion fire had previously burned in the 1990's.

B. Survey Methods

The Motion fire was investigated on 23 August 2008 and again on 25 August 2008. The investigation consisted of driving the main roads including portions of Route 1 and Route 3 within the Chappie Shasta Off-highway park (OHV park), South Fork

Mountain Road, Benson Drive, and Whiskey Creek Road. Due to limited field time, only the areas within the lower elevations of the burn area that had the highest risk to life and development were assessed.

5.2 Observations

A. General Observations

Prior to the fire, the vegetative cover, starting at the lower elevations and moving upward, consisted largely of a dense cover of mixed chaparral that transitioned into mixed hardwoods followed by mixed conifers in the headwaters region of Whiskey Creek, South Fork Spring Creek, and South Fork Squaw Creek. Discussions of the vegetative cover are covered under other specialist reports.

Based on our observations and on burn area severity maps provided by the USFS (BAER, 2008), the south and west facing slopes burned hot compared to the north and east facing slopes. Moreover, the fire burned most severe in areas with a pre-existing high fire regime, which included the chaparral ground at low elevations. In areas that were mostly timbered, the burn severity was low to moderate. However, it appears that the timber mortality in areas that were listed as moderately burned is extremely high and we suspect that after only a few years a majority of remaining timber will succumb to wind damage, snow load, and bug kill. Thus, the true effects of the fire in regards to vegetative cover may be realized 5 to 10 years after the initial burn. The vegetative cover in areas within the riparian corridors appears to have sustained very little burn damage.

Field observations indicate the presence of erosion features consisting of incised rills and channels occurring within the headwalls and along the steep flanks of swales within the watershed, particularly within the lower elevations that are vegetated by Chaparral. Based on the geomorphic expression of these features, it appears that they form as a result of concentrated runoff eroding the soils rather than linked to shallow debris slide failures.

Large-scale, deep-seated rotational slide failures were identified within the timbered ground in the upper elevations. In addition, field evidence suggests that isolated debris flows, slides, and falls can occur along the steep channel walls of the local stream courses. Many such failures appear to have culminated in mixed colluvial and alluvial deposits occurring at the mouth of tributary channels that drain into the main watercourses.

The riling and mass-wasting features described above can be adversely affected by the loss of vegetative cover. The primary mechanisms for this are the loss of mechanical support (root cohesion and anchoring) of the hillslope materials and the increases in runoff resulting from reductions in interception, infiltration, and evapotranspiration caused by the loss of vegetative cover.

B. Specific Observations

Site-specific observations were made of several part-time residences comprised of remote cabins positioned along the corridor of Wiskey Creek, residences along Benson Drive, and several bridges within the burn area. These high-value sites were evaluated in more detail from the regional overview to better assess potential risks from near-site debris flow, rock fall, floods, and other geologic hazards that may be present and that are not readily obvious after performing the regional overview. The locations of high-values at risk identified through our observations are shown in Map #6 and are briefly described in the following.

5.3 Emergency Determination

The values at risk considered in this assessment include the possible loss of life and infrastructure related to residential structures, bridges, and public highway corridors within the burn area, the loss of infrastructure related to the local road systems, and the loss of natural resources related to excessive sediment entering the local watercourses.

General

Several culverted road crossings were observed along the main road systems within the burn area. The size of the culverts do not appear to provide sufficient capacity to convey the likely increased flows and debris that will occur as a result of the burn. As a result, the capacity of the culverts is interpreted to have a high risk of getting overwhelmed and may lead to the culvert crossings either failing or causing flows to be re-routed to areas that are not conditioned to handle such flows. The net result being a loss in access, capital expenses related to repairing the failed crossings, and increased sediment entering the local watercourses.

As a result of the steep and rocky nature of the slopes and soils present, respectively, direct treatment of the hillside using mulch, seed etc., is unlikely to be economically viable.

Site-Specific

Items identified as values at risk include: 1) the OHV staging area; 2) a Bridge across Cottonwood Creek; 3) a Culvert along Route 1; 4) two domestic-use water supply lines; 5) the Spring Creek Debris Basin; 6) structures at risk positioned along Whiskey Creek and South Fork Spring Creek; and 7) portions of State Highway 299 (Map #6).

Point MT-1 corresponds to the OHV park near the base of Shasta Dam (W40.71403, N-122.43731). This area was identified as having a risk of post-fire flooding and debris generation that could impact park improvements. This area was extensively addressed within the USFS BAER report (BAER, 2008) and the reader is referred to that report for a description of the site conditions.

Point MT-2 corresponds to a bridge that spans over Cottonwood Creek (W40.70480, N-122.45082). This bridge is also covered within the USFS BAER report (BEAR, 2008). Our observations indicate the watershed up gradient of Cottonwood Creek was extensively and severely burned. Due to the erosive nature of the slopes in the upper watershed, it is likely that excessive post-fire related flows and debris movement will impact Cottonwood Creek. This, coupled with the fact that the bridge is located at the first major depositional segment of the Cottonwood Creek channel, places a high risk that the capacity of the bridge to pass water and debris will be decreased as sediment beneath the bridge gets deposited. An engineering analysis of this bridge is provided in other specialist reports.

Point MT-3 is a domestic water supply inlet located at the base of a steep headwall that was severely burned (W40.71342, N-122.45346). Due to the severity of the burn and the high erosive nature of the soils within the headwall, there is a high risk that turbid water and sediment will impact the water supply. An engineering analysis addressing this water intake is provided in other specialist reports.

Point MT-4 is the location of a culvert that exhibited an immediate threat of becoming plugged as a result of the post-fire conditions (W40.72712, N-122.45845). The culvert is at the base of two adjacent swales, both of which have been impacted by a large rotational slide within their headwaters. This slide has historically produced slide debris into the swales through the failure of steeply inclined slopes along the toe of the rotational slide. Currently, the northern swale contains a depositional lobe of alluvium that has impacted the road surface immediately above the culvert. This material, in addition to additional debris that will be generated at the site due to a lack of vegetative cover caused by the fire, exacerbates the already present high risk of plugging. In the event the culvert becomes plugged, debris and water will flow over the road and scour out the fill prism.

Point MT-5 is the Spring Creek Debris Basin (W40.63074, N-122.48028). The Spring Creek Debris Basin is discussed herein based on the potential loss of infrastructure (e.g. decreased in storage capacity) as a result of the up gradient fires. Our general observations indicated that there is a high risk of debris slides, flows, and excessive soil erosion to occur within the watershed that will result in sediment infilling within the Spring Creek Debris Basin that will likely exceed historical rates. An engineering evaluation of potential impacts that this may have is addressed in other specialist reports.

Point MT-6 is the site of a Shasta County bridge and a single-family residence that is at risk of being adversely affected by post-fire conditions (W40.63559, N-122.50523). This area was extensively addressed within the USFS BAER report (BAER, 2008) and in a report prepared by the California Geologic Survey (Wopat, 2008). The reader is referred to those reports for a description of the site conditions.

Point MT-7 is a single-family cabin adjacent to Whiskey Creek (W40.68798, N-122.56824). This cabin is founded on an alluvial/colluvial fan deposit at the mouth

of an unnamed class III swale. Based on the presence of this deposit and the structures proximity to the mouth of the class III swale, there appears to be an existing, non-fire related risk, of the cabin being impacted by debris and flows emanating from the swale.

In addition, the toe of the alluvial fan that the cabin is founded on is actively being eroded by Whiskey Creek. This erosion has resulted in a near vertical slope to extend back from the creek to within about 4 feet of the foundation of the cabin. Increased flow within Whiskey Creek as a result of the fire will likely accelerate the erosion of the alluvial material and will cause a reduction in bearing capacity or a complete failure of the foundation system supporting the cabin.

Point MT-8 is a domestic water supply inlet located within a steep basin southeast of Copley Mountain (W40.66427, N-122.47864). Due to the severity of the burn and the high erosive nature of the soils within the basin up gradient, there is a high risk that turbid water and sediment will impact the water supply. An engineering analysis addressing this water intake is provided in other specialist reports.

State Highway 299: Portions of State Highway 299 traverse beneath steep slopes within the burn area. Roots and organic mater often assists in retaining rocks and other debris on steep slopes. The loss of this organic mater due to the fire can therefore cause an increased risk of rock and debris fall that may impact 299.

5.4 Recommendations

A. General Recommendations

1. Performing hydrologic and hydraulic analyses for each culvert within the burn area was outside the scope of this investigation. However, the controlling agency/owner of the roads within the burn area is encouraged to perform such analyses to assess the capacity of each culvert and develop a rank based on flow alone that can be used to prioritize the treatment of culvert crossings within and down gradient of the burn area.

2. Site-specific analyses should be performed by the controlling agency/owner to assess the potential impacts from debris torrents, debris flows, hyperconcentrated flows, and sedimentation resulting from winter rains. The results of these focused assessments should also be used to prioritize the treatment of culvert crossings within and down gradient of the burn area. The controlling agency/owner is encouraged to include the State Resource Water Quality Control Board and Fish and Game in the review and prioritization of the culverts.

3. It is recommended that the appropriate controlling agency/owner should perform consistent monitoring and maintenance of the crossings within and immediately

down gradient of the burn area. As previously entioned in this report, these activities include performing inspections during the winter months, particularly after heavy rain storms, removing any material collected in the pipe that may reduce its capacity to convey water and debris; and removing debris within the channel immediately up gradient of the pipe to reduce subsequent plugging potential.

Depending on the circumstances behind suspect crossings that are determined to have a high risk of failure, treatments that could be applied, include:

(a) Replacing the culvert with a rock-lined ford;
(b) Replacing the culvert with an appropriately sized culvert;
(c) Installing a relief culvert;
(d) Installing a debris rack or stand pipe on the existing culvert; and
(e) Constructing a critical dip to divert flow back into the channel as soon as possible.

B. Site-Specific Recommendations

Point MT-1: Please refer to other specialist reports herein and to the USFS BAER report (BAER, 2008) for recommendations pertaining to this site.

Point MT-2: Please refer to other specialist reports herein and to the USFS BAER report (BAER, 2008) for recommendations pertaining to this site.

Point MT-3: Please refer to other specialist reports herein for recommendations pertaining to this site.

Point MT-4: To reduce the potential of excessive flows and slide/flow debris from impacting the culvert crossing and washing out the fill prism, it is recommended to:

- Remove the lobe of deposited sediments perched immediately up gradient of the culvert inlet;
- Replace the existing culvert with either a rock-lined rolling dip, if possible, or with a sufficiently sized culvert designed to convey additional fire-related flows and debris; and
- Perform routine monitoring within the upper elevations of the class III swales to evaluate the presence of any slide activity that could migrate down gradient and compromise the culvert.

Point MT-5: Please refer to other specialist reports herein for recommendations pertaining to this site.

Point MT-6: Please refer to other specialist reports herein, to the USFS BAER report (BAER, 2008), and the California Geologic Survey report (Wopat, 2008) for recommendations pertaining to this site

Point MT-7: To reduce the potential of excessive flows and slide/flow debris from impacting the cabin, it is recommended to:

- Design and place rock-slope protection along the bank of Whiskey Creek to prevent debris and flows from scouring out the foundation of the cabin;
- Maintain the class III swale up gradient of the cabin to keep it free of large woody debris that could migrate down gradient and become lodged, creating a debris dam that increases the diversion potential within the swale; and
- Perform routine monitoring within the upper elevations of the class III swale to evaluate the presence of any slide activity that could migrate down gradient and compromise the cabin.

State Highway 299: To reduce the potential impact of rock and debris fall along Highway 299, it is recommended that the controlling agency monitor the 299 corridor for increased rock fall and debris slide hazards. As required, perform increased maintenance along problematic road segments to remove the debris and place signage warning travelers of the hazard.

STEIN FIRE

6.1 Resource Condition Assessment

A. Resource Setting

The Stein fire encompasses about 1,148 acres of land in Shasta County, immediately up gradient of Shasta Lake (Map #7).

The burned area resides within the Klamath Mountain geomorphic province (CGS Note 36) and is underlain by bedrock composed of the Pit Formation of Permian age (Fraticelli, et. al., 1987). The Pit Formation is composed of well-indurated, gray and black shale with interbedded layers of tuff, and to a lesser extent isolated areas of sulfide enrichment.

The Stein fire exhibits steep topography with alternating ridge/swale topography that trends to the northwest. The majority of the drainage within the Stein fire area is directed down gradient to Shasta Lake via sheet flow and class II and III swales. Elevations with the burn area range from 1,000 feet to about 2,300 feet above sea level.

B. Survey Methods

Through discussions with Mr. Bruce Beck, CalFire Branch Director, who witnessed the fire suppression activities, and our own desktop review of the local topographic and geologic setting, it was determined that the Stein fire represented little to no risk to human life, infrastructure, and resource as a result of geologic hazards. Consequently, an on-site review was not performed and no recommendations are provided.

PINE FIRE (west side)

7.1 Resource Condition Assessment

A. Resource Setting

The Pine fire encompasses about 1,757 acres in Shasta County and is composed of two fires separated by the drainage of Little Cow Creek (Map #7). Due to the remote location, limited access, and low threat to values at risk, the fire on the east side of Little Cow Creek was not evaluated; hence, our investigation and the text that follows only addresses the fire located on the west side of Little Cow Creek.

The Pine fire resides within the Klamath Mountains geomorphic province (CGS Note 36) and is underlain by bedrock composed of the Pit Formation of Permian to Triassic age and the Bully Hill Rhyolite, also of Permian age. These two bedrock types are locally overlain by younger Pliocene volcanics belonging to the Tuscan Formation (Fraticelli, et. al., 1987). The Pit Formation is well-indurated and consists of gray and black shale with interbedded layers of tuff with some isolated areas of sulfide enrichment; the Bully Hill Rhyolite is well-indurated and consists of porphyritic and nonporphyritic quartz keratophyre with isolated bodies of sulfide enrichment; and the Tuscan Formation is composed locally of volcanic lahars that cap local ridge tops.

The Pine fire exhibits steep topography with alternating ridge/swale topography that trend to the southeast. The majority of the drainage within the Pine fire area is directed down gradient to Little Cow Creek, which is paralleled by Highway 299 and forms the fires eastern boundary. Elevations within the burn area range from 1,100 feet near Highway 299 to about 1,900 feet above sea level.

According to fire history records provided by CAL FIRE (http://frap.fire.ca.gov/data/frapgisdata/download.asp?rec=fire), portions of the Pine fire had previously burned in the 1920's, 1930's, and the 1940's.

B. Survey Methods

The Pine fire was investigated on 20 August 2008 and included discussing the fire area with local residences and driving portions of Highway 299, Sugar Pine Camp Road, and Little Backbone Ridge Road.

7.2 Observations

A. General Observations

Prior to the fire, the vegetative cover in the burned area consisted mostly of chaparral with pockets of mixed hardwood and conifer stands. Discussions of the vegetative cover are covered under other specialist reports.

Based on our observations, the majority of the fire is considered to have a low to moderate burn severity with isolated patches being more intensely burned. The more severe burn areas generally corresponded with chaparral vegetation positioned on south facing slopes.

Field observations indicate the presence of erosion features consisting of incised rills and channels occurring within the headwalls and along the steep flanks of swales within the watershed, particularly within the lower elevations that are vegetated by chaparral. Based on the geomorphic expression of these features, it appears that they form as a result of concentrated runoff eroding the soils rather than linked to shallow debris slide failures.

In addition, field evidence suggests that isolated debris slides and falls can occur along the steep channel walls of the local stream courses and along Highway 299. Many such failures appear to have culminated in mixed colluvial and alluvial deposits occurring at the mouth of tributary channels that drain into Little Cow Creek

The riling and mass-wasting features described above can be adversely affected by the loss of vegetative cover. The primary mechanisms for this are the loss of mechanical support (root cohesion and anchoring) of the hillslope materials and the increases in runoff resulting from reductions in interception, infiltration, and evapotranspiration caused by the loss in vegetative cover.

B. Specific Observations

Site-specific observations were made of residences and road corridors located inside and immediately down gradient of the burn area. These high-value sites were evaluated in more detail from the regional overview to better assess potential risks from near-site debris flow, rock fall, floods, and other geologic hazards that may be present and that are not readily obvious after performing the regional overview. The locations of high-values at risk identified through our observations are shown in Map #7 and are briefly described in the following.

7.3 Emergency Determination

The values at risk considered in this assessment include the possible loss of life and infrastructure related to residential structures and public highway corridors within the burn area, the loss of infrastructure related to the local road systems, and the loss of natural resources related to excessive sediment entering the local watercourses.

General

Several culverted road crossings were observed along the main road systems within the burn area, particularly along Highway 299 and Sugar Pine Camp Road. The size of the culverts do not appear to provide sufficient capacity to convey the likely increased flows and debris that will occur as a result of the burn. As a result, the capacity of the culverts

is interpreted to have a high risk of getting overwhelmed and may lead to the culvert crossings either failing or causing flows to be re-routed to areas that are not conditioned to handle such flows. The net result being a loss in access, capital expenses related to repairing the failed crossings, and increased sediment entering the local watercourses.

As a result of the steep and rocky nature of the slopes and soils present, respectively, direct treatment of the hillside using mulch, seed etc., is unlikely to be economically viable.

Site-Specific

Items identified as values at risk include a residence located at Ingot and portions of State Highway 299 (Map #7).

Point P-1 corresponds to the Ingot dismantlers and residential development located at about W40.72734 and N-122.07812. This site is founded on an alluvial/colluvial deposit at the mouth of an unnamed swale. The swale up gradient of the site appears to have been lightly to moderately burned, resulting in an anticipated reduction in canopy of about 30% or more. This reduction in canopy, coupled with the naturally steep slopes within the swale (i.e. 55% and greater), and the presence of an existing alluvial/colluvial deposit at its mouth with Little Cow Creek, suggests a high risk of increased flooding and debris slide/flow activity that can impact the site. An engineering analysis of this site is provided in other specialist reports.

State Highway 299: Portions of State Highway 299 traverses beneath steep slopes within the burn area. Roots and organic mater often assist in retaining rocks and other debris on steep slopes. The loss of this organic mater due to the fire can therefore cause an increased risk of rock and debris fall that may impact Highway 299.

7.4 Recommendations

A. General Recommendations

1. Performing hydrologic and hydraulic analyses for each culvert within the burn area was outside the scope of this investigation. However, the controlling agency/owner of the roads within the burn area is encouraged to perform such analyses to assess the capacity of each culvert and develop a rank based on flow alone that can be used to prioritize the treatment of culvert crossings within and down gradient of the burn area.

2. Site-specific analyses should be performed by the controlling agency/owner to assess the potential impacts from debris torrents, debris flows, hyperconcentrated flows, and sedimentation resulting from winter rains. The results of these focused assessments should also be used to prioritize the treatment of culvert crossings

within and down gradient of the burn area. The controlling agency/owner is encouraged to include the State Resource Water Quality Control Board and Fish and Game in the review and prioritization of the culverts.

3. It is recommended that the appropriate controlling agency/owner should perform consistent monitoring and maintenance of the crossings within and immediately down gradient of the burn area. Activities that are recommended to be incorporated in the monitoring and maintenance program include:
   (a) Performing inspections during the winter months, particularly after heavy rain storms;
   (b) Remove any material collected in the pipe that may reduce its capacity to convey water and debris; and
   (c) Remove debris within the channel immediately up gradient of the pipe to reduce subsequent plugging potential.

Depending on the circumstances behind suspect crossings that are determined to have a high risk of failure, treatments that could be applied, include:

(a) Replacing the culvert with a rock-lined ford;
(b) Replacing the culvert with an appropriately sized culvert;
(c) Installing a relief culvert;
(d) Installing a debris rack or stand pipe on the existing culvert; and
(e) Constructing a critical dip to divert flow back into the channel as soon as possible.

B. Site-Specific Recommendations

Point P-1: Please refer to other specialist reports herein for recommendations pertaining to this site.

State Highway 299: To reduce the potential impact of rock and debris fall along Highway 299, it is recommended that the controlling agency monitor the Highway 299 corridor for increased rock fall and debris slide hazards. As required, perform increased maintenance along problematic road segments to remove the debris and place signage warning travelers of the hazard.

VENTURE FIRE

8.1 Resource Condition Assessment

A. Resource Setting

The Venture fire encompasses about 1,911 acres in Shasta County and is roughly situated immediately west of the Pit River (Map #8).

The Venture fire resides within the Cascade Range geomorphic province (CGS Note 36) and is underlain by bedrock composed of basalt flows of Pleistocene age. Quaternary alluvium is mapped within the local flood plain of Hat Creek and the Pit River (Lydon, et. al., 1960). Local deposits of diatomite were observed adjacent to Hat Creek.

The Venture fire exhibits generally rolling topography with very little vertical relief. The steepest slopes observed occur along a gentle escarpment that projects down to the flood plain of Hat Creek and the Pit River. Slopes in this area approach 65% in gradient but generally have short slope distances. Elevations within the burn area range from 2,750 feet near the Pit River to about 3,150 feet above sea level.

B. Survey Methods

The Venture fire was investigated on 20 August 2008 and included driving portions of Highway 299 and an access road to an active quarry site located west of Hat Creek.

8.2 Observations

A. General Observations

Prior to the fire, the vegetative cover consisted mostly of chaparral with pockets of mixed hardwood and conifer stands. Discussions of the vegetative cover are covered under other specialist reports.

Based on our observations, the majority of the fire is considered to have a low to moderate burn severity with isolated patches being more intensely burned.

Field observations indicate the presence of erosion features consisting of incised rills and channels occurring within the headwalls and along the steep flanks of swales that project down gradient along the escarpment situated immediately west of Hat Creek. Based on the geomorphic expression of these features, it appears that they form as a result of concentrated runoff eroding the soils rather than linked to shallow debris slide failures. This soil erosion has culminated in alluvial fan deposits occurring at the mouth of swales that drain onto the west side of the Hat Creek flood plain.

The erosional features described above can be adversely affected by the loss of vegetative cover. The primary mechanisms for this are the loss of mechanical support

(root cohesion and anchoring) of the hillslope materials and the increases in runoff resulting from reductions in interception, infiltration, and evapotranspiration caused by the loss of the vegetative cover.

B. Specific Observations

Site-specific observations were made of local road systems and development associated with the Hat Creek rest area. These high-value sites were evaluated in more detail from the regional overview to better assess potential risks from near-site debris flow, rock fall, floods, and other geologic hazards that may be present and that are not readily obvious after performing the regional overview. The locations of high-values at risk identified through our observations are shown in Map #8 and are briefly described in the following.

8.3 Emergency Determination

The values at risk considered in this assessment include the possible loss of infrastructure related to a damaged culvert crossing that has been jeopardized by fire and the loss of natural resources related to excessive sediment entering the local watercourses.

General

Riling and other erosional features where observed along off-highway vehicle trails that have been pioneered within the area of the fire. Due to the reduction in rain-drop impact and increased runoff as a result of the reduced canopy cover, there will likely be an increase in post-fire erosion along these trails. The risk of this erosion having an adverse effect is low, however, due to the low delivery as a result of a large deposition site provided by the floodplain of Hat Creek.

Site-Specific

Point V-1 corresponds to a culvert crossing that has been damaged during the fire (W40.98080, N-122.57146). This culvert crossing consists of two plastic pipes that have been partially burned. Because of the condition of these pipes, there is a risk that they will be unable to pass increased post-fire flows. An engineering analysis of this crossing is provided in other specialist reports.

8.3 Recommendations

A. General Recommendations

In order to reduce the impact of un-regulated off-highway use within the burn area, it is recommended that signs be placed to deter such activities. In particular, signs should be concentrated along the steep slopes of the escarpment located west of Hat

Creek. Road access could also be limited by maintaining locked gates at the entrance point of the major roads.

B. Site-Specific Recommendations

Point V-1: It is recommended that the damaged pipes at this location get replaced to reduce the potential of a catastrophic failure of the crossing.

WITHROW FIRE

9.1 Resource Condition Assessment

A. Resource Setting

The Withrow fire encompasses about 249 acres in Shasta County north of Shingletown, California (Map #1).

The Withrow fire resides mostly within the Cascade Range geomorphic province with some overlap onto rock belonging to the Great Valley geomorphic province (CGS Note 36). The fire is underlain by bedrock composed of well-indurated, volcanic lahar flows of Pliocene age and less –indurated, Cretaceous age, deposits of mudstone and sandstone belonging to the Chico Formation (Lydon, et. al., 1960).

The Withrow fire is positioned along the crest and northern flank of a large ridge that is composed of volcanic rock. As a result, the upper elevations of the fire, along the crest of the ridge, exhibit smooth, rolling slopes of low gradient. Moving to the flank of the ridge, the slope gradients become very steep (>65%) and the topographic expression consists of bench-step topography as a result of deferential weathering between layered volcanic flow deposits. At the base of the ridge, within the lower elevations of the fire, the slopes transition to smooth, rolling, low gradient ground near the valley bottom that is occupied by Snow Creek. Elevations within the burn area range from 2,400 feet to about 3,300 feet above sea level.

B. Survey Methods

The Withrow fire was investigated on 20 August 2008 and included driving several of the local roads within the burn area.

9.2 Observations

A. General Observations

Prior to the fire, the vegetative cover consisted mostly of mixed conifer along the ridge top and mixed hardwoods and brush along the steep slopes descending towards Snow Creek. Discussions of the vegetative cover are covered under other specialist reports.

Based on our observations, the majority of the fire is considered to have a low to moderate burn severity with isolated patches being more intensely burned.

Geomorphic evidence suggests that the steep slopes on the southern flank of Snow Creek are prone to isolated, shallow, debris slides and rock fall.

9.3 Emergency Determination

Although there is a recognized potential that isolated, shallow, debris slides and rock fall can occur within the burn area along the southwestern flank of Snow Creek, the overall risk that these types of failures have on values at risk is considered low due to the low intensity burn in this region, the overall competency of the slopes, and the long distance to any value at risk. As a result, the Winthrow fire is interpreted as having no significant threat and, therefore, no recommendations are made.

SHINGLETOWN FIRE

10.1 Resource Condition Assessment

A. Resource Setting

The Shingletown fire encompasses about 388 acres in Shasta County southwest of Shingletown, California (Map #1).

The Shingletown fire resides within the Cascade Range geomorphic province (CGS Note 36) and is underlain by bedrock composed of basalt flows of Pleistocene age (Lydon, et. al., 1960).

The Shingletown fire exhibits rolling topography with very little vertical relief. The slopes approach about 45% in gradient. The steepest slopes observed occur along the southern flank of the fire where the slopes start to descend into Baldwin Creek located about 5,000 feet further to the south. Elevations within the burn area range from 2,900 feet to about 3,900 feet above sea level.

B. Survey Methods

The Shingletown fire was investigated on 20 August 2008 and included driving several of the local roads within the burn area.

10.2 Observations

A. General Observations

Prior to the fire, the vegetative cover consisted mostly of mixed conifer with an understory of brush and hardwoods. Discussions of the vegetative cover are covered under other specialist reports.

Based on our observations, the majority of the fire is considered to have a low to moderate burn severity with isolated patches being more intensely burned.

10.3 Emergency Determination

Due to the low gradient ground, distance to any value at risk, and lack of geologic concern within the burn area, the Shingletown fire is interpreted as having no significant threat and, therefore, no recommendations are made.

KIRKMAN FIRE

11.1 Resource Condition Assessment

A. Resource Setting

The Kirkman fire encompasses about 2,053 acres in Shasta County (Map #9). The Kirkman fire resides mostly within the Cascade Range geomorphic province with some overlap onto rock belonging to the Great Valley geomorphic province (CGS Note 36). The fire is underlain by bedrock composed of well-indurated, volcanic lahar and basaltic flow deposits of Pliocene age and less –indurated, Cretaceous age, deposits of mudstone and sandstone belonging to the Chico Formation (Lydon, et. al., 1960).

The Kirkman fire is positioned along the crest and flanks of an east-west trending, interfluvial ridge that separates Bear Creek to the south from Clough Gulch to the north. The ridge is composed of layered volcanic rock. As a result, the upper elevations of the fire, along the crest of the ridge, exhibit smooth, rolling slopes of low gradient. Moving to the flanks of the ridge, the slope gradients become very steep (>65%) and the topographic expression consists of bench-step topography as a result of deferential weathering between layered volcanic flow deposits. At the base of the north side of the ridge, within the lower elevations of the northern portion of the fire, the slopes transition to smooth, rolling, low gradient ground near the valley bottom that is occupied by Clough Gulch. Elevations within the burn area range from 650 feet to about 1,250 feet above sea level.

B. Survey Methods

The Kirkman fire was investigated on 21 August 2008. Due to poor access, our evaluation was almost entirely performed from Old Cow Creek Road to the west and Highway 44 to the south.

11.2 Observations

A. General Observations

Prior to the fire, the vegetative cover consisted mostly of mixed hardwoods, brush, and some grassland in the lower elevations. Discussions of the vegetative cover are

covered under other specialist reports.

Based on our observations, the majority of the fire is considered to have a low to moderate burn severity with isolated patches being more intensely burned.

Geomorphic evidence suggests that the steep slopes on the northern and southern flank of the fire, above Clough Gulch and Bear Creek, respectively, are prone to isolated, shallow, debris slides and rock fall.

11.3 Emergency Determination

Although there is a recognized potential that isolated, shallow, debris slides and rock fall can occur within the burn area along the steep slopes above Clough Gulch and Bear Creek, the overall risk that these types of failures have on values at risk is considered low due to the low intensity burn in these regions and the overall competency of the slopes. As a result, the Kirkman fire is interpreted as having no significant threat and, therefore, no recommendations are made.

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Personnel Communication, Mr. Bruce Beck, CAL FIRE Branch Director, 8 August 2008.

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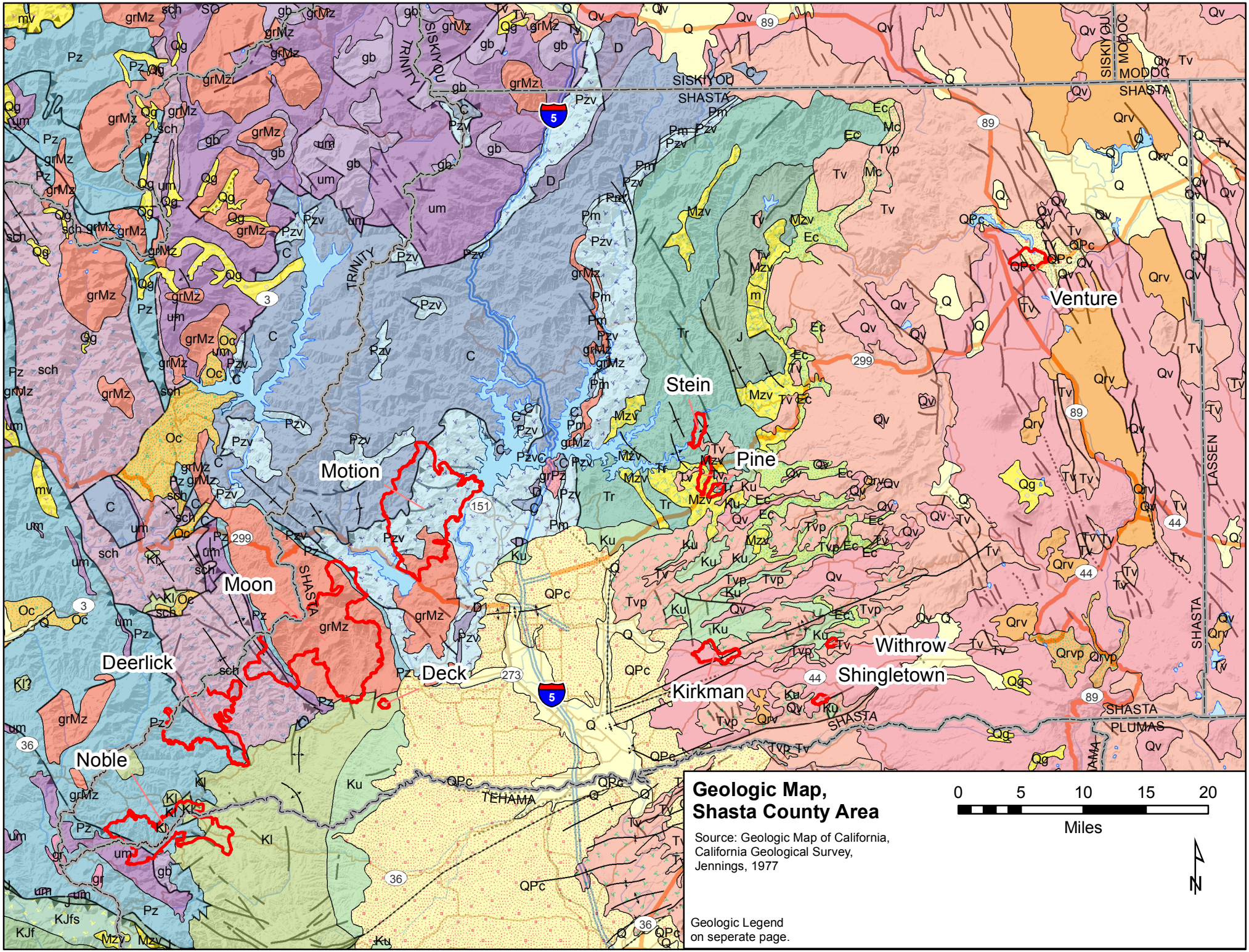
Geologic Map,
Shasta County Area
Source: Geologic Map of California,
California Geological Survey,
Jennings, 1977
0 5 10 15 20
Miles
N
Geologic Legend
on seperate page.
Venture
Stein
Pine
Motion
Moon
Deerlick
Deck
Noble
Kirkman
Withrow
Shingletown
SISKIYOU
MODOC
SHASTA
TRINITY
LASSEN
PLUMAS
TEHAMA

GEOLOGIC LEGEND
(GENERALIZED DESCRIPTION OF ROCK TYPES)

MARINE SEDIMENTARY ROCKS

CENOZOIC – QUATERNARY – Pleistocene–Holocene

Qs — Extensive marine and nonmarine sand deposits, generally near the coast or desert playas.

Q — Alluvium, lake, playa, and terrace deposits; unconsolidated and semi-consolidated. Mostly nonmarine but includes marine deposits near the coast.

CENOZOIC – TERTIARY – Pliocene — **P** — Sandstone, siltstone, shale, and conglomerate; mostly moderately consolidated.

CENOZOIC – TERTIARY – Miocene — **M** — Sandstone, siltstone, shale, and conglomerate; mostly moderately consolidated.

CENOZOIC – TERTIARY – Oligocene — **O** — Sandstone, shale, conglomerate; mostly well consolidated.

CENOZOIC – TERTIARY – Eocene — **E** — Shale, sandstone, conglomerate, minor limestone; mostly well consolidated.

CENOZOIC – TERTIARY – Paleocene — **Ep** — Sandstone, shale, and conglomerate, mostly well consolidated.

NONMARINE (CONTINENTAL) SEDIMENTARY ROCKS

Qls — Selected large landslides, such as Blackhawk Slide on north side of San Gabriel Mountains; early to late Quaternary.

Qg — Glacial till and moraines. Found at high elevations mostly in the Sierra Nevada and Klamath Mountains.

QPc — Pliocene and /or Pleistocene sandstone, shale, and gravel deposits; mostly loosely consolidated.

Mc — Sandstone, shale, conglomerate, and fanglomerate; moderately to well consolidated.

Oc — Sandstone, shale, and conglomerate; mostly well consolidated.

Tc — Undivided Tertiary sandstone, shale, conglomerate, breccia, and ancient lake deposits.

Ec — Sandstone, shale, conglomerate; moderately to well consolidated.

VOLCANIC ROCKS

Qrv **Qrvp**

Qrv: Recent (Holocene) volcanic flow rocks; minor pyroclastic deposits.

Qrvp: Recent (Holocene) pyroclastic and volcanic mudflow deposits.

Qv **Qvp**

Qv: Quaternary volcanic flow rocks; minor pyroclastic flows.

Qvp: Quaternary pyroclastic and volcanic mudflow deposits.

Tv **Tvp**

Tv: Tertiary volcaniv flow rocks; minor pyroclastic deposits.

Tvp: Tertiary pyroclastic and volcanic mudflow deposits.

Ti — Tertiary intrusive rocks; mostly shallow (hypabyssal) plugs and dikes.

PLUTONIC ROCKS

grCz — Cenozoic (Tertiary) granitic rocks – quartz monzonite, quartz latite, and minor monzonite, granodiorite, and granite; found in the Kingston, Panamint, Armarosa, and Greenwater Ranges in southeastern California.

MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS

MESOZOIC – TERTIARY-CRETACEOUS — **TK** — Sandstone, shale, and minor conglomerate in coastal belt of northwestern California; included by some in Franciscan Complex. Previously considered Cretaceous, but now known to contain early Tertiary microfossils in places.

MESOZOIC – CRETACEOUS — **Ku** — Upper Cretaceous sandstone, shale, and conglomerate.

MESOZOIC – CRETACEOUS — **Kl** — Lower Cretaceous sandstone, shale, and conglomerate.

K — Undivided Cretaceous sandstone, shale and conglomerate; minor nonmarine rocks in Peninsular Ranges.

KJf **KJfm** **KJfs**

KJf: Franciscan Complex: Cretaceous and Jurassic sandstone with smaller amounts of shale, chert, limestone, and conglomerate. Includes Franciscan melange, except where seperated – seeKJfm.

KJfm: Melange of fragmented and sheared Franciscan Complex rocks.

KJfs: Limestone and dolomite, sandstone and shale; in part tuffaceous.

MESOZOIC – JURASSIC — **J** — Shale, sandstone, minor conglomerate, chert, slate, limestone; minor pyroclastic rocks.

MESOZOIC – TRIASSIC — **Tr** — Shale, conglomerate, limestone and dolomite, sandstone, slate, hornfels, quartzite; minor pyroclastic rocks.

sch — Schists of various types; mostly Paleozoic or Mesozoic age; some Precambrian.

PALEOZOIC – PERMIAN — **Pm** — Shale, conglomerate, limestone and dolomite, sandstone, slate, hornfels, quartzite; minor pyroclastic rocks.

ls — Limestone, dolomite, and marble whose age is uncertain but probably Paleozoic or Mesozoic.

PALEOZOIC – CARBON-IFEROUS — **C** — Shale, sandstone, conglomerate, limestone, dolomite, chert, hornsfels, marble, quartzite; in part pyroclastic rocks.

Pz — Undivided Paleozoic metasedimentary rocks. Includes slate, sandstone, shale, chert, conglomerate, limestone, dolomite, marble, phyllite, schist, hornfels, and quartzite.

PALEOZOIC – DEVONIAN — **D** — Limestone and dolomite, sandstone and shale; in part tuffaceous.

PALEOZOIC – SILURIAN-ORDOVICIAN — **SO** — Sandstone, shale, conglomerate, chert, slate, quartzite, hornfels, marble, dolomite, phyllite; some greenstone.

PALEOZOIC – CAMBRIAN — **Ca** — Sandstone, shale, limestone, dolomite, chert, quartzite, and phyllite; includes rocks that are possibly Precambrian.

PRECAMBRIAN — **pC** — Conglomerate, shale, sandstone, limestone, dolomite, marble, gneiss, hornfels, and quartzite; may be Paleozoic in part.

MIXED ROCKS

gr-m — Granitic and metamorphic rocks, mostly gneiss and other metamorphic rocks injected by granitic rocks. Mesozoic to Precambrian.

m — Undivided pre-Cenozoic metasedimentary and metavolcanic rocks of great variety. Mostly slate, quartzite, hornfels, chert, phyllite, mylonite, schist,

pC — Complex of Precambrian igneous and metamorphic rocks. Mostly gneiss and schist intruded by igneous rocks; may be Mesozoic in part.

METAVOLCANIC ROCKS

Mzv — Undivided Mesozoic volcanic and metavolcanic rocks. Andesite and rhyolite flow rocks, greenstone, volcanic breccia, and other pyroclastic rocks; in part strongly metamorphosed. Includes volcanic rocks of Franciscan Complex: basaltic pillow lava, diabase, greenstone, and minor pyroclastic rocks.

mv — Undivided pre-Cenozoic metavolcanic rocks. Includes latite, dacite, tuff, and greenstone; commonly schistose.

Pzv — Undivided Paleozoic metavolcanic rocks. Mostly flows, breccia, and tuff, including greenstone, diabase, and pillow lavas; minor interbedded sedimentary rocks.

PLUTONIC ROCKS

grMZ — Mesozoic granite, quartz monzonite, granodiorite, and quartz diorite.

um — Ultramafic rocks, mostly serpentine. Minor perodotite, gabbro, and diabase. Chiefly Mesozoic.

gb — Gabbro and dark dioritic rocks; chiefly Mesozoic.

gr — Undated granitic rocks.

grPz — Paleozoiv and Permo-Triassic granitic rocks in the San Gabriel and Klamath Mountains.

grpC — Conglomerate, shale, sandstone, limestone, dolomite, marble, gneiss, hornfels, and quartzite; may be Paleozoic in part.

Geologic boundary.

Fault traces, solid where well located; dashed where approximately located or inferred; and dotted where concealed by younger rocks or by lakes or bays. Fault traces are queried where continuation or existence is uncertain. Many concealed faults in the Great Valley are based on maps of selected subsurface horizons, so locations shown are approximate and may indicate structural trends only. All offshore faults, based on acoustic-reflection profiles records are dashed.

Thrust faults (barbs on upper plate), solid where well located, dashed where approximately located or inferred; and dotted where concealed by younger rocks or by lakes or bays. Fault surface generally dips less than 45 degrees, but locally may have been subsequently steepened.

Anticlinal fold.

Dotted offshore and where concealed under alluvium in the Great Valley and elsewhere. Concealed folds may be confined to certain units, and their location is approximate.

Anticlinal fold.

Source: Geologic Map of California, California Geological Survey, Jennings, 1977

NOTE: This legend has been formatted for on-screen viewing as a PDF document. When printing, increase page size to 11" x 17" to improve readibility.

DRAFT TECHNICAL SPECIALIST REPORT
STATE EMERGENCY ASSESSMENT TEAM (SEAT) Emergency Report

Resource: Engineering

Fire Name: Shasta Lightning Complex CA-SHU-004727 June 2008

Author Name: Mohammed Seyar Musazay, P.E (License# 72924)
Department of Water Resources
1614 9th Street
Sacramento, Ca, 95814
(916) 653-8404

I. Resource Condition Assessment

A. Setting

Shasta Lightning Complex fires that were assessed in this mission burned a total area of 100873 acres. The fires were in 11 distinct geographical areas of Shasta County which were ignited on June 21st due to lightning. The fires burned National Forest, BLM, National Parks and private lands. The fires included in this assessment are the following:

1. Noble

   Not inspected. Preliminary investigation didn't warrant site visit for engineering survey.

2. Deerlick

   The fire burned 13,936 acres with low to moderate intensities. The area consists of foothills with very steep slopes. Fuels consist of mostly chaparral and Manzanita with few areas of timber.

3. Moon

   This is largest fire of the Shasta Lightning Complex with an area of 35,888 acres. The area is located north of cities of Ono and Igo. The fire severity was mainly low with some areas of moderate burn. The burn area contains unburned old abandoned cabins and few occupied residences.

4. Deck

   Not inspected. Preliminary investigation didn't warrant site visit for engineering survey.

5. Motion

   The second largest fire of the Shasta Lightning Complex it burned an area of 28,330 acres. The area is located south west of Shasta Dam and includes very sensitive areas including the Iron Mountain Mine complex which is a declared Federal super fund site. Also impacted with this fire are the Spring Creek Reservoir, Whiskeytown and Keswick Reservoirs.

6. Stein

   Not inspected. Preliminary investigation didn't warrant site visit. The site is very remote with no vehicular access. The fire is expected to only impact water quality in the Shasta Lake.

7. Pine

   The fire burned an area of 1,757 acres south and north of Highway 299. The terrain is hilly consisting of high elevation areas with small drainage channel flowing under Highway 299 into Little Cow Creek. There are individual homes north of Highway 299 in the burn area that survived the fire. There are no potential post fire risks to these homes. The burned area south of highway 299 is remote and inaccessible by vehicle. Risks to life, property and resources were deemed none existing to warrant a foot inspection.

8. Venture

   The fire located on the north eastern edge of Shasta Lightning Complex burn an area of 1,911 acres. Most portions of the burn area drain into HAT Creek which is a tributary to PIT River. PIT River flows into Shasta Lake. The burn severity ranges from low to moderate.

9. Withrow

   This fire north of Highway 44 burned an area of 249 acres. This low intensity fire was in a very steep terrain inaccessible by vehicle. There are no potential risks to life property and resources.

10. Shingletown

    The fire burned 388 acres. Burn severity ranges from low to moderate. The area is located close to city of Shingletown. The residential areas are in higher elevation then the fire and are not expected to be impacted by post fire hazards. The fire is expected to have water quality impacts to Baldwin Creek.

11. Kirkman

The mostly brushy and oak fire burned an area of 2,054 acres. The fire is located north of Highway 44. The area consists of rolling hills and foothills. The burn severity is considered low.

B. Survey Methods

In order to evaluate the risk to life, property and resources a preliminary risk assessment was done using geographic maps, BARC maps, contour maps, hydrologic data and other available resources before site visits. Areas with potential risk were identified and noted for assessment. The potential risk areas were accessed by vehicle and a thorough on the ground investigation was completed. Areas where vehicle access was limited or non-existing and potential risks to life, property and resources were deemed possible the area was accessed by foot and investigated. Special attention was paid to structures, residential properties and environmental resources.

II. Findings of the On-The-Ground Survey (Observations)

A. Values at Risk

1. Noble

Not inspected. Preliminary investigation didn't warrant field investigation.

2. Deerlick

No risk to engineering features identified.

3. Moon

- Eagle Creek Bridge on Platina Road (N40.47402, W122.61643 map point M-2. Possible impact damage to the mid-span column of the bridge from debris flow.

- Rainbow Lake Rd Bridge north of Rector Creek Road (N40.48233, W122.63276 map point M-1). Possible blockage of the bridge from debris flow and compromising the integrity of the bridge.

4. Deck

Not inspected. Preliminary investigation didn't warrant field investigation.

5. Motion

    - Concrete Channel north of OHV Staging Area (N40.71403, W122.43731 map point MT-1). Burned dead trees in the channel severely reducing the capacity of the channel.
    - Cottonwood Creek Bridge (Baily Bridge) on Coram Road (N40.70480, W122.45082 map point MT-2). Possible damage to bridge from debris flow or floods.

    - Spring Creek Reservoir: Increased expected runoff, higher debris flows and increased sediment (N40.63074, W122.48028 map point MT-5.

    - Benson Drive Residence: House along the South Fork of Spring Creek and bridge (N40.635559, W122.50523 map point MT-6) with six feet freeboard close to the property. Low risk of flood damage to the property and bridge.

6. Stein

    Not inspected. Preliminary investigation didn't warrant field investigation.

7. Pine

    - Ingot Dismantlers off highway 299 (N40.72737, W122.07812 map point P-1). Possible blockage of the culvert under the property and flooding of the structures on top of the culvert.

8. Venture

    - Water Quality. HAT Creek and PIT River flow into Shasta Lake and will impact water quality of Shasta Lake.

9. Withrow

    No risk to engineering features identified.

10. Shingletown

    No risk to engineering features identified.

11. Kirkman

    - Clough Creek Bridge (N40.54824, 122.07751 map point K-1). Existing erosion problem on east side abutment of the bridge. The higher flows from the fire will increase the erosion and will endanger the integrity of the bridge.

III. Emergency Determination

The values considered in this assessment include the heightened risk to possible loss of life, property and resources due to increased runoff, debris flows, rock falls, floods and flash floods. In general, the increase risk to loss of life from these fires is deemed low due to remoteness of the areas and lack of populated development in fire effected areas. The risk to natural resources particularly water resources of the state is a particular concern due to the importance of the Shasta Complex to economic well being of Californians. The Shasta Complex which includes Shasta Lake, Keswick and Whiskey town Reservoirs is the main source of water for Central Valley project and it has great impact on State Water Project. The water from the Complex flows down the Sacramento River to the Delta. The delta water is then pumped to the farmers and urban users in the bay area, San Joaquin valley and southern California by Central Valley project and State Water Project and other entities. Any impact to the water quality in the Shasta Complex will affect water users throughout the state.

The fires have created a complex water quality situation which requires in depth study. The Iron Mountain Mine complex which has greatly impacted the water quality of the area due to leaching of heavy metals into water supply in the past is expected to increase those adverse effects. The fires have exposed large areas of soil and rock that will increase sediment and runoff and effectively increase the flow of heavy metals into the Spring Creek Reservoir. If the flows are increased enough where Spring Creek Reservoir makes uncontrolled releases into Keswick Reservoir the impact to water quality will be great compounded by the fact that Shasta Lake water will have adverse quality issues at the same time.

Local entities that are directly affected by the fires include City of Redding Water District, City of Shasta Lake, Bella Vista Water, Clear Creek CSD, Centerville CSD and Mountain Gate CSD. Contacts were made with the local water users to ascertain their concerns regarding the impact of fires to their water supply. The local water users who use Shasta Lake as their water supply should expect very low impact to their supply. The water user down stream of Shasta Dam should expect water quality problems with their water supply and be cognizant of the problem. The heavy metals will have very adverse affect on the aquatic organism in the Keswick Dam and Sacramento River if it is not controlled and mitigated properly.

City of Redding Water uses two primary surface water sources. The Sacramento River is used for Foothill Water Treatment Plant and Whiskeytown Reservoir is used for Buckeye Water Treatment Plant. Whiskeytown Reservoir is expected to have low water quality problems. As mentioned before, the water quality problems at Shasta Lake and more pertinent water quality problems due to Iron Mountain Mine are expected to have adverse effects on Foothill Water Treatment Plant.

IV. Recommendations

A. General Recommendations

In order to minimize the post fire risks to life, property and resources a proactive and coordinated effort by private property owners, local government, state and federal agencies is recommended. These efforts include Early Alert warning system and evacuation plans, monitoring of bridges, roads and culverts, clean up of woody debris from channels and dams with approval of Fish and Game and other regulatory agencies, posting of warning signs and closure of roads and bridges during forecasted high rainfall events. Other efforts include limiting public access to the burn areas, avoidance of soil disturbance by use Off Highway Vehicles and closure of trails and restoration native vegetation. In areas where either stream or spring water is used by private property owners as water supply proactive approach is recommended to monitor water quality and to avoid usage of such water during rain events until such time when the water quality is returned to pre-fire conditions. Local municipal water users, Central Valley Project operators and other affected water users are advised to monitor water quality and to take appropriate steps to minimize the fire impacts to water supply and to mitigate the loss of water quality. Regulatory and responsible agencies need to take a proactive approach to the Iron Mountain Mine issue and in depth study of the problem should be done. The problem needs to be mitigated and a solution found in order to minimize the adverse effects of the problem.

B. Specific Recommendations:

1. Eagle Creek Bridge (map point M-2): The bridge should be monitored and inspected after flood or high flow events to make sure the column has not been compromised.

2. Rainbow Lake Road Bridge (map point M-1): The stream area immediately upstream of the bridge and under the bridge should be cleared of debris and dead trees to allow free flow of water and to reduce impact to bridge. Blockage is possible during rain event. The bridge should be monitored and inspected after flood or high flow events and kept cleared of woody debris.

3. Concrete Lined Channel in OHV staging Area (map point MT-1): The channel should be cleared of dead trees and woody debris and channel capacity restored to designed specification. The burned wood trail bridge at the mouth of the channel should be closed and made inaccessible to the public until it is either repaired or replaced.

4. Cottonwood Creek Bridge (map point MT-2): As mentioned in Shu-Lightning Cx 2500-8 report this bridge is higher risk of damage due to debris flows and floods. As suggested by the BAER report BLM is advised to mitigate the problem and find a reasonable solution.

5. Spring Creek Reservoir (map point MT-5): The expected water quality issues with Shasta Dam due to the fires and expected increased flows into Spring Creek Reservoir will create a unique problem. Mitigation of such a complex issue is outside of scope of this assessment. Responsible parties are urged to monitor the problem and find appropriate solutions.

6. Benson Drive Residence (map point MT-6): Resident should be aware of the problem and monitor rain events and evacuate during forecasted high events. The bridge is not expected to have any problem. In case the bridge does fail in a severe event the resident should seek shelter in higher grounds.

7. Ingot Dismantlers (map point P-1): There are existing drainage problems with the culvert that runs under the facility according to the owner. These problems will be heightened due to debris flows and expected higher flows in rain events. The culvert was not accessible during site visit. The problem should be studied and an engineered solution should be found by responsible entities. The owner should be aware of the risks and have evacuation plans during forecasted intense rain events. The culvert should always be kept cleared of debris and sediments in order to maximize the flow capacity.

8. Clough Creek Bridge (map point K-1): Shore up east bank of Clough Creek up to 50 feet upstream of the bridge with the same type of rocks that is used in the immediate vicinity of the bridge. Riprap the east abutment of the bridge with large rocks to prevent further erosion and prevent damage abutment. Inspect and monitor the bridge after the application of the solution.

V. References

Shu-Lightning complex burned- area report (Reference FSH 2509.13)
http://yosemite.epa.gov/r9/sfund/r9sfdocw.nsf/db29676ab46e80818825742600743734/b32731488ba88e8788257007005e943d!OpenDocument

DRAFT TECHNICAL SPECIALIST REPORT
STATE EMERGENCY ASSESSMENT TEAM (SEAT) Emergency Report

Resource: Wildlife

Fire Name: Shasta Lightning Complex CA-SHU-004727 June 2008

Author Name: Richard Lis, Ph.D. Botanist
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The focus of this report is to evaluate possible deleterious effects to wildlife and special status terrestrial wildlife and invertebrate species on State Responsibility Area (SRA) lands (State, County, local, and private ownership) caused by the Noble, Deer Lick, Deck, Moon, Motion, Stein, Pine Venture, Withrow, Shingletown, and Kirkman Fires. It does not attempt to address those lands (primarily Federal) effected by the fires evaluated in FS-2500-8 (SHU-Lightning Complex Burned-Area Report).

Assessment of the wildlife setting was focused upon the search for special status terrestrial wildlife species (SSTWS) and invertebrate species and the potential for damage to the organisms or their habitat. Most terrestrial wildlife species have the potential to evade or escape the destructive path of a fire and frequently return to re-colonize a site soon after their particular habitat needs have been re-established. Wildfire also frequently improves habitat for many species by changing the plant community compositional mosaic on the landscape.

I. Resource Condition Assessment

A. Setting

1. Nobel

The primary SSTWS species in the SRA area is San Joaquin pocket mouse (*Perognathus inornatus* ssp. *inornatus*); while the only known special status invertebrate is Wawona riffle beetle (*Atractelmis wawona*).

2. Deerlick

The primary SSTWS species in the SRA area is: pacific fisher while there were no identified special status invertebrates.

3. Deck

   There were no SSTWS species in the SRA area, and no known special status invertebrates.

4. Moon

   The primary SSTWS species in the SRA area are American badger and pacific fisher; there were no identified special status invertebrates.

5. Motion

   The primary SSTWS species in the SRA area are: bald eagle (*Haliaeetus leucocephalus*) and Shasta salamander (*Hydromantes shastae*); the identified special status invertebrates include: Klamath sideband (*Monadenia churchi*), and Oregon shoulderband (*Helminthoglypta hertleini*).

6. Stein

   The SSTWS species in the SRA area of the Stein fire include bald eagle (*Haliaeetus leucocephalus*), and silver-haired bat (*Lasionycteris noctivagans*). There were no identified special status invertebrates.

7. Pine

   There was one possible SSTWS species in the SRA area of the Pine fire: Shasta salamander (*Hydromantes shastae*). There were no identified special status invertebrates.

8. Venture

   There are two SSTWS species in the SRA area of the Venture fire: great blue heron (*Ardea herodias*) and bank swallow (*Riparia riparia*). There were several identified special status invertebrates: Great Basin rams-horn (*Helisoma newberryi*), Archimedes pyrg (*Pyrgulopsis archimedis*), topaz juga (*Juga acutifilosa*), and nugget pebblesnail (*Fluminicola seminalis*).

9. Withrow

   There was a single habitat concern for primary SSTWS species in the SRA area of the Withrow fire for willow flycatcher (*Empidonax traillii*) habitat. There were no identified special status invertebrates.

10. Shingletown

    There were no primary SSTWS species in the SRA area and no identified special status invertebrates.

11. Kirkman

There were no primary SSTWS species in the SRA area and no known special status invertebrates.

B. Wildlife Survey Methods

Wildlife survey methods consisted of identifying the location of the fire, reviewing topography, reviewing preliminary BARC maps for fire intensity, searching the fire area and surrounding areas for SSTWS and communities using the California Natural Diversity Database (CNDDB 2008), reviewing biology and ecology species to determine possible susceptibility to negative impacts from severe fire or fire suppression activities, generating maps of occurrence locations of SSTWS, and field review of the burn areas of selected SSTWS locations.

II. Findings of the On-The-Ground Survey (Observations)

A. Values at Risk

1. Noble

The Wawona riffle beetle (WRB) is at high risk from increases in sediment deposition and/or flooding flows. The WRB is found in the riffles and rapids and has a strong preference for inhabiting submerged aquatic mosses, and have a need for clear, clean, well oxygenated water (Shepard and Barr 1991). Even small amounts of sediment have a high potential to deposit in its preferred habitat and suffocate the beetles. The WRB has been found in 10 occurrences in the State; population estimates are not given in each occurrence, although given that this habitat is often limited in area, numbers in occurrence are not thought to be high.

In addition to WRB, N. Fork Beegum is home to Eubrianax edwardsii an aquatic beetle that also needs very clear, clean well oxygenated water. Shepard (2008) has found that the larval form of this beetle is parasitized by a rare mite which has not yet been identified. Thus, the N. Fork of Beegum Creek is home to at least three uncommon aquatic invertebrates that need very high water quality.

Excessive sediment deposition is most likely to occur from the numerous culverts that are improperly sized for the drainage area, in immanent danger of failing due to accumulation of debris and sediment, or poorly installed resulting in excessive erosion at the exit point of the culvert. Flooding flows are more likely to negatively impact the riparian zone, when they are suddenly released, upon the breach or failure of a culvert and sudden release of a large volume of water.

Pre-fire conditions in the riparian corridor were stable although some sediment depositional threats existed due to the pre-existing culvert problems; however, in

the post-fire conditions of the watershed and the high probability for increased erosion and sediment deposition into the creeks, the treats have increased substantially and are high.

2. Deerlick

   There are risks to in-stream invertebrates from erosion and deposition of sediment in the stream channels. The fires have reduced vegetative cover and exposed slopes to increased transport of sediments.

3. Deck

   No risks observed or identified to wildlife resources.

4. Moon

   There are risks to in-stream invertebrates from erosion and deposition of sediment in the stream channels. The fires have reduced vegetative cover and exposed slopes to increased transport of sediments.

5. Motion

   There are risks to in-stream invertebrates from erosion and deposition of sediment in the stream channels. The fires have reduced vegetative cover and exposed slopes to increased transport of sediments.

6. Stein

   No risks observed or identified to wildlife resources.

7. Pine

   No risks observed or identified to wildlife resources.

8. Venture

   For the special status invertebrates fire effects would not come from damage to the riparian zone, but from possible erosion adjacent to the streams or rivers. These mollusks are quite sensitive to sediment deposition and require clean sediment free surfaces for survival.

   For the SSTWS, no fire effects were observed that would interfere with survival of the great blue heron or bank swallow. A bank swallow rookery site was observed and there were no direct observable fire effects.

9. Withrow

   No risks observed or identified to wildlife resources.

10. Shingletown

    No risks observed or identified to wildlife resources.

11. Kirkman

    No risks observed or identified to wildlife resources.

III. Recommendations

A. General

The recommendations for repair and rehabilitation of culverts and water crossings described as being at risk in this report would mitigate potential risk to in-stream invertebrates from erosion, and sediment deposition into stream channels.

B. Specific Recommendations

1. For protection of wildlife resources in the North Fork Beegum Creek, particularly stream invertebrates, the rehabilitation recommendations described for Forest Service Road 29N08 by Young (2008) and in the Geology section of this report should be followed.

2. Monitor N. Fork of Beegum Creek for sediment input for a minimum of 5 years as part of a stream corridor protection plan.

References

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DRAFT TECHNICAL SPECIALIST REPORT
STATE EMERGENCY ASSESSMENT TEAM (SEAT) Emergency Report

Resource: Fisheries

Fire Name: Shasta Lightning Complex CA-SHU-004727 June 2008

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I. Resource Condition Assessment

A. Setting: see the Botanical and Geological SEAT Reports

General Physical Fisheries Setting

Locally, creeks are either intermittent or continually running. A creek originates at some elevated source, such as a spring or lake, and flows downward at a rate relative to slope or gradient and the volume of surface runoff or discharge. Velocity generally declines at progressively lower altitudes, and the volume of water increases until the enlarged stream finally becomes sluggish. Over this transition from a rapid, surging creek to a slow, sluggish river, water temperature and turbidity will tend to increase, dissolved oxygen will decrease and the bottom will change from rocky to muddy.

The rate at which a stream erodes its channel is determined by the nature of the substrate, composition of the water, climate, and the gradient. The greater the slope, the greater the capacity to transport abrasive materials through increased velocity.

Seasonally, flow decreases from high volume in the spring, from snow melt and rain, to low volume in the fall, and becomes variable in the winter according to the hydrograph of the region. Stream dewatering in the summer naturally occurs when the riparian zone plant community removes more water than is available on the surface, above-ground channel; but, the flow usually continues subsurface. The local species of fish and aquatic organisms inhabiting the creek have adapted to these physical factors.

Potentially destabilizing factors to the natural setting include land slides and debris torrents, and human impacts such as water diversion and water consumption, as well as activities which alter the temperature, turbidity, water chemistry, riparian shading cover, and instream refugia available in the creek, sometimes due to mining, timber harvesting, farming, grazing, and housing development.

Composition

The majority of fast stream insect inhabitants live in riffles, on the underside of rubble and gravel, sheltered from the current. Characteristic of the riffle insects are the nymphs of mayflies, caddisflies, alderflies, stoneflies; and the larva and pupae of true flies. In pools, the dominant insects are burrowing mayfly nymphs, dragonflies, damselflies and water striders. Water moss and heavily branched filamentous algae are held to rocks by strong holdfasts and align with the current. Other algae grow in spheric, or cushionlike colonies with smooth, gelatinous surfaces. Algae growth in streams often exhibits zonation on rocks, which is influenced by depth and current.

With increasing temperatures, decreasing velocities and accumulating bottom sediment, organisms of the fast water are replaced by organisms adapted to slower moving water. Mollusks and crustaceans replace the rubble-dwelling insect larvae. Backswimmers, water boatmen and diving beetles inhabit sluggish stretches and backwaters. Emergent vegetation grows along river banks, and duckweed floats on the surface. Abundant decaying matter on the river bottom promotes the growth of plankton populations that are not usually found in fast water. The local species of fish and other vertebrate aquatic organisms inhabiting the creek have adapted to these foraging conditions which essentially constitute the bottom of the food chain. As the bottom of the food chain is altered from the natural assemblage to that which responds to a disturbed physical setting, so too the assemblage of fish and other aquatic vertebrate organisms responds with changes in both abundance, and distribution.

See appendix 1 for those species which are of concern associated with burned areas in Shasta County.

B. Survey Methods:

1. The Shasta SEAT consistently surveyed wildfire areas via ground-based transportation and personal observation according to assess points allowed by land owners. On site we recorded GPS coordinates, elevation, representational photography, and notes. Given the extensive area of coverage within the eleven wildfire areas, and the abbreviated time frame for collecting information, there was no other sampling frame developed for scientific and statistical analysis.

II. Findings of the On-The-Ground Survey (Observations)

The following waypoints, from a Garmin GPS 60, for each fire area are provided for reference.

A. Noble Fire Area

Beegum Creek has been surveyed sporadically by personnel of the California Department of Fish and Game since 1973. Counts have ranged from a high of 477 adult Chinook in 1998 to a low of 0 (1982, 1989, and 1997). Most years, less than 10 spring-run Chinook have been counted. According to past reports, the habitat for

spring-run Chinook within the Cottonwood Creek basin has been limited by the amount of cold water flows during the summer holding period.

With the construction of Keswick Dam and numerous dams on other streams, the salmon and steelhead of Beegum Creek currently hold the record for the longest distance traveled in freshwater before reaching their spawning sites in California today (378 miles from Golden Gate). Beegum Creek is noteworthy since it is one of just a few undammed tributaries to the Sacramento River (via Cottonwood Creek), and is located on the west side of the Sacramento valley which is generally hotter and drier than higher Eastern Sierra side. The remoteness and difficulty in accessing the holding areas make it probable that the observations (timing-survival) noted during surveys are similar to what may have occurred in the past before human beings made changes to the Sacramento watershed ecosystem (Doug Killam. Dept. of Fish and Game. pers. comm.).

Beegum Gorge is a cold water corridor for spring-run Chinook salmon and winter-run steelhead trout. Spawning for Chinook is September through October and eggs develop in redds from November through December. This area is protected via a temporal window from instream disturbance and minimized turbidity during spawning and egg development. Additionally the Riffle Beetle, *Atratelmis wawona*, is an aquatic insect of special concern as well as the Northwestern Pond Turtle *Actinemys marmorata marmorata* present in this area.

1. Values at Risk - spring-run Chinook and Central Valley steelhead

037	22-AUG-08 2:26:06PM	N40 21.856 W122 51.806	2304 ft
	Overlook into burn area, extremely steep looking toward Sulphur Gulch		
038	22-AUG-08 4:45:05PM	N40 18.835 W122 56.450	2405 ft
	Culvert for creek in the riparian zone of Zachary Gulch		
039	22-AUG-08 4:45:19PM	N40 18.835 W122 56.450	2406 ft
	Culvert, ~12” diameter, partially occluded		
040	22-AUG-08 4:59:28PM	N40 18.776 W122 56.709	2414 ft
	Two culverts, ~24” in diameter, within the riparian area, drainage from intense burn, very steep slope		
041	22-AUG-08 5:11:47PM	N40 18.649 W122 56.729	2269 ft
	Water temperature 21 degrees centigrade; last campground along Beegum Creek, border of Shasta and Tehama Counties		

B. Deerlick Fire Area

Hot south-facing slopes, cool north-facing slopes, riparian ok, crest mostly ok, no significant salmonid fisheries or other species of concern to protect although riparian

habitat is home to a variety of non-game aquatic insects, invertebrates, reptiles, amphibians, and fish; indications of multiple burns over the years on the hills observed in burn boundaries of vegetation.

080	25-AUG-08 2:42:16PM	N40 28.838 W122 48.670	2601 ft
081	25-AUG-08 3:49:00PM	N40 26.367 W122 46.374	1993 ft
	Dunkin Chute, Bully Chute, salamander larvae, garter snake		
082	25-AUG-08 4:28:06PM	N40 26.664 W122 50.618	2632 ft
	Crest		
083	25-AUG-08 4:58:39PM	N40 26.907 W122 51.279	2468 ft
	Cabin, RMEF, near creek at the bottom		
084	25-AUG-08 5:11:28PM	N40 26.888 W122 51.191	2409 ft
	Horse barn right next to creek channel, minnows present		

C. Moon Fire Area

Drainage possible to Trinity River and North Fork Cottonwood Creek possible migratory corridor for Central Valley and Klamath Mountain Province steelhead, SONC coho, and Trinity River and fall-run Chinook (Randal Benthin. Department of Fish and Game. pers. comm.) to protect; the foothills yellow-legged frog, and the northwestern pond turtle are species of concern, although the riparian habitat is home to a variety of other non-game aquatic insects, invertebrates, reptiles, amphibians, and native fish.

1. Values at Risk – salmon, trout, frog, and turtle species mentioned above

050	23-AUG-08 4:51:59PM	N40 32.704 W122 34.725	1548 ft
	Zogg Mine Road, new bridge		
051	23-AUG-08 5:02:27PM	N40 31.124 W122 33.046	1236 ft
	South Fork Clear Creek bridge		
052	24-AUG-08 9:43:53AM	N40 29.897 W122 36.406	1296 ft
	Irrigation ditch tributary of Eagle Creek; area was intensely burned; saw turkeys, boar, deer, bear sign, and squirrels		
060	24-AUG-08 10:13:51AM	N40 31.211 W122 37.041	2150 ft
	Summit of Eagle Creek road, gets about 18” of snow in the winter		
061	24-AUG-08 10:31:21AM	N40 31.225 W122 36.893	2085 ft
	R/R flat car bridge crossing, resident rainbow trout ~8”		
062	24-AUG-08 10:34:33AM	N40 31.355 W122 37.051	2090 ft
	Eagle Creek Orchards; stream temp. 16º C; ~8” resident rainbow trout		

3 juvenile Northwestern Pond turtles, *Actinemys marmorata marmorata*

068 24-AUG-08 11:50:38AM N40 30.999 W122 36.838 1948 ft
Eagle Creek-water falls- possible fish migration barrier

069 24-AUG-08 12:25:23PM N40 30.710 W122 36.765 1747 ft
Eagle Creek-water falls- possible fish migration barrier

070 24-AUG-08 1:26:02PM N40 30.386 W122 36.536 1610 ft
"Green" island in riparian zone, otherwise burned area

071 24-AUG-08 1:51:04PM N40 30.624 W122 37.069 1855 ft
Crest view of burns

072 24-AUG-08 2:08:38PM N40 30.300 W122 37.206 1741 ft
Surface soil temp. 51º C

074 24-AUG-08 3:27:30PM N40 28.456 W122 37.018 946 ft
Eagle Creek Bridge on Placer Road

075 24-AUG-08 4:27:14PM N40 28.704 W122 37.104 956 ft
Upstream from Eagle Creek Bridge, Air temp. 40º C

078 25-AUG-08 11:48:38AM N40 31.768 W122 42.510 2475 ft
Cottonwood Creek, w/i THP- bulldozer crossing adjacent to creek bridge crossing; Perennial stream, channel 10-20', water temp. 14º C; air temp. 27º C in riparian zone

079 25-AUG-08 12:25:05PM N40 32.162 W122 40.472 2468 ft North Fork Cottonwood Creek, metal bridge stream crossing, perennial stream channel 10-20', water temp. 14º C; air temp. 25º C in riparian zone; banana slug, snail egg masses

D. Deck Fire Area - not visited

Drainage to North Fork and mainstem of Cottonwood Creek possible migratory corridor and spawning habitat for Central Valley steelhead and fall-run Chinook to protect; no other species of concern to protect although riparian habitat is home to a variety of non-game aquatic insects, invertebrates, reptiles, amphibians, and fish.

1. Values at Risk- salmon, and trout species mentioned above

E. Motion Fire Area

No significant salmonids fisheries to protect though there is Chinook salmon and resident rainbow trout spawning in parts of the habitat within Whiskey Creek; Kokanee salmon and brook trout are stocked non-natives; the foothills yellow-legged frog, the western tailed frog, and the northwestern pond turtle are species of concern,

although the riparian habitat is home to a variety of other non-game aquatic insects, invertebrates, reptiles, amphibians, and native fish.

1. Values at Risk - salmon, trout , frog, and turtle species mentioned above

030 21-AUG-08 12:11:57PM N40 43.292 W122 25.983 1178 ft
Dry Creek Rd. on river, north side, near dam face, high intensity burn

031 21-AUG-08 1:06:12PM N40 43.510 W122 27.544 1078 ft
Road 1 at head of Lake Shasta finger

032 21-AUG-08 2:00:36PM N40 44.403 W122 28.121 1174 ft
Squaw Creek bridge crossing

033 21-AUG-08 3:14:40PM N40 42.856 W122 26.219 649 ft
OHV Staging Area- concrete channel- ~20' wide x ~10' deep x~200' long, east end bridge; burned down to concrete channel-debris transport likely

034 21-AUG-08 3:16:37PM N40 42.906 W122 26.247 594 ft
OHV Staging Area- concrete channel- ~20' wide x ~10' deep x~200' long, west end bridge- partially burned

035 21-AUG-08 3:59:27PM N40 42.630 W122 27.131 1007 ft
Residence at top of hill, moderate to high intensity burn around home

036 21-AUG-08 4:57:50PM N40 42.278 W122 27.052 725 ft
Cottonwood Creek crossing, Bailey bridge, OAC access point

042 23-AUG-08 9:29:02AM N40 37.762 W122 28.194 685 ft
Bridge crossing below catchment dam- highly toxic water quality

043 23-AUG-08 10:07:32AM N40 38.116 W122 30.302 1100 ft
South Fork Spring Creek, Benson Drive; numerous minnows

044 23-AUG-08 10:57:57AM N40 38.543 W122 31.226 2347 ft
South Fork Mountain, Look-out Rd.

045 23-AUG-08 11:14:45AM N40 38.751 W122 31.568 2477 ft
South Fork Mountain, Look-out Rd.

046 23-AUG-08 1:22:10PM N40 41.624 W122 33.224 2909 ft
Ridge road of Whiskey Creek

047 23-AUG-08 1:42:39PM N40 41.038 W122 33.970 1498 ft
Whiskey Creek Bridge; 4-5 trout in pool- 200-270 mm; Red-legged frog

049 23-AUG-08 2:33:49PM N40 41.355 W122 34.072 1565 ft
Bulldozer stream crossing- Maddox Gulch; two ponds-numerous bluegill, largemouth bass, American bullfrogs

077 25-AUG-08 9:14:14AM N40 39.844 W122 28.726 1126 ft
Next to side-shaft mine, Yellow-legged frog in pool just inside mine entrance

F. Stein Fire Area- not visited

No significant salmonids fisheries to protect; Hardhead, Tule perch, the foothills yellow-legged frog, the Shasta salamander, and the northwestern pond turtle are species of concern, although the riparian habitat is home to a variety of other non-game aquatic insects, invertebrates, reptiles, amphibians, and fish.

1. Values at Risk - fish, frog, and turtle species mentioned above

G. Pine Fire Area

No significant salmonids fisheries to protect; the northwestern pond turtle is a species of concern, although the riparian habitat is home to a variety of other non-game aquatic insects, invertebrates, reptiles, amphibians, and fish.

1. Values at Risk– turtle species mentioned above

023 20-AUG-08 12:33:01PM N40 43.940 W122 05.428 1741 ft
Little Cow Creek & Cedar Creek drainage to Lake Shasta; terrain too steep to mitigate protection of low risk fishery; residence on Sugar Pine Camp off Backbone Rd.

H. Venture Fire Area

No significant salmonids fisheries to protect; hardhead, tule perch, Pit roach, rough sculpin, big-eye marbled sculpin, the northwestern pond turtle, Shasta crayfish, western ridged mussel, nugget pebblesnail, and eel-grass pondweed are species of concern, although the riparian habitat is home to a variety of other non-game aquatic insects, invertebrates, reptiles, amphibians, and fish.

1. Values at Risk– fish, invertebrate, turtle, and plant species mentioned above.

021 20-AUG-08 10:02:31AM N40 58.802 W121 34.281 2810 ft
Sand quarry drainage to Pit River and possibly to Hat Creek

022 20-AUG-08 10:43:43AM N40 58.682 W121 33.461 2871 ft
Road adjacent to Hat Creek Campground, just upstream of burned area

I. Withrow Fire Area

No significant salmonids fisheries to protect; although the riparian habitat is home to

a variety of other non-game aquatic insects, invertebrates, reptiles, amphibians, and fish.

027	20-AUG-08 4:45:10PM	N40 32.090 W121 53.641	3169 ft
	Snow Creek drainage- moderate to low intensity burned area		

J. Shingletown Fire Area

Spring-run Chinook, foothill yellow-legged frog, and the northwestern pond turtle are species of concern, although the riparian habitat is home to a variety of other non-game aquatic insects, invertebrates, reptiles, amphibians, and fish.

1. Values at Risk – salmon, frog, and turtle species mentioned above

026	20-AUG-08 3:52:22PM	N40 28.607 W121 54.129	3418 ft
	Drainage to Baldwin Creek- low to moderate burn intensity		

K. Kirkman Fire Area

Central Valley steelhead trout, foothill yellow-legged frog, and the northwestern pond turtle are species of concern, although the riparian habitat is home to a variety of other non-game aquatic insects, invertebrates, reptiles, amphibians, and fish.

1. Values at Risk – trout , frog, and turtle species mentioned above

028	21-AUG-08 10:34:03AM	N40 32.910 W122 04.638	656 ft
	North side, South Cow Creek Rd., Clough Creek drainage		
029	21-AUG-08 10:58:52AM	N40 31.612 W122 06.353	857 ft
	South side, Hwy 44, Bear Creek Drainage		

III. Emergency

With respect to an emergency, the threat level is low to moderate for salmonids and other aquatic species of special concern, with the exception of the corridor for spring-run Chinook and Central Valley steelhead in the Beegum Creek drainage for which the threat level is moderate.

IV. Recommendations

A. General Recommendations

1. To minimize negative effects to any community of fish, amphibians, reptiles and aquatic insects one should stabilize potentially detrimental erosion upslope and including the riparian zone. According to the suite of prescriptions contained in the BAER Catalog as appropriate to slope, and cost/benefit, and risk management, erosion can be minimized to reduce sedimentation and turbidity due to the losses of upslope stability from wildfire.

2. Even though pioneering stream crossings are usually attributed to fire suppression activities and not due directly to wildfire, it is advisable that all stream crossings for emergency heavy equipment movement after the wildfire is controlled be closed with appropriate measures such as berm, rock rip rack, or slash placement from the road bed to the bank shore of the creek to prevent further damage to the aquatic habitat, unless there are specific conditions associated with approved Timber Harvest Plans to maintain the crossings.

B. Specific Recommendations

1. Reference appendix 1 for species of concern in each fire area.

2. The Noble Fire area places spring-run Chinook and winter-run steelhead at moderate risk due to the probable delivery of sediment into Beegum Creek and the lack of riparian vegetation shading to keep the water temperatures from increasing. I concur with the BAER report and the California Regional Water Quality Control board, August 8, 2008, Beegum Road Inspection report recommendations that speak to ways these salmonids can be protected with road maintenance improvements.

3. Deerlick Fire area- no recommendations. Default to BAER Report.

4. After the Moon Fire swept through the riparian corridor of Eagle Creek above N40 29.897 W122 36.406, debris was exposed. Evidence of ~10 oil drums and other discarded personal property either in the stream channel or within the annual fluctuation zone of the channel were observed and should be removed to prevent further damage to the aquatic ecosystem.

5. Within the Moon Fire area, the waterfalls at waypoint 68 and 69, on page 5 of this report are, according to the BAER report, natural barriers to movement of resident rainbow trout above the falls. If as a result of the fire, future debris and flow blows the fish out of their habitat, then they may not be able to return; therefore, the importance of mitigation above the falls to reduce the increased debris and flow is increased to preserve the salmonid population structure above and below the falls.

6. Since the Deck Fire contains habitat used by salmonids and the slopes are not as steep leading into the riparian corridor, stabilization of soil should be implemented as per the recommendation from the BAER report.

7. Motion Fire- consideration for the protection of foothills yellow-legged frog, the western tailed frog, and the northwestern pond turtle of special concern should be undertaken when operating or clearing debris and fire-killed trees from the concrete channel at the OHV staging area. The trees and shrubs present inside the concrete channel indicate that clean-up has not occurred for at least twenty years. Consideration for these species may include appropriate surveys by the responsible entity, BOR, and transportation of any species found prior to the clean-up to similar downstream habitat.

8. The Stein Fire area was not visited because it is remote and inaccessible; therefore, even though it has habitat for species of concern such as the Shasta salamander, there is not a high enough risk to justify implementation of mitigation measures. Default to BAER report for further recommendations.

9. Pine Fire- no recommendations. Default to BAER Report.

10. In the Venture Fire area, the road adjacent to or across the creek from the Hat Creek Campground, off Highway 44, is upstream and outside of the burned area; however, there has been enough traffic to fluff the diatomaceous earth into about six inches of dust depth along the road. Mitigation measures referred in the Shasta SEAT Geological Technical Report should reduce the risk of contaminating the creek with dust and thereby reduce the negative effects to the fishery with increased turbidity.

11. Withrow Fire- no recommendations. Default to BAER Report.

12. The Shingletown Fire area contains habitat used by salmonids, frogs and turtles of special concern; therefore, mitigation measures to reduce risk to their populations should be employed to stabilize soil from erosion before it is transported into the stream bed. Since the area is not too steep, stabilization could be achieved with land treatments from the BAER catalog, such as chipping or slash spreading.

13. Since Bear Creek in the Kirkman Fire area, contains anadromous fisheries, it rises in priority to protect the stream from upslope erosion and subsequent sedimentation. According to the suite of prescriptions contained in the BAER Catalog as appropriate to slope, and cost/benefit, and risk management, erosion can be minimized to reduce sedimentation and turbidity due to the losses of upslope stability from wildfire.

References

California Natural Diversity Database. 2008 Rarefind 3, Version 3.1.0 (August 2, 2008 update). Sacramento, California: California Department of Fish and Game.

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Appendix 1.

Species of concern associated with the Shasta SEAT						
Noble Fire	**QUADNAME**	**SCINAME**	**COMNAME**	**FEDSTATUS**	**CALSTATUS**	**CDFG**
1	Beegum	Oncorhynchus tshawytscha spring-run	spring-run chinook salmon	Threatened	Threatened	
2	Beegum	Perognathus inornatus inornatus	San Joaquin pocket mouse	None	None	
3	Beegum	Atractelmis wawona	Wawona riffle beetle	None	None	
4	Beegum	Harmonia stebbinsii	Stebbins' harmonia	None	None	
5	Beegum	Limnanthes floccosa ssp. floccosa	woolly meadowfoam	None	None	
6	Beegum	Eriastrum brandegeeae	Brandegee's eriastrum	None	None	
Noble Fire	**QUADNAME**	**SCINAME**	**COMNAME**	**FEDSTATUS**	**CALSTATUS**	**CDFG**
1	Platina	Oncorhynchus tshawytscha spring-run	spring-run chinook salmon	Threatened	Threatened	
2	Platina	Atractelmis wawona	Wawona riffle beetle	None	None	
3	Platina	Sedum laxum ssp. flavidum	pale yellow stonecrop	None	None	
4	Platina	Limnanthes floccosa ssp. floccosa	woolly meadowfoam	None	None	
5	Platina	Eriastrum brandegeeae	Brandegee's eriastrum	None	None	
6	Platina	Leptosiphon nuttallii ssp. howellii	Mt. Tedoc leptosiphon	None	None	
Deerlick Fire had no species of concern						
Moon Fire	**QUADNAME**	**SCINAME**	**COMNAME**	**FEDSTATUS**	**CALSTATUS**	**CDFG**
1	Igo	Rana boylii	foothill yellow-legged frog	None	None	SC
2	Igo	Haliaeetus leucocephalus	bald eagle	Delisted	Endangered	
3	Igo	Myotis yumanensis	Yuma myotis	None	None	
4	Igo	Myotis evotis	long-eared myotis	None	None	
5	Igo	Lasionycteris noctivagans	silver-haired bat	None	None	
6	Igo	Lasiurus blossevillii	western red bat	None	None	SC

Moon Fire	QUADNAME	SCINAME	COMNAME	FEDSTATUS	CALSTATUS	CDFG
7	Igo	Corynorhinus townsendii	Townsend's big-eared bat	None	None	SC
8	Igo	Antrozous pallidus	pallid bat	None	None	SC
9	Igo	Martes pennanti (pacifica) DPS	Pacific fisher	Candidate	None	SC
10	Igo	Actinemys marmorata marmorata	northwestern pond turtle	None	None	SC
11	Igo	Anomobryum julaceum	slender silver moss	None	None	
Deck Fire had no species of concern						
Motion Fire	**QUADNAME**	**SCINAME**	**COMNAME**	**FEDSTATUS**	**CALSTATUS**	**CDFG**
1	Shasta Dam	Rana boylii	foothill yellow-legged frog	None	None	SC
2	Shasta Dam	Haliaeetus leucocephalus	bald eagle	Delisted	Endangered	
3	Shasta Dam	Martes pennanti (pacifica) DPS	Pacific fisher	Candidate	None	SC
4	Shasta Dam	Actinemys marmorata marmorata	northwestern pond turtle	None	None	SC
5	Shasta Dam	Anthicus sacramento	Sacramento anthicid beetle	None	None	
6	Shasta Dam	Anthicus antiochensis	Antioch Dunes anthicid beetle	None	None	
Motion Fire	**QUADNAME**	**SCINAME**	**COMNAME**	**FEDSTATUS**	**CALSTATUS**	**CDFG**
1	Whiskeytown	Ascaphus truei	western tailed frog	None	None	SC
2	Whiskeytown	Rana boylii	foothill yellow-legged frog	None	None	SC
3	Whiskeytown	Myotis yumanensis	Yuma myotis	None	None	
4	Whiskeytown	Myotis evotis	long-eared myotis	None	None	
5	Whiskeytown	Lasionycteris noctivagans	silver-haired bat	None	None	
6	Whiskeytown	Lasiurus blossevillii	western red bat	None	None	SC
7	Whiskeytown	Corynorhinus townsendii	Townsend's big-eared bat	None	None	SC
8	Whiskeytown	Martes pennanti (pacifica) DPS	Pacific fisher	Candidate	None	SC
9	Whiskeytown	Actinemys marmorata marmorata	northwestern pond turtle	None	None	SC
10	Whiskeytown	Sedum paradisum	Canyon Creek stonecrop	None	None	

11	Whiskeytown	Sagittaria sanfordii	Sanford's arrowhead	None	None	
Stein Fire	**QUADNAME**	**SCINAME**	**COMNAME**	**FEDSTATUS**	**CALSTATUS**	**CDFG**
1	Devils Rock	Hydromantes shastae	Shasta salamander	None	Threatened	
2	Devils Rock	Rana boylii	foothill yellow-legged frog	None	None	SC
3	Devils Rock	Haliaeetus leucocephalus	bald eagle	Delisted	Endangered	
4	Devils Rock	Falco peregrinus anatum	American peregrine falcon	Delisted	Endangered	
5	Devils Rock	Progne subis	purple martin	None	None	SC
6	Devils Rock	Lasionycteris noctivagans	silver-haired bat	None	None	
7	Devils Rock	Corynorhinus townsendii	Townsend's big-eared bat	None	None	SC
8	Devils Rock	Martes pennanti (pacifica) DPS	Pacific fisher	Candidate	None	SC
9	Devils Rock	Actinemys marmorata marmorata	northwestern pond turtle	None	None	SC
10	Devils Rock	Lower Pit River/Canyon River	(Hardhead/Tule Perch River)	None	None	
11	Devils Rock	Vespericola shasta	Shasta hesperian	None	None	
12	Devils Rock	Helminthoglypta hertleini	Oregon shoulderband	None	None	
13	Devils Rock	Monadenia troglodytes troglodytes	Shasta sideband	None	None	
14	Devils Rock	Clarkia borealis ssp. arida	Shasta clarkia	None	None	
15	Devils Rock	Clarkia borealis ssp. borealis	northern clarkia	None	None	
16	Devils Rock	Neviusia cliftonii	Shasta snow-wreath	None	None	
Pine Fire	**QUADNAME**	**SCINAME**	**COMNAME**	**FEDSTATUS**	**CALSTATUS**	**CDFG**
1	Oak Run	Actinemys marmorata marmorata	northwestern pond turtle	None	None	SC
2	Oak Run	Alkali Seep	Alkali Seep	None	None	
3	Oak Run	Limnanthes floccosa ssp. bellingeriana	Bellinger's meadowfoam	None	None	
4	Oak Run	Limnanthes floccosa ssp. floccosa	woolly meadowfoam	None	None	
5	Oak Run	Clarkia borealis ssp. arida	Shasta clarkia	None	None	

6	Oak Run	Agrostis hendersonii	Henderson's bent grass	None	None	
Venture Fire	**QUADNAME**	**SCINAME**	**COMNAME**	**FEDSTATUS**	**CALSTATUS**	**CDFG**
1	Cassel	Ardea herodias	great blue heron	None	None	
2	Cassel	Pandion haliaetus	osprey	None	None	
3	Cassel	Haliaeetus leucocephalus	bald eagle	Delisted	Endangered	
4	Cassel	Grus canadensis tabida	greater sandhill crane	None	Threatened	
5	Cassel	Empidonax traillii	willow flycatcher	None	Endangered	
6	Cassel	Progne subis	purple martin	None	None	SC
7	Cassel	Riparia riparia	bank swallow	None	Threatened	
8	Cassel	Cottus asperrimus	rough sculpin	None	Threatened	
9	Cassel	Cottus klamathensis macrops	bigeye marbled sculpin	None	None	SC
10	Cassel	Lavinia symmetricus mitrulus	Pit roach	None	None	SC
11	Cassel	Mylopharodon conocephalus	hardhead	None	None	SC
12	Cassel	Corynorhinus townsendii	Townsend's big-eared bat	None	None	SC
13	Cassel	Martes pennanti (pacifica) DPS	Pacific fisher	Candidate	None	SC
14	Cassel	Actinemys marmorata marmorata	northwestern pond turtle	None	None	SC
15	Cassel	Pit R. Drainage	Rough Sculpin/Shasta Crayfish Spring Stream	None	None	
16	Cassel	Lower Pit River/Canyon River	(Hardhead/Tule Perch River)	None	None	
17	Cassel	Pacifastacus fortis	Shasta crayfish	Endangered	Endangered	
18	Cassel	Gonidea angulata	western ridged mussel	None	None	
19	Cassel	Colligyrus convexus	canary duskysnail	None	None	
20	Cassel	Fluminicola seminalis	nugget pebblesnail	None	None	
21	Cassel	Pyrgulopsis archimedis	Archimedes pyrg	None	None	
22	Cassel	Pyrgulopsis rupinicola	Sucker Springs pyrg	None	None	
23	Cassel	Juga acutifilosa	topaz juga	None	None	

24	Cassel	Juga occata	scalloped juga	None	None	
25	Cassel	Lanx patelloides	kneecap lanx	None	None	
26	Cassel	Helisoma newberryi	Great Basin rams-horn	None	None	
27	Cassel	Potamogeton zosteriformis	eel-grass pondweed	None	None	
Withrow Fire had no species of concern						
Shingletown Fire	**QUADNAME**	**SCINAME**	**COMNAME**	**FEDSTATUS**	**CALSTATUS**	**CDFG**
1	Shingletown	Rana boylii	foothill yellow-legged frog	None	None	SC
2	Shingletown	Oncorhynchus tshawytscha spring-run	spring-run chinook salmon	Threatened	Threatened	
3	Shingletown	Actinemys marmorata marmorata	northwestern pond turtle	None	None	SC
4	Shingletown	Northern Interior Cypress Forest	Northern Interior Cypress Forest	None	None	
5	Shingletown	Paronychia ahartii	Ahart's paronychia	None	None	
6	Shingletown	Clarkia borealis ssp. arida	Shasta clarkia	None	None	
7	Shingletown	Carex vulpinoidea	brown fox sedge	None	None	
8	Shingletown	Rhynchospora capitellata	brownish beaked-rush	None	None	
9	Shingletown	Fritillaria eastwoodiae	Butte County fritillary	None	None	
Kirkman Fire	**QUADNAME**	**SCINAME**	**COMNAME**	**FEDSTATUS**	**CALSTATUS**	**CDFG**
1	Clough Gulch	Rana boylii	foothill yellow-legged frog	None	None	SC
2	Clough Gulch	Actinemys marmorata marmorata	northwestern pond turtle	None	None	SC
3	Clough Gulch	Northern Interior Cypress Forest	Northern Interior Cypress Forest	None	None	
4	Clough Gulch	Paronychia ahartii	Ahart's paronychia	None	None	
5	Clough Gulch	Limnanthes floccosa ssp. floccosa	woolly meadowfoam	None	None	
6	Clough Gulch	Clarkia borealis ssp. arida	Shasta clarkia	None	None	

DRAFT TECHNICAL SPECIALIST REPORT
STATE EMERGENCY ASSESSMENT TEAM (SEAT) Emergency Report

Resource: Botany

Fire Name: Shasta Lightning Complex CA-SHU-004727 June 2008

Author Name: Richard Lis, Ph.D. Botanist
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2440 Athens Avenue
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I. Resource Condition Assessment: Botany

A. Setting

The Shasta Lightning Complex fires which were assessed for this report burned a total of area of 100,873 acres. The fires began on June 21, 2008 due to thousands of dry lightning strikes that day. The fires burned on federal, state, and private lands. The fires assessed as part of this report are the following:

1. Noble

   The Noble fire occurred in an area of high relief at the southern end of the Klamath mountain province. The primary area of survey was the Beegum gorge region of the fire, within this area the dominant plant communities observed were: chamise chaparral, scrub oak, canyon live-oak, mixed ghost pine-ponderosa pine, riparian tan oak Douglas fir riparian, and alder cottonwood riparian. With the exception of the riparian communities the remaining communities are strongly adapted to varying degrees of xeric conditions during the summer and fall, with moist conditions during the winter and spring. Special Status Plant Species in the SRA of the Noble Fire include *Erythronium revolutum* (coast fawn lily) and *Eriastrum brandegeae* (Brandegee's eriastrum).

2. Deerlick

   The Deerlick fire occurred in an area of high relief near the southern end of the Klamath mountain province. The primary area of survey was the Duncan Creek drainage area of the fire, within this area the dominant plant communities observed were: chamise, scrub oak, canyon live-oak, mixed ghost pine-ponderosa pine, riparian tan oak Douglas fir riparian, and alder cottonwood riparian. With the exception of the riparian communities the remaining communities are strongly adapted to varying degrees of xeric conditions during the summer and fall, with moist conditions during the winter and spring. Special Status Plant Species in the SRA of the Noble Fire

include *Viburnum ellipticum* (oval-leaved viburnum) and *Eriastrum brandegeae* (Brandegee's eriastrum).

3. Deck

The Deck fire occurred in an area of blue oak woodland and annual grasslands.

4. Moon

The Moon fire occurred in an area of varying relief at the eastern edge of the Klamath mountain province. The primary areas of survey were: Zogg Mine Road region, Eagle Creek watershed, Rector Creek watershed area, Moon Fork of Cottonwood Creek, and the North Fork of Cottonwood Creek; within this area the dominant plant communities observed were: scrub oak, canyon live-oak, mixed ghost pine-ponderosa pine, riparian tan oak Douglas fir riparian, alder cottonwood riparian. Special Status Plant Species in the SRA of the Moon fire include *Eriogonum ursinum* var. *erubescens* (blushing wild buckwheat) and *Epilobium siskiyouense* (Siskiyou fireweed). One special status plant community, northern interior cypress, is also found there.

5. Motion

The Motion fire occurred in an area of high relief at the eastern edge of the Klamath mountain province. The primary area of survey consisted of the northern, north-eastern, eastern, and southern regions of the fire zone. Within this area the dominant plant communities observed were: chamise-manzantia chaparral, scrub oak, canyon live-oak, mixed ghost pine-ponderosa pine, and alder cottonwood riparian. Special Status Plant Species in the SRA of the Motion Fire include *Sagittaria sanfordii* (Sanford's arrowhead) and *Eriastrum brandegeae* (Brandegee's eriastrum).

6. Stein

The Stein fire occurred in an area of high relief in the foothills of the southern end of the Cascades. Within this area the dominant plant communities observed were: manzanita chaparral, canyon live-oak, mixed ghost pine-ponderosa pine, and alder cottonwood riparian. Special Status Plant Species in the area of the Stein Fire include Neviusia cliftonii (Shasta snow-wreath).

7. Pine

The Pine fire occurred in an area of moderate to high relief in the foothills of the southern end of the Cascades. Within this area the dominant plant communities observed were: manzanita chaparral, canyon live-oak, mixed ghost pine-ponderosa

8. pine, and alder cottonwood riparian. The fire generally had a low burn severity on north and east facing slopes. Severity was moderate to high in back-burned areas and south facing slopes. One SSPS occurred in the area of the Pine Fire: *Clarkia borealis* ssp. *arida* (Shasta clarkia).

9. Venture

   Venture fire occurred in an area of low to moderate relief in the Cascade mountains. The primary area of survey was in the southeastern region of the fire near the confluence of the Pit River and Hat Creek. Within this area the dominant plant communities observed were: mixed oak woodland, ponderosa pine forest, and alder cottonwood riparian. The fire burn severity was primarily in the low to moderate range, but attained severe status sporadic isolated locations. One SSPS occurred in the area of the Venture fire: *Potamogeton zosteriformis* (eel-grass pondweed).

10. Withrow

    The Withrow fire occurred in an area of high relief in the western foothills of southern end of the Cascade Mountains. The primary area of survey was through the central and southern half of the burned area. Within this area the dominant plant communities observed were: mixed black oak woodland ponderosa pine. The fire occurred in very steep terrain in the headwaters of the Snow Creek watershed. The fire itself was of low burn severity throughout the survey area. One SSPS occurred in the area of the Withrow fire: *Fritillaria eastwoodiae* (Butte county fritillary).

11. Shingletown

    The Shingletown fire occurred in an area of moderate relief in the western foothills of the southern end of the Cascade Mountains. The primary area of survey was the central interior area of the fire. Within this area the dominant plant communities observed were: ponderosa pine forest with a associates of black oak (*Quercus kelloggii*) and incense cedar (*Calocedrus decurrens*), and an understory of manzanita (*Arctostaphylos* species). The burn intensity was generally low on north, east, and western slopes, and moderate on south facing slopes. There were no SSPS in the SRA of the Shingletown fire; however a population of northern interior cypress (dominants of the population include *Cupressus macnabiana*, *Quercus garryana*, and a diverse assemblage of chapparal plants) may occur at extreme north-western edge of the Shingletown fire.

12. Kirkman

The Kirkman fire occurred in an area of gently rolling hill that is bordered by the very steep canyon of Bear Creek. The dominant plant communities observed were: blue oak woodland, annual grassland, mixed oak ghost pine woodland, willow cottonwood riparian, and ephemeral creek channel bed with scattered willows. There were no SSPS in the SRA of the Kirkman fire.

B. Botanical Survey Methods

Botanical survey methods consisted of identifying the location of fire, reviewing topography, reviewing preliminary Burned Area Reflectance Classification (BARC) maps for fire intensity, searching fire area and surrounding areas for special status plant species (SSPS) and communities using the California Natural Diversity Database (CNDDB 2008), reviewing species biology and ecology to determine possible susceptibility to negative impacts from varying fire intensity or fire suppression activities, generating maps of occurrence locations of SSPS, field review of burn intensity of selected SSPS locations, field review of fire effects on dominant plant species of observed plant communities with particular attention to the riparian and wetland communities, observations made of capacity for resprouting and regeneration of dominant plant species given local burn severity, identification of noxious weeds, and non-native invasive plant species that may have potential for rapid establishment given new avenues of invasion from fire effects.

For the Deck Fire, it was determined that a field survey of the fire was unnecessary after receiving a report of that fire by Mr. Bruce Beck regarding the habitat types and burn conditions.

For the Stein Fire, it was determined that a field survey of the fire was unnecessary after receiving a report of that fire by the single private land-owner Mr. Dane Wittington who confirmed that the area had burned in much the same manner as the Pine Fire; as far as review of SRA lands he felt there was no need for our team to conduct a survey.

II. Findings of the On-The-Ground Survey (Observations)

C. Values at Risk

1. Noble

The riparian zone in the North Fork Beegum Creek is at high risk from increases in sediment deposition and/or flooding flows. Excessive sediment deposition is likely to occur from problems with culverts along Forest Service road FSNO8.

2. Deerlick

   The riparian zone and in-stream channel is at high risk from erosion and sedimentation from up-slope sediment sources.

3. Deck

   No risk to botanical resources.

4. Moon

   The riparian zone in Eagle Creek, in Ono, from the Platina Road bridge upstream was severely burned in the fire. The severe burn damage to the riparian is localized in this area, although the exact extent could not be determined in this assessment as it extends at least 2,000 feet upstream from the bridge (Point M-2); however, mid-stream and headwater reaches were surveyed on one privately owned property and in these areas the riparian zone of Eagle Creek sustained low or no fire effects.

   In addition the decomposed granite in the Moon fire, the area is very susceptible to erosion and sediment deposition into streams and water-courses.

5. Motion

   The riparian zone in the lower reach of Cottonwood Creek (located in Coram in the concrete open box culvert was burned extensively), in the upstream area of the concrete, has an assortment of non-native plants growing in the culvert.

   A number of small creeks between Coram and south towards Iron Mountain Road are heavily infested with one or more of the following invasive weeds: tree of heaven (Ailanthus altissima), French broom (Spartina junceanum), or Nerium oleander (oleander).

6. Stein

   No risk to botanical resources.

7. Pine

   Possible fire damage or damage from fire suppression activities to one population of *Clarkia borealis* ssp. *arida* which occurs along Sugar Pine Road.

8. Venture

   No risk to botanical resources.

9. Withrow

No waterbars or erosion control devices were observed on the fire lines that were cut by bulldozers.

10. Shingletown

No risk to botanical resources.

11. Kirkman

A population of perennial pepperweed (*Lepidium latifolium*) was located at the bridge crossing of S. Cow Creek Road over Clough Creek (Bridge 06CO265) (Point K-1). The perennial pepperweed was growing primarily in the rip-rap on the east bank, with scattered plants distributed slightly up-stream and down-stream of the bridge.

III. Emergency Determination

A. The values considered in this assessment identify increased risk to water quality and damage with the riparian zone and dependent wildlife. The risk to the riparian resources in the N. Fork Beegum Creek area of the Noble fire is considered to be high due to the fragile nature of current infrastructure along the road and the very high quality habitat of the stream and riparian vegetation.

B. The riparian zone in the lower reaches of the Eagle Creek drainage, above the bridge by the Moon fire, incurred severe burn damage. Although this is a natural event it may result in additional damage from high water flows. The riparian vegetation exists on an alluvial terrace that appears to have a high potential for mobilization if sudden high flows occur; however, the individual riparian plants are showing signs of resprouting (as of August 24th) and should continue to grow into the fall.

C. In the Motion Fire, the riparian zone in the boxed culvert sustained damage, and although a man-made structure, it provides the major riparian cover in the lower reach of Cottonwood Creek away from the Sacramento River. High flows or sediment could impair the riparian, and non-native species occurring in the culvert and may increase in cover in the burned upstream region of the culvert. Risk to the riparian habitat is low.

Also in the Motion fire there are numerous drainages between Coram and Iron Mountain Road that are currently infested with one or more invasive weeds. Although direct threats from these weeds in the local area are low, the potential threats to the Sacramento River system from these quantity of invasive plants is moderate, given the potential for much higher flows to come down these creeks and wash parts of the plants out that may establish new populations of these weeds downstream in the Sacramento River.

D. The threat presented by the presence of perennial pepperweed (*Lepidium latifolium*) is high in this creek and all downstream watercourses. This is a very invasive plant and has the potential to form vast monocultural stands in the riparian zone and to move beyond that into agricultural fields and pastures.

IV. Recommendations

A. General Recommendations

1. Minimize the amount of vegetation removed while clearing chokepoints in watercourse channels, to those essential to reduce risk to life and property. Vegetation smaller than 3 inches in diameter should be left in the channel, and only the actual channel should be cleared (unless a threat to life and property exists upslope of the channel).

2. Implement recommendations to repair culverts and improve drainage from fire damaged areas to minimize the potential for erosion and sediment deposition into creeks and rivers, and implement best management practices throughout the watershed to minimize sediment mobilization and transport.

3. Redistribute soil that was piled into berms or piles during creation of bulldozer lines to increase site re-colonization by native plants, except for water control structures such as water bars.

4. Block or disguise entrances to bulldozer lines with boulders, logs, gates, shrubs or other means to minimize trespass by motorized vehicles.

5. Avoid planting or seeding non-native or invasive species.

6. Conduct invasive weed surveys during the 2009 and 2010 growing season along bulldozer lines and roads used by fire suppression equipment.

7. Promptly control weed populations upon detection, and follow up with monitoring and control for at least two years.

8. Avoid livestock grazing in burned areas until at least the 2009-2010 growing season (longer if rainfall is below the long-term average in the year following the fire).

9. Avoid disturbing islands of unburned vegetation, which provide wildlife habitat as well as seed source for natural revegetation.

B. Specific Recommendations

1. Riparian Protection in N. Fork Beegum Creek, should be implemented by following recommendations in this report for culvert rehabilitation and road repair.

2. The riparian zone that was severely burned in the lower region of Eagle Creek upstream of Platina road should be evaluated to determine if the resprouting trees and shrubs would be able to sustain flows of the 100 year flood. It is possible that the large dead portions of the trees may lead to up-rooting of the plants in extreme flows. If this is the case then the riparian shrubs and trees may benefit from a reduction in the amount of dead floatable wood. If it is determined that such removal of dead wood could benefit the riparian plants. Care in tree cutting should be exercised to only remove dead wood as the live parts of the tree will aid in the recovery of the riparian zone.

3. The riparian vegetation in the concrete culvert of Cottonwood Creek near Coram could be cleared of dead wood, and non-native species. If live trees must be cut then it is recommended that general recommendation #1 (above) be followed.

4. The drainages between Coram and Iron Mountain Road should be surveyed for non-native plants and determinations made concerning the likelihood of the plants spreading out of the watershed. Control and eradication measures are recommended to begin to reduce threats from these invasives to the Sacramento River. Implementing this recommendation will result in reduce hazards from this source for future fires that will occur in this watershed.

5. On the Pine fire the population of Clarkia borealis ssp. Arida is recommended for survey to determine if it incurred effects from the fire or suppression activities and remediation implemented if possible.

6. Waterbars and erosion control measures are recommended to be installed on the fire lines cut on the Withrow fire.

7. Perennial pepperweed at Clough Creek Brige: Survey extent of perennial pepperweed population in channel. Prepare multi-year control plan using herbicides.Coordinate control plan activities with any plans to do earth or channel work in vicinity of bridge. Any riprap, soils, or gravels moved from the site should be handled as contaminated materials and treated following recommendations of California Department of Food and Agriculture. Any vehicles working in the site should be washed prior to leaving the site in controlled wash stations that will collect and seeds or other reproductive propagules.

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DRAFT TECHNICAL SPECIALIST REPORT
STATE EMERGENCY ASSESSMENT TEAM (SEAT) Emergency Report

Resource: Forestry

Fire Name: Shasta Lightning Complex CA-SHU-004727 June 2008

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I. Resource Condition Assessment

A. Overview

The Shasta Lightning Complex is a combination of 11 fires stretching from as far west as Beegum Gorge on the Shasta-Tehama and Trinity divide to the eastern most portions of Shasta County on The Pit River. The Shasta Lightning Complex consisted of 11502.7 acres of United states Forest Service, 15570.2 acres of Bureau of Reclamation, 9178 acres of National Park Service, 56530.5 acres of Private land and 7 acres of State. The total acreages for the 11 fires within Shasta County is 92,788 acres with the largest being 35,662.9 acres and the smallest at 249.3 acres.

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The purpose of the SEAT post fire watershed assessment and recovery operation was to identify on-site and downstream threats to public health or safety from landslides, debris torrents, flooding, road hazards, and other fire related problems. In addition to these, other goals were to identify threats to watershed resources, including: excessive erosion, impaired water quality; threats to wildlife, fisheries, botanical values, and cultural resources. Lastly the team was tasked to determine measures needed to prevent or mitigate identified threats during on the ground field inspections.

This assessment was to evaluate and identify both the direct and indirect effects of the recent fires on the existing forest systems and associated Mixed Chaparral and Mixed Oak woodland habitats. Elevations ranged from approximately 300 feet above sea level to as high as 6000 feet where the fires reached towards the top of Shasta Bally. Due to the large geographic area of these 11 fires there is a wide variety of vegetation types. They range from Klamath Mixed Conifer, Ponderosa Pine, Eastside Pine and Sierran Mixed Conifer forests, to Montane Hardwood-Conifer, Closed-Cone Pine, Valley Oak woodland, Mixed Oak woodland, Mixed Chaparral, Chamise Chaparral and Annual Grassland.

B. Resource Setting

1. Noble

The Noble Fire is located in the western most portions of Shasta and Tehama County in the Upper Cottonwood Creek drainage. Of the 14,948.2 acres of the Noble fire, 7395.3 acres are located within Shasta County. CALWATER version 2.2 State planning watersheds associated with the Noble fire within Shasta County are, Upper Beegum Creek, Middle Beegum Creek and small portions of North Fork Beegum Creek, Lower Beegum Creek, Baker Creek and Cow Gulch. The topography associated with the Noble fire has slopes ranging from 20 to 100 percent.

The major soil types associated with the Noble fire are from the Nuens, Sehorn and Stonyford series. Nuens and Stonyford soils consist of well drained soils underlain by metavolcanic rock, mainly greenstone, while Sehorn soils are well-drained and underlain by sedimentary rock. The forest types associated with Sehorn and Stonyford soils in general, are lower elevation Chamise Chaparral, Mixed Chaparral, and Annual Grasslands. These vegetation types are predominate on both the north and south slopes of the eastern portions of the Noble fire. Towards the North West portions of the Noble fire where the Nuens soil type's transition, Klamath Mixed Conifer forest types can be found with some Montane Hardwood-Conifer and Mixed Oak-Foothill Pine forests. The Mixed Oak-Foothill forests in this area tend to have a high composition of Foothill pine (*Pinus sabiana*).

2. Deerlick

The Deerlick fire is located in approximately 23 air miles southwest of Redding California in Shasta County, within the Upper Cottonwood Creek drainage. The Deerlick fire is 13619.1 acres in size. CALWATER version 2.2 State planning watersheds associated with the Deerlick fire are Upper Duncan Creek, Swett Canyon and small portions of Knob Gulch and Rocky Creek. The topography associated with the Deer Creek fire has slopes ranging from 10 to 95 percent.
The major soil types associated with the Deerlick fire are from the Stonyford-Maymen-Henneke series and the Sheetiron-Marpa-Barpeak series. Stonyford-soils are well drained soils that are underlain by greenstone while Maymen-Henneke soils consist of somewhat excessively drained soil underlain by sedimentary or meta-sedimentary rock. The Sheetiron soils are well-drained and somewhat excessively drained soils that are underlained by sedimentary or metamorphic rock and the Marpa-Barpeak series are mostly well drained soils that are underlain by shale or slate. These soils can be associated with a stony loam that has steeper slopes and a high erosion hazard. The forest types associated with all of these soils, with the

exception of the Sheetiron and Marpa soils are lower elevation Chamise Chaparral, Mixed Chaparral and Annual Grasslands. Although the Sheetiron and Marpa soils do have Mixed Chaparral and Annual Grasslands associated with them, the conifers are more widespread. In some of the north facing draws, mostly in the northern portions of the fire, close to Ditch Fork Duncan Creek and above, Klamath Mixed Conifer forest type exist along with Montane Hardwood-Conifers in low to moderate numbers.

3. Moon

The Moon fire is located just west of Redding, with portions of the fire residing within the Whiskeytown Recreation Area south of Whiskeytown Lake and to the north east and west of the town of Ono. The Moon fire burned a total of 35673.9 acres in the Upper Cottonwood Creek Drainage and Clear Creek drainage area of Shasta County. CALWATER version 2.2 State planning watersheds associated with the Moon fire are, Moonfork Cottonwood Creek, Jerusalem Creek, North Fork Cottonwood Creek, Eagle Creek, Andrews Creek, Bee Creek, Ducket Creek, and Taylor Gulch. The topography associated with the Moon fire has slopes ranging from 5 to 100 percent.

The two major soil types associated with the Moon fire are from the Kanaka-Corbett-Chaix series and the Sheetiron-Marpa-Barpeak series. These to soils series make up over 95% of the entire Moon fire. The Kanaka-Corbett-Chaix series is a well-drained and somewhat excessively drained soil that is underlain by weathered granitic or metavolcanic rock. Erosion hazard for this soil is extremely high. The Kanaka-Corbett-Chaix soil series makes up approximately 80% of the entire fire area. The Sheetiron soils are well-drained and somewhat excessively drained soils that are underlained by sedimentary or metamorphic rock and the Marpa-Barpeak soils are mostly well drained soils that are underlain by shale or slate. The Sheetiron-Marpa-Barpeak series makes up approximately 20% of the entire fire area. The vegetation associated with both of these soil types are Klamath Mixed Conifer, Montane Hardwood-Conifer, Mixed Oak-foothill Pine, Chamise Chaparral and Mixed Chaparral. Much of the lower sloped areas within the fire have Foothill Pine, Chamise Chaparral forest types and Mixed Chaparral and the mid-sloped to upper slopes transition into the Montane Hardwood-Conifers and Klamath Mixed Conifer forest types. Most of the upper reaches of the watersheds and ridges are either vegetated with some Chamise Chaparral or are bare due to extreme slope steepness and shallow soils.

4. Deck

The Deck fire is located just South east of Ono and Patina Road. The Deck fire burned a total of 263.1 acres in the Upper Cottonwood Creek drainage area of Shasta County. CALWATER version 2.2 State planning watersheds associated with the Deck fire is Bee Creek. The topography associated with the Deck fire has slopes ranging from 5 to 35 percent.

The soil type associated with the Deck fire is from the Sehorn-Millsholm-Lodo series. Sehorn soils are well-drained and underlain by sedimentary rock. The forest types associated with Sehorn and Stonyford soils in general are lower elevation Mixed

Chaparral and Annual Grasslands with some Valley Oak Woodland in the west and southwest areas of the fire. These vegetation types are predominate on both the north and south slopes of the eastern portions of the Noble fire. Erosion hazard for this soil is slight.

5. Motion

The Motion fire is located just Northwest of Redding bordering Whiskey Creek road in the Southwest and in the north east bordering Shasta lake south past Coram Ranch. The Motion fire burned a total of 28,329 acres in the Shasta Lake, Spring Creek and Clear Creek drainage area of Shasta County. CALWATER version 2.2 State planning watersheds associated with the Motion fire are Motion Creek, Lower Squaw Creek, Upper Squaw Creek, Whiskey Creek, White Rock Gulch, and Flat Creek. The topography associated with the Moon fire has slopes ranging from 15 to 100 percent.

The major soil types associated with the Motion fire are from the Kanaka-Corbett-Chaix series, the Neuns-Goulding-Boomer-Aubern series, and the Sheetiron-Marpa-Jocal series. These soils make up approximately 95% of all the soils found within the Motion fire. The Kanaka-Corbett-Chaix series is a well-drained and somewhat excessively drained soil that is underlain by weathered granitic or metavolcanic rock. Erosion hazard for this soil is extremely high. The Sheetiron soils are well-drained and somewhat excessively drained soils that are underlained by sedimentary or metamorphic rock. The Nuens soils consist of well drained soils underlain by metavolcanic rock, mainly greenstone with a moderate to high erosion rating.

The vegetation associated with these soil types are, Closed-Cone Pine, Mixed Oak-Foothill Pine, Klamath Mixed Conifer, Chamise Chaparral and Mixed Chaparral. Most of the Klamath Mixed Conifer is located in the north to northwest facing draws and in the upper elevations. The more dominant vegetation type within the Motion fire is Mixed Chaparral and Valley Oak (*Quercus lobata*) combined with a large component of knob cone (*Pinus Attenuata*) and foothill pines.

6. Stein

The Stein fire is located approximately 20 air miles to the East of Redding and is adjacent to the east side of the Pit river Arm of Shasta Lake. The Stein fire burned a total of 1147.8 acres in the Shasta Lake drainage of Shasta County. CALWATER version 2.2 State planning watershed associated with the Stein fire is Sugar Pine Canyon. The topography associated with the Stein fire has slopes ranging from 25 to 85 percent.

The major soil type associated with the Stein fire is from the Neuns-Marpa Hohman-Gouldan-Boomer series. This soils series consists of well-drained soils that are underlain by basic metavolcanic rock, mainly greenstone with some shale or slate. Erosion hazard for these soils is moderate to high. The forest types associated with these soils in general are Montane Hardwood-Conifer, Closed-Cone Pine, and shrubs.

7. Pine

The Pine fire is located approximately 20 mile East of Redding along Highway 299 within the Cow Creek drainage. Although 564 acres of the Pine fire burned in the drainages to the south of Highway 299 the majority (1193 acres) of the fire burned to the west of the highway above the town of Ingot for a total acreage of 1757 acres. CALWATER version 2.2 State planning watersheds associated with the Pine fire are Bear Gulch Ingot, and Sugarpine canyon. The topography associated with the Pine fire are slopes ranging from 5 to 80 percent.

The major soil types and forest types associated with the Pine fire are similar to the Stein fire mentioned above which are the Sheetiron-Marpa-Jocal series and the Neuns-Goulding-Boomer-Auburn series and can be referenced there. The forest types associated with these soils similar to the Stein fire. The portion of the Pine fire that is to the southeast of highway 299, does have a slightly denser Klamath mixed conifer composition, and does not appear to have had substantial damage as a result of the fire.

8. Venture

The Venture fire is located approximately 12 miles northeast of Burney, CA. The Venture fire is a total of 1911.4 acres in size and is within the Upper Pit River drainage area. CALWATER version 2.2 state planning watersheds associated with the Venture fire are SW Side Lake Britton, Long Valley, and Baum Lake. The topography associated with the Venture fire are slopes ranging from 0 to 70 percent.

The major soil types associated with the Venture fire are the Scarface-jimmerson–Gasper series and Loveness-lava flows-Hunsinger-Fleener-Chirpchatted series. These soils are moderately drained and underlain by basalt and volcanic rock. Erosion hazard associated with these soils is moderate to high. Vegetation associated with these soils are the transition from the Ponderosa Pine to the Eastside Pine forest type, Mixed Chaparral and Annual grassland forests.

9. Withrow

The Withrow fire is located approximately 22 air miles East of Redding within the Bear Creek drainage. The Withrow fire burned a total of 249.3 acres. CALWATER version 2.2 state planning watersheds associated with the Withrow fire is Upper Bear Creek. The topography associated with the Withrow fire are slopes ranging from 10 to 80 percent.

The major soil types associated with the Withrow fire are the Sehorn-Millsholm-Lodo series and the McCarthy-Cohasset-Aiken series. Sehorn soils are well-drained and underlain by sedimentary rock. The forest types associated with Sehorn-Millsholm-Lodo soils in general, are to the west and lower elevation areas of the fire and are, Oak Woodland, Mixed Chaparral and Annual Grasslands. McCarthy-Cohasset-Aiken series are well drained soils underlain by basalt and volcanic rock. Erosion hazard associated with these soils is moderate to high Vegetation associated with this soil is in the

transition from the Klamath Mixed Conifer to the Sierran Mixed Conifer forests and Close-Cone Pine and brush.

10. Shingletown

The Shingletown fire is located approximately 5 miles southeast of the town of Shingletown within the Battle Creek drainage. The Shingletown fire burned a total of 388 acres. CALWATER version 2.2 State planning watersheds associated with the Shingletown fire is Baldwin Creek. The topography associated with the Shingletown fire are slopes ranging from 10 to 80 percent.

The major soil type associated with the Shingletown fire is the Toomes-Supan series. The Toomes-Supan soils are well-drained and somewhat excessively drained soils that are underlain by lava or tuffaceous breccia. Erosion hazard associated with these soils is moderate to high. Vegetation associated with this soil is similar to the Withrow fire.

11. Kirkman

The Kirkman fire is located approximately 10 miles east of the town of Palo Cedro, within the Bear Creek and Cow Creek drainage. The Kirkman fire burned a total of 2053.6 acres. CALWATER version 2.2 State planning watersheds associated with the Kirkman fire, are Bear Creek Canyon, Upper Bear Creek Canyon, and Lower South Cow Creek. The topography associated with the Kirkman fire are slopes ranging from 5 to 75 percent.

The major soil types associated with the Kirkman fire are the Toomes-Supan series, and McCarthy-Cohasset-Aiken series. Refer to the Shingletown and Withrow fires for these soil profiles Due to lower elevations associated with this fire, the vegetation associated with these soils are mainly Closed-Cone Pine and Valley Oak with a brush understory. Some Mixed conifers were also present in the riparian areas along Bear Creek.

C. Survey Methods

Reconnaissance methods for the were performed by both vehicle and by travel on foot through portions of all fires except the Deck, and Stein fire due to access and low values at risk. On July 29th I participated in a helicopter flight provided by the BAER team, where we were able to visually asses the severity of the burn and condition of the associated watersheds for the Noble, Deerlick, Moon and Motion Fires. In addition, on August 22nd a second flight provided by Herb Baldwin, district manager of Sierra Pacific Industries was flown. The main focus was to evaluate the burn severity and the possible short and long term effects the fire could have on the existing forested area. Survey methods also included estimating vegetation cover and loss with provided BARC maps.

II. Findings of the On-The-Ground Survey (Observations)

A. Observations

1. Noble

Evaluations for the Noble fire in Beegum Gorge and Forest Road 29N06 display moderate to severe burns. The vegetation makeup is predominantly *Manzanita (Arctostaphylos sp.),* Chamise (*Adenostoma fasciculatum)* and buckbrush *(Ceanothus cuneatus*). It appeared that while the vegetation burned extremely hot on the south and west facing slopes the north and east facing slopes were burned at a low to moderate severity. It should be noted that most of the Mixed Chaparral species, primarily the chamise were showing signs of vigorous sprouting. The north western portions of the Noble fire have Klamath Mixed Conifer stands, mostly on the north facing slopes intermixed with Montane Hardwood-Conifer and Mixed Oak –Digger pine stands. The montane hardwood-conifer and foothill pine forest types were predominantly on the south and western exposures. Some Access to the burn area in the northwest portions was flown with the helicopter but due to time constraints we were not able to make any visual observations of that portion of the fire by way of vehicle or on foot.

2. Deerlick

Evaluations for the Deerlick fire displayed low, moderate and severe burn conditions. The Deerlick vegetation burned extremely hot to the south and west facing slopes the north and east facing slopes were burned at a low to moderate level. It appears that due to changing wind conditions and favorable temperatures the burn formed a mosaic pattern of burned and unburned slopes throughout the fire area. The vegetation makeup is predominantly Manzanita (*Arctostaphylos sp*.), Chamise (*Adenostoma fasciculatum)* and buckbrush *(Ceanothus cuneatus*). However, in the northern portions of the Deerlick fire, mainly in the Ditch Fork Duncan Creek, draws to the southwest of Duncan creek including many north-facing slopes, are areas of Klamath Mixed conifer, Montane Hardwood-Conifer and Mixed Oak-Foothill Pine forest types that received low to moderate burn severity consuming the duff and occasionally crowning into the canopy. Snag trees associated with roads and structures were relatively low. There was one Douglas Fir (*Pseudotsuga menziesii),* 10-12 inches at DBH that had low to moderate burn effects on the bark reaching up approximately 6 feet on the uphill side of the tree. The tree is situated on the uphill cut bank of a seasonally used road and has 10-20 % of its root structure hanging from the cut bank and is leaning north towards a recreational cabin. See map point DL-1 on the Deerlick fire overview map and table.
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3. Moon

Due to the size of the moon fire affects range from complete deforestation to slight burn effects. Lower slopes located above the Town of Ono had mixed burn severities. Most of

the south and west facing slopes burned with high severity leaving sticks, or in some cases just a basal stub of the mixed chaparral associated with that area. The north and west lower slopes found above Ono burned low to moderate. This created a mosaic pattern of burned and unburned vegetation throughout those lower slopes. While completing the on the ground survey it was evident that while much of the mixed chaparral and hardwood species in the area burned with high severity, the level of mortality would be low. In our observations for these lower slopes the Chaparral and the hardwood tree were beginning to re-sprout from the bole and in some cases from the upper canopy. In the mid-slopes primarily within the mixed conifer stands, burn intensity had a high variability. Understory fuel consumption in much of these stands was 100% which lead to a tremendous amount of impact to the existing tree bole. In many instances trees showed signs of being burned 30 to 40 feet up the bole and in complete circumference. In addition visual observations from both the ground and air reveal that in some cases more than 70% of some stands have at least 80 to 100% crown burn effects. In the lower portions of these drainages and the riparian areas burn severity was not as prevalent. The most impacted forested stands by the Moon fire appear to be Moon Fork, Cottonwood Creek, Jerusalem Creek, Eagle Creek and North Fork Cottonwood Creek drainages. On the north side of the fire facing Whiskeytown Lake, the fire moved through the forested stands with a moderate intensity. On the north facing side of South Fork

Mountain moving to the west, below Shasta Bally and the Brandy Creek drainage area, observations in the field reveal that these forested areas have elevated levels of damage. Fire affects range from having 30 to 40% of the stand having at least 60% crown burn effects to mostly light under burning.

During the evaluation of the Moon fire the presence of snags was noted, as well as trees that due to the fire effect have been damaged and have an increased potential of becoming hazard trees. Although most of the visible hazard trees have been cleared during the post fire suppression efforts trees that are still living that have been damaged still pose a risk for future hazards. Instances that would create problematic situations would be post fire mortality and high winds or large storm events.

4. Deck

On-the-Ground surveys were not conducted for the Deck fire, therefore there are no observations to note.

5. Motion

Due to the size of the Motion fire affects range from complete deforestation to slight burn effects. Areas that had high severity burns were located in the Squaw Creek drainage, drainages associated with Coram ranch to the south, west and north, most of the spring creek drainage, portions of the west facing slopes associated with Whiskey Creek arm of Whiskeytown Lake and portions of the headwaters of Mad Ox Gulch and Whiskey Creek. Most of the fire associated with mixed conifer stands did not burn with high intensity. However, the fire did have similar affects to the timber as with the Moon fire.

Increased mortality is evident and it is expected to continue to increase for several more years. In general the Motion fire was inconsistent with its burn pattern, skunking around in the underbrush until favorable condition were present for it to make runs. The fire affects were mostly moderate and where the fire made runs on the steeper slopes high severity was evident.

During the evaluation of the Motion fire the presence of snags was noted, as well as trees that due to the fire effect have been damaged and have a increased potential of becoming hazard trees. Although most of the visible hazard trees have been cleared during the post fire suppression efforts trees that are still living that have been damaged still pose a risk for future hazards. Snags associated with the upper portions of South Fork Mountain road to the radio tower, the Westside road towards Squaw Creek, upper portions of Benson drive and any other roads associated with the mixed conifer and knobcone/foothill pine forest types. Instances that would create problematic situations would be post fire mortality, high winds and/or large storm events and over-steepened cut-banks.

6. Stein

On the Ground surveys were not conducted for the Stein fire. Only a small portion of land in the south east portion within the Stein fire is private, the rest is owned and managed by the USFS.

7. Pine

The Pine fire burned mostly during favorable conditions where the outside air temperature was favorable and winds were low. Montane Hardwood-Conifer vegetation types have adapted to low and moderate fire intensities. Many of the species associated with this forest type respond favorably to fire. As a result most of the fire burned with a low to moderate intensity. There are however portions of the fire in the steeper slopes and towards the top of the ridges by backbone road that burned moderate to high severity. In these stands partially consumed trees and brush killed by the fire remains as standing fuel.

8. Venture

The venture fire burned at a moderate intensity due primarily to the lack of slope and sparse vegetation. Low site and fuels allowed this fire to burn with relative small impact. There are some areas that burned at higher intensities due primarily to steeper slopes. The on-the-ground survey of these fires revealed that there was low impact.

9. Withrow

The Withrow fire was a low intensity burn that had a relative light effect on the forest and other surrounding vegetation. The north portion of the fire was steep with slopes over 50%. The vegetation makeup of that area appeared to be mostly brush and Mixed Oaks,

and had a low burn severity. The southern portion of the fire was also low severity and spotty in nature. The effects of the fire were low.

10. Shingletown

The Shingletown fire was a low intensity burn that had a relative light effect on the forest and other surrounding vegetation. The north portion of the fire was dominated by a Sierran Mixed Conifer forest that was affected moderately by the fire. Mostly understory vegetation burned with occasional flare-ups into the crowns. The vegetation makeup of the area to the southern portions of the fire appeared to be mostly brush and Closed–Cone Pines and oaks, in addition to a low burn severity. The effects of the fire were low.

10. Kirkman

The Kirkman fire was a low intensity burn that had a relative light effect on the forest and other surrounding vegetation. With exception to the riparian areas of this fire which had almost no impact, the fire affects were low to moderate.

B. Values at Risk

1. Noble

- The single most important value at risk associated with this fire is the federally and state listed spring-run Chinook salmon (*Oncorhynchus tshawytscha*), and the federally listed Central Valley steelhead (O. mykiss). Due to the loss of vegetation on the slopes above the North Fork Beegum creek, increased sediment and delivery to the creek are expected and could impact spring-run Chinook salmon and Central Valley steelhead. (Refer to the Fisheries section & SHU-Lightning Complex Burned-Area Report).

- Using the helicopter flight as aerial reconnaissance and the review of the BARC map confirm that the forested stands in north western portions of the Noble fire have low risk for threats to watershed resources, including: excessive erosion, impaired water quality; threats to wildlife, fisheries, botanical values, and cultural resources. Due to the low to moderate burn severity within these forests, mortality within these stands will be low.

2. Deerlick

- The value at risk which is identified above is the cabin. The cabin is located on the downhill side of the seasonal road while the tree is located directly across from the cabin. There is a large White Mixed Oak tree (*Quercus lobata*) partially blocking the cabin which will help in deflecting the tree if it were to succumb to the effects of the fire.

- Due to the Deerlick fires low burn severity through the mixed conifer and hardwoods stands there are no values at risk associated with these forested areas.

3. Moon

- As stated in the Moon fire observations section, a considerable amount of forested ground has been damaged by the Moon fire. The largest threat from this fire that threatens these forested stands is the impact from insects. Wood borers in the families Buprestidae and Cerambycidae are principal colonizers of trees killed or severely damaged by fire. Some of these insects are attracted by smoke and can

  be found ovipositing in trees that are still smoldering. Because they colonize trees that are dead or dying, they are not considered a direct threat to tree survival. Bark beetles, in contrast, are more likely to colonize trees that are lightly to moderately injured by fire and may kill trees that might otherwise have survived. Guidelines that estimate tree survival take these insects into account. A commonly voiced concern is that larger fires will generate bark beetle outbreaks that eventually kill healthy, undamaged trees. This, however, has never been observed in California and therefore is not considered likely. Most fire-related mortality takes place within 3-4 years following the fire, and this is the time frame for which survival estimates apply. Fire injuries can, however, have a longer lasting impact on tree health and may contribute to mortality beyond this time frame, especially when combined with other stressors. (Unpublished literature; Don Owen 2008 Tree Mortality)

- The impacts of fire are highly variable across the landscape and from tree to tree due to such factors as the distribution and abundance of fuel, topographic influences, and weather. Additionally, tree susceptibility to injury varies by species, vigor, and time of year. Less vigorous trees are more susceptible to damage, and all trees are most susceptible to injury during the early part of the growing season when height growth is occurring. Fire intensity early in the season may be reduced by higher moisture contents in fuels and duff, but this was not the case for the Shasta Lightning Complex (SLC) of fires. Because of ongoing drought and this year's dry spring, there were drier fuels and a greater number of drought stressed trees across the landscape than would normally occur at this time of year. Also, the early summer SLC fires corresponded with the height of activity
  for a number of bark beetle species. (Unpublished literature; Don Owen 2008 Tree Mortality)

4. Deck

Due to the size of the Deck fire, its moderate slope and location, it was determined that this fire had no values at risk.

5. Motion

The value at risk for the Motion fire is the increased threat towards the Mixed Conifer stands due to increased pressure from insects such as wood borers and bark beetles The portions of the Motion fire where there is a mixed conifer component has an elevated risk associated with it due largely to the limited amount of forest management that is being

practiced. While the Motion fire does not have as much of a forested resource as the Moon fire, the information provided in the Values at Risk section apply for the Motion fire as well. See the Moon fire report for a more detailed overview of values at risk.

6. Stein

Due to the location of the Stein fire, and its large ownership by USFS, values at risk would be encompassed within their forest management plan.

7. Pine

Increased fuel loads, both dead and dying from the recent fire combined with overstocked stands have increased the possibility of a larger more intense fire that could threaten existing homes in the immediate area.

8. Venture – None

9. Withrow – None

10. Shingletown – None

11. Kirkman – None

III. Emergency Determination

A. Noble

1. North Fork Beegum Creek is critical cold water habitat for spring-run Chinook salmon (*Oncorhynchus tshawytscha*), and the federally listed Central Valley steelhead (O. mykiss).

2. In general most of the Forested and Mixed Chaparral vegetation types have adapted to low and moderate fire intensities. Chaparral is a fire resistant species and has evolved to respond favorably to it. Klamath mixed conifer forests as well as Montane Hardwood-Conifers also have reasonable resistance to low and moderate severity fires. Visual observations from both the ground and the air, including the use of the BARC map to determine fire severity within these areas, shows that the value at risk here is low.

B. Deerlick

1. Douglas fir is a fairly fire-resistant tree that's bark protects the cambium during low to moderate burn intensity fires. Due to the existing condition and location of the Douglas fir on the cut bank of the road paired with the effect of the recent burn damage does raise some concern towards the future of this tree. The threat to the cabin from possible wind-throw or bank failure should be considered low to moderate.

C. Moon

1. In general most of the Forested and Mixed Chaparral vegetation types have adapted to low and moderate fire intensities. Mixed Chaparral is a fire resistant species and has evolved to respond favorably to it. Klamath mixed conifer forests as well as Montane Hardwood-Conifers also have reasonable resistance to low and moderate severity fires. However, with the Moon fire there are large areas of mixed conifer that have been affected by high severity fire. Visual observations from both the ground and the air, including the use of the BARC map to determine fire severity within these areas, provide enough evidence to determine that the value at risk here to be high.

D. Deck – None

E. Motion

1. Mixed conifer forest and chaparral vegetations have adapted over time to periodic low to moderate fires. Most chaparral and Montane hardwood types including knobcone pine are fire dependent and respond favorably to fire. However, when high intensity fires occur, soils become hardened and trees and brush that could once handle moderate severity do not react as favorably when introduced to higher severity fires. When looking at the entire fire as a whole the forested areas of the Motion fire is not the dominant vegetation type. That does not preclude it from needing management as a result of the fire. Visual observations from both the ground and the air, including the use of the BARC map to determine fire severity within these areas, provide enough evidence to determine that the value at risk here to be moderate.

F. Stein – None

G. Pine

1. Visual observations from the ground verified that the severity of the Pine fire was low to moderate. However due to increased fuel loads as stated above risk to existing structures from a repeat event elevate this area to a moderate risk level.

H. Venture – None

I. Withrow – None

J. Shingletown – None

K. Kirkman – None

IV. Recommendations

A. General Recommendations

1. Noble

- Recommendations for the slopes adjacent to the North Fork of Beegum Creek can be referenced in the Fisheries report and in the SHU-Lightning Complex Burned-Area Report.

- The areas of the Noble fire that has conifer stands should be evaluated for existing mortality from the fire as well as future mortality as trees succumb to the effects of the fire. Trees that have not been killed by the fire with light to moderate fire damage could also be at an increased risk to bark beetle mortality in the next one to three years. Increased fuel load due to lack of post fire management could lead to increased risk for future catastrophic fire. Areas that have increased mortality should be considered for fire salvage and or biomass where practical. Forested areas that have been affected by the fire should also be evaluated for the next several years for mortality and possible future management.

2. Deerlick

- The areas of the Deerlick fire that has conifer stands should be evaluated for existing mortality from the fire as well as future mortality as trees succumb to the effects of the fire. Trees that have not been killed by the fire with light to moderate fire damage could also be at an increased risk to bark beetle mortality in the next one to three years. Increased fuel load due to lack of post fire management could lead to increased risk for future catastrophic fire. Areas that have increased mortality should be considered for fire salvage and or biomass where practical. Forested areas that have been affected by the fire should also be evaluated for the next several years for post fire effects.

3. Moon

- The areas of the Moon fire that has conifer stands should be evaluated for existing mortality from the fire as well as future mortality as trees succumb to the affects of the fire. Trees that have not been killed by the fire with light to moderate fire damage could also be at an increased risk to bark beetle mortality in the next one to three years. Increased fuel load due to lack of post fire management could lead to increased risk for future catastrophic fire. Areas that have increased mortality should be considered for fire salvage and or biomass where practical. Harvesting of live, injured trees that are not predicted to survive will enable wood to be utilized before it is degraded by insects and pathogens, and will remove trees that

- potentially could serve as breeding sites for bark beetles. Future precipitation patterns cannot be predicted, but they will undoubtedly influence tree vigor and susceptibility to bark beetle attack (Unpublished literature; Don Owen 2008 Tree Mortality).

- Following are some general guidelines (based on Wagener 1961) for evaluating the survival of fire-injured trees (Unpublished literature; Don Owen 2008 Tree Mortality).

  (a) When no green foliage remains on a fire-damaged tree, the tree is already dead or likely to die.
  (b) For most conifers, foliage death is roughly equivalent to twig and bud death. For these trees, if 35% or more of the foliage remains green, the tree is likely to survive. For the Shasta Lightning Complex, this should be modified to 40% or more green foliage for trees of average or above vigor and to 50% or more for trees of lower vigor.
  (c) Ponderosa and Jeffrey pines have different criteria. For these species, foliage death is often greater than twig or bud death. Hence, the amount of green foliage remaining on the tree immediately following the fire usually underestimates the proportion of the crown (twigs and buds) that is still alive. For trees evaluated during the same season as the fire, if 10% or more of the foliage remains green, the tree is likely to survive. For the Shasta Lightning Complex fires, this should be modified to 20% or more green foliage. For trees evaluated after bud break the year following injury, if 50% or more of the crown is alive, the tree is likely to survive. This should be modified to 60% or more for trees of lower vigor.
  (d) The amount of cambium killed at the base of the bole is also an important consideration in tree survival. The above guidelines for crown damage assume that light to moderate cambial kill has occurred. For most conifers, this means cambial kill of less than 25% of the circumference of the bole at the base of the tree. Cambial kill can be difficult to assess, particularly when the damage is light to moderate. When bark is completely blackened and has been eroded to the point where its structure is no longer discernable, assume that the cambium beneath is dead.

- Landowners need to be aware and monitor the increased mortality that will continue for the next several years along frequently traveled roads as well as adjacent to homes and structures for the development of future hazard trees. Be aware of wind events and the potential for already weakened trees being blown over onto roads and structures, primarily during the winter period.

4. Deck – None

5. Motion

- The recommendations for the Motion fire will be the same as stated with the Moon Fire. See Moon fire recommendations for more.

6. Stein – None

7. Pine

- Inevitably there will be some increased mortality within this forest system due to the affects of the Pine Fire. Land owners should be aware of this and monitor the adjacent forests in close proximity to their homes. Fuel reductions in the form of biomass were practical, salvage of dead and dying trees and maintaining a clean, clear and defensible space around homes would be advised.

8. Venture

- Inevitably there will be some increased mortality within these forest systems due to the affects of fire. Land owners should be aware of this and monitor the adjacent forests for increased mortality due to fire affects including potential insect damage. Fuel reductions in the form of biomass were practical, salvage of dead and dying trees is advised.

9. Withrow – None

10. Shingletown – None

11. Kirkman – None

B. Specific Recommendations

1. Noble – None

2. Deerlick

- Specific recommendations are to evaluate and monitor the tree for signs of increased damage as a result from the fire. Removal of tree if necessary to prevent damage in the event it should fall on the cabin could be considered.

3. Moon – None

4. Deck – None

5. Motion – None

6. Stein – None

7. Pine – None
8. Venture – None
9. Withrow – None
10. Shingletown – None
11. Kirkman – None

Fire Overview Photos

Pine Mortality in Motion Fire

Mixed Conifer Mortality in Moon Fire

High Severity Burned Chaparral in Moon Fire

Valley Oak Regeneration in Moon Fire

Fire Overview Photos

Possible Future Snag, South Fork MT Road

Deerlick Fire High Severity

References

SHU-Lightning Complex Burned-Area Report, (BAER Report) Reference FSH 2509.13, USDA Forest Service, 8/14/2008

BARC Map

Owen, Don. “Re:Tree Mortality.” E-mail to Matt Boone. 28 Aug., 2008

Beck, Bruce, CAL FIRE, Fire Suppression

A Guide to Wildlife Habitat of California: October 1988.

Soil Survey of Shasta County Area, California: U.S. Government Printing Office, 1974.

DRAFT TECHNICAL SPECIALIST REPORT
STATE EMERGENCY ASSESSMENT TEAM (SEAT) Emergency Report

Resource: Cultural Resources

Fire Name: Shasta Lightning Complex CA-SHU-004727 June 2008

Author Name: Richard Jenkins, Senior State Archaeologist
California Department of Forestry and Fire Protection (CAL FIRE)
6105 Airport Road
Redding CA 96002
Office: (530) 224-4749

I. Resource Condition Assessment

A. Setting

Many dozens of previously recorded cultural resources exist within the eleven fire subject assessment area. Additional sites were discovered by Cal Fire archaeologists during Initial Attack and during Fire Suppression Repair activities. Many dozens if not hundreds of additional unrecorded/undiscovered sites are thought to exist as much of the study area has never been systematically surveyed for cultural resources.

Cultural resources in the study area are of three main types. Prehistoric sites in the area include tool making sites, seasonal camps, and village sites. Historic sites include trails and roads, cabins, dams, bridges, and mine sites. Native American cultural sites, such as sacred sites and special plant collecting locales, can also occur. Groups that inhabited the area at time of historic contact included the Wintu in the west and Achomawi (aka Pit River tribe) in the east.

This technical report includes an evaluation of resources within the State Responsibility Area (SRA) that were not previously inspected and reported on by a Federal Burned Area Emergency Rehabilitation (BAER) Team that earlier studied the Shasta Lightning Complex. While the Federal team focused on lands managed by the United States Forest Service (USFS), Bureau of Land Management (BLM), and Bureau of Reclamation (BOR), it also included private lands that were immediately adjacent and readily accessible. General treatments or mitigations are offered to lessen potential impacts to cultural resources within the SRA not covered in the BAER report.

B. Survey Methods

The primary focus of the cultural resource assessment was on those areas that the SEAT Team will be making treatment recommendations that include ground disturbing activities. The use of heavy equipment to excavate soils can cause irreparable harm to prehistoric and historic sites which are considered non-renewable resources. Specific methods for establishing the presence/absence of cultural resources in the proposed treatment areas

included 1) a check of the archaeological data base that was compiled by Cal Fire archaeologists in June and July for the Shasta Lightning Complex and 2) a pedestrian field inspection to search for prehistoric and historic artifacts, features, and sites within the Area of Potential Effect (APE).

Areas examined using these methods included the following:

1. Noble Fire – None.
2. Moon Fire – Map Point M-3. Deepening/widening of Class III watercourse diversion channel away from 2 cabins.
3. Deck Fire – None.
4. Stein Fire – None.
5. Pine Fire – None.
6. Venture Fire – None.
7. Withrow Fire – None.
8. Shingletown Fire – None.
9. Kirkman Fire – Map Point K-1. Extend rock rip rap along stream channel to protect adjacent bridge footings.

The secondary focus of the cultural resource assessment was to evaluate known archaeological sites for potential risk due to erosion, soil deposition, vandalism, etc. All field inspection was restricted to SRA lands. Field inspections were conducted between August 24th and August 26th, 2008.

C. Contacts

Katie Sanchez of the Native American Heritage Commission (NAHC) in Sacramento was consulted about the assessment project on August 21, 2008 prior to the author's assignment to the SEAT team. A similar conversation with James Hayward, Sr. of the Redding Rancheria occurred the same day. Letters that described the goals of the project and solicited input and locations of known archaeological and cultural sites were mailed to the NAHC, Redding Rancheria, Winnemem Wintu Tribe, Wintu Tribe and Toyon-Wintu Cultural Center, Roaring Creek Rancheria, Pit River Tribe, Pit River

Environmental Office, the Ajomawi and Hammawi Bands of Pit River Indians, Howard Wynant, and the Shasta Tribe on August 21st as well. Local BLM archaeologist Eric Ritter was consulted on August 27, 2008 regarding his involvement in the preparation of the Federal BAER Team report for Federal lands within the Shasta Lightning Complex.

II. Findings of the On-The-Ground Survey (Observations)

A. Values at Risk

No cultural resources, either prehistoric or historic, were found to be at risk from proposals made by the Shasta Lightning Complex SEAT Team. This conclusion was based upon the absence of recorded sites in the area, the negative findings of the field inspections, and the lack of response form local Native American groups that were asked to divulge the existence of any archaeological or cultural sites known to them within the fire complex area.

Cultural resources known/recorded for the area were also evaluated for risk due to erosion, soil deposition, vandalism, and other possible degradations. This evaluation was based upon direct observations of the sites made during the authors' post-fire inspections in July and other observations made during the current assignment. One known prehistoric village site was initially thought to be at risk from soil deposition from adjacent slopes but the field inspection found said slopes to contain lenses of rock that will curtail soil movement. Note that cultural sites within SRA lands that were damaged during initial attack and in need of erosion control measures were treated during the fire suppression repair phase of the incident

III. Emergency Determination

The author is unaware of any emergency that exists in terms of threat to cultural resources within the study area.

IV. Recommendations

As previously stated many dozens of known/recorded cultural resources exist in the Shasta Lightening Complex area. None of the known resources are threatened by SEAT Team proposal made in this report. Future project activities in other fire areas, not examined during this study, could affect known/recorded prehistoric or historic sites.

It is therefore recommended that proponents for projects that involve ground disturbance outside of the project areas identified in this report check the archaeological data base maintained by the Northeast Information System (CHRIS) office located at California State University, Chico ((530) 898-6256). This contact, called an "Archaeological Records Check", will determine 1) whether known/recorded cultural resources exist in the project area and 2) whether or not the area has been previously surveyed for cultural resources. If this contact results in the determination that no sites are known <u>and</u> that a cultural resource survey has already taken place in the project area no further cultural resource work would be required.

If the records check results in the determination that an archaeological site is present in the proposed project area, <u>or</u> that the area has never been the subject of an archaeological survey, input from an archaeologist should be sought. The CHRIS office maintains a list of consulting archaeologists that are available to perform needed site boundary identification, development of site protection measures, site evaluation measures if protection is not possible, and project area surveys if needed. Many local agencies, including the USFS, BLM, BOR, Caltrans, and CAL

FIRE, have archaeologists on staff that may be available for consultation, and perhaps field work, depending on agency policies and workload.

Projects that involve ground disturbance should also contain a Native American contact element. The NAHC in Sacramento ((916) 653-4040) maintains a list of local Native American groups, organized by county, and will refer project proponents to appropriate contacts. The purpose of such contacts is to allow Native Americans an opportunity to disclose the locations of archaeological and especially cultural sites that may be known only by them. These same groups should also be given an opportunity to comment on any protection or mitigation measures proposed by the project proponent for Native American archaeological or cultural sites located within project areas.

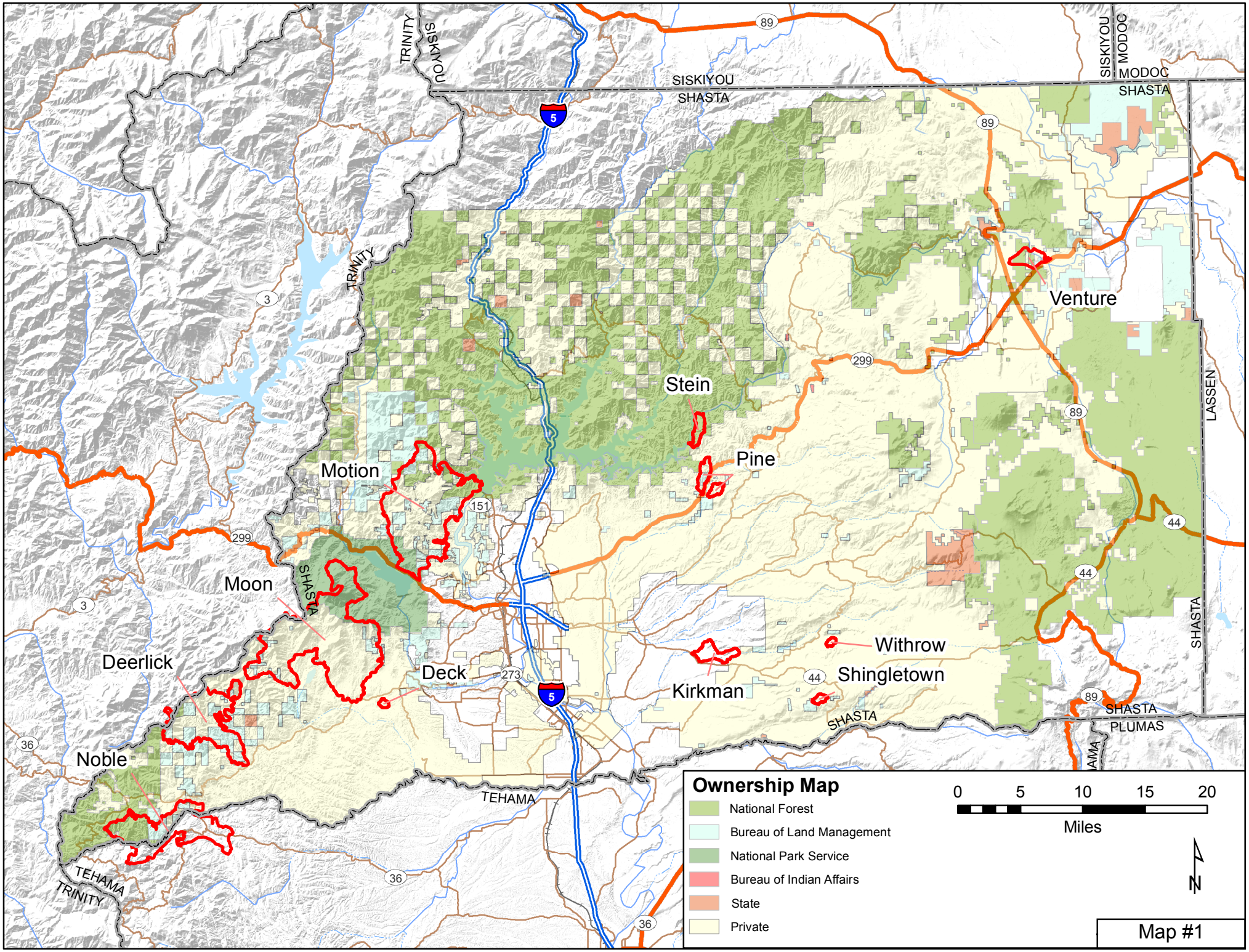
References

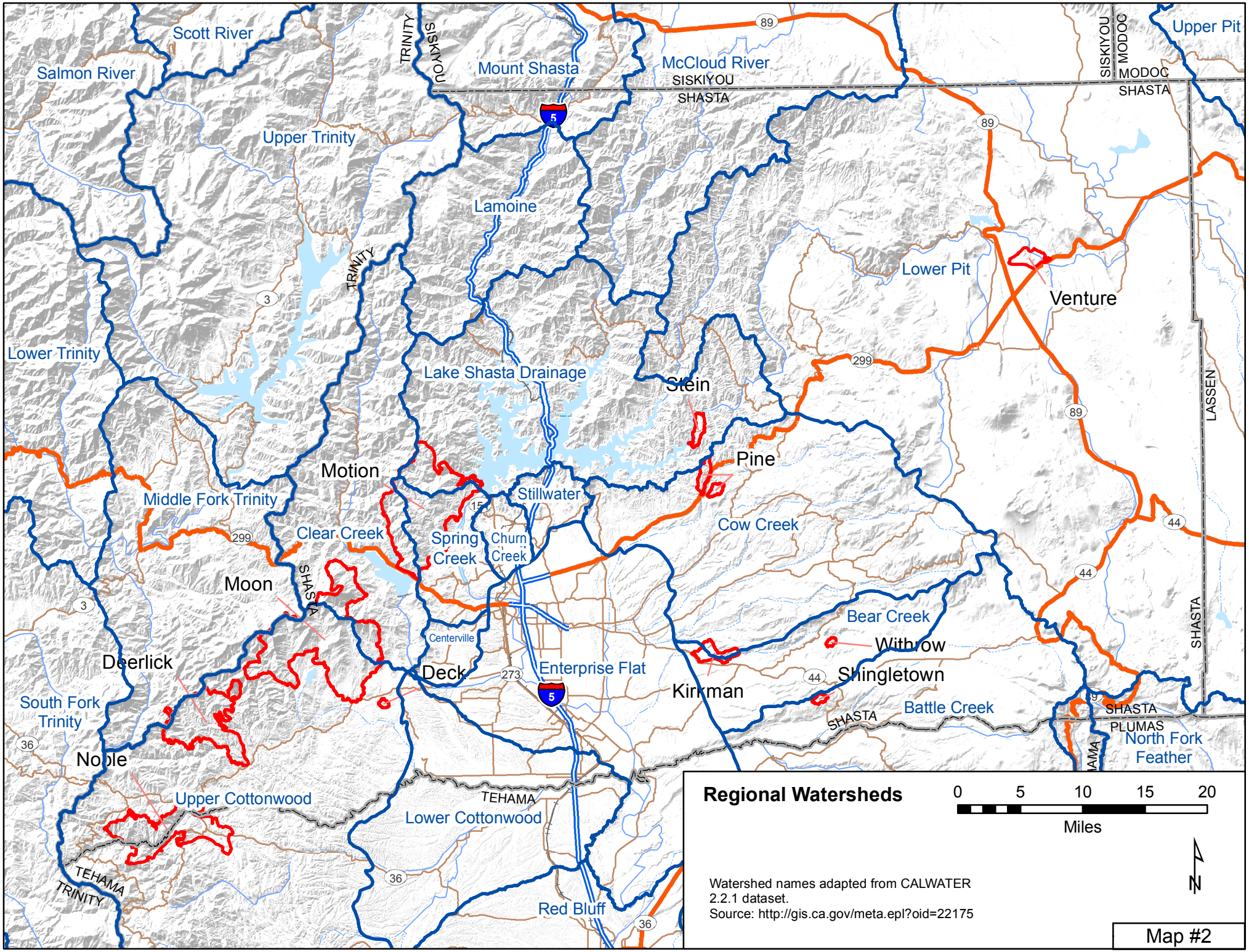
Cultural Resource Narrative for the Shasta Lightning Complex, Final Report CA-SHU-004727,Shasta County, California, by Richard Jenkins and Scott Mattingly, Cal Fire Northern Region Headquarters, Redding and Humboldt-Del Norte Unit, Fortuna, respectively, July 31, 2008. (Reference Info)

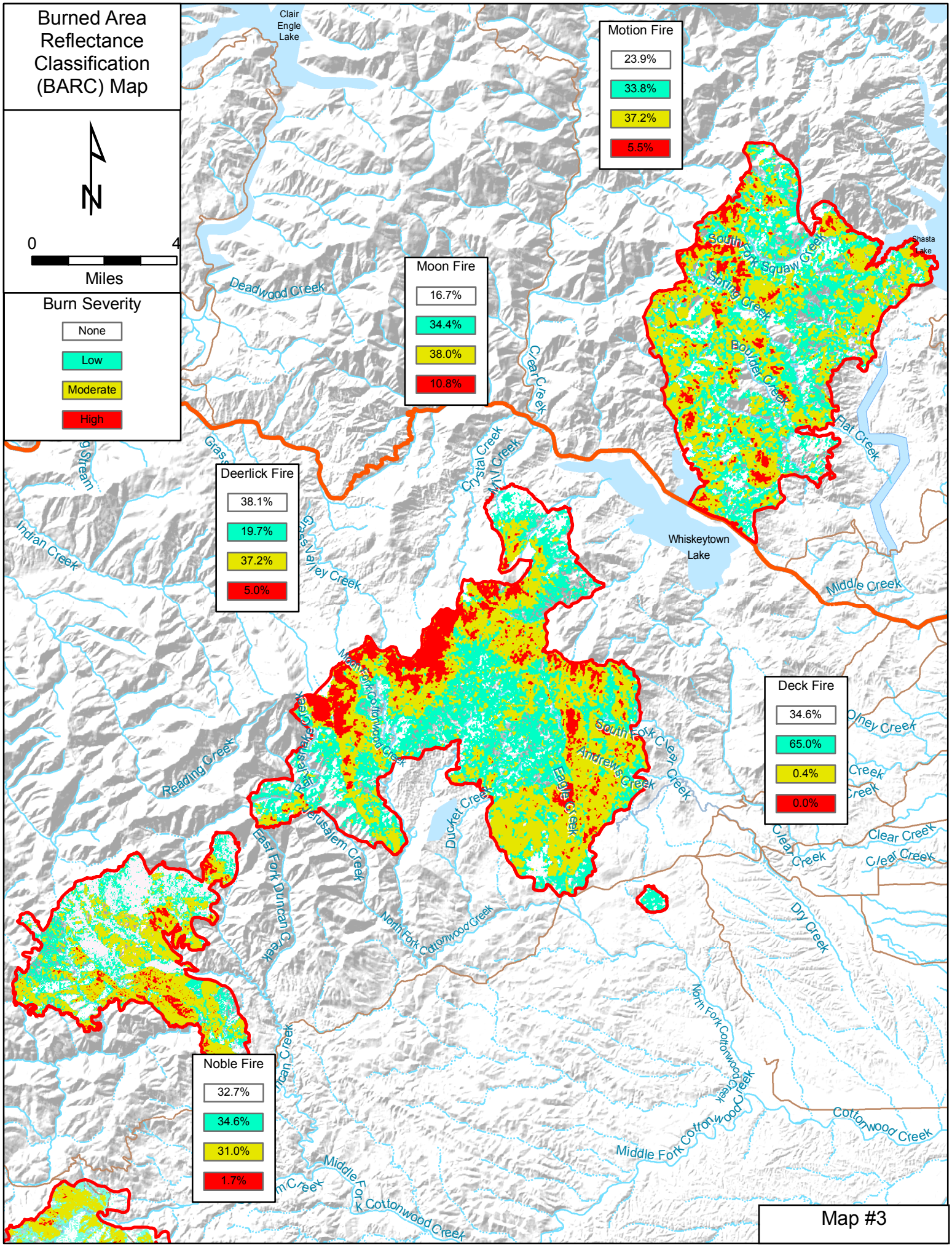
Archaeological Records Check data gathered by the author for the Shasta Lightning Complex. Confidential archaeological site records and maps were obtained by the author from the Northeast Information Center for the California Historical Resources Information System (CHRIS) office located at California State University, Chico during several visits in June and July, 2008.

Interagency Burned Area Emergency Stabilization Plan, Front Country Fires BAER, Cultural Resource Assessment, by Eric Ritter, Bureau of Land Management Redding Resource Area Archaeologist, N.D. (no date).

SHU-Lightning Complex Burned-Area Report, (BAER Report) Reference FSH 2509.13, USDA Forest Service, 8/14/2008.


Ownership Map
National Forest
Bureau of Land Management
National Park Service
Bureau of Indian Affairs
State
Private
0 5 10 15 20
Miles
N
Map #1
Venture
Stein
Pine
Motion
Moon
Deerlick
Deck
Kirkman
Withrow
Shingletown
Noble
SISKIYOU
SHASTA
MODOC
LASSEN
PLUMAS
TEHAMA
TRINITY
5
89
3
299
151
273
44
36


Regional Watersheds
0 5 10 15 20
Miles
Watershed names adapted from CALWATER 2.2.1 dataset.
Source: http://gis.ca.gov/meta.epl?oid=22175
Map #2
Scott River
Salmon River
Upper Trinity
Lower Trinity
Middle Fork Trinity
South Fork Trinity
Mount Shasta
McCloud River
Upper Pit
Lower Pit
Lamoine
Lake Shasta Drainage
Stillwater
Spring Creek
Churn Creek
Clear Creek
Cow Creek
Bear Creek
Battle Creek
North Fork Feather
Upper Cottonwood
Lower Cottonwood
Enterprise Flat
Centerville
Red Bluff
Venture
Stein
Pine
Motion
Moon
Deerlick
Noble
Deck
Kirkman
Withrow
Shingletown
TRINITY
SISKIYOU
SHASTA
MODOC
LASSEN
PLUMAS
TEHAMA


Burned Area Reflectance Classification (BARC) Map
N
0
4
Miles
Burn Severity
None
Low
Moderate
High
Motion Fire
23.9%
33.8%
37.2%
5.5%
Moon Fire
16.7%
34.4%
38.0%
10.8%
Deerlick Fire
38.1%
19.7%
37.2%
5.0%
Deck Fire
34.6%
65.0%
0.4%
0.0%
Noble Fire
32.7%
34.6%
31.0%
1.7%
Clair Engle Lake
Shasta Lake
Whiskeytown Lake
Deadwood Creek
Clear Creek
Crystal Creek
Grass Valley Creek
Indian Creek
Reading Creek
Middle Creek
Olney Creek
Flat Creek
South Fork Squaw Creek
Spring Creek
Boulder Creek
North Fork Cottonwood Creek
Shasta Bar
Jerusalem Creek
East Fork Duncan Creek
Ducker Creek
Eagle Creek
Andrews Creek
South Fork Clear Creek
Dry Creek
Middle Fork Cottonwood Creek
Cottonwood Creek
Map #3

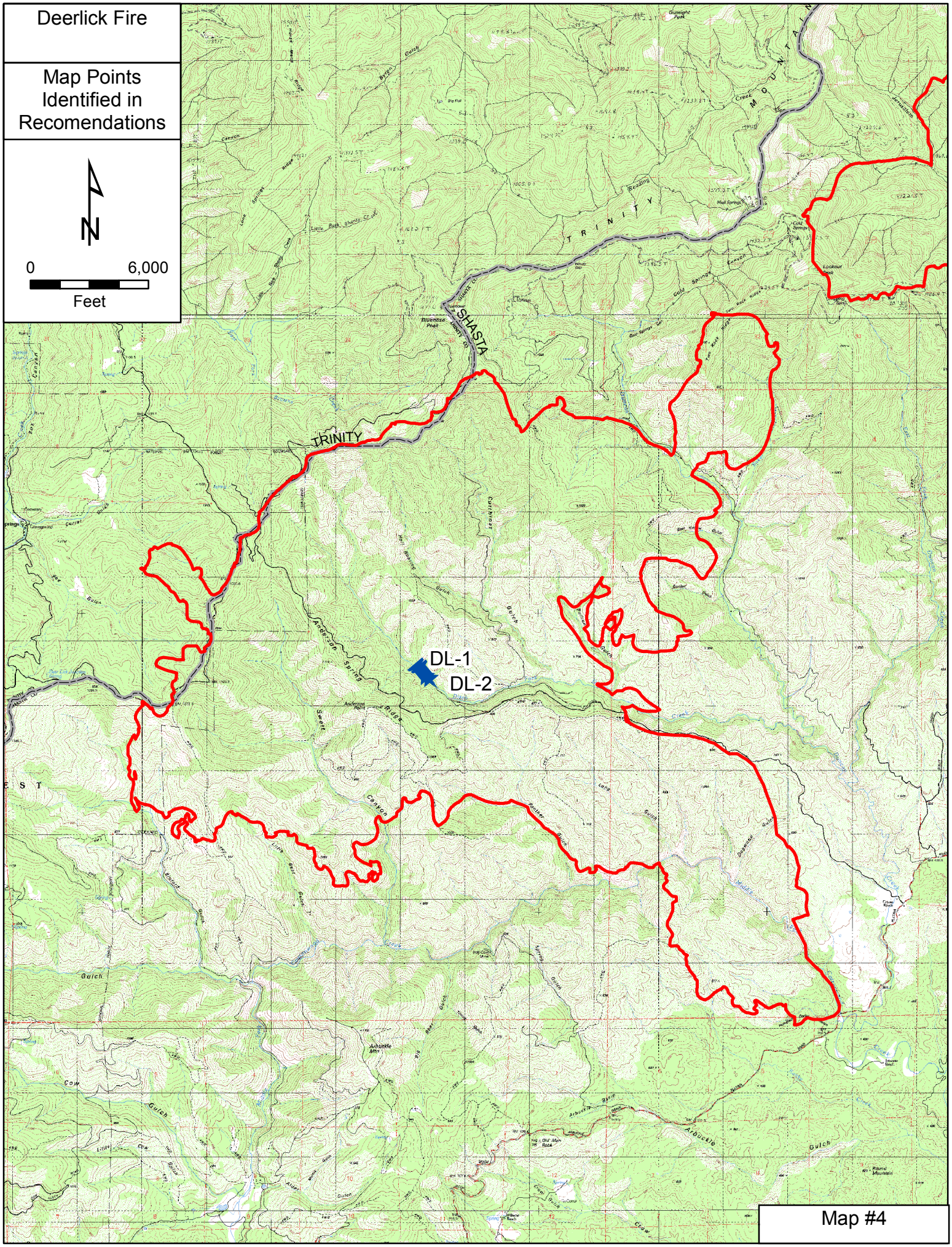
Deerlick Fire

Map Points Identified in Recomendations

N

0 6,000

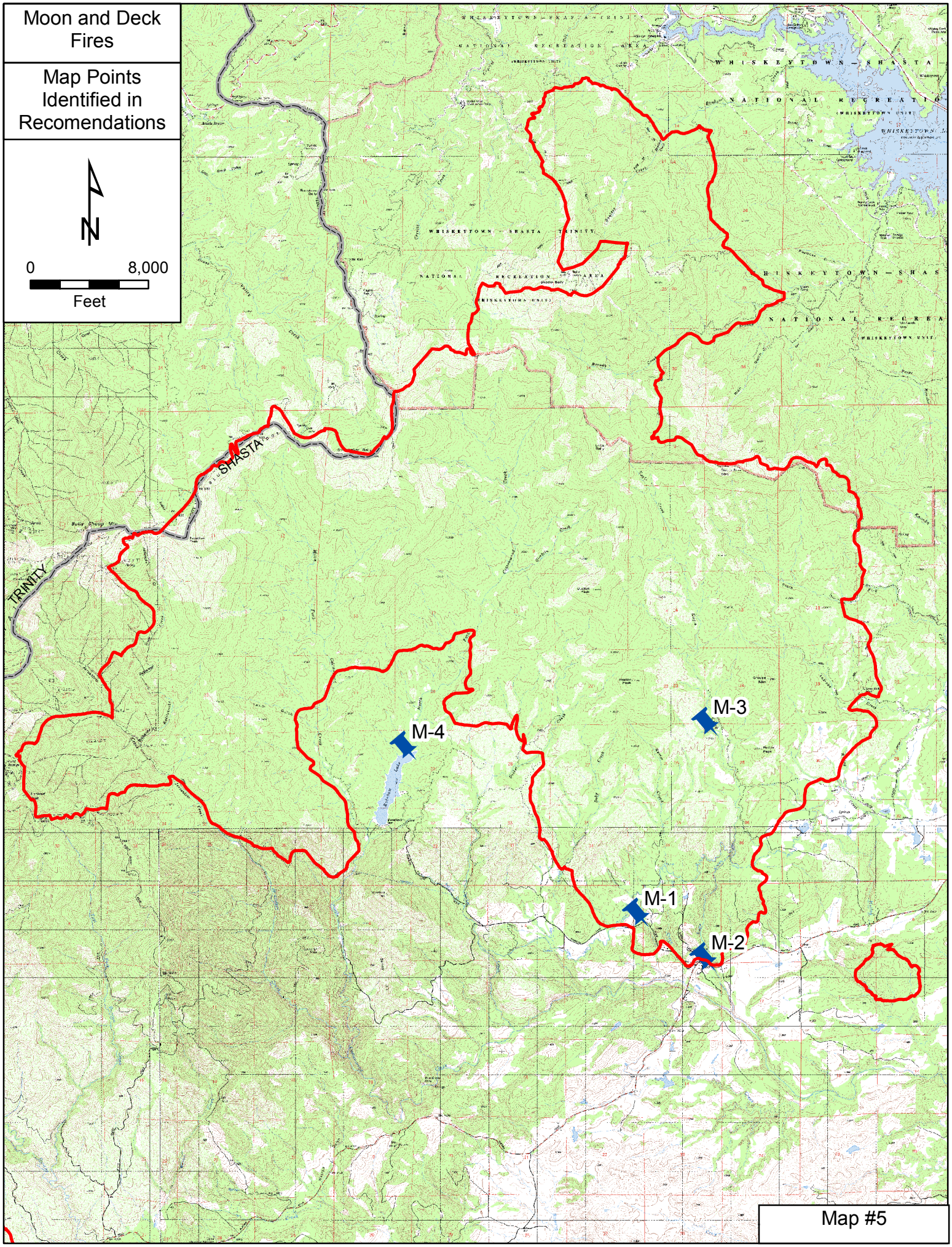
Feet



Map #4

Moon and Deck Fires

Map Points Identified in Recomendations



Map #5

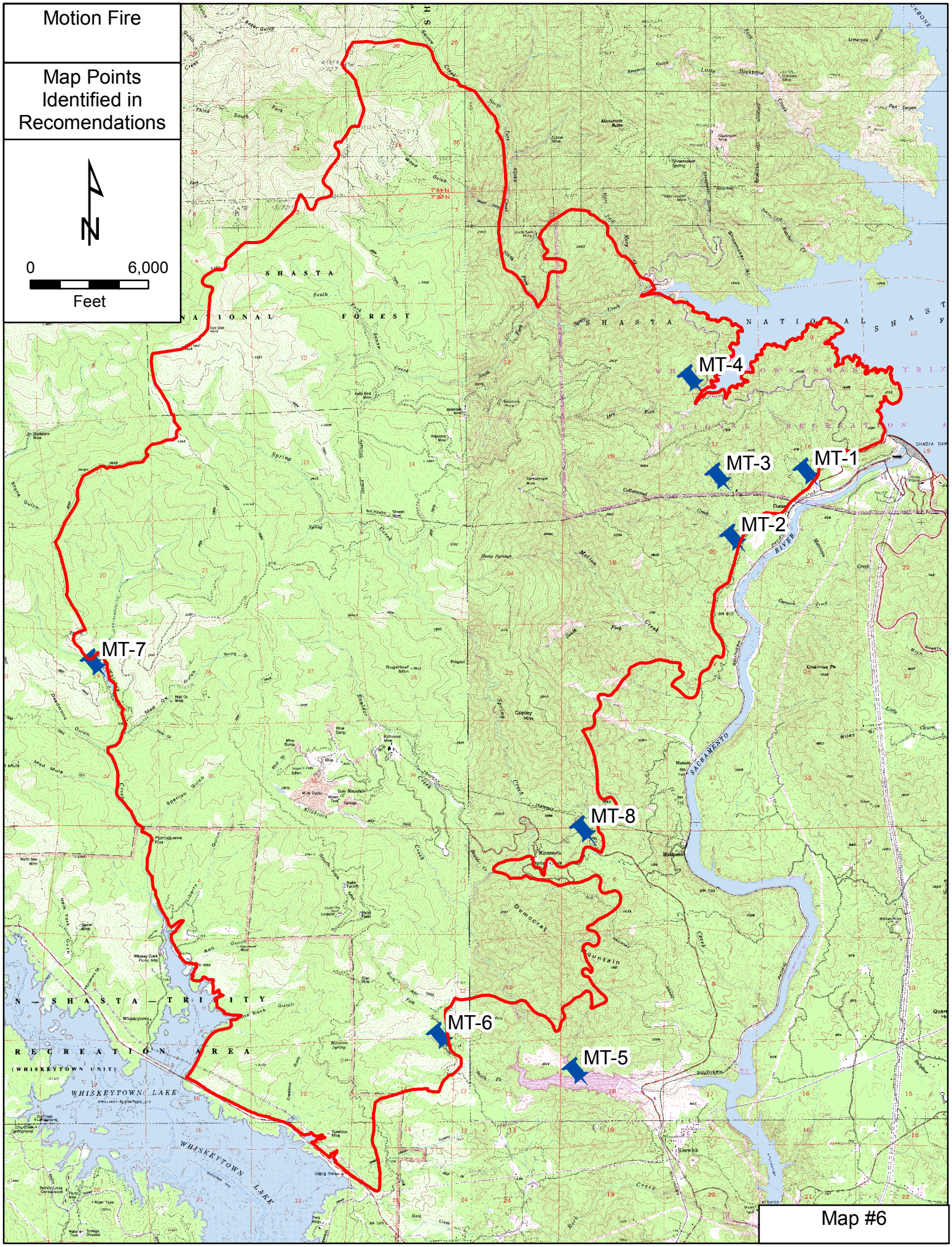
Motion Fire

Map Points Identified in Recomendations

N

0 6,000

Feet



Map #6

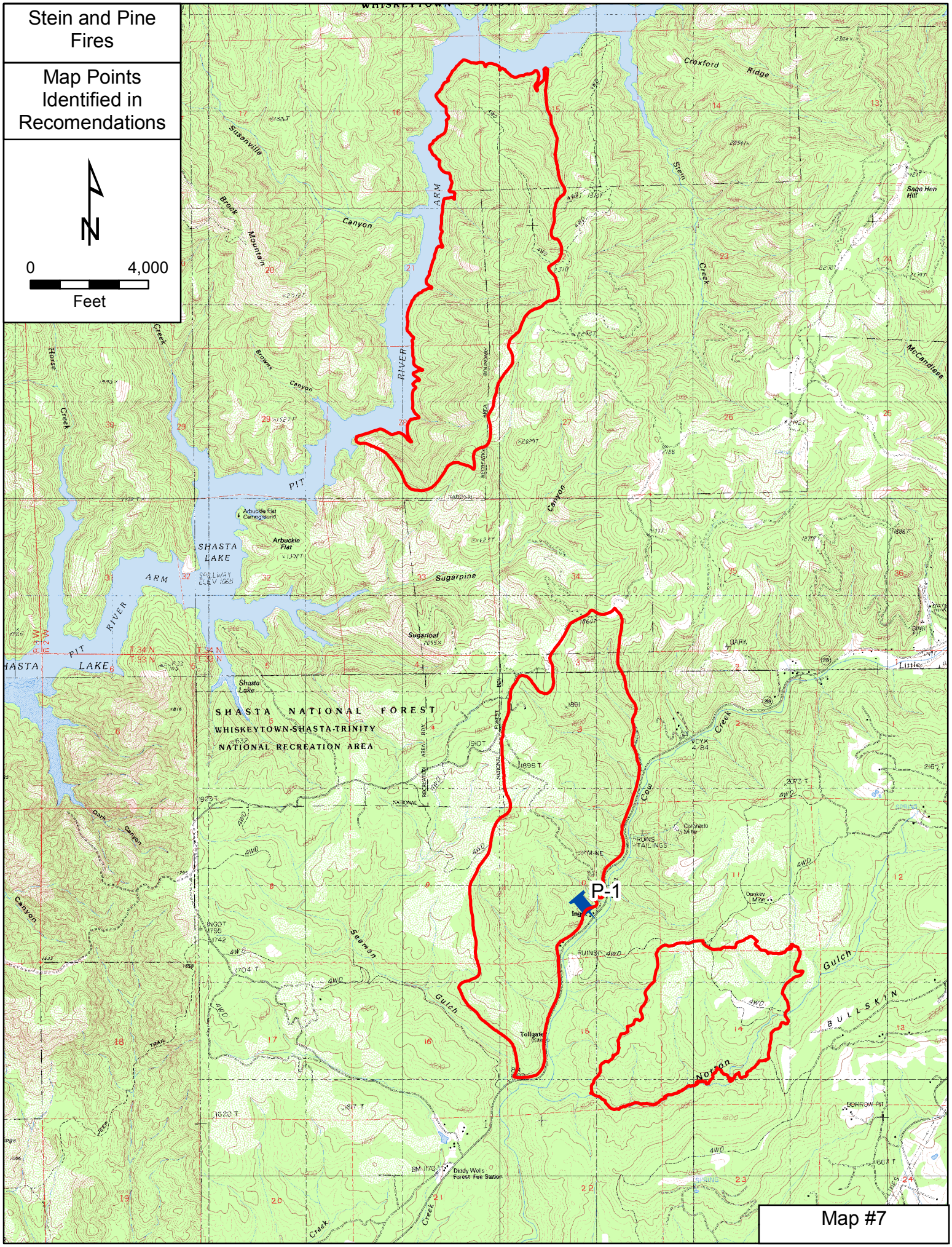
Stein and Pine Fires

Map Points Identified in Recomendations

N

0 4,000

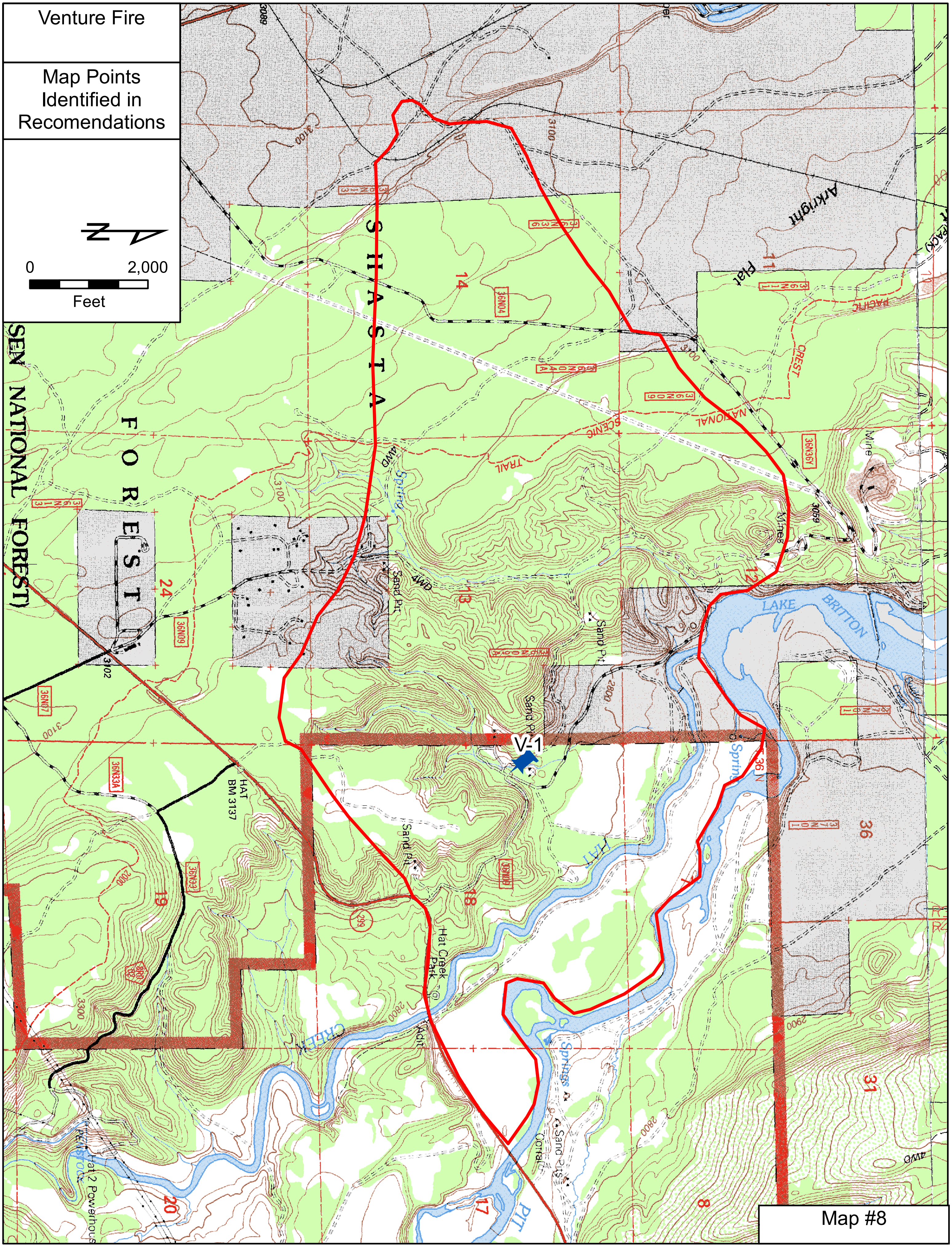
Feet



Map #7

Venture Fire

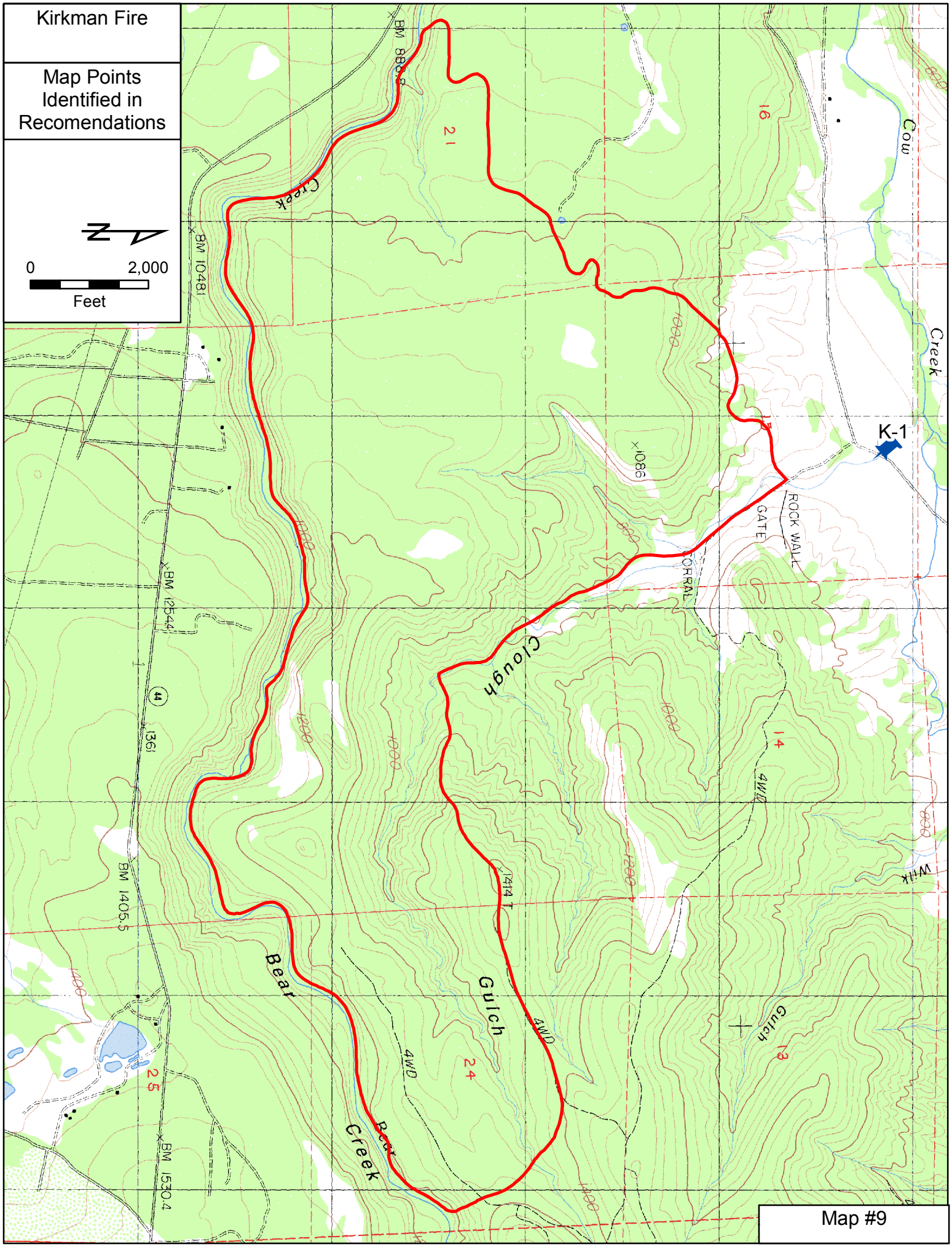
Map Points Identified in Recomendations



Kirkman Fire

Map Points Identified in Recomendations

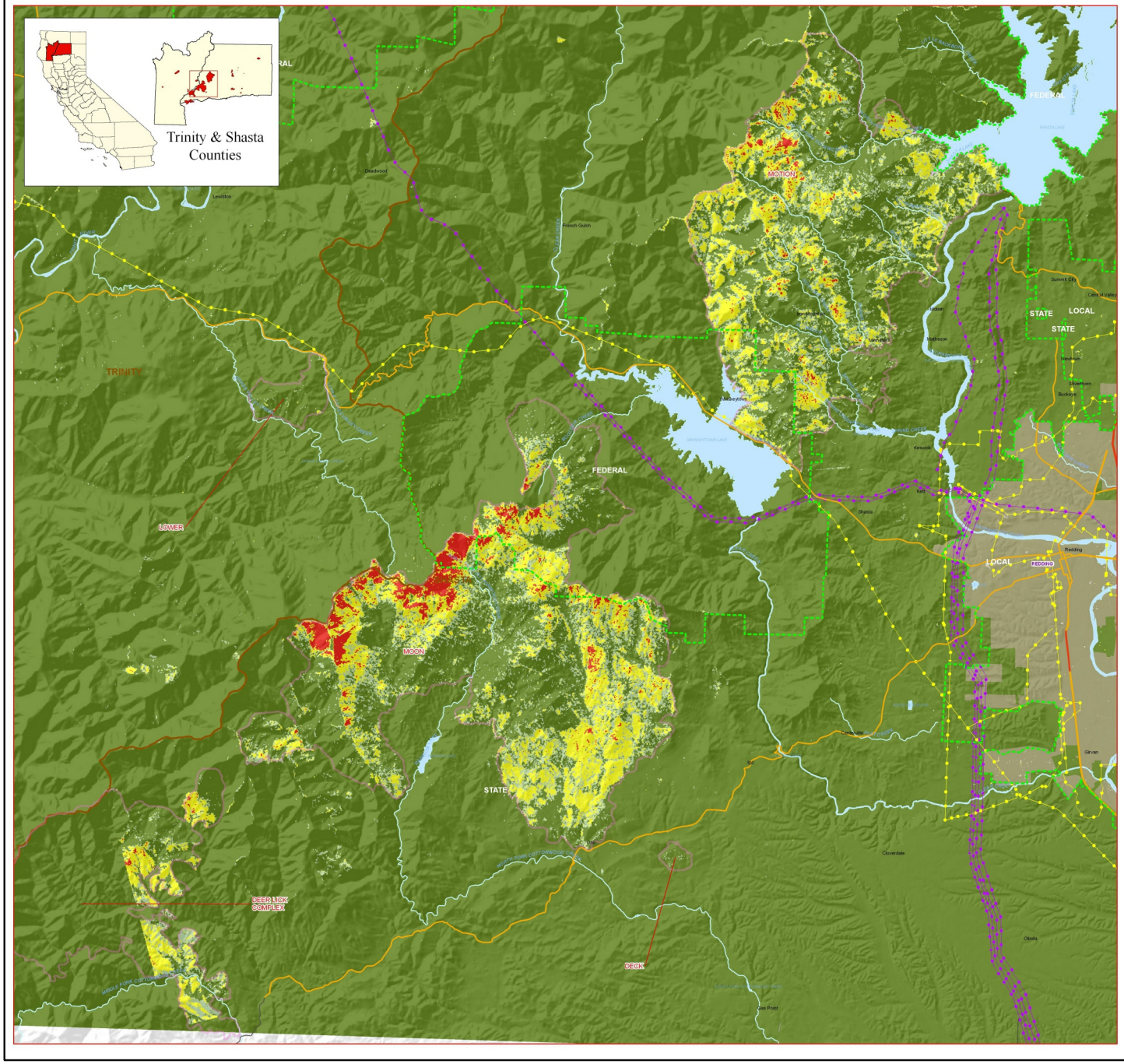
0 2,000 Feet



Map #9

SHU LIGHTNING COMPLEX
SEAT Analysis
BARC4 Fire Severity

CA-SHU-004727



Fire Perimeters as of 7/22/08

BARC4 Fire Severity

Value

- Unchanged
- Low Severity
- Moderate Severity
- High Severity
- DPA Group Boundary

Transportation

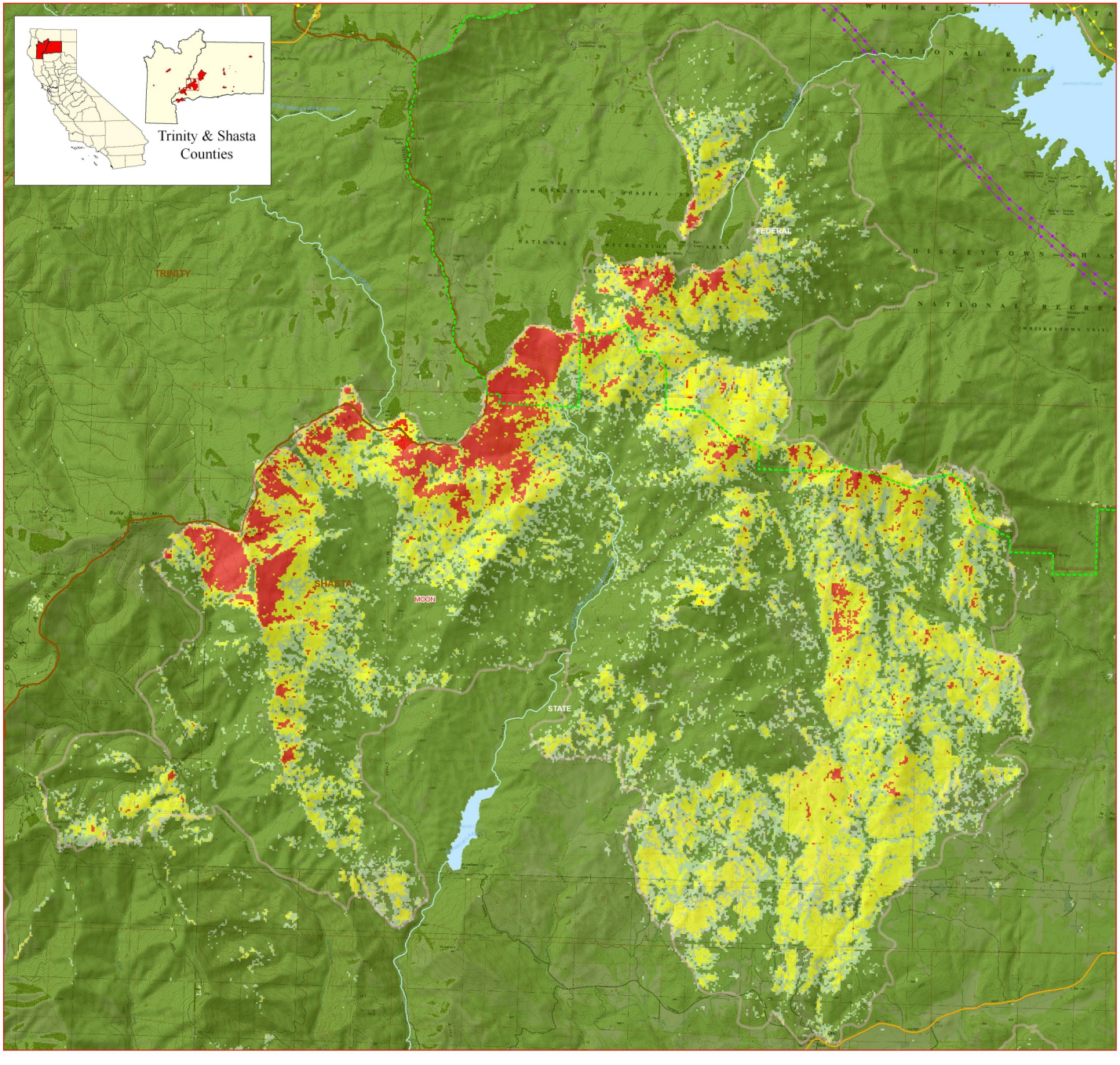
- Freeways
- Highways
- Primary
- Secondary

Transmission Line

- 500KV
- 230KV
- 115KV
- County Boundary
- Open Water

0 0.5 1 2 3
Miles

Created by OES-GIS, Doug Huls
August 12, 2008
active_incident fires 2008 SHU_CA-SHU-004727/
SHU_BARC4_FireSeverity_C.mxd



SHU LIGHTNING COMPLEX
Moon Fire
SEAT Analysis
BARC4 Fire Severity

CA-SHU-004727

Fire Perimeters as of 7/22/08

BARC4 Fire Severity

Value

- Unchanged
- Low Severity
- Moderate Severity
- High Severity
- DPA Group Boundary

DPA05_1 - DPA_Group

Transportation

- **Freeways**
- **Highways**
- **Primary**
- **Secondary**

Transmission Line

- **500KV**
- **230KV**
- **115KV**
- County Boundary
- Open Water

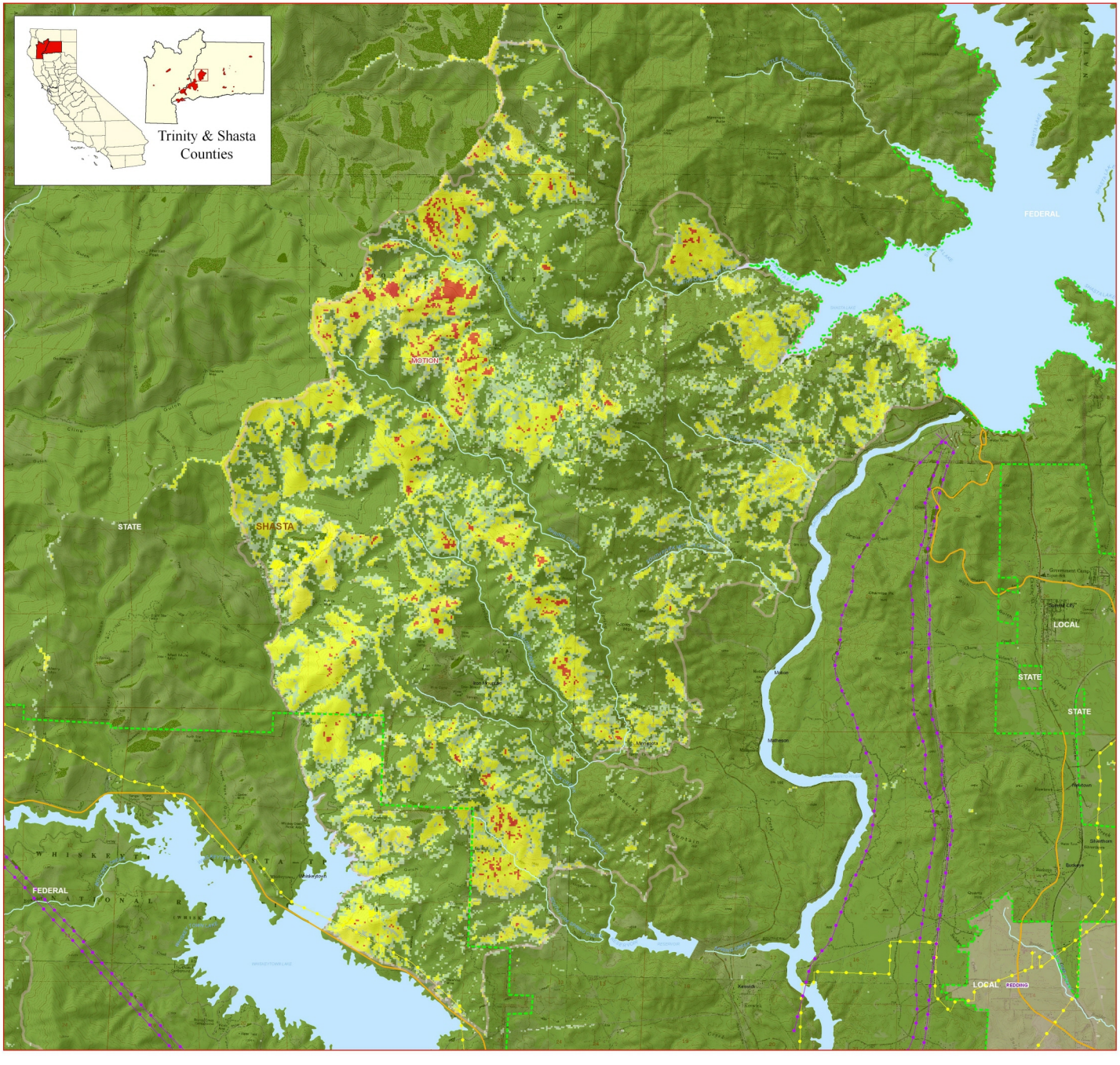
0 0.25 0.5 1 1.5

Miles

Created by OES-GIS, Doug Huls
August 12, 2008
active_incident fires 2008 SHU_CA-SHU-004727/
SHU_Moon_BARC4_FireSeverity_C.mxd

SHU LIGHTNING COMPLEX
Motion Fire
SEAT Analysis
BARC4 Fire Severity

CA-SHU-004727



Fire Perimeters as of 7/22/08

BARC4 Fire Severity

Value

- Unchanged
- Low Severity
- Moderate Severity
- High Severity
- DPA Group Boundary

DPA05_1 - DPA_Group

Transportation

- Freeways
- Highways
- Primary
- Secondary

Transmission Line

- 500KV
- 230KV
- 115KV
- County Boundary
- Open Water

0 0.25 0.5 1 1.5

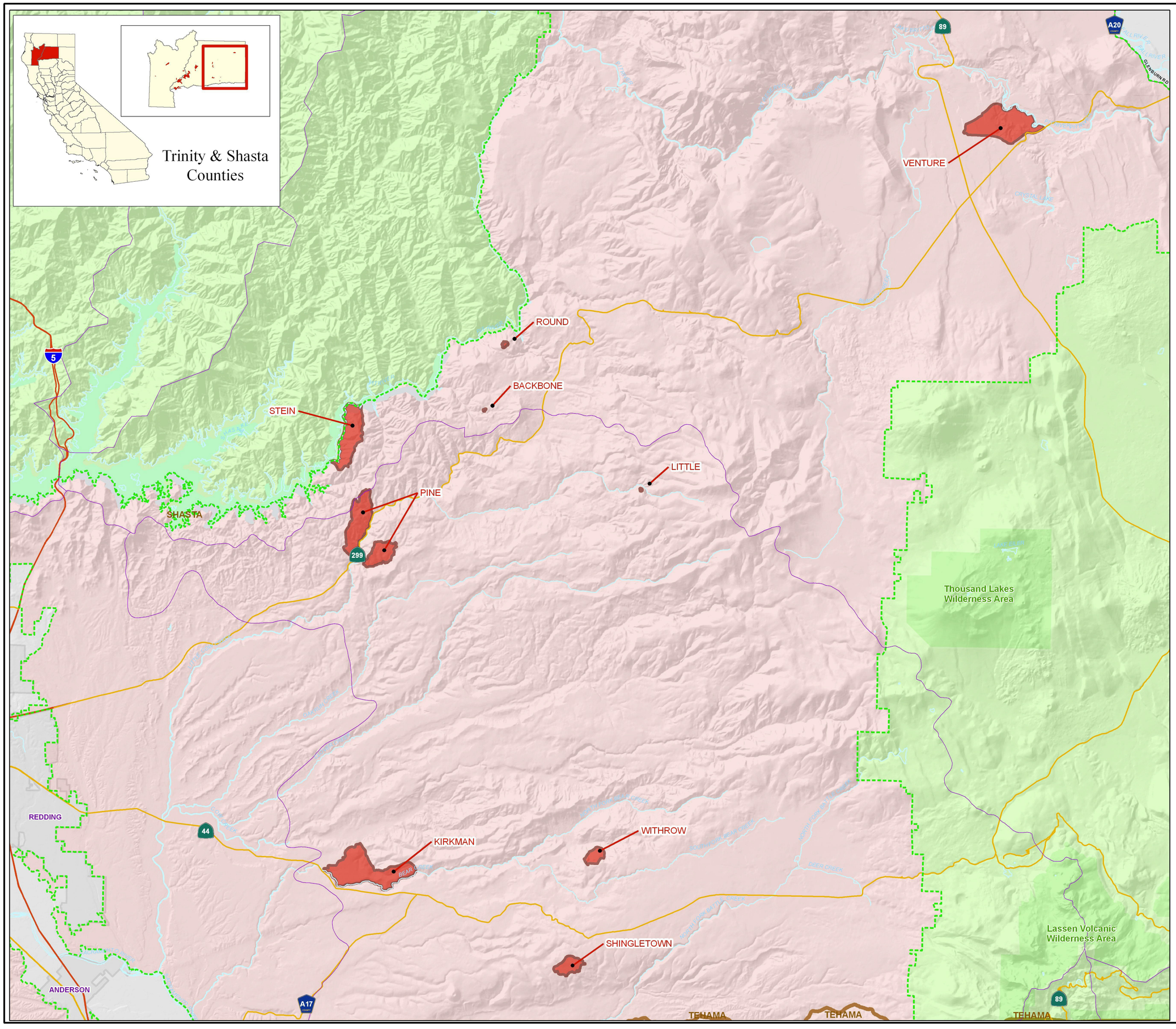
Miles

Created by OES-GIS, Doug Huls
August 12, 2008
active_incident/fires/2008/SHU_CA-SHU-004727/
SHU_Motion_BARC4_FireSeverity_C.mxd

SHU LIGHTNING COMPLEX

MAP 1

CA-SHU-004727
as of 07/22/08
Shasta & Trinity Counties



DPA Group Boundary

Transportation

- Freeways
- Highways
- Primary
- Secondary
- SHU Complex - 07/22/08
- HUC8 Boundary

DBA Group

- Federal
- State
- Local
- Incoporated City Limits

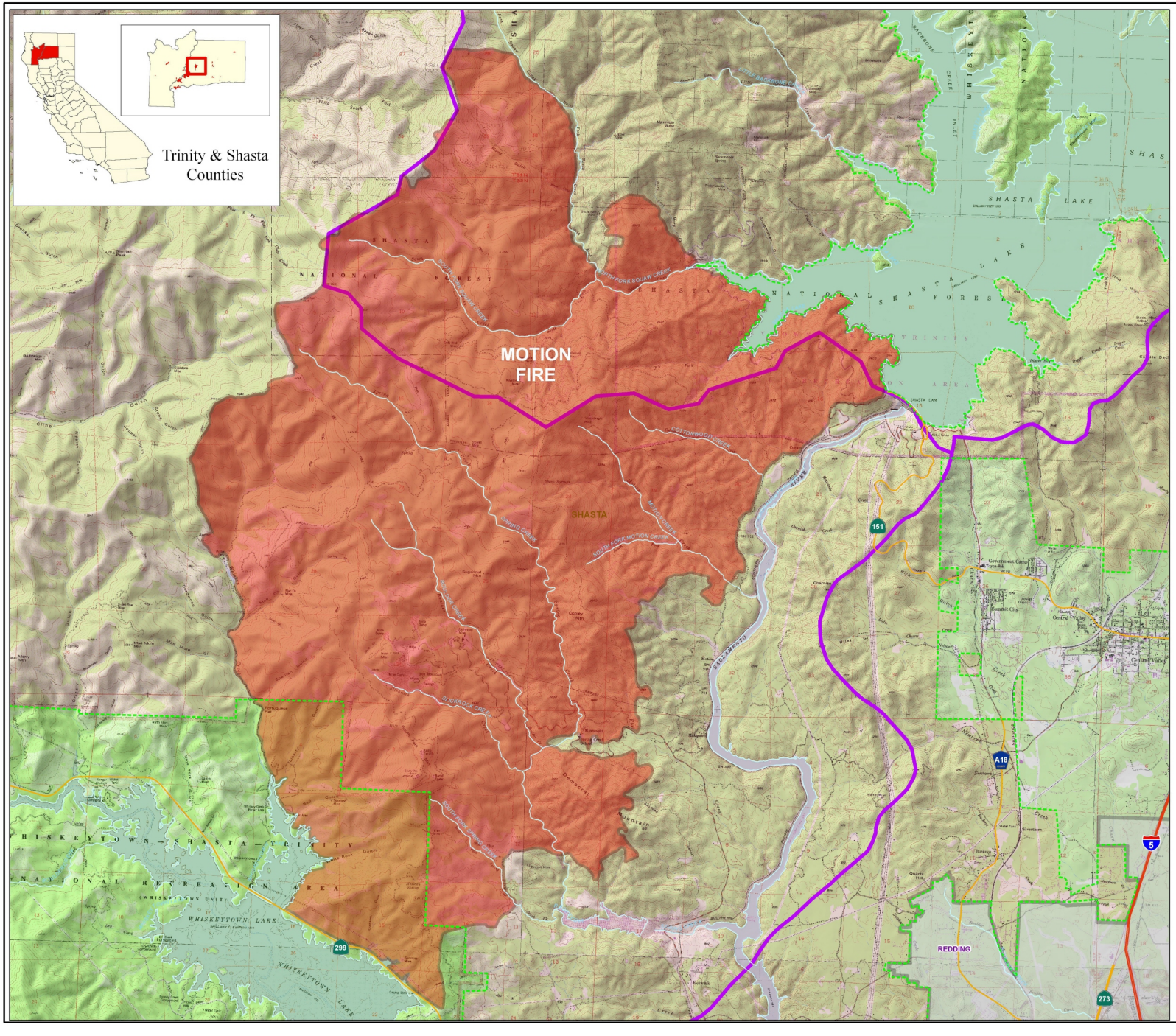
0 50 100 200
Miles

Created by OES-GIS, Leo Anguiano
August 12, 2008
active_incident/fires/2008/SHU_CA-SHU-004727/
SHU_Map1_081208_v92.mxd

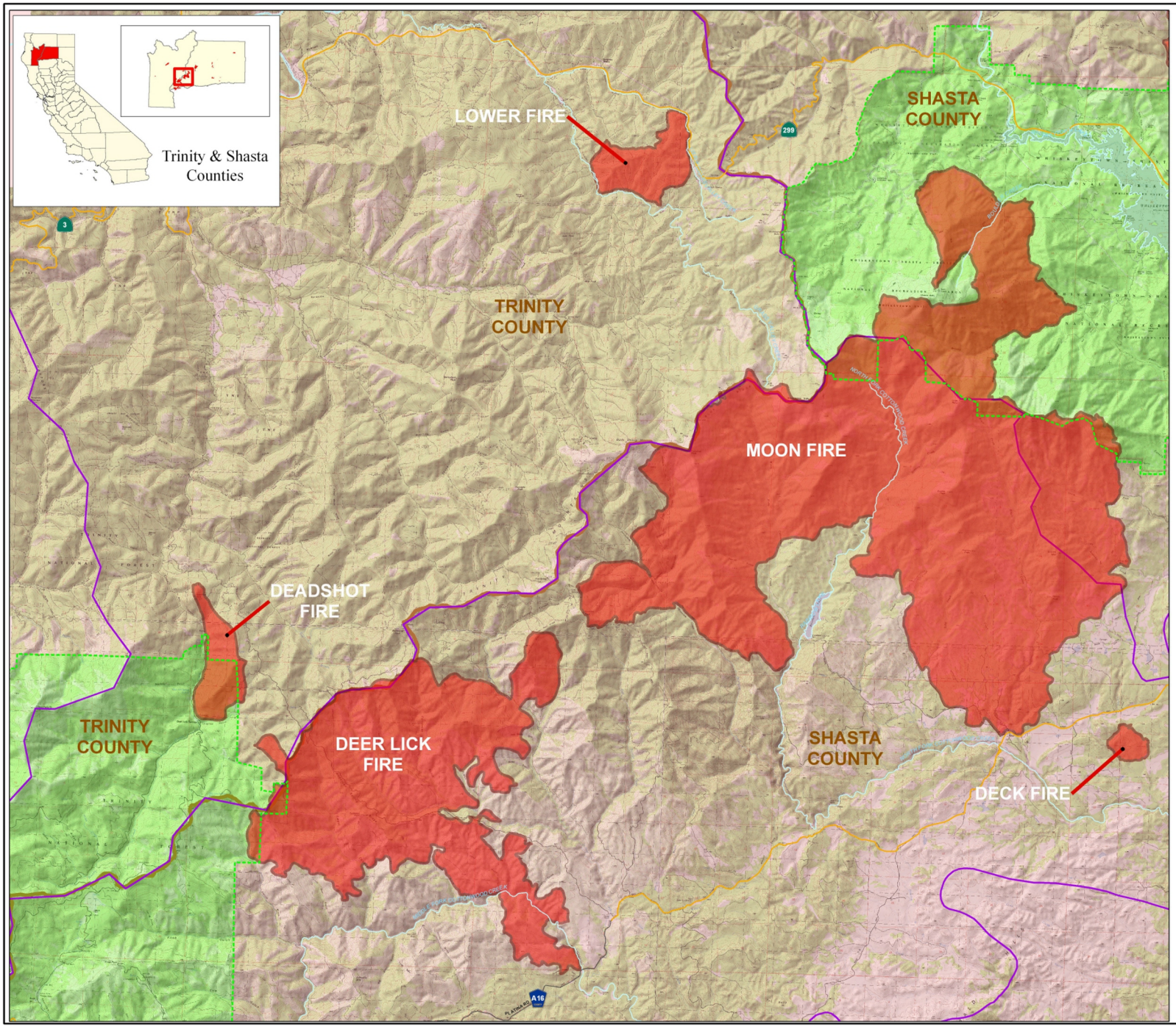
SHU LIGHTNING COMPLEX

MAP 2

CA-SHU-004727
as of 07/22/08
Shasta & Trinity Counties



Created by OES-GIS, Leo Anguiano
August 12, 2008
active_incident/fires/2008/SHU_CA-SHU-004727/
SHU_Map2_081208_v92.mxd



SHU LIGHTNING COMPLEX

MAP 3

CA-SHU-004727
as of 07/22/08
Shasta & Trinity Counties

DPA Boundary

Transportation

- Freeways
- Highways
- Primary
- Secondary

SHU Complex - 07/22/08

HUC8 Boundary

DPA Group

- Federal
- State
- Local
- County Boundary

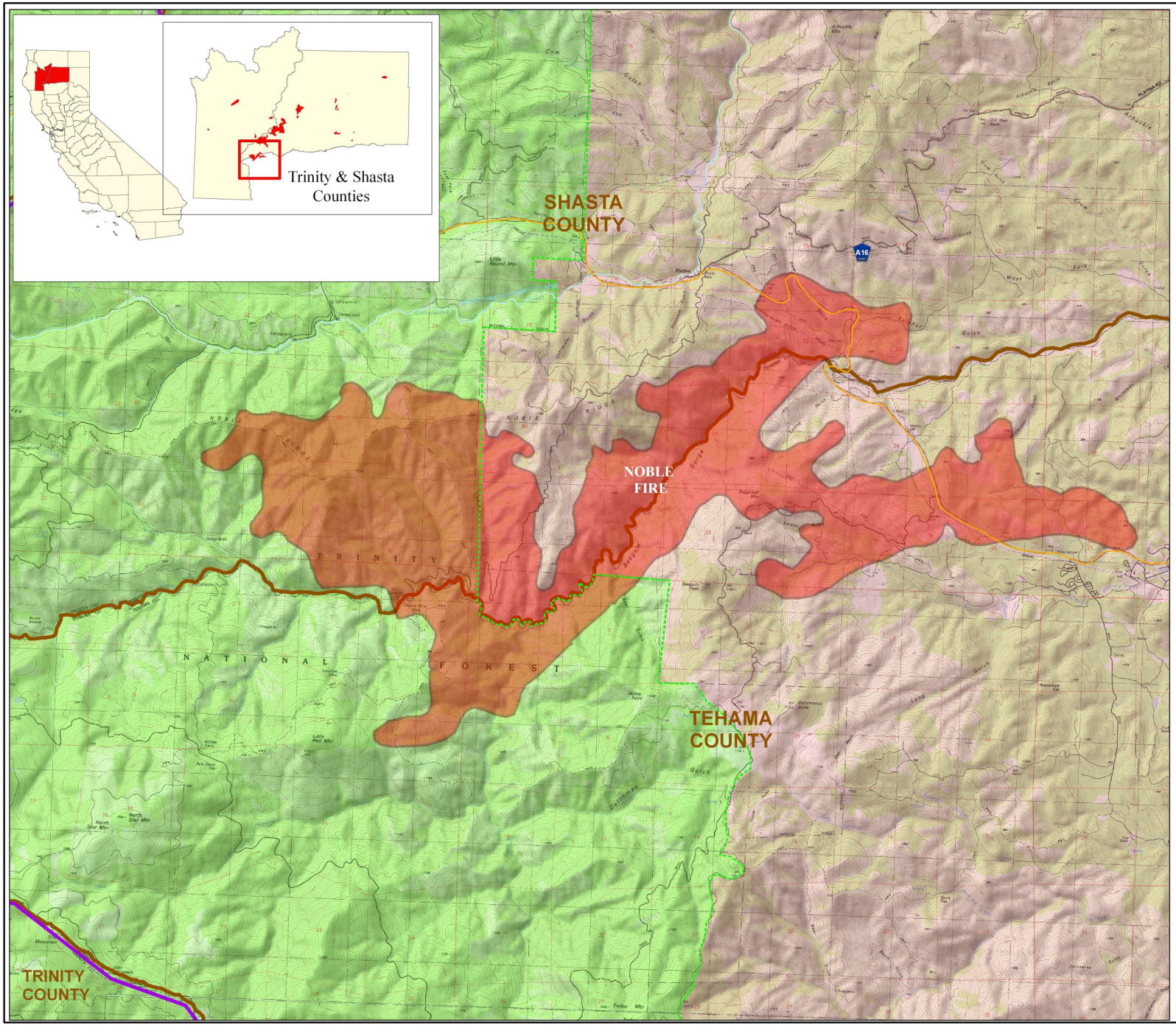
0 50 100 200
Miles

Created by OES-GIS, Leo Anguiano
August 12, 2008
active_incident/fires/2008/SHU_CA-SHU-004727/
SHU_Map3_081208_v92.mxd

SHU LIGHTNING COMPLEX

MAP 4

CA-SHU-004727
as of 07/22/08
Shasta & Trinity Counties



DPA Group Boundary

Transportation

- Freeways
- Highways
- Primary
- Secondary

SHU Complex - 07/22/08

HUC8 Boundary

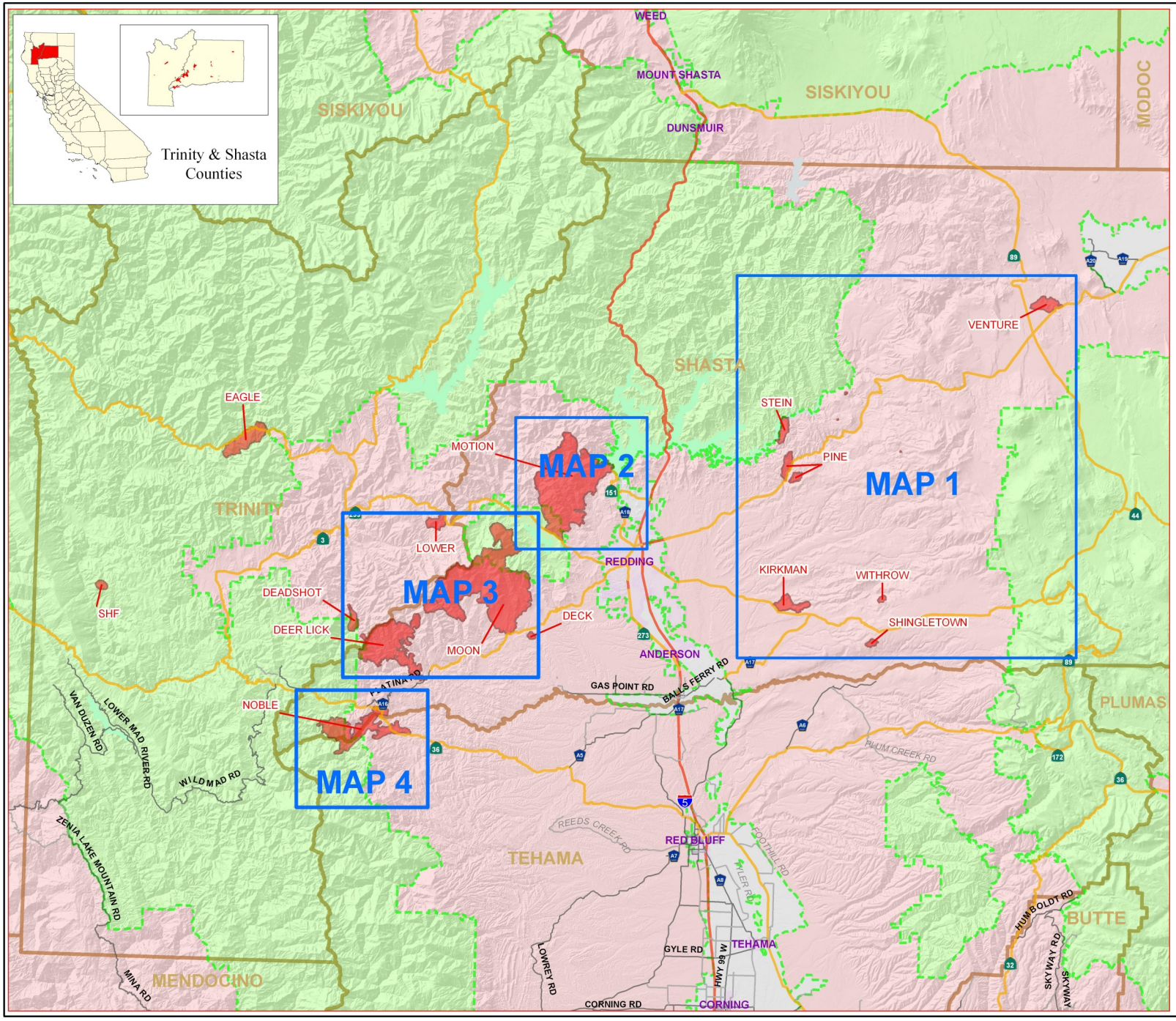
DBA Group

- Federal
- State
- Local

County Boundary

0 1 2
Miles

Created by OES-GIS, Leo Anguiano
August 12, 2008
active_incident:fires:2008:SHU_CA-SHU-004727:
SHU_Map4_081208_v92.mxd

SHU LIGHTNING COMPLEX

CA-SHU-004727
as of 07/22/08
Shasta & Trinity Counties